出國報告（出國類別：國際會議）

第 18 屆環境與自然資源國際研討會（ICENR 2016 : 18th International Conference on Environment and Natural Resources）西元 2016 年研討會出國報告書

服務機關：行政院環境保護署
姓名職稱：劉薦任技士馥萱
派赴國家：美國舊金山
出國期間：**105** 年 **6** 月 **4** 日至 **105** 年 **6** 月 **12** 日
報告日期：**105** 年 **7** 月 **15** 日

摘　　要

第 18 屆環境與自然資源國際研討會(ICENR 2016 : 18th International Conference on Environment and Natural Resources)是由全球知名之世界科學工程與技術學院(WASET，World Academy of Science, Engineering and Technology)所舉辦，該研討會主要針對環境、經濟、生態、資源、醫療等議題提出相關研究成果，舉凡最新科技、新穎技術及永續政策等面向作出討論，供學術界、教育界、環保團體、政府組織等專業人士與會之共同交流溝通平台，每年會議地點分布世界五大洲，遍及世界各處，顯示該學院重視交流、分享、互動之機制，期待各方共同肩負對環境保護之責任，合力達成環保、經濟、公義的永續發展新世界。

目　　錄

壹、出國目的

世界科學，工程與技術科學院(WASET，World Academy of Science, Engineering and Technology)為國際性學術組織，訂於 2016 年 6 月 9 日至 6 月 10 日於美國舊金山舉辦第 18 屆環境與自然資源國際研討會（ICENR 2016 : 18th International Conference on Environment and Natural Resources），本次會議分成 2 天舉行，分別討論 2 大項議題，包括第 1 天最新科學技術發表，第 2 天的環境資源管理及環境策略推動等內容，共有來自世界 20 餘國近 100 人與會，會議論文發表約 50 篇。

本次會議來自各國不同領域的專家學者就各專業領域提出發表，其中精選幾篇重要論文，並作簡略性介紹，內容如下：1.土壤污染處理技術-紫外光活化過硫酸鹽氧化甲基第三丁基醚(MTBE)之研究，2.水污染處理技術-以紫外線光/過硫酸鹽活化磺胺二甲嘧啶(sulfamethazine, SMT)，3.舊金山綠屋頂發展趨勢。

另外，針對美國舊金山環境保護面向中篩選 2 大主題作探討及分析，包含政策制度面：美國與我國環評制度分析、舊金山金銀島開發案，環境與生態面：舊金山漁人碼頭灣區海獅生態及生物累積性。

藉由本次出國機會，瞭解美國與我國環評機制之差異，並透過舊金山金銀島個案開發案，探討政策、土地、環保、居住正義、經濟發展等之不同面向分析；同時，瞭解舊金山海岸城市觀光及海灣港區海獅生態之緊密關係與衝擊；並探討本次研討會會議相關重點研究論文，期許為環保生態盡一份心力，邁向永續發展與環境保護之新境界。

貳、行程

日期	地點	工作內容
105 年 6 月 4 日（六）至 105 年 6 月 5 日（日）	臺北至舊金山	啟程
105 年 6 月 6 日（一）	舊金山	參訪加州柏克萊大學－環保節能「綠公寓」，體驗環保與生活的踐行結合。
105 年 6 月 7 日（二）	舊金山	已接洽 Google 員工，得以參訪加州 Google 總部，欲從中瞭解 Google 永續經營理念、太陽能應用、環保綠建築及風力綠色能源研發等技術。
105 年 6 月 8 日（三）	舊金山	準備會議資料
105 年 6 月 9 日（四）	舊金山	參加第 18 屆環境與自然資源國際研討會，本日會議分項議題包括：土壤污染處理技術、水污染處理技術。
105 年 6 月 10 日（五）	舊金山	參加第 18 屆環境與自然資源國際研討會，本日會議分項議題包括：舊金山綠屋頂發展趨勢。
105 年 6 月 11 日（六）	舊金山	整理並翻譯會議資料。
105 年 6 月 12 日（日）	舊金山至臺北	返程

參、關於美國舊金山

舊金山位於美國加州北部之海灣城市，別名為金門城市或霧城等，位於舊金山半島北端，東臨舊金山灣、西臨太平洋，該城市之地形地貌多半是綿延之丘陵地形，且為多霧氣候，夏季降雨不多，氣溫通常不超過攝氏 20 度，係屬典型的涼夏型地中海式氣候。

於經濟發展中，其舊金山市區主要以觀光發展為主，通常座落著大型旅館、餐飲服務、百貨業及大型展覽會場，特別是靠近北海岸之漁人碼頭 39 號碼頭吸引最多旅客駐足及遊憩，而鄰近的惡魔島行程亦是各國旅客不容錯過之歷史及觀光熱門景點。舊金山市郊主要以生技產業或網路公司為主，例如維基百科、Twitter、盧卡斯電影、McKesson Corporation 世界最大醫療企業等。

本次出國報告著重於美國舊金山環境保護面向，並篩選 2 大主題作探討，包含政策制度面：美國與我國環評制度分析、舊金山金銀島開發案。環境與生態面：舊金山漁人碼頭灣區海獅生態及生物累積性。

政策制度面－美國與我國環評制度分析：

分析我國與美國環評制度，我國環評制度緣起自美國制度，美國制度由目的事業主管機關於核發開發行為許可前，徵詢各相關機關（包含美國環保署）提供意見，以作為該目的事業主管機關給予核准之參考，總而言之，性質僅是評估機制，該目的事業主管機關係依據國家環境政策法（NEPA）第 102 條所規定之環評制度，以及環境品質委員會（Council of Environmental Quality）所命令發布之細部規定辦理環評審查，最終結果則作為決策之參考，其決策權與政治責任者皆在目的事業主管機關。

反看環評制度引進我國時，原為由目的事業主管機關「會同」環保署進行環評相關審查作業，經立法院修正為，目的事業主管機關「轉送」環保署進行環評相關審查作業，並賦予否決該開發行為之權利，將評估政府政策行為改成審查開發行為，也從諮詢建議之角色，轉換為必須做出具有行政處分之「審查結論」，其「審查結論」包含認定不應開發、審核通過等種類，且後續該開發行為之執行訂有追蹤及監督機制，以及相關違反環評書件內容及審查結論之罰則，自始我國環評制度展開全世界獨有之機制，環評制度相關比較表格如下：

環評制度比較	美國	我國
主管機關	開發單位的主管機關 （類似我國目的事業主管機關）	環保署
其他機關	涉及相關法律管轄權與環保項目的所有機關	目的事業主管機關
主管機關與其他機關之關係	合作 共同討論	分開 ✓ 支持開發 （目的事業主管機關） ✓ 表示意見 （相關機關或各方民眾及團體）
主管機關應作事項	邀集受影響之聯邦、州和地方機構、印第安部落、開發單位、任何有興趣的人	邀集目的事業主管機關、相關機關、團體、學者、專家、居民代表
否決權	無	有
追蹤及監督	無	追蹤由（目的事業主管機關負責） 監督由（環保署負責）

政策制度面－舊金山金銀島開發案：

舊金山金銀島原非島，其實是用建築舊金山金門大橋所挖掘出來的底泥，所堆砌出來之人工島嶼，後來該人工島於上世紀 40 年代至 50 年代，提供美國海軍作為軍事基地，主要用於修補和打撈曾暴露於原子彈爆炸的船隻及相關核子能軍事武器研究之基地，並於 1993 年由美國海軍同意以 1.05 億美元的價格將金銀島出售給舊金山市政府。

由於金銀島歷經海軍試驗核子能相關之計劃，以至於於土地中殘留部分放射性污染，且存有尚未完全清除之疑慮，於個別地表中之表層土壤中仍有部分遺留放射性物質，經檢測該島部分區域其放射性物質之輻射量約為美國環保署規定的人體接觸上限的 400 倍。

雖說該島存有放射性污染之疑慮，惟該處交通十分便利，僅須搭乘公車 10 分鐘內便可前往舊金山市區，故舊金山市政府金銀島發展局將過去海軍部分宿舍提供予有意願者至島上居住，且過去 10 年間，金銀島房租價格上漲 53%，大約加收 245 美元，原房租價位約為 450 美金，即使是上漲多增加 245 美元的房租，金銀島仍然是舊金山市民尋求低價公寓的不二選擇。

後因海軍宿舍過於老舊，舊金山市政府金銀島發展局考量該島之交通便利及地形平坦等其他適合發展之因素，提出該島未來投資與發展之目標，由開發商里納爾公司及其合作伙伴仍有極大之意興建 8,000 個住屋單位、一家有 500 個客房的旅館和約 30 萬平方英尺商業用地（包含博物館、觀光景點以及相關文教發展等建設）。

雖然上述該開發案，獲得許多人支持，但仍有部分環保團體及議員提出放射性污染應先完全移除才可開發之要求，並提出相關佐證及說明，表示海軍在島上清理污染工作進行的不徹底，曾暴露在原子彈爆炸和消除放射物訓練中造成的污染比預想的要嚴重。

該舊金山市長李孟賢知道金銀島的放射性污染問題，表示舊金山市政府已經敦促海軍回應加州衛生署進行全面清理放射性物質的要求，並說明經有害物質監控部門表示，舊金山金銀島目前殘留之放射性物質含量不會對人體的健康造成傷害，所有金銀島房屋開發項目仍將於依原計畫啟動。

圖 1 舊金山地圖

圖 2 舊金山市區多為延綿之山丘

圖 3 舊金山金銀島人工島

環境與生態面：舊金山漁人碼頭灣區海獅生態及生物累積性

舊金山最著名的景點便是漁人碼頭，漁人碼頭海灣之所以出名，除了規劃完善的觀光路線外，就是可以於都市海灣上、軍事艦隊旁，看到一隻隻的海獅們，海獅是在 1990 年駐進舊金山，因當時 1989 年 10 月份，舊金山發生地震，造成流離失所的海獅群，於 1990 年在船港附近尋覓到碼頭 39 的夾板作為未來的新家。

後來，當舊金山市府發現這群可愛的海獅後，便將原 39 碼頭上的船隻撤離，提供海獅們安身棲地之所，也因為當時漁產豐富、生態資源充足，其海獅們便居留於此，於全盛時間可達 1,700 頭，現今約莫 150 到 600 頭。

惟商業跟觀光業發展蓬勃，造成當地生態及海洋資源減少，且常有發生污染的情事，雖有舊金山市府成立海獅生態監督小組，卻發生近日許多加州海獅因攝食有毒海藻，而患有癡呆跟記憶力衰退的情形，甚至部分死亡，該小組研究出是因為近年來全球暖化及環境污染造成海洋生態系統變化，大量的軟骨藻酸等藻類繁殖生成許多毒素，其有毒軟骨藻酸蝕海獅大腦，造成牠們大腦中掌控記憶的「海馬區」出現結構異常，嚴重影響海獅的記憶力；就算海獅們沒有直接攝取軟骨藻，如果魚或其他物種吃下肚後，經由食物鏈的生物累積，同樣會使得較上層金字塔的海獅們受害，且生物累積效應亦會間接影響到人類生命安全。

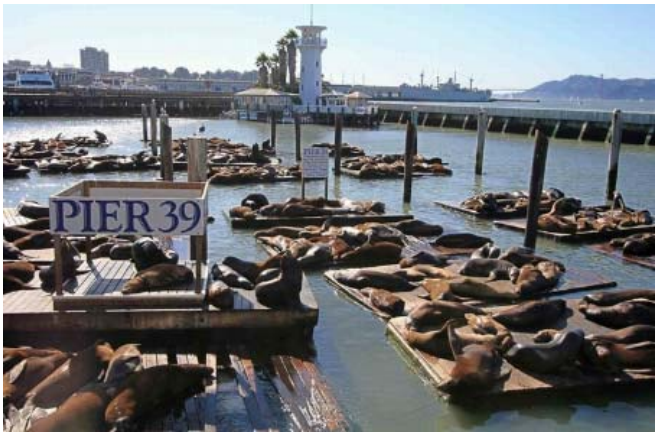

圖 4 舊金山漁人碼頭海獅區

圖 5 舊金山漁人碼頭觀光人潮

肆、活動地點內容及參加人員

2016 年 6 月 9 日至 6 月 10 日於美國舊金山舉辦第 18 屆環境與自然資源國際研討會，此次年會參加人員包含美國（地主國）、印度、英國、泰國、印尼、越南、馬來西亞、臺灣……等國家的人員參加，共約 100 人左右，本署由綜合計畫處劉薦任技士代表參加。

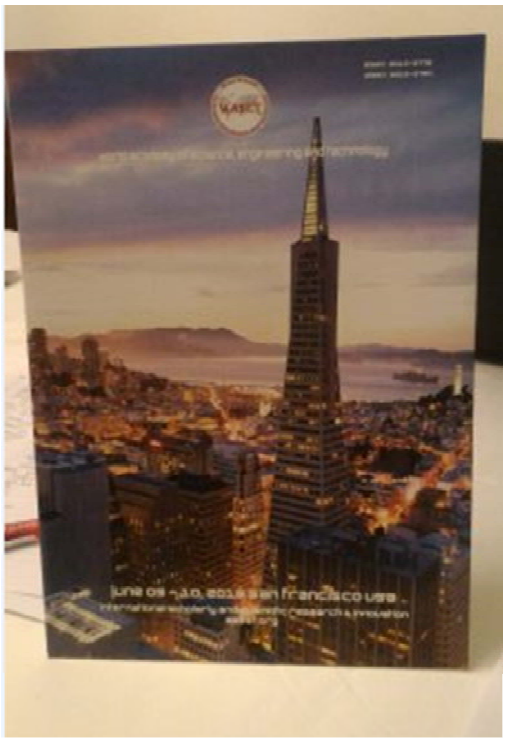

圖 6 第 18 屆環境與自然資源國際研討會海報

圖 7 劉馥萱技士與主辦單位合影

圖 8 第 18 屆環境與自然資源國際研討會現場

伍、2016 年第 18 屆環境與自然資源國際研討會

本次會議來自各國不同領域的專家學者就各種領域研究提出發表，其中精選幾篇重要論文，摘要如下：

一、 土壤污染處理技術-紫外光活化過硫酸鹽氧化甲基第三丁基醚(MTBE)之研究

有關土壤及地下水污染整治技術中，由於現地化學氧化法處理時間較其他技術方便且快速，其產生之過硫酸鹽因具有高反應性之硫酸根自由基(SO_4^-)，得以氧化土壤中有機污染物，達到處理污染整治之功效。惟未活化的過硫酸鹽對有機污染反應速率很慢，無法在短時間內快速氧化有機物，因此該研究主要目的，係藉由紫外光之方式活化過硫酸鹽，使其加速氧化甲基第三丁基醚(MTBE)，本研究採用兩種不同波長之紫外光線，分別為 254 nm 和 365 nm 波長，並同時探討在不同 pH 系統和不同濃度甲基第三丁基醚(MTBE)與氧化劑莫耳濃度比例系統研究，試圖尋找最佳之活化過硫酸鹽對甲基第三丁基醚(MTBE)之氧化反應動力。

最終實驗結果顯示，254 nm 波長之紫外光能有效活化過硫酸鹽，產生自由基，快速地破壞甲基第三丁基醚(MTBE)，於反應時間 1 小時內，其過硫酸鹽被消耗 40 %，甲基第三丁基醚(MTBE)之降解率為 99.5 %，同時隨著反應時間之增加，反應初期產生之氧化中間產物會逐漸轉變為丙酮，並在反應時間 50 分鐘後，53%的甲基第三丁基醚(MTBE)將礦化成二氧化碳(CO_2)。

然而，365 nm 波長之紫外光，卻不如預期，於反應時間 1 小時內，其過硫酸鹽並無明顯消耗，甲基第三丁基醚(MTBE)之降解率僅有 25%，其氧化降解速率較差。

二、 水污染處理技術-以紫外線光/過硫酸鹽活化磺胺二甲嘧啶(sulfamethazine, SMT)

抗生素除可用於人類及畜禽疾病控制外，也可作用於生長促進激素，因此使用相當頻繁與廣泛，惟抗生素雖有其正面功效，惟一旦經過放流水進入生態食物鏈中後，對其生物累積效應及人體產生高風險之疾病亦有所隱憂，且通常環境中常存有磺胺二甲嘧啶(sulfamethazine, SMT)之抗生素類新興污染物。

因此本研究將磺胺二甲嘧啶(sulfamethazine, SMT)置放於不透光反應器中，並於不同 pH 值之實驗條件下，透過紫外光激活所產生之過硫酸鹽高氧化自由基，降解含有磺胺二甲嘧啶(sulfamethazine, SMT)之廢水處理技術。

最終實驗結果，採透過高效液相層析儀(high performance liquid chromatography, HPLC)檢視處理效率，其磺胺二甲嘧啶(sulfamethazine, SMT)

之降解率於 pH 值等於 6.5 時為最低，而於 pH 值等於 11 時為最高，顯示其反應降解速率於較鹼性之環境中，較為快速。

三、 舊金山綠屋頂

舊金山位於太平洋與舊金山灣區狹長半島之頂端，其地形皆為小山丘堆疊銜接而成，進而形成不同風貌之都市風情，為推廣把自然帶入城市，把人帶入自然之理念，將都市建築結合立體綠化，便是最直接也最有成效之工法代表，以建築為樹，都市為林之概念，進一步改善最接近你我生活之新綠能型態。

由於都市發展之特性使然，除熱島效應外，對於地表逕流及水循環亦有其嚴重影響，都市地區之降雨無法蓄留於地表，大面積之瀝青鋪面及水土建材導致都市污水系統之癱瘓，為避免驟降之雨水形成沖刷地表之逕流，都市增加綠化面積為最佳方式，提供減緩、分散、吸納之功能，綠屋頂便是藉由植物及土壤之吸水作用，減緩雨水直接流入下水道之速度，預估可減緩 30 分鐘至 4.5 小時，同時近年來，為因應環境及社會之變化，綠屋頂之設計大多從平面農場改成為垂直農場，剩餘面積則可應用於太陽能板之設置，或從高樓大廈之綠屋頂漸漸推廣到住宅之溫室水耕農場。

本次研究主要著重於舊金山市區之綠屋頂推動，從綠屋頂植生之分類、綠屋頂及綠牆設計等兩大議題著手，針對舊金山獨有之旱季及霧季，其綠屋頂上的植生態樣係以高山且耐旱植物為主,其總共分享超過 100 種植物之試驗結果,並研討各種植物之存活率、植生地被和用水預算對都市熱島效應之影響、綠地面積對生物之棲地與生物多樣性指標之貢獻、綠地基礎建設對都市空氣品質之改善以及對二氧化碳之固碳效應，從經濟、環境及生態多樣化等三大面向探討最佳之操作方式。

陸、心得及建議

我國環評制度探討與分析

我國環評雖與美國有著類似的審查流程，卻因角色互換，導致後續皆產生不同之發展趨勢與結果，近期我國多有媒體關切環評審查時程過長等爭議，爰此，行政院指示應檢討我國環評制度，使環評既能發揮實質篩選開發行為功能，又能提升審查效率，同時，為了因應國土計畫法施行，應加強政策環評功能，落實環評通過後的追蹤監督，並於近期積極推動環評法規修正，以強化環評功能與效率，期待藉由分階段、漸進方式逐步建置完善之環評制度。

至於是否俟時機成熟時，回歸環評美國制度，改由目的事業主管機關審查，從政策決策端起點即納入環境保護之考量，尚須研議，其原因係因我國原環評制度已施行近 20 年，尚須考量許多配套修正及因應措施，目的事業主管機關責任之強化、國土計畫之施行、行政機關實務操作以及不同利害者之間之合理公平，保證落實資訊公開、各方民眾決策及參與之機制、保障司法救濟等配套建置，衡酌相關分析結果等許多考量因素後，進行多方產業、學界、環保團體之溝通再溝通後，並獲得共識後再予以決定。

第 18 屆環境與自然資源國際研討會

本次會議所提論文研究題目包含甚廣，尤其以科學性技術之研究論文居多，可藉由此次研討會瞭解新穎科學技術、醫療生物科技之發展趨勢，除科學性論文外，部分環保技術論文亦可作為我國環境保護及污染防治（防制）推動之參考，雖非全面針對環境影響評估等相關課題進行討論，但對於各論文之發表內容，亦可看出國外推動環境保護及科學技術發展不遺餘力之決心，得作為我國之借鏡。

CERTIFICATE OF ATTENDANCE

This certificate is awarded to

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INTERNATIONAL SCIENTIFIC RESEARCH AND EXPERIMENTAL DEVELOPMENT

SAN FRANCISCO, USA

JUNE 09-10, 2016

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February 18, 2016

Ms. Fu-Hsuan Liu
Environmental Protection Administration
Taiwan

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The International Scientific Committee has the pleasure of inviting you as listener delegate to the ICENR 2016: 18th International Conference on Environment and Natural Resources to be held in San Francisco, USA on June, 9-10, 2016.

We look forward to your participation in the ICENR 2016: 18th International Conference on Environment and Natural Resources.

Sincerely,
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San Francisco, USA

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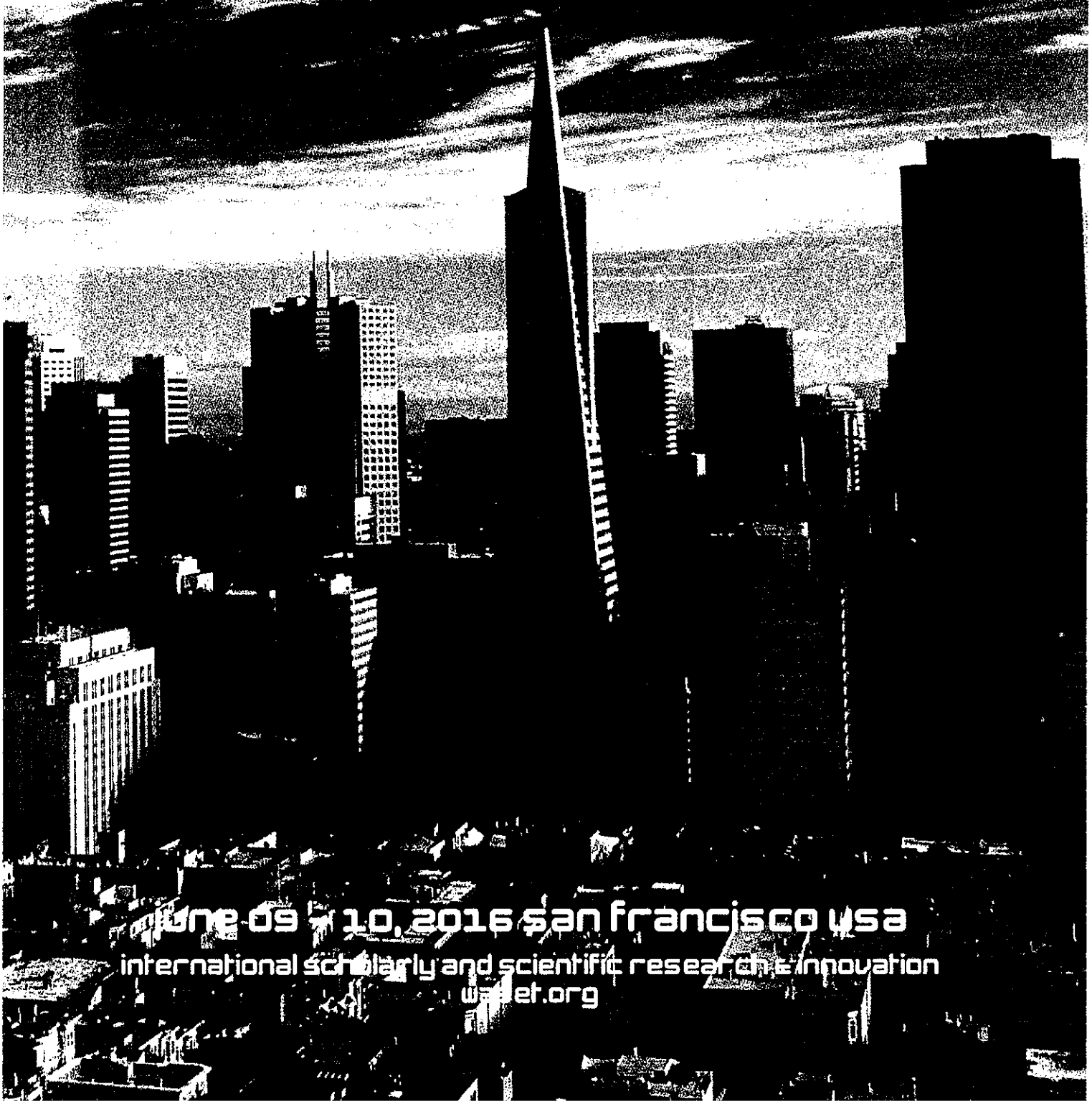

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REMARKS: All presenters should be ready in the meeting room at least 10 minutes prior to the start of the session. Presenters should introduce themselves to the session chair and upload their papers to the computer.

CONFERENCE VENUE

Marines' Memorial Club & Hotel

609 Sutter Street

San Francisco, CA 94102, USA

PROGRAM CHAIR

Prof. James A. Nelson

New Mexico State University, USA

CONFERENCE REGISTRATION

June 9, 2016 from 07:40 to 16:00

June 10, 2016 from 07:40 to 11:00

CONFERENCE PROGRAM

June 9, 2016, HALL A

Session I: 08:00-10:10

Coffee Break: 10:10-10:20

Chair: Vinti Davar, Thilivhali Emmanuel Tshikalange

1		Biodegradation Effects onto Source Identification of Diesel Fuel Contaminated Soils	Colin S. Chen, Chien-Jung Tien, Hsin-Jan Huang National Kaohsiung Normal University Taiwan
2	e-Poster	The Potential of Edaphic Algae for Bioremediation of the Diesel-Contaminated Soil	C. J. Tien, C. S. Chen, S. F. Huang, Z. X. Wang National Kaohsiung Normal University Taiwan
3		Analysis of Trend and Variability of Rainfall in the Mid-Mahanadi River Basin of Eastern India	Rabindra Kumar Panda, Gurjeet Singh Indian Institute of Technology Bhubaneswar India

4	e-Poster	Application of 1-MCP on 'Centro' Melon at Different Days after Harvest	L. P. L. Nguyen, G. Hitka, T. Zsom, Z. Kókai Szent István University Hungary
5		Promotion of Healthy Food Choices in School Children through Nutrition Education	Vinti Davar Kurukshetra University India
6	e-Poster	An Integrative Computational Pipeline for Detection of Tumor Epitopes in Cancer Patients	Tanushree Jaitly, Shailendra Gupta, Leila Taher, Gerold Schuler, Julio Vera Friedrich-Alexander University, Erlangen-Nurnberg Germany
7		A Textile-Based Scaffold for Skin Replacements	Tim Bolle, Franziska Kreimendahl, Thomas Gries, Stefan Jockenhoevel Institut für Textiltechnik der RWTH Aachen University Germany
8	e-Poster	Stimulation of Nerve Tissue Differentiation and Development Using Scaffold-Based Cell Culture in Bioreactors	Simon Grossemy, Peggy P. Y. Chan, Pauline M. Doran Swinburne University of Technology Australia
9		Antimicrobial Activity of Ethnobotanically Selected Medicinal Plants Used in the Treatment of Sexually Transmitted Diseases	Thilivhali Emmanuel Tshikalange, Phiwokuhle Mamba University of Pretoria South Africa
10	e-Poster	Ethnobotanical Study of Medicinal Plants Used by Indigenous People of Community Forest User Groups of Parbat District, Nepal	Gokul Gaudel, Zhang Wen Hui, Dang Quang Hung, Le Thi Hien, Liang Xiao Northwest A&F University China
11	e-Poster	Evaluation of Alpha-Glucosidase Inhibitory Effect of Two Plants from Brazilian Cerrado	N. A. P. Camaforte, P. M. P. Vareda, L. L. Saldanha, A. L. Dokkedal, J. M. Rezende-Neto, M. R. Senger, F. P. Silva-Jr, J. R. Bosqueiro São Paulo State University, UNESP Brazil
12	e-Poster	Identification of the Antimicrobial Effect of Liquorice Extracts on Gram-Positive Bacteria: Determination of Minimum Inhibitory Concentration and Mechanism of Action Using a luxABCDE Reporter Strain	Madiha El Awamie, Catherine Rees The University of Nottingham United Kingdom
13	e-Poster	Herbal Cosmetics: Revival of the Age Old Beauty Therapy in Ultra Modern World	Hannah S. Elizabeth, D. Gnanasekaran, D. Vijay, M. R. Manju Gowda, Antony George Bharathi College of Pharmacy India
14	e-Poster	Introduction of a Medicinal Plants Garden to Revitalize a Botany Curriculum for Non-Science Majors	Rosa M. Gambier, Jennifer L. Carlson Suffolk County Community College United States
15	e-Poster	Improvement in Safety Profile of Semecarpus Anacardium Linn by Shodhana: An Ayurvedic Purification Method	Umang H. Gajjar, K. M. Khambholja, R. K. Patel Babaria Institute of Pharmacy India
16	e-Poster	Rooibos Extract Antioxidants: In vitro Models to Assess Their Bioavailability	Ntokozo Dambuza, Maryna Van De Venter, Trevor Koekemoer Nelson Mandela Metropolitan University South Africa

17	e-Poster	The Potential of Ursolic Acid Acetate as an Agent for Malarial Chemotherapy	Mthokozisi B. C. Simelane University of KwaZulu-Natal South Africa

June 9, 2016, HALL A

Session II: 10:20-13:00

Lunch: 13:00-14:00

Group photo will be taken during coffee break in the conference room.

You can share the photos you have taken at http://waset.org/conference/2016/06/san-francisco/photos

Chair: Mian Jiang, Ratna Tantra

1		Metal Extraction into Ionic Liquids and Hydrophobic Deep Eutectic Mixtures	E. E. Tereshatov, M. Yu. Boltoeva, V. Mazan, M. F. Volia, C. M. Folden III Texas A&M University United States
2		A Green Analytical Curriculum for Renewable STEM Education	Mian Jiang, Zhenyi Wu University of Houston Downtown United States
3		Synthesis of Cardanol Oil Building Blocks for Polymer Synthesis	Sylvain Caillol University of Montpellier France
4		Substitution of Formaldehyde in Phenolic Resins with Innovative and Bio-Based Vanillin Derived Compounds	Sylvain Caillol, Ghislain David University of Montpellier France
5	e-Poster	New Platform of Biobased Aromatic Building Blocks for Polymers	Sylvain Caillol, Maxence Fache, Bernard Boutevin University of Montpellier France
6		Syntheses of Biobased Hybrid Poly(epoxy-hydroxyurethane) Polymers	Adrien Cornille, Sylvain Caillol, Bernard Boutevon Institut Charles Gerhardt - UMR 5253 France
7		Can We Meet the New Challenges of NonIsocyanates Polyurethanes (NIPU) towards NIPU Foams?	Adrien Cornille, Marine Blain, Bernard Boutevin, Sylvain Caillol Institut Charles Gerhardt - UMR 5253 France
8		Solubility Measurements in the Context of Nanoregulation	Ratna Tantra National Physical Laboratory United Kingdom
9	e-Poster	Ultradrawing and Ultimate Pensile Properties of Ultra-High Molecular Weight Polyethylene Nanocomposite Fibers Filled with Cellulose Nanofibers	Zhong-Dan Tu, Wang-Xi Fan, Yi-Chen Huang, Jen-Taut Yeh Hubei University China

10		Synthesis of Carbon Nanotubes from Coconut Oil and Fabrication of a Non Enzymatic Cholesterol Biosensor	Mitali Saha, Soma Das National Institute of Technology (NIT), Agartala, Tripura India
11	e-Poster	High-Yield Synthesis of Nanohybrid Shish-Kebab of Polyethylene on Carbon NanoFillers	Dilip Depan, Austin Simoneaux, William Chirdon, Ahmed Khattab University of Louisiana at Lafayette United States
12	e-Poster	Indicator-Immobilized, Cellulose Based Optical Sensing Membrane for the Detection of Heavy Metal Ions	Nisha Dhariwal, Anupama Sharma Panjab University India
13	e-Poster	Estimation of Nitrogen (NH4+) Using pH Sensitive Electrolyte Insulator Semiconductor Capacitor	Praveen Sahu, Enakshi Bhattacharya, Anju Chadha Indian Institute of Technology Madras India
14	e-Poster	Selective Circular Dichroism Sensor Based on the Generation of Quantum Dots for Cadmium Ion Detection	Pradthana Sianglam, Wittaya Ngeontae Khon Kaen University Thailand
15		Surface Acoustic Wave (SAW)-Induced Mixing Enhances Biomolecules Kinetics in a Novel Phase-Interrogation Surface Plasmon Resonance (SPR) Microfluidic Biosensor	M. Agostini, A. Sonato, G. Greco, M. Travagliati, G. Ruffato, E. Gazzola, D. Liuni, F. Romanato, M. Cecchini Scuola Normale Superiore di Pisa Italy
16	e-Poster	The Effect of Surface Modified Nano-Hydroxyapatite Incorporation into Polymethylmethacrylate Cement on Biocompatibility and Mechanical Properties	Yu-Shan Wu, Po-Liang Lai, I-Ming Chu National Tsing Hua University Taiwan

June 9, 2016, HALL A

Session III: 13:50-16:00

Group photo will be taken at the end of the session in the conference room.

Chair: Yi-Hsiu Lai, Aisling Parkes

1		Actual and Perceived Financial Sophistication and Wealth Accumulation: The Role of Education and Gender	Christina E. Bannier, Milena Neubert Johannes Gutenberg-Universität Mainz Germany
2		Bank Internal Controls and Credit Risk in Europe: A Quantitative Measurement Approach	Ellis Kofi Akwaa-Sekyi, Jordi Moreno Gené University of Lleida Spain
3		Transform to Succeed: An Empirical Analysis of Digital Transformation in Firms	Sarah E. Stief, Anne Theresa Eidhoff, Markus Voeth University of Hohenheim Germany
4		Drivers of Digital Product Innovation in Firms: An Empirical Study of Technological, Organizational, and Environmental Factors	Anne Theresa Eidhoff, Sarah E. Stief, Markus Voeth, Sarah Gundlach University of Hohenheim Germany

5		Identifying and Understand Pragmatic Failures in Portuguese Foreign Language by Chinese Learners in Macau	Carla Lopes University of Macau Macao
6		More Than a Game: An Educational Application Where Students Compete to Learn	Kadir Özsoy Anadolu University Turkey
7	e-Poster	An Explanatory Practice Example: The Reasons of Students Not Doing Any Extra Work	Özge Özsoy Anadolu University Turkey
8	e-Poster	A Study on Bilingual Semantic Processing: Category Effects and Age Effects	Lai Yi-Hsiu National University of Kaohsiung Taiwan
9	e-Poster	Story of Sexual Violence: Curriculum as Intervention	Karen V. Lee The University of British Columbia Canada
10		Moving Forward to Stand Still: Social Experiences of Children with a Parent in Prison in Ireland	Aisling Parkes, Fiona Donson University College Cork Ireland
11	e-Poster	Self-Assessed Confidence in Residency Training Programs	J. Idowu, S. Pasha, L. Yogendran Richmond University Medical Center United States
12	e-Poster	Risk Factors Associated with Increased Emergency Department Visits and Hospital Admissions Among Child and Adolescent Patients	Lalanthica Yogendran, Manassa Hany, Saira Pasha, Benjamin Chaucer, Simarpreet Kaur, Christopher Janusz Richmond University Medical Center United States
13	e-Poster	STEM Curriculum Development Using Robotics with K-12 Students in Brazil	Flavio Campos SENAC São Paulo Brazil
14	e-Poster	Teaching Professional Competences through Projects: Experiencing Curriculum Development through Active Learning	Flavio Campos, Patricia Masmo, Fernanda Yamamoto SENAC São Paulo Brazil

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Session IV: 16:00-19:00

Chair: Zheng Jian, Hsueh-Sheng Chang

1		Towards Developing a Self-Explanatory Scheduling System Based on a Hybrid Approach	Jian Zheng, Yoshiyasu Takahashi, Yuichi Kobayashi, Tatsuhiro Sato Hitachi Ltd. Japan

2	A Flute Tracking System for Monitoring the Wear of Cutting Tools in Milling Operations	Hatim Laalej, Salvador Sumohano-Verdeja, Thomas McLeay Advanced Manufacturing Research Centre United Kingdom
3	A Comparative Study of Force Prediction Models during Static Bending Stage for 3-Roller Cone Frustum Bending	Mahesh Chudasama, Harit Raval Government Engineering College, Dahod India
4	A Method to Predict the Thermo-Elastic Behavior of Laser-Integrated Machine Tools	C. Brecher, M. Fey, F. Du Bois-Reymond, S. Neus RWTH Aachen University Germany
5	Analysis of Roll-Forming for High-Density Wire of Reed	Yujeong Shin, Seong Jin Cho, Jin Ho Kim Yeungnam University Korea, Republic Of
6	Analysis of Cascade Control Structure in Train Dynamic Braking System	B. Moaveni, S. Morovati Iran University of Science and Technology Iran, Islamic Republic Of
7	Black Box Model and Evolutionary Fuzzy Control Methods of Coupled-Tank System	Selin Yaman, Saeid Rostami Illinois Institute of Technology United States
8	Feasibility of a Biopolymer as Lightweight Aggregate in Perlite Concrete	Ali A. Sayadi, Thomas R. Neitzert, G. Charles Clifton Auckland University of Technology New Zealand
9	Exploring Coexisting Opportunity of Earthquake Risk and Urban Growth	Chang Hsueh-Sheng, Chen Tzu-Ling National Cheng Kung University Taiwan
10	Investigation of Regional Differences in Strong Ground Motions for the Iranian Plateau	Farhad Sedaghati, Shahram Pezeshk University of Memphis United States
11	Microseismicity of the Tehran Region Based on Three Seismic Networks	Jamileh Vasheghani Farahani University of Tehran Iran, Islamic Republic Of
12	Further Development in Predicting Post-Earthquake Fire Ignition Hazard	Pegah Farshadmanesh, Jamshid Mohammadi, Mehdi Modares Illinois Institute of Technology United States

June 10, 2016, HALL A

Session V: 08:00-11:00

Coffee Break: 11:00-11:15

Group photo will be taken during coffee break in the conference room.

Chair: Doru Anastasiu Popescu, Gunasekaran Raja

1		An Optimal Steganalysis Based Approach for Embedding Information in Image Cover Media with Security	Ahlem Fatnassi, Hamza Gharsellaoui, Sadok Bouamama Carthage College Tunisia
2		Improving Cryptographically Generated Address Algorithm in IPv6 Secure Neighbor Discovery Protocol through Trust Management	M. Moslehpour, S. Khorsandi Amirkabir University of Technology Iran, Islamic Republic Of
3		A Distributed Cryptographically Generated Address Computing Algorithm for Secure Neighbor Discovery Protocol in IPv6	M. Moslehpour, S. Khorsandi Amirkabir University of Technology Iran, Islamic Republic Of
4		Preserving Privacy in Workflow Delegation Models	Noha Nagy, Hoda Mokhtar, Mohamed El Sherkawi Cairo University Egypt
5		Approximately Similarity Measurement of Web Sites Using Genetic Algorithms and Binary Trees	Doru Anastasiu Popescu, Dan Rădulescu University of Pitesti Romania
6		Using Genetic Algorithms to Outline Crop Rotations and a Cropping-System Model	Nicolae Bold, Daniel Nijloveanu University of Agronomic Sciences and Veterinary Medicine Bucharest Romania
7	e-Poster	Data Collection with Bounded-Sized Messages in Wireless Sensor Networks	Min Kyung An Sam Houston State University United States
8		Proxisch: An Optimization Approach of Large-Scale Unstable Proxy Servers Scheduling	Xiaoming Jiang, Jinqiao Shi, Qingfeng Tan, Wentao Zhang, Xuebin Wang, Muqian Chen Institute of information engineering ,cas China
9		Cooperative Cross Layer Topology for Concurrent Transmission Scheduling Scheme in Broadband Wireless Networks	Gunasekaran Raja, Ramkumar Jayaraman Anna University, Madras Institute of Technology India
10		Network Coding with Buffer Scheme in Multicast for Broadband Wireless Network	Gunasekaran Raja, Ramkumar Jayaraman, Rajakumar Arul, Kottilingam Kottursamy Anna University, Madras Institute of Technology India
11		Energy Detection Based Sensing and Primary User Traffic Classification for Cognitive Radio	Urvee B. Trivedi, U. D. Dalal Government Polytechnic, Dahod India
12		Temperature Dependence of Relative Permittivity: A Measurement Technique Using Split Ring Resonators	Sreedevi P. Chakyar, Jolly Andrews, V. P. Joseph Christ College, University of Calicut India

June 10, 2016, HALL A

Session VI: 11:15-13:00

Lunch: 13:00

Chair: Emmanuel Dele Balogun, Michael K. H. Leung

1		Disaggregating and Forecasting the Total Energy Consumption of a Building: A Case Study of a High Cooling Demand Facility	Juliana Barcelos Cordeiro, Khashayar Mahani, Farbod Farzan, Mohsen A. Jafari Rutgers University United States
2		Ramification of Oil Prices on Renewable Energy Deployment	Osamah A. Alsayegh Kuwait Institute for Scientific Research Kuwait
3		Trade Policy Incentives and Economic Growth in Nigeria	Emmanuel Dele Balogun University of Lagos Nigeria
4		Recovery of Boron as Homogeneous Perborate Particles from Synthetic Wastewater by Integrating Chemical Oxo-Precipitation with Fluidized-Bed Homogeneous Granulation	Chiung-Chin Huang, Jui-Yen Lin, Yao-Hui Huang National Cheng Kung University Taiwan
5		Effect of Equivalence Ratio on Performance of Fluidized Bed Gasifier Run with Sized Biomass	J. P. Makwana, A. K. Joshi, Rajesh N. Patel, Darshil Patel Nirma University India
6		Plasmonic Resonance Based Photocatalysis and Photovoltaics for Solar Utilization	Michael K. H. Leung, Wenguang Fan City University of Hong Kong Hong Kong
7	e-Poster	UV Light-Activated Peroxydisulfate Oxidation of Imidacloprid in Synthetic Wastewater	Yi-An Liao, Lu-Wei Kuo, Yu-Jen Shih, Yao-Hui Huang National Cheng Kung University Taiwan
8	e-Poster	Electrocoagulation of Ni(OH)2/NiOOH for the Removal of Boron Using Nickel Foam as Sacrificial Anode	Yu-Jen Shih, Yao-Hui Hunag National Cheng Kung University Taiwan
9	e-Poster	Copper Removal from Synthetic Wastewater by a Novel Fluidized-bed Homogeneous Crystallization (FBHC) Technology	Cheng-Yen Huang, Yu-Jen Shih, Ming-Chun Yen, Yao-Hui Huang National Cheng Kung University Taiwan

PROGRAM GUIDELINES

1.GUIDE FOR ORAL AND e-POSTER PRESENTATIONS

We kindly ask ORAL presenters to prepare electronic presentations of 15 minutes (allowing 5 minutes for discussions) and e-POSTER presenters to prepare short electronic presentations of 5 minutes (allowing 5 minutes for discussions) (NO PRINT OUTS). A Linux-based operating system is used for both Oral and e-Poster presentations. All presenters should make a PDF file version of their presentation and upload it to the system.

2. PRESENTATION SET UP

Laptop Computer, Projector, USB Flash Drive (No CD Drive), MS. PowerPoint/AcrobatReader

3. SYSTEM SECURITY ALERT

As many delegates insert their USB devices into the laptop computer provided for the presentations, we cannot avoid Cyber/Computer viruses. You are kindly advised to bring a USB Flash Drive containing ONLY your .ppt, .ptx or .pdf presentation file or risk other files

being corrupted or made permanently inaccessible.

4. ROLE OF THE SESSION CHAIR

The duties of the Session Chair include the following:

1. Arrive at the conference hall at least 10 minutes before the session begins. Identify the paper presenters and discussant(s) in advance, and introduce yourself. Remind each presenter of the time limits that apply, and describe the method you will use to alert them of time limits during the actual presentation.
2. At the start of the session, introduce yourself to the audience, announce the session/title, and offer a brief overview indicating how the papers are related.
3. Prior to each presentation, introduce the speaker, announce the paper's title, the name(s) of the author(s), and provide brief comments regarding the affiliation and/or background of each presenter. Identify the individual who will be speaking if it is someone other than the first author.
4. During the presentations enforce time limits strictly so that no author (or audience member) monopolizes someone else's time. Oral paper presentations each have 20 minutes (15 minutes for full presentation papers, 5 minutes for discussions), and 10 minutes for e-Poster (electronic poster) presentations (5 minutes for poster presentation, 5 minutes for discussions).
5. Once presentations are complete (oral paper presentations and e-Poster presentations), the remaining time can be used for informal discussion between the audience and session participants. It is your job to field questions from the audience.
6. Try to conduct the session as informally as possible (e.g., use first names when addressing participants and members of the audience) to encourage as much audience participation as possible.

5. BEST PAPER AWARDS

A 'Best Paper Award' will be conferred on the author(s) of a full paper presented at the conference. Selection is made based on the best combined marks of the paper review and presentation quality appraisal conducted by the Session Chair at the conference venue, and assessed by the Program Committee. Award winners will be announced after the conference. The author(s) of a selected paper will receive a signed and stamped official Best Conference Paper Award e-certificate.

LIST OF PAPERS IN THE CONFERENCE PROCEEDINGS CD

SESSION 1

Chair : Mohamed Mohamed Aly Abdalla

1	Oral	**Effect of Chromium Yeast on Hematological Parameters in Camel Calves (Camelus dromedaries) Reared under Hot Summer Conditions** Khalid Ahmed Abdoun, Mohamed Abdulwahid Alsoufi, Ibrahim Abdullah Alhidary King Saud University Saudi Arabia
2	Poster	**Showing Broccoli and Cabbage Genotypes Biodiversity Using Randomly Amplified Polymorphic DNAs (RAPD)** M. M. A. Abdalla, M. H. Aboul-Nasr, Shimaa H. Mosallam Assiut University Egypt
3	Poster	**Application of 1-MCP on 'Centro' Melon at Different Days after Harvest** L. P. L. Nguyen, G. Hitka, T. Zsom, Z. Kókai Szent István University Hungary
4	Poster	**Nectariferous Plant Genetic Resources for Apicultural Entrepreneurship in Nigeria: Prerequisite for Conservation, Sustainable Management and Policy** C. V. Nnamani, O. L. Adedeji Ebonyi State University Abakaliki Nigeria
5	Poster	**A Life Cycle Assessment of Multi-Crystalline Solar Photovoltaic (PV) Technology** Anushka Pal Riga Technical University Latvia
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7	Oral	**Disaggregation of Coarser Resolution Radiometer Derived Soil Moisture to Finer Scales** Gurjeet Singh, Rabindra K. Panda Indian Institute of Technology Bhubaneswar India
8	Oral	**Effect of Climate Change on Groundwater Recharge in a Sub-Humid Sub-Tropical Region of Eastern India** Suraj Jena, Rabindra Kumar Panda IIT Bhubaneswar India
9	Oral	**Biodegradation Effects onto Source Identification of Diesel Fuel Contaminated Soils** Colin S. Chen, Chien-Jung Tien, Hsin-Jan Huang National Kaohsiung Normal University Taiwan
10	Poster	**The Potential of Edaphic Algae for Bioremediation of the Diesel-Contaminated Soil** C. J. Tien, C. S. Chen, S. F. Huang, Z. X. Wang National Kaohsiung Normal University Taiwan
11	Oral	**Natural Radioactivity in Foods Consumed in Turkey** Gursel Karahan, Hizir Asliyuksek, Ahmet Bozkurt, Erol Kam Yıldız Technical University Turkey
12	Oral	**Analysis of Trend and Variability of Rainfall in the Mid-Mahanadi River Basin of Eastern India** Rabindra Kumar Panda, Gurjeet Singh Indian Institute of Technology Bhubaneswar India
13	Oral	**Characteristics of Carrot Juice Treated with Aframomum danielli a Natural Food Preservative** Oyetunji John Adenuga Portable Sanitation Association International (PSAI) Nigeria
14	Poster	**Trend of Overweight and Obesity, Based on Population Study among School Children in North West of Iran: Implications for When to Intervene** Sakineh Nouri Saeidlou, Fatemeh Rezaiegoyjeloo, Parvin Ayremlou, Fariba Babaie Urmia University of Medical Sciences Iran, Islamic Republic Of
15	Oral	**Soil Surface Insect Diversity of Tobacco Agricultural Ecosystem in Imogiri, Bantul District of Yogyakarta Special Region, Indonesia** Martina Faika Harianja, Zahtamal, Indah Nuraini, Septi Mutia Handayani, R. C. Hidayat Soesilohadi Universitas Gadjah Mada Indonesia
16	Oral	**Development of Folding Based Aptasensor for Ochratoxin a Using Different Pulse Voltammetry** Rupesh K. Mishra, Gaëlle Catanante, Akhtar Hayat, Jean-Louis Marty Banasthali University Rajasthan India India
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Sudan University of Science and Technology Sudan

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Mohammad Mohammadzadeh, Alireza Ghasempour
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Kogi State University Nigeria

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54	Oral	**In Vitro Hepatoprotective and Anti-Hepatitis B Activitis of Cyperus rotundus Rhizome Fractions** Mohammad K. Parvez, Ahmed H. Arbab, Mohammed S. Al-Dosari King Saud University Saudi Arabia

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63	Oral	**Extraction, Synthesis, Characterization and Antioxidant Properties of Oxidized Starch from an Abundant Source in Nigeria** Okafor E. Ijeoma, Isimi C. Yetunde, Okoh E. Judith, Kunle O. Olobayo, Emeje O. Martins National Institute for Pharmaceutical Research and Development Nigeria
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202 Poster **Copper Removal from Synthetic Wastewater by a Novel Fluidized-bed Homogeneous Crystallization (FBHC) Technology**
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218 Oral **Improving Cryptographically Generated Address Algorithm in IPv6 Secure Neighbor Discovery Protocol through Trust Management**
M. Moslehpour, S. Khorsandi
Amirkabir University of Technology Iran, Islamic Republic Of

219 Oral **A Distributed Cryptographically Generated Address Computing Algorithm for Secure Neighbor Discovery Protocol in IPv6**
M. Moslehpour, S. Khorsandi
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220 Oral **An Optimal Steganalysis Based Approach for Embedding Information in Image Cover Media with Security**
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221 Oral **Proxisch: An Optimization Approach of Large-Scale Unstable Proxy Servers Scheduling**
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222 Oral **Preserving Privacy in Workflow Delegation Models**
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226 Oral **Using Genetic Algorithms to Outline Crop Rotations and a Cropping-System Model**
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University of Agronomic Sciences and Veterinary Medicine Bucharest Romania

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229 Oral **Cooperative Cross Layer Topology for Concurrent Transmission Scheduling Scheme in Broadband Wireless Networks**
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Saint Petersburg State University Russian Federation

附錄：論文篇

Disaggregating and Forecasting the Total Energy Consumption of a Building: A Case Study of a High Cooling Demand Facility

Juliana Barcelos Cordeiro, Khashayar Mahani, Farbod Farzan, Mohsen A. Jafari

***Abstract*—Energy disaggregation has been focused by many energy companies since energy efficiency can be achieved when the breakdown of energy consumption is known. Companies have been investing in technologies to come up with software and/or hardware solutions that can provide this type of information to the consumer. On the other hand, not all people can afford to have these technologies. Therefore, in this paper, we present a methodology for breaking down the aggregate consumption and identifying the high-demanding end-uses profiles. These energy profiles will be used to build the forecast model for optimal control purpose. A facility with high cooling load is used as an illustrative case study to demonstrate the results of proposed methodology. We apply a high level energy disaggregation through a pattern recognition approach in order to extract the consumption profile of its rooftop packaged units (RTUs) and present a forecast model for the energy consumption.**

***Keywords*—Energy consumption forecasting, energy efficiency, load disaggregation, pattern recognition approach.**

I. Introduction

IN 2014, residential and commercial buildings consumed 41% of energy resources in the US [1]. Studies have shown that energy efficiency can be improved by 5 to 15% when it is known which devices are consuming the energy [2], and this information can be achieved by breaking down the energy load, also known as energy disaggregation. Thus, due to the importance of load disaggregation, many companies such as Bidgely, Enetics and Intel, have been developing non-intrusive load monitoring (NILM) technologies to break out energy loads [3].

Appliance Load Monitoring (ALM) methods can be found in the literature as methods that perform energy sensing and provide the breakdown of the energy data. They have NILM and ILM as their major approaches. The NILM approach only requires a single meter per building or residence and it was developed as a cheaper alternative to the ILM since this one requires at least one sensor per appliance [4].

According to Hart [5], "A nonintrusive appliance load monitor determines the energy consumption of individual appliances turning on and off in an electric load, based on detailed analysis of the current and voltage of the total load, as measured at the interface to the power source". Since not all appliances consume constant power, Hart [5] proposed following operational state groups:

1. On/Off appliances: this group comprehends most of the household appliances that at any given time may be either on or off, but with only a single type of ON state, for example light bulb and water pump;
2. Finite State Machine (FSM): multi-state appliances with finite operation states belong to this group, such as washing machine and dishwashers;
3. Continuously Variable: this group comprehends the appliances with infinite operation states, such as light dimmers and sewing machines.

A fourth operational state group is defined in [6] as "Permanent consumer devices" which includes appliances that are on ON mode 24 hours per day and 7 days in the week and have their active and reactive power consumption approximately constant, such as aquarium pump.

The appliance features used to disaggregate the energy consumption through NILM approaches can be categorized as steady state (power change features, V-I trajectory, voltage noise, etc.), transient state (transient power, start-up current waveforms, voltage noise) and non-traditional [4].

Even though NILM techniques are powerful, they are impracticable when dealing with low-frequency data (1h – 15min), wherefore some authors use pattern recognition approaches to estimate high level properties from the energy consumption [7]-[9].

In this work, we applied the pattern recognition methodology. Resolution of utilized time-series data is 15 minutes and no information about appliances features is recorded.

One may not only want to know which appliances are impacting the total energy consumption but also predict how much the total consumption is going to be due to changes in certain controllable input, for instance asset operation schedule. Combining energy disaggregation method with prediction of energy consumption in end uses will create the beneficial approach to control the building energy consumption and improve the energy efficiency. Once the user can forecast the energy consumption, the mathematical programming could be formulated to minimize the energy consumption, which is an advantage for both consumer and the environment. However, the energy system of building is quite complex since different energy types can compose the system, such as heating/cooling load, electricity and hot water. The building energy behavior is dependent on factors like occupancy, weather conditions, HVAC (Heating, Ventilating and Air-Conditioning) systems and their schedules, etc. Therefore, due to the complexity of the problem, a precise forecasting is difficult.

The energy consumption prediction methods can be divided as engineering method, statistical methods, neural networks, support vector machines and grey models [10], [11]. The one chose to perform this study was the statistical method, which correlates the energy consumption to the variables of influence.

In conclusion, in this paper, we perform a methodology for breaking down the aggregate power consumption into the main end-uses profiles and creating the forecast model for these energy consumers. The load-forecasting model could be used for optimal operational control of any kind of building. We demonstrate a performance of such approach for an illustrative case study, an establishment that requires high cooling. This establishment will be denominated here as "Facility X".

The paper is structured as follows. In Section II, a general problem definition is presented while in Section III, the case study problem is described. Section IV describes the methodology utilized to extract RTUs profile from aggregate metered data. In Section V, preliminary data analysis is demonstrated to show the correlation between consumption data and some important measurable features such as ambient temperature and internal temperature. In Section VI, the regression model, used to forecast the consumption profile of RTUs will be explained and finally the conclusion is presented in Section VII.

II. Problem Definition

Even though techniques such as NILM have been focused by many authors in order to perform energy disaggregation, they turn to be more difficult to perform when the data set is not complete. For example, one may pursue data to analyze in which the time horizon does not fit on the NILM techniques or even do not have enough information about the existents appliances on the building in study, which is a challenge when analyzing the data.

In this work, we use pattern recognition approach to break down the aggregate consumption in its major end-uses profiles. This is done by observing if the total power consumption varies when the operational state (on/off) of a particular appliance is changed.

After knowing the major energy types that compose the energy system of a building, it is possible to estimate the energy consumption through a forecasting model.

A. Forecasting Formulation

Since building energy behavior depends on many factors, in this paper we considered features such as schedule of the RTUs, external and internal temperature, and the time of the day as independent variables of our linear regression model which has the sub-hourly energy consumption (kWh) as the dependent response variable. The energy consumption model proposed in this work is adapted from [12] and, given n sub hourly intervals, it can be written as:

$$\hat{Y}_i = \beta_0 + \beta_1 x_{1i} + \sum_{k=1}^{5} \beta_{2k} x_{2ik} + \sum_{k=1}^{5} \beta_{3k} x_{3ik} + \sum_{k=1}^{5} \beta_{4k} x_{4ik} + \sum_{m=1}^{95} \beta_{5m} x_m \quad \forall \; i = 1, 2, \dots n \tag{1}$$

where $\hat{Y}_i$ is the estimated energy consumption; all β are the parameter estimators; x_{1i} is the total number of RTUs operating; x_{2ik} is the difference between the internal and external temperature for each zone k; x_{3ik} is the difference between the zone temperature at time t and at time $t-1$ in zone k; x_{4ik} is the cooling set-point temperature of RTU in zone k; and x_m is a dummy variable to indicate time interval of the day.

III. Case Study Description

The Facility X has 6 RTUs and two energy meters that collect the total energy consumption of the building.

The available range data to perform this study is 8/19/2009 to 11/08/2012 and has two time scales:

- 15 minutes resolution: Energy consumption data for both meters, zone temperature, set-point temperature and state of operation for each RTU;
- Daily resolution: Energy consumption data and average outside temperature.

The energy consumption data for each RTU is not available and it is not known each meter is connected to which assets. Thus, in order to extract the consumption profile of the RTUs it is necessary to analyze the consumption data and schedule of the Facility X to disaggregate the metered consumption data. And, as second step, in order to forecast the energy consumption, it is necessary to analyze the temperature data, RTUs schedule and energy consumption.

IV. Disaggregation Methods and Results

Since the RTUs are the only appliance data available for Facility X, in our study we applied a pattern recognition approach in order to identify which meter collect data from those assets and if the RTUs are cooling or heating systems.

As mentioned earlier, energy consumption data for both meters with daily and 15 minutes time resolution, and the states of operation (occupied/setback) of each RTU with 15 minutes resolution are provided.

The method used in this study to disaggregate the meters data was by recognizing the impact caused on the pattern of the power consumption caused by the RTUs' schedule. In other words, if the power consumption varies when the RTU state of operation changes it means that the meter is responsible for collecting the respective RTU energy consumption.

In Figs. 1 (a) and (b), power consumption and schedules for 08/19/2009 are demonstrated, respectively. It can be seen that the power consumption of Meter 1 starts by the time the RTUs

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1, 3 and 5 have their operation state changed from setback to occupied, and a slightly increase in the power consumption occurs when RTUs 2 and 4 have their operation state changed as well. The same pattern can be observed in the end of the day: when RTUs 2 and 4 turn to the setback point, the power consumption has a visible drop and then goes back to zero, which can be explained by the change in the operation state of the RTUs 1, 3 and 5. In respect to RTU 6, operation state changes results in Meter 2 profile changes and doesn't have impact on Meter 1 consumption profile.

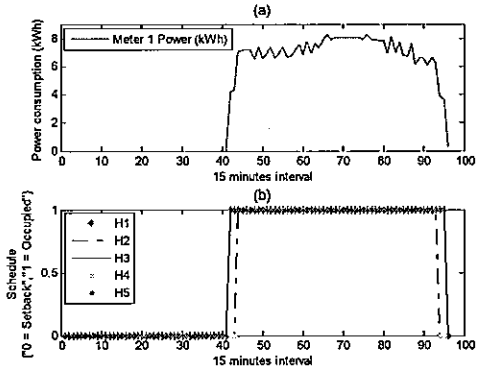

Fig. 1 (a) Meter 1 Electricity Consumption and (b) RTUs' schedule strategy in 08/19/2009

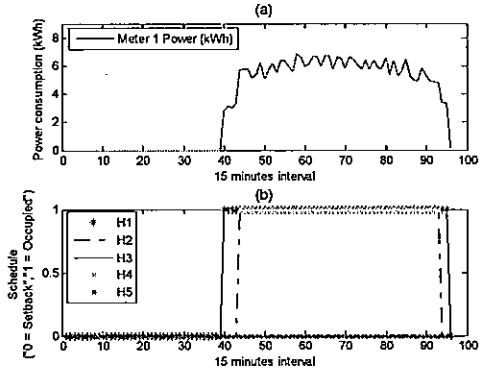

Fig. 2 (a) Meter 1 Electricity Consumption and (b) RTUs' schedule strategy in 08/19/2010

Figs. 2 (a) and (b) show the power consumption and the RTUs' schedule, respectively, of the following year (08/19/2010), where it can be seen that a drop in the maximum power consumption of Meter 1 occurs (approximately from 8kWh to 7kWh) as the same time RTU 2 has its operation state on setback point during the entire day.

The following step is to analyze if the 5 RTUs load designated to Meter 1 are cooling and/or heating. Therefore, in order to analyze it, a comparison between Meter 1 power consumption and average zone temperature of the 5 RTUs was performed and a sample of the summer (August) can be seen in Fig. 3. It can be seen that the average internal temperature is high during the time that the power consumption is zero, and it starts to decrease as power consumption increases and vice-versa. For winter samples, a heating pattern was observed since the average zone temperature is low when the energy consumption is 0 and while the energy consumption increases the temperature gets higher values.

In conclusion, RTUs 1, 2, 3, 4 and 5 are responsible for the store cooling and heating and have Meter 1 collecting their

energy consumption, while Meter 2 collects the energy consumption of RTU 6, general lighting and equipment.

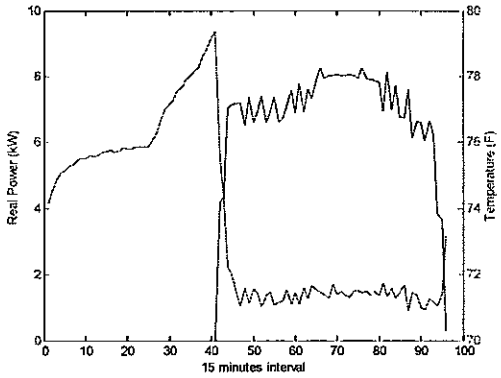

Fig. 3 Meter 1 Electricity Power x Internal Temperature

V. Preliminary Data Analysis

In this section, we are going to perform feature selection analysis in order to find the variables that are correlated with the energy consumption, such as temperature data and RTUs schedule, for a daily level.

The features' combinations are:

- A–Average outside temperature;
- B–RTUs' hours of operation and average outside temperature;
- C–Average zone temperature, RTUs' hours of operation and average outside temperature.

The Regression statistics results, for the three combinations groups, can be seen on Table I. The *R-Square* values show that for every feature added, the dependence of Meter 1 is increased.

TABLE I
REGRESSION STATISTICS FOR A, B, AND C COMBINATIONS

Statistics	A	B	C
R-square	0.846	0.876	0.902
Adjusted R-square	0.846	0.875	0.900
Standard Error	54.00	48.46	43.22
Observations	994	994	994

Finally, we conclude that Outside Temperature, RTU's schedule strategy and Zone temperature are important features that must be included in the multiple linear regression model, which is develop the following section.

VI. Forecast Model

The energy consumption prediction method applied in this paper is the multiple linear regression in which the independent variables considered are: Total number of RTUs operating, difference between RTU's respective zone temperature and external temperature, difference between zone temperature at time t and time $t-1$ in each control zone, RTU's cooling set-point temperature, and the dummy variable indicating the time interval of the day, and the dependent variable is the sub-hourly electricity consumption of Meter 1 (kWh).

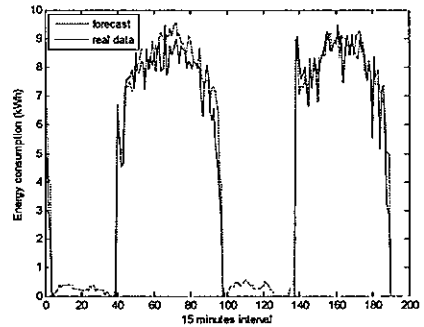

Fig. 4 Real Energy Consumption vs. Forecasting

The forecast model developed in this paper will focus on a cluster composed by 5 months with highest consumption level namely; May, June, July, August and September.

We used hold out methodology to measure the error of the forecast model. Meaning, we split the data into two groups: the training and the testing sets. As mentioned in section 3, our

dataset is from 8/19/2009 to 11/08/2012. We considered 2 summers as training set and the other summer as the testing set.

In order to develop the linear regression and obtain an equation such as in (1), we considered 2 sets of data as training data and then, to validate the model, we tested it on a 3rd set of data.

The multiple linear regression was performed in MATLAB and, as it can be seen on Table II, the forecasting model developed has a root mean square error (RMSE) of 1.07 and an R-square value of 0.865, which shows that the independent variables considered in proposed model have great impact on the energy consumption (dependent variable). Fig. 4 illustrates the comparison between the real energy consumption and the forecasted values for two sample days (July 10th and July 11th).

Upon completion of the training step and obtaining the multiple linear regression model, we evaluated the performance by analyzing the real prediction error of the model through its application to the testing set. As result, the RSME for testing set is 1.2345 kWh which is acceptable since the peak of consumption is around 9.5 kWh.

TABLE II
REGRESSION STATISTICS FOR FORECASTING MODEL

Statistics	Value
R-square	0.865
Adjusted R-square	0.865
Root Mean Square Error	1.07
Observations	29193

VII. CONCLUSION

Building energy efficiency has been on focus since it represents a big percentage of the total energy consumption of a region. Energy efficiency brings advantages for both the environment and the consumer, wherefore companies have been investing on technologies that help the user to save energy and, as result, money. On the other hand, not all consumers can afford such technologies, even though companies promise they will pay back over time.

Studies have shown that when the consumer know which equipment/assets impact in their building's energy consumption, energy efficiency can be achieved by up to 15%. Companies have been investing on NILM technologies to perform energy disaggregation, but since these techniques are impracticable when dealing with low-frequency data (1h – 15min) an alternative is to use pattern recognition approach, which estimates high level properties from the energy consumption.

Another way of saving energy is by predicting the energy consumption due to certain features such as schedules and changing on the weather conditions, for example. Multiple linear regression is the statistical method used in this work, which is among many methods to forecast energy consumption.

In conclusion, in this paper we combine the two major energy efficiency techniques and show our methodology through a case study. The building in study is a generic facility categorized by high cooling demand in which the data given was limited to aggregate meter energy data, rooftop package units (RTUs) schedules and features such as cooling and heating set-points. Besides not having more information about the building and its assets, the facility has two meters and no information about their energy collection division was known.

Finally, considering that the facility fits in the group of users that cannot afford energy saving technologies, we performed a pattern recognition approach to identify the major end-uses profiles of its energy consumption so that an energy forecasting model could be developed. The multiple linear regression performed for the training set has an R-square value of 0.865 and the root square mean error (RSME) for the testing set is acceptable for a value of 1.2345 kWh since the peak of consumption is around 9.5 kWh.

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Disaggregation of Coarser Resolution Radiometer Derived Soil Moisture to Finer Scales

Gurjeet Singh, Rabindra K. Panda

Abstract—Soil moisture is a key hydrologic state variable and is intrinsically linked to the Earth's water, climate and carbon cycles. On ecological point of view, the soil moisture is a fundamental natural resource providing the transpirable water for plants. Soil moisture varies both temporally and spatially due to spatiotemporal variation in rainfall, vegetation cover, soil properties and topography. Satellite derived soil moisture provides spatio-temporal extensive data. However, the spatial resolution of a typical satellite (L-band radiometry) is of the order of tens of kilometers, which is not good enough for developing efficient agricultural water management schemes at the field scale. In the present study, the soil moisture from radiometer data has been disaggregated using blending approach to achieve higher resolution soil moisture data. The radiometer estimates of soil moisture at a 40 km resolution have been disaggregated to 10 km, 5 km and 1 km resolutions. The disaggregated soil moisture was compared with the observed data, consisting of continuous sensor based soil moisture profile measurements, at three monitoring sites and extensive spatial near-surface soil moisture measurements, concurrent with satellite monitoring in the 500 km2 study watershed in the Eastern India. The estimated soil moisture status at different spatial scales can help in developing efficient agricultural water management schemes to increase the crop production and water use efficiency.

Keywords—disaggregation, eastern India, radiometers, soil moisture, water use efficiency

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Drivers of Digital Product Innovation in Firms: An Empirical Study of Technological, Organizational, and Environmental Factors

Anne Theresa Eidhoff, Sarah E. Stief, Markus Voeth, Sarah Gundlach

Abstract—With digitalization increasingly changing the rules of competition, firms face the need to adapt and assimilate digital technologies in order to remain competitive. Firms can choose from various possibilities to integrate digital technologies including the option to embed digital technologies aiming to innovate products or to develop digital products. However, the question of which specific factors influence a firm's decision to pursue digital product innovation remains unanswered in research. By adopting the Technology-Organization-Environment (TOE)-framework we have designed a qualitative exploratory study including eleven German practitioners to investigate relevant contingency factors. Our results indicate that the most critical factors for a company's decision to pursue digital product innovation can be found in the technological and environmental dimensions, namely customers, competitive pressure, technological change, as well as digitalization fit.

Keywords—Digital innovation, digitalization, product innovation, TOE-framework.

I. Introduction

DIGITAL technologies are a driving force in today's economy, as they can enhance the competitiveness of a firm to increase its flexibility and market reach, as well as the efficiency and effectiveness of processes and products – while often lowering operating costs [1]. Under the term digital technologies, combinations of information systems, computing, communication and connectivity technologies can be subsumed [2], all of which fundamentally transform business activities.

Digital technologies have facilitated innovation that has led to disruptive changes in business activities of firms in former established industries, such as music and publishing [3]. Firms in both industries have only hesitantly accepted the rapid technological developments and initially reacted by ignoring the unavoidable fundamental changes [4]. These industries were the first to be affected because their products could easily be encoded into a digital format and thus become completely digitalized [5]. The music and publishing industries are prime examples in which negligence concerning the impact of digitalization on established business activities led to a financial crisis and decline of many firms in these industries. Bearing these developments in mind and despite all progress companies have made, they still must face the challenge to outline the possible consequences of digitalization alongside the increasing emergence of new digital technologies for their business and assimilate these technologies in order to improve their competitiveness [2]. One possibility firms are starting to pursue is to leverage digital technologies by embedding these in their product and service offerings [6] which leads to product innovation.

Digital technologies with their unique properties have become the "primary driver of business innovation" [7, p.331] and have thus opened up new possibilities for innovation [8]. Advances in digital technologies have created substantial opportunities for generating digital product innovation [9]. In this regard, a digital product innovation is either a new product which is embodied in digital technology or is enabled by it [7]. Examples of digital product innovation are new platforms, e.g. ERP-systems, new consumer products, e.g. smartphone apps, and existing products substantially enhanced by the addition of digital technologies, e.g. digitally connected machines [9]. In order to stay competitive product innovation is crucial for organizational success in times of ever shorter product life cycles [10]. However, despite the high awareness of the importance of assimilating digital technologies for a firm's value creation, performance and survival, scholars and practitioners alike struggle to understand how to optimally and effectively leverage digital technologies [3]. In this matter, [3] propose to integrate digital technologies into products which offer firms a strategic option to secure future business. Nonetheless, as firms can choose from various possibilities to integrate digital technologies [2], the question arises as to which specific factors influence a firm's decision to pursue digital product innovation. Prior research has been conducted to identify crucial factors for the adoption and implementation of new technologies by using the established TOE-framework [11, p. 33], [12]. Building upon the TOE-framework, our research goal is to investigate major factors that can be regarded as influential on the specific decision to digitalize products. In order to do so, we conducted in-depth field interviews with practitioners who are in the process of developing their digital business strategy. These interviews aim to identify crucial factors for this question.

The paper is organized as follows. First, we present a brief literature review on the TOE-framework with its corresponding technological, organizational and environmental factors influencing the adaption and implementation of new technologies. Second, we describe our methodological approach, provide information on the sample and present our results. Finally, we conclude our paper with implications for academia and for management, as well as mentioning some limitations.

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II. Literature Review and Research Model

The TOE-framework [11, p.33] summarizes previous research on the adoption of innovative digital technology and aims to elaborate on crucial factors influencing users' adoption of new information technology. The TOE-framework is an organization-level theory and represents how a firm's context influences the adoption and implementation of innovation [13]. The framework contains three major components that affect the process of adopting innovative technologies, namely technology, organization and environment and these components present both opportunities and hindrances for innovation [11]. Although the framework has its primary goal in the elaboration of factors that lead to an adoption of new technologies within organizations, such as e-business usage, enterprise systems or communication technologies, e.g. [12], we infer that this conceptual framework can be transferred to the context of innovation projects in which firms instigate these innovations. Our approach is based on the fact that product innovation research also involves identifying contingency factors that promote the acceptance and usage of these innovations among customers, e.g. [14]. Hence, the developed approach offers a fruitful avenue to explore the transferability of the TOE-framework respecting firms' innovations.

The technology dimension of the framework includes both internal and external technologies available to the firm, such as equipment and processes. Technology is obviously a major influencing factor regarding the digitalization of products as new technologies facilitate innovation [15]. New technologies are driven by the technological change to which firms must constantly adapt their business activities and offerings [16]. The large improvements in digital technology itself within the last ten years, e.g. faster mobile connectivity and more digital services have unleashed new opportunities by digitalizing key functions and capabilities of conventional, physical products such as cars, phones, cameras, and even books [2]. Previous literature highlights the role of digital capabilities for new product success in a firm's ability to acquire and apply various technologies [17] as this is critical for product innovation [1].

Organizational factors will affect the firm's intention to adapt new technologies for product innovation [18, p.16] as these factors are a prerequisite for the ability to respond to digital innovations [19]. In the context of a firms' adoption and implementation of new technologies, literature in this field has observed that corporate strategy [15], organizational culture and organizational structure [15], financial resources [20] as well as top management support [15], are influential factors. The corporate strategy entails how a strategic vision influences innovation management and how a firm positions itself in relation to its competitors [15]. This vision outlines the future direction of an organization and its medium and long-term activities and objectives [21]. The strong influence of organizational culture has been widely elaborated upon as a major driver and key factor in the management of innovation and the creation of value, e.g. [15]. An appropriate organizational structure is necessary for the successful adoption and integration of technology [15]. Further, [15, p. 9] indicates that a complete separation of organizational culture and organizational structure is a challenge, "as both have developed parallel over the lifetime of the organization". The adoption of new digital technologies can be substantially hindered by a lack of financial resources [22]. Financially stable firms are more likely to adopt new technology than financially less stable firms, as a good financial situation allows a firm to take more risks [20]. Top management support refers to which extent the executives understand the function and characteristics of product innovation based on digital technologies [15]. With regard to this, the study of [23] found that top manager's support has a major effect on the adoption and implementation of information technology.

The environmental dimension represents the current operating environment of firms and has been identified as a major driver for innovation and organizational change [11], [24]. With the emergence of new technologies and the increasing digitalization, new entrants with innovative business models have endangered established business models and have changed the "rules of competition" [8, p. 494]. This leads to fundamentally changed environments in which firms operate. Previous studies concluded that competitive pressures enhance the adoption and implementation of new technologies [25] and that the resulting pressure increases the intensity of product innovation [26]. According to [27], the integration of digital technologies in a firm can be mobilized by the industry in which a firm operates as this influences the degree of digitalization in the particular industry. Although most studies in pertinent literature do not include customers in their research, we propose to do so as they represent a factor to be taken into account when investigating the development of innovation. In this matter, the increasing digitalization requires consideration of two additional aspects, namely changing customer expectations and the possibility of customer empowerment [28].

TABLE I
Factors Influencing Digitalization at Product Level (Multiple Indications Possible)

Technological factors	Organizational factors	Environmental factors
Technological resources [15]	Corporate strategy [15]	Competitive pressure [25]
Digital competencies [1]	Organizational culture [15]	Industry structure [27]
Technological change [16]	Organizational structure [15]	Customers [29]
	Financial resources [20]	
	Top management support [15]	

Due to the omnipresence of digital technologies and unlimited information access, customer expectations have changed. This leads to customers applying higher demands on the quality of information and product offerings of firms [29]. Further, customer empowerment reflects consumers' enhanced

ability to access, understand and share information [28] and this concept has been of growing interest in prior studies on product innovation, e.g. [30].

Based on the discussion above, the framework which will be evaluated in the exploratory study contains eleven variables and categorizes them in accordance with the dimensions of the underlying TOE-framework. Table I summarizes these factors.

III. Methodological Approach

In order to analyze the factors that influence the digitalization of products, we conducted in-depth field interviews with eleven German practitioners, all of whom are responsible for implementing their company's digitalization strategy. A crucial criterion to be chosen as an expert in our study was the prerequisite that the companies had recently faced, the strategic decision of whether and how to digitalize their business. The practitioners work in different industries, namely media, telecommunication, financial, automotive, pharmaceutical, online advertising, logistics, and insurance. With regard to size, the number of employees of the represented companies ranges from 51 to 300,000. The position the interviewed experts hold can be broken down as following: four of them are CEOs, three are heads of business development, and the remaining four experts work in a staff function assigned to digital transformation. By selecting a variety of different industries, we obtained a diversified sample enabling a grasp on a broad scope of factors influencing the digitalization of products. As digitization is relevant to both firms and industries we chose to analyze B2B, as well as B2C companies, to cover different facets of digitization influences. The participants were provided the interview guideline at least one week prior to the interview. All interviews took place in June and July 2015. The interviews lasted between twenty to forty-five minutes. For validation purposes we recorded and transcribed all interviews. The study focused primarily on the experts' evaluation concerning the question: Which of the factors derived from the literature review on the TOE-framework have a major influence on a firm's decision to pursue digital product innovation? Further, the practitioners were asked to name influential factors that had not been included in the interview guidelines. In order to analyze the data, two researchers independently sorted and analyzed the statements. Further, the answers were coded with the help of a qualitative data analysis tool (MAXQDA) to secure a thorough data analysis, as well as to analyze the interviews systematically. Following the structure of the TOE-framework the chosen codes were (1) technological, (2) organizational, (3) environmental, and (4) additional factors identified by the experts.

IV. Empirical Results

Our empirical results include insights into relevant factors for the digitalization of the TOE-framework dimensions namely, technological, organizational, and environmental factors influencing the digitalization of products. All experts agree that the adoption of digital technologies offers ample possibilities to enhance existing or to create completely new products. Based on our derived research model, the experts were asked to evaluate the factors within the dimensions environment, organization, and technology. An overview of the major factors is provided in Table II.

TABLE II
Factors Influencing Digitalization at Product Level (Multiple Indications Possible)

Factors influencing the digitalization of products	Characteristics	Counts
Environmental factors	Customers	8
	Competitive pressure	7
Technological factors	Technological change	5
Organizational factors	Financial resources	2
Additionally identified factor	Digitalization fit	4

The environment dimension reflects external forces involved in a firm's adoption of digital technologies. With eight experts stressing the important influence of customers for adopting new technologies and seven indications for competitive pressure, the results show that the environmental dimension is the most important among those given. In order to satisfy and retain their increasingly tech-savvy customers, firms need to consider how to innovate and enhance their product or service offered by integrating digital technologies in order to address these changing needs and to develop products correspondingly. Consequently, in order to adequately respond to customer needs, firms must improve their customer orientation and take advantage of the technology-based opportunities of customer empowerment. In line with other research regarding information technology adoption, e.g. [12], competitive pressure (seven indications) is a major factor influencing a firm's decision to digitalize products, as competition forces firms to constantly review and revise their service offerings and thus remain competitive. Some experts recognize the opportunity of digital technologies to enable firms to develop entirely new products that serve unmet customer needs in order to "*use this as a unique selling point over the competitors*" as quoted by one expert. It can be noted, that in all interviews the competitive pressure to assimilate digital technologies for product innovation does not originate from other established players, but rather from innovative digital start-ups like FinTechs or born-digitals like Google entering new domains.

The technology dimension represents technical issues of adopting digital technologies in order to create digital products. In this matter, technological change (five mentions) is the main driving force that influences the orientation towards digital products. Due to technological change firms must constantly rethink their product offerings in order to grasp opportunities arising through the implementation of new digital technologies. When considering the technological dimension, four experts added the factor, digitalization fit, which describes the feasibility of assimilating digital technologies into existing products or completely digitizing established products. According to one expert, for example, banking is regarded to be "*perfectly suited for digitalization, because the product can be completely digitalized,*" and thus programmable, which facilitates simply adding new mobile services or further improving existing digital products regarding their efficiency, effectiveness, and convenience [29]. The experts stress this factor as the possibility and the degree of feasibility to digitize products or to innovate a digital product complementary to existing products, as a prerequisite to address the question of implementing technology-based product innovation. To date the factor, digitalization fit, has been neglected in digitalization literature and shall be regarded as a new factor in research.

According to our experts, organizational factors play a solely subordinated role. Only financial resources, as a possible hindrance, were named to be relevant when assessing important factors for digitalizing products. These firms name the unpredictability of financial returns as a reason for not pursuing digital product innovation.

When evaluating the obtained results, it can be derived that organizational factors can be neglected when the decision to adopt digital technologies in order to innovate products is made. Thus, rather than the TOE-framework, a framework consisting solely of technological and environmental factors sufficiently explains contingency factors that facilitate or hinder a firm's decision to pursue technology-based product innovation.

V. Conclusion and Implication

The goal of this paper was to investigate relevant factors that influence a firm's decision to pursue digital product innovation. In order to do so we developed a research approach based on the TOE-framework which contains factors influencing the adoption and implementation of new technologies derived from an extensive literature review with the context of product development. These factors were tested in a qualitative exploratory study with practitioners who are responsible for implementing their firm's digitalization strategy. Among the initially derived factors which originate from the technological and environmental dimensions, four can be regarded as the most influential. Customers, competitive pressure, technological change, and financial resources are major influencing factors for the decision to adopt digital technologies to innovate products. Further, with the factor, digitalization fit, we add a new contingency which may prove to be important in further research.

Drawing upon our empirical findings, we can derive some implications for academia and management. To scholars our work offers deeper insights into firms' strategic decisions to assimilate digital technologies. Our research shows that approaching an established framework under a new perspective can be evaluated as a fruitful avenue to strengthen and transfer the framework's application. For practitioners, this study identifies relevant factors that influence a firm's decision to use digital technologies in order to enhance their product portfolio. The results shed light on the issue of digitalization fit which means that managers must evaluate possibilities to integrate digital technologies into their products or to invent new digital products complementary to existing products.

Although this study provides valuable insights regarding factors influencing a firm's strategic decision to digitalize products, some limitations have to be mentioned. This study investigates only a limited number of organizations, and thus consequently, contains only a very small number of cases for each industry. Further, the factors which have been neglected in the introduced research approach could easily interrelate. The study design should be repeated with a larger sample and extended to different settings. Future research could extend to approach further facets of firms, for example, to analyze factors influencing the digitalization of processes and the adjustment of business models by using digital technologies.

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Effect of Chromium Yeast on Hematological Parameters in Camel Calves, *Camelus dromedaries* Reared under Hot Summer Conditions

M. A. Alsofi, K. A. Abdoun, I. A. Alhidary

***Abstract*—**The intention of this study was to evaluate the effect of dietary Cr supplementation on haematological parameters in camel calves reared under hot summer conditions. Fifteen male camel calves (5-6 months old) were randomly allotted to three dietary treatments (n = 5) for a period of 84 days. Camel calves were fed ad libitum on basal diet without Cr supplementation (control), basal diet supplemented with 0.5 mg Cr/kg DM (Cr 0.5) or basal diet supplemented with 1.0 mg Cr/kg DM (Cr 1.0). During this blood, samples were collected every four weeks for hematological examination. Obtained results revealed that dietary Cr supplementation to camel calves reared under hot summer did not show significant effects (P> 0.05) on hematological variables. However, the neutrophil to lymphocytes ratio (N:L ratio) was significantly (P<0.05) reduced in camel calves fed on diets supplemented with chromium. In conclusion, N:L ratio reduction in camel calves fed diets supplemented with chromium.

***Keywords*—**Camel calves, Chromium, hematological, immune response.

I. Introduction

THERE has been recently a great attention on camel industry based on milk, meat and wool production. The majority of dromedary camels are reared in arid and semi-arid regions, which are characterized by extreme summer temperature. In domestic animals, Cr has been recognized as an essential trace mineral, and suggested to alleviate stress associated effects [1]. Chromium supplementation to the animal's diet has deceased total iron binding capacity, ferritin, haemoglobin and haematocrit by 11%, 22%, 17% and 17% respectively [2]. Moreover, dietary chromium supplementation in broilers has reduced heterophils count, increased lymphocytes count and consequently reduced heterophils/ lymphocytes ratio without effecting monocytes, basophils and eosinophils count [3]. In contrast, [4] reported that Cr supplementation has increased haematocrit of stressed feeder calves. It has also been observed that chromium picolinate supplementation to broiler diet has significantly increased haemoglobin concentration and tended to increase the haematocrit [5]. It is worth to mention that exposure of chickens to high temperatures decreased the blood haematocrit and haemoglobin values [6]. Considerable research indicates that chromium can affect immune response and disease resistance in cattle [7], [8].

Chromium is important in altering the immune response by immune stimulatory or immunosuppressive processes as shown by its effects on T and B lymphocytes, macrophages, cytokine production and immune responses that may induce hypersensitivity reactions [9], [10]. Chromium supplementation has reduced morbidity from respiratory diseases [4]. However, to our knowledge; there is no single report about the possible effects of Cr on the hematological of camels. Therefore, the objective of this study was to investigate the effect of dietary chromium supplementation on hematological of dromedary camel calves exposed to hot dry environmental summer conditions.

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II. Materials and Methods

Fifteen Al-Mejaheem male camel calves (5-6 months old) were used in an 84-day study. On day 1, camels were randomly assigned to one of three dietary treatments (5 animals / treatment). The study was undertaken during the hot summer season of Saudi Arabia (June to September) at the Animal Research Station affiliated to the Department of Animal Production, King Saud University, Riyadh, Saudi Arabia.

The treatments included basal diet without Cr supplementation (Control), basal diet supplemented with 0.5 mg Cr/kg DM (Cr 0.5) and basal diet supplemented with 1.0 mg Cr/kg DM (Cr 1.0). All experimental diets were provided by ARASCO (WAFI, ARASCO, Riyadh, Saudi Arabia), and are formulated to meet the nutritional requirements of growing camels (Table I). Chromium was supplemented to the experimental diet in form of Cr-yeast (0, 0.5 and 1.0mg Cr/kg DM). Chromium was supplied from a high-Cr yeast source (Alltech, Lexington, KY) that contained 1g Cr/ kg of yeast. Feed was offered ad libitum and all animals had free access to clean fresh tap water throughout the experiments.

Blood samples were collected from all camel calves before feeding by jugular venepuncture on day 1, 28, 56 and 84 of the experimental first phase using 10mL vacutainer tubes (BD Franklin Lakes, NJ, USA) containing K3-ethylenediamine tetra-acetic acid (K3 EDTA). Samples collected were processed immediately within 3 hours of blood collection to measure white blood cell count (WBC), total red blood cell count (RBC), haemoglobin level, haematocrit (PCV), mean cell volume (MCV), mean corpuscular haemoglobin (MCH) and mean corpuscular haemoglobin concentration (MCHC) using haematology analyser (Vetscan HMII, Abaxis

Veterinary Diagnostics, Northern California, USA) according to the manufacturer's instructions.

TABLE I
NUTRIENTS COMPOSITION OF THE BASAL DIET (DM BASIS)

Nutrient	Dietary content
DE (MJ/kg)	2.95
CP (%)	13.0
CF (%)	9.0
Fat (%)	2.0
Ca (%)	1.2
P (%)	0.5
Na Cl (%)	0.7
Cr (mg/kg)	5.0
Cu (mg/kg)	22.0
Fe (mg/kg)	140.7
Mn (mg/kg)	136
Zn (mg/kg)	137

Statistical Analysis

All data obtained from the study were analysed using repeated measures and the Proc Mixed model (SAS Institute Inc., Cary, NC, USA). Dietary treatment (levels of Cr), were included in the model as main effects. Camels within treatment were used as a random variable (error term). Data were presented as the least square mean ±SE and differences were considered significant at P≤ 0.05. All recorded and calculated variable were subjected to analysis of variance (ANOVA) in a Completely Randomized Design (CRD) by following a statistical package using SAS [11] statistical computer package program. Duncan's Multiple Range Test (DMRT) was used to compare treatment means: The following model was used:

$$Yijk = \mu + Ti + eijk$$

where: $Yijk$ = dependent variable, μ = overall mean of the population, Ti = mean effect of the ith treatments (Cr levels: 0.0, 0.5, and 1.0, mg/kg), $eijk$ = unexplained residual element assumed to be independent and normally distributed.

III. RESULTS AND DISCUSSIONS

Chromium supplementation to the diet of camel calves did not show significant effects (P> 0.05) on total RBC, hemoglobin concentration (Hb), hematocrit (PCV) and erythrocyte indices (Figs. 1-5 and Table II). Although, chromium inclusion in the diet of camel calves did not alter the total leucocytes count (WBCS) (Fig. 4). However, it has significantly (P< 0.05) affected their differential counts. Whereas, N: L ratio was significantly (P< 0.05) reduced in camel calves fed on diets supplemented with chromium (Fig. 5). The hematological variables of camel calves examined in this study did not show any variation as a result of dietary chromium supplementation. This supports the previous reports on Holstein cows [12]. In contrast, [4] reported an increase in hematocrit of Cr-supplemented stressed feeder calves. This discrepancy could be related to the different form of Cr (organic vs inorganic) used in these studies or the different hydration status of the animals. However, chromium supplementation to the diet of camel calves resulted in a reduction of N: L ratio. It is well documented that heterophils are particularly sensitive to adrenocorticotropic hormone [13]. Thus, the increase in lymphocytes and decrease in neutrophils count, with the subsequent reduction of neutrophil: lymphocyte ratio of Cr supplemented heat-stressed camel calves observed in the present study would be related the reported Cr-induced reduction in blood cortisol level [14].

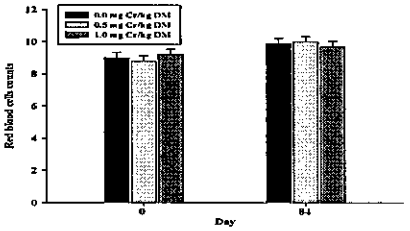

Fig. 1 Effect of dietary chromium supplementation on RBCs count (10^6/ml) in camel calves at the beginning and the end of the experimental period (bars represent means ± SE; bars within the same period with different superscripts are significantly different at P< 0.05; n = 5)

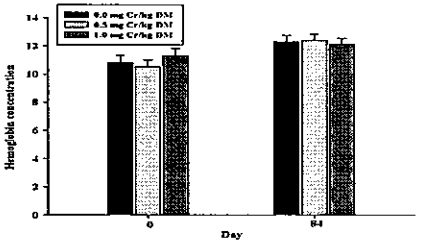

Fig. 2 Effect of dietary chromium supplementation on hemoglobin concentration (g/dl) in camel calves at the beginning and the end of the experimental period (bars represent means ± SE; bars within the same period with different superscripts are significantly different at P< 0.05; n = 5)

IV. CONCLUSION

Chromium supplementation to the diet of camel calves did not show significant effects on hematological variables. Except, N:L ratio was reduced in camel calves fed on diets supplemented with chromium.

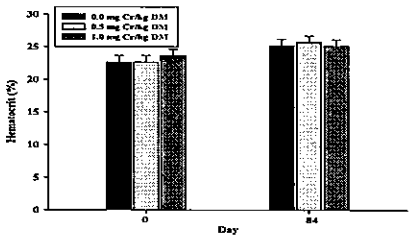

Fig. 3 Effect of dietary chromium supplementation on hematocrit (%) in camel calves at the beginning and the end of the experimental period (bars represent means ± SE; bars within the same period with different superscripts are significantly different at P< 0.05; n = 5)

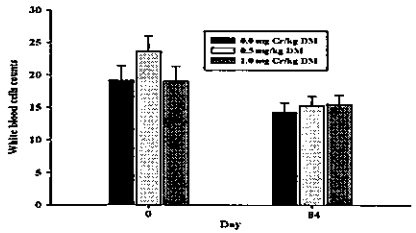

Fig. 4 Effect of dietary chromium supplementation on WBCs counts (10^3/ml) in camel calves at the beginning and the end of the experimental period (bars represent means ± SE; bars within the same period with different superscripts are significantly different at P< 0.05; n = 5)

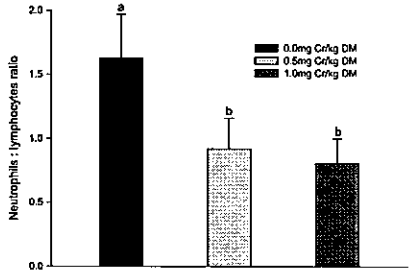

Fig. 5 Effect of dietary Cr supplementation on neutrophil/lymphocyte ratio in camel calves (bars represent means ± SE; bars with different superscripts are significantly different at P< 0.05; n = 5)

TABLE II
EFFECT OF DIETARY CHROMIUM (CR) SUPPLEMENTATION ON HAEMATOLOGICAL INDICES IN CAMEL CALVES AT THE BEGINNING AND THE END OF THE EXPERIMENTAL PERIOD

Measurements	day	Supplemental Cr mg/kg 0.0	0.5	1.0	SEM	P-value
MCV (fL)	0	25.0	25.7	25.8	0.79	0.731
	84	25.8	25.6	25.6	0.50	0.948
MCH (pg)	0	11.9	12.2	12.2	0.27	0.647
	84	12.5	12.4	12.4	0.25	0.938
MCHC (g/dl)	0	47.7	47.4	47.7	0.90	0.954
	84	48.7	48.4	48.1	0.76	0.841
Red cell distribution width (%)	0	26.8	27.5	28.8	0.84	0.287
	84	26.3	26.5	27.5	0.80	0.537

Data represent means and pooled standard error of mean (SEM); Cr was supplemented as high-chromium yeast; MCV = mean corpuscular volume; MCH = Mean corpuscular hemoglobin; MCHC = Mean corpuscular hemoglobin concentration (n = five per treatment group).

ACKNOWLEDGMENTS

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Effect of Climate Change on Groundwater Recharge in a Sub-Humid Sub-Tropical Region of Eastern India

Suraj Jena, Rabindra Kumar Panda

Abstract—The study region of the reported study was in Eastern India, having a sub-humid sub-tropical climate and sandy loam soil. The rainfall in this region has wide temporal and spatial variation. Due to lack of adequate surface water to meet the irrigation and household demands, groundwater is being over exploited in that region leading to continuous depletion of groundwater level. Therefore, there is an obvious urgency in reversing the depleting groundwater level through induced recharge, which becomes more critical under the climate change scenarios. The major goal of the reported study was to investigate the effects of climate change on groundwater recharge and subsequent adaptation strategies. Groundwater recharge was modelled using HELP3, a quasi-tw--dimensional, deterministic, water-routing model along with global climate models (GCMs) and three global warming scenarios, to examine the changes in groundwater recharge rates for a 2030 climate under a variety of soil and vegetation covers. The relationship between the changing mean annual recharge and mean annual rainfall was evaluated for every combination of soil and vegetation using sensitivity analysis. The relationship was found to be statistically significant ($p<0.05$) with a coefficient of determination of 0.81. Vegetation dynamics and water-use affected by the increase in potential evapotranspiration for large climate variability scenario led to significant decrease in recharge from 49-658 mm to 18-179 mm respectively. Therefore, appropriate conjunctive use, irrigation schedule and enhanced recharge practices under the climate variability and land use/land cover change scenarios impacting the groundwater recharge needs to be understood properly for groundwater sustainability.

Keywords—Groundwater recharge, climate variability, Land use/cover, GCM

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Effect of Crack Presence and Growth on Gas Turbine Blades Using Modal Analysis

Morteza Raki, Abolghasem Zabihollah, Omid Askari

Abstract—Rotary equipments are being used in many industries such as oil and petrochemical, power generation plants and so on. It is possible that the blade suffer some damages including crack and crack propagation. Crack propagation is a reason of catastrophic failure in turbine blades. So detection of crack presence and its propagation is the Concern for designers to prevent damages and may reduce cost of maintenance of the systems. This paper studies the effect of cracks presence and crack propagation on turbine blade`s vibration. A typical gas turbine used in a gas station belonged to NISOC (National Iranian Oil Company) and located in Ahvaz has been considered for investigation. A finite element model will be used for the blade in which the modal response of the structure with and without crack will be studied. A proof-of-the-concept experimental set-up will be presented to illustrate the performance and functionality of the proposed on-line structural health monitoring system for the gas turbine`s blade.

Keywords—gas turbine, blade, crack growth, modal analysis

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Effect of Distance Education Students Motivation with the Turkish Language and Literature Course

Meva Apaydin, Fatih Apaydin

Abstract—Role of education in the development of society is great. Teaching and training started with the beginning of the history and different methods and techniques which have been applied as the time passed and changed everything with the aim of raising the level of learning. In addition to the traditional teaching methods, technology has been used in recent years. With the beginning of the use of internet in education, some problems which could not be soluted till that time has been dealt and it is inferred that it is possible to educate the learners by using contemporary methods as well as traditional methods. As an advantage of technological developments, distance education is a system which paves the way for the students to be educated individually wherever and whenever they like without the needs of physical school environment. Distance education has become prevalent because of the physical inadequacies in education institutions, as a result; disadvantageous circumstances such as social complexities, individual differences and especially geographical distance disappear. What's more, the high-speed of the feedbacks between teachers and learners, improvement in student motivation because there is no limitation of time, low-cost, the objective measuring and evaluation are on foreground. In spite of the fact that there is teaching beneficences in distance education, there are also limitations. Some of the most important problems are that : Some problems which are highly possible to come across may not be solved in time, lack of eye-contact between the teacher and the learner, so trust-worthy feedback cannot be got or the problems stemming from the inadequate technological background are merely some of them. Courses are conducted via distance education in many departments of the universities in our country. In recent years, giving lectures such as Turkish Language, English, and History in the first grades of the academic departments in the universities is an application which is constantly becoming prevalent. In this study, the application of Turkish Language course via distance education system by analyzing advantages and disadvantages of the distance education system which is based on internet.

Keywords—Distance Education, Turkish Language, Motivation, Benefits

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Effect of Equivalence Ratio on Performance of Fluidized Bed Gasifier Run with Sized Biomass

J. P. Makwana, A. K. Joshi, Rajesh N. Patel, Darshil Patel

***Abstract*—Recently, fluidized bed gasification becomes an attractive technology for power generation due to its higher efficiency. The main objective pursued in this work is to investigate the producer gas production potential from sized biomass (sawdust and pigeon pea) by applying the air gasification technique. The size of the biomass selected for the study was in the range of 0.40-0.84 mm. An experimental study was conducted using a fluidized bed gasifier with 210 mm diameter and 1600 mm height. During the experiments, the fuel properties and the effects of operating parameters such as gasification temperatures 700 to 900 °C, equivalence ratio 0.16 to 0.46 were studied. It was concluded that substantial amounts of producer gas (up to 1110 kcal/m³) could be produced utilizing biomass such as sawdust and pigeon pea by applying this fluidization technique. For both samples, the rise of temperature till 900 °C and equivalence ratio of 0.4 favored further gasification reactions and resulted into producer gas with calorific value 1110 kcal/m³.**

***Keyword*—Sized biomass, fluidized bed gasifier, equivalence ratio, temperature profile, gas composition.**

I. Introduction

AGRICULTURAL residues are potentially an attractive feedstock for producing energy as their use contributes little or no net carbon dioxide to the atmosphere [1]. Major agricultural crops in the state of Gujarat are: Wheat, bajra, rice, maize, groundnut, mustard, sesame, pigeon pea, green gram, gram, cotton, and sugarcane. Presently, the most conventional way of handling these waste streams is to burn them with energy recovery or for landfilling. However, both combustion and landfill use cause secondary pollution problems. Novel disposal technologies are in high demand to provide for more energy efficient and environmentally and economically sound solutions. An alternative to these combustion and landfill uses is gasification. Biomass can be used as a solid fuel, or converted into liquid or gaseous forms, for the production of electrical energy, heat, chemicals or fuels. Biomass conversion technologies convert biofuels into a form usable for energy generation. Thermochemical gasification of biomass is a well-known technology that seems to be a feasible application and has been developed for industrial applications [2]-[5]. Atmospheric air gasification of biomass and waste in a bubbling fluidized bed reactor is an attractive, simple process to convert a solid material to a gaseous fuel [6]. This process leads to a fuel gas suitable for co-firing in existing boilers and with proper gas cleaning it may be used as an alternate fuel for gas engines and gas turbines for generating electricity [7].

The quality of the gas produced (composition, production of CO, H_2, CO_2 and CH_4 and energy content) and the gasification performance (gas yield) depend upon feedstock origin, gasifier design and operating parameters such as temperature, static bed height, fluidizing velocity, equivalence ratio, gasifying agent which are explain elsewhere [7]-[11]. Warnacke demonstrated that the gas composition is a function of gasifier design whereby the same fuel may give different calorific values with different gasifiers [10]. Among all designs, the fluidized bed gasifier has been shown to be a versatile technology capable of burning practically any waste combination with high efficiency. Fluidization is one of the most promising technologies due to a series of reasons. The great operating flexibility makes possible to utilize different fluidizing agents, reactor temperatures and gas residence times, to add reagents along the reactor freeboard or riser and to operate with or without a specific catalyst. Fluidized beds are used for a broad variety of fuels; this flexibility with respect to different fuels is actually another stronghold of fluidized beds. In terms of the utilized fuels, coal has been most often applied so far, but also waste and biomass have been utilized and are forecast to play a more important role in the future. Fluidized bed conversion of solid fuels into producer gas is also of significant economic importance nowadays; especially in developing countries. The development of fluidized bed gasifiers for small particle materials has made a great progress in biomass gasification. The productivity of the fluidized bed gasifiers was raised about 5 times as many as of the fixed bed gasifier and the heating value of the gas increased about 20%. Bed materials such as silica sand, calcined limestone, etc. are used in fluidized bed gasification systems for effective heat and mass transfer. A fluidized bed reactor operating under medium temperature (around 900-1,000 °C), is an alternative to agricultural waste gasification with air as gasifying agent [3].

In this work, a laboratory scale fluidized bed gasifier was developed to investigate the characteristics of gasification of biomass having specific size. The effect of gasification temperatures, fluidization velocity, static bed height and equivalence ratio (ER) on gas composition, gas yield and gas heating value were studied.

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II. Experimental Section

A. Experimental Set Up

Agricultural wastes (sawdust from a local saw mill and pigeon pea, *Cajanus cajan*, from farm) were selected for this study. The samples of pigeon pea were air dried for 2 to 3 days to remove moisture and to facilitate crushing. After crushing sizing of these materials was done by passing the materials through different sieves. Specific sizes of these materials were taken for this study was in the range of 0.40 to 0.84 mm. The proximate analyse and cold flow fluidization properties of the both biomass and bed material (sand) were reported in Tables I and II. The schematic diagram of the experimental facility used in this study is shown in Fig. 1. The gasifier was specially designed for operation under atmospheric or pressurized conditions. The fluidized bed gasifier, having an internal diameter of 210 mm and height of 1600 mm, was made of heat resistant stainless steel and surrounded by individually controlled ceramic bend heater (located at the bed section) to supply heat for startup. The gasifier reactor was surrounded by glass wool to counter the heat loss from the reactor. Six K-type thermocouples (T_1, T_b, T_2, T_3, T_4, and T_5) were installed across the reactor: the probe T_1 installed below the distributor plate for measuring the temperature of inlet air to the reactor. Two K-type thermocouples (T_b and T_2) were installed at the bed section of the reactor. The probe T_b installed at bed section (at the height of 150 mm above the distributor plate) measures the temperature of static bed and probe T_2 installed at bed section (at the height of 400 mm above the distributor plate) measures the temperature of fluidized bed. Another two K-type thermocouples (T_3 and T_4) were installed at the freeboard section of the reactor. The probe T_3 installed at bed section (at the height of 1000 mm above the distributor plate) measures the temperature of pyrolised gas and probe T_4 installed at bed section (at the height of 1300 mm above the distributor plate) measures the temperature of producer gas in the section. The remaining K-type thermocouple (T_5) was installed at the gas outlet pipe after the cyclone saperator. The samples were delivered into the dense bed zone of the gasifier using a calibrated feeder. Prior to gasification tests, both the fuel samples were taken in the range 0.4-0.84 mm in order to ensure the homogeneity on the biomass composition. Air was supplied by a regenerative blower at an atmospheric temperature via a multi-orifice plate distributor. Flow rate of air was measured by digital flow meter installed at downstream of the regenerative blower. Sampling gas bags were employed to collect the product gas just leaving the cyclone separator for gas composition analysis using on line producer gas analyser.

TABLE I
Proximate Analysis of the Feed Materials

Material	Moisture content	Ash content	Volatile matter	Fixed Carbone
Saw Dust	7.4336	4.8179	78.4249	9.3237
Pigeon Pea	7.8363	4.5508	78.6119	9.0010

TABLE II
Fluidization Properties of the Feed Materials and Bed Material

Material	Particle size (mm)	Fluidization Regime	Minimum fluidization velocity (m/s)	Maximum air velocity (m/s)
Sand	0.4-0.595	Bubbling	0.4	0.6
Saw dust	0.4-0.841	Bubbling	0.26	0.6
Pigeon pea	0.4-0.841	Bubbling	0.28	0.6

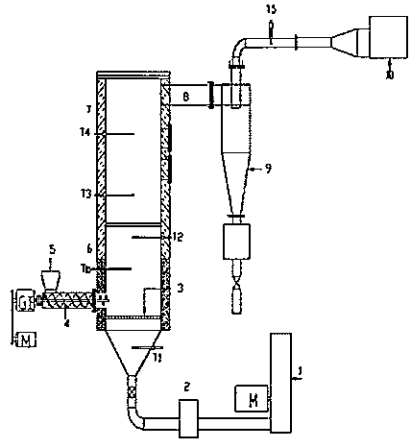

Fig. 1 Schematic diagram of the fluidized bed gasification system: 1: Regenerative Blower, 2: Digital Flow Meter, 3: Distributor Plate, 4: Screw Feeder, 5: Feed Hoper, 6: Bed Section, 7: Free Board Section, 8: Gas Outlet, 9: Cyclone Separator, 10: Burner

B. Experimental Procedures

Experiments were conducted on fluidized bed gasifier with sawdust and pigeon pea as feed material. Ceramic band heater is switched on which cuts off at 550 °C maintaining constant temperature. After temperature is reached air is blown from bottom until the bed temperature is uniform. Then biomass is fed at required feed rate and air flow rate is regulated as per predetermine equivalence ratio. After 5 to 10 minutes the bed temperature increases up to 700 to 900 °C due to gasification of biomass. The producer gas produced in this process passes through the fluidized bed section, cyclone separator and burner. Experiments were conducted on fluidized bed gasifier with sawdust having size in between 0.4 to 0.84 mm as a feed material and sand with size 0.4 to 0.595 mm as a bed material. Air is used as fluidizing agent. The experiments were conducted with six different equivalence ratio as indicated in Table III. Temperatures at six different locations along the length of gasifier were recorded. The sample of producer gas was collected in balloon after cyclone separator for gas composition. Same set of experiments also repeated for pigeon pea as feed material with same particle size as above sawdust. In these experiments sand was used as bed material and air

was used as fluidizing agent. These experiments were conducted for five different equivalence ratio as indicated in Table III.

TABLE III
TEMPERATURE PROFILE THROUGH THE GASIFIER REACTOR

Material	ER	T1	T2	T3	T4	T5	Tb
Sawdust	0.35	44.5	453.5	330.5	309.5	139.5	647.5
	0.41	46.67	689.67	534	519	262.67	689.67
	0.44	45	512	313.5	289.5	112.5	1053.5
	0.49	46.33	493.67	343	320.67	138.71	717.78
	0.52	47.67	544	475.33	472.33	213.67	726
	0.61	31.67	535	477	483.67	185.33	683
Pigeon Pea	0.38	43	650	485	460	196.67	963.33
	0.48	43.67	594	424.33	426.67	180	842.67
	0.52	46.4	605	303.6	275.6	98.2	1094.8
	0.58	44.67	548.33	446.33	443.67	203.67	777.67
	0.68	44.67	566.67	451.67	442.67	172	780.67

III. Results and Discussion

Experiments were conducted on 50 kg fuel/hr (variable capacity) bubbling fluidized bed gasifier with sized biomass to check the effect of equivalence ratio on gas calorific value, Temperature profile through reactor and efficiency of the gasifier. Effect of sized biomass on temperature profile, gas calorific value and gasifier efficiency is discussed in following section.

A. Gasifier Temperature Profile

The average temperatures recorded at the inlet (T_1), dense bed (T_b, T_2), freeboard (T_3, T_4), and gas outlet (T_5) are given in Table III. Figs. 2 and 3 show the gasifier temperature profiles in the dense bed, free- board and the exit of the gasifier at different equivalence ratios for feed material sawdust and pigeon pea. The lowest temperature readings were recorded below the distributor plate (T_1) and ranged from 32 to 48 °C. This was due to the cooling effect of the incoming air. The temperatures recorded in the bed section T_b and T_2 ranged from 650 °C to 1100 °C and 450 to 700 °C, respectively. This was due to the dense bed which had a much higher temperature. The temperature readings obtained from the two probes in the dense bed (T_b and T_2) showed that the temperature distribution within the bed was very uniform as compared with a downdraft gasifier, in which the temperature can swing by as much as 300 to 400 °C [12]. This stability attested to good particle distribution within the bed. The large heat exchange generated by the rapidly moving solid particles and does away with the harmful hot spots occurring in downdraft or updraft gasifiers. These are very much within the range of 627 to 927 °C reported in the literature [13], [14] for desirable operation of a fluidized bed gasifier. The behavior of the freeboard temperature is 150 to 200 °C relatively lower than the bed section temperature (T_2). The increase in gasifier temperatures with increasing equivalence ratio can be explained by the fact that at higher equivalence ratios more air (or oxygen) per unit weight of fuel was available for the exothermic carbon combustion that released heat and thus, gives rise to the gasifier temperature.

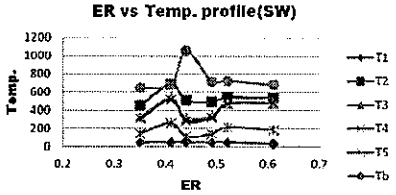

Fig. 2 Temperature profile in FBG with feed material sawdust

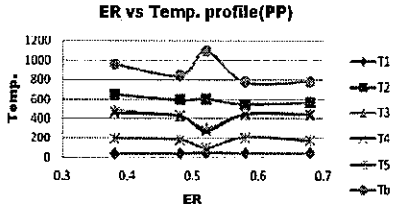

Fig. 3 Temperature profile in FBG with feed material pigeon pea

B. Producer Gas Composition

The various components of the gas produced at various equivalence ratios are summarized in Table IV. The results revealed that the concentration of major readings of CO_2 was in the range of 9-13.5 vol %. From the fuel gases which are of major interest, CO had the highest concentration (7.47-13.02 vol %), followed by H_2 (1.63-12.87 vol %), and then CH_4 (3.54-8.08 vol %). The other components (O_2, C_2H_2+C_2H_4 and C_2H_6) were produced with lower concentrations. Generally, as the equivalence ratio was increased, the concentrations of CO_2 and N_2 increased while the concentration of the fuel (combustible) gases (CO, H_2CH_4, C_2H_2+C_2H_4 and C_2H_6) decreased. For sawdust material maximum amount of CO (13.02 vol %) and maximum amount of H_2 (12.87 vol %) was obtained at the equivalence ratio (0.41). For pigeon pea material maximum amount of CO (11.44 vol %) and maximum amount of H_2 (12.44 vol %) was obtained at the equivalence ratio (0.52). As stated by [15], ER not only represents the oxygen quantity introduced to the reactor but also affects the gasification temperature under the condition of auto thermal operation. While on the other hand, higher ER means higher gasification temperature, which can accelerate the gasification and improve the product purity to a certain limit. Therefore, the gas composition is affected by the two contradictory factors of ER. Also, [4] suggested that this increase in CO and H_2 is due to thermal cracking of hydrocarbons and tars at a higher temperature. While the decrease in CO and H_2 with further increase in ER due to partial combustion of different gaseous components resulted in further increase in CO_2 concentration.

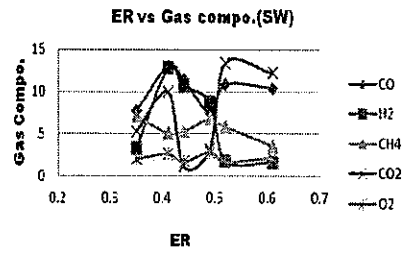

Fig. 4 Producer gas composition in FBG with feed material sawdust

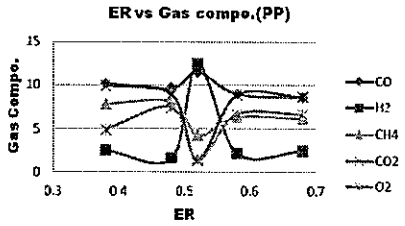

Fig. 5 Producer gas composition in FBG with feed material pigeon pea

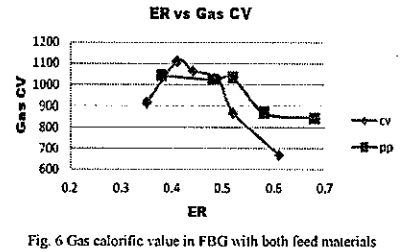

Fig. 6 Gas calorific value in FBG with both feed materials

TABLE IV
PRODUCER GAS COMPOSITION AND GAS CV OF BOTH FEED MATERIAL AT DIFFERENT EQUIVALENCE RATIO

Material	ER	CV	CO	H_2	CH_4	CO_2	O_2
Sawdust	0.35	915	7.65	3.27	7.05	5.24	2.04
	0.41	1110	13.02	12.87	5.05	10.02	2.6
	0.44	1066	11.47	10.71	5.2	1.17	1.71
	0.49	1027	7.47	8.78	6.73	3.16	2.79
	0.52	870	10.84	1.8	5.8	13.44	1.7
	0.61	668	10.44	1.61	3.54	12.25	2.17
Pigeon Pea	0.38	1044	10.22	2.56	7.83	9.97	4.88
	0.48	1024	9.68	1.63	8.08	8.93	7.41
	0.52	1033	11.44	12.44	4.28	1.4	1.49
	0.58	869	9.01	2.24	6.31	8.86	6.6
	0.68	846	8.58	2.45	6.13	8.63	6.62

C. Gas Higher Heating Value

The results of the gas higher heating value are given in Table II and presented in Fig. 6. The higher heating value of the product gas for sawdust was reported in the range of 668 to1110 kcal/m³ while same for pigeon pea was in the range of 846 to 1044 kcal/m³. The results revealed a pronounced effect of the equivalence ratio on the higher heating value of the gas. Increasing the equivalence ratio resulted in a decrease in the higher heating value of the gas due to decreases in the concentrations of methane which has relatively large heating values. For sawdust maximum amount of higher heating value was 1110 kcal/m³ at equivalence ratio 0.41 and for pigeon pea maximum amount of higher heating value was 1044 kcal/m³ at equivalence ratio 0.38.

IV. Conclusions

In present time whole world facing energy crises. Fossil fuel reserves are depleting at faster rate. For sustainable development renewable energy sources are the only and premising solution. Since India is agricultural country, ample biomass is available for energy supplement and gasification is established technique to trap the energy from biomass.

Now in present work experiments were carried out on fluidized bed gasifier with sawdust and pigeon pea material. Following are the measure conclusions.

- Most efficient equivalence ratio for both the biomass is 0.38 to 0.41 and fluidization velocity for selected sized biomass (i.e. 0.4-0.841 mm) is 0.4 m/s.
- For better gasification of biomass required temperature of the bed material during starting the gasifier is 550°C while same during running stage is 700°C. Freeboard temperature should be maintained at 475°C to 550°C. Gas temperature should be maintained at 200°C to 250°C. Thermal (Hot Gas) Efficiency of the system at best ER for sawdust is 73.5% and for pigeon pea is 70.5 %.

Gasification of sized biomass was successfully performed in a fluidized bed gasifier, producing a fuel gas with a higher heating value in the range of 668 to 1110 kcal/nM³ and 846 to 1044 kcal/nM³ for sawdust and pigeon pea, respectively, which could be used in many end use applications. Among the gasification parameters tested, the equivalence ratio appeared to have the most pronounced effect on the reactor temperature, the gas composition, the gas heating value. The selection of suitable equivalence ratio would depend on the final use of the gas produced. As a higher ER had complex effects on tests results and there existed an optimal value for this factor, which was different according to different operating parameters. The influence of equivalence ratio on the performance of a gasifer could be regarded as the effect of reactor temperature as the reactor was found to be ER dependent.

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Efficacy of Cool's and Rhythmic Stabilizationexercises on Pain Severity and Functional Disability in Patients with Shoulder Impingement Syndrome

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Abstract—Shoulder impingement syndrome is the most common disorder of the shoulder, resulting in functional loss and disability. **Objective:** This study was designed to compare between the effects of scapular muscle training (Cool's exercises) versus rhythmic stabilization exercises in treatment of shoulder impingement syndrome. **Methods:** Thirty patients participated in this study; they were assigned randomly into two experimental groups. The first experimental group (A) consisted of 15 patients with a mean age (21.87±2.72) years; they received graduated rhythmic stabilization exercises and stretching of the posterior capsule. The second experimental group (B) consisted of 15 patients with a mean age (22.27±2.94) years; they received scapular muscle training exercises in addition to stretching of the posterior capsule. Treatment was given 3 times per week, every other day, for 4 consecutive weeks. Patients were evaluated pretreatment and post treatment for shoulder pain severity and functional disability. **Results:** Both groups showed highly statistical significant reduction in pain severity and functional disability measured post treatment when compared with their corresponding values in pretreatment assessment. **Conclusion:** Both of rhythmic stabilization exercises and scapular muscle training are effective interventions to reduce shoulder pain severity and functional disability.

Keywords—Impingement syndrome, scapular exercises, rhythmic stabilization exercises, posterior capsule stretch.

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Efficacy of Ethanolic Extract of *Aerva Javanica* Aerial Parts in the Amelioration of CCl_4-induced Hepatotoxicty and Oxidative Damage in Rats

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***Abstract*—**We investigated ex vivo and in vivo antioxidative and hepatoprotective effect of *Aerva javanica*. Total ethanol extract of *A. javanica* aerial parts was prepared, and tested on DCFH-toxicated HepG2 cell in CCl_4-injured Wistar rats. MTT-assay was used to determine cell viability, and serum biochemical markers of liver injury as well as histopathology were performed. In vitro DPPH and β-carotene free-radical scavenging assay and phytochemical screening of the extract was done. Furthermore, *A. javanica* total extract was standardized and validated by HPTLC method. While DCFH-injured cells were recovered to about 56.7% by 100 microg/ml of the extract, a 200 microg/ml dose resulted in hepatocytes recovery by about 90.2%. Oral administration of the extract (100 and 200 mg/kg.bw/day) significantly normalized the serum SGOT, SGPT, GGT, ALP, bilirubin, cholesterol, HDL, LDL, VLDL, TG and MDA levels, including tissue NP-SH and TP in CCl_4-injured rats. In addition, the histopathology of dissected liver also revealed that *A. javanica* cured the tissue lesion compared to reference drug, Silymarin. In vitro assays revealed strong free-radical scavenging ability of the extract and presence of alkaloids, flavonoids, tannins, sterols and saponins where Rutin, a well-known antioxidant flavonoid was identified. Our finding therefore, suggests the therapeutic potential of *A. javanica* in various liver diseases. However, isolation of the active principles, their mechanism of action and other therapeutic contribution remain to be addressed.

Keywords*— *Aerva javanica, antioxidant, hepatoprotection, rutin.

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EFL Learners' Views about Different Feedback Types

Ümran Üstünbaş, Sevda Çimen

Abstract—In recent years, while research on various feedback types has gained importance, the number of the studies on feedback on learners' oral performance has outnumbered the ones on the writing skill. In aspect of feedback on writing performance, the effectiveness of different feedback types on students' works has been highly investigated. However, it seems that learners' preferences about the effective feedback type which complements with their needs have been neglected. Therefore, this study aims to focus on the learners' views about the effective feedback type by investigating their writing performance through three writing tasks. The participants of the study are 150 EFL learners who study at the School of Foreign Languages at a state university in Turkey and have A2 level language proficiency according to CEFR descriptions. These learners are provided with intensive language education through an integrated course model and writing skill plays a significant role in this model. The learners keep track of their language development with an ongoing portfolio assessment. In this sense, their written works are given feedback and revised by using correction codes. As the design of the study, the participants are divided into five feedback groups; namely direct written feedback, metalinguistic explanation, direct written feedback and revision, metalinguistic explanation and revision and a control group. Following a treatment session consisting of three writing tasks, the learners' performances are evaluated and they are interviewed considering their views about the effects of each feedback type. In light of the findings, this study offers implications for instructors and curriculum developers in terms of developing effective ways of giving feedback for writing performance which are appealing to students' needs and preferences by reshaping existing teaching practices and curriculum.

Keywords—beliefs, correction, feedback, writing

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Electrochemical Corrosion of Steels in Distillery Effluent

A. K. Singh, Chhotu Ram

***Abstract*—**Present work relates to the corrosivity of distillery effluent and corrosion performance of mild steel and stainless steels SS304L, SS316L, and 2205. The report presents the results and conclusions drawn on the basis of (i) electrochemical polarization tests performed in distillery effluent and laboratory prepared solutions having composition similar to that of the effluent (ii) the surface examination by scanning electron microscope (SEM) of the corroded steel samples. It is observed that pH and presence of chloride, phosphate, calcium, nitrite, and nitrate in distillery effluent enhance corrosion whereas presence of sulphate and potassium inhibit corrosion. Among the materials tested, mild steel is observed to experience maximum corrosion followed by stainless steels SS304L, SS316L and 2205.

***Keywords*—**Steel, distillery effluent, electrochemical polarization, corrosion.

I. Introduction

DISTILLERIES, in India, are mostly molasses based and are considered highly water polluting [1]. Alcohol manufacturing process in these distilleries includes three main steps namely raw material preparation, fermentation and distillation. Among these, the distillation process releases largest amount of effluent [2]. This effluent is then treated anaerobically before it is discharged to the nearby water body. The untreated effluent from distillation stage is expected to be more corrosive due to its lower pH, higher temperature, and its constituents e.g. chloride, total dissolved solids, chemical constituents responsible for its colour etc. The literature survey reveals scanty work done related to corrosion in distillery effluent. One study is on the determination of corrosion rate of steels during evaporation of distillery spent wash in incineration system. It was observed that mild steel experienced significant corrosion whereas stainless steel 316 showed negligible corrosion [3]. Another work suggests the possibility of corrosion in distillery due to various factors. Thus high concentration of sulphate in distillery effluent was found to be responsible for causing sulphide corrosion in presence of sulphate reducing bacteria in biodigestor. Other factors responsible for higher corrosivity were low pH (< 4.5), high chloride and other chemical constituents in the effluents [4]. In another study, the material of construction of ethanol producing plant for acid hydrolysis has been suggested to be corrosion resistant alloys. Non-resistant alloys in the form of pipes, tank and heat exchangers corrode and may leach metal ions into the feedstock. Use of these alloys also limit the useful life of process machinery [5]. Thus the conditions in distillery plant appear to be highly corrosive for materials of construction. Keeping this in view, a program was initiated to investigate (i) corrosivity of effluents and (ii) performance of material of construction against corrosion in distillery effluents. In two previous studies of the present authors, electrochemical corrosion investigation on steels in anaerobic treated distillery effluent [6] and in-plant corrosion tests of steels in distillery effluent treatment plant [7] were reported. Next, it was planned to investigate (i) the effect of various constituents of distillery effluents on its corrosivity and (ii) the performance of steels against corrosion in these effluents. The work presented here relates to the corrosivity of untreated effluents. The work includes performing corrosion tests on mild steel and stainless steels, candidate materials for plant construction, in effluents prepared synthetically and those obtained from distillery. On the basis of these tests, influence of various constituents of the effluents on its corrosivity was examined. In addition, the performance of the tested steels against corrosion in effluents was also studied.

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II. Materials and Methods

A. Materials

Mild steel, austenitic stainless steel SS304L and SS316L and duplex stainless steel 2205 were considered for corrosion tests in the present work. Stainless steel samples were supplied by Avesta Sheffield AB, Sweden and mild steel was obtained from local market. Chemical composition of these steels is shown in Table 1. For electrochemical tests, 1 cm^2 of the steel sample was embedded in epoxy resin and an electrical connection was made via a copper wire. Surface preparation to mirror finish, of steel specimens, was done by abrading them using emery papers from coarse to fine (up to 1000 grit) and then then subjecting to final finishing using 4/0 polishing paper as per the ASTM standard [8]. Polished samples were ultrasonically degreased in acetone before the measurements were undertaken.

B. Characterization of Distillery Effluents

Untreated distillery effluent was collected from effluent treatment plant (ETP) of a nearby distillery unit. It was stored at 4°C to minimize compositional changes, if any. Characterization of effluent was done by determining biochemical oxygen demand (BOD) and chemical oxygen demand (COD) by BOD bottle method and closed reflux titrimetric method respectively. Chloride and sulphate were estimated by argentometric titration and gravimetric method respectively. Total dissolved solids (TDS) and total suspended solids (TSS) were estimated by gravimetric method. Concentration of Fe^{2+}, Cu^{2+}, Zn^{2+}, Cd^{2+}, Ni^{2+} and Mn^{2+} were measured by atomic absorption spectrophotometer (GBC, model Awanta, Australia) while amount of K^+ and Ca^{2+} was measured by flame photometer. The amount of nitrate and nitrite ions was measured by UV-vis spectrophotometer whereas that of phosphate ions was determined by stannous chloride method. In all the cases, the methods adopted were as per APHA standard [9]. The composition of distillery effluent is observed to be in accordance with effluents from molasses based Indian distillery [10]. To analyse the effect of chemicals on corrosivity of the effluent, the laboratory solution was prepared by adding inorganic chemicals in amount similar to those observed in distillery effluent. Table 2 shows the composition (as ppm by weight) of distillery effluent and composition of actual compounds added in case of laboratory prepared solution.

TABLE I
Composition of Steel Samples (weight%)

Sample	C	Si	Mn	P	S	Cr	Mo	Ni	Cu	N
Ms	1.35	0.80	1.87	--	--	--	--	--	--	--
304L	0.025	0.344	1.619	0.027	0.001	18.214	0.294	8.258	0.269	0.074
316L	0.029	0.298	1.652	0.028	0.001	16.919	2.174	10.332	0.373	0.044
2205	0.020	0.52	1.450	0.020	0.002	22.25	3.08	5.48	--	0.150

C. Electrochemical Test

Electrochemical polarization tests were carried for investigating (i) the corrosivity of effluents and (ii) the performance of steels against corrosion. These tests were performed, at 25±1°C, in a corrosion cell consisting of a saturated calomel electrode (SCE) as a reference electrode, graphite rods as auxiliary, and the test specimen as working electrode all immersed in the test solution. These electrodes were connected to "Voltalab" Radiometer (Electrochemical Laboratory Model PGZ301) for recording the polarization curves, as per ASTM standard [8], using software Voltamaster 4. To estimate open circuit potential (OCP) of steels, its variation with time was measured for 2 hours. Corrosion rates of the steels in test solutions were obtained from tafel polarization tests. Anodic polarization curves were recorded for estimating pitting potential and passivation range while cyclic polarization curves were recorded for estimating repassivation potential of the tested steels in test solutions. All the polarization curves were measured with a scan rate of 0.166 mV/sec as per ASTM standard [×]. Potentiostatic tests were carried to recheck pitting potential of the tested steels in test solution as per the ASTM standard Each electrochemical test was repeated to check variation in the corrosion parameters. All the potentials referred in paper have been measured with respect to saturated calomel electrode.

III. Result and Discussion

A. Corrosivity of Distillery Effluent

Figure 1(a - d) represents open circuit potential vs. time curve, tafel plot, cyclic polarization and potentiostatic curves in the distillery effluent. Electrochemical parameters obtained from these curves are shown in Table 3. Lowest value of OCP in case of mild steel and highest in case of SS 2205 indicate respectively poor corrosion resistance of former and better corrosion resistance of the latter steel. This is supported by the observation of maximum corrosion rate of mild steel and minimum of duplex stainless steel 2205 (Table 3). The extent of uniform corrosion of mild steel in distillery effluent (corrosion rate 190.5 µm/year) and in laboratory prepared solution (corrosion rate 227.83 µm/year) suggest that distillery effluents are corrosive. Thus use of mild steel to handle these media does not appear to be a viable option. Corrosion rates experienced by mild steel in distillery effluent during the in-plant test and immersion test [7] were observed to be 141.47 and 163.3 µm/year in accordance with the present results on corrosion rate. It was planned to test stainless steels to check their suitability as alternate materials of construction.

However, stainless steels have tendency to experience localized corrosion. It was, therefore, thought necessary to check resistance of stainless steels against localized corrosion in the test media. Accordingly, cyclic polarization and potentiostatic tests were also performed on stainless steels (Fig.1c and d).Thus pitting potential, obtained from cyclic polarization curves, is found to be minimum for 304L and maximum for 2205 indicating lowest resistance against pitting of former and maximum of latter stainless steel. This is further confirmed by the results obtained from potentiostatic test (Table 3). Similar conclusions, regarding relative corrosion resistance of the tested stainless steels, can be drawn on the basis of values of passivation range and passivation current density (Table 3). Repassivation potential, showing resistance of metal against crevice corrosion, is observed to be maximum for 2205 followed by those of 316L and 304L (Table 3). Areaof hysteresis loop, in cyclic polarization curve, indicates the amount of localized corrosion. Size of hysteresis loop is observed to be quite low in 2205 and high in case of 304L (Fig. 1c). Thus stainless steel 304L demonstrates minimum resistance while 2205 demonstrates maximum resistance against localized corrosion in distillery effluent. One can compare these results with those obtained after exposure of stainless steel samples in In-plant test and in immersion test. Thus SEM photographs of the corroded stainless steel samples (Fig. 2 and 3) show extent of pitting. Maximum pit depth is observed as 19, 14 and 8 µm on the corroded steel samples after the in-plant test exposure and as 27, 21 and 12 µm on the corroded steel samples after the immersion test exposure in case of SS304L, SS316L and 2205 respectively [7]. These results are in accordance with the results of electrochemical tests. From these results, it can also be apprehended that with slight increase in Cl^- content and in concentration of

oxidants in the effluent, its corrosivity may enhance to a level such that stainless steels 304L and 316L starts experiencing localized corrosion.

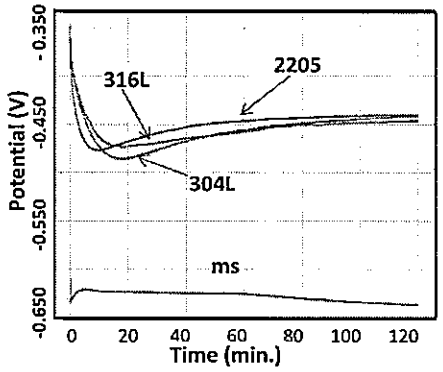


Fig. 1 (a) OCP vs. time curve of SS304L in distillery effluent

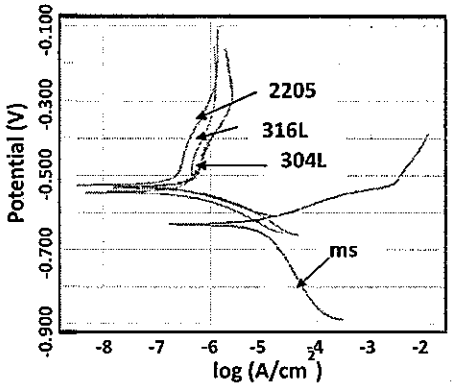


Fig. 1 (b) Tafel plot of tested steels in distillery effluents

To investigate dependence of corrosivity of distillery effluent on its components, measurements were also carried in laboratory prepared solutions of pH 4.16 and having chloride, sulphate, phosphate, potassium, calcium, nitrate, nitrite, zinc, and iron in the amount as observed in distillery effluent. Influence of nickel, cadmium, manganese, copper ions on corrosivity was not studied due to their comparatively very low amount in the distillery effluent (Table 2). Anodic polarization curves of stainless steel 304L recorded in these solutions are shown in Fig. 4 and respective pitting potential are given in Table 4. One thus observes that 304L has very low pitting potential in pH 4.16 solution having Cl^- only (Fig.4, curve 1) indicating aggressive character of Cl^- in acidic

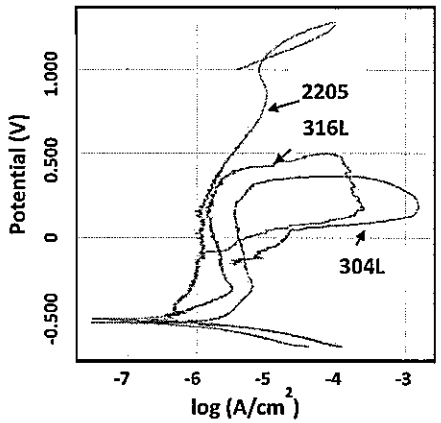


Fig. 1 (c) Cyclic polarization curves of stainless steels in Distillery effluent

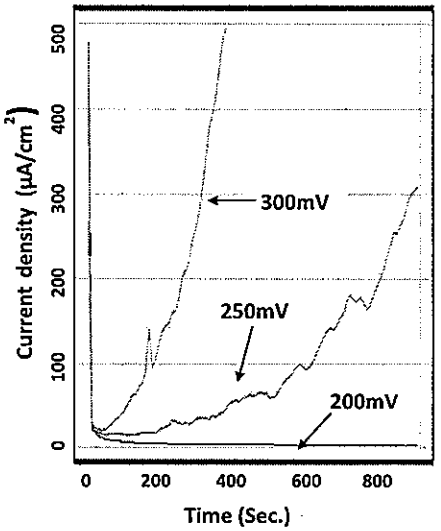


Fig. 1 (d) Current vs. time curve of stainless steel 304L in distillery effluent.

solutions, as observed earlier also [11]. It has been suggested that Cl^- ions substantially decrease the effectiveness of passive film by penetrating through the film, due to its small size, and combine with metal cations [12]. Addition of SO_4^{--} in the solution increases pitting potential (Curve 2 in Fig. 4 and

TABLE 2
COMPOSITION OF DISTILLERY EFFLUENTS AND AMOUNT OF ACTUAL COMPOUNDS ADDED TO MAKE LABORATORY PREPARED SOLUTION

S.No.	Parameter	Distillery Effluent	Laboratory prepared solution
1.	pH	4.16±0.03	4.16±0.02
2.	Chloride	5500±60	5500±60 as $NaCl$
3.	Sulphate	5050±90	5050±50 as Na_2SO_4
4.	Phosphate	250±15	250±10 as H_3PO_4
5.	Potassium	12100±30	12100±25 as KOH
6.	Calcium	650±20	650±15 as $CaCl_2$
7.	Nitrate	225±18	225±8 as $NaNO_3$
8.	Nitrite	130±12	130±10 as $NaNO_2$
9.	Zn^{++}	33±4	33±5 as ZnO
10.	Fe^{++}	214±12	214±10 as $FeOH_2$
11.	TDS	81000±150	33880±80
12.	TSS	6855±120	38±5
13.	COD	110000±180	--
14.	BOD	47100±250	--
15.	Ni^{++}	0.98±0.05	--
16.	Cd^{++}	0.112±0.02	--
17.	Mn^{++}	6.18±0.02	--
18.	Cu^{++}	6.85±0.04	--
19.	Colour	Dark brown	--

Table 4). Thus inhibitive action of sulphate was observed on stainless steel at concentration present in the distillery effluent. Earlier investigation [13] also suggests inhibitive action of sulphate in the chloride solution by affecting pit initiation as well as pit growth rate on SS304. Addition of phosphate in present solution reduces pitting potential (curve 3 of Fig. 4 and Table 4) thus increasing the risk of pitting. This observation is in accordance with an earlier study [14] which exhibits dissolution of passive film in the presence of phosphate at low pH. From curve 4 of Fig. 4 and Table 4, one observes increase in pitting potential due to addition of potassium. This observation is supported by an earlier finding on corrosion of carbon steel in acidic media [15] where inhibition efficiency was observed to increase with thiocynate concentration.

In another work, potassium iodide was suggested as corrosion inhibitor of stainless steel in acidic solution [16].The effect of calcium (curve 5) is observed to reduce pitting potential. Ding [17] has concluded that corrosion of X65 steel in oil field simulated water is enhanced if amount of Ca^{++} ions in them is lying between 256 to 512 mg/L. This has been proposed to be due to grain growth and resulting destabilization of the scale formed on steel. Addition of nitrate and nitrite (curve 6) shows slight increase in the corrosivity of synthetic solution. As per an earlier investigation [18], role of nitrate strongly depends upon pH and it stimulates corrosion of carbon steels in acidic solutions. Addition of zinc and iron in synthetic solution does not exhibit significant effect on corrosivity of the effluent at the studied concentrations. Thus presence of chloride, phosphate, calcium, nitrate and nitrite at acidic pH appears to play important role in enhancing the corrosivity while sulphate and potassium seem to inhibit corrosion in distillery effluent.

TABLE 3
CORROSION PARAMETERS OF STEELS

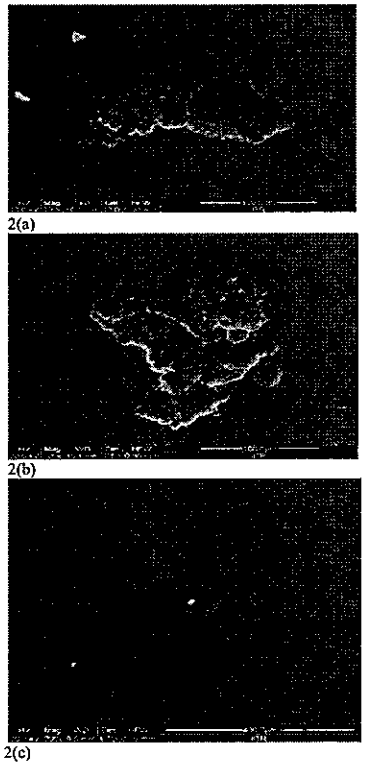
Metals	Distillery effluent	Laboratory prepared solution
Open Circuit Potential (V_{SCE})		
Ms	-0.630±0.005	-0.667±0.002
304L	-0.452±0.005	-0.215±0.009
316L	-0.444±0.003	-0.201±0.007
2205	-0.432±0.007	-0.153±0.007
Corrosion Rate (μm/year)		
Ms	190.5±2.54	227.83±11.9
304L	2.997±0.076	3.406±0.310
316L	2.895±0.051	2.743±0.178
2205	2.489±0.050	1.295±0.127
Pitting Potential (Cyclic polarization test) (V_{SCE})		
304L	0.285±0.028	0.195±0.014
316L	0.370±0.025	0.300±0.012
2205	1.075±0.015	0.950±0.016
Pitting Potential (Potentiostatic test) (V_{SCE})		
304L	0.250-0.300	0.200-0.250
316L	0.350-0.400	0.300-0.350
2205	1.000-1.050	0.950-1.000
Repassivation Potential (V_{SCE})		
304L	-0.110±0.025	-0.190±0.00
316L	-0.040 ±0.030	-0.115±0.016
2205	1.050± 0.025	0.860±0.020
Passivation Range		
304L	0.735±0.020	0.540±0.030
316L	0.843±0.016	0.630±0.028
2205	1.520±0.025	1.330±0.015

TABLE 4
PITTING POTENTIAL OF SS-304L IN LABORATORY PREPARED SOLUTION (ALL VALUES ARE GIVEN IN PPM BY WEIGHT EXCEPT PH)

Curve	Laboratory prepared solutions	E_p(mV_{SCE})
1	pH4.16+Cl^- 5500	210±20
2	pH4.16+Cl^- 5500+SO_4^{--} 5050	285±15
3	pH4.16+Cl^- 5500+SO_4^{--} 5050+PO_4^{---} 250	120±10
4	pH4.16+Cl^- 5500+SO_4^{--} 5050+PO_4^{---} 250+K^+ 12100	385±15
5	pH4.16+Cl^- 5500+SO_4^{--} 5050+PO_4^{---} 250+K^+ 12100+Ca^{++} 650	245±25
6	pH4.16+Cl^- 5500+SO_4^{--} 5050+PO_4^{---} 250+K^+ 12100 +Ca^{++} 650 +NO_3^- 225 +NO_2^- 130	210±20
7	pH4.16+Cl^- 5500+SO_4^{--} 5050+PO_4^{---} 250+K^+ 12100 +Ca^{++} 650 +NO_3^- 225 +NO_2^- 130+ Zn^{++} 34+ Fe^{++} 214	215±5

B. Corrosion Performance of mild steel and Stainless Steel

The results from electrochemical test (Table 3) indicate much higher corrosion rate for mild steel in comparison to stainless steels as such necessitating the use of later steels in handling these liquors. However, stainless steels may undergo localized corrosion and therefore one needs to compare their resistance against pitting and crevice corrosion. Thus a comparison of

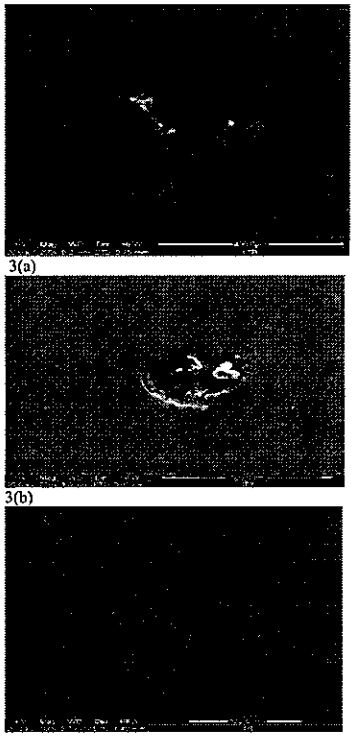


2(a)

2(b)

2(c)

Fig. 2 SEM micrograph of corroded stainless steels after in-plant test in tank having untreated distillery effluent: 2(a). 304L (100x), 2(b). 316L (100x), 2(c). 2205 (200x)



3(a)

3(b)

3(c)

Fig. 3 SEM images of stainless steels after immersion test in untreated distillery effluent: 3(a). 304L (200x), 3(b).316L (250x), 3(c). 2205 (100x).

parameters (Table 3) showing their comparative resistance against pitting and crevice corrosion, in laboratory prepared solution as well as distillery effluent was done. Higher OCP, pitting potential, passivation range and repassivation potential for 2205 exhibit its maximum corrosion resistance whereas lowest values of these parameters indicate minimum corrosion resistance of SS304L in distillery effluents among the tested stainless steels. SEM photographs of corroded stainless steel coupons exposed in in-plant test (Fig. 2) and in immersion test (Fig. 3) also show minimum pitting in case of SS 2205 and maximum in case of SS304L. Further, lower corrosion rate were observed for stainless steel 2205 followed by 316L and 304L. Hence, tested stainless steels may be put in following order of increasing resistance against localized and uniform corrosion : 304L< 316L < 2205. A comparison of composition of stainless steels indicate (i) maximum amount of Cr, Mo and N in 2205 (ii) 304L has higher amount of Cr and N than those in 316L and (iii) amount of Mo is higher in 316L than 304L. Stainless steels owe their corrosion resistance primarily to the presence of Cr(>12%) in them. Presence of chromium results in formation of $Cr(OH)_3/Cr_2O_3$ which act as passive layer and therefore provides corrosion resistance [19]. This is manifested in terms of shifting of the corrosion potential to nobler direction and reduction of active/passive current density [20]. Presence of Mo in 316L, on oxidation, leads to formation of MoO_2 in addition to Cr_2O_3, both of which are protective type; hence, 316L shows better resistance against localized corrosion than 304L [21]. In the presence of N and Mo, molybdenum nitride forms which help retain molybdenum ion in the passive film by acting as inhibitor to dissolution of molybdenum ion [22], [23]. According to another hypothesis [24], N in solid solution on dissolution produces NH_4^+ by reaction given below

$$N^{3-} + 4H^+ \rightarrow NH_4^+$$

which raises pH of the electrolyte presence in the pits and stabilises them. These results suggested better resistance against localized corrosion in case of N bearing stainless steels. Consequently, duplex stainless steel 2205 shows maximum resistance against localized corrosion while 304L shows poorest corrosion resistance among the tested stainless steels.

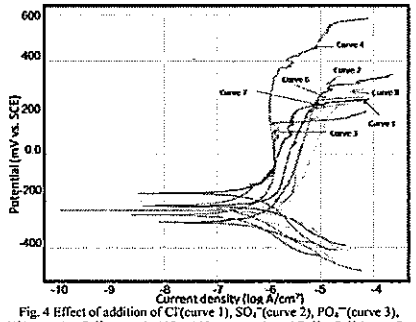


Fig. 4 Effect of addition of Cl^-(curve 1), SO_4^{2-}(curve 2), PO_4^{3-}(curve 3), K^+(curve 4), Ca^{++}(curve 5), $NO_3^- + NO_2^-$ (curve 6) and $Zn^{++} + Fe^{++}$ (curve 7), on anodic polarization curves of stainless steel 304L in laboratory prepared solutions

IV. Conclusion

Present paper deals with the corrosivity of distillery effluent and corrosion performance of mild steel and stainless steels exposed to the effluent. Role of distillery effluent chemistry on corrosivity was investigated by electrochemical polarization tests conducted in Distillery effluent and synthetic effluent. Thus pH, chloride, phosphate, calcium, nitrate, nitrite are observed to play a role in increasing whereas sulphate and potassium are observed to inhibit the corrosivity. In these effluents, mild steel show unacceptably higher corrosion rate thereby necessitating the testing on stainless steels. Among these stainless steels, 2205 is observed to have higher corrosion resistance than 316L whereas 304L shows minimum resistance. The presence of alloying elements i.e. Cr, Mo and N in stainless steels are found to exhibit important role in imparting corrosion resistance of stainless steels.

Acknowledgment

C. Ram is thankful to Ministry of Human Resource Development (MHRD) New Delhi, India for the research grant for pursuing Ph. D work. Acknowledgment is also due to the management of Distillery near Saharanpur for helping in conducting in-plant test and collection of distillery effluents.

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Electrochemical Immunosensor for Sensitive detection of Benzo[alpha]Pyrene in Aqueous Phase

M.B. Ebrahim-Habibi, F.A. Mahyari, H. Rafii-Tabar, P. Sasanpour

***Abstract*—**Benzo[alpha]pyrene (BaP), as a member of polycyclic aromatic hydrocarbons (PAHs), has implied very strong mutagenic and carcinogenic effects on live organisms. In this regard detection and monitoring of its presence in various environments are of great importance. Among detection methods developed for this purpose, immunosesnors based on electrochemical reactions have offered dominant abilities. Carbon nanotubes (CNTs) have potential application in the field of electrochemical sensing. Because of their high conductivity and large surface area, CNTs can be exploited as support for the immobilization of biomolecules responsible for biorecognition processes in electrochemical based immunosensors. In the present study, a label-free electrochemical immunosensor for sensitive detection of BaP has been constructed. The glassy carbon electrode (GCE) has been modified with functionalized (carboxylated or aminated) single wall carbon nanotubes (SWNTs). By suspension in protein G solution and monoclonal antibody (mAB) the surface of electrode is modified accordingly. In order to characterize the functionalization of the surface (SWNTs and protein G loading on the surface of SWNTs), scanning electron microscopy (SEM), fourier transform infrared spectroscopy (FTIR), and SDS-PAGE electrophoresis has been employed. The bare GCE, protein G/carboxyl- or amino-SWNTs/GCE, and modified electrode incubated with different concentrations of BaP were characterized using cyclic voltammetry technique. All experiments were done in the potential range of -0.2 to +0.6 V versus Ag/AgCl, as a reference electrode, with scan rate of 0.05 Vs^{-1} in the presence of 2.5 mM $[Fe(CN)_6]^{3-/4-}$ solution containing 0.5 M KCl as a redox probe. The decrease in the current of $[Fe(CN)_6]^{3-/4-}$ is proportional to the increase of concentration of BaP. The results show that the proposed immunosensor exhibited a relatively wide linear response between 10.0-100.0 $ngmL^{-1}$ of BaP with a detection limit of 5 ng mL^{-1} in aqueous phase under the optimum conditions. It was also found that the amount of loaded protein G and the orientation of antibody, after interacting with protein G, were correlated with different functional groups of SWNTs. Developed biosensor showed excellent responses for monitoring of BaP in aqueous phase. In conclusion, a label-free electrochemical strategy was reported for the detection of BaP. This approach could be valuable for the design of BaP biosensors and likely lead to many detection applications in environmental medium and biological matrix such as blood.

***Keywords*—**Benzo[alpha]Pyrene, Single wall carbon nanotubes, Electrochemical,, Immunosensor, Protein G.

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Electrocoagulation of $Ni(OH)_2$/NiOOH for the Removal of Boron Using Nickel Foam as Sacrificial Anode

Yu-Jen Shih, Yao-Hui Hunag

***Abstract*—**Electrocoagulation (EC) using metallic nickel foam as anode and cathode for the removal of boron from solution was studied. The electrolytic parameters included pH, current density, and initial boron concentration for optimizing the EC process. Experimental results showed that removal efficiency was increased by elevating pH from 4.0 to 8.0, and then decreased at higher pH. The electrolytic efficacy was not affected by current density. In respect of energy consumption, 1.25 mA/cm^2 of current density was acceptable for an effective EC of boron, while increasing boric acid from 10 to 100 ppm-B did not impair removal efficiency too much. Cyclic voltammetry indicated that the oxide film, $Ni(OH)_2$ and NiOOH, at specific overpotentials would result in less weight loss of anode than that predicted by the Faraday's law. The optimal conditions under which 99.2% of boron was removed and less than 1 ppm-B remained in the electrolyte would be pH 8, four pairs of electrodes, and 1.25 mA/cm^2 in 120 min as treating wastewaters containing 10 ppm-B. XRD and SEM characterization suggested that the granular crystallites of hydroxide precipitates was composed of theophrastite.

***Keywords*—**Borohydrides, hydrogen generation, NiOOH; electrocoagulation, cyclic voltammetry, boron removal.

I. Introduction

BORON is available in the environment as calcium and sodium borates or as a result of anthropogenic pollution in the form of boric acid and borate salts [1]. Borate salts in solution exists as highly soluble poly-borate ions of high concentration, but it appears as a monomer with low concentration (< 25 ppm) [2]. Boron is essentially applied in the manufacture of borosilicate glass, detergents, semiconductor, cosmetics, flame retardants, fertilizers, and dyestuff production [3], [4], and is unintentionally discharged into the environment during the manufacturing processes. With increasing use of borohydrides, such as $NaBH_4$, NH_3BH_3 and $N_2H_4BH_3$, as hydrogen storage materials for creating clean energy nowadays [5], their major by product, boric acid, however, is toxic to the environment [6]. Recently, World Health Organization (WHO) has regulated an upper limit of 2.4 mg B L^{-1} for drinking water [7]. Electrocoagulation (EC) generates coagulants through creating metallic hydroxide flocks from the electrochemically soluble anodes; metallic hydroxides can be either from precipitation of dissolved anode elements depending upon the solubility product constant or immediately through forming a thin film of oxidized layer, resulting from the electron transfer [8]-[10].

EC is effective for treating several industrial effluents containing organic and inorganic pollutants [11], [12]. As compared to conventional technologies, merits of EC include the high removal efficiency, compact treatment facility, and controllable sludge production [13]. EC involves three stages: (i) coagulants formation due to electrolytic oxidation of sacrificial electrodes, (ii) destabilization of the contaminants, and (iii) flocculation of insoluble particles [14]. Meanwhile, hydrogen gas and oxygen are released from the cathode and the anode, respectively. The gas production is beneficial to rise the flocculated particles to the water surface [15], [16].

Using metallic foam as a sacrificial electrode not only catalytically alters the energy barrier of electron transfer but also provide extremely high surface area to carry out the redox reaction [17]. Nickel foam is an attractive battery material because of its high specific capacitance, well-defined electrochemical activity and good stability [18]. The pe-pH diagram for Ni-H_2O system at 298 K reveals the general domain of nickel metal anodically dissolved in acidic solution (Fig. 1).

$$Ni \rightarrow Ni^{2+} + 2e^- \quad E^0 = -0.236\ V_{(vs.\ NHE)} \qquad (1)$$

Dissolved nickel ions Ni^{2+} were hydrolyzed as $NiOH^+$, $Ni(OH)_{2(aq)}$, $Ni(OH)_3^-$, $Ni(OH)_4^{2-}$, and $Ni_4(OH)_4^{4+}$ by water media, depending upon solution pH. Ni(II) reaches equilibrium with nickel hydroxide at a specific proton activity (i.e. $[H^+]$). The precipitation is therefore determined by pH of the electrolyte.

$$Ni(OH)_{2(s)} + 2H^+ = Ni^{2+} + 2H_2O \quad \log K_{sp} = 12.74 \qquad (2)$$

$$Ni(OH)_{2(s)} + 2e^- = Ni + 2OH^- \quad E^0 = -0.215\ V_{(vs.\ NHE)} \qquad (3)$$

when pH reaches close to the precipitation equilibrium value of nickel oxide (hydroxide), Ni_3O_4 or NiOOH (around pH 8 to 14), an insoluble oxide film accumulates at the interface between electrode and electrolyte at a specific overpotential.

$$NiOOH_{(s)} + e^- = NiO_{(s)} + OH^- \quad E^0 = 0.45\ V_{(vs.\ NHE)} \qquad (4)$$

This work aimed to examine the feasibility of EC using Ni foam as the sacrificial electrode for boron removal from the

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solution. Experimental parameters included the initial pH, current density, and boron concentration for optimizing EC. The electrochemistry and characterization of nickel oxide film collected from the surface of electrode before and after treating the boric acid were also analyzed using cyclic voltammetry, zetapotential, SEM and XRD equipment.

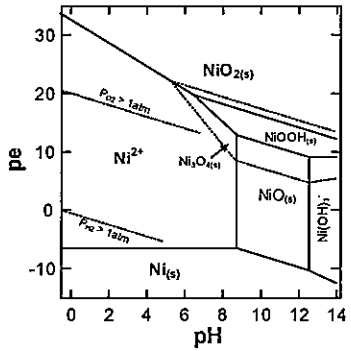

Fig. 1 pe-pH of Ni⁰- Ni(II)-Ni(III)-Ni(IV)

II. Methodology

The batch experiment of electrocoagulation was carried out in an electrolytic cell that was made of Pyrex glass with dimensions of 12 cm × 10 cm × 8 cm (WLH). Nickel foam as cathode and anode in pairs (10 cm × 10 cm) were placed at 1 cm intervals and connected to a DC power supplier. Fig. 2 depicts the configuration of electrolytic cell. The desired concentration of boron solution and sodium chloride (KCl, 99.5%, Showa) as background electrolyte were fed into reactor. All batch solutions were magnetically stirred at 300 rpm. The power supplier in a constant current mode was switched on to carry out experiments, during which temperature and pH of reaction solutions were monitored. At specific time intervals, the samplings withdrawn were filtered by 0.45 um filter, while precipitates were digested using 3M HNO_3. Boron and nickel elements in filtrates and digests were analyzed by an inductively coupled-plasma emission spectrometer (ICP-OES, JY 2000-2, HORIDA). Cyclic voltammetry (CV) was conducted within a three-electrode system using a potentiostat (CHI611C, CH Instrument, Inc., USA) to characterize the anode materials. A Hg/HgO electrode (BAS Inc., Japan) was used as a reference electrode, which was in contact with the working electrode in solution. The stainless steel (316, 0.0045" in wire diameter) as the counter electrode. The submerged area of electrodes in the electrolyte solution (80 mL) was 1×2.5 cm^2. A scanning electron microscope (SEM, JEOL JSM-6700F, Japan) and an X-ray powder diffractometer (XRD, Rigaku RX III, Japan) were used to determine the surface morphology and the structural phase of aluminum hydroxide, respectively.

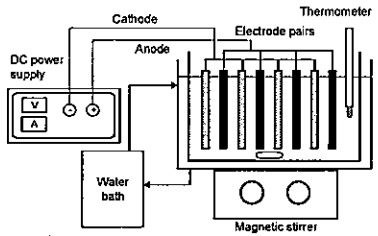

Fig. 2 Apparatus of electrocoagulation.

III. Results and Discussion

A. Characterization of Electro-Generation of Ni Oxide Film

Nickel is a reactive element that forms compounds in the oxidation state -1, 0, +1, +3, and +4. Nickel oxyhydroxide (NiOOH) is a black-colored compound driven by the electrochemical potential in alkaline solution (4). There are two different crystallographic forms of nickel hydroxide, the α and the β types. During charging, β-$Ni(OH)_2$ transforms with good reversibility in the b phase of nickel oxyhydroxide (β-NiOOH). If the β-$Ni(OH)_2$ electrode is overcharged, a different phase of nickel oxyhydroxide called γ-NiOOH is formed. γ-NiOOH can also be generated by charging α-$Ni(OH)_2$. To assess the anodic oxidation of metallic nickel, the cyclic voltammetry (CV) of nickel foam as working electrodes with 0.1 M sodium sulfate at pH 10 was conducted as shown in Fig. 3 (a). Accordingly, during positive sweep two polarization currents occurred at onset potentials of around 0.4 and 0.85 V which were attributed to $Ni(OH)_2$ to β-NiOOH and to γ-NiOOH, respectively. Besides, there was a reduction peak current during negative scanning. Both of reductive and oxidative peak current followed a straight-line dependence on the square root of sweep rate ($v^{1/2}$), indicating at 0.85 V of oxidation was diffusion-controlled (Fig. 3 (b)).

Fig. 4 presents XRD patterns of fresh nickel foam before and after potential sweeping of 0.4 to 1.2 V for 1 h. The diffraction peaks of Ni foam well fit the metallic nickel without impure phases, and after electrochemical oxidation, the oxide film formed on Ni foam electrode is primarily consisted of $Ni(OH)_2$ whose structure phase is proven to be a theophrastite, a beta type nickel hydroxide [19]. In addition, some peaks are attributed to the NiO/NiOOH compound. The structural characterization of electrolysis of Ni foam indicated that under a specific overpotential the substrate of metallic nickel could be converted to oxides in 2+ and 3+ states at pH 10. According to the preliminary test (not shown here), the passivation and dissolution of nickel by electricity only took place at pH below 7. The polarization of oxide film was

created at pH higher than 7.5, and peak currents of E_{a1} and E_{a2} (Fig. 3 (a)) would significantly increase with increasing pH.

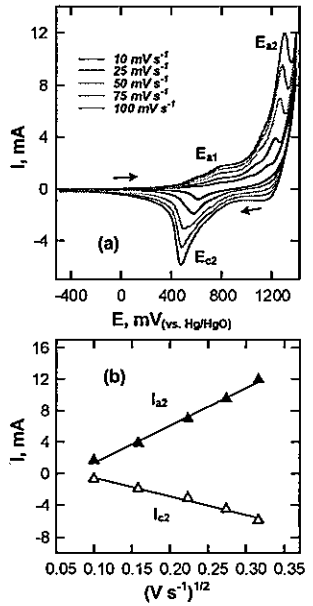

Fig. 3 (a) CV curves of Ni foam (Ref.: Hg/HgO, counter: stainless steel, electrolyte: 0.1 M Na_2SO_4, pH 10); (b) peak current as a function of square root of sweeping rate

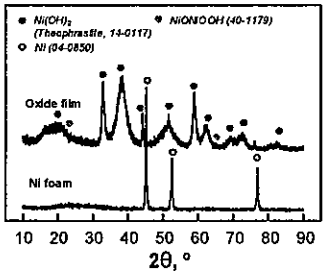

Fig. 4 XRD patterns of Ni foam and oxide film formed on Ni foam after electrochemical reaction

SEM micrograph of the Ni foam and the electro-generation of nickel hydroxide on the nickel substrate is as shown in Fig. 5. The open-pore structure of foam allows the electrolyte to flow through the electrode and has larger effective surface for electroactive reactions than a flat electrode. The smooth surface of Ni transforms to an irregular layer of hydroxides after the electrolysis in alkaline solution. Under higher magnification (Fig. 5 (c)), the hydroxide film is constructed by nano-sized agglomerates, which yield large quantities of electrosorption sites for boric acid.

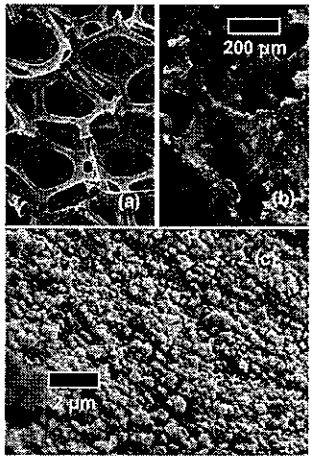

Fig. 5 SEM micrograph of Ni foam (a) before and (b) electrolysis in 0.1 M Na_2SO_4 at pH 10 for 1 h. (c) The nano-granular hydroxide film on the surface of oxidized nickel

B. Electrocoagulation of Boric Acid in Solution

The pH of electrolyte determines not only the overpotential of electrolytic oxidation of nickel anode but also the efficiency of precipitation of the oxide film, and thus influences the coagulation of boron compounds. As shown in Fig. 6, boron removal significantly varies with pH (a controlled one) in a range of 4 to 12 (initial 100 ppm-B) as the current density and the stirring speed are kept at 2.5 mA cm^{-2} and 300 rpm, respectively. Boron level decreases with the increasing pH and reaches a minimum around pH 8 at which the removal efficiency is 96.2% within 120 min. Boron removal varied by pH could be resulted from some factors: (a) the formation of nickel hydroxide and oxyhydroxide, (b) pH_{pzc} (point of zero charge) of precipitates, and (c) hydrolysis of boric acid. As predicted by solubility curve (no shown here), K_{sp} of 12.74 led to the solubility approaching a minimum at pH 8 to 12 at which Ni(II) was rather insoluble as a form of $Ni(OH)_{2(s)}$. Furthermore, NiOOH under higher overpotential than hydroxide was generated at pH higher than 7.5 (Fig. 1). This would reflect on the soluble nickel ions decreasing with elevating pH; at pH above 8, aqueous Ni(II) was lower than 10 ppm. On the other hand, the zetapotential analysis indicates a

pH_{pzc} of 10.2 for the nickel sludge collected from the electrolysis free of boron (oxides is positively charged at pH < 10.2, as shown in Fig. 7 (a)). The boric acid dissolves in several poly-borate ions whose speciation yields a significant amount of negatively charged ions at pH higher than 8 (Fig. 7 (b), pK_a = 8.9 for $B(OH)_3/B(OH)_4^-$). Consequently, the optimal pH of EC of boron was 8 which was attributable to the electrostatic force.

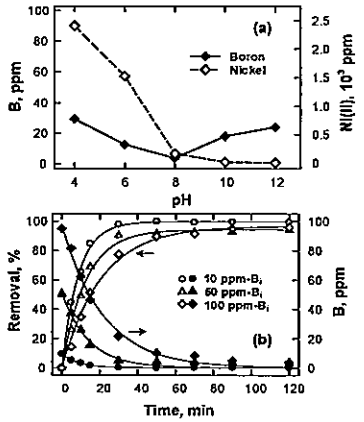

Fig. 6 (a) Soluble boron and nickel levels in the end solution as a function of pH (initial B = 100 ppm, current density = 2.5 mA cm^{-2}, contact time = 120 min). (b) Effect of initial boron concentration on the removal efficiency (current density = 1.25 mA cm^{-2}, pH 8)

In order to examine the treatability of boric acid using metallic nickel as the sacrificial anode, EC of boron was conducted with initial levels of 10, 50, and 100 ppm-B (under current density of 1.25 mA cm^{-2} and pH 8.0). Fig. 6 (b) indicates that the efficiency slightly decreases from 99.2% to 96% in 120 min of EC with increasing initial boron concentration from 10 to 100 ppm-B (the boron in the end solution was 0.07 ppm for initial 10 ppm-B). The initial concentrations of boron did not remarkably affect the efficiency of EC. It implied that the amount of nickel oxide created by the electricity was capable of coagulating at least 100 ppm-B, even though the initial rate of removal varied with the initial boron concentrations. Boron of 10 ppm was removed faster than that of 100 ppm. The k_{obs} of initial 10, 50, and 100 ppm-B were 0.122, 0.079, and 0.046 min^{-1}, respectively.

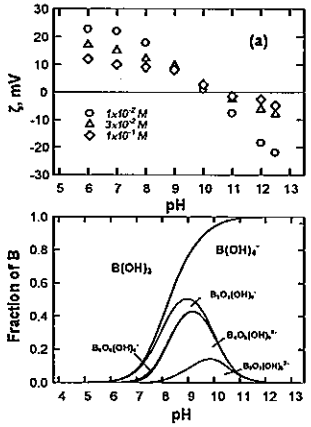

Fig. 7 (a) Zeta potential as a function of pH for the Ni sludge of electrocoagulation (0.1 M Na_2SO_4) at difference concentrations of inert electrolyte (KCl). (b) Speciation of hydrolyzed boric acid in forms of poly-borate ions

C. Energy Efficiency of EC Using Ni Foam

In electrochemical processes, the current density controls the rate of anode oxidation, gas evolution, as well as the growth of flocs. The effect of current density being varied by 1.25 and 2.5 mA cm^{-2} on the boron removal is investigated (Fig. 8 (a)) (constant current 2.0 and 4.0 A, respectively). Accordingly, the current density insignificantly affects the efficiency of EC; 96% of boron removal was achieved for both current applied. However, the energy consumption increases from 18 to 120 kWh m^{-3} by elevating the current density from 1.25 to 2.5 mA cm^{-2}, while both of boron levels in 120 min are lower than 5 ppm-B (Fig. 8 (a)). It suggests that energy is not effectively used for EC at higher current density than 1.25 mA cm^{-2}.

The current density can be related to an ideal dissolved nickel hydroxide by the second Faraday law, which converts the electron quantity passing through the electrode to the formation of redox species.

$$W_{theo} = \frac{Q \times MW}{z \times F} \quad (5)$$

where, W is the weight of the oxidized component of concerns, Q is total charge involved the electron transfer, which is equal to net current multiplying the reaction time (I×t), MW is the molecule weight of nickel (that is 58.69 g mol^{-1}), z is the valency number of the substance and F is the Faradaic constant (96,500 C mol^{-1}). As shown in Fig. 8 (b), the measured weight losses are lower than the Faradaic values. The discrepancy among these two values decreases with increasing current density for the sake of the electron transfer

predominately immobilizing an oxide film on the surface of nickel foam rather than releasing nickel ions into the solution.

Researches of chemical precipitation using the precipitates of metal hydroxides and electrocoagulation using metal sacrificial anodes for the removal of boron from the aqueous solution are summarized in Table I. Among the transition metals, iron, zinc and aluminum salts are commonly utilized for chemical precipitation of boron. However, the efficacy through mechanism of co-precipitation and adsorption by the metal hydroxide is averagely low (< 90%). Particularly, the direct precipitation should be conducted at high pH and temperature (> 60 °C, pH > 12) to improve the sludge formation and mass transportation. On the contrary, the electrocoagulation exhibits better removal efficiency of boron than chemical precipitation; generally, iron, aluminum alloy, and zinc are capable of treating 100-1000 ppm-B to a level of lower than 10 to 100 ppm using current density of 10 to 50 mA cm^{-2}. In present work, Ni foam for carrying out EC for 10 ppm-B achieved removal efficiencies of 99.2% in 120 min at room temperature and pH 8, leading to an end solution of < 1 ppm-B The experimental results evidence that Ni foam as anode of EC will be more feasible for decontamination of boron wastewaters than conventional anode materials in practical applications.

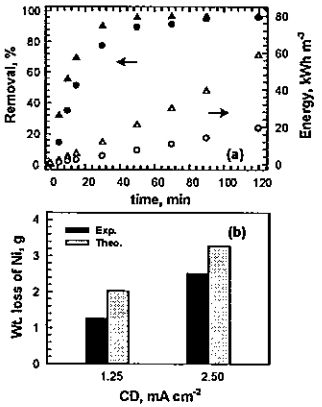

Fig. 8 (a) Effect of current density on the removal of boron and energy consumption of EC process (●○ 1.25 mA cm^{-2} ▲△ 2.50 mA cm^{-2}). (b) The measured and Faradaic weight loss of Ni foam after treating 100 ppm-B (current density = 2.50 mA cm^{-2}, pH 8, contact time = 120 min)

IV. Conclusions

This work investigated the electrocoagulation of synthetic wastewater containing 10 to 100 ppm boric acid. Metallic nickel in foam structure as sacrificial electrodes eliminated more than 96% of boron at pH 8 and room temperature. The boron level of 10 ppm could be lower than 1 ppm-B by 120 min of EC. Based on the consideration of energy-saving, a current density of 1.25 mA cm^{-2} applied by four pairs of electrodes is most appropriate for boron removal. The increment in initial boron concentration (from 10 to 100 ppm-B) insignificantly impacted the efficiency, but slightly reduced the initial rate of EC of boron. Cyclic voltammetry proved the oxidation of $Ni(OH)_2$ to β- and γ-NiOOH at corresponding overpotentials of 0.4 and 0.85 V. An oxide film immobilized on nickel substrate could result in less weight loss of anode than the value of Faraday's law anticipated. SEM images revealed that the precipitates from EC was constructed by granular crystallites which were theophrastite phase, a beta type nickel hydroxide, according to XRD analysis. Electrocoagulation using Ni foam was more reliable than the conventional chemical precipitation using transition metal salts in the decontamination of boron-containing wastewaters.

TABLE I
Comparison of Chemical Precipitation and EC Using Various Metal Hydroxides and Metal Anodes

Coagulants	Chemical conditions	Efficiency
Chemical coagulation & adsorption		
Chitosan-Fe(OH)$_3$ [20]	Sea water, pH 8.3, specific surface area = 37.3 m^2 g^{-1}, Boron < 5 ppm	10.7 mmol-B mol-Fe(OH)$_3^{-1}$
Al(OH)$_3$, Fe(OH)$_3$, Mg(OH)$_2$, Co(OH)$_2$, Ni(OH)$_2$, Zn(OH)$_2$ [21]	pH 8.5 for Al(OH)$_3$ and Fe(OH)$_3$; pH 8.8 for Mg(OH)$_2$; pH 7.5 for Co(OH)$_2$, Ni(OH)$_2$, and Zn(OH)$_2$ Boron = 10-300 ppm 2.4 g L^{-1} metal ions	Capacity = 90 g kg^{-1} for 300 ppm-B; Ni>Al>Co>Fe>Mg>Zn
Ca(OH)$_2$ [22]	10 g L^{-1} Ca(OH)$_2$ 60 °C, pH 12.4 Boric aicd = 750 ppm	removal = 87% in 8h
Electrocoagulation		
Anodes	Electrolytic conditions	Efficiency
Fe/Al [12]	Distance of electrodes = 3 mm pH 6.5-7 for Al pH 8.5-9 for Fe Boric acid = 100-1000 ppm 8 pairs of electrodes	30 mA cm^{-2} current density for 100 ppm-B, Removal = 70% by Al, 62% by Fe in 60 min; Energy = 0.55 kWh m^{-3}
Al [23]	Distance of electrodes = 5 mm $Na_2B_4O_7$ = 100-1000 ppm pH 8 8 pairs of electrodes	5 A current (= 7.45 g coagulant), removal = 94% for 1000 ppm-B, Energy = 22 kWh m^{-3}
Al [24]	Electrode area = 20 cm^2 Boric acid = 123 ppm, pH 8	50 mA cm^{-2} current density Removal < 60%
Fe [25]	Distance of electrodes = 5 mm Boric acid = 10-30 ppm, pH 7 3 pairs of electrodes	12.5 mA cm^{-2} current density Removal = 98% in 60 min
Zn [2]	Distance of electrodes = 5 mm Electrode area = 0.2 dm^2 Boric acid < 10ppm, pH 7 Boric acid = 10 ppm	0.2 mA cm^{-2} current density, removal = 93.2%, Energy = 1.007 kWh m^{-3} in 200 min
Ni (present work)	Distance of electrodes = 1 cm 4 pairs of electrodes	1.25 mA cm^{-2} current density, removal = 99.2%, Energy = 20 kWh m^{-3} in 120 min

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ELF in the Classroom: Use of ELF and Its Effects on Speaking Anxiety in Turkish Tertiary Level EFL Setting

Baki Dursun, Kemal Benk

***Abstract*—**English as a Lingua Franca (ELF) has become an increasingly hot topic in many of the developing countries including Turkey. Likewise, in most of these expanding circle countries the way of teaching English has been redesigned in accordance with Lingua Franca Core. Admittedly, the focus was on Grammar-based teaching formerly; however, with the introduction of the ELF, the shift is now more on teaching speaking abilities and strategies of negotiation of meaning. Though there are several reasons for this shift, one of the major contributions stems from the teacher training programs offered by Turkish universities as M.A. programs. Therefore, the aim of this paper is to compare and contrast the similarities and divergences among the instructors who have taken ELF classes in their teacher training program and those who have not. With a longitudinal design, for five months, classes of two different groups of teachers (ELF Group vs. Traditional Group) have been observed and three teachers have been selected for each group. During the observations, principles of Lingua Franca Core offered by Jenkins have been taken into account and used to form the rubric for the observations. After the five-month period, a Likert scale type questionnaire have been given to the students to explore their level of anxiety while speaking. Independent samples t-test have been administered to see the groups differences statistically. The results of the study will be presented during the conference.

***Keywords*—**ELF, teacher training, speaking, anxiety

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Energy Detection Based Sensing and Primary User Traffic Classification for Cognitive Radio

Urvee B. Trivedi, U. D. Dalal

***Abstract*—**As wireless communication services grow quickly; the seriousness of spectrum utilization has been on the rise gradually. An emerging technology, cognitive radio has come out to solve today's spectrum scarcity problem. To support the spectrum reuse functionality, secondary users are required to sense the radio frequency environment, and once the primary users are found to be active, the secondary users are required to vacate the channel within a certain amount of time. Therefore, spectrum sensing is of significant importance. Once sensing is done, different prediction rules apply to classify the traffic pattern of primary user. Primary user follows two types of traffic patterns: periodic and stochastic ON-OFF patterns. A cognitive radio can learn the patterns in different channels over time. Two types of classification methods are discussed in this paper, by considering edge detection and by using autocorrelation function. Edge detection method has a high accuracy but it cannot tolerate sensing errors. Autocorrelation-based classification is applicable in the real environment as it can tolerate some amount of sensing errors.

***Keywords*—**Cognitive radio (CR), probability of detection (P_D), probability of false alarm (P_F), primary User (PU), secondary user (SU), Fast Fourier transform (FFT), signal to noise ratio (SNR).

I. Introduction

In the last few years, the demand for digital wireless communication has increased dramatically. Due to the flexible protocols and standards in wireless communication network new and valuable applications such as mobile internet access, electronic healthcare monitoring service and many others have emerged. Due to this trend there is a great demand on premium radio resources especially the radio spectrum. So, the spectrum scarcity comes into an emerging problem nowadays, in fact the spectrum scarcity is not by limitation of the spectrum resource but by inefficiency of the spectrum usage [1]. To utilize the wasted radio resources more efficiently, cognitive radio (CR) technology, which uses unused spectrum bands not interfering licensed users, has emerged [3]. A spectrum sensing technique for searching the unused spectrum in CR system is a key function and it requires high precision and fast speed processing. Spectrum sensing methods are divided into two categories; an energy detector and a feature detector [5], [6].

The main aim for CR techniques is to sense the spectrum with much lower complexity so many precise spectrum sensing techniques had been developed for signal identification in the field such as Radar engineering are unsuitable for CR techniques because of their high complexity [5]. To search the unused spectrum faster and more correctly, the two-stage sensing architecture was proposed by IEEE 802.22 working group (WG) [2], [4]. At the first stage fast sensing is done by an energy detector that searches spectrum bands of relatively high power, which are determined as occupied channels. Then a feature detector senses only filtered spectrum bands accurately at the second stage. Therefore, the main role of the energy detector at the first stage is to send the unassured channels to the second stage quickly.

Various methods are used for energy detection such as cyclostationary feature detector, matched filter, Fast Fourier Transform (FFT) and Discrete Wavelet Packet Transform (DWPT). Spectrum sensing techniques based on the FFT are easy to implement and conventional technique for cognitive radio but have a drawback of low accuracy [7]-[9].

Classification of traffic pattern of primary channels allows a more accurate prediction of future idle times. The classification algorithm uses binary information collected by spectrum sensing. Two types of classification algorithm are proposed, one calculates the average separation of peaks of sensed binary data by detecting the edges and other uses discrete autocorrelation function to check periodicity of traffic from the sensed binary pattern [10], [11].

In this paper, Section II describes a brief introduction to Fast Fourier transform based Energy Detector, Section III gives the performance analysis of FFT based Energy detector, Section IV introduces traffic classification techniques for cognitive radio, Section V gives performance analysis of traffic classification techniques and finally Section VI concludes the paper.

II. Energy Detection Algorithm by Using Fast Fourier Transform

Energy Detection is the most common way of spectrum sensing because of its low computational and implementation complexities. In this method the receivers do not need any knowledge on the primary user's signal. Therefore, this is the most generic method of signal detection. The signal is detected by comparing the output of the energy detector with a threshold which depends on the noise floor. The fundamental challenge with the energy detector based sensing is the selection of the threshold for detecting primary users. The other challenges include its ability to differentiate interference from primary users and noise and poor performance under low signal-to-noise

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ratio values [5]-[7]. Two probabilities are of interest for spectrum sensing: *Probability of detection* (P_D), i.e. the probability of the algorithm correctly detecting the presence of primary user, and *Probability of false alarm* (P_F), i.e. the probability of the algorithm falsely declaring the presence of primary user when primary user is not present [5], [6].

A. FFT-Based Energy Detector

It is a non-coherent detection method that detects the primary signal based on the sensed energy. This architecture also provides the flexibility to process wider bandwidths and sense multiple signals simultaneously [6].

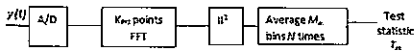

Fig. 1 FFT based energy detector

In order to measure signal energy, the received signal is first sampled, then converted to frequency domain by taking FFT followed by squaring the coefficients and then taking the average. The detector computes the energy of received signal and compares it to certain threshold to decide whether the desired signal is present or not. Here the K_{FFT} indicates the no. of FFT points with respect to power of 2. It depends on the total no. of time samples which is to be considered. More no. of time samples better the detection probability [6], [11]. The sampling frequency determines the frequency range or bandwidth of the spectrum and that for a given sampling frequency, the number of points acquired in the time-domain signal record determine the resolution frequency. To increase the frequency resolution for a given frequency range, increase the number of points acquired at the same sampling frequency. The no. of FFT bins in N point FFT is equal to N/2, where N is the number of points in the acquired time-domain signal. The first frequency bin is at 0 Hz, that is, DC. The last frequency bin is at Fs/2 – Fs/N, where Fs is the frequency at which the acquired time-domain signal was sampled. The frequency bins occur at Δf intervals where Δf = Fs/N. The total interval of frequency bin is from DC to Fs/2 – Fs/N with an increment of Δf. Thus, the detector computes the energy of the received signal after taking average of M bins and compares it with the threshold value (the noise floor) to decide whether the primary signal is present or not [5]. As shown in Fig. 1, the energy of the received signal, also termed as the decision value of energy detector, is given by (1) [8]

$$T = \sum_{n=1}^{N} |x(n)|^2 \tag{1}$$

where $x(n)$ is the received signal and N is the number of its samples in the band of concern [6], [8].

The decision value is subjected to the test of two hypotheses H_0 and H_1. H_0 is the null hypothesis meaning that the received signal comprises of noise only. If the decision value given by (1) is less than threshold, H_0 is true as shown in (2). On the other hand, if the decision value is larger than the threshold, i.e. the receivedsignal comprises of both signal and noise, H_1 is true as shown in (3).

$$H_0 : x(n) = w(n); signalabsent \tag{2}$$

$$H_1 : x(n) = s(n) + w(n); signalpresent \tag{3}$$

where n = 1, 2, ...N is the sample index, $w(n)$ is the noise and $s(n)$ is the primary signal required to detect with zero mean and variance of σ_s^2. $w(n)$ is additive white Gaussian noise (AWGN) with zero mean and variance of σ_w^2. Two probabilities are of interest for spectrum sensing: *probability of detection*, which is defined, under hypothesis H_1 i.e. the probability of the algorithm correctly detecting the presence of primary user [8]; and *probability of false alarm*, which is defined, under hypothesis H_0 [8] i.e. the probability of the algorithm falsely declaring the presence of primary user. The lower the probability of false alarm, there are more chances for which the secondary users can use the frequency bands when they are available [6]. For a good detection algorithm, the probability of detection should be as high as possible while the probability of false alarm should be as low as possible.

The test statistic is a random variable whose probability density function (PDF) is chi-square distributed. When N is sufficiently large, we can approximate the PDF using Gaussian distribution according to the central limitation theorem.

$$\mathcal{H}_0 \sim \mathcal{N}(N\sigma_w^2, 2N\sigma_w^4) \tag{4}$$

$$\mathcal{H}_1 \sim \mathcal{N}(N(\sigma_s^2 + \sigma_w^2), 2N(\sigma_s^2 + \sigma_w^2)^2) \tag{5}$$

Referred to constant false alarm rate (CFAR) principle, we have probability of false alarm P_F as [8];

$$P_F = P(X > \gamma | H_0) \tag{6}$$

$$P_F = Q\left(\frac{\gamma - N\sigma_w^2}{\sigma_w^2\sqrt{2N}}\right) \tag{7}$$

$$P_D = P(X > \gamma | H_1) \tag{8}$$

$$P_D = Q\left(\frac{\gamma - N(\sigma_s^2 + \sigma_w^2)}{(\sigma_s^2 + \sigma_w^2)\sqrt{2N}}\right) \tag{9}$$

where $Q(a) = {}^1/_2\, erfc(a/\sqrt{2})$, $erfc(.)$ is complementary error function, and γ is the decision threshold.

If Statistics > γ, we can make a decision that the channel is occupied by one PU or more. Otherwise, the channel is vacant, and SUs could make use of the channel at this moment.

III. Simulation Environment

In the simulation environment a TV signal is detected. And the algorithm applies to detect the probability of detection vs. SNR.

The steps, result of the test and analysis are given below.

Step 1: ATV signal is detected.

Step 2: Additive White Gaussian noise is added with signal.

Step 3: FFT of final signal is calculated.

Step 4: The level of threshold is decided and variance is calculated.

Step 5:Probability of detection is calculated at various SNR using FFT.

Fig. 2 shows the result of probability of detection vs. SNR. From the result it is clear that as SNR increases, probability of detection also increases.

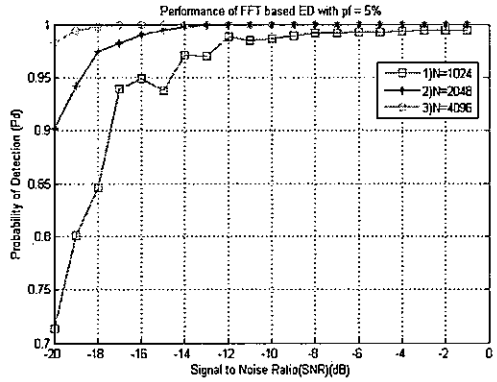

Fig. 2 Pd vs. SNR for FFT based energy detector

When no. of FFT points (N) is large enough, the probability of detection is close to 1. In fact, the larger the N, the more information about the primary signal. But by increasing N, system complexity is increased and performance will be slower.

IV. Classification of Primary User Traffic

The sensing of primary channels is a periodic sampling process to determine the state (ON or OFF) of the channels at every sampling instant. The outcome of sensing is a binary sequence for each channel. When a sufficiently long history of traffic patterns of channels is stored in the database, the patterns can be classified and appropriate prediction performed [12]-[14]. A couple of traffic periods are enough for periodic traffic but to classify random traffic more no. of traffic periods needs to consider. Traffic classification helps for 'intelligent channel selection' in cognitive radio. By adding limited "intelligence" to secondary users, they can take advantage of inherent patterns of primary users' spectrum usage; observe, model and make predictions about future changes in spectrum availability. Secondary users then use these predictions, along with current observations, to determine spectrum usage patterns to achieve reliable communication while minimizing disruption to primary users [16]. In order to achieve high resource utilization, one would prefer precise prediction. Unfortunately, prediction accuracy deteriorates quickly as the prediction interval increases. Clearly there is a tradeoff between a large prediction interval and a small prediction error [15]. Two types of classification algorithm are proposed in this paper one is based on edge detection and the other is autocorrelation based classification.

In edge detection based classification it is assumed that all channels are sensed perfectly. From the channel data, separation of peaks is calculated. The idle time of channel can be calculated from peak separation. For periodic or deterministic data, separation of peak always remains constant. From the calculated data it is determined that weather the data in particular channel is periodic or not. For periodic data the peak separation is constant and for stochastic data the peak separation varies.

A. Channel Usage Pattern for Stochastic Traffic

Channels are modeled as ON/OFF model or 0/1 state, 0 for free channel and 1 for occupied channel by either licensed or other unlicensed user under the assumption that there are no priority considerations among the unlicensed users. This 0/1 alternating model is referred to as channel usage pattern where unlicensed users can utilize only portions of the OFF periods to communicate with other nodes. Simulation is done on 10 different channels. Channel usage pattern of single channel consists of stochastic traffic is demonstrated in Fig. 3.

From the traffic pattern it is clear that ON/OFF time are not constant. It changes in random manner.

B. Calculation of Peak Separation for Stochastic Traffic

Fig. 4 shows the peak separation of stochastic traffic of channel 'd'.

It is clear from the Fig. 4 that for stochastic traffic peak separation is not constant. It varies with Pus appearance.

C. Calculation of Peak Separation for Periodic Traffic

Fig. 5 shows the periodic channel generation with fixed ON and OFF times.

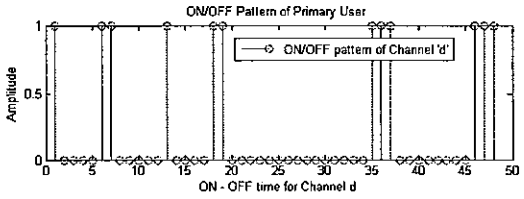

Fig. 3 ON/OFF traffic pattern of channel 'd' with stochastic traffic

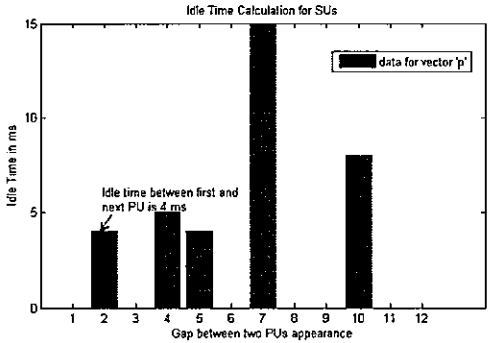

Fig. 4 Peak separation of primary user traffic

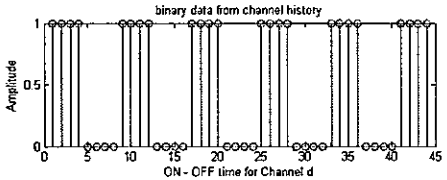

Fig. 5 ON/OFF traffic pattern of periodic traffic for channel 'd'

As shown in Fig. 6, for periodic traffic the peak separation is always constant. Edge detection based algorithm works perfectly for any no. of primary users.

For autocorrelation based classification first the autocorrelation of input sequence is calculated. Then calculate average separation between consecutive local max values, r_{av}. Then calculate standard deviation of separations, *std*. If deviation is zero, traffic is periodic. If the deviation is higher than average separation of peaks traffic is considered as stochastic [12], [13]. Same channels which are used for edge detection are used for autocorrelation based classification.

Edge detection method always classified correct. While in autocorrelation based classification some percentage of error may occur. The reason for error is if the ON/OFF times are too short or too long the outcomes sometimes are not as expected. Sometimes due to fake maxima the outputs are not appropriate.

Simulations are performed on 12 different channels for 10 times. Among those 10 channels are classified perfectly and 2 channels are wrongly classified.

Fig. 7 shows the histogram of error percentage of autocorrelation based classification. From simulation, it is also known that which channels are wrongly classified. Following Fig. 8 shows the channels which are wrongly classified

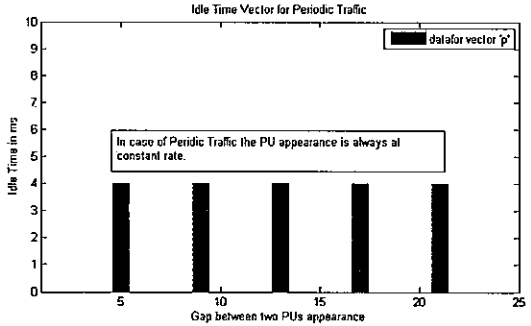

Fig. 6 Peak separation of primary user traffic

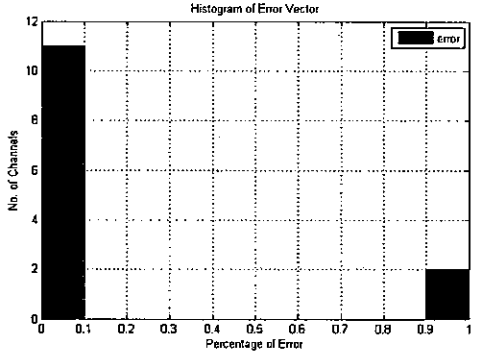

Fig. 7 Percentage of error in autocorrelation based classification

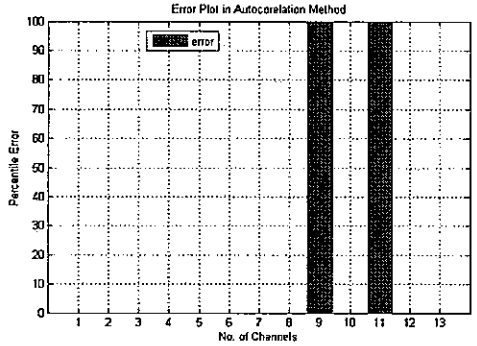

Fig. 8 Channels classified wrongly by autocorrelation method

Fig. 8 shows that from 12 channels channel no. 9 and 11 are wrongly classified.

Edge detection based classification works perfectly for any no. of channels if sensing is perfect. It cannot tolerate any misdetection or false alarm. Whereas autocorrelation based classification can tolerate some percentage of error in detection. But when the ON/OFF times are too long or too short the outcomes sometimes are not as expected.

Further improvement in classification is proposed which is based on multihypothesis sequential probability ratio test (MSPRT). A modified MSPRT classifier is based on the average likelihood function considering partial knowledge of the PU traffic parameters. Using the sequential algorithm, this method can achieve higher classification performance compared to the traditional maximum likelihood classifier using constant number of samples [17].

V. Conclusion

Energy detection is the conventional technique for spectrum sensing in cognitive radio. The key challenge for the Energy Detector is the detection of the weak signal in real environment corrupted by noise and suffering from interference. Energy detector using FFT is one of the simplest detection mechanisms among those proposed so far. In this paper probability of detection is calculated for different values of SNR. It is observed that as the value of SNR increases P_d also increases for different sample numbers. It is also observed that as no. of samples increased, the P_d is increased but then system performance becomes slower. Classification helps to identify primary user traffic pattern. In this paper two types of classification algorithm are discussed. Classification method is proposed that divides traffic patterns into stochastic and deterministic ones. Edge detection based classification is accurate but it cannot tolerate sensing errors which limits its applicability in real environment. Autocorrelation based classification method is simple to implement but some amount of error may occur due to fake maxima generation. From practical point of view, the method based on autocorrelation function can be used in real-time applications. The method can be used by CR systems to allow more accurate predictive channel selection. Furthermore, traffic classification can enable a good resource management tool for optimization of the network.

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Energy System for Algerian Green Building in Tlemcen, North Africa

M.A.Boukli Hacene, N.E.Chabane Sari, A. Benzair

***Abstract*—**This article highlights a method for natural heating and cooling of systems in areas of moderate climate. Movement of air is generated inside a space by an underground piping system. In this paper, we discuss a feasibility study in Algeria of air-conditioning using a ground source heat pump (GSHP) with vertical mounting, coupled with a solar collector. This study consists of modeling ground temperature at different depths, for a clay soil in the city of Tlemcen. Our model is developed from the non-stationary heat equation for a homogeneous medium and takes into consideration the soil thermal diffusivity. It uses the daily ambient temperature during a typical year for the locality of Tlemcen.

The study shows the feasibility of using a heating / cooling GSHP in the town of Tlemcen for the particular soil type; and indicates that the duration of air flow in the borehole has a major influence on the outgoing temperature drilling. This paper was published on Renewable and Sustainable Energy Reviews [1].

***Keywords*—**Collector, depth, heat pump, diffusivity, temperature.

I. Introduction

GROUND temperature constitutes essential input data for various construction projects such as the design of airport runways and roads; determining the depth at which drains can be installed in buildings without the risk of freezing; the excavation of building foundations; and the design and construction of basements. As conservation and storage of energy becomes increasingly necessary in today's society, ground temperature is an important aspect of calculation and evaluating energy needs when determining heat loss in basements and examining the possibility of using ground heat as a source for the heat pumps. It is therefore incumbent on engineers and architects to understand the factors in determining soil temperatures and how they vary with season and depth. The aim of our work is to study the compatibility and relative efficiency of a heating and cooling heating and cooling pump, with the sole source of heat deriving from the soil, based on the fact that soil temperature varies throughout the year and is constant at certain depths regardless of soil type. [2]

II. Principles of GSHP System

- The ground source heat pump (GSHP) draws heat from the soil via sensors that are buried in pipes. A typical heat pump requires only 100-200kWh electricity to transform environmental heat, and provides 300kWh freely available useable heat. In all cases, the amount of useable heat generated will be greater than the primary energy used to operate the pump itself. Heat pumps also have a relatively low level of CO_2 emissions [3].

- The three important elements of a GSHP include:
  - o The ground loop.
  - o A heat pump.
  - o A system of heat distribution.

III. Technology of GSHP

The sensors (of the GSHP System) can be installed horizontally or vertically.

In the latter case, they are also known as geometric probes.

Horizontal sensors: These pipes (usually polythene) are buried horizontally at shallow depth (0.6–1.2 m) and contain a circulating coolant. The sensors are installed on the land adjacent to the building (Fig. 1).

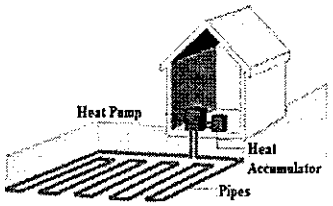

Fig. 1 Representation of horizontal sensors [4]

Vertical sensors: A vertical probe that draws energy from the basement of the ground. A sensor is placed into a hole in the pump tube (U-tube, double U or polyethylene) containing a heat transfer fluid-bearing.

The hole is then sealed with cement and bentonite. The depth of drilling is up to 200m (Fig. 2).

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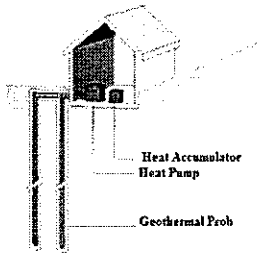

Fig. 2 Vertical sensors representation [4]

At 10m depth, soil temperature is effectively constant throughout the year at close to 13◦C. The temperature increases by 2◦C to 3◦C per 100 m of increasing depth.Why Use the GSHP System for Energy Needs in Our Case?

We focus on the heating and cooling that accounts for up to 80% of total energy consumption in a house.

Two methods are proposed to allow heating and natural cooling in areas of a moderate climate. A Ground Source Heat Pump system (GSHP presented previously) and the Controlled Mechanical Ventilation system double flow (CMV), where the fresh air introduced into the house is heated by recovering heat from exhaust air. The energy efficiency with CMV, compared to GSHP, is 70%.[4]

Many studies [5] showed that the GSHP system is more suitable than conventional systems or other renewable energy-based systems because of its simple implementation, low cost, and high performance. This system, based on a new concept of using natural resources, takes into account the fixed value of soil temperature measured at a given depth throughout the year and improves environmental quality via the incorporation of clean energy with precise control of room temperature by adjusting the circulation time of the coolant in the circuit. In this context, two configurations are considered. The first comprises a vertically positioned sensor and the second comprises a horizontal configuration. Comparison of these two configurations allows us to deduce that the vertical system is advantageous because of its profitability.

Systems currently available for heating and cooling use a natural flow of heated or cooled air. Our system allows a control of the temperature at the exit by adjusting the circulation time of the fluid in the circuit. This represents the **innovative** and **original** in such systems appearance.

V. Economical Aspect of GSHP

Costs of GSHP system: 10.000€ to 18.000€. Running costs depend on a number of factors including the size of the hot/cold water loads and the size of the home [6].

Using average system efficiencies from the field trial, the above (GSHP) evaluations have been demonstrated when replacing conventional existing heating system in a 3 bed semi-detached home.

Finally, the investment required to integrate the GSHP system in a building can be recovered within a few years by compensation investment through energy savings from reduced energy consumption. Nevertheless, the paramount benefit lies in the exploitation of renewable energies, respect for the environment, and following the example of other traditional energy systems.

VI. Using the GSHP System for Energy Needs in a House

Recall that a house is said to be ecologically sound when two criteria are met: first, at least 80% of the energy consumption is saved compared to the average consumption of a classical house. This consumption can increase until zero and even negative consumption (clear production of energy); and second, the use of ecological, healthy, and durable materials [7]. The principal requirements of an ecological dwelling are:

- Orientation and understanding of how to make use of the sun
- Ability to track "hidden" carbon emissions
- Thermal isolation
- Walls made of healthy and natural materials
- Ventilation that uses new air in sufficient quantity
- Windows to banish simple glazing
- Making use of renewable energies for heating and cooling [2].

The aim of our work is the theoretical operation of system GSHP in a house located at Tlemcen, in a district called "Birouana." The ground composition of Birouana is shown in Fig. 15. This requires an understanding of the compatibility of the installation as well as the variation in ground temperature. Figs. 3 and 4 shows the integration of system GSHP in an ecological house. Figs. 5–7 shows a schematic of the GSHP coupled with the solar panels, for winter and summer cycles.

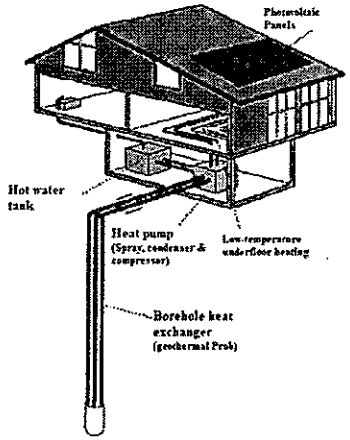

Fig. 3 Heating by GSHP system [8]

VII. The Located of the City of Tlemcen

Tlemcen (presented on Fig. 8) is a town in the north - west of Algeria (North Africa), 580 km from the capital Algiers, at latitude 34.56 °, longitude -1.19 °, and an altitude of 830 m. It is characterized by hot, dry summers and cold winters, comprising a semi-arid Mediterranean climate. It is important to note that the climate is somewhat tempered by the influence of the nearby Mediterranean Sea (45 km).

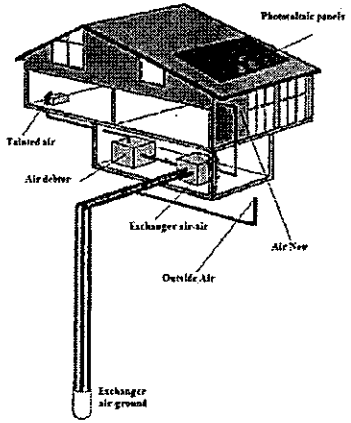

Fig. 4 Cooling by GSHP system [8]

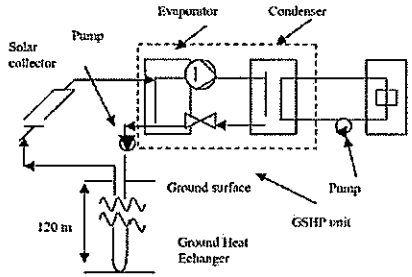

Fig. 5 Schematic of GSHP system coupled with solar collectors (winter cycle) [2]

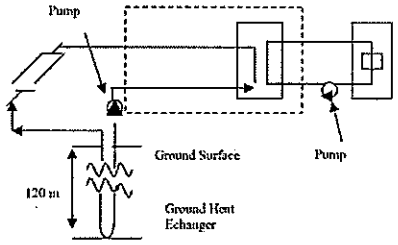

Fig. 6 Schematic of GSHP system coupled with solar collectors (summer cycle) [2]

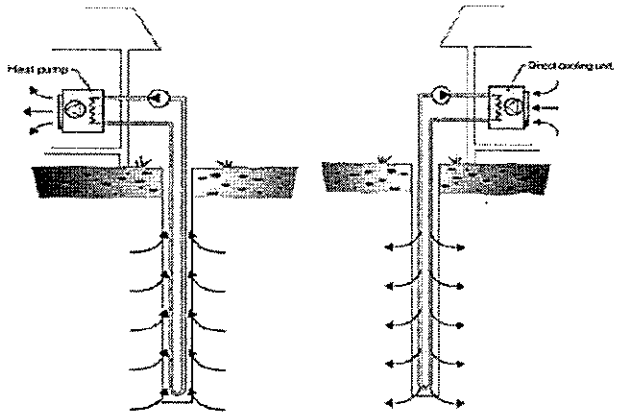

Fig. 7 Typical GSHP system for a single family house [9]

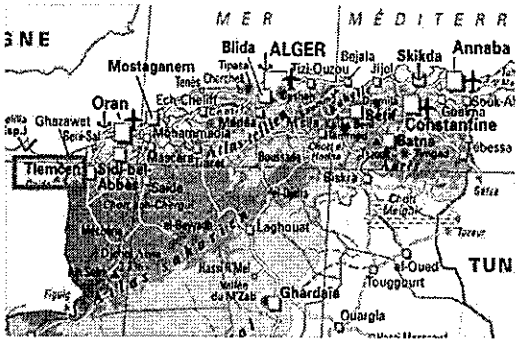

Fig.8 Geographical location of Tlemcen [10]

VIII. The Ground Temperature

The ambient air temperature fluctuation around average Ta, daily or annually, could be considered a sinusoidal function with an angular frequency ω during the period t_0. Mathematically, this fluctuation is described by:

$$T(t) = T_a + A_s.\cos(2\pi\frac{t}{t_0}) \quad (1)$$

The ground temperature at depth z (m), with thermal conductivity λ (W/m, K) and volumetric heat capacity C (J/m3, K), also oscillates in a sinusoidal pattern according to (2) [11], [12]:

$$T(t,z) = T_a + A_s.e^{\frac{z}{d_0}}.\cos(2\pi\frac{t}{t_0} - \frac{z}{d_0}) \quad (2)$$

The amplitude of temperature change at the ground surface generally corresponds to that of air. Eq. (2) indicates that the amplitude decreases exponentially with distance from the surface at a rate prescribed by the time required to complete a cycle. Soil temperatures are generally constant over the year at depths greater than 5-6 m. The mean annual ground temperature is almost constant with depth, but it increases by about 1 ° C per 50 m due to geothermal heat from the center of the earth. [13].

An inspection of the expression of soil temperature {(2)} reveals two effects of depth on ground temperature: a damping of the amplitude of variation and a phase shift of the peak temperatures. For example, the amplitude is damped to a tenth of its value to a depth equal to 2.3 times that of penetration, d, and the heat wave in the ground. This leads to a constant temperature (ie a variation of less than 0.1 ° C throughout the year) for depths greater than 4.6 d.

The phase shift is beneficial because it increases the temperature difference between ambient air and soil. The maximum phase shift, that is to say a phase shift equal to half of the year, occurs at a depth of 3.14 d. However, at this depth the amplitude of the temperature variation is damped to 4% of its value at the surface. This means that we can't fully benefit from an energy standpoint.

Depth of penetration of the heat wave in the ground is represented as d_0. It is given by:

$$d_0 = \sqrt{\frac{\lambda . t_0}{C.\pi}} \text{ or } d_0 = \sqrt{\frac{D_f . t_0}{\pi}} \quad (3)$$

Knowing the thermal diffusivity of the soil, D_f, is sufficient to assess soil temperature as a function of time and depth. Diffusivity D_f depends on the nature of the soil. Different compositions of the outer layer of the basement Maghreb have been [14], to obtain for example:

TABLE I
THE DIFFERENT LAYERS OF GROUND MAGHREB [14]

Composition	D_f [m²/s]
Limestone	$0.6939.10^{-6}$
Dry Gravel	$0.2666.10^{-6}$
Saturated Gravel	$0.75.10^{-6}$
Dry Sand	$0.2758.10^{-6}$
Saturated Sand	$0.9230.10^{-6}$
Dry Clay/Silt	$0.3226.10^{-6}$
Saturated Clay Silt	$0.7083.10^{-6}$

Generally, the magnitude of the soil temperature A_g decreases with depth:

$$A_g = A_o . e^{-\frac{z}{d_0}} \quad (4)$$

Amplitude of air temperature (A_a) relative to the soil temperature is half of the difference between the daytime maximum value and the night time minimum value.

T(t,z)	ground temperature at depth h m below ground surface (°C)
T_a	average ambient air temperature (°C)
A_a	air temperature amplitude (°C)
A_z	ground temperature amplitude (°C)
T	time over a year (s)
t_0	temperature variation period (s), in this case to=24*3600 s for daily variation, or to=8760*24 for annual variation
d_o	penetration depth (m)
z	depth (m)
λ	thermal conductivity (W/m.K)
C	volumetric heat capacity (J/m³.k)

The shifting time φ between outside temperature and soils temperature at depth z is:

$$\varphi = t_2 - t_1 = \frac{z}{2}.\sqrt{\frac{C.t_0}{\lambda.\pi}} \quad (5)$$

The depth z_{op} can be determined from the thermal properties of soil.

The optimal depth z_{op} is the depth at which the temporal shift is equal to $t_0/2$, i.e. where the maximum outside temperature is associated with the minimum temperature at z_{op}, we deduce from (5):

$$\varphi = \frac{t_0}{2} = \frac{z_{op}}{2}.\sqrt{\frac{C.t_0}{\lambda.\pi}} \Rightarrow z_{op} = \pi.\sqrt{\frac{\lambda.t_0}{C.\pi}} = \pi.d_0 \quad (6)$$

φ	The shifting time φ between outside temperature and soils temperature at depth z
z_{op}	The optimal depth (m)
t_0	temperature variation period (s), in this case to=24*3600 s for daily variation, or to=8760*24 for annual variation
d_o	penetration depth (m)
z	depth (m)
λ	thermal conductivity (W/m.K)
C	volumetric heat capacity (J/m³.k)

The amplitude of ground temperature, at depth z_{op} is shown in Fig. 9:

$$A_g = A_o.e^{-\pi} \Rightarrow \frac{A_g}{A_a} = 4.321 \quad (7)$$

It follows from ((7)) that the temperature amplitude at optimal depth z_{op} is not a function of ground thermal properties, but depends on the temperature amplitude at ground surface.

Fig. 9 shows the difference between air temperature (i.e. ground surface temperature) and ground temperature at optimal depth for annual cyclic change of ambient air temperature.

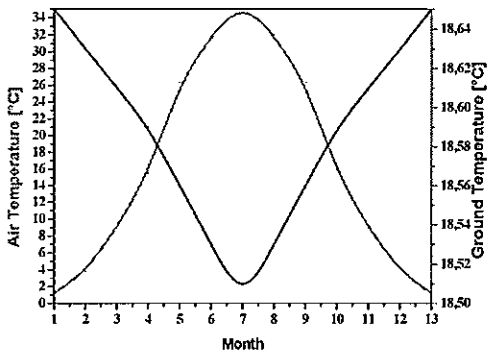

Fig. 9 Temperature fluctuations in air and ground, for D_f=0.6939.10⁻⁶ m²/s, entire year Z_{op}=7.305 m [2]

All soils don't have the same thermal conductivity. For example, a clay soil does not conduct heat the same way as bedrock. The experiment in (Hassiba Stambouli-Meziane, (2009), showed that rocky soils have greater thermal efficiency. Soil thermal diffusivity of the town of Tlemcen is 0.6939.10-6 m² / s, because the land is rich in limestone lithothamnides fossil shells of coquina type of post-Miocene aquifers. These are based on calcareous clays interbedded sandstone Tortonian age [15].

Fig. 10 shows the subterranean temperature, which is a function of depth at different times of the year.

Below a critical depth, which is a function of thermal properties of the earth, seasonal temperature changes at the soil surface become equivalent to the temperature changes of the air. At this critical depth, the soil temperature is warmer than the air temperature during the winter and cooler than the air temperature during the summer.

The heat absorbed by the earth in summer is stored in the soil and then available for use in winter [12]. The extracted thermal energy is a renewable resource due to seasonal variation in temperature. The effect of global warming on soil temperature has been neglected in the current analysis.

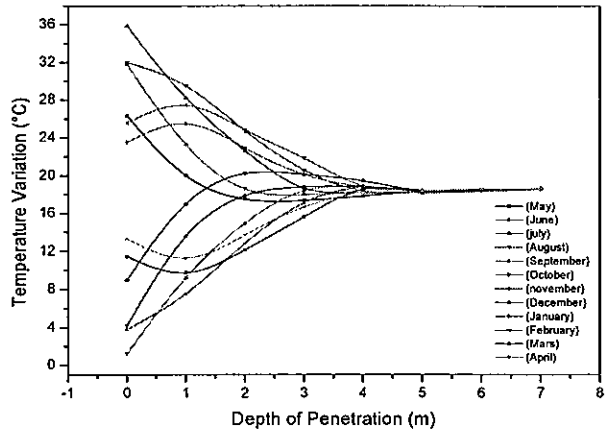

Fig. 10: Temperature profile through the ground in Tlemcen (Limestone Ground) [5]

IX. Conclusion

The feasibility study in this work shows that heating and cooling through a system of ground source heat pumps is possible [economical, optimizes energy efficiency, ...] for the town of Tlemcen. The optimal depths to place a heat pump for air conditioning and heating are sufficiently similar that it could be considered one facility for both applications.

There is a depth that maximizes the number of days during which a large thermal potential is available. However, the technical and economic optimization of the depth can be done only after choosing the technology and site, because the depth of the plant influences the cost in two ways. First, the cost of opening a well increases with depth. But at the same time the thermal potential increases, which reduces the size and cost of the system. The number of days that potential heat is maintained profitably also dictates the viability of the system. A techno-economic study of the optimal pump depth, comprising various case studies, could form an extension of this work

We can also conclude that the duration of air flow has a major influence on the outgoing temperature drilling. In winter, the flow must be slowed compared to the summer, and not only the temperature of the soil can be used for heating and cooling a home, but can also indicate an optimal temperature, while varying the circulation time. Other influential parameters that are not time-dependent include the depth of drilling, borehole diameter, air flow rate, and the injection rate of heat to obtain the desired output temperature. An experiment is necessary to validate these models and results.

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English Loanwords in the Egyptian Variety of Arabic: What Morphological and Phonological Change Occurred to them?

Mohamed A. Yacoub

Abstract—This paper investigates the English loanwords in the Egyptian variety of Arabic and reaches three findings. Data, in the first finding, were collected from Egyptian movies and soap operas; over two hundred words have been borrowed from English, code-switching was not included. These words then have been put into eleven different categories according to their use and part of speech. Finding two addresses the morphological and phonological change that occurred to these words. Regarding the phonological change, eight categories were found in both consonant and vowel variation, five for consonants and three for vowels. Examples were given for each. Regarding the morphological change, five categories were found including the masculine, feminine, dual, broken, and non-pluralize-able nouns. The last finding is the answers to a four-question survey that addresses forty eight native speakers of Egyptian Arabic and found that most participants did not recognize English borrowed words and thought they were originally Arabic and could not give Arabic equivalents for the loanwords that they could recognize.

Keywords—Sociolinguistics, Loanwords, Borrowing, Morphology, Phonology, Variation, Egyptian Dialect

I. Introduction

It has been taken for granted that all languages of the world play the role of either the giver or the borrower through a process known as *language contact* (Hock and Joseph and others). In case of Arabic, it extensively plays the role of the borrower nowadays. It is noticed that languages' sounds—either consonant or vowel— are not identical across languages, so it is expected that loanwords undergo a process of phonological, morphological, or semantic change when crossing from one language to another.

Arabic, which is a language of—at the very least— a two-thousand years history, maintains its syntactic, semantic and other systems of the language almost unchanged. Sherif Al-Shubashi states that "Arabic is the only language in the world whose rules haven't changed for 1500 years" (13). It is spoken as a first language in twenty two countries with a total number of 223,010,130 speakers of it as a first language (Ethnologue Languages of the World). In terms of consonants, Arabic possesses nine consonant sounds that English is lacking, which are (ص ض ,خ ,ح ,ق ,غ ,ع ,ظ ,ط) (/sˤ/, /x/, /ħ/, /dˤ/, /q/, /gh/, /aˤ/, /ðˤ/, /tˤ/), and Arabic lacks the /p/, /v/, /tʃ/,[1] and /dʒ/ from English consonants. Unlike consonants, Arabic utilizes only six vowel systems compared to the many more vowel sounds in English. The vowel pairs (long and short) are /a/ and /æ/, /i/ and /ɪ/, and /o/ and /u/ (Thompson-Panos and Thomas-Ruzic 612). These differences in vowel and consonant sounds between Arabic and English play a role in the phonological variation. Speakers of Arabic either adopt a new sound—which enriches the sounds of the language— or replace it by a native one as the case in *video* which is uttered in Arabic as فيديو *'fideo,'* in which /v/ becomes /f/, and as راديو *'radio'* in which /eɪ/ becomes /æ/.

The Egyptian variety of Arabic is the variety which is spoken as a first language whose population number is about 91,000,000 people according to the census of January 2013. It is a dialect from the many different dialects of the Arab region (like Sudanese, Gulf, and Shami dialects). The linguistic situation in Egypt is best described as diglossic where two forms of a language exist together. The first form is high (H) and is spoken in formal situations and used as a language of mass media, and the low form (L) is used for the daily conversations. However, form L starts to appear in the mass media and exist in some formal speeches, as well. This paper, hence, addresses three findings. First, it detects the English loanwords that exist in The Egyptian variety of Arabic. Second, it investigates the morphological and phonological change of these loanwords. Third, a survey study was conducted to find out the reaction of the participants towards these borrowed words.

II. Literature Review

The term 'loanwords' is defined by many linguists in the field of language contact. D. Crystal approaches "loanwords" as introducing a word which belongs to one language or dialect to another (118). T. Bynon, closely enough, determines that loanwords are those words that transfer across the boundaries of languages (98). The loanwords usually belong to technical fields such as science, technology, or other words that belong, for example, to the church or the military ... etc. Loanwords usually fill a semantic or stylistic gap in the target language. When speaking of crossing language boundaries, L. Bloomfield introduces a differentiation between "intimate borrowing and remote borrowing." The former occurs when a loanword moves from a language or a variety of languages to another one that lives side by side with it in a single community. On the other hand, when borrowing occurs cross nationally or internationally and across geographical boundaries, the situation is best described as a "remote borrowing" (89).

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[1] The method of transcription used in this study is the IPA according to Cambridge Dictionaries Online.

Daniel Owino introduces a classification of different types of borrowing that are recognized in the literature of linguistics (27).

1) "The direct type of borrowing," in which the borrower language adopts into its system both the form and meaning of a loanword.
2) "Loan translation or calques," where the target language creates new morphemes, and phonemes instead of the foreign ones. In this case, the foreign words only serve as "a model for a native creation." This is the complete opposite of the first kind since none of the morphemes or phonemes of the loanwords plays any role in the new word of the target language.
3) "Semantic extension (semantic calques):" what happens in this case is that an original word in the target language is given a new meaning for the foreign word. Consequently, the same native word will have multiple meanings that expand to carry the new word. In this case and the previous one, the target language is kept pure from foreign elements.
4) "Loanshift:" this happens when the target language refuses to accept the new loanword with the cultural meaning that is attached to it. Subsequently, what is borrowed is the verbal expression of the loanword. The borrowing aspect happens in only the semantics of the word. In this case and the previous two, the target language is kept pure from foreign elements.
5) "Loanblend:" the borrower here adapts or borrows a part of the word and blends it with an original part of the target language.
6) "Loan creations:" this means the new coinages in target language to match "designations available in a language of contact."
7) "Hybrid borrowing:" this refers to a context that has three languages: target languages; source language one; and source language two. For instance, a country that was colonized by France has a source language one which is French, beside its own language (Arabic, for example). When this country needs to borrow a new word from English (which plays the role of the second source language), it replaces the English word for a French one. This is called "Hyper Borrowing."

The need to borrow a word from one language to another has been studied by linguists, and the reasons why people borrow have been posited. *Prestige* is one of the reason why people borrow; "When something is PRESTIGIOUS, we may feel a NEED to imitate or borrow it" (Hock and Joseph 259).[2] C. F. Hockett points out that "people are expected to emulate those they admire" (68). U. Weinreich and Owino refer to the point that the borrower may wish to conform to the majority whose first language is the source language (56-28). In the case of Egypt, English is believed to be highly prestigious. This belief, I argue, is the result of establishing English-as-a-means-of-instruction schools in Egypt, which charge high tuition and are dedicated to the children of the rich people or as they view themselves as the first-class people. Students of these schools end up in the AUC (The American University in Cairo), or other similar universities that are not obtainable for the ordinary people. This status of segregation gives birth to a predilection for English and preferring it to Arabic since these schools have become the dream of every child and parent in Egypt. *Colonization* is another important reason why people borrow. Countries that colonize big territories affect their language (Wajih Abderrahman 225). The case is clear when the linguistic situation in North African countries like Morocco, Tunisia, and Algeria (all French colonies) is taken into consideration. In the case of the English language, English people colonized many countries like India, Egypt, Australia, New Zealand, South Africa, Zimbabwe and many other countries, in some of which the colonizer changed the language of education and/or the language of the medium of instruction to English. *Religion* can be one of the reasons of why borrowing occurs. For instance, many non-Arabs whose religion is Islam use Arabic Islamic words once they master few words in Arabic since Muslims believe that the Quran—the Muslims' Holy Book—is not translatable and all Muslims must pray in Arabic. Thus, those non-Arabs start borrowing Arabic words the moment they convert into Islam. *The need to fill* is another major reason for borrowing. When new innovations, concepts, places ... etc. appear, the need for words that express them appears, too. It is being believed that borrowing a word is easier and faster than coining a new one (R. W. Langacker and Hockett 73). This need happens a lot in the field of modern technology. "*Pernicious homonymy*" has been defined by Weinreich to be a very good reason for borrowing. If the target language has clashing homonyms, the solution seems to be in borrowing a word from a source language (59). *Frequency* is also one of the reasons. If a word in the target language suffers from low frequency compared to a highly frequent word from the source language, this highly frequent word might get borrowed to replace the low-frequency one (Weinreich 56). Not only frequency but also *accuracy* can be a reason for the borrowing. When a word in the source language conveys the meaning more accurately from the one in the target language, it usually gets borrowed. The one in the target language starts to lose its effectiveness (Weinreich 58). "*Cacophemistic Purposes*," which is a reason for borrowing, is defined by Weinreich to express the need to replace a word in the target language that has unfavorable or negative associations; it gets replaced by another borrowed word from a source language (59). *Euphemism* could be a good reason for borrowing. When a word in the target language is considered too harsh, blunt, unpleasant or embarrassing, a new word is borrowed to express the same meaning but softly. Finally, trade and business related words get globalized and then borrowed due to marketing products with certain names attached to them in the stores or on TV commercials, and then these words or names become popular for anyone to use.

Regarding the phonological adaptation, L. M Hyman argues that language borrows sounds according to the phonemic approximation. He argues that when words are borrowed, a process of approximation occurs to the new sounds that do not exist in the new language. Hence, he concludes that sounds of loanwords undergo a process of "phonological constraints" (1-84). Agreeing with Hyman's conclusion, N. A. Mwihaki, M. Picard and J. Nicol conclude that morphemes of the loanwords are borrowed based on the closest sounds in the target language (39, 52).

K. Hansford and G. Hansford who studied loanwords in Chimburung also claim that loan phonemes correspond with nearest native phonemes of the target language (39-50). F. Katamba and F. Rottland examine the syllable structure of loanwords of English in Luganda by using Lugandan data. They conclude that English loan phonemes are uttered in a way that they assimilate the closest phonemes in Luganda (101). N. A. Mwihaki who examined the same thing in English loanwords that exist in Gikuyu argues that when phonemes are adapted, the process involves substituting the phonological characteristics of the source language with equivalent ones in the target language (41). Concerning the stages that a loanword might require to be borrowed into the target language, R. Ohly argues for four stages of adaptation through which a loanword passes when borrowed from Afrikaans into Herero. First, these words get a local class prefix, then they get accommodated into the language. Next, the phonological rules start to apply partly to the new loanwords. Finally, a stage of "assimilated loans" is brought into the target language through a process of nativization (197).

Weinreich introduces two reasons for how languages adapt new sounds and conform to the sounds of the loanwords. First, depending on the speakers, Weinreich argues that if the speaker is a monolingual, then he/she tries unconsciously to adapt the new sound into the closest sound in his language, and if the speaker is bilingual, then he/she produces the same sound. Second, depending on the prestigious status of the source language in the culture of the target language, speakers might nativize the sounds of the new loanword, or keep it as it is. If the source language is prestigious, then speakers strive to keep the sounds because it is a sign of education or high social status, and vice-a-versa (207).

Wajih Hamad Abderrahman examines the impact of the English language on the process of word formation in Arabic. The researcher indicates that the influence of the English language on Arabic is multifaceted; however, he chooses only word formation to study. He concludes that Arab translators bear part of the responsibility behind this huge number of borrowed words because they are not qualified enough in the target language, which is Arabic (231). In other words, when those translators translate a text from English to Arabic, they sometimes use the same English words in Arabic and don't try to find pure Arabic equivalents. By doing so, more English words appear in Arabic.

The concepts of *substratal* and *adstratal* languages are discussed by Kees Versteegh who addresses borrowing from Arabic into other languages. Versteegh tries, through a historical approach, to trace the languages that were affected by Arabic—because of Islam—like Swahili, Hausa, Persian, Urdu, and Turkish, raising some questions like 1) "what was the role of Arabic literary culture in the transmission of Arabic elements (e.g., the terminology of writing, grammar, and scholarship)? 2) Is it possible to distinguish in all situations two layers of borrowing?" He concludes that it is difficult to "draw too many conclusions from the material since there is no chronological/diachronic analysis of the Arabic material in any language." He also concluded that it is impossible to know "how the developments of these borrowed words from Arabic took place" (470, 502-503).

Eiman Mustafawi investigates the difference between borrowing and code-switching using materials from twelve hours of natural conversations recorded on tapes and collected from seven native speakers of Gulf Arabic whose ages ranged between 24 and 35. She concludes that "lone items must be characterized as borrowings, not codeswitches, and that borrowing and codeswitches are products of different processes" (220, 229). The same conclusion was drawn by other researchers such as Shana Poplack, Susan Wheeler, and Anneli Westwood (389-406), David Sankoff, S. Poplack, and Swathi Vanniarajan (71-101), S. Poplack and Meechan Meechan (199-232), Danielle Turpin (221-233), Reza Ghafar-Samar and Marjory Meechan's (203, 2019), Svitlana Budzhak-Jones (161-182), and Ejike Eze (183-201). All those researchers conclude that codeswitching is different from borrowing.

Sarah G. Thomason summarizes forty eight articles written about "Arabic in contact with other languages" as an assignment given to her by the encyclopedia's editors. She finds that all the articles address these points: 1) Arabic loanwords in other languages and the reason why these words were borrowed from Arabic into other languages. She found that Islam as a religion had the greatest impact as a reason of borrowing; 2) Structural interference as the irregular (broken) plural that is still found in other languages—especially those in or near the Arabophone territories—like Swahili and Turkish; 3) Multi-lingualism and its effect in the regions that have a strong Arabic presence; and 4) Language planning in general. She finds the authors address the idea of teaching Arabic in different regions. (1-4, 12-18, 20-22).

III. Academy of the Arabic Language in Egypt (AAL)

Established on December 13th, 1932 by a royal decree, the academy is to sponsor, protect and purge Arabic from the foreign words that might affect the Arabic tongue. Egyptian scholars and linguists were eager to establish it to defend the standard Arabic against the use of the regional dialects and alien or obtrusive words. The academy aims at having Arabic keep pace with the modern languages, expressing the modern needs of the age, opening the door for Arabizing and neologizing foreign words based on the urgent need of the age, and permitting a linguistic facilitation without ingratitude to Arabic (Academy of Arabic Language). These duties are carried out through the different production manifestations of the AAL that are:

[2] These two words are capitalized in the original text.

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1. The Magazine of the Academy: it is an academic and linguistic magazine that the ALL publishes every six months;
2. The ALL publishes books about the language, its origins, its dialects, and its odd speeches;
3. Scientific decisions in regards to language matters and problems;
4. The scientific and technical terms and the words of civilization;
5. Linguistic dictionaries and lexicons including a) the Lexicon of the Quranic words, b) the Big Lexicon *Al-Mu'ajam Al-Kabeer*, c) the Mediator Lexicon *Al-Mu'ajam Al-waseet*, d) the Terse Lexicon *Al-Mu'ajam Al-Wajeez*;
6. The scientific dictionaries:

a. The Dictionary of Geology;
b. The Dictionary of the Nuclear Physics and Electronics;
c. The Dictionary of Chemistry and Pharmacy;
d. The Dictionary of Philosophy;
e. The Dictionary of Modern Physics;
f. The Dictionary of Hydrology;
g. The Dictionary of Biology and Agriculture;
h. The Dictionary of Psychology and Education;
i. The Dictionary of Geography;
j. The Dictionary of the Medical Terms;
k. The Dictionary of Oil;
l. The Dictionary of Mathematics;
m. The Dictionary of Computer Science;
n. The Dictionary of The Mechanical Engineering;
o. The Dictionary of Law;
p. The Dictionary of the Terms of the Prophetical Speeches, *Hadeeth*,
q. The Dictionary of Jurisprudence, *Al-Fiqh* (the official website of the AAL).

The importance of mentioning the AAL in this study lies in the role it plays in creating new words to replace the ones borrowed from other languages (from English in this study). It seems that ALL fails in reaching out to people and/or delivering its publications to them as the survey will show later in this paper. It is possible that the AAL is not having an effect in Egypt since it is not empowered by law, though it was established by one (by a law).

IV. Methodology

This paper represents three findings, and each finding answers one of the three questions. Finding number one introduces the English loanwords used in the Egyptian variety of Arabic. Finding number two investigates the phonological and morphological change in the English loanwords in Arabic by classifying them into categories. The last finding, which answers question number three, is done by conducting a survey that contains six relevant survey-items for the participants to answer. The answers were then analyzed and put into categories.

A. Research Questions

The paper addresses three major questions.

1. What are the English loanwords in Arabic that this study can detect?[3]
2. What are the morphological and phonological change that occur to the English loanwords when they end up in Arabic?
3. How do the participants react towards these borrowed words?[4]

V. Finding One: English Loanwords in Arabic

5.1 Data Collection

Data was collected from two sources, movies and soap operas. Egypt is known for its precession in the field of media production. The movies and soap operas that were selected assimilate reality and produce a good picture of everyday life and language use. These words are in the lexicon of almost every Egyptian monolingual person. I was cautious not to mix borrowing with codeswitching. They are different terms (Mustafawi and others c.f. page 3-4). I wrote down the words that I, as a native speaker of Arabic, am used to hearing from everybody else in Egypt, especially those who are not bilingual. Furthermore, no attention was paid to the origin of these words beyond that they exist in the English dictionaries as English words. Some of these words were known to laymen many years ago, and some others have just entered the language and are known mostly by the young people. In addition, I eliminated many words that are not being used by the majority such as *message, movie, good, school, modern, weekend, recycling, French fries* ... etc., and I also eliminated names like *Google, Facebook, Photoshop, Twitter, PlayStation, Nescafe* ... etc. because they are harder to use Arabic alternatives for. Additionally, I didn't pay attention to the many technical loanwords because they are known only to a few people not to the majority.

The first of the two mentioned sources is the soap operas, and it includes: راجل ومت مئات 'raggil wa-sit sittat' "A Man and Six Women;" الكبير قوي 'Al-kabeer Qawii' "The Very Big;" فرقة ناجي عطا الله 'Firqat Naggi Attallah' "Naggi Attalah's Team;" أولاد الأكابر 'Awlad Al-Akabber' "The Elites' Children;" ساره 'Sara' "Sarah;" رحلة المليون 'Rihllat Al-Milliouon' "Journey of the Million;" سنبل بعد المليون 'Sunbul Baad Al-Million' "Sonbul after the Million;" حضرة المتهم أبي 'Hadrat Al-Mutaham Abii' "Dear Mr. Defendant, My Father;" الحاج متولي 'Al-Hajj Metwalli' "Mr. Metwalli;" زهرة وأزواجها الخمسة 'Zuhraa Wa Azzwajaha AL-Khamsa' "Zuhra and Her Five Husbands;" and الرجل العناب 'Al-rajul Alennab' "The Man of Roselle." The second, the movies, includes أمير البحار 'Ameer Al-behaar' "The Admiral;" الباشا تلميذ 'Al-Basha Telmeeth' "The Student Pasha;" التجربة الدنماركية 'Al-Tajrubaa Aldenemarkiia' "The Danish Try;" اكس لارج 'Ex-larj' "X-Large;" مطب صناعي 'Matab Sinaaii' "An Artificial Speed Bump;" and الف مبروك 'Alf Mabrouk' "A Thousand Congratulations."[5]

[3] The reason for this question is that no study, as far as I know and could find by search, counted the number of the English loanwords in Arabic, and I wanted to make a seminal one here.

[4] In the survey section, I will define what I mean by "react."

5.2 Detected Words

It has been noticed that most English loanwords in Arabic are nouns in their parts of speech, and that is why the first eight groups are "nouns." "Verbs... nevertheless are not as readily borrowed as nouns" (Hock and Joseph 245). Below I will categorize the words into groups in order to know from what area Arabic borrows more.

1) Technology and Industry-Related Words:

It was found that the most borrowed words belong to the category of technological words. "The most easily borrowed words belong to more specialized forms of discourse, often referring to technology," and "borrowing of technological vocabulary is ... a modern phenomenon" (Hock and Joseph 246). The words that were noticed are:

Academy, answer machine, asphalt, automatic, bank, battery, beach buggy, cable, cafeteria, camera, ceramic, cassette, CD, cement, code, computer, data, download, DVD, electronics, email, film, flash, hardware, icon, internet, gas, geology, graphics, gym, keyboard, laptop, laser, link, mall, metro, micro bus, microphone, microware, mini bus, missed call, mobile (cell phone), mouse, model, modem, motherboard, motorcycle, online, password, post, processor, radar, radio, ram, receiver, remote (control), router, saloon, software, supermarket, taxi, technology, telephone, television, video, virus, website, and *wi-fi.*

A) Clothes-Related Words:

Modern clothes might be a part of technology, as well, because they are products of technological machines. However, I found it better to separate clothes from technology category. The clothes-related words that were found are:

Badge, body (a kind of women's shirt/t-shirt), *boot, boxer* (boxer wear), *cap, ice-cap, jacket, makeup, pants, sandal, shorts, style* (used only to describe clothes), *top* (bra), *T-Shirt, under* (underwear), and *X-large* (as a size),

B) Medicine-Related Words:

Some but not many medical words were found here. They are:

Alzheimer, Aspirin, biology, cancer, diet, doctor, hysteria, Influenza, physiology, protein, psychology, schizophrenia, shampoo, and *vitamin.*

C) Home-Related Words:

In this category, I included types of food and machines related to home-use stuff. These words are:

biscuit, burger, cake, chips, chocolate, cream, décor, design, freezer, fresh, garage, ice cream, jumbo (big size of a sandwich), *ketchup, kilo, lamb, list, liter, macaroni, mayonnaise, Nescafe, original, parking, perfume, roof, Sandwich, sticker, Toilet, villa,* and *zero.*

D) Media-Related Words:

Media has its own share in the English loanwords in Arabic. These words are:

Album, caricature, cartoon, classic, comedy, coupon, drama, folklore, program, studio, and *tragedy.*

E) Sports-Related Words:

Egyptians like sports, especially soccer. Since these sports were not Egyptian discoveries or inventions, Egyptians borrowed words that are attached to these sports. These words are:

Captain, center, coach, game, goal, karate, match, medal, shoot, sports, squash, stadium, tennis, and *ultras.*

F) Politics-Related Words:

Politics is something international, and translators might prefer to use these words as they are. These words are:

Agenda, application, atlas, bureaucracy, check, course, democracy, dictator, Logistics, Marxist, police, port, pragmatic, protocol, section, strategy, and *visa.*

G) People and Relations-Related Words:

English loanwords used for People and relations are:

Aunt, baby, bravo, business, Bye, desk, card, centimeter, charisma, class, etiquette, group, madam, mama, mechanic, mercy (used as thank-you word), *meter, million, millionaire, mode, Mr., Miss, interview, papa, prestige, prince, professor, romance, routine, secretary, sex, sister,* and *uncle.*

H) Verbs

Words of other parts of speech rather than nouns are not so many. "Verbs ... are not as readily borrowed as nouns." This doesn't mean that verbs "are totally impervious to borrowing," but rare (Hock and Joseph 246). The verbs are:

Cancel, chat, finish, like, post, relax, save, set up (to set up a program on the computer), *share, stop,* and *used.*

I) Adverbs

I think the case of verbs apply to the case of adverbs in that they are rare and not very common. The adverbs are:

Already, offside (as two words used in soccer game) *OK, out,* and *over.*

J) Adjectives

The adjective are: *Automatic, classic, fresh, jumbo, large, logistic, modern, online, original, pragmatic, sorry,* and *X-romantic.*

The following chart shows a comparison among the categories of the English loanwords in Arabic. Each column represents the number of the loanwords of each category named below:

[5] These movies and soap operas are easily accessible on YouTube by typing the title into the YouTube search tab.

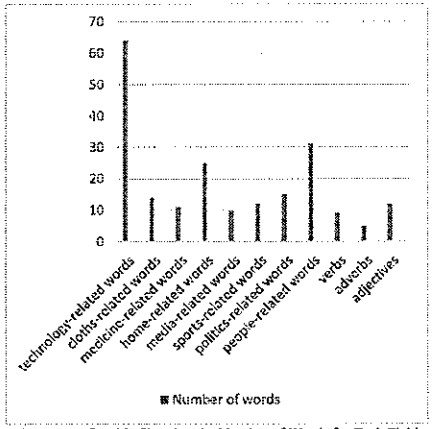

Figure 1: A Graphic Showing the Number of Words for Each Field.

VI. Finding Two: The Morphological and Phonological Change

Finding number two deals with the morphological and phonological change of these loanwords. I am going to categorize the change into two main sections. The first one deals with the phonological change, and the other one deals with the morphological one. Under each one, there are subcategories illustrating the change in detail.

A. Phonological Change

The phonological change in the 200+ English loanwords of this study is found to be one of the following:

a) /f/ for /v/

The voiced consonant fricative /v/ doesn't exist among the Arabic sounds, and hence Arabs change any word that carries this characteristic into the /v/'s voiceless fricative counterpart /f/. Example of this category includes: فيديو 'fideo' "video;" برافو 'brfo' "bravo;" and انترفيو 'interfiew' "interview." [6] However, some educated or bilingual Egyptians pronounce the /v/ as it is. In addition, there has been a try to insert a new consonant letter into Arabic that carries the characteristics of the voiced consonant fricative /v/.

b) /b/ for /p/

The voiceless consonant labial /p/ doesn't exist among the Arabic consonant sounds, as well, and, hence, Arabs use its voiced consonant labial counterpart /b/ as in كمبيوتر 'koubyoutar' "computer;" سوبر ماركت 'subbar market' "super market;" بروفيسور 'brofessour' "professor;" and جروب 'groub' "group." Again, there has been a try to add the /p/ letter to the Arabic alphabet, but it is neither widely accepted nor recognized yet.

c) /r/ is rolled.

The consonant palatal /r/ is not pronounced in Arabic as it is in English. It is "rolled" in Arabic, and it is a voiced repetitious sound. However, Arabs stigmatize those who pronounce the Arabic /r/ the same way it is pronounced in English and describe him/her of having *rhotacism* (a term used to describe inability of pronouncing the sound /r/). Examples of this change includes روتين 'rʕoutine' "routine;" متر 'metrʕe' "meter;" and ريلاكس 'rʕelax' "relax."

d) /ʃ/ for /tʃ/

The palatal fricative /ʃ/ replaces the palatal affricative /tʃ/ as in شيبس 'shibs' "chips;" شيك 'sheek' "check;" and شوكولاته 'shokolata' "chocolate." The reason for this change might be that Arabs are not used to pronouncing palatal affricative /tʃ/ due to its non-existence in the Arabic sound system. It could be represented in Arabic by two letters ت /t/ followed by ش / ʃ/ but that is not practiced.

e) /z/ for /s/, /t/ for /tʃ/, and /ʃ/ for /dʒ/.

The reason why I combined these three changes is that I only found one example for each. The voiceless fricative alveolar /s/ is replaced by the its voiced counterpart /z/ in the example of ميزد كول 'mizzd kaul' "missed call." As for the second pair, the alveolar stop /t/ replaces the palatal affricative /tʃ/ in the example of كاريكاتير 'karikatair' "caricature." Regarding the last pair, the palatal fricative /ʃ/ replaces the voiced palatal affricative /dʒ/ in جراش 'garash' "garage." It is predicted that these groups will contain more words since the process of borrowing doesn't stop.

From a) to e) of the phonological change above dealt with the variation in the consonant sounds. The change regarding vowel sounds is to be examined below.

f) /æ/ for /eɪ/

Egyptians use the open-mid front vowel /æ/ instead of the diphthong /eɪ/ as in رادیو 'rædio' "radio;" and cable 'kæbl' "cable." Arabic doesn't have a big variety of vowels, so when there are unfamiliar vowels in the English loanwords, these peculiar vowels change into the nearest native vowel in Arabic following the rule of approximation.

g) /æ/ or /u/ for /ʌ/

Egyptian use the close back /u/ for the open-mid back /ʌ/ as in فيروس 'fayrous' "virus" and أونكل 'ounkle' "uncle," and the open-mid front vowel /æ/ for /ʌ/ as in باص 'bæs' "bus."

h) /ɛ/ for /aɪ/

The open-mid front /ɛ/ replaces the diphthong /aɪ/ in words like ميكروفون 'makrafoun' "microphone;" ميكروباص 'mikroubas' "microbus;" and موتوسيكل 'motousikl' "motorcycle." /aɪ/ is alien vowel sound to the Arabic vowel system, and it is lacking a letter or even group of letters to represent it.

B. Morphological Change

The change in morphology in these loanwords happens in only the nouns and verbs. For nouns, the change happens when the words get pluralized or dualized. Since Arabic is a gender-language, everything in the language should be either masculine or feminine. Plural system in Arabic is threefold; regular masculine, regular feminine, and broken irregular. As for the dual, regardless of the gender, it has its own rule that will be exemplified below. It was also found that some nouns are not subject to the plural form even if they are plural in English as illustrated below. For verbs, some verbs were found to be conjugated the same way their Arabic counterparts are, and some others are anti-conjugation. In other words, they

[6] See Appendix 1 for detailed analysis of each word.

are used as if they were nouns, which is going to be clarified and illustrated below, as well.

a) Regular Feminine Plural

The regular feminine plural in Arabic is formed by adding the morpheme [aat ات] to the end of a word regardless of the word's syntactic position in the sentence as a subject or an object. Surprisingly, most of the English loanwords in Arabic follow this pattern. Examples of this include بروفيسورات 'brofessoraat' "professors;" سسترات 'sistraat' "sisters;" كيلوهات 'kilohaat' "kilos;" شامبوهات 'shamboohat' "shampoos;" and شيبس 'shibsiyaat' "chips." See example 1 below:

1. درستي عشر بروفيسورات
'Darras ni ashar brofessoraat.'
Taught me ten professors
"Ten professors taught me."

The example above shows how the loanword 'professor' gets pluralized in a sentence following the regular feminine plural pattern by adding the morpheme [aat] to the end of the word. The word 'professor' in this sentence, which is in plural, could mean either gender, i.e. male or female professors. The semantics of the word 'professors' is genderless in this sentence, which is rare in Arabic. In Arabic, almost any word has a gender. It could be concluded that loanwords do not only enrich the Arabic vocabulary but also the syntax system itself.

b) Regular Masculine Plural

Regular masculine plural in Arabic differs according to the syntactic position of the noun in the sentence. If the noun is in the position of the subject, then it takes the morpheme [youn ون], and [yeen ين] if in the position of the object to get pluralized. Only a few English loanwords follow this pattern, the thing that needs a further study. Examples of this includes ديكتاتوريون, ديكتاتوريين 'diktatryoun' or 'distatoryeen' "dictators;" ميكانيكيون, ميكانيكين 'mikanikyoun' or 'mikannikyeen' "mechanics;" and رومانسيون, رومانسيين 'roumansyoun' or 'roumansyeen' "romantics." See example 2 below:

2. هؤلاء ميكانيكيون رائعون
'haoulaa mikanikyoun ra'oun'
These mechanics amazing.
"These are amazing mechanics."

In example 2 above, unlike example 1, the loanword 'mechanics' refers only to male mechanics. The loanword 'mechanics' above is located as the subject of the verb, and that is why the morpheme [youn] was attached to it. If this loanword comes in the position of the object of the sentence, the morpheme [yeen] will be added instead.

c) Irregular Broken Plural

Arabic irregular broken plural has no set rule of how to form the plural of a word. However, the word is to be broken down into its three root letters and then the plural form starts from there. Only few loanwords of this study were found to follow this pattern such as كباتن 'kabatin' "captains;" برامج'barameg' "programs;" دكاتره 'dakatraah' "doctors;" and أفلام 'aflaam' "films." See example 3 below:

3. شاهدت خمسة أفلام
'Shahatu khmsata aflam'
Watched five films.
"I watched five films."

In the irregular broken pattern of plural in Arabic, singular words get reshaped in order to be pluralized according to this pattern. In Arabic, every word has a group of letters called 'root letters' which usually are three. The words that follow the irregular broken pattern keep these root letters unchanged but change the other letters. In the example above "film," the three root letters are "f," "l," and "m," and that is why the irregular broken plural of this word is 'aflam.' We can notice that the three root letters are there in the plural, too.

d) Non Pluralize-able Nouns

Arabic is similar to English in that both languages have the so-called non-count nouns. When examining the English loanwords of this study, it was found that some loanwords become non-count when they end up in Arabic although they are countable in English such as طنط 'tant' 'aunt;" أنكل 'unkil' "uncle," and بارکینج 'barking' "parking." See example 4 below:

4. أنا عندي ثلاثة أنكل
'Ana Andi Thalatha unkil'
I have three uncle.
"I have three uncles."

In this example, the word 'uncle' is not following any plural pattern, and that is why the speakers of Arabic add a number before the loanword of this kind without pluralizing the word itself. The reason might be the difficulty of pronouncing these loanwords with any of these morphemes [aat], [youn], or [yeen] attached.

e) Dual Form

The dual form in Arabic is formed according to its syntactic position in the sentence, either subject or object. If it is in a subject position, then the morpheme [aan ان] is added to the end of the word, and if it is in the object position, then the morpheme [een إين] is added regardless of the nouns' gender. Examples of the dual in the study loanwords includes, but not limited to, باصين باصان 'basaan' or 'baseen' "two buses;" كاميراتان, كاميرتين 'kamertataan' or 'kamerateen' "two cameras;" جاكتان, جاكتين 'jaketaan' or 'jakteen' "two jackets." In the Egyptian variety of Arabic, Egyptians stick to only the morpheme [een إين] regardless of the position of the noun. See example 5 below:

5. رأيت كاميرتين جميلتين
'rayt u kamerat een jamelateen'
Saw I cameras two beautiful.
"I saw two beautiful cameras."

In the example above, the morpheme [een] in 'kamerateen' "two cameras" indicates the duality, i.e. "two." Unlike the plural patterns, the dual pattern is very straightforward and applies to all the loanwords detected in this study. It also applies to the words that don't take plural form like *uncle* and *aunt*.

VII. Finding Three: The Survey Study

This survey study was conducted to find answers to four questions through which the participants' reaction to the loanwords will be clear.[7] The survey, through the first question, investigates the participants' knowledge of the loanwords where they were asked to identify the twelve English loanwords in the question. It was hypothesized that

[7] See Appendix 2 for the survey in Arabic and translated into English.

not all the participants were aware of all the loanwords. Participants, through the second question, were requested to provide Arabic equivalents for twelve English loanwords in the question. There was neither an intention to choose the number of words in this question (12) nor was there a certain reason to choose those twelve words. It was a random process since all words are equal and could carry out the mission. The third question addressed the AAL and if the participants are aware of its role or not. The fourth question investigated the factors that resulted in borrowing this large number of English loanwords. Answering these questions might contribute to the literature of loanwords between Arabic and English and paves the way for future studies, and for comparisons and investigations in the same area.

A. Participants

Forty eight subjects who represent different ages, sexes, education, and social background were used to participate in this study. All of them were Egyptians, and all of them were in Egypt at the time of filling out the survey. All of them use the English loanwords used in the survey.

7.1 Instrumentation

It is a survey designed and written in Arabic by the researcher himself, which consists of six questions mentioned above. The questions were designed and written by the researcher in an attempt to get the best of the participants' understanding of the English loanwords of the study.

7.2 Data Collection and Analysis

The survey was sent via email to Egypt to be distributed by two of my assistants, then it was scanned and emailed back to me. The results were analyzed and conclusions were drawn and put in tables.

VIII. Results

Table 1: Participants' Responses to the First Question:

	The word	Identified	Non-identified
1.	Match	35	13
2.	Computer	41	7
3.	Radio	24	24
4.	Camera	30	18
5.	Comedy	33	15
6.	Sandwich	33	15
7.	captain	26	22
8.	film	25	23
9.	protocol	41	7
10.	mechanic	20	28
11.	jacket	34	14
12.	technology	36	12

These are the twelve words that were used for the first question. The question says "identify which words are borrowed from English." It was clear that not a word was completely identified as a borrowed by all the participants. Participants show a little lack of awareness in terms of recognizing the alien words. This makes me skeptical of the second question that not all of them will be able to find Arabic equivalents.

Table 2: Participants' Responses for the Second Question.

	The word	Able to give Arabic equivalent	unable to give Arabic equivalent
1.	Course	34	14
2.	Academy	24	24
3.	Freezer	25	23
4.	Ice Cream	23	25
5.	Check	30	18
6.	Application	25	23
7.	Sandwich	15	33
8.	Etiquette	19	29
9.	Internet	14	34
10.	Comedy	35	13
11.	Camera	22	26
12.	Classic	14	34

This was a hard question for the participants and the one which took the longest time to answer (as my assistants informed me). It was not a piece-of-cake- mission for the participants to brainstorm and remember if they ever heard an Arabic equivalent for one of these words or not.

Table 3: Participants' Responses towards the Role of the AAL: [8]

	The question	yes	no
3.1	Are you aware of the AAL role?	12	35
3.2	Is the ALL ineffective?	10	2

It was not predicted that most of the participants (35 out of 47) did not know what the AAL was, and those who knew (12) believed that it was ineffective.

The sixth question examines the factors that made this process of borrowing happen. The factors that the subjects mentioned are, a) the weak economics and politics of Arabs, b) the lack of Arabs' inventions, c) school subjects don't inspire students to love Arabic, d) work market requires English as a must for applicants to get a good job, e) the media emphasizes the importance of English and invite people who code switch a lot to show up on the screen of TV in the talk show programs and other programs as well, f) the laws that protect Arabic are not activated.

IX. Discussion and Conclusion

When I started this project, I did not expect that I would get this big number of borrowed words especially after I filtered them from code switching, loanwords that are not used by the majority of people, technical words, and foreign names. The gathered words underwent phonological and morphological change. Regarding vowels, Arabic has less vowels than English, which makes it difficult for Arabs to produce the exact same vowels and hence this is one reason for the phonological change. Changing in morphemes in nouns happens when making them plural or dual. Plural system in Arabic—which is a grammatical gender language— is fourfold: regular masculine; regular feminine; irregular broken; and dual. A surprising finding of this study is that

[8] One person left this question blank.

only fourteen words out of 200+ have irregular broken plural (match, bank, captain, program, doctor, film, meter, million, card, section, goal, taxi, visa, cartoon), and only two follow the regular masculine plural (dictator, mechanic). Eighty-four words are not pluralize-able even if they are countable in English like *uncle* and *aunt*, and one hundred and eleven words are pluralized following the regular feminine. It is recommended that a further study examines the reason why. When Arabs want to pluralize the words that are not pluralized or phrases like "missed call," they put the number they want before it but don't pluralize the word itself. For instance, one would say "I have four 'uncles' or 'missed calls." As for the adjectives, it was surprising that English loan adjectives in Arabic don't follow the rule of pluralizing the adjectives with pure Arabic origins. In other words, adjectives from Arabic origins get dual and plural forms just like the nouns, but the loan adjectives don't.

As for the survey, not all the participates, most of whom are college-level students and above, were able to identify the English loanwords and thought they were original Arabic ones as detailed by number in the table of survey question one above. Surprisingly, almost none of them were able to find Arabic equivalents for all of these words. Although some of them claimed that they knew the equivalents, but—ironically— they either gave wrong equivalents or gave other loanwords to the ones of the question. For instance, one has given "gentle" to be an Arabic equivalent for the word "check," which is both incorrect and not Arabic.[9]

In the question that asks about if the participants are aware of the role of the AAL, only twelve said "yes" and 35 were not aware of it, and even didn't know what it was. From the twelve, ten said it was ineffective, and two provided excuses for it. As I hypothesized in the beginning of this study, AAL was issued by law but never empowered by it, which lessens its role and effect in the Egyptian society. Also, I think the AAL is ineffective not only because of the law but also because of the speed of technology devices that appear, and the connection between the east and west through the internet doesn't allow any time for the ALL to spread the Arabic equivalents. By the time of writing this paper, a new word appeared which is called "hashtag" used on Facebook and Twitter for the presidential elections candidates. This word was unknown to me and millions of other Egyptians two months ago or so.

Compliance with Ethical Standards

The author declares that he has no conflict of interest.

Appendix 1

A detailed analysis of the phonological and morphological change that occurred to the English loanwords when they ended up in the Egyptian variety of Arabic.

a) The Technology and industry-related words:

	The word	Phonological Change	Morphological change
1.	Telephone	None	The morpheme [aat] is added to the end of the word to form the plural, and the morpheme [ein] is added to form the dual.
2.	Television	/y/ becomes /ziou/	Same like number one
3.	Video	/v/ becomes /f/	[haat] for plural, [hein] the dual
4.	Cable	/e/ becomes /ei/	Same like number one
5.	Radio	/ei/ becomes /ei/	[haat] for plural, [hein] the dual
6.	Camera	There's a long /i/ between /m/ and /r/.	Same like number one, except [tein] for the dual.
7.	Technology	An /ei/ is added at the end	N/A
8.	Email	None	Same like number one
9.	Website	None	Same like number one
10.	Internet	None	N/A
11.	Computer	/p/ becomes /b/	Same like number one
12.	Software	None	N/A
13.	Hardware	None	N/A
14.	CD	None	[haat] for the plural, [bein] for the dual
15.	DVD	None	[haat] for the plural, [bein] for the dual
16.	Virus	/f/ for /v/ and /u/ for /y/	Like # one, usually no dual
17.	Wifi	None	N/A
18.	Remote	/r/ is rolled (the tip of the long rolls ups and downs)	Same like number one
19.	Receiver	/r/ is rolled	Same like number one
20.	Motorcycle	/r/ is totally omitted, and the vowel /ai/ becomes /e/	Same like number one
21.	Metro	/r/ is rolled	N/A
22.	Laser	None	Same like number one
23.	Motherboard	The fricative /δ/ becomes /z/, and the /r/ gets rolled.	[aat] for the plural, [tein] for the dual
24.	Ram	/r/ is rolled	[aat] for the plural, [tein] for the dual
25.	Processor	/b/ for /p/ and the /r/is rolled	Same like number one
26.	Keyboard	None	Same like number one
27.	Mouse	None	Same like number one
28.	Mobile (cell phone)	None	Same like number one
29.	Electronics	*Electronyiaat* is how it's uttered	[aat] for plural, no dual
30.	Beach buggy	None	Same like number one
31.	Cassette	/e/ becomes /i/	Same like number one
32.	Answer machine	None	like # one, only the 2nd word
33.	Mini bus	/i/ becomes /ei/ in bus	Same like number one
34.	Micro bus	/u/ becomes /ou/ in bus	Same like number one
35.	Battery	An /ei/ is added at the end	[aat] for the plural, [tein] for the dual
36.	Download	/ou/ becomes /u/	N/A
37.	Taxi	None	*Takkasi* as plural, the ending morpheme [ein] for the dual
38.	Router	None	Same like number one
39.	Code	/ou/ becomes /u/	Same like number one

[9] He thought the word "check" meant stylish from the French loanword "très chic"

40.	Password	/t/ becomes /oo/	Same like number one
41.	Microphone	/ai/ becomes /c/	Same like number one
42.	Microwave	None	Usually N/A[10]
43.	Film	None	*Afflam* is the plural, the ending morpheme [cin] for the dual
44.	Icon	An /iz/ is added at the end	[aat] for the plural, [tein] for the dual
45.	Flash	None for some people, some others add /az/ added at the end	[aat] for the plural, [tein] for the dual
46.	Missed call	/s/ becomes /z/	N/A
47.	Asphalt	None	N/A
48.	Radar	/a/ becomes /az/ and /r/ is rolled	Same like number one
49.	Cement	/az/ is added to the beginning, and the /t/ is omitted.	N/A
50.	Supermarket	/p/ becomes /b/	Same like number one
51.	Ceramic used as n.	Short /t/ becomes long /i/	N/A
52.	Gas	/s/ becomes /z/	N/A
53.	Bank	None	Benouk
54.	Academy	An /az/ is added at the end	[aat] for plural, [tein] the dual
55.	Link	None	Same like number one
56.	Saloon	None	Same like number one
57.	Data	/ei/ becomes /ae/	N/A
58.	Cafeteria	None	[aat] for plural, [tein] the dual
59.	Model	/o/ becomes /i/	Same like number one
60.	Gym	None	Same like number one
61.	Medal	/ia/ and /az/ is added at the end	[aat] for plural, [tein] the dual
62.	Geology	/az/ is added at the end	N/A
63.	graphics	None	N/A
64.	scanner	/r/ is rolled	Same like number one

b) Cloths-related words

The word		Phonological Change	Morphological change
65.	T-shirt	None	Same like number one
66.	pants	/b/ for /p/ and /s/ omitted, *bantaloon* is how it's uttered	Same like number one
67.	jacket	None	Same like number one
68.	makeup	/b/ for /p/	N/A
69.	cap/ ice cap	/b/ for /p/	Same like number one
70.	sandals	/s/ is omitted	Same like number one
71.	boot	None	Same like number one
72.	shorts	/s/ is omitted	Same like number one
73.	top (bra)	None	Same like number one
74.	under (wear)	None	Same like number one
75.	style	None	Same like number one
76.	body	None	Same like number one
77.	badge	None	Same like number one
78.	boxer (wear)	/r/ is rolled	Same like number one

c) Medicine-related words

The word		Phonological Change	Morphological change
79.	Influenza	None	N/A
80.	Cancer	None	N/A
81.	Hysteria	None	N/A
82.	schizophrenia	1st syllable reads /sjizu/	N/A
83.	doctor	/o/ is replaced by /oo/	*Dakkatra* is plural, the ending morpheme [cin] for the dual
84.	Psychology	None	N/A
85.	Biology	None	N/A
86.	Aspirin	/i/ for /ei/, /n/ for /p/, /r/ rolled	N/A
87.	shampoo	/o/ for /u/, /b/ for /p/	[haat] for plural, usually no dual
88.	diet	None	N/A
89.	regime (diet)	None	[aat] for plural, usually no dual

d) Home-related words

The word		Phonological Change	Morphological change
90.	Sandwich	/az/ is added after the /d/	Same like number one
91.	Parking	/n/ for /p/ and /r/ is rolled.	N/A
92.	Ketchup	None	N/A
93.	Mayonnaise	None	N/A
94.	Perfume	*barfan* is how it's uttered	Same like number one
95.	Toilet	None	Like #1, usually no dual
96.	Chips	/jj/ for /tf/, /b/ for /p/, sometimes the long /i/ is added to the end	Like #1 with no dual form, and some people don't pluralize it.
97.	Biscuit	*Baskaweet* I how it's uttered	Like #1 with no dual form, and some people don't pluralize it.
98.	Ice cream	/r/ is rolled	Like #1, usually no dual form
99.	Cake	None, some add /ezh/ to the end	[aat] for plural, [tein] the dual.
100.	Freezer	/ei/ for /i/, /r/ is rolled	Same like number one
101.	Macaroni	/az/ for /i/, r is rolled	Usually N/A
102.	Chocolate	/j/ for /tf/, /azh/ to the end	Usually N/A
103.	design	None	Same like number one
104.	décor	/r/ is rolled	Same like number one
105.	burger	Usually none	N/A
106.	roof	None	N/A
107.	villa	/f/ for /v/ for some people	[aat] for plural, [tein] the dual.
108.	garage	Some ppls. /j/ for /dz/, /r/ rolled	Same like number one
109.	cream	/i/ becomes /ei/	Like #1, usually no dual form
110.	lamb	/azh/ is added to the end	[aat] for plural, [tein] the dual.
111.	Sticker	/r/ is rolled	Same like number one
112.	Zero	/r/ is rolled	Usually N/A
113.	List	/azh/ is added to the end	[aat] for plural, [tein] the dual.
114.	Liter	Long /i/ becomes short /e/	Same like number one
115.	Kilo	/s/ becomes /i/	Same like number one

[10] When I say "usually" with *none* or *N/A*, it means that some people may pluralize it like number one, but it is very uncommon usage.

e) Media-related words

The word		Phonological Change	Morphological change
116.	Studio	None	[haat] for plural, [hein] for dual.
117.	Comedy	None	N/A
118.	Tragedy	/r/ is rolled	N/A
119.	drama	/r/ I rolled	N/A
120.	folklore	None	N/A
121.	program	*Bernameg* is how it is uttered	*Barameg* is plural, and [cin] dual
122.	caricature	/t/ for /tf/, /r/ is rolled	Usually N/A
123.	cartoon	/r/ is rolled	*Karateen* is pl. [tein] or [cin] du.
124.	Coupon	/a/ becomes /oo/, /n/ for /p/	Same like number one
125.	album	/a/ becomes /oo/	Same like number one

f) Sports-related words

The word		Phonological Change	Morphological change
126.	Captain (coach)	/b/ for /p/	*cabtain* is plural, and [cin] dual
127.	match	/t/ becomes /tf/	*Mutusha* is plural, and [cin] dual
128.	Coach	/oo/ becomes /o/	Usually N/A
129.	ultras	None	N/A
130.	Karate	/i/ becomes /ei/	
131.	Shoot	None	N/A
132.	Sports	/b/ for /p/	N/A
133.	tennis	None	N/A
134.	Squash	None	N/A
135.	Stadium	[um] is not pronounced	Usually N/A
136.	Goal	Some /n/ for /l/	*Agwan* is plural, and [cin] dual
137.	game	None	Usually N/A

g) Politics-related words

The word		Phonological Change	Morphological change
138.	Protocol	/b/ for /p/	Same like number one
139.	Police	/b/ for /p/	N/A
140.	Strategy	/azh/ is added to the end	[aat] for plural, [tein] the dual
141.	democracy	*Demokratiah* is how it's uttered	N/A
142.	Beaurucracy	*Biocratiah* is how it's uttered	N/A
143.	dictator	/ae/ for /ei/,/oo/ for /o/, /r/ rolled	[rein]/ [reoun] pl, [eiyin] dual
144.	agenda	None	[aat] for plural, [tein] the dual
145.	Atlas	None	N/A
146.	Port	/b/ for /p/, and /l/ is omitted	N/A
147.	Course	None	Same like number one
148.	Section	None	Sakation is plural, and [cin] dual
149.	Check	/jj/ for /tf/, /i/ or /e/	Same like number one
150.	visa	/f/ for /v/, /z/ for /s/	*Fiyaz* plural, [tein] the dual.
151.	Desk	None	Same like number one
152.	Application	/b/ for /p/	Same like number one

h) People and relations-related words

The word		Phonological Change	Morphological change
153.	Etiquette	None	N/A
154.	Bye	None	N/A
155.	Madam	/o/ becomes /a/	[aat] for plural, [tein] the dual.
156.	Prestige	/b/ for /p/, /r/ is rolled	N/A
157.	Mr.	/r/ is rolled	Same like number one
158.	Miss	Some ppl short /i/ for long /i/	[aat] for plural, usually no dual
159.	Mercy	Stress is on the 2nd syllable	N/A
160.	Brave	/r/ is rolled	N/A
161.	Papa	/b/ for /p/	N/A[11]
162.	Mama	None	N/A
163.	Aunt	/t/ for /ae/	N/A
164.	Uncle	/u/ for /a/	N/A
165.	Charisma	/ae/ For /o/	N/A
166.	Millionaire	None	Same like number one
167.	Business	None	N/A
168.	Mechanic	/i/ for /i/, /kit/ is added the end	[iyah], [rein]/ [reoun] pl, [eiyin] dual
169.	Sex[12]	None	N/A
170.	Card	/r/ is rolled, /t/ for /d/	*Kroot* is pl., [tein] dual
171.	Sister	None	Usually N/A
172.	Group	/r/ is rolled, /b/ for /p/	Same like number one
173.	Prince	/b/ for /p/, /r/ is rolled	N/A
174.	Baby	None	[haat] plural, [hein] dual
175.	Interview	/r/ is rolled, some ppl. /i/ for /e/	[haat] plural, [hein] dual
176.	Secretary	*Sekertera* fem., *sekerteer* mal.	[raat] fem. Pl., [tein] fem., dual [ein], usually no male pl. or du.
177.	Professor	/ o/ becomes /oo/, /r/ is rolled	Same like #1 for male & female
178.	Mode	/ ao/ becomes /u/	N/A
179.	Routine	/r/ is rolled	N/A
180.	million	/ o/ becomes /oo/	*Malayeen* is plural, [ein] dual
181.	meter	/i/ is omitted, /r/ is rolled	*Amtaar* is plural, [ein] dual
182.	centimeter	/i/ is omitted, /r/ is rolled	Same like number one
183.	note	/az/ is added at the end	Same like number one
184.	chef	/e/ becomes /i/	Same like number one

i) Verbs

The word		Phonological Change	Morphological change
185.	cancel	None	These five verbs (cancel, finish, chat, save, share) are fully conjugated the same way original Arabic verbs are in the Egyptian Variety of Arabic.
186.	finish	None	
187.	chat	/j/ for /tf/	
188.	save	None, some ppl. /i/ for /v/	
189.	share	/r/ is rolled	
190.	stop	/b/ for /p/	These four verbs (stop, like, post, relax) aren't conjugated, and are just used as they are.
191.	like	None	
192.	post	/b/ for /p/	
193.	relax	None	

j) Adverbs

The word		Phonological Change	Morphological change
194.	Out	None	N/A
195.	Offside	/f/ for /d/,	N/A
196.	OK	None	N/A

[11] The plural goes with Arabic word for papa and mama "Abb" as "Abbaa," and "Um" as "Umahat."

[12] This word is used as a taboo word, usually, to refer to bad movies on the internet.

197.	Over	/t/ is rolled	N/A
198.	Already	/t/ is rolled	N/A

k) Adjectives

The word		Phonological Change	Morphological change
199.	Automatic	/a/ for /æ/	N/A
200.	Online	The /n/ is omitted	N/A
201.	Modern	Stress is on the second syllable	N/A
202.	X-large	None	N/A
203.	Jumbo	/ou/ becomes /u/	N/A
204.	fresh	/r/ is rolled	N/A

1. Match,
2. Computer,
3. Radio,
4. Camera,
5. Comedy,
6. Sandwich,
7. captain,
8. film,
9. protocol,
10. mechanic,
11. jacket
13. technology

*Give Arabic equivalent for the following words:*Course

14. Academy
15. Freezer
16. Ice Cream
17. Check
18. Application
19. Sandwich
20. Etiquette
21. Internet
22. Comedy
23. Camera
24. Classic

برتوكول
ميكانيكي
جاكيت
تكنولوجيا
كوميدي
فيلم
ساندويتش
كابتن
ماتش(كوره)
كمبيوتر
راديو
كاميرا

س2: ماهو المقابل العربي للكلمات التالية:

انترنت
كوميدي
كاميرا
كلاسيكي
شيك
اباليكيشن
ساندويتش

205.	classic	*Classiky* is how it is uttered	Like #1, usually no dual form
206.	Original	/t/ is rolled	N/A
207.	Sorry	/t/ is rolled	N/A
208.	Used	/d/ for /t/	N/A
209.	Logistic	None	N/A
210.	Pragmatic	None	N/A

APPENDIX 2

Survey Questionnaires

1) Circle the words that you think is from English:

2)

a) Are you aware of the role of the Academy of Arabic Language? Yes..... No .....

b) Is it effective in the way that it can convince people to use the words it forms instead of the borrowed ones?

……
……
……

3) What are the social factors, in your point of view, that participated into the appearance of this big number of English loanwords and the lack of using Arabic equivalents?

……
……
……
……
……
……

الاسم: .....

الجنس: .....

العمر: .....

مستوى التعليم: .....

س1: ميز الكلمات غير العربية مما يلي: (ضع دائرة حول الكلمات الغير عربية)

اتيكيت
كورس
أكاديمية
فريزر
ايس كريم

س3: هل أنت على علم بدور مجمع اللغة العربية في تنقية الكلمات الدخيلة على اللغة العربية؟ هل المجمع مقصر؟

.....
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.....

س4: برأيك ما هي الأسباب أو العوامل التي أدت إلى دخول هذه الكلمات الى اللغة. مثال للأسباب (ضعف اقتصاد وسياسة العرب, عدم وجود مخترعات عربية, تفكك العرب, أن المدارس ومواردها لا تزرع حب اللغة العربية في التلاميذ, أم هل اللغة العربية ضعيفة ..الخ)

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Enhanced Bioproduction of Moscatilin in Dendrobium ovatum through Hairy Root Culture

Ipsita Pujari, Abitha Thomas, Vidhu S. Babu, K. Satyamoorthy

Abstract–Orchids are esteemed as celebrities in cut flower industry globally, due to their long-lasting fragrance and freshness. Apart from splendor, the unique metabolites endowed with pharmaceutical potency have made them one of the most hunted in plant kingdom. This had led to their trafficking, resulting in habitat loss, subsequently making them occupiers of IUCN red list as RET species. Many of the orchids especially wild varieties still remain undiscovered. In view to protect and conserve the wild germplasm, researchers have been inventing novel micropropagation protocols; thereby conserving Orchids. India is overflowing with exclusive wild cultivars of Orchids, whose pharmaceutical properties remain untapped and are not marketed owing to relatively small flowers. However, their germplasm is quite pertinent to be preserved for making unusual hybrids. Dendrobium genus is the second largest among Orchids exists in India and has highest demand attributable to enduring cut flowers and significant therapeutic uses in traditional medicinal system. Though the genus is quite endemic in Western Ghat regions of the country, many species are still anonymous with their unknown curative properties. A standard breeding cycle in Orchids usually takes five to seven years (Dendrobium hybrids taking a long juvenile phase of two to five years reaching maturity and flowering stage) and this extensive life cycle has always hindered the development of Dendrobium breeding. Dendrobium is reported with essential therapeutic plant biochemicals and 'Moscatilin' is one, found exclusive to this famous Dendrobium genus. Moscatilin is reported to have anti-mutagenic and anti-cancer properties, whose positive action has very recently been demonstrated against a range of cancers. Our preliminary study here established a simple and economic small-scale propagation protocol of Dendrobium ovatum describing in vitro production of Moscatilin. Subsequently for enhancing the content of Moscatilin, an efficient experimental related to the organization of transgenic (hairy) D. ovatum root cultures through infection of Agrobacterium rhizogenes 2364 strain on MS basal medium is being reported in the present study. Hairy roots generated on almost half of the explants used (spherules, in vitro plantlets and calli) maintained through suspension cultures, after 8 weeks of co-cultivation with Agrobacterium rhizogenes. GFP assay performed with isolated hairy roots has confirmed the integrative transformation which was further positively confirmed by PCR using rolB gene specific primers. Reverse phase-high performance liquid chromatography and mass spectrometry techniques were used for quantification and accurate identification of Moscatilin respectively from transgenic systems. A noticeable ~3 fold increase in contents were observed in transformed D. ovatum root cultures as compared to the simple in vitro culture, callus culture and callus regeneration plantlets. Role of elicitors e.g., Methyl jasmonate, Salicylic acid, Yeast extract and Chitosan were tested for elevating the Moscatilin content to obtain a comprehensive optimized protocol facilitating the in vitro production of valuable Moscatilin with larger yield. This study would provide evidence towards the in vitro assembly of Moscatilin within a short time-period through not a so-expensive technology for the first time. It also serves as an appropriate basis for bioreactor scale-up resulting in commercial bioproduction of Moscatilin.

Keywords—bioproduction, Dendrobium ovatum, hairy root culture, moscatilin

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Enhancing the Safety Climate and Reducing Violence against Staff in Closed Hospital Wards

Valerie Isaak

Abstract—This study examines the effectiveness of an intervention program aimed at enhancing a unit-level safety climate as a way to minimize the risk of employees being injured by patient violence. The intervention program conducted in maximum security units in one of the psychiatric hospitals in Israel included a three day workshop. Safety climate was examined before and after the implementation of the intervention. We also collected data regarding incidents involving patient violence. Six months after the intervention a significant improvement in employees' perceptions regarding management's commitment to safety were found as well as a marginally significant improvement in communication concerning safety issues. Our research shows that an intervention program aimed at enhancing a safety climate is associated with a decrease in the number of aggressive incidents. We conclude that such an intervention program is likely to return the sense of safety and reduce the scope of violence.

Keywords—violence, intervention, safety climate, performance, public sector

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Environmental Efficacy on *Heracleum persicum* Essential Oils

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Abstract—Essential oils of *Heracleum persicum* (Apiaceae) have been widely used from many years ago, but the difference of its properties among different populations have not been identified up to now. Hydrodistillation Clevenger type was used to obtaining the fruit essential oils of four populations of *H. persicum* from different localities in Iran, then they were characterized by GC-FID and GC-MS analyses. Some ecological factors were also measured. The oils of four populations were compared to determine the similarities and differences and the relationships between these factors and ecological factors. Based on the result, 18-32 different components were identified in four populations, while the percentage of the main components was higher in population with lower number of components. According to the statistical analyses of chemical components and ecological factors, it can be concluded that some ecological factors such as altitude, less humidity, high difference between day and night temperature and salty soil would lead to lower number of components in essential oil, whereas they consist the higher percentage.

Keywords—Chemotaxonomy, Persian hogweed, ecological factors, Apiaceae.

I. Introduction

ESSENTIAL oils (volatile or ethereal oils) have long been used due to their importance in medical and food industries [1]. Despite their act as attracting or repelling agents to insects and defense material against some environmental factors such as heat or cold, the role of essential oils in plants are not completely known yet [2]. Essential oils can be found in special secretory structures in 10% of the plant kingdom. Some factors such as physiological differences, environmental conditions, geographic dissimilarities, genetic factors and evolution, political/social conditions and amount of plant material/space influence chemical variability and yield for each species [3]. So similar essential oils with different chemical composition can be achieved from the same plant species that reminds us the concept of chemotypes [1]. In other words chemotaxonomy helps us in selection of commercially valuable chemotypes [4].

The genus *Heracleum* L. with more than 100 species is considered as one of the widespread members of the Apiaceae family (Umbellifera). Eight species of this genus are distributed in Iran, often growing along the riversides and humid mountain regions [5]-[7]. *Heracleum persicum* Desf. ex Fischer is a polycarpic, perennial herb with the height of 150 to 200 cm, with numerous hairy hollow stems, up to 50 mm thick and red brown at the base. The sheathing leaves are alternate and pinnate with 5-6 leaflets. There are 5 white petals, 5 minute sepals and 5 stamens in each flower. Fruits are schizocarp, broadly obovate with 9-12 mm long and clavate oil ducts [8]-[10].

The fruits of *H. persicum* are widely used as flavoring ingredient. They have also been widely used in traditional and folk medicine of Iran (carminative, antiseptic, anthelminthic, diuretic, digestive, tonic, aphrodisiac and analgesic agent) [5], [6], [11].

Heracleum species are known as aromatic and rich source of essential oils since many years ago [12]. Different reports showed that the essential oils exist in different parts of *Heracleum* species [5], [6], [11]-[20]. Different pharmacological activities such as anti-inflammatory, analgesic [21], antioxidant [14], [20], [22], anticonvulsant [23], antitumor [22], cytotoxic [7], [24], [25], immunomodulatory effects, antimicrobial and antifungal activities [6], [12], [14], [17], [26], antidermatophytic [11], contraceptive [27] and adjunctive treatment for patients with hypertriglyceridemia [28] have been reported for different species of *Heracleum*. In addition, their essential oils have showed insecticidal activity [29] and enhancing broiler performance [30]. The chemical composition of essential oils from different parts of *Heracleum* species mainly consists of monoterpenes, oxygenated monoterpens, sesqiterpenes, and aliphatic esters [5], [11], [18]. Coumarins, furanocoumarins, anthraquinones, stilbenes, furanocoumarin dimers, flavonoids and the other kinds of metabolites have been isolated and identified from different species of this genus [12].

In order to evaluate whether different conditions (environmental and edaphic factors) would change the quality and quantity of oil yield, we analyzed essential oils isolated from the ripen fruits of *Heracleum persicum* growing wild in four different parts of Iran. Beside this, some morphometrical characters of fruits and soil characteristics were analyzed in order to find any possible relationships between different factors.

II. Material and Methods

A. Essential Oils' Analyses

1. Plant Material

The fruits of four populations of *Heracleum persicum* Desf. Ex Fischer were collected from their natural habitats in different parts of Iran, during July and August of 2014. Voucher specimens have been deposited at Islamic Azad University Herbarium (IAUH), Tehran (Table I).

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TABLE I
Sample Number, Geographical Location and Voucher Number of Four Investigated Populations of *Heracleum persicum*

Sample	Species	Collection Site	Province	Latitude (N)	Longitude (E)	Altitude (m.a.s.l.)	Voucher number [a]
P1	*H. persicum*	Bardsir- Lalehzar	Kerman	29°30'49.8''	056°41'06.5''	2879 m	IAUH-000014879
P2	*H. persicum*	Mashhad- Zoshk	Razavi Khorasan	36°19'28.3''	059°10'59.2''	1770 m	IAUH-000014880
P3	*H. persicum*	Hamedan- DarehMoradBeik	Hamedan	34°44'53.8''	048°30'25.1''	2027 m	IAUH-000014881
P4	*H. persicum*	Ramsar- JavaherDeh	Mazandaran	36° 51' 20''	050° 28' 28''	1800 m	IAUH-000014882

a. Voucher Nos. of samples deposited with Avicenna Herbarium of Islamic Azad University of Tehran (IAUH).

2. Isolation of Essential Oils

Clevenger-type apparatus was used to obtain the essential oils from the air dried fruits by hydrodistillation for 3 h. The pale yellow essential oils were mixed with hexane, dried by adding anhydrous Na_2SO_4, and then stored in sealed dark vials at 4-5°C until GC analyzing. The percentage of essential oils yields were calculated as w/w.

3. GC Analysis

The GC analyses were carried out using a Shimadzu 15A gas chromatography with a split/splitless injector (250°C) and a flame ionization detector (250°C). The type of the column was DB-5 capillary (30 m × 0.25 mm, film thickness 0.32 μm) with N_2 (1 mL/min) as carrier gas. The oven temperature was programed at 60°C for 3 min, then rising to 250°C with a 6°C/min rate and finally held constant at 250°C for 5 min. For qualification purpose, the relative contents of the essential-oil constituents being calculated based on their peak areas in the GC-FID profiles without using of internal standards or correction factors, expressed as percentage.

4. GC/MS Analysis

The GC/MS analyses were performed using Hewlett-Packard (HP-6890/5973) GC-MS system coupled with an HP-5MS column (30 m × 0.25 mm, film thickness 0.32 μm). The column temperature was the same as described above (cf. GC analysis). Helium (1 ml/min) was used as carrier gas with 70 eV ionization energy in MS, 40-300 amu mass range and 1 s scan time. The percentage of essential oil components was calculated from GC pack areas without correction factors. The identification of the individual compounds was based on the comparison of their mass spectra, retention times and indexes with corresponding data in the literature [31] and websites [9], [32], [33]. Retention indexes were determined by retention times for n-alkanes being injected with the same chromatographic condition.

B. Soil Analysis

Soil samples were taken from the base of the plants at 20 cm depth in all localities and the samples were carried to the laboratory for more analyses. Physical analysis of the soil sample to determine the soil texture was performed by bouyoucos hydrometer method [34]. Likewise chemical analysis was carried out to determine the acidity rate (in saturation extract examined by pH meter) [35] and EC (by electrical conductivity meter) [36]. Moreover, organic carbon (OC) (modified Walkley and Black method, [37]), some cations such as Ca^{2+}, K^+ and Na^+ (Atomic absorption spectroscopy (AAS)) [36], Cl^- anion (ion chromatography) [38], $CaCO_3$ (Calcimeter Bernard method) [37], phosphor (Olsen method) [39], and available nitrogen (Kjeldahl method) [40] were analyzed.

C. Fruits' Morphological Analysis

For morphological survey, following morphological data were measured: height and basal diameter of five individuals in each population, and the length, width and weight of 10 fruits from five individuals in each population.

D. Statistical Analyses

SPSS v. 21 software (IBM Inc, Chicago, IL) was applied for statistical analysis. First of all, normality of data was analyzed by Kolmogorov–Smirnov test. In order to compare the means, ANOVA test and non-parametric Kruskal-Wallis test were performed for normal and non-normal data, respectively. Using the essential oil components as variables, the Ward method [5] with the standard Euclidean coefficient was used to do hierarchical cluster analysis (HCA). We used the same method for cluster analysis of populations using morphological. In order to find the relationship between different factors, bivariant analysis with Pearson and Spearman correlation coefficient were used.

III. Results

A. Characterization of Essential Oils

Table II represented the composition, their relative percentages and oil yields of the essential oils isolated from four populations of *H. persicum*. All examined essential oils with yellow color and a strong odor, exhibited a considerable variation both in the oil yields and their contents. The oil yields showed wide-ranging from 2.24 to 6.02% being recorded for Kerman and Hamedan, respectively. While those of the oils from Mashhad (3.26%) and Ramsar populations (3.40%) showed intermediate values.

An obvious variation was found in the number and the percentage of oil composition. According to Table II, the minimum and maximum number of oil components were related to the Kerman (18) and Ramsar (32) and these numbers were 30 and 31 for Hamedan and Mashhad, respectively.

Based on our results, 47 different compounds were identified by GC/MS in different populations (Table II). The essential oils were complex mixtures of alcohol (0-0.86%), aldehyde (0-1.72%), aliphatic esters (with the highest amount of 84.29-92.64%), monoterpene hydrocarbons (0-3.19%), oxygenated monoterpenes (0-3.39%), hydrocarbon (0-0.38%) and phenylpropanoids (0-3.18%). Hexyl butyrate with contents of 16.54% (Mashhad) – 26.41% (Kerman) and octyl

acetate with 16.09% (Hamedan) – 17.71% (Mashhad) were recognized as the two main oil components with equally high amounts in different populations of *H. persicum*. Hexyl 2-methyl butyrate (3.03% in Hamedan and 9.53% in Kerman) and N-Octyl 2-methyl butyrate (4.92% in Ramsar and 9.95% in Hamedan) showed the next higher amounts.

TABLE II
ESSENTIAL-OIL COMPOSITION AND YIELDS OF THE FRUITS OF FOUR INVESTIGATED POPULATIONS OF *H. PERSICUM*

Number	Compound Name	CAS#	KI	P1	P2	P3	P4
1	Octane	111-65-9	800	-	-	0.38	-
2	Isopropyl butyrate	638-11-9	844	-	-	0.57	-
3	Hexanol	111-27-3	870	-	-	-	0.86
4	Isopropyl-2-methyl butyrate	66576-71-4	885	1.15	3.5	1.05	4.43
5	Isopropyl 3-methyl butyrate	32665-23-9	904	1.38	4.22	1.69	2.92
6	Isobutyl isobutyrate	97-85-8	911	-	0.36	0.43	0.74
7	α-Pinene	90-56-8	939	-	-	-	0.42
8	Butyl isobutyrate	97-87-0	955	1.07	0.61	-	2.15
9	unknown			-	1.52	0.74	1.38
10	Butyl butyrate	109-21-7	994	-	-	1.61	1.67
11	*n*-Octanal	124-13-0	998	-	0.45	1.72	0.81
12	unknown			-	0.79	-	1.25
13	Isobutyl isovalerate	589-59-3	1004	-	-	-	0.48
14	Hexyl acetate	142-92-4	1009	1.31	1.09	1.68	2.57
15	Isopentyl isobutyrate	2050-01-3	1013	-	-	-	0.31
16	*p*-Cymene	99-87-6	1026	-	1.97	-	1.61
17	unknown			1.21	-	-	-
18	Butyl isovalerate	109-19-3	1047	-	0.67	-	2.49
19	unknown			0.77	0.58	-	1.82
20	Pentyl isobutyrate	2445-72-9	1055	-	-	-	0.62
21	γ-Terpinene	99-85-4	1059	-	3.19	0.83	2.24
22	Linalool	78_70_6	1096	3.39	-	1.61	-
23	Hexyl propanoate	2445-76-3	1101	-	1.13	-	0.53
24	2-Methyl butyl isovalerate	2445-77-4	1104	-	-	-	0.44
25	**Hexyl isobutyrate**	2349-07-7	1151	6.29	6.06	2.16	7.12
26	**Hexyl buyrate**	2639-63-6	1192	**26.41**	**16.54**	**21.77**	**19.56**
27	**Octenol acetate**	26806-12-2	1198	7.93	2.89	4.89	2.48
28	Decanal	112-31-2	1201	-	1.09	-	-
29	***n*-Octyl acetate**	112-14-1	1211	**16.93**	**17.71**	**16.09**	**16.43**
30	unknown			-	-	0.73	-
31	**Hexyl 2-methyl butyrate**	10032-15-2	1236	**9.53**	**8.58**	**3.03**	**8.46**
32	Hexyl isovalerate	10032-13-0	1244	-	-	0.81	-
33	*E*-Anethole	4180-23-8	1284	-	1.21	-	-
34	Octyl propionate	142-60-9	1302	-	0.36	1.16	-
35	unknown			-	0.54	-	0.43
36	**Octyl Isobutyrate**	109-15-9	1317	5.73	5.44	4.91	3.88
37	unknown			-	0.78	1.56	0.53
38	**Hexyl Hexanoate**	6378-65-0	1383	5.94	4.4	7.45	3.35
39	*n*-Octyl butyrate	110-39-4	1434	1.32	3.92	7.5	2.63
40	unknown			-	-	1.25	-
41	unknown			-	-	0.67	-
42	unknown			-	0.42	-	-
43	unknown			-	0.62	0.61	0.47
44	***N*-Octyl 2-methyl butyrate**	29811-50-5	1436	**7.65**	**6.81**	**9.95**	**4.92**
45	unknown			-	-	0.72	-
46	unknown			0.97	1.58	1.72	-
47	unknown			1.01	0.98	0.69	-
	Alcohol			-	-	-	0.86
	Aldehyde			-	1.54	1.72	0.81
	Aliphatic esters			92.64	84.29	86.75	88.18
	Monoterpene hydrocarbons			-	3.19	0.83	2.66
	Oxygenated monoterpenes			3.39	-	1.61	-
	Hydrocarbon			-	-	0.38	-
	Phenylpropanoids			-	3.18	-	1.61
	oil yield %			**2.24%**	**3.26%**	**6.02%**	**3.40%**
	The number of components in each population			18	31	30	32
	Total identified %			**97.25**	**92.19**	**91.31**	**94.14**
	The percentage of unknown components in each population			2.75	7.81	8.69	5.86

B. Properties of the Soil Analysis

Table III shows the results of soil analysis for four locations. Among these data EC (2.76 ms/cm in Kerman and 1.6 ms/cm in Ramsar), Na (14.7% in Kerman and 1.2% in Ramsar), Cl (18.9% in kerman and 8% in Ramsar) and $CaCO_3$ (14.6% in Kerman and 7.3% in Hamedan) showed the considerable variety.

TABLE III
SOIL ANALYSES RESULTS

Number	EC (ms/cm)	pH	Ca (meq/lit)	Na (meq/lit)	Cl (meq/lit)	CaCo3%	Sand %	Silt %	Clay %	Texture	OC %	N %	P (ppm)	K (ppm)
P1	2.76	7.77	5.1	14.7	18.9	14.6	53.2	30.1	16.7	Loam	0.13	0.019	4.51	191.7
P2	1.909	7.59	4.6	10.9	13.1	11.8	57.3	27.9	14.8	Sandy Loam	0.16	0.18	6.07	201.9
P3	1.614	7.19	2.8	7.3	12.8	7.3	45.9	32.3	21.8	Loam	0.31	0.039	8.34	231.7
P4	1.587	7.12	9.6	1.2	8	8.12	42.8	35.1	22.1	Loam	1.22	0.16	8.07	231.5

TABLE IV
THE MEAN AND STANDARD DEVIATION OF MORPHOLOGICAL DATA

Population	Height cm	Basal Diameter cm	Length mm	Width mm	Weight g
P1	183.0 ± 59.56^{b}	3.000 ± 0.96^{b}	12.2390 ± 1.13^{c}	7.2044 ± 0.68^{b}	$.027980 \pm 0.0064^{b}$
P2	204.0 ± 60.14^{c}	3.000 ± 1.11^{b}	9.3452 ± 1.2^{a}	6.7162 ± 0.75^{a}	$.020120 \pm 0.007^{a}$
P3	153.0 ± 16.16^{a}	1.740 ± 0.56^{a}	11.5280 ± 1.13^{b}	6.4970 ± 0.52^{a}	$.020800 \pm 0.0044^{a}$
P4	174.0 ± 21.29^{b}	3.400 ± 0.93^{c}	12.9722 ± 1.88^{d}	7.8248 ± 1.25^{c}	$.028920 \pm 0.012^{b}$

The descriptive statistics are presented in terms of the mean ± SD. Mean values with the same letters indicated homogeneous subsets for α=0.05 according to Duncan test

TABLE V
CORRELATION COEFFICIENT OF SOME ESSENTIAL OIL ELEMENTS WITH ECOLOGICAL FACTORS

Elements name Ecological factors	The number of components	Oil yield	Hexyl isobutyrate	Hexyl buyrate	Octenol acetate	n-Octyl acetate	Hexyl 2-methyl butyrate	Octyl isobutyrate	Hexyl hexanoate	N-Octyl 2-methyl butyrate
Altitude	-0.990**	-0.427**	0.057	0.935**	0.974**	-0.032	0.276**	0.604**	0.438**	0.293**
EC	-0.959**	-0.693**	0.318**	0.706**	0.841**	0.382**	0.569**	0.755**	0.184**	0.08
pH	-0.756**	-0.680**	0.314**	0.356**	0.617**	0.717**	0.589**	0.898**	0.096	0.074
Ca	0.217**	-0.466**	0.774**	-0.170*	-0.429**	-0.077	0.556**	-0.713**	-0.852**	-0.919**
Na	-0.765**	-0.386**	-0.041**	0.453**	0.739**	0.540**	0.266**	0.898**	0.436**	0.423**
Cl	-0.900**	-0.354**	-0.089**	0.692**	0.903**	0.303**	0.209**	0.916**	0.543**	0.479**
$CaCO_3$	-0.797**	-0.810**	0.480**	0.411**	0.615**	0.681**	0.724**	0.788**	-0.43	-0.095
OC	0.506**	0.015	0.380**	-0.257**	-0.582**	-0.451**	0.088	-0.961**	-0.629**	-0.673**
N	0.723**	-0.192**	0.516**	-0.906**	-0.898**	0.480**	0.346**	-0.427**	-0.841**	-0.723**
P	0.813**	0.787**	-0.445**	-0.434**	-0.641**	-0.664**	-0.697**	-0.808**	0.002	0.055
K	0.725**	0.743**	-0.405**	-0.306**	-0.558**	-0.761**	-0.663**	-0.854**	0.005	0.026

**Correlation is significant at the 0.01 level (2-tailed)
*Correlation is significant at the 0.05 level (2-tailed)

C. Fruits Morphometric Feature

Table IV demonstrates means and standard deviations of morphometric data. Based on Duncan test, Mashhad and Ramsar populations showed the lower and higher amounts, respectively.

D. Statistical Analyses

The dendrogram achieved from hierarchical cluster analysis (HCA) of the relative contents of the essential oils (Fig. 1) indicated that four populations of *H. persicum* were divided into two clusters; one including Kerman population and the other one divided to two clusters: Hamedan and Ramsar-Mashhad.

The dendrogram achieved from hierarchical cluster analysis (HCA) of the morphological data (Fig. 2) indicated that four populations of *H. persicum* were divided into two clusters; one including Mashhad population and the other one divided to two clusters: Hamedan and Ramsar-Kerman.

Interaction between altitude, the soil properties and the essence efficiency as correlation coefficient between them, were given in Table V. As it is observed, the number of components for essential oil in each populations were negatively correlated with altitude, EC, pH, Na, Cl and $CaCO_3$. Oil yield is negatively correlated with altitude, EC, pH, Ca, Na, Cl, $CaCO_3$ and N. The main components of the essential oil that are mentioned in Table V totally showed positive correlation with altitude, EC, pH, Na and Cl and negative correlation with Ca, P, K and N. Interaction between morphometrical data and some ecological factors are given in Table VI. Morphometrical data of the fruits showed positive correlation with altitude, Ca and OC. Table VII demonstrated the correlation coefficient of some essential oil with morphometrical elements. Oil yield showed negative correlation with width and weight of the fruits. The number of oil components showed negative correlation with length and weight of the fruits.

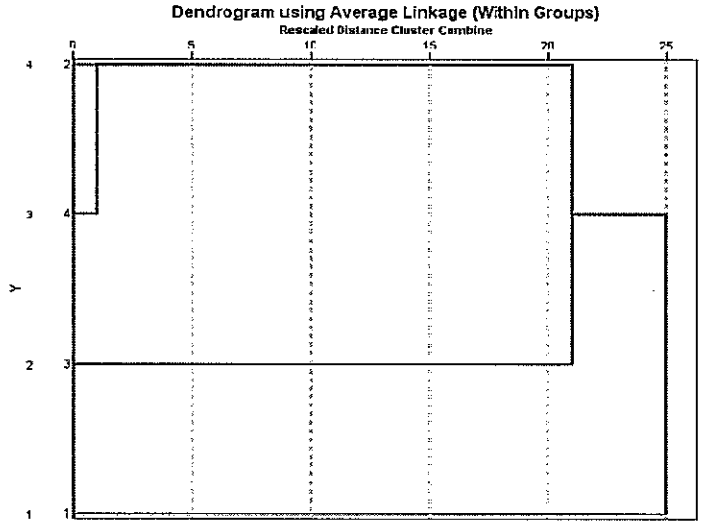

Fig. 1 Dendrogram achieved from hierarchical cluster analysis of the contents of the essential-oil components of the four populations of *H. persicum*, using average linkage between groups (rescales distance cluster combine)

TABLE VI
CORRELATION COEFFICIENT BETWEEN SOME MORPHOMETRICAL ELEMENTS AND ECOLOGICAL FACTORS

Elements name / Ecological factors	Height	Basal Diameter	Length	Width	Weight
Altitude	-0.020	-0.006	0.244**	0.021	0.192**
EC	0.142*	0.141**	0.039	0.023	0.155**
pH	0.254**	0.141**	-0.267**	-0.102	0.000
Ca	0.054	0.461**	0.396**	0.501**	0.341**
Na	0.161**	-0.061**	-0.298**	-0.248**	0.094
Cl	0.077	-0.093**	-0.109	-0.191**	-0.069
$CaCO_3$	0.258**	0.236**	-0.149*	0.011	0.094
OC	-0.103	0.249**	0.443**	0.412**	0.254**
N	0.218**	0.321**	-0.267**	0.147*	-0.055
P	-0.249**	-0.216**	0.150*	0.004	-0.087
K	-0.278**	-0.194**	0.263**	0.063	-0.020

**Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

TABLE VII
CORRELATION COEFFICIENT OF SOME ESSENTIAL OIL WITH MORPHOMETRICAL ELEMENTS

Elements / Ecological factors	Oil yield	number of components	Hexyl isobutyrate	Hexyl buyrate	Octenol acetate	Octyl acetate	Hexyl 2-methyl butyrate	Octyl isobutyrate	Hexyl hexanoate	N-Octyl methyl butyrate
Plant Height	-0.284**	-0.035	0.262**	-0.150*	-0.065	0.375**	0.301**	0.163*	-0.224**	-0.197**
Basal diameter	-0.493**	-0.046	0.568**	-0.094	-0.133	0.276**	0.529**	-0.111	-0.514**	-0.538**
Fruit Length	-0.048	-0.181*	0.114	0.417**	0.184**	-0.520**	0.024	-0.381**	-0.033	-0.153*
Fruit Width	-0.292**	-0.024	0.405**	0.055	-0.085	-0.074	0.317**	-0.309*	-0.378**	-0.437**
Fruit Weight	-0.260**	-0.185**	0.287**	0.225**	0.111	-0.116	0.251**	-0.158*	-0.186**	-0.261**

**Correlation is significant at the 0.01 level (2-tailed)
* Correlation is significant at the 0.05 level (2-tailed)

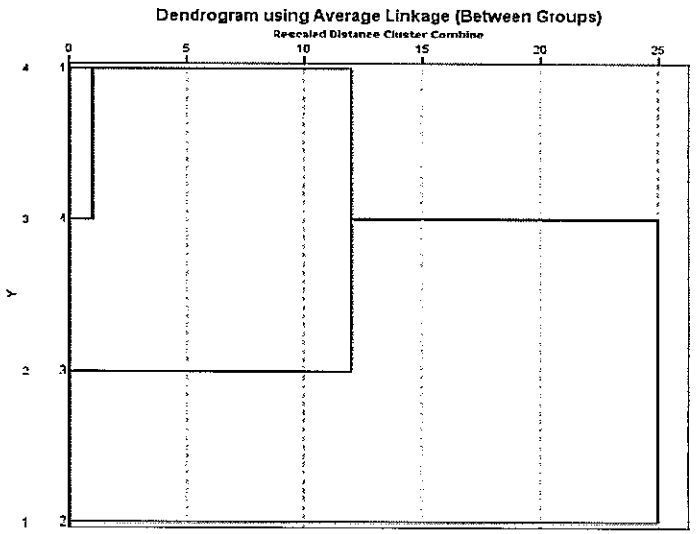

Fig. 2 Dendrogram achieved by hierarchical cluster analysis of the contents of the morphological data of the four populations of *H. persicum*, using average linkage between groups (rescales distance cluster combine)

IV. Discussion

In fact, an important part of this study is the variation of the oil yields and their contents within different populations. The range of oil yields of the fruits in this study was 2.24-6.02% that is consistent with the result of prior studies; 3.8% [5], 1.6-4.9% [18], 4 [21], 1.6 [29], 1.8 [22]. Based on Tables II, III, and V, oil yield showed higher amounts in low altitudes, with acidotic pH and low amounts of salts. Such a this result can be inferred from study of [18]; some locations such as Yazd showed low oil yield (2.2%), while Kelardasht showed the high one (3.5%) [18].

The second factor is the number of components in each population which was changed from 18 (Kerman) to 32 (Ramsar). Similar studies recorded the same results: 33 [5], 21-35 [18], 32 [7], [22], [29], 23 [21]. Based on [18], Yazd with the climate similar to Kerman in our study, showed the lowest number of components in that study (21), while Kelardasht with the climate similar to Ramsar in our study showed high number of components (32) [18].

The main part of the components are aliphatic esters; hexyl butyrate and octyl acetate are the components with the highest amounts in our study. It is proposed that co-occurrence of these two components is one character to determine *H. persicum* base on chemical composition [5], [18]. Octenol acetate, n-octyl acetate, hexyl-2-methyl butyrate, octyl isobutyrate, hexyl hexanoate and n-octyl-2-methyl butyrate showed the next high amounts. These results were in agreement with the previous reports [5], [7], [18], [21], [29].

Kerman population with the highest elevation, EC, pH and salt (Table III), having the lowest oil yield and number of components and higher amounts in main components (Table II), separated from other populations at the first based on dendrogram 1 (Fig. 1). At the second step, Hamedan population separated and Mashhad and Ramsar populations showed the most similarity in chemical composition. Kerman is located in the southern half of Iran with low precipitation, large difference in temperature in day and night and higher amount of salt in soil and is the first cluster separated from other populations; whereas three other populations are located in northern half of Iran with higher amount of precipitation, small day/night temperature difference lower amount of salt in soil and showed the high similarity in number of the components and their percentage.

Duncen test results approved the results of clustering analysis of morphometrical data; Ramsar and Mashhad populations are totally differentiated from each other. It should be mentioned that these results are not consistent with the essential oil clustering analysis. It can be concluded from Table VII that lower weight of the fruits, higher number of components and amount of oil yields.

V. Conclusion

Our findings in this study enable us to predict some essential oil properties of *Heracleum persicum* base on ecological factors. It can be inferred from above discussion that some ecological factors such as high altitude, low precipitation and salty soil would result in few components in essential oil, while the main components including the high percentage. However, more phytochemical studies with more samples and genetic investigation would help us to establish a strong relationship among these factors.

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Estimation of Nitrogen (NH_4^+) Using pH Sensitive Electrolyte Insulator Semiconductor Capacitor

Praveen Sahu, Enakshi Bhattacharya, Anju Chadha

***Abstract*—**The standard method of nitrogen (NH_4^+ form) estimation is the Kjeldahl method. Among the several steps in this method, nitrogen determination involves either titration (of excess acid), colorimetry using Nessler's reagent or the charge on NH_4^+ using an ion sensitive electrode. The present work reports an improved (faster and simpler) method of measuring NH_4^+ generated by Kjeldahl's method using pH sensitive Electrolyte Insulator Semiconductor Capacitor sensor (EISCAP) in the range 10 to 400 ppm.

***Keywords*—**EISCAP, Kjeldahl, nitrogen estimation, pH sensor.

I. Introduction

NITROGEN estimation is an important and routine practice in most of the biological and environmental research laboratories. Kjeldahl method is a universally recognized method for the estimation of nitrogen in various samples such as protein, soil, fertilizers, and waste water [1]. Digestion stage of this method consists of decomposing the organic substance by heating with sulphuric acid, reducing nitrogen to ammonium sulfate. Subsequently on distillation with sodium hydroxide, the ammonium salt converts to ammonia (NH_3) [2].The amount of ammonia present, and thus the amount of nitrogen present in the sample, needs to be further estimated by chemical analysis which is time-consuming and labor intensive[3]. Especially in the case of laboratory scale soil analysis due to the time consumed, fertilizer recommendations get delayed and farmers have to suffer.

In the present work, we attempt to provide a solution by adopting Electrolyte Insulator Semiconductor Capacitor (EISCAP) sensor to estimate NH_4^+ ion concentration based on the change in pH of boric acid in the determination stage. Figure.1 shows the complete process schematics and the use of EISCAP sensor in determination stage.

Estimation of a large number of samples can be made more efficient and cost effective by using EISCAP because of its quick response time.

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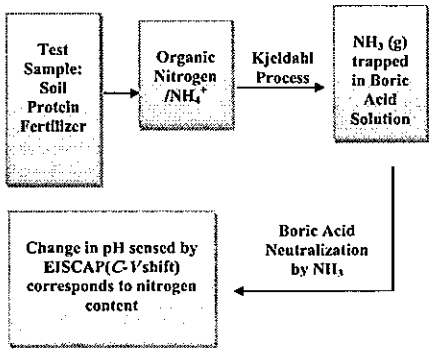

Fig.1 Process Schematics: Nitrogen estimation with EISCAP at determination stage.

II. Methodology

To study the response (*C-V* shift) of EISCAP, corresponding to the change in pH [4] of Boric acid we have used NH_4Cl as a standard solution containing desired ammonium ion. And it was subjected to Kjeldahl processes where finally total nitrogen content present in the sample was converted into adducts (ammonium borate salt) form.

pH of ammonium borate was measured using the digital pH meter and compared with the theoretically obtained pH values from the Henderson Hasselbalch equation [5] for weak acid (NH_3) and weak acid (H_3BO_3) interaction. The equation is given by:

$$p_{} = p_{} a + \log\left[\frac{[B^-]}{[H_{}]}\right] \quad (1)$$

Here, [HA] is molar concentration of acid; [B$^-$] is molar concentration of acid's conjugate base; K_a is the acid dissociation constant

Further, Nesslerization [6] of ammonium borate was used to obtain the amount of ammonium ion extracted from Kjeldahl. Finally, the calibration curve i.e. pH versus concentration of ammonium ion (NH_4^+) was obtained. The above calibration is used to correlate pH measured by EISCAP to concentration of ammonium ion (NH_4^+) as a single step determination method.

III. Results and Discussion

For experimental demonstration, EISCAPs were fabricated using conventional microfabrication techniques with Silicon Nitride (SiN) as a pH sensitive layer. The fabricated sensors were calibrated using different pH solutions (as shown in Fig.2).The pH sensitivity was found to be 55 mV/pH (as shown in Fig.3.)

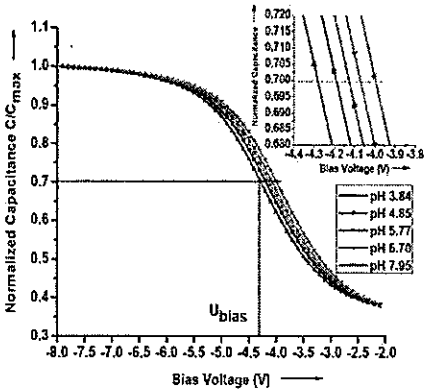

Fig. 2 Normalized *C-V* curves for solutions of different pH

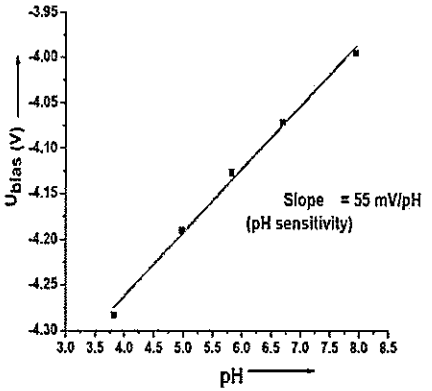

Fig. 3 U_{bias} Vs. pH; where U_{bias} is voltage at C/C_{max}=0.7

Different concentrations of NH_4Cl standard solution containing desired ammonium ion were prepared. This adduct solution was used as an electrolyte in the EISCAP. The shift in voltage at 70 % of maximum capacitance (U_{bias}) was used to estimate the amount of NH_4^+ present in the test sample.

A shift in Ubias towards right was observed with increase in pH which correlates to amount of NH_4^+ from 10 to 400 ppm and follows Henderson Hasselbalch equation. (Figure.4)

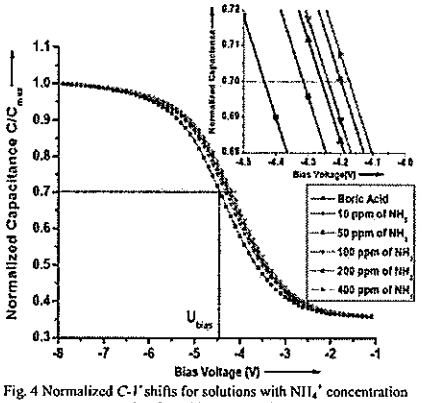

Fig. 4 Normalized *C-V* shifts for solutions with NH_4^+ concentration varying from 10 ppm to 400 ppm

IV. Conclusion

This simplified procedure estimates nitrogen in the range 10 to 400 ppm, thus indicating promising potential applications in the fields of agriculture, food and clinical diagnosis.

Acknowledgment

The authors would like to thank Interdisciplinary program, Center for NEMS and Nanophotonics (CNNP), IIT Madras and Department of Electronics & Information Technology (DeitY) for providing the necessary laboratory infrastructure.

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Ethanolamine Detection with Composite Films

S. A. Krutovertsev, A. E. Tarasova, L. S. Krutovertseva, O.M. Ivanova

***Abstract*—**The aim of the work was to get stable sensitive films with good sensitivity to ethanolamine (C_2H_7NO) in air. Ethanolamine is used as adsorbent in different processes of gas purification and separation. Besides it has wide industrial application. Chemical sensors of sorption type are widely used for gas analysis. Their behavior is determined by sensor characteristics of sensitive sorption layer. Forming conditions and characteristics of chemical gas sensors based on nanostructured modified silica films activated by different admixtures have been studied. As additives molybdenum containing polyoxometalates of the eighteen series were incorporated in silica films.

The method of hydrolythic polycondensation from tetraethyl orthosilicate solutions was used for forming such films in this work. The method's advantage is a possibility to introduce active additives directly into an initial solution. This method enables to obtain sensitive thin films with high specific surface at room temperature. Particular properties make polyoxometalates attractive as active additives for forming of gas-sensitive films. As catalyst of different redox processes, they can either accelerate the reaction of the matrix with analyzed gas or interact with it, and it results in changes of matrix's electrical properties

Polyoxometalates based films were deposited on the test structures manufactured by microelectronic planar technology with interdigitated electrodes. Modified silica films were deposited by a casting method from solutions based on tetraethyl orthosilicate and polyoxometalates. Polyoxometalates were directly incorporated into initial solutions. Composite nanostructured films were deposited by drop casting method on test structures with a pair of interdigital metal electrodes formed at their surface. The sensor's active area was 4.0 x 4.0 mm, and electrode gap was equal 0.08 mm. Morphology of the layers surface were studied with Solver-P47 scanning probe microscope (NT-MDT, Russia), the infrared spectra were investigated by a Bruker EQUINOX 55 (Germany). The conditions of film formation varied during the tests. Electrical parameters of the sensors were measured electronically in real-time mode.

Films had highly developed surface with value of 450 m^2/g and nanoscale pores. Thickness of them was 0,2-0,3 μm. The study shows that the conditions of the environment affect markedly the sensors characteristics, which can be improved by choosing of the right procedure of forming and processing. Addition of polyoxometalate into silica film resulted in stabilization of film mass and changed markedly of electrophysical characteristics. Availability of $Mn_3P_2Mo_{18}O_{62}$ into silica film resulted in good sensitivity and selectivity to ethanolamine. Sensitivity maximum was observed at weight content of doping additive in range of 30–50% in matrix.

With ethanolamine concentration changing from 0 to 100 ppm films' conductivity increased by 10-12 times. The increase of sensor's sensitivity was received owing to complexing reaction of tested substance with cationic part of polyoxometalate. This fact results in intramolecular redox reaction which sharply change electrophysical properties of polyoxometalate. This process is reversible and takes place at room temperature.

***Keywords*—** ethanolamine, gas analysis, polyoxometalate, silica film

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Ethnobotanical Study of Medicinal Plants Used by Indigenous People of Community Forest User Groups of Parbat District, Nepal

Gokul Gaudel, Zhang Wen Hui, Dang Quang Hung, Le Thi Hien, Liang Xiao

***Abstract*—The community forests of Nepal serve as a major source of medicinal plants for majority of local people who are dependent on traditional health care system. This study aims to explore the ethnobotanical information of the medicinal plants used by five different community forest user groups of Parbat district of Nepal. Research was conducted during different periods of the year 2015, using semi-structured, open-ended questionnaires, formal and informal interviews, and group discussions. In total 145 different plant species within 77 families were documented, majority of them being herb were found to be used to treat 84 different ailments. In terms of plant parts use: whole plants, barks, fruits, leaves were found to be in top priorities. Oral administration was the dominant route (57%), followed by both oral and dermal route (29%) and dermal only (14%). Females were found to have 24% more ethnobotanical knowledge than male. The knowledge of ethnobotanical medicinal plants was found excellent on age group 65-75. This study showed that community forests of Parbat district are rich in medicinal plants but the new generation were found less interested to use them. Easy access to modern medicines, lack of documentation and knowledge transfer to young generations are the major causes of diminishing utility of traditional medicinal practices.**

***Keywords*—Ailments, community forest, ethnobotany, medicinal plants, Parbat.**

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Evaluation of Alpha-glucosidase Inhibitory Effect of Two Plants from Brazilian Cerrado

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***Abstract*—Diabetes mellitus is a disease characterized by deficiency of insulin secretion and/or action which results in hyperglycemia. Nowadays, acarbose is a medicine used by diabetic people to inhibit alpha-glucosidases leading to the decreasing of post-feeding glycaemia, but with low effectiveness and many side effects. Medicinal plants have been used for the treatment of many diseases including diabetes and their action occurs through the modulation of insulin-depending processes, pancreas regeneration or inhibiting glucose absorption by the intestine. Previous studies in our laboratory showed that the treatment using two crude extracts of plants from Brazilian cerrado was able to decrease fasting blood glucose and improve glucose tolerance in streptozotocin-diabetic mice. Because of this and the importance of the search for new alternatives to decrease the hyperglycemia, we decided to evaluate the inhibitory action of two plants from Brazilian cerrado - B.H. and *Myrcia bella*. The enzymatic assay was performed in 50 µL of final volume using pancreatic α-amylase and maltase together with theirs commercial substrates. The inhibition potency (IC_{50}) was determined by the incubation of eight different concentrations of both extracts and the enzymes for 5 minutes at 37°C. After, the substrate was added to start the reaction. Glucosidases assay was evaluated measuring the quantity of p-nitrophenol in 405 nmin 384 wells automatic reader. The *in vitro* assay with the extracts of B.H. and *M. bella* showed an IC_{50} of 28,04µg/mL and 16,93 µg/mL for α-amilase, and 43,01µg/mL and 17 µg/mL for maltase, respectively. *M. bella* extract showed a higher inhibitory activity for those enzymes than B.H. extract. The crude extracts tested showed a higher inhibition rate to α-amylase, but were less effective against maltase in comparison to acarbose (IC_{50} 36µg/mL and 9 µg/mL, respectively). In conclusion, the crude extract of B.H. and *M. bella* showed a potent inhibitory effect against α-amylase and showed promising results to the possible development of new medicines to treat diabetes with less or even without side effects.**

***Keywords*—alfa-glucosidases, diabetes mellitus, glycaemia, medicinal plants.**

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Examining Ethiopian Banking Industry in Relation to Factors Affecting Profitability: From 2008 to 2012

Zelalem Zerihun

Abstract—In this study, attempts were made to assess the bank-specific, industry-specific, and macro-economic factors affecting bank profitability. Data were collected from ten commercial banks in Ethiopia, covering the period of 2008-2012. A mixed method research approach was adopted for this research. Documentary analysis and in-depth interview were also used to substantiate the data. The study found out that capital strength, income diversification, bank size and gross domestic product are statistically significant and they have a positive relationship with banks' profitability. However, operational efficiency and asset quality have a negative relationship with banks' profitability. The relationship for liquidity risk, concentration and inflation were found to be statistically insignificant. The study revealed that focusing and reengineering the banks in light of the key internal drivers could enhance the profitability as well as the performance of the commercial banks in Ethiopia. In addition to this, the study suggests that banks in Ethiopia should not only be concerned about internal structures but also they must consider both the internal environment and the macro-economic environment in designing strategies to improve their profit or their performance.

Keywords—Ethiopian banking industry, macro-economic factors, documentary analysis, capital strength, income diversification

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Examining the Effect of Online English Lessons on Nursery School Children

Hidehiro Endo, Taizo Shigemichi

Abstract—Introduction & Objectives: In 2008, the revised course of study for elementary schools was published by MEXT, and from the beginning of the academic year of 2011-2012, foreign language activities (English lessons) became mandatory for 5th and 6th graders in Japanese elementary schools. Foreign language activities are currently offered once a week for approximately 50 minutes by elementary school teachers, assistant language teachers who are native speakers of English, volunteers, among others, with the purpose of helping children become accustomed to functional English. However, the new policy has disclosed a myriad of issues in conducting foreign language activities since the majority of the current elementary school teachers has neither English teaching experience nor English proficiency. Nevertheless, converting foreign language activities into English, as a subject in Japanese elementary schools (for 5th and 6th graders) from 2020 is what MEXT currently envisages with the purpose of reforming English education in Japan. According to their new proposal, foreign language activities will be mandatory for 3rd and 4th graders from 2020. Consequently, gaining better access to English learning opportunities becomes one of the primary concerns even in early childhood education. Thus, in this project, we aim to explore some nursery schools' attempts at providing toddlers with online English lessons via Skype. The main purpose of this project is to look deeply into what roles online English lessons in the nursery schools play in guiding nursery school children to enjoy learning the English language as well as to acquire English communication skills. Research Methods: Setting; The main research site is a nursery school located in the northern part of Japan. The nursery school has been offering a 20-minute online English lesson via Skype twice a week to 7 toddlers since September 2015. The teacher of the online English lessons is a male person who lives in the Philippines. Fieldwork & Data; We have just begun collecting data by attending the Skype English lessons. Direct observations are the principal components of the fieldwork. By closely observing how the toddlers respond to what the teacher does via Skype, we examine what components stimulate the toddlers to pay attention to the English lessons. Preliminary Findings & Expected Outcomes: Although both data collection and analysis are ongoing, we found that the online English teacher remembers the first name of each toddler and calls them by their first name via Skype, a technique that is crucial in motivating the toddlers to actively participate in the lessons. In addition, when the teacher asks the toddlers the name of a plastic object such as grapes in English, the toddlers tend to respond to the teacher in Japanese. Accordingly, the effective use of Japanese in teaching English for nursery school children need to be furtherexamined. The anticipated results of this project are an increased recognition of the significance of creating English language learning opportunities for nursery school children and a significant contribution to the field of early childhood education.

Keywords—teaching children, English education, early childhood education, nursery school

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Expected Present Value of Losses in the Computation of Optimum Seismic Design Parameters

J. García-Pérez

***Abstract*—An approach to compute optimum seismic design parameters is presented. It is based on the optimization of the expected present value of the total cost, which includes the initial cost of structures as well as the cost due to earthquakes. Different types of seismicity models are considered, including one for characteristic earthquakes. Uncertainties are included in some variables to observe the influence on optimum values. Optimum seismic design coefficients are computed for three different structural types representing high, medium and low rise buildings, located near and far from the seismic sources. Ordinary and important structures are considered in the analysis. The results of optimum values show an important influence of seismicity models as well as of uncertainties on the variables.**

***Keywords*—Importance factors, optimum parameters, seismic losses, seismic risk, total cost.**

I. Introduction

THE optimum decision process for structural systems to be built on seismic sites can be made by selecting a combination of seismic design criteria, quality control, and repair and maintenance strategies leading to the minimum present value of the sum of the initial costs and those that may occur during the life cycle of the system. In the latter, those costs due to possible damage and failure as well as actions of repair and maintenance are included. If the relationship between utility for society and expected present value of its assets is taken as linear, a design will be approximately optimum when it minimizes the objective function given by initial cost and expected present value of the losses due to earthquakes [1], [2]. This approach does not take into account higher order statistical moments of monetary values, risk attitudes, and cognitive limitation of decision-makers. Furthermore, the economic model does not include the design cost as well as all studies required by this design. It is advisable to use a decision tree, which shows alternatively through branches, all the decisions that the designer can make and all the events that can occur [23]. This diagram allows for analyzing as a whole all possible solutions because probabilities and utilities can be set in the appropriate places [3]. Other decision rules can be used to identify the optimum seismic design such as the stochastic dominance, which includes the use of restrictions in the quality of social life, the socially tolerable risk, and attitudes toward risk of the decision-maker. The cumulative prospect theory developed by [4] includes several aspects of human cognitive process and risk perception in decision making. As long as these formulations are still at the research stage, the life cycle optimization described at the beginning of the paragraph is used here in order to find the optimum parameters.

This paper starts by describing three different seismicity models, including one for characteristic earthquakes, which are usually used to represent the occurrence of earthquakes. Because of the roles played by costs in the decision process, we then discuss initial costs as well as losses due to earthquakes. Then the effect on optimum values due to uncertainties in the parameters is examined. Different cases for optimum design coefficients are analyzed, and importance factors are computed for near-source sites as well as for those far from the seismic source.

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II. Seismicity

A. Local Seismicity, Poisson Process with Known Parameters

Seismic activity is usually well represented by curves like those shown in Fig. 1 where the exceedance rate, λ, is the number of earthquakes per unit volume and per unit time having magnitudes greater than M. Up to a few years ago, it was assumed that the magnitude-recurrence curve for a local seismic source had the shape of a straight line like curve A in Fig. 1, as a result of the analysis of observed data in the whole earth's crust or in large zones. Gutenberg and Richter [5] obtained expressions which results can be written as:

$$\lambda_G = \alpha_G e^{-\beta M} \tag{1}$$

where α_G and β are constants. On the other hand, according to Cornell and Vanmarcke [6] the exceedance rate of magnitudes of the earthquakes originated in a tectonic province can be taken as $\lambda_V = \lambda_0 (e^{-\beta M} - e^{-\beta M_m})/(e^{-\beta M_0} - e^{-\beta M_m})$, where λ_0, β, and M_m are unknown parameters, and M_0 is the magnitude above which the seismic catalogue is complete. This function can be conveniently expressed by:

$$\lambda_V = \begin{cases} \alpha_V (e^{-\beta M} - e^{-\beta M_m}) & if \quad M \le M_m \\ 0 & if \quad M > M_m \end{cases} \tag{2}$$

This curve is a straight line for small earthquakes, and as M increases, it turns concave downwards taking a value of zero for $M > M_m$, and accepts the fact that M_m is the maximum magnitude that can be generated in the corresponding seismic source (curve B in Fig. 1).

In the process of occurrence of earthquakes discussed above, a hypothesis is made that the probabilistic distribution of waiting times between seismic events, with magnitudes in a given interval, is of the exponential type. Thus, the number of events with magnitudes in this interval has a Poisson distribution, that is, the hazard does not change with the time elapsed without the occurrence of large earthquakes. However, certain discrepancies with this model have been recognized because statistical data show that in some regions, the relationship between frequency and magnitude of earthquake occurrence presents anomalies consisting of the lack of earthquakes of certain magnitudes compared to the worldwide average. That is, earthquake magnitudes are sometimes grouped within a narrow band of values, giving rise to the so-called characteristic earthquake [7], [8]. This is why it has been concluded that seismicity models should represent seismic activity as the superposition of two subprocesses (curve C in Fig. 1). In the first subprocess, events occur completely in a random manner, without it being possible to make some prediction either deterministic or semi-deterministic. In our case, this subprocess will be given by (2). The second subprocess consisting entirely of characteristic earthquakes, with large magnitude whose intervals between occurrences are less uncertain than those associated to the first subprocess, can be put in the form

$$\lambda_c = \begin{cases} s_c & if \quad M \le M_c \\ 0 & if \quad M > M_c \end{cases} \tag{3}$$

where s_c is a constant. Thus, the total local seismicity is given by adding (2) and (3).

$$\lambda(M) = \begin{cases} \alpha_V (e^{-\beta M} - e^{-\beta M_m}) + s_c & if \quad M \le M_m \\ s_c & if \quad M_m < M \le M_c \\ 0 & if \quad M > M_c \end{cases} \tag{4}$$

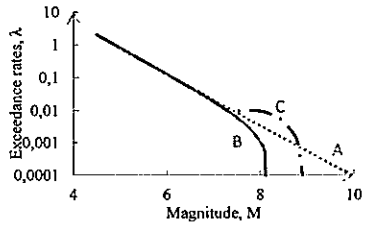

Fig. 1 Seismicity models

B. Attenuation

Attenuation laws are relations among magnitude, distance and intensity in firm ground, the majority of expressions provide peak ground acceleration, velocity, or displacement, as well as response spectral ordinates for a given period and critical damping. Under linear conditions and for the far field, peak ground acceleration can be represented by [9]

$$z \approx H e^{\beta' M} \tag{5}$$

where H is a function of the coordinates of the focus or rupture area and of the site of interest, as well as of the properties of the material beneath the site, and β' is a constant.

C. Regional Seismicity

The exceedance rate of z can be calculated by combining the exceedance rates of magnitudes and the attenuation law. This can be done for the different seismicity models; Here we show the one corresponding to the two subprocesses. Thus, by combining (4) and (5), we obtain the exceedance rate of z as:

$$\lambda(z) = \begin{cases} \alpha_4 (z^{-\alpha_5} - z_m^{-\alpha_5}) + s_c & if \quad z \le z_m \\ s_c & if \quad z_m < z \le z_c \\ 0 & if \quad z > z_c \end{cases} \tag{6}$$

which is valid when the material of earth's crust behaves linearly between the source and site of interest. Furthermore, the site-source distance is large compared to the dimensions of the rupture area. z_m and z_c correspond to M_m and M_c respectively, and α_4 and α_5 are constants. For convenience, we will write $\lambda = \lambda(z)$. Fig. 2 shows the exceedance rates of intensities for the three different cases considered here.

Now, let $\kappa = -d\lambda/dz$ denote the density of occurrence of earthquakes with intensity z. Thus, we could write:

$$\kappa = \begin{cases} \alpha_4 \alpha_5 z^{-\alpha_5 - 1} & if \quad z \le z_m \\ s_c \delta(z - z_c) & if \; z > z_m \end{cases} \tag{7}$$

where $\delta(.)$ is Dirac's delta. Here s_c represents the occurrence rate of characteristic earthquakes.

Equation (5) still works for small M near a source, but there is a saturation phenomenon for large M. Thus, for large earthquakes near a source, z does not increase in the same proportion with M as it does for large distances [10]. Something similar occurs at sites distant from the source, when the nonlinear behavior of the soil reduces the response spectral ordinates for large magnitudes [11]. We assume in this case that at a given exceedance rate, all values of z duplicate except z_m, which is the maximum intensity that can occur at the site of interest.

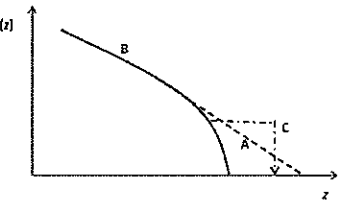

Fig. 2 Exceedance rates of intensities

D. Magnitudes and Occurrence Times of Characteristic Earthquakes

Based on the analysis of self-organizing systems [12] and on data from real earthquakes [13], it can be assumed that the

magnitudes of characteristic earthquakes conforms to a slip-predictable model [14], [15]. If t denotes the time of the last characteristic earthquake, we can write

$$M_c = \begin{cases} M_r & if\ \ t \le t_r \\ M_r + F\ln\left(\frac{t}{t_r}\right) & if\ \ t \ge t_r \end{cases} \quad (8)$$

For Mexican subduction earthquakes, the threshold magnitude of the characteristic earthquake, the corresponding recurrence time, and the constant F are [13]: $M_r = 7.4$, $t_r = 26.7$, and $F = 1.43$, respectively.

The assumption that arrival times of all earthquakes at the site of interest constitute a Poisson process is adequate when nothing is known about arrival times other than the magnitude exceedance rates, or when significant earthquakes can arrive from a number of independent sources. However, when significant earthquakes originate in a single source and there is an idea of the recurrence period of the characteristic earthquake, one should take into account the non-Poisson nature of their arrival times. Jara and Rosenblueth [13], based on a study of Mexican characteristic subduction earthquakes, find that the best probability density function to describe the occurrence of large earthquakes is the lognormal distribution.

III. Costs

A. Initial Construction Cost

Let u be the initial cost of a structure designed with coefficient c. Based on work by [16]-[20], it is reasonable to adopt

$$u = \begin{cases} C & if\ c \le c_0 \\ [1 + \alpha_2(c - c_0)^{\alpha_3}]C & if\ c > c_0 \end{cases} \quad (9)$$

where, if the structure is not designed to resist earthquakes, C would be its corresponding cost and c_0 would be its lateral resistance, and takes values of 0.05 to 0.13 for high-rise and low-rise buildings, α_2 and α_3 are constants with values of 0.5, and 1.1 to 1.4 for low-rise and high-rise buildings, respectively.

B. Losses Due to Earthquakes

Direct Material Loss

Let D_z be the direct material loss due to damage to the building itself when subjected to an intensity z. According to data and studies done by [21], [22], given an earthquake of intensity z, the expected loss due to material damage to the building itself at the instant of the earthquake is proportional to the power 1.6 of the quotient $\zeta = z/c$ when $1 \le \zeta \le 7$. We will take $D_z = u\xi(\zeta)$, where the function $\xi(\zeta)$must increase with z, thereby decreasing as c increases so that $\lim_{z\to 0}\xi = 0$ and $\lim_{z\to\infty}\xi = 1$. Furthermore, it must tend very fast to zero when z tends to zero because we know that earthquakes of low intensity do not cause any damage. Thus according to empirical data and all considerations made, the following expressions are used for $\xi(z,c) = \xi(\zeta)$. $\xi(\zeta) = 0.025\zeta^6 - 0.015\zeta^9$ if $\zeta \le 1$, and $\xi(\zeta) = (0.188 + \zeta^{1.8})/(117.8 + \zeta^{1.8})$ if $\zeta > 1$ (see Fig. 3).

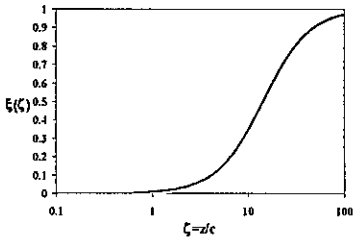

Fig. 3 Loss rate of structures in terms of intensity and seismic design coefficient

Indirect Economic and Non-Economic Loss

This loss represents all damages that earthquakes cause to society. It must be insignificant when $\xi(\zeta)$ is small, because there is practically no damage done to the contents of the buildings. Furthermore, it should exceed $u\xi(\zeta)$ when $\xi(\zeta)$ is close to one, because it corresponds to buildings under collapse, causing usually nearly the total loss of its content, the loss of many human lives and the economic chaos in the affected area.

In computing all possible losses, intangibles such as human lives must be taken into account. In this case, it is not a trivial matter to establish monetary equivalents, and this kind of purely economic approach deserves further study, because just considering this loss as an additive term in the formation of an objective function may lead to absurd results.

Different approaches have been developed to deal with the problem, namely, human capital, consumption and its variations, consideration of legacies or bequests, willingness to pay, and quality of life. A review of these methods is done by Garcia-Pérez [23], and a lower limit is obtained for this intangible by making it equal to the expected present value of the person's contribution to the gross domestic product. By using data for Mexico, this limit results in 45 000 US dollars. The main objection to this human-capital approach is that it looks only at the economic side of the problem. Mishan [24] suggested that in resource allocation, in order to achieve an improvement in the sense of Pareto, it is required to take into account each person's willingness to reduce his/her risk of dying. A Pareto improvement is said to exist when individuals, who gain from a social change, are able to compensate those who stand to lose from the change and still leave a net gain. Also, Usher [25] published a formal treatment to the problem of establishing the amount that a rational person must be willing to invest, in order to reduce such a risk, taking into account his/her utility curve. We should, therefore, look at the amount that a person is willing to invest in order to reduce the probability of losing her/his life. Garcia-Pérez [23] discusses the willingness-to-pay approach and computes a factor, using an individual utility curve, whereby one has to multiply the value assigned to life by the human-capital approach and obtain the value that the person would assign to her/his life. This factor is always greater than one and could be much greater. Research is needed especially regarding the choice of utility curves in both individual and social problems.

Expected Present Value of Seismic Losses

The loss caused by an earthquake of intensity z at the instant that it occurs,L_z, must include all seismic losses given by the direct material loss and the indirect economic and noneconomic loss as discussed above. Thus $L_z = u\xi(\zeta)[1 + b\xi(\zeta)]$, where b is a factor considerably greater than 1.

If the earthquake arrival times constitute a multiple Poisson process, and we assume that the original condition is restored to the structure after each earthquake, and the discount rate γ is independent of time and the expected cost of damage and failure per unit time is $d_0 = \int_0^\infty \kappa L_z\, dz$, [26], then the expected present value of all seismic losses becomes $v = \int_0^\infty d_o e^{-\gamma t} dt$, and after substituting all variables, the following expression is obtained:

$$v = \frac{u}{\gamma}\left\{\int_0^{z_m} \frac{\alpha_4\alpha_5}{z^{\alpha_5+1}}\xi(z/c)[1 + b\xi(z/c)]dz + s_c\xi(z_c/c)[1 + b\xi(z_c/c)]\right\} \quad (10)$$

It is convenient to write $\zeta_m = z_m/c$ in (10) and integrate with respect to ζ rather than with respect to z. Thus, we get:

$$v = \frac{u}{\gamma}\left\{\frac{\alpha_4\alpha_5}{c^{\alpha_5}}\int_0^{\zeta_m} \frac{\xi(\zeta)[1+b\xi(\zeta)]}{\zeta^{\alpha_5+1}}d\zeta + s_c\xi(\zeta_c)[1 + b\xi(\zeta_c)]\right\} \quad (11)$$

Similar expressions can be derived considering $\lambda_G$and λ_V by using the corresponding numerical value of α_4, the maximum values of the intensity, and excluding characteristic earthquakes. This will be illustrated through some examples below.

C. Expected Present Value of the Total Cost

The expression to be minimized is the expected present value of the total cost including the initial cost (9), as well as the losses due to earthquakes (11), given by:

$$w = \frac{u}{\gamma}\left\{\gamma + \frac{\alpha_4\alpha_5}{c^{\alpha_5}}\int_0^{\zeta_m} \frac{\xi(\zeta)[1+b\xi(\zeta)]}{\zeta^{\alpha_5+1}}d\zeta + s_c\xi(\zeta_c)[1 + b\xi(\zeta_c)]\right\} \quad (12)$$

IV. Uncertainties

So far, we have treated all parameters as deterministic. However, uncertainties in each one of them become very high. Thus, we now take into account the effect on spectral ordinates of uncertainties in some parameters. We treat α_4, α_5, $\beta'$and the initial cost of a structure u as deterministic, since c, the base shear coefficient, is chosen by the designer or fixed by a code. Since most parameters are obtained from linear regression between their logarithms and known quantities, we assign lognormal distributions to random variables with standard deviations and modes or deterministic values in (11). Uncertainties in the structural capacity are considered by assigning a standard deviation of 0.4 to the design coefficient, which is reasonable for reinforced concrete frames. The expected value of a linear function of a power of a random function, for example, z^p, where p is any real number, is computed as the function's median times $\exp(p^2\sigma_{ln z}^2/2)$. In the case of nonlinear functions, the two-point estimates method developed by Rosenblueth [27] is used. We also take $b = 12$, $\sigma_{ln b} = 1$, $s_c = 0.02$, $\sigma_{ln s_c} = 0.2$, $\hat{c}$ the mode of c,and $\zeta_m^{++} = z_m^{++}/c^+$, $\zeta_m^{+-} = z_m^{+-}/c^+$ and so on. Thus, the expected present value of the total cost with uncertainties is:

$$\bar{w} = u(1 + I_1 + I_2) \quad (13)$$

where, $I_i = \frac{\alpha_4\alpha_5}{4\gamma c^{\alpha_5}}[3.32(I_i^{++} + I_i^{+-}) + 0.3(I_i^{-+} + I_i^{--}) + A_i]$. And for $i = 1,2$ we have that: $I_1^{++} = \int_0^{\zeta_m^{++}}[\xi(\zeta)/\zeta^{\alpha_5+1}]d\zeta$, etc.; $I_2^{++} = 19.78\int_0^{\zeta_m^{++}}[\xi^2(\zeta)/\zeta^{\alpha_5+1}]d\zeta$, etc., and the values of: $A_1 = 0.01[\xi(\zeta_c^+) + \xi(\zeta_c^-)]$, and $A_2 = 0.1978[\xi^2(\zeta_c^+) + \xi^2(\zeta_c^-)]$.

V. Discount and Construction Rates

The present values of the losses have been obtained by considering a discount function, $\exp(-\gamma t)$, where γ is a constant discount rate, often taken as 0.05/yr, because this is the value used in major financial transactions carried out in recent decades. However, surveys in the US of the discount rate [28], which must be applied to the social value of a human life, lead to the conclusion that $\gamma(t)$ decreases rapidly with time. Any discount function can be approximated as closely as wished by replacing it with $\sum_i \rho_i \exp(-\gamma_i t)$ where $\sum_i \rho_i = 1$ and $\gamma_i > 0$ for all i. Whatever the parameters ρ_i and γ_i may be, if the process under study is Poisson, there is always an equivalent discount rate independent of time that leads us exactly to the same results for the total expected present value [29]. By using an expression of the form $e^{-\gamma(t)t} = 0.56e^{-0.45t} + 0.44e^{-0.033t}$, Rosenblueth [29] finds an equivalent discount rate of $\gamma = 0.0686$.

In this study, we have been dealing with a single building that we assume will be designed and built immediately. Codes are intended to be applied to buildings that will be erected at different times and over several years, for example t_f. In this case, it is convenient to minimize the expected present value of all costs of the structures that will be built in the zone where the codes apply. Let $\psi = \psi(t)$ denote the expected number of structures to be built per unit area and per unit time. The expected present value of the number of buildings that will be built is then $\phi = \int_0^{t_f} \psi e^{-\gamma(t)t} dt$. The expected present value of the initial costs is $u\phi$. Thus if a building is constructed at time $t \le t_f$ after the code is enacted, and if the discount rate is constant, then the expected seismic loss for this building actualized to time t is given by (11). Now the number of buildings constructed between t and $t + dt$ is ψdt.Therefore, the expected present value of the losses is $v\phi$ [30]. The problem of finding optimum seismic design parameters, when different structural types are built in a region, has been solved by using both genetic algorithms [31] and artificial neural networks [32].

If we are interested in a single structure built at $t = 0$, we find v affected by the factor $1/\gamma$ which, in the case of the

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equivalent discount rate gives a value of 14.6. Now, if we are concerned with a building code that will be in use for ten years before it is updated, and if ψ is constant over this period, we find that by using $e^{-\gamma(t)}$, u must be multiplied by 5ψ and that the factor in v is 116ψ. Therefore, v has a weight relative to u, which is 1.6 times greater than that in the single structure when we consider that buildings will be constructed over the ten year period.

VI. Time Dependent Non-Poisson Characteristic Earthquakes

Based on a study by Jara and Rosenblueth [13], we can assume for illustrative purposes that characteristic earthquakes belong to either of two populations. In the first population, twenty per cent of the events have an exponential distribution for the time t with expected value of 1.5 yr between events, and the second population has a lognormal distribution with median 40.6 yr and standard deviation of natural logarithm of t equal to 0.4. The expected value of t in the second population is then $40.6\exp(0.4^2/2) = 43.7\ yr$ and that which is for all characteristic events is $m_t = 36.7\ yr$. In the case of a single structure to be designed and built immediately, if the slip-predictable process is ignored, by numerical integration it is found that the expected loss at the time that a characteristic earthquake strikes must be multiplied by a factor that varies between 0.18 and 0.41 corresponding to 5 and 75 yr after the last earthquake, rather than be multiplied by $1/\gamma m_t = 0.4$,as in a Poisson process to obtain the expected present value of all such earthquakes.

We use the data from subduction earthquakes from the coast of Mexico given by (5), and we will take the maximum value of $M_c$equal to 8. Then it is found that the increase in $M_c$with time increases the lower limit by a small factor while the upper stays below $0.41\exp[\varepsilon'(8-7.4)]$that turns to be 0.84 when using $\varepsilon' = 1.2$ [9]. If we are concerned with a building code that will be in use for ten years before it is updated, and if we assume that ψ is time independent, it is found that the lower limit exceeds $1.6(5)0.18 = 1.4\psi$ while the upper limit is less than $1.6(5)84 = 6.7\psi$, regardless of when the last characteristic earthquake occurred.

VII. Examples

A. Optimum Seismic Design Coefficients

Far-Field Site

Three different types of structures will be under study representing high- medium- and low-rise buildings. The corresponding parameters used in (9) are shown in Table I. The following values are used in the calculations: $\alpha_4 = 3.75\,x\,10^{-4}$, $\alpha_5 = 3.3$, $\gamma = 0.05$, $z_m = 0.4$ and $z_c = 0.8$, both with $\sigma = 0.5$. Optimum values of c are obtained by minimizing the expected present value of all costs. This minimization process requires that $dw/dc = 0$. Thus, we obtain optimum values for the three different types of structures under study for both deterministic parameters and with uncertainties and for three local seismicity curves as shown in Table II. This table displays results in column A considering the Gutenberg and Richter curve, those corresponding to Cornell and Vanmarcke in column B, including characteristic earthquakes (12) in column C. The results considering uncertainties with (13) are presented in the last column of this table.

TABLE I
Parameters for Three Different Types of Structures

Parameters	Type of structure		
	High	Medium	Low
c_0	0.05	0.1	0.13
α_2	0.5	0.5	0.5
α_3	1.4	1.2	1.1

TABLE II
Optimum Seismic Design Coefficients for Far-Field-Site

Structural type	Using (12) (w)			Using (13) ($\bar{w}$)
	A	B	C	
High	0.166	0.174	0.341	0.525
Medium	0.151	0.155	0.316	0.489
Low	0.140	0.147	0.296	0.335

Near-Field Site

Consider now a site in the near-field. Equation (5) still works for small M, but is no longer valid for large magnitude earthquakes due to a saturation phenomenon. Thus, for large earthquakes near a source, z does not increase in the same proportion with M as it does for large distances [10]. The following intensities are used in order to calculate the optimum coefficients, given by the ordinates of the pseudo-acceleration spectrum expressed in terms of the gravity acceleration, $z_m = 0.5$, $z_c = 0.9$ and $\alpha_4\alpha_5 = 20\,x\,10^{-3}$. Results for the three different types of structures are displayed in Table III.

Importance factors at a near-field can be computed following a methodology developed by García-Pérez et al [33]. Usually building codes require that very important structures (those whose failure or collapse might cause a large loss of lives, an extraordinary economic loss, and public buildings that are essential during emergencies) be designed for a seismic coefficient equal to that used for ordinary structures multiplied by the importance factor. Therefore, we find the value of c first, which at the far-field minimizes the total cost. This c applies to ordinary structures taken from Table II column C, because we will consider the two seismicity subprocesses. After this, we compute the factor by which we must multiply b to increase the computed optimum to $1.5c$ (important structures), so that the importance factor is equal to 1.5 at the far-field site. Now we go to the near-field site and compute the optimum design coefficients, assuming that the values of b for both ordinary and important structures are the same as at the far-field site. These values are given in Table III. The ratio between these values gives us the importance factor corresponding to the near-field site as displayed in Table III. This factor decreases for the near field site as was previously pointed out in [33].

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TABLE III
Optimum Seismic Design Coefficients for Near-Field-Site

Structural type	Ordinary	Important	Importance factor
High	0.425	0.570	1.34
Medium	0.401	0.536	1.34
Low	0.377	0.508	1.35

VIII. Concluding Remarks

The expected present value of total cost is used to compute optimum seismic design parameters for sites far and near a seismic source, respectively. High, medium and low structural types have been considered in the analysis. Different seismicity models are used and uncertainties are included in some variables to study their influence in the computation of optimum values. Concepts such as discount factor, construction rate, and indirect economic and non-economic loss are reviewed. The results show that taking into account the concepts studied here modify the optimum values, and that importance factors are lower in the near-field site assuming that the importance factor at a far-field site is optimum.

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Experimental Study on the Flexural Strength of Cold-Formed Steel Joists Included Stiffened Openings in Reinforced Concrete Frames

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Abstract—Abstract—Cold formed steel sections can be used as joists in the floor system of conventional steel or concrete structures in addition to use of them as original or porter members of the light steel frames (LSF). Lightness, Ease of installation, reducing the time of implementation and reducing the financial costs are the benefits of these joists. The possibility of creating some openings on the web of these sections can provide enough space for passing electrical and mechanical accessories or other needs. In this regard this research examines the Flexural strength of C or U shaped cold formed steel sections that connects to the main beams of the concrete structures for transferring the gravity load. Therefore, five samples were made in the scale of 50% and have been experimented for flexural test. The joists connections were enclosed in concrete and the variable parameters are existence of roofs concrete, the thickness of the sheets, effects of the openings of the web and the shape of the sections. In order to evaluate the analytical samples, modeling and Finite Element Analysis of samples was performed by Abaqus software to compare analytical with experimental results. The results of the tests show us that the existence of the concrete on the surface of the joists Reduces the horizontal and vertical displacement, Increased thickness has a great effect in increasing the flexural strength of the joists. Suitability of the Flexural strength of these joists shows us that they can be used as appropriate alternative instead of typical concrete joists in building of roof of the insite structures.

Keywords—Keywords—Concrete Joists, Cold formed steel sections, Reinforced concrete frame, Flexural strength, Finite element method.

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Exploring the Physical Environment and Building Features in Earthquake Disaster Areas

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Abstract—Earthquake is an unpredictable natural disaster and intensive earthquakes have caused serious impacts on social-economic system, environmental and social resilience. Conventional ways to mitigate earthquake disaster are to enhance building codes and advance structural engineering measures. However, earthquake-induced ground damage such as liquefaction, land subsidence, landslide happen on places nearby earthquake prone or poor soil condition areas. Therefore, this study uses spatial statistical analysis to explore the spatial pattern of damaged buildings. Afterwards, principle components analysis (PCA) is applied to categorize the similar features in different kinds of clustered patterns. The results show that serious landslide prone area, close to fault, vegetated ground surface and mudslide prone area are common in those highly damaged buildings. In addition, the oldest building might not be directly referred to the most vulnerable one. In fact, it seems that buildings built between 1974 and 1989 become more fragile during the earthquake. The incorporation of both spatial statistical analyses and PCA can provide more accurate information to subsidize retrofit programs to enhance earthquake resistance in particular areas.

Keywords—Earthquake disaster, spatial statistical analysis, principle components analysis, clustered patterns.

I. Introduction

ASIAN region has been regarded as most frequently hit by natural disasters. Earthquakes are infrequent hazards but unpredictable which result in higher fatalness [1]-[4]. Such earthquake disasters have an enormous impact on social-economic system, environmental and social resilience [5]. Asia is prone to earthquake and riddled with faults. Recently, large-scale earthquakes have inflicted severe damage on Sichuan in China (2008), Haiti (2010), Tōhoku earthquake in Japan (2011), Yunnan in China (2014). The Great Hanshin Earthquake in Japan in 1995 raised even serious issues that such advanced engineering country defeated. Over 6,000 people dead and over US$100 billion economic lost in the earthquake [6]. Again, the threat posed by even larger earthquakes has outpaced the ability to mitigate the impacts to acceptable levels.

Earthquakes do not kill people, buildings do [7]. Although cities are artificial environments shielding inhabitants against natural disasters, inadequate shield may result in secondary disaster on human live and property. When buildings located nearby earthquake-prone areas and constructed upon poorer soil areas might result in earthquake-induced ground damages such as fault rupture, landslides and liquefaction [8]. In addition, many existing buildings built before any improved seismic provisions required. And limited engineering structures are unable to resist earthquake induced ground damages. Inappropriate land usage and highly dense population with intensive earthquake disaster result in higher living environment risks. The security of urban areas confronting of natural extremes is no longer tenable.

Land use planning and zoning are two critical non-structural measures on controlling physical development within urban regions in earthquake-prone areas. However, it is difficult for zoning boards and planning committees to do further restriction on questionable lands for limited credible earthquake projection. Consequently, development continues in the potential path of earthquake prone areas and the existing built environment is lacking awareness for the possible risk [8]. The identification of sensitive geologic environment might help decision makers come up more compatible land use regulation for future development and retrofitting requirement for existing development.

Taiwan locates on the frequent convergence of the Philippine Sea Plate and the Eurasian Plate. There are forty-two active faults identified by geologists. The 921 Earthquake was a 7.3 MS earthquake, and it caused serious impacts on both social and economic system. In that day, we lost 2,500 people and over 10,000 people were injured [9]. Since then, a fault zone area of 15 meters on each side of fault trace has been regulated [10]. However, the earthquake damages were not only clustered along the fault. Therefore, this study attempts to explore potential similarities on those damaged buildings by using spatial statistical analyses and principal component analysis. The identification of potential sensitive physical environment might be some reference for future land use plan. Section II is the case study of land use management along the fault. Section III is the research design including conceptual model and methods. Section IV is the results and Section V is the contribution. This study concludes in the last section.

II. Case Studies: Land Use Management Along Fault

Southern California lies on the boundary between the Pacific and North American plates and is riddled with faults and prone to earthquakes. One quarter of the earthquake risk for the U.S. lies in Southern California [11]. By understanding when and where earthquakes may occur might provide great help on mitigating loss. The U.S. Geological Survey incorporates detailed long-term forecasts into official National Seismic Hazard Map. Such map has been applied in public and private

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sector on evaluating insurance rate on buildings, risk assessment, disaster mitigation strategies [12]. Still, the earthquake prediction is a challenge because the accurate stop and begin time of rupture is hard to capture [13].

Alquist-Priolo (AP) Earthquake Fault Zonation Act has been passed in California afterwards in 1972, and geologic investigations are required to restrict housing construction across faults [12]. The AP Act is a state law designed to reduce the hazard from surface fault rupture during an earthquake for associated damage of houses, commercial buildings and other structures with extensive surface fault ruptures.

The law requires the State Geologist to establish regulatory zones (know as Earthquake Fault Zones) around the active fault traces. Such map will then be approved and distributed to planning bodies to control future development by regulating land divisions, buildings height, setback and others in those high surface rupture zones. Currently, there are 922 seismic hazard zone reports, 1,830 maps, and 671 GIS datasets are allowed people to download and check whether their property might be near or within an active fault [12].

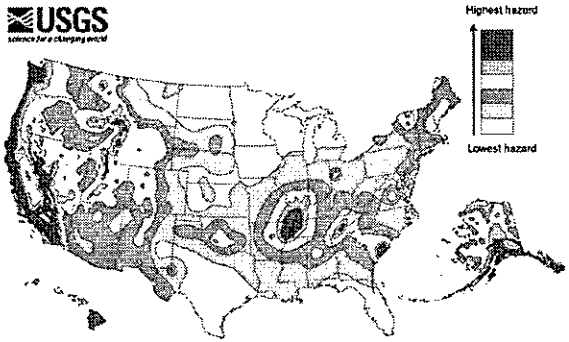


Fig. 1 Simplified 2014 Hazard Map (PGA, 2% in 50 years) [12]

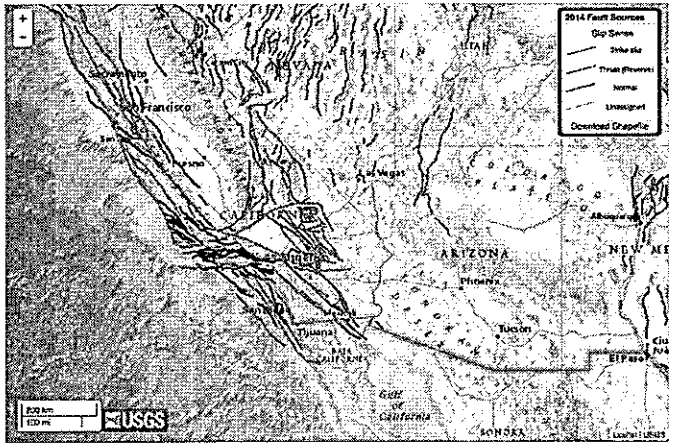


Fig. 2 Fault Source Map in the U.S. [12]

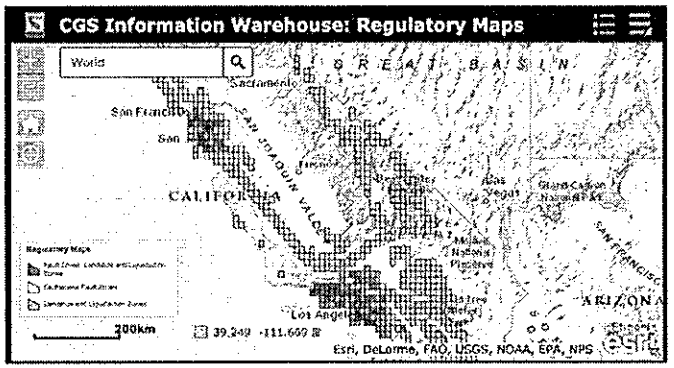


Fig. 3 AP Fault Zone and Seismic Hazard Zone maps [12]

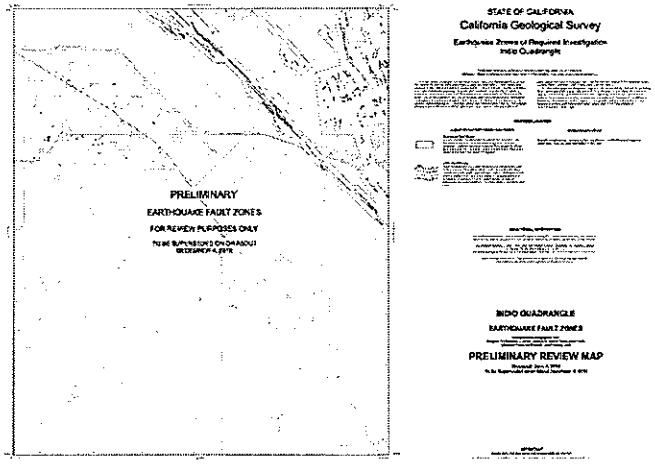


Fig. 4 Earthquake Zones of required investigation in Indio Quadrangle [12]

III. Research Design

Earthquake disaster is a joint product of nature and human society, and such can be revised by humans but is not ultimately reducible to a human construction. After 921 Chi-Chi Earthquake, over 2,400 people dead, 10,000 people injured, and 100,000 buildings damaged [9]. Due to the epicenter, fault dislocation and ground deformation, huge live and property losses were aggregated in the central Taiwan, and 5,213 damage buildings are used in this study [9]. The application of two spatial statistic analyses is to probe into if there is any significant cluster pattern on particular distance. Afterwards, principle component analysis (PCA) will be applied to categorize particular features of damage buildings.

A. Methodology

a. PCA

PCA, which was developed by Pearson in 1901 [14], has been commonly employed in the social and physical sciences, and the details of extracting components for a data matrix and their interpretation have been presented by Hotelling [15]. The basic theory behind PCA is to transform a set of correlated variables into a set of uncorrelated variables by linear

transformation. PCA is independent of any hypothesis of data probability distribution and is generally applied to highlight patterns within multivariable data [16]. PCA has several advantages, such as flexibility in the data reduction process and the ability to retain important patterns among multivariate data.

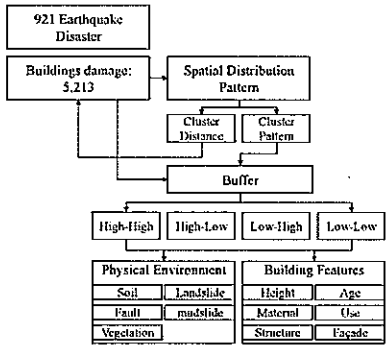


Fig. 5 Research design framework

The total variance is unchanged via orthogonal linear transformation. The first principle component (PC) is designed to have the largest variance, and the second principle component the second largest variance. The ranking of the PCs is based on the eigenvalues that are associated with each PC. This mathematical transformation identifies p variables that account for the total variability, which are divided into p PCs. The choice of the number of PCs is subjective and based on the extent that PCs are interpretative [17].

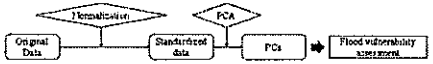


Fig. 6 Technical flow chart of flood vulnerability PCA

b. Spatial Autocorrelation Analysis

Spatial autocorrelation statistics detect the degree of similarity between objects occurring in nearby locations by measuring and testing the clustering/dispersal based on Tobler's statement in 1970 that everything is related but near things are more closely related [18]. This study applies Moran's I to test for the significance of spatial pattern. Moran's I can be defined as

$$I(d) = \frac{n\sum\sum w_{ij}(x_i-\bar{x})(x_j-\bar{x})}{W\sum(x_i-\bar{x})^2} \quad (1)$$

where x_i and x_j are the values of variables in areal unit i and unit j; $\bar{x}$ is the mean value of variables in all spatial units; w_{ij} is the spatial weights matrix; $(x_i-\bar{x})(x_j-\bar{x})$ is cross –product of the variances between neighboring values and the overall mean; W is the sum of all elements of the spatial weights matrix.

The value of Moran's I ranged from -1 to 1. -1 indicates an extremely negative spatial autocorrelation while 1 is extremely positive autocorrelation. In order to detect the spatial autocorrelation, it should be compared to the expected value of Moran's I:

$$E(I) = -(1)/(n-1) \quad (2)$$

E(I) is always negative for *E(I)* is inversely related to the areal units. $I > E(I)$ indicates a clustered pattern for similar features in adjacent areal units; $I \cong E(I)$ indicates random pattern for no particular patterns or similarity; $I < E(I)$ indicates a dispersed pattern for different features in adjacent areal units.

IV. Results

A. Study area

The interaction of the Eurasian and Philippine Sea plates causes the frequent rate of earthquakes. In Taiwan, there are 20 faults belonged to the Holocene active fault, and 13 faults belonged to the Late Pleistocene active fault, and 4 faults belonged to concealed or inferred. 90% of Taiwan's 23 million people live in the west island [19].

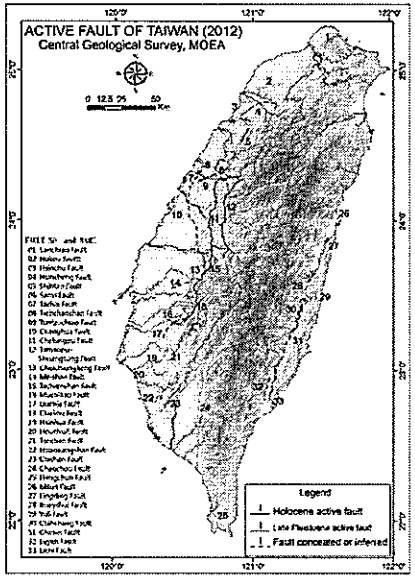


Fig. 7 Active fault of Taiwan [19]

B. Spatial Distribution of Damaged Buildings

The result of LISA shows that 470 spatial units are High-High (high values of damage clustered), 346 spatial units are High-Low (high values of damage surrounded by low values of damage), 152 spatial units are Low-High (low values of damage surrounded by high values of damage), and 833 spatial units are Low-Low (low values of damage clustered). Other damage buildings are distributed randomly in the study area.

TABLE I
THE SPATIAL DISTRIBUTION OF DAMAGE BUILDINGS ACCORDING TO LISA

	High-High	High-Low	Low-High	Low-Low
Serious damage	470	346	0	0
Moderate damage	0	0	46	262
Slight damage	0	0	106	571

C. PCA

a. Physical Environment

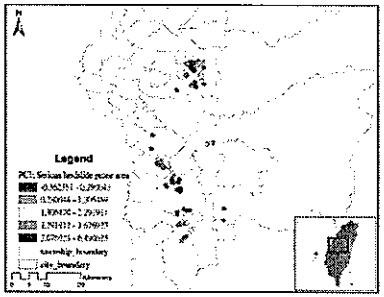
For the High-High category, the PCA of twelve indicators extracted four components that explained 69% of the variance and 0.678 of the KMO value in the data. The indicators "high landslide risk", "moderate landslide risk" and "colluvial" show high positive correlation in HH_PC1 and explained 32% of the variance. HH_PC1 is renamed "serious landslide prone area." The second principle component HH_PC2 explains 14% of the variance with the indicators "fault distance" and "mudslide stream distance." HH_PC2 is renamed "close to fault and mudflow." The indicators "vegetation" is highly positive in HH_PC2 and explained 12% of the variance. HH_PC3 is renamed "soft ground surface." The fourth principal component HH_PC4 explains 12% of the variance with the indicators "uncovered" and "mudslide stream distance." HH_PC4 is renamed "mudslide prone area."

b. Building Feature

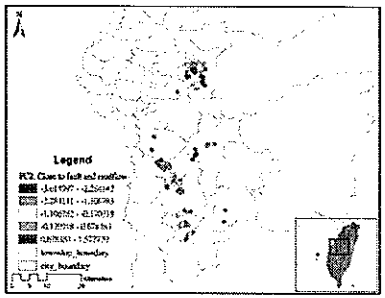
For the High-High category, the PCA of six indicators extracted two components that explained 47% of the variance and 0.640 of the KMO value in the data. HH_PC1 represents 29% of the total variance, and the indicators "year" and "anti-earthquake structure" show a high positive significance. In order to investigate how "year" affect High-High category, the PCA of five indicators extracted two components that explained 54% of the variance and 0.210 of the KMO value in the data. Although the KMO value is too low, the two components reveal the building feature in "1974-1982" and "1983-1989." HH_PC2 represents 17% of the total variance, and the indicator "material" is highly positive. In order to investigate how "material" affect High-High category, the PCA of three indicators extracted one component that explained 61% of total variance and 0.448 of the KMO value. Although the KMO value is not significant enough, the component reveals the building feature in "reinforced concrete."

V. Contribution

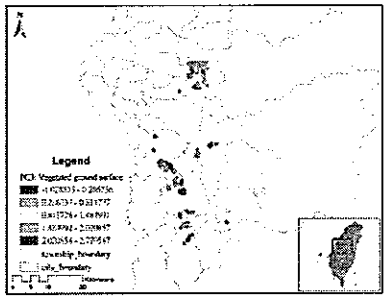
Earthquake is infrequent but unpredictable disaster, and even larger magnitude has outpaced the ability of human beings to mitigate. Land use regulation and zoning have been discussed quite a while as nonstructural engineering measures, and they have been implemented mostly in fault zone area to prevent the surface rupture disaster. However, earthquake induced disaster are more than surface rupture such as liquefaction, landslide, land subsidence and so on. The results in this study show that there are similar physical environment features and way beyond the fault itself. Besides, the newest structure followed the newest Building Code and Regulations but defeated in the end. The continued allowed development in such sensitive geological or earthquake prone areas might result in another fatalness disaster in the future.



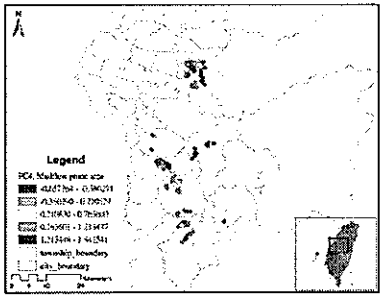
(a) HH_PC1: Serious landslide prone area



(b) HH_PC2: Close to fault and mudflow

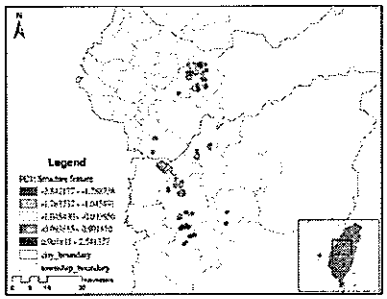


(c) HH_PC3: Vegetated ground surface

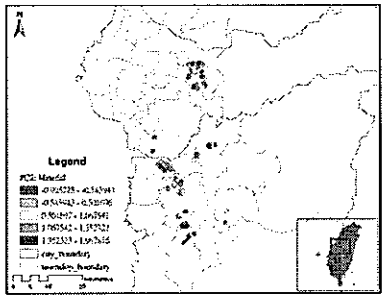


(d) HH_PC4: Mudslide prone area

Fig. 8 Principle components of physical environment in High-High category



(a) HH_PC1: Structure features



(b) HH_PC2: Material

Fig. 9 Principle components of building feature in High-High category

ACKNOWLEDGMENT

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Exploring Coexisting Opportunity of Earthquake Risk and Urban Growth

Chang Hsueh-Sheng, Chen Tzu-Ling

Abstract—Earthquake is an unpredictable natural disaster and intensive earthquakes have caused serious impacts on social-economic system, environmental and social resilience, and further increase vulnerability. Due to earthquakes don't kill people, buildings do. When buildings located nearby earthquake-prone areas and constructed upon poorer soil areas might result in earthquake-induced ground damage. In addition, many existing buildings built before any improved seismic provisions began to be required in building codes and inappropriate land usage with highly dense population might result in much serious earthquake disaster. Indeed, not only do earthquake disaster impact seriously on urban environment, but urban growth might increase the vulnerability. Since 1980s, "Cutting down risks and vulnerability" has been brought up in both urban planning and architecture and such concept has way beyond retrofitting of seismic damages, seismic resistance, and better anti-seismic structures, and become the key action on disaster mitigation. Land use planning and zoning are two critical non-structural measures on controlling physical development while it is difficult for zoning boards and governing bodies restrict development of questionable lands to uses compatible with the hazard without credible earthquake loss projection. Therefore, identifying potential earthquake exposure, vulnerability people and places, and urban development areas might become strongly supported information for decision makers. Taiwan locates on the Pacific Ring of Fire where a seismically active zone is. Some of the active faults have been found close by densely populated and highly developed built environment in the cities. Therefore, this study attempts to base on the perspective of carrying capacity and draft out micro-zonation according to both vulnerability index and urban growth index while considering spatial variances of multi factors via geographical weighted principle components (GWPCA). The purpose in this study is to construct supported information for decision makers on revising existing zoning in high-risk areas for a more compatible use and the public on managing risks.

Keywords—Carrying capacity, Earthquake disaster, geographical weighted principle components (GWPCA), Urban growth, Vulnerability

I. Introduction

ASIAN region has been regarded as most frequently hit by natural disasters. Earthquakes are infrequent hazards but unpredictable which result in higher fatalness [1,2,3,4]. Such earthquake disasters have an enormous impact on social-economic system, environmental and social resilience, and further increase vulnerability [5]. Asia is prone to earthquake and riddled with faults. Recently, large-scale earthquake has inflicted severe damage on Sichuan in China (2008), Haiti (2010), Tōhoku earthquake in Japan (2011), Yunnan in China (2014). The 921 Earthquake in Taiwan was a 7.3 MS earthquake occurred in 1999, nearly 2,500 people were killed, 11,500 people injured, and US$10 billion damage lost. The Great Hanshin Earthquake in Japan in 1995 raised even serious issues that such effective engineering and hazard mitigation country defeated, over 6,000 people killed, 10 times as many were injured, over US$100 billion damage lost. Again, the threat posed by even larger earthquakes has outpaced the ability to mitigate the impacts to acceptable levels.

Earthquakes don't kill people, buildings do [6]. Although cities are artificial environments shielding inhabitants against natural disasters, inadequate shield may result in much serious human live and property lost. When buildings located nearby earthquake-prone areas and constructed upon poorer soil areas such as loose saturated sands, reclaimed or otherwise created lands, and deep deposits of soft clays might result in earthquake-induced ground damage such as liquefaction, landslides, settlement, and distributed fault rupture easily [7]. In addition, many existing buildings built before any improved seismic provisions began to be required in building codes that are unable to resist ground shaking. Inappropriate land usage and highly dense population with intensive earthquake disaster result in higher living environment risks. The security of urban areas confronting of natural extremes is no longer tenable.

Land use planning and zoning are two critical non-structural measures on controlling physical development within urban regions in earthquake-prone areas. However, it is difficult for zoning boards and governing bodies restrict development of questionable lands to uses compatible with the hazard without credible earthquake loss projection. Consequently, development continues in the potential path of intense ground shaking, and ground failures, and existing development in these areas remains at risk [7]. The identification on potential earthquake exposure, vulnerability people and places, and urban development areas might become strongly supported information for both decision makers on revising existing zoning in high-risk areas for a more compatible use and the public on managing risks.

Taiwan locates on the Pacific Ring of Fire where a seismically active zone is (the frequent convergence of the Philippine Sea plate and the Eurasian Plate), and geologists have identified forty-two active faults. The seismic data has been collected from metropolitan area, fault belt, and special geology area since 1992, which can be referred to future seismic hazard projection. Some of the active faults have been found close by densely populated and highly developed built environment in the cities, and the two contrasting features of the city mean to find ways to live with hazard. Therefore, this study attempts to base on the perspective of carrying capacity and draft out micro-zonation according to both vulnerability index and urban growth index while considering spatial variances of multi factors via geographical weighted principle components (GWPCA). Afterwards, bivariate spatial association statistic can detect the degree of similarity between objects occurring in nearby locations and such statistic may apply for the discussion of the conflicts between vulnerability and urban development. The ultimate goal is to get well along with fault and earthquake in urban development area. Hence, the administrable mechanism of active faults developed circumscription is necessary for the contest between earthquake vulnerability and urban growth.

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San Francisco USA Jun 09-10, 2016, 18 (6) Part IX

II. Case Studies: Land Use Management Along Fault

A. America

Southern California lies on the boundary between the Pacific and North American plates and is riddled with faults and is prone to earthquakes. One quarter of the earthquake risk for the U.S. lies in Southern California [8]. By understanding when and where earthquakes may occur might provide great help on mitigating loss. The U.S. Geological Survey incorporates detailed long-term forecasts into official National Seismic Hazard Map. National Seismic Hazard Maps display earthquake ground motions for various probability levels across the United States and are applied in seismic provisions of building codes, insurance rate structures, risk assessments, and other public policy [9]. Still, the earthquake prediction is a challenge because the accurate stop and begin time of rupture is hard to capture, fault depth reaching project is expensive, what the forces are cause the faults to snap, and faults interact with each other and so on [10].

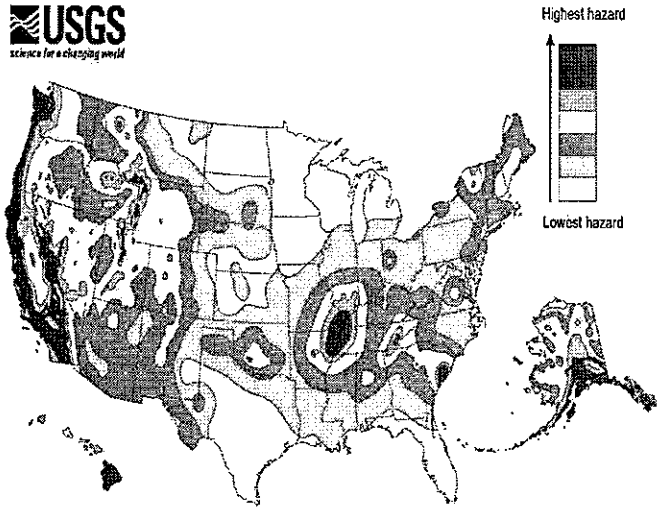

Fig. 1 Simplified 2014 Hazard Map (PGA, 2% in 50 years) (Resource: http://earthquake.usgs.gov/hazards/products/conterminous/index.php#2014)

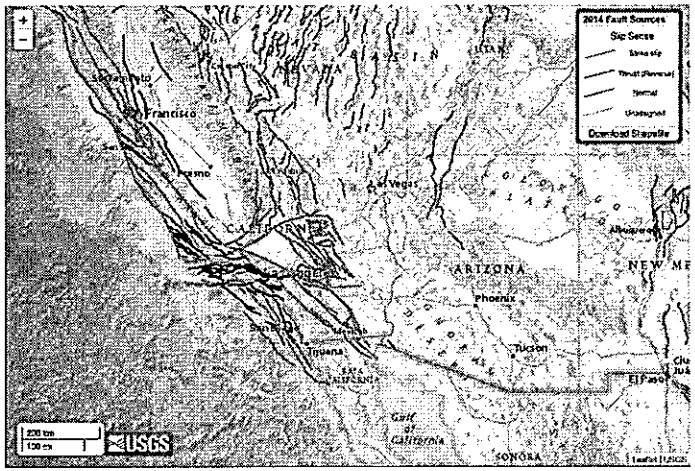

Fig. 2 Fault Source Map in the U.S. (Resource: http://earthquake.usgs.gov/hazards/products/conterminous/index.php#2014)

Alquist-Priolo (AP) Earthquake Fault Zonation Act has been passed in California afterwards in 1972, and geologic investigations are required to restrict housing construction across faults. The AP Act is a state law designed to reduce the hazard from surface fault rupture during an earthquake for associated damage of houses, commercial buildings and other structures with extensive surface fault ruptures.

The law requires the State Geologist to establish regulatory zones (known as Earthquake Fault Zones) around the surface traces of active faults and to issue appropriate maps. The maps are distributed to all affected cities, counties, and state agencies for their use in planning and controlling new or renewed construction. Local agencies must regulate most development projects within the zones. Projects include all land divisions and most structures for human occupancy. Single family wood-frame and steel-frame dwellings up to two stories not part of a development of four units or more are exempt. However, local agencies can be more restrictive than state law requires.

Currently, there are 922 seismic hazard zone reports, 1,830 maps, and 671 GIS datasets are allowed people to download and check whether their property might be near or within an active fault.

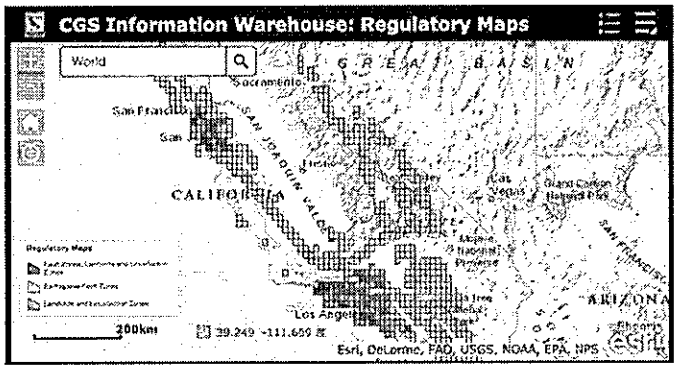

Fig. 3 AP Fault Zone and Seismic Hazard Zone maps (Resource: Department of Conservation, California)

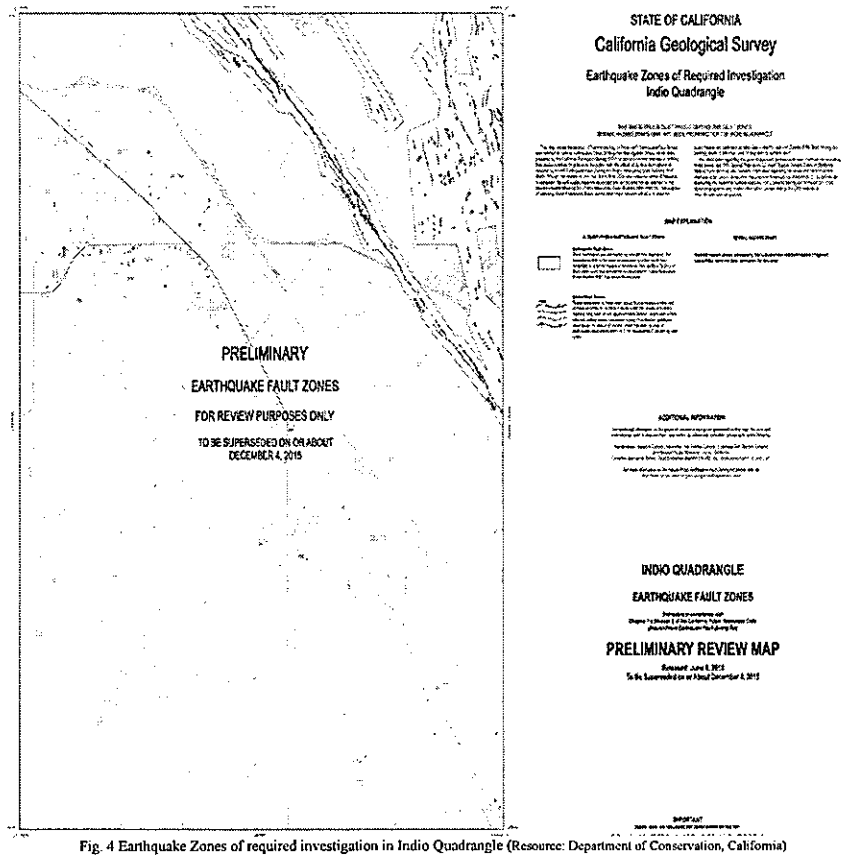

Fig. 4 Earthquake Zones of required investigation in Indio Quadrangle (Resource: Department of Conservation, California)

B. Japan

The Headquarters for Earthquake Research Promotion [11] based upon observation, measurement, and survey to prepare "National Seismic Hazard Maps for Japan." The seismic hazard maps include two types of maps, "probabilistic seismic hazard maps" and "seismic hazard maps for specified seismic source faults." The "probabilistic seismic hazard maps" take the long-term possibility of earthquake occurrences and show the possibilities of strong shaking. The "seismic hazard maps for specified seismic source faults" assume a scenario for the rupture and show the distribution of strong shaking caused by individual earthquake.

Prof. Toshikata Sano promoted the construction of reinforced concrete buildings after investigating the building damage of the 1906 San Francisco earthquake. In 1919, the Urban Building Law and Urban Planning Law were promulgated to regulate buildings and city planning in Tokyo, Yokohama, Nagoya, Kyoto, and Kobe. In 1920, the Urban Building Law Enforcement Order limited the building height to 65 feet in residential areas and to 100 feet in non-residential areas. In the meanwhile, the Building Law Enforcement Regulations specified structural design requirements for timber, masonry, brick, reinforced concrete and steel construction.

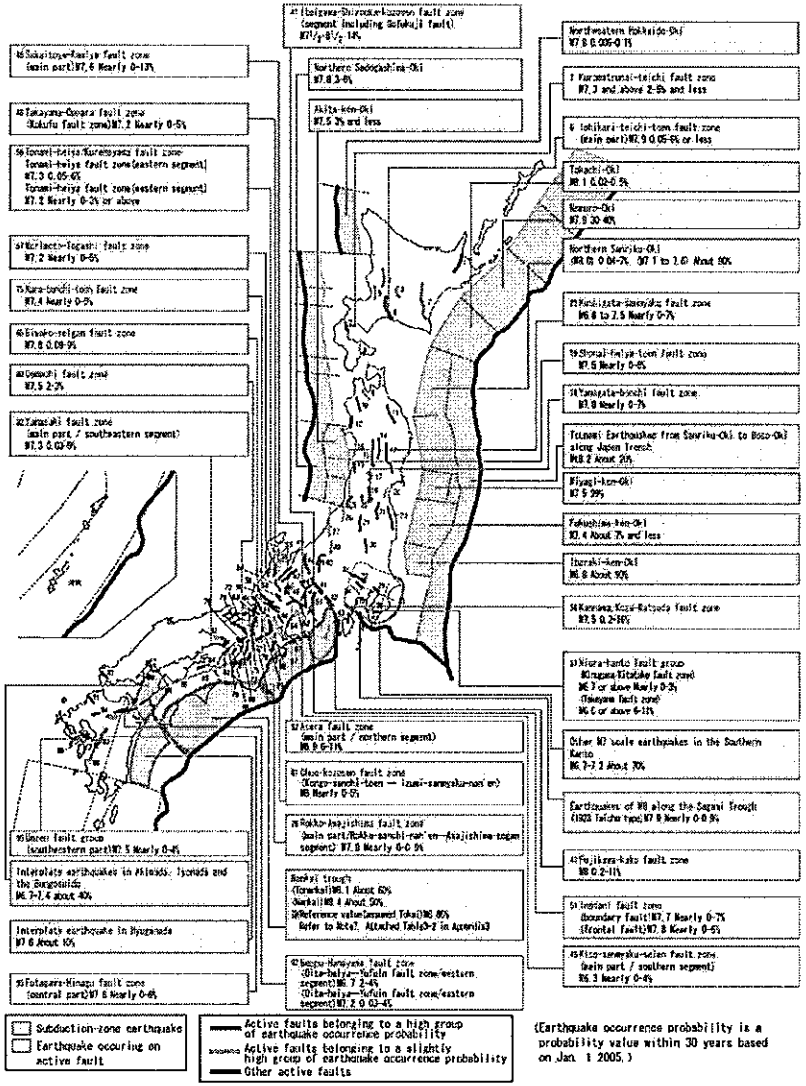

Fig. 5 The main long-term evaluation results of the 98 major active fault zones and regions of subduction-zone earthquakes (Resource: National Seismic Hazard Maps for Japan)

After 1923 Kano earthquake, significant damage was observed in steel and reinforced concrete construction. Due to 20% of reinforced concrete structures partial damage and 80% of reinforced concrete structures survived with light or no damage. In 1924, the revision of Urban Building Law Enforcement Regulations included the use of design seismic coefficient of 0.1 proposed by Prof. Toshikata Sano. In 1950, due to 1923 Kanto earthquake disaster, the Building Standard Law (replaced the role of the Urban Building Law) limited the building height of 100 feet and the design seismic coefficient was increased to 0.2. In 1963, the Building Standard Law Enforcement Order removed the building height limitation, and buildings taller than 45 meter was required the approval of the Minister of Construction. In 1981, the Building Standard Law Enforcement Order then revised to relax the height limitation to 60 meter required the approval of the Minister of Construction.

III. RESEARCH DESIGN AND METHODOLOGY

A. Study area

The interaction of the Eurasian and Philippine Sea plates causes the frequent rate of earthquakes. In Taiwan, there are 20 faults belonged to the Holocene active fault, and 13 faults belonged to the Late Pleistocene active fault, and 4 faults belonged to concealed or inferred. 90% of Taiwan's 23 million people live in the west island.

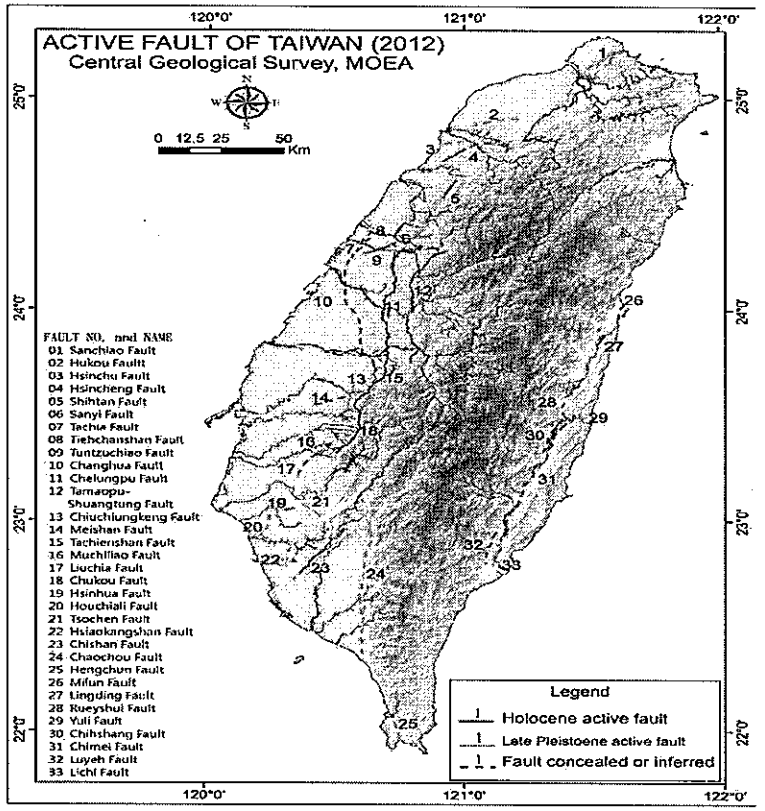

Fig. 5 Active fault of Taiwan (Resource: http://fault.moeacgs.gov.tw/TaiwanFaults_2009/PageContent.aspx?type=C&id=5)

B. Research design

Earthquake disaster is a joint product of nature and human society, and such can be revised by humans but is not ultimately reducible to a human construction. In addition, most active earthquake faults have been confirmed after city has been built on upon but they are centers of human opportunities as well. Thus, preparing for potential earthquakes requires an improved understanding of how varied of earthquake exposure (associated with location, depth, and magnitude) and vulnerability people or places are located, and potential urban development areas might be useful to not only mitigate earthquake risk but guide appropriately on urban development. Overall, a more compatible land use and the public on managing risks is the ultimate goal.

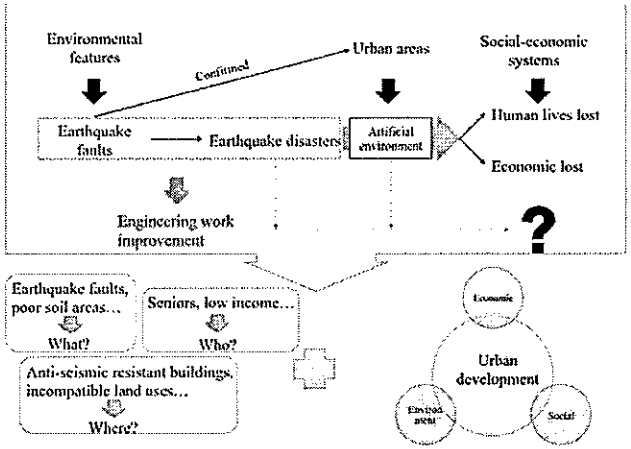

Fig. 6 Research design framework

C. Methodology

a. Principle component analysis

PCA, which was developed by Pearson in 1901 [12], has been commonly employed in the social and physical sciences, and the details of extracting components for a data matrix and their interpretation have been presented by Hotelling [13]. The basic theory behind PCA is to transform a set of correlated variables into a set of uncorrelated variables by linear transformation. PCA is independent of any hypothesis of data probability distribution and is generally applied to highlight patterns within multivariable data [14]. PCA has several advantages, such as flexibility in the data reduction process and the ability to retain important patterns among multivariate data.

The total variance is unchanged via orthogonal linear transformation. The first principle component (PC) is designed to have the largest variance, and the second principle component the second largest variance. The ranking of the PCs is based on the eigenvalues that are associated with each PC. This mathematical transformation identifies p variables that account for the total variability, which are divided into p PCs. The choice of the number of PCs is subjective and based on the extent that PCs are interpretative [15].

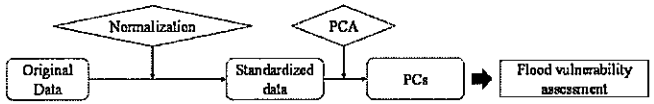

Fig. 6 Technical flow chart of flood vulnerability PCA

b. Geographic weighted principle component analysis

Many studies have disregarded spatial characteristics [16] in the data and have simply applied a standard PCA; the resulting operational scale is global [17]. However, spatial effects may provide a more complete understanding of a given process. For studies concerning spatial analysis, PCA can be replaced with GWPCA for a specific spatial heterogeneity. A well-known application of GWPCA is provided by Lloyd's study, which extended the work of Fotheringham et al. in 2002 [18].

In GWPCA, localized PCA is computed and continuously varied over space. A set of means, variances and covariance that are related to geographical weights is generated for each data location around the means and is calculated in GWPCA [19]. GWPCA follows the notations of Fotheringham et al. [19]; the vector of observed variables at location i has coordinates (u, v). To obtain a GWPC, the decomposition of the GW variance-covariance matrix provides the GW eigenvalues and eigenvectors.

The decomposition of the GW eigenvalues and eigenvectors occurs as follows:

$$L(u_i, v_i)V(u_i, v_i)L(u_i, v_i)^T = \Sigma(u_i, v_i) \ldots\ldots\ldots (1)$$

where is a matrix of GW eigenvectors, and is a diagonal matrix of GW eigenvalues. The matrix of GW component scores T can be calculated as

$$T(u_i, v_i) = XL(u_i, v_i) \ldots\ldots\ldots (2)$$

where the product of the i^{th} row of the data matrix with the local eigenvectors for the i^{th} location provides the i^{th} row of local component scores.

The estimation of the bandwidth is a major challenge in GWPCA. Two measures of bandwidth are available in GWPCA: a fixed-distance kernel and an adaptive kernel. A fixed-distance kernel indicates a constant radius that is centered on each observation. An adaptive kernel selects a constant number of neighbors without considering distance. In this study, we applied a fixed-distance kernel to discuss the validity of the interpretations. The results of the GWPCA models were tested. Monte Carlo simulations and spatial autocorrelation have commonly been employed for this purpose [20]. We utilized Monte Carlo simulations to generate random variables.

IV. Contribution

Earthquake disaster is a joint product of nature and human society, and such can be revised by humans but is not ultimately reducible to a human construction. In addition, most active earthquake faults have been confirmed after city has been built on upon but they are centers of human opportunities as well. Thus, preparing for potential earthquakes requires an improved understanding of how varied of earthquake exposure (associated with location, depth, and magnitude) and vulnerability people or places are located, and potential urban development areas might be useful to not only. mitigate earthquake risk but guide appropriately on urban development. Overall, a more compatible land use and the public on managing risks is the ultimate goal.

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Extraction, Synthesis, Characterization and Antioxidant Properties of Oxidized Starch from an Abundant Source in Nigeria

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***Abstract*—Starch** has gained interest as a renewable and environmentally compatible polymer due to increase in its use. However, starch by itself could not be satisfactorily applied in industrial processes due to some inherent disadvantages such as its hydrophilic character, poor mechanical properties, its inability to withstand processing conditions such as extreme temperatures, diverse pH, high shear rate, freeze thaw variation and dimensional stability.

The range of physical properties of parent starch can be enlarged by chemical modification which invariably enhances their use in a number of applications found in industrial processes and food manufacture. In this study, *Manihot esculentus* starch was subjected to modification by oxidation. Fourier Transmittance Infra- Red (FTIR) and Raman spectroscopies were used to confirm the synthesis while Scanning Electron Microscopy (SEM) and X- Ray Diffraction (XRD) were used to characterize the new polymer. DPPH (2, 2-diphenyl-1-picryl-hydrazyl-hydrate) free radical assay was used to determine the antioxidant property of the oxidized starch.

Our results show that the modification had no significant effect on the foam capacity as well as on the emulsion capacity. Scanning electron microscopy revealed that oxidation did not alter the predominantly circular-shaped starch granules, while the X-ray pattern of both starch, native and modified were similar. FTIR results revealed a new band at 3007 and 3283cm-1.

Differential scanning calorimetry returned two new endothermic peaks in the oxidized starch with an improved gelation capacity and increased enthalpy of gelatinization. The IC50 of Oxidized starch was notably higher than that of the reference standard, ascorbic acid.

***Keywords*:** Antioxidant activity, DPPH, *M.esculentus*, oxidation, starch.

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Fast Authentication Using User Path Prediction in Wireless Broadband Networks

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***Abstract*—Wireless Interoperability for Microwave Access (WiMAX) utilizes the IEEE 802.1X mechanism for authentication. However this mechanism incurs considerable delay during handoffs. This delay during handoffs results in service disruption which becomes a severe bottleneck. To overcome this delay, our article proposes a key caching mechanism based on user path prediction. If the user mobility follows that path, the user bypasses the normal IEEE 802.1X mechanism and establishes the necessary authentication keys directly. Through analytical and simulation modeling, we have proved that our mechanism effectively decreases the handoff delay thereby achieving fast authentication.**

Keywords
Authentication, authorization, and accounting (AAA), handoff, mobile, User Path Prediction (UPP) and User Pattern.

1. INTRODUCTION

Wireless broadband networks have emerged as a promising wireless technology due to its high data rate, wide coverage, low cost and built in support for mobility. In spite of all the advantages, there are numerous security issues which may result in deployment challenges. A major security aspect is authentication. WiMAX offers a flexible means for authenticating Subscriber Stations and users to prevent from unauthorized use. One authentication mechanism supported by the IEEE 802.16e is the Extensible Authentication Protocol (EAP) based authentication. EAP based authentication uses a backend authentication server (AS) such as an authentication, authorization, and accounting (AAA) server, which allows users to choose an authentication method suitable for the existing credentials without requiring the authenticator to be updated to support each new authentication approach.

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With most applications being driven by highly mobile users, there is a need to study the mobility issue as part of the system. When a Mobile Station (MS) handovers from one Base Station (BS) to another, the MS will perform a full EAP authentication with the AS. This involves a series of steps which can be summarized as a 3-way handshake with BS and finally exchange the Traffic Encryption Key (TEK). However, EAP mechanism takes excessive time due to its public key cryptographic operations. Also, the Round Trip Time (RTT) associated with every handoff is time consuming. Any failure in this process may lead to session termination due to any of the reasons such as latency or lack of resources. In order to reduce the handover latency, mobile WiMAX supports handover optimization, allowing users to reuse key materials from previous authentication. However, it creates critical security issues such as a lack of valid entity authentication.

Various solutions that are aimed at improving latency resulted in security compromise. Shing et al. proposed a key caching mechanism to speed up the handoff for mobile WiMAX. With this mechanism, when an MS leaves the old ASN-GW, the MS key record is cached in the old ASN-GW. If the MS returns to the old ASN-GW before the MSK lifetime expires, it can reuse the MSK without executing the IEEE 802.1X authentication. On the other hand, the old ASN-GW consumes extra storage to maintain the MS key records when the MS leaves the old ASN-GW. This is considered as a major overhead. Re-authentication can avoid a full EAP-based authentication in handover by reusing the information exchanged between the MS and the AS in the previous authentication. The EAP re-authentication protocol (ERP) allows MS and the AS to use the extended master session key (EMSK) from previous EAP authentication for master session key (MSK) derivation. Thus, instead of carrying out a full EAP authentication, the MS and the AS will only need a single round trip to exchange the ERP messages. This reduces the overhead considerably. Discarding the other issues, our paper is aimed in improving the efficiency of authentication thereby achieving seamless handover in mobile WiMAX. This paper is organized as follows. The basic authentication mechanism using EAP is described in section 2. The core purpose of this paper and the proposed work is mentioned in section 3. The formal verification using probabilistic distributions and the performance analysis of our proposal are presented in Section 4 and Section 5, respectively. And finally, in Section 6, we conclude the paper along with the future work.

2. RELATEDWORK

2.1. EAP Framework and Authentication

The basic authentication in WiMAX is carried out using the Authentication Authorization and Accounting (AAA) server. EAP is used for this basic authentication and it is encapsulated in Privacy Key Management (PKMV2). IEEE 802.1X authentication scheme is used for the initial network entry as in Figure 1. The basic process of authentication is through ASN-GW which serves as the authenticator for MS. It forwards the authentication messages between the AAA server and the MS. ASN-GW stores information after authentication. The authenticator sends the EAP request message to MS which in turn responds with the EAP response and the user identity (AAA server address and user account). The message is then forwarded to AAA server using the AAA server address. Then the AAA server issues an EAP request to MS, MS responds with a random number MS-RAND. The AAA server contacts Home Location Register (HLR) to obtain a RAND number and generate a Singed RESponse (SRES) and a cipher key K_c. The AAA then utilizes the K_c and MS-RAND to compute Master Session Key (MSK) and EAP integrity key K_{EAP}. Message Authentication Code (MAC) is derived from K_{EAP} and the AAA sends the MAC and the RAND to MS. The MS then uses the RAND, MS-RAND and K_i (from sim card) to generate its SRES*, K_c, MSK, K_{EAP}. Then it verifies the MAC it received from AAA server. This ensures that AAA server is authenticated. The MS then responds with MAC*, SRES*, K_{EAP}. The AAA also verifies the MAC* using the SRES. This ensures MS is authenticated. The MSK, MSK lifetime and the MS authorization profile is sent to ASN-GW. The ASN-GW derives AK using the BS address and MSK. The MS informed with the authentication successful message. The BS then generates the Traffic Encryption Key (TEK) to ensure the integrity.

3. PROPOSED SCHEME

With fast moving users handovers occur more frequently and the available handover authentication mechanisms do deteriorate. To support fast moving users, we propose a key caching mechanism with User Path Prediction (UPP). Mobility of fast moving users is not always random. Most of the users follow a general pattern. This pattern can be extracted and can be used for authentication. The user mobility is logged in the User Database of the AAA server. Fast moving users following a general pattern will have frequent visits to some BSs. Every visit of the user will be logged and pattern mining algorithms can be used on these logs to determine the frequent pattern. Once the pattern is determined and every user is associated with his frequent pattern, the authentication keys can be given to the BSs in that pattern to facilitate fast authentication during handoffs. The authentication mechanisms based on UPP during the initial network entry and during handoffs are described below.

Case 1: Initial Network entry

Step 1. As with normal authentication mechanisms, all the steps of 802.1X authentication takes place during the initial network entry and the MSK is derived for the user (MS).

Step 2. Once the MS enters the network after its initial authentication, the frequent pattern of the MS is determined from the User Database log of the AAA server.

Step 3. The MSK established during the initial network entry is given to the BSs in the frequent pattern of the MS.

Case 2: Handover authentication

Step 1. The identity of the MS is examined by processing the certificate using certificate authority (CA).

Step 2. Once the identity of the MS is confirmed, the MSK obtained by the BS is used directly.

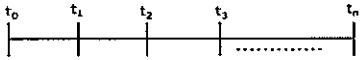
A detailed description of the message exchanges that occur in UPP based handoff authentication is described in figure 2.

4. MATHEMATICAL ANALYSIS

4.1. Systematic analysis of existing algorithm with UPP

Although this proposed algorithm effectively avoids the execution of IEEE 802.1X authentication, it consumes extra storage to keep track of the user's pattern along with the key which includes 512 or 1024 bits totally. This can be justified with the fact that the actual time taken by the user to follow normal IEEE 802.1X authentication mechanism is gargantuan.

4.2. Movement time line of MS



Let,

t_0 – Initial network entry authentication occurs

t_1 – MS moves to a random ASN or new ASN

t_2 – MS moves via the predicted pattern

t_n – End point of mobility

Hence,

$$T_k = t_n - t_1$$

If MS does not take the path via pattern, the key remains unused.

If the MS follows predicted pattern, the time taken would be,

$$T_k^* = T_k - S, \text{ where } S = t_2 - t_1$$

T_k – Entire life time, which may vary exponentially

T_k^* - Reuse time period

As with any stochastic process, the comparison of IEEE 802.1X mechanism with UPP based mechanism can be accomplished by analyzing the time factor.

Three output measures are evaluated in our study:

1. α : the probability that the MS returns to the old ASN-GW
2. $E[T_k | (t_2 - t_1) \geq T_k]$: The MS doesn't take the predicted path
3. $E[T_k^* | (t_2 - t_1) \leq T_k]$: MS uses the path along the pattern

We derive the above output measures for exponentially distributed S with fixed T and then generalize the derivation for generally distributed S with exponentially distributed T.

A. Derivation for Exponentially Distributed S and Fixed T

Suppose that the departure of the MS from the old ASN-GW is a random observer to the MSK lifetime. For the fixed MSK lifetime T, from the residual life theorem, T_k has a uniform distribution over $0 \leq T_k \leq T$. Then, α is derived as

$$\alpha = P[T \leq T_k] = \int_{T_k=0}^{T} \left(\frac{1}{T}\right)\left(\int_{S=0}^{T_k} \lambda e^{-\lambda S} dS\right) dT_k$$

$$\alpha = \frac{e^{-\lambda T} + \lambda T - 1}{\lambda T}$$

$$E[T_k | S \geq T_k] = \frac{E[T_k \text{ and } S \geq T_k]}{P[S \geq T_k]}$$

$$E[T_k \text{ and } S \geq T_k] = \int_{S=0}^{T} \lambda e^{-\lambda S}\left(\int_{T_k=0}^{S} T_k \left(\frac{1}{T} dT_k\right)\right) + \int_{S=T}^{\infty} \lambda e^{-\lambda S}\left(\int_{T_k=0}^{T} T_k \left(\frac{1}{T} dS\right)\right) = \frac{1 - e^{-\lambda T}}{\lambda^2 T} - \frac{e^{-\lambda T}}{\lambda}$$

$$E[T_k | S \geq T_k] = \frac{E[T_k \text{ and } S \geq T_k]}{P[S \geq T_k]} = \frac{1 - e^{-\lambda T}}{\lambda^2 T} - \frac{e^{-\lambda T}}{\lambda}\left(\frac{1}{1-\alpha}\right) = \frac{1}{\lambda} - \frac{T e^{-\lambda T}}{1 - e^{-\lambda T}}$$

Similarly,

$$E[T_k^* | S \leq T_k] = \frac{E[T_k^* \text{ and } S \leq T_k]}{P[S \leq T_k]}$$

Where,

$$E[T_k^* \text{ and } s \leq T_k] = \int_{T_k=0}^{T} \left(\frac{1}{T}\right)\left[\int_{S=0}^{T_k} (T_k - S)\lambda e^{-\lambda T_k} dS\right] dT_k = \frac{T}{2} - \frac{1}{\lambda} + \frac{1 - e^{-\lambda T}}{\lambda^2 T}$$

From the above equations,

$$E[T_k^* \text{ and } s \leq T_k] = \left(\frac{T}{2} - \frac{1}{\lambda} + \frac{1 - e^{-\lambda T}}{\lambda^2 T}\right)\left(\frac{1}{\alpha}\right) = \left(\frac{T}{2} - \frac{1}{\lambda} + \frac{1 - e^{-\lambda T}}{\lambda^2 T}\right)\left(\frac{\lambda T}{e^{-\lambda T} + \lambda T - 1}\right) = \left(\frac{\lambda T^2}{2(\lambda T + e^{-\lambda T} - 1)}\right) - \left(\frac{1}{\lambda}\right)$$

B. Derivation for Generally Distributed S and Exponential T

T_k is exponentially distributed with mean $E[T] = 1/\mu$. Let S have an arbitrary distribution with density function f(S) and Laplace transform $f^*(S)$. Then, α is derived as

$$\alpha = \int_{T_k=0}^{\infty} \mu e^{-\mu T_k}\left(\int_{S=0}^{T_k} f(s) dS\right) dT_k = f^*(\mu)$$

$$E[T_k \text{ and } s \geq T_k] = \int_{S=0}^{\infty} f(s)\left(\int_{T_k=0}^{S} T_k \mu e^{-\mu T_k} dT_k\right) ds = \frac{1}{\mu} + \left(\frac{df^*(s)}{ds}\right) - \frac{f^*(\mu)}{\mu}$$

$$E[T_k | s \geq T_k] = \frac{E[T_k \text{ and } s \geq T_k]}{P[T_k | s \geq T_k]} = \left\{\frac{1}{\mu} + \left(\frac{df^*(s)}{ds}\right) - \frac{f^*(\mu)}{\mu}\right\}\left\{\frac{1}{1 - f^*(\mu)}\right\}$$

$$E[T_k^* \text{ and } s \leq T_k] = \int_{T_k=0}^{\infty} \mu e^{-\mu T_k}\left(\int_{s=0}^{T_k} (T_k - s) f(s) ds\right) dT_k = \frac{f^*(\mu)}{\mu}$$

$$E[T_k^* | s \geq T_k] = \frac{E[T_k^* \text{ and } s \geq T_k]}{P[s \leq T_k]}$$

5. PERFORMANCE MEASURE

The authentication mechanism based on User Path Prediction reduces the authentication latency by 32% for the given input than the existing IEEE 802.1X mechanism. Therefore on an average scale, the UPP based algorithm is proved to be better than the existing one considering fast authentication. When the availability of the cached MSK is considered, every time when the user deviates from the frequent path, the deviation is recorded and it is considered for determining the pattern, next time. The performance measure is found by taking the ratio of slope values of the vectors and parameters from the analytic proof discussed in the previous section. Based on the proof, a graph is constructed for both the mechanism and a comparison is made as shown in the figure 3 and figure 4. The graph is constructed based on the expectation value (E[t]) along horizontal axis and the total mobility time (t) along vertical axis. Values of UPP based mechanism for best case; average case and worst case are compared with the IEEE 802.1X mechanism and plotted in a planar graph. It is found that, under best and average case scenario, the UPP based mechanism is exponentially efficient with reduction in latency whereas in worst case scenario, it coincides with the existing work depicting the fact that, if the user does not have frequent path, or if the user is not frequently mobile, UPP based mechanism is not efficient and hence follows the standard procedure. For simulating the proposed model, the Network Simulator ns-2 is used. NS2 as such does not support WiMAX technology. Therefore the WiMAX patch with WiMAX 802.16 PHY and MAC functions for ns-2, provided by National Institute of Standards and Technology (NIST) is used. The performance evaluation based on the trace files of ns-2 is shown in figure 5. The RTT for authentication message exchanges between the UPP based authentication and normal IEEE 802.1x are plotted.

6. CONCLUSION AND FUTURE WORK

This paper proposed a caching mechanism where the keys are cached only along a predicted path. The most frequent pattern in the user's path is determined using suitable pattern predicting algorithm to minimize the computational complexity. The resources for authentication can be reserved along this pattern so as to reduce the wastage of resources and making authentication faster along the pattern as the resources are already reserved. The future work is aimed at analysing and extracting all the services that a user avails in a particular BS. This will allow us to provide only the services that the user frequently avails in a BS, thereby further optimizing the allocation of resources without compromising in security or handoff time.

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Feasibility of a Biopolymer as Lightweight Aggregate in Perlite Concrete

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***Abstract*—**Lightweight concrete is being used in the construction industry as a building material in its own right. Ultra-lightweight concrete can be applied as a filler and support material for the manufacturing of composite building materials. This paper is about the development of a stable and reproducible ultra-lightweight concrete with the inclusion of poly-lactic acid (PLA) beads and assessing the feasibility of PLA as a lightweight aggregate that will deliver advantages such as a more eco-friendly concrete and a non-petroleum polymer aggregate. In total, sixty-three samples were prepared and the effectiveness of mineral admixture, curing conditions, water-cement ratio, PLA ratio, EPS ratio and perlite ratio on compressive strength of perlite concrete are studied. The results show that PLA particles are sensitive to alkali environment of cement paste and considerably shrank and lost their strength. A higher compressive strength and a lower density was observed when expanded polystyrene (EPS) particles replaced PLA beads. In addition, a set of equations is proposed to estimate the water-cement ratio, cement content and compressive strength of perlite concrete.

***Keywords*—**Perlite concrete, poly-lactic acid, expanded polystyrene, concrete.

I. Introduction

PERLITE is a siliceous volcanic glass containing 2-5% combined water. It can be expanded about 4-20 times by transforming chemically bound water (2-5%) to vapour when subjected to temperature within its softening range (above 870 °C). Expanded perlite is a high porosity aggregate with lower density, lower thermal conductivity value, and higher sound absorption. Expanded perlite is also classified as an artificial pozzolanic material due to its glassy structure along with a high silicon dioxide (SiO_2) and aluminium oxide (Al_2O_3) content [1].

Perlite is not technically used in concrete yet [2], [3]. A number of experimental and analytical studies have been conducted on the effectiveness of perlite on physical and mechanical properties of fresh and hardened concrete [1]-[11]. It has been reported that expanded perlite is a proper artificial aggregate with potential uses as coarse and fine aggregate to produce lightweight concrete with a density of lower that 800 kg/m^3 [4], [5]. Ozkan et al. [2] have concluded that thermal conductivity and unit weight of perlite concrete significantly decreased as the expanded perlite is replaced with natural aggregate. In addition, the same trend was observed in terms of compressive strength and elastic modulus as the content of expanded perlite enhanced [2]. Moreover, increasing the amount of expanded perlite significantly increased the water absorption and sorptivity. Gurhan et al. [6] have concluded that expanded perlite is capable of being used as a lightweight construction material. Additionally, the effect of expanded perlite and hydroxypropyl methylcellulose (HPMC) on hydration heat of concrete has been investigated by Lei et al. [7]. They have found that expanded perlite causes a significantly delayed hydration induction period and an acceleration period of cement pastes. Demirboga et al. [8] have found that thermal conductivity of concrete is a factor of porosity and increasing the expanded perlite percentage resultant in a lower thermal conductivity value due to the porous structure of the perlite. This trend is observed in another study about the influence of perlite on thermal conductivity [9]. They have found that perlite brings down the density and thermal conductivity value of the matrix. Yu et al. [10] found that the addition of perlite powder significantly improved the high-freeze-thaw resistance, fire resistance and causes an increase in the alkali silica reaction of the matrix due to the microcrystalline quartz (mostly chalcedony) content of perlite. Bekir et al. [3] have reported that the mechanical properties of concrete increased as the ratio of perlite decreased. Turkmen et al. [11] have found that slump flow is a factor of viscosity and the addition of silica fume increases the cohesiveness of the matrix due to an increase in the number of solid-to solid contact points. The addition of expanded perlite aggregate (EPA) remarkably decreased the unit weight of the matrix mainly due the fact that EPA has a lower specific gravity compared with normal aggregate. Moreover, they have concluded that the capillarity coefficient of concrete depends on curing time, curing conditions and EPA ratio. Kotwica et al. [1] have reported that waste perlite significantly decreased the calcium hydroxide content and increased the amount of hydration products within hardened pastes.

EPS is inert, hydrophobic and a stable low density foam which is obtained from styrene monomer. EPS has an excellent resistance to alkalis, methanol, ethanol silicone oils, halide acids, oxidizing and reducing agents and partial resistance to paraffin oil, vegetable oils, diesel fuel and Vaseline [12]. It has been reported [12] that toxicity levels of EPS are less than other ordinarily used materials. Compared with wood, polystyrene foam produces almost the same amount or less toxic gas, carbon monoxide and carbon dioxide when subjected to an ignition source. A wide range of lightweight concrete densities can be produced by

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incorporating and substituting of a certain ratio of natural aggregate with EPS beads [13], [14]. Research on EPS concrete and EPS aggregate traces back to 1973 [15]. The extremely low density and hydrophobic nature of EPS beads constrains the application of EPS concrete. In fact, beads tend to float (10-20 kg/m^3) when used as lightweight aggregate and cause serious segregation and poor mix distribution in the matrix. The bonding additives such as epoxy resin (aqueous dispersions of polyvinyl propionate), water-emulsified epoxies [15], [16], and chemically treated EPS [17] particles are used to increase the interfacial bonding strength between beads and matrix. It was reported that mineral admixtures such as silica fume [18], [19], fly ash [20], [21] and ground granulated blast furnace slag were used as bonding additives to increase the interfacial bonding strength between beads and the matrix and to improve dispersion of EPS beads in the cement matrix [13]. It has been confirmed and reported that the compressive strength of EPS concrete is reduced as a certain amount of EPS beads replaces natural aggregate [12]-[27]. Ravindrarjah et al. [17] have concluded that the water-cement ratio of EPS concrete should be retained as low as possible to obtain the highest compressive strength. Moreover, EPS concrete exhibited acceptable resistance to chemical attacks such as calcium hydroxide, sodium sulphate and ammonium sulphate solution, and its resistance to 5% hydrochloric acid enhanced as the water-cement ratio decreased. Schachow et al. [22] have investigated the differences between mechanical properties of EPS and vermiculite concrete and concluded that an air-entraining agent and the lightweight aggregate volume directly affect the compressive strength and density of concrete. Lower compressive strength and density is obtained as the volume of EPS and foam is enhanced [23]. This trend can be due to the fact that lightweight aggregate has lower specific unit weight along with near zero strength and the fact that the air-entraining agent increases the porosity of concrete which causes a considerable reduction in the compressive strength of the matrix. Furthermore, vermiculite concrete shows a lower thermal conductivity value than EPS concrete due to higher porosity of vermiculite. However, EPS concrete has advantages in terms of water absorption ratio (almost zero) and unit weight (lighter than vermiculite). Chen et al. [24] have indicated that the inclusion of foam substantially enhances the slump value of EPS concrete as a result of the fact that foam reduces the bulk density of the matrix and increases the volume of cement paste. In addition, the introduction of foam with its small spherical bubbles acts as ball bearings in the matrix and reduces the internal friction between particles. They have also found that an increase in the volume of foam causes a decrease in compressive strength of concrete. Moreover, they have concluded that thermal and mechanical properties of EPS foamed concrete is a factor of cement content and EPS volume. Madandoust et al. [25] have found that the slump flow enhanced, when the volume of EPS is increased. The slump flow increased as a result of lower internal friction between cement paste and particles due to spherical shape, smooth surface and hydrophobic nature of EPS. The addition of nano-SiO_2 decreased the slump flow due to the fact that nano-SiO_2 has a higher surface area and promotes the packing of particles. This trend causes higher internal friction between the particles of the matrix resultant in a lower slump flow. The influence of nano-SiO_2 is reduced as the volume of EPS particles increased. Kan et al. [26] have concluded that the density of lightweight concrete is more sensitive to the slump flow value than the water-cement ratio. A higher compressive strength and density is observed as the cement-EPS ratio is increased.

The mechanical properties of chemically treated EPS lightweight concrete have been investigated by Ravindrarajah et al. [17]. They have concluded that a higher compressive strength and tensile strength is obtained with a lower water-cement ratio. In addition, the higher shrinkage value observed by inclusion of EPS aggregate is mainly due to the lower resistance of EPS particles, because of their smooth surface and spherical shape, to the shrinkage of the cement paste. Furthermore, polystyrene aggregate is a stable aggregate when subjected to calcium hydroxide, sulphate solutions and ammonium sulphate solutions. Xu et al. [27] have found that mechanical properties of EPS lightweight concrete are a factor of EPS volume, water-cement ratio, cement content and sand content. However, EPS volume and cement/sand content are the most and least important factors in design of EPS concrete. The lower degree of compaction and workability obtained with an increase in EPS volume is mainly due to the compressible nature and low unit weight of EPS. Compared with normal concrete, the failure mode of EPS concrete was more gradual. The stress-strain diagram of EPS concrete was almost the same as normal concrete. However, the length of the elastic segment and the slope of the stress-stain curve increased as the volume of EPS decreased.

One of the main problems associated with the use of polystyrene (such as EPS) is the environmental impact of this material. Millions of tons of waste polystyrene are produced by the packing industries. European countries prohibited EPS from landfills and manufacturing companies are responsible for collection and recycling of EPS in these countries [28]. As a matter of fact, EPS is non-biodegradable, resistant to photolysis and derived from non-renewable petroleum resources (according to EN 13432). In addition, pentane emission during the manufacturing of polystyrene products is another problem which considerably affects the environment. It has been stated [30], [31] that estimated volatile organic compounds (VOCs) escaping into to the atmosphere is about 250000 to 300000 tons/year. Moreover, increases in oil prices considerably affect polymer products prices as the polymers used in foams are mainly obtained from petroleum. Thus, the parameters such as environmental concerns, fluctuation of crude oil prices along with natural gas pricing on polymer markets causes a growing interest in developing materials with more environmentally friendly characteristics [28]-[32]. In order to eliminate the influence of petroleum polymer on the environment, and to replace non-renewable oil derived polymers with renewable bio-based resources, several bio-polymer materials were developed with non-petroleum materials. From all the available bio-polymers, PLA is one of

the readily available and a more cost-competitive bio-plastics which is progressively preferred as alternative for petroleum polymers (i.e. polyethylene, polypropylene and polystyrene) due to its eco-friendly profile and performance features. PLA is being introduced as foamed packing for food applications due to its advantages such as excellent insulation properties, good mechanical properties and its characteristics in terms of heat resistance or flame retardancy [12], [25]. Based on European standard EN 13432, PLA is considered and categorized as a sustainable and compostable polymer. PLA is produced through ring-opening polymerization of lactide and a dimer of lactic acid, which is derived from fermented corn starch. Moreover, carbon dioxide (CO_2) as an eco-friendly blowing agent is used for expansion of PLA polymer [28]-[32].

The paper aims to assess the feasibility of expanded poly-lactic acid (EPLA) lightweight aggregate as a proper substitution for petroleum polymer such as EPS and to produce a more economical and environmentally friendly ultra-lightweight concrete. In addition, no information is available on the performance of PLA concrete and its contribution as lightweight aggregate.

TABLE I
CHEMICAL COMPOSITION OF CEMENT AND SILICA FUME

Composite (%)	Ordinary Portland Cement (OPC)	Silica Fume (SF)
Silicon dioxide (SiO_2)	22.8	94.7
Aluminium oxide (Al_2O_3)	4.20	0.80
Iron oxide (Fe_2O_3)	2.30	0.50
Calcium oxide (CaO)	64.8	0.91
Magnesium oxide (MgO)	1.00	0.27
Sodium Oxide (Na_2O)	0.19	-
Potassium oxide (K_2O)	0.49	-
Sulphur trioxide (SO_3)	0.42	-
Loss on ignition	0.76	2.00

TABLE II
COMPARING THE RESULTS OF TABLE OF INPRO AND PROPOSED EQUATION

Density	Provided Table (INPRO)			Proposed equation		
	w/c*	P/C*	Cement Content	w/c*	P/C*	Cement Content
576	0.79	1/4	376	0.79	1/4	376
488	0.96	1/5	301	0.95	1/5	300.5
432	1.07	1/6	252	1.10	1/6	252
352	1.43	1/8	188	1.42	1/8	189

w/c is water-cement ratio, P/C is perlite-cement ratio.

II. EXPERIMENTAL PROCEDURE

A. Materials

Portland cement type GP as per NZS3122:2009 with a 28-day compressive strength of 45.0 MPa is used as the main binding material for all the mixtures. Silica fume (with a SiO_2 content of 94.7%) replaces 15% of the cement content to increase the cohesiveness of the matrix, reduce the segregation and improve the compressive strength. It is worth mentioning that mineral admixtures, i.e. fly ash, silica fume and micro silica, reduce the porosity of concrete and improve the strength of the interfacial zone between the cement matrix and aggregates [20], [21], [33]-[36]. Three types of lightweight aggregate viz. EPLA, EPS, expanded perlite (EP) are used. The EP with a nominal size of 0-4 mm (SiO_2 content of 74%) is used as fine aggregate in this study. EPLA beads with a bulk density of 35 kg/m^3 and an average diameter of 5 mm was obtained from Scion (a crown research institute in New Zealand). A commercially available spherical EPS with bulk density and average diameter of 10 kg/m^3 and 5 mm is used as a comparison for PLA particles. In order to decrease the unit weight of light weight concrete and to reduce the shrinkage of perlite aggregate an air entraining agent (Sika air mix) from Sika.NZ is used with the dosage of 30-150 ml/m^3 of concrete weight. The chemical composition of cementitious materials is provided in Table I.

B. The Logic of the Mix Design

Design of lightweight concrete is complex due to the variation on lightweight aggregate properties. Normal concrete is mostly designed based on the water-cement ratio, while lightweight concrete is affected by specific absorption rates of lightweight aggregate and its bulk density. The ACI 211.2 standard [37] recommended two different methods for designing lightweight concrete. The weight method is used for concrete containing lightweight coarse aggregate and normal fine aggregate, while concrete containing coarse and fine lightweight aggregate or a combination of normal and the lightweight aggregate can be designed as per the volumetric method. However, the provided methods, relevant tables and guidelines are limited to a compressive strength of greater 20.7 MPa, which is much higher than compressive strengths of insulating ultra-lightweight concrete, which can be less than 2.0 MPa. In order to find an optimum mix ratio and to obtain a more practical mix ratio for insulating concrete such as perlite concrete, the following equations are proposed to estimate the water-cement ratio (1) and cement content (2) of perlite concrete by knowing the required density.

$$\frac{w}{c} = a = \frac{0.76\gamma^{0.0001\gamma}}{0.0001\gamma.\gamma^{0.5}} \quad (1)$$

$$\begin{cases} 1000 = \frac{(\frac{\gamma}{a})^{0.5}}{RD_c.RD_p}C + \frac{123a(\frac{a}{\gamma})^{0.5}}{RD_p}C + 10aV_p \\ \gamma = \gamma^{\frac{1}{1+a}}C + aC + RD_pV_p \end{cases} \quad (2)$$

where, γ is density of concrete (kg/m^3), a is water-cement ratio, C is cement content (kg/m^3), RD_C is relative density of cement, RD_p is relative density of perlite, V_p is perlite volume (m^3).

Provided table by Industrial Processors Limited (INPRO) New Zealand for mix proportions of perlite concrete and the results from proposed equations are compared in Table II. The results indicate that the proposed equation for mix design of perlite concrete provides a reliable estimate.

C. Mix Proportions

The mix proportions and target density values of the proposed concrete are shown in Table III. The sample with 100% perlite (100P0S1/4 and 100P0S1/6) is used as a

reference for PLA perlite and EPS perlite concrete. However, the mechanical properties of bio-polymer perlite concrete (PLA perlite) are compared with EPS perlite concrete to assess the differences between petroleum and bio polymer aggregate when used as lightweight aggregate in concrete. A total number of 63 samples with differences in water-cement ratio, PLA ratio, EPS ratio, perlite ratio, cement content, silica fume content and density are prepared. In addition, EP is used in the place of natural sand to reduce the unit weight of concrete.

TABLE III
MIX PROPORTIONS OF PERLITE, EPS PERLITE AND PLA PERLITE CONCRETE

P/C*	Target density (kg/m³)	Specimen	Cement (kg/m³)	Water (kg/m³)	Perlite (kg/m³)	PLA (kg/m³)	EPS (kg/m³)	Silica Fume (kg/m³)	Air-Entraining (m³)
1/4	576	100P0S1/4	376.0	300.0	185.0	0	0	0	0.0041
		75P25E0S1/4	376.0	275.0	138.7	0	2.5	0	0.0041
		75P25PL0S1/4	376.0	275.0	138.7	9.0	0	0	0.0041
		50P50E0S1/4	376.0	250.0	92.5	0	5.0	0	0.0041
		50P50PL0S1/4	376.0	250.0	92.5	18.0	0	0	0.0041
		25P75E0S1/4	376.0	225.0	46.2	0	7.5	0	0.0041
		25P75PL0S1/4	376.0	225.0	46.2	27.0	0	0	0.0041
1/6	432	100P0S1/6	252.0	270.0	185.0	0	0	0	0.0041
		100 P15S1/6	214.2	270.0	185.0	0	0	37.8	0.0041
		75P25E0S1/6	252.0	245.0	138.7	0	2.5	0	0.0041
		75P25E15S1/6	214.2	245.0	138.7	0	2.5	37.8	0.0041
		75P25PL0S1/6	252.0	245.0	138.7	9.0	0	0	0.0041
		75P25PL15S1/6	214.2	245.0	138.7	9.0	0	37.8	0.0041
		50P50E0S1/6	252.0	225.0	92.5	0	5.0	0	0.0041
		50P50E15S1/6	214.2	225.0	92.5	0	5.0	37.8	0.0041
		50P50PL0S1/6	252.0	225.0	92.5	18.0	0	0	0.0041
		50P50PL15S1/6	214.2	225.0	92.5	18.0	0	37.8	0.0041
		25P75E0S1/6	252.0	200.0	46.2	0	7.5	0	0.0041
		25P75E15S1/6	214.2	200.0	46.2	0	7.5	37.8	0.0041
		25P75PL0S1/6	252.0	200.0	46.2	27.0	0	0	0.0041
		25P75PL15S1/6	214.2	200.0	46.2	27.0	0	37.8	0.0041

P/C is perlite-cement ratio; w/c is water-cement ratio.

D. Test Methods and Curing Conditions

The perlite and cement were blended in a rotary mixer for about 1 min. Before adding water, an appropriate amount of air entraining agent was mixed with the required amount of water and then 70% of the mixed water (water + air entraining agent) were added to the perlite/cement mixture and mixed for 3 min. The remaining water was added to the mixture and mixing continued for about 5 min. The density and compressive strength tests were carried out on 100x200mm (diameter x height) standard cylinders as per ASTM C567 [38] and ASTM C495 [39], respectively. The cylinders were demoulded after 24±2 h. Two types of curing regimes, namely moist curing and air curing were chosen to assess the effect of the curing environment on mechanical properties of PLA perlite concrete. In the case of moist curing, the specimens were kept in water curing at 20 °C for the whole curing period and then oven dried at 110±5 °C for 24 h a day before the scheduled date of test (28 days), while air cured samples were kept in a laboratory environment for the whole curing period after demoulding.

III. TEST RESULTS AND DISCUSSION

A. Density

Density of lightweight concrete mostly depends on the bulk density of lightweight aggregate and the cement content. As expected, the density and strength of perlite concrete was reduced with an increase in PLA and EPS. In total four density ranges were obtained by replacing perlite aggregate with certain percentages of PLA and EPS aggregate. The density of dry concrete was varied from 532.5 kg/m³ to 374.4 kg/m³ and 439.3 kg/m³ to 266.5 kg/m³ for specimens with the perlite-cement (p/c) ratio of 1/4 and 1/6, respectively. Compressive strength tests (after 28 days) were carried out on air-dried samples. The unit weights of specimens in wet and dry conditions are shown in Table IV. The experimental results show that factors such as volume of perlite, water absorption ratio and PLA/EPS volume significantly affect the unit weight of concrete in the dried and fresh state. In the case of the 100% perlite sample, the unit weight was decreased from 645.2 kg/m³ to 532.5 kg/m³ and 542.0 kg/m³ to 439.3 kg/m³ for the concrete with p/c ratio of 1/4 and 1/6, respectively. The unit weight reduction was 99.6 kg/m³, 102.1 kg/m³, 85.5 kg/m³, 88.9 kg/m³, 75.7 and 75.5 kg/m³ in concretes containing 25% EPS, 25% PLA, 50% EPS, 50% PLA, 75% EPS and 75% PLA, respectively. Thus, the decline of unit weight in the dried state is an indication of a higher amount of open pores in the perlite structure. The PLA concretes were 3%, 15% and 27% lighter than perlite concretes, while an even higher reduction was observed in EPS concretes due to the lower unit weight of EPS beads.

TABLE IV
FRESH AND DRY DENSITY OF PERLITE, PLA PERLITE AND EPS PERLITE CONCRETE

P/C*		Target density (kg/m³)	Actual density (kg/m³)						
			100P	75P25E	75P25PL	50P50E	50P50PL	25P75E	25P75PL
1/4	Fresh	-	645.2	565.5	574.3	519.4	536.9	450.1	467.2
	Dry	576	532.5	487.5	472.2	433.9	448.0	374.4	391.7
1/6	Fresh	-	542.0	457.2	469.7	409.1	412.7	322.3	351.1
	Dry	432	439.3	359.1	385.6	323.9	332.5	266.5	290.4

P/C is perlite-cement ratio.

B. Compressive Strength

1. Influence of Perlite-Cement Ratio

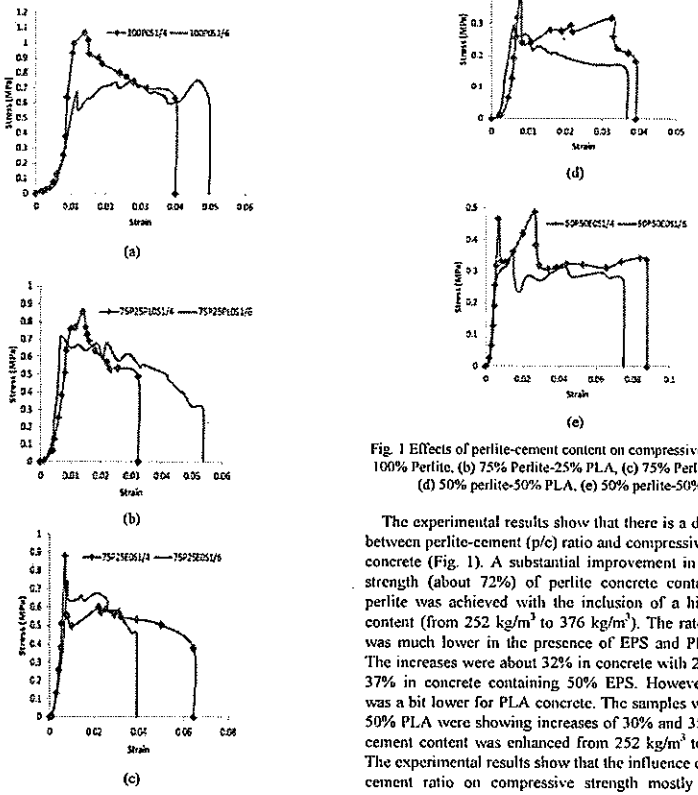


Fig. 1 Effects of perlite-cement content on compressive strength: (a) 100% Perlite, (b) 75% Perlite-25% PLA, (c) 75% Perlite-25% EPS, (d) 50% perlite-50% PLA, (e) 50% perlite-50% EPS

The experimental results show that there is a direct relation between perlite-cement (p/c) ratio and compressive strength of concrete (Fig. 1). A substantial improvement in compressive strength (about 72%) of perlite concrete containing 100% perlite was achieved with the inclusion of a higher cement content (from 252 kg/m³ to 376 kg/m³). The rate of increase was much lower in the presence of EPS and PLA particles. The increases were about 32% in concrete with 25% EPS and 37% in concrete containing 50% EPS. However, this trend was a bit lower for PLA concrete. The samples with 25% and 50% PLA were showing increases of 30% and 35% when the cement content was enhanced from 252 kg/m³ to 376 kg/m³. The experimental results show that the influence of the perlite-cement ratio on compressive strength mostly depends on aggregate characteristics and interfacial bond strength between components of the matrix. The interfacial zone between the aggregate and the paste significantly affects the stress-strain response of concrete under a uniaxial compression load. As a matter of fact, the micro cracks are initially starting to propagate at the interfacial zone which causes an increment in

strain rate rather than applied stress. This resulted in discontinuity of the interconnected network of matrix and aggregate, and thus a failure of the matrix. However, compared with normal concrete, the failure modes of lightweight concrete are considerably different. This can be attributed to the porous structure of lightweight aggregate and lower strength. The penetration of fresh cement into the open pores of lightweight aggregate resulted in higher interfacial bond between the components of the matrix. Moreover, the applied stress and micro cracks can propagate in the structure of aggregates and cause a higher deformability and strength. It is worth noting compressive strength of normal concrete is a factor of aggregate strength, while lightweight aggregate concrete mostly depends on the strength of cement and the interfacial zone of the matrix. In the case of polymer materials, the presence of hydrophobic aggregates such as PLA and EPS causes a lower compressive strength and lower interfacial bond. In addition, the compressible behaviour of PLA/EPS aggregate accelerates the propagation of micro carks and de-bonding failure of aggregates. Compared with EPS particles, the interfacial bond between PLA and the matrix was much lower due to the shrinkage of aggregate and alkali reactivity with cement paste during the hydration process (Fig. 2).

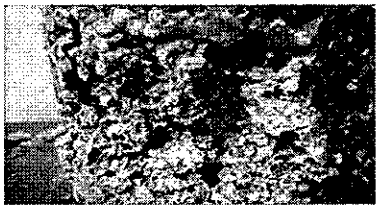


Fig. 2 Effect of alkaline environment on PLA aggregate

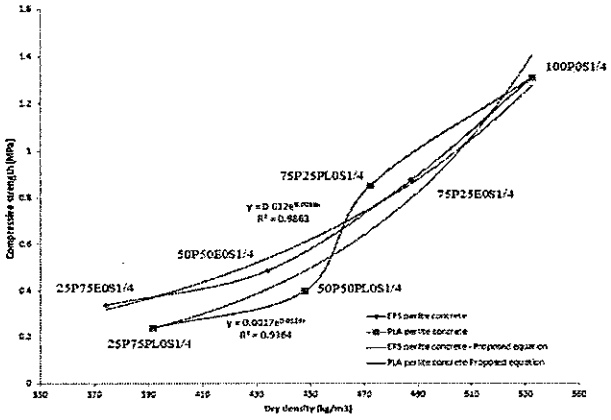


Fig. 3 Influence of EPS and PLA ratio on compressive strength of concrete

2. Influence of PLA and EPS Ratio

The variation of compressive strength with differences in perlite, PLA and EPS ratios is shown in Fig. 3. The results indicate that the strength of concrete was reduced with an increase in the PLA and EPS ratio. The compressive strength of the sample containing 25% PLA was 0.85 MPa, which was approximately 54% lower than the control sample (100% perlite). A further reduction in compressive strength was obtained with an increase in the PLA ratio. The compressive strength of 0.41 MPa and 0.22 MPa was obtained as 50% and 75% of perlite aggregate was replaced with PLA particles. This trend shows a considerable reduction of 219% and 495% in compressive strength of perlite concrete. In addition, most of the PLA beads easily de-bonded from the matrix due to close to zero interfacial bonds at the interface area of bead and paste. A lower reduction rate of 50%, 172% and 309% was observed in samples containing 25%, 50% and 75% EPS aggregate, respectively. This trend can be attributed to the proper interfacial bond between EPS beads and the matrix. Thus, the bond strength of the interfacial zone plays a significant role in the compressive strength of the matrix. The interfacial bond strength increased the compressive strength of concrete by 2%, 17% and 45% as the 25%, 50% and 75% of PLA aggregate was replaced with EPS aggregate. Moreover, samples containing PLA and EPS beads exhibited different behaviour and failure modes. In the case of EPS concrete, the failure mode was more gradual with the ability to retain the load after failure due to the compressible behaviour of EPS

beads. Contrary, a sudden disintegration was observed for PLA concrete, due to the close to zero interfacial bond strength between matrix and PLA beads through its alkaline reactivity with cement (Fig. 4). It can be noted EPS beads were sheared off along the failure plane due to proper interfacial bonds between EPS and the matrix, while all of the PLA beads were de-bonded from the matrix and collapsed suddenly. The following equation is proposed to estimate the compressive strength of EPS perlite (3) and PLA perlite concrete (4).

$$f_{cEPS} = 0.012e^{0.008\gamma} \quad (3)$$

$$f_{cPLA} = 0.0017e^{0.0126\gamma} \quad (4)$$

where, f_{cEPS} is compressive strength of EPS concrete, f_{cPLA} is compressive strength of PLA concrete, γ is density of concrete.

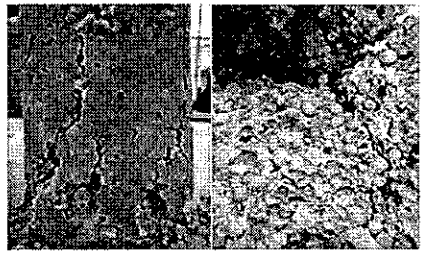
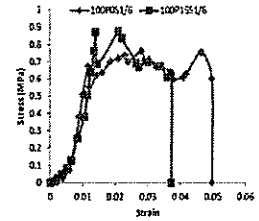


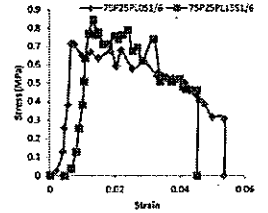
Fig. 4 Failure modes of PLA concrete

3. Influence of Silica Fume

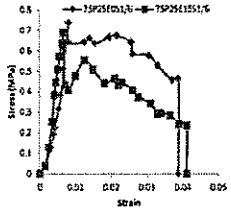
In order to solve the problem associated with the hydrophobic natures of PLA and EPS aggregate and to improve the cohesiveness of the matrix and the interfacial bond, a certain amount of silica fume (15%) was used in specimens with a perlite-cement ratio of 1/6 (Fig. 5). In the case of 100% perlite aggregate (control specimens), the compressive strength of concrete was increased by 15% with the inclusion of silica fume (Fig. 5 (a)). However, the substitution of mineral admixture imposes an inverse effect on compressive strength of EPS and PLA concrete. A decline of 6% and 64% was observed in compressive strength of sample containing 25% and 50% EPS aggregate (Figs. 5 (c) and (e)). This phenomenon can be attributed to the fact that the thermal resistivity of EPS particles and the inclusion of silica fume (SF) accelerate the hydration heat and the absence of adequate moisture at the initial stage of curing results in an incomplete hydration process and lower strength. This trend was different in PLA concrete. A considerable development in compressive strength (38%) was observed in a sample containing 25% PLA (Fig. 5 (b)), whereas the addition of SF imposes an inverse effect on concrete with a PLA volume of 50% (49% reduction, Fig. 5 (d)). It can be concluded that the alkaline reactivity of PLA and its sensitiveness to the alkaline environment accelerates its reaction in the presence of SF. However, there is no evidence available on the reactivity of PLA with SF of the matrix yet.



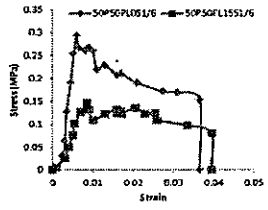
(a)



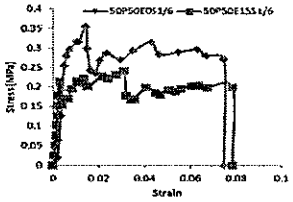
(b)



(c)



(d)

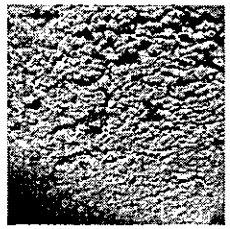


(c)

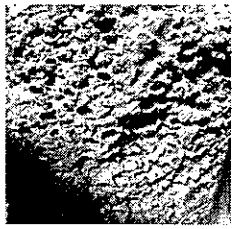
Fig. 5 Effects of silica fume on compressive strength: (a) 100% Perlite, (b) 75% Perlite-25% PLA, (c) 75% Perlite-25% EPS, (d) 50% perlite-50% PLA, (e) 50% perlite-50% EPS.

4. Influence of Curing Regimes

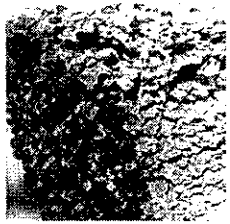
The curing of concrete plays a significant role in the performance and strength development of concrete. ACI-318 [40] has suggested that the concrete should be kept in a moist environment for at least the first seven days. The experimental results show that the compressive strength of perlite concrete after 28 days was decreased by 8% as the curing method was changed from air curing to moist curing. This trend can be attributed to the higher water absorption characteristics of perlite and the fact that sufficient water for an appropriate curing was held in the interior pore structure of perlite aggregate and the additional moisture affects the chemical interaction with the cement. In the case of aired cured samples, the pressure differences between voids of EP and cement is the main factor affecting the release of stored water. This free stored water eases the hydration reaction in air curing conditions. The results show that the inclusion of 25% EPS causes an increase in compressive strength from 0.87MPa to 0.90MPa as the curing method changed from air curing to moist curing. Whereas, a lower compressive strength (10% reduction) was observed in specimens made with 25% PLA. The influence of the curing method was more noticeable when the volume of PLA was increased (Fig. 6). The moist curing reduced the compressive strength of specimens with 50% and 75% PLA by 53% and 48%, respectively. An explanation might be the alkaline-reactivity of PLA with cement causes an expansion and increases the absorption ratio of PLA particles. After expansion, PLA particles were more sensitive to the moist environment and shrank up to three times of their original size. This reduces the formability of concrete and the holes around the PLA beads cause a stress concentration in this area. In contrast, the rate of reduction in compressive strength is much lower for concrete containing EPS particles. The effectiveness of moist curing was observed in specimens with 75% EPS particles as the compressive strength increased from 0.39MPa to 0.49MPa due to the thermal properties of EPS and better interfacial bond strength. Thus, PLA particles are sensitive to the alkaline environment of the cement paste and considerably shrank and lost their strength and moist curing becomes an inappropriate method for concrete containing PLA beads. In addition, a special curing is required for PLA concrete to obtain better durability. Finally, due to the sensitivity of PLA particles to a moist environment, it is recommended that perlite aggregate with its high water absorption ratio is used as a base aggregate for PLA concrete.



(a)



(b)



(c)

Fig. 6 Effect of moist curing on PLA perlite concrete: (a) contains 25% PLA, (b) contains 50% PLA, (c) contains 75% PLA

5. Stress-Strain Analysis

The stress-strain response is used as an indicator for material characteristics. It was reported that the stress-strain response of lightweight concrete with lightweight aggregate is typically linear until 90% of peak stress, while this value is around 30% to 45% for normal concrete. The factors such as maximum stress, (known as compressive strength, elastic modulus, peak and ultimate strength significantly affect the stress-strain response of concrete. Fig. 7 presents the stress-strain curve for perlite, EPS and PLA concrete with density ranges of 487 to 276 kg/m^3. The results indicate that the stress-strain relationship of the proposed concrete was almost linear until the peak point of stress. Compared with the stress-strain response of perlite concrete, PLA/EPS concretes show different responses in terms of higher deformability and compressibility. The stress-strain response of concrete can be divided into four stages of stiffness namely; elastic platform, elastic stage, strengthening stage and descending stage [41]. The slow rate of increment in strain and corresponding stress normally takes place in the elastic region mainly due to a collapse and compaction of the pore structure of the matrix and lightweight aggregate. The steepness of the elastic region was increased with compacting of more collapsed pores. The results show that an increase in EPS/PLA volume results in lower compaction stress due to the higher compactibility of PLA/EPS beads. A higher compaction stress was observed in perlite concrete, while this value was much lower in specimens with 75% EPS/PLA beads. The second, elastic stage, of stiffness is the linear part of the stress-strain response. The results show that the gradient and yield strength of the elastic segment significantly depends on the PLA/EPS ratio. However, a higher steepness is observed in specimens with PLA aggregate as a result of de-bonding in the interfacial area between matrix and PLA beads. All specimens show an oscillating manner in the strengthening stage due to the higher porosity of concrete, encapsulating of PLA/EPS beads along with generating of micro cracks at the interface of the matrix and particles. The stress was decreased and levelled off to a plateau at the descending stage. At this stage, the stress remains at an almost constant value, while the increment of strain can be seen. The fluctuation during the descending stage was due to the compressible behaviour of PLA/EPS beads, crashing and collapsing of remaining pores. Strain values of 0.008, 0.007, 0.014, 0.026, 0.08, 0.019 and 0.007 were obtained for specimens 100P0S, 75P25E0S, 75P25PL0S, 50P50E0S, 50P50PL0S, 25P75E0S and 25P75PL0S at the peak stress, respectively. The results indicate that a considerable increment in strain was observed when the volume of PLA/EPS increased. However, the strain of PLA concrete was much higher than EPS concrete. The higher strain (0.08) was observed in specimens with 50% perlite and 50% PLA. Whereas, an inverse effect on strain capacity was obtained as the volume of PLA enhanced from 50% to 75%. This decline can be attributed to the interfacial bond problem of PLA particles. Thus, the introduction of PLA/EPS aggregates improves the ductility and energy absorption capacity of concrete. However, a full disintegration after the descending segment and lower ductile behaviour was observed in concrete containing PLA particle.

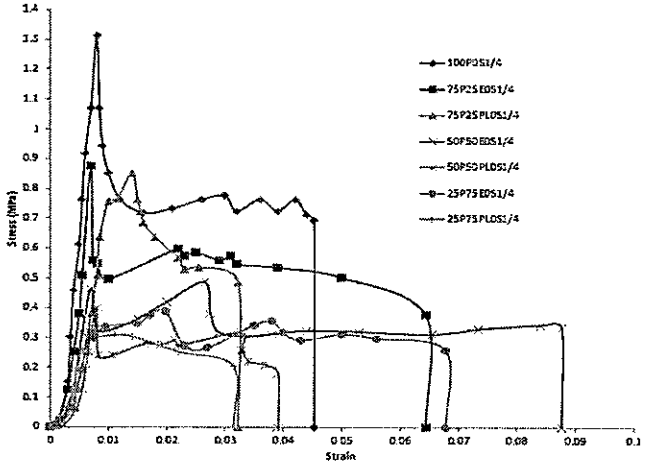


Fig. 7 Stress-strain response of perlite, EPS perlite and PLA perlite concrete

IV. Conclusions

Based on the experimental results from density, compressive strength and curing conditions of perlite, PLA perlite and EPS perlite concrete the following conclusions can be drawn:

1- The substitution of cement with 15% silica fume imposes an inverse effect on compressive strength of PLA and EPS concrete.
2- The density and strength of perlite concrete reduced with an increase in PLA and EPS.

3- The interfacial bond strength between PLA and EPS particles remarkably affect the stress-strain response of concrete.
4- Density ranges of 260 kg/m^3 and 290 kg/m^3 were obtained as 75% of perlite aggregate volume was replaced with EPS and PLA particles, respectively.
5- The cement content ratio and interfacial bond strength between matrix and lightweight aggregate directly affect the strength of lightweight concrete.
6- A considerable increment in strain was observed when the volume of PLA/EPS increased.

Comparison between PLA and EPS concrete can be summarized as:

1- The interfacial bond between PLA and the matrix was much lower.
2- PLA particles are sensitive to the alkaline environment of cement paste and considerably shrank and lost their strength.
3- Moist curing is an inappropriate method for concrete containing PLA beads.
4- The failure modes of PLA concrete were more brittle due to interfacial bond problems.

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