出國報告（出國類別：交流及參訪）

美國愛荷華州立大學進行國際學術及產學合作交流

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摘要

國立高雄第一科技大學自從與美國愛荷華州立大學 (Iowa State University, USA) 締約成爲姐妹校以來，皆以促進兩校國際合作及學術交流，以提昇本校之研究與教學水準。經本系陸續邀請美國愛荷華州立大學土木環工系教授蒞臨本校進行短期授課及講座，並進一步與本系教師共同開授國際遠距教學專業課程，由此可見，本校與愛荷華州立大學之學術交流極爲實質良好且密切。爲鼓勵校內教師積極參與國際學術研究，加強與國外修改學術機構建立實質且長久合作關係，提升學術研究水準及國際能見度。本計畫中之目的即爲進一步與該校洽談國際產學實務研發合作與交流、引進國外學程、鼓勵交換學生及深入進修，並與該機構討論進行研發與國際產學合作的機會，以進一步提出美國國家科學基金會 (NSF) 及我國國科會、以及相關部會之國際研究合作計畫。

關鍵字: 美國愛荷華州立大學 (Iowa State University), 國際研究合作, 學術交流

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一、前言及目的

國立高雄第一科技大學於 2004 年與美國愛荷華州立大學 (Iowa State University, USA) 締約成爲姐妹校，以促進國際合作及學術交流，提昇本校之研究與教學水準。2007 年本系曾於 6 月及 12 月二度邀請美國愛荷華州立大學土木環工系 Shihwu Sung 教授蒞臨本校進行短期授課及講座，之後更於 96 學年度第一學期與本系教師共同開授國際遠距教學專業課程，由此可見，本校與愛荷華州立大學之學術交流極爲實質良好且密切。

爲鼓勵校內教師積極參與國際學術研究，加強與國外修改學術機構建立實質且長久合作關係，提升學術研究水準及國際能見度。本計畫中將進一步與該校洽談國際產學實務研發合作與交流、引進國外學程、鼓勵交換學生及深入進修，採取雙聯學制，並與該機構討論進行研發與國際產學合作的機會，以進一步提出美國國家科學基金會 (NSF) 及我國國科會國際研究合作計畫。本次參訪及交流之預期效益如下：

一、建立與美國愛荷華州立大學之實質合作與交流機制，達到資源共享並提升研究水平的雙贏局面。

二、共同執行國際產學合作研究計畫，提本系學生海外實習機會，提升本系學術研究水準及國際能見度。此外亦可培養學生國際觀，啓發學生未來繼續深造之動力，同時可使學生瞭解國際上相關科系人才所需具備的專業知識及能力。

二、過程

若依照其進行的時序劃分，(一) 起始階段：與美國愛荷華州立大學連繫，由提案老師蒐集該姐妹校之相關系所的相關資訊,於相關研究專長及主題中徵求對方學校之意見與意願，並擬定研究主題與內容；(二) 實際交流訪問階段：派遣教師進行國外姐妹校相關系所實地交流訪問,並赴相關研究單位及業界進行實地拜訪及會商,參觀相關重點課程的教學、實驗及研究情況收集資料；(三) 與對方學校相關科系教授及業界廠商討論交流與產學合作機會，提出國際產學合作計畫書草案。(四) 建立國際交流與合作管道，以進行兩校間教師與學生的交流進修。推動學生海外實習或交換學生。(五) 撰寫與檢討階段：參訪後撰寫結案報告，以提供後續相關國際學術交流活動參考之用。

參訪交流行程：

7/4 搭機前往美國愛荷華州立大學 (DL-276→DL-620→DL-3003)

7/5-7/9 參觀校園，進行專題專題及講座。

1. 講題：Micro-Aeration for Sulfide Removal in Anaerobic Treatment of High Solid Wastewater: A Pilot-Scale Study, 演講者：Prof. Shihwu Sung
2. 講題：Enhancement of carbon monoxide mass transfer by hollow fiber membrane: An innovative reactor for syngas fermentation,
   演講者：Dr. Henry Lee
3. 講題：Anammox application for wastewater treatment,
   演講者： Samuel Cotter
4. 講題：Temperature-phased anaerobic digestion of wastewater sludges,
5. 演講者：Dr. Albert Chen

7/10-7/11 假日

7/12-7/16 系所實驗室及研究中心、業界廠商參觀訪問。

1. 參觀 Prof. Say-Kee Ong 實驗室
2. 參觀 Prof. Hans van Leeuwen 實驗室
3. 參觀 Prof. Shihwu Sung 實驗室及模廠試驗
4. 參觀 Prof. Timothy G. Ellis 實驗室
5. 參觀 Iowa Energy Center- Biomass Conversion Center
6. 參觀 Ames Water Pollution Control Facility

7/17-7/18 假日

7/19-7/23 與擬合作教授及業界廠商 (International Industries, Inc.) 交流討論，討論國際產學合作方向，撰寫國際產學合作研究計畫書草案，資料整理。

7/24 假日

7/25-7/26 搭機返國 (DL-4092→DL-619→DL-275)

三、心得與建議

1. 愛荷華州立大學介紹

愛荷華州立大學位於美國中西部愛荷華州的安姆斯 (Ames) 市，爲美國著名國際化大學之一，目前擁有學生數約 28,000 人，以及 約 100 個主修科系及學程。學生分別來自全美 50 個州和全世界超過 110 個國家。愛荷華州立大學 2010 於 US News & World Report 中，排名全美國家級大學第 50 名，其中的工學院爲全美排名第 38 名，土木環工系更於 2010 排名中爲第 20 名。愛荷華州立大學土木環工系主要之教育任務爲提昇學生土木營建及環境工程之學識、社會及倫理；以學生使創造並連繫工程概念與技術。該系在課程設計上主要以提供學生終身職場必須地且持續地面對之技術與管理上的學識與技能。愛荷華州立大學土木環工系中，共分成五個分組，分別爲環境工程組、營建工程組、大地工程組、結構工程組及運輸工程組。其中環境工程組由 8 教授組成，其主要之研究領域包括：

(1) 飲用水及水再利用之物化處理技術

(2) 都市廢水、污泥處理及氮磷去除

(3) 工業及農業廢水之厭氧處理

(4) 工業廢水之物化及好氧氧處理

(5) 廢水及廢棄物之能資源回收

(6) 人爲及自然環境中污染物傳輸

(7) 污染場址復育技術

(8) 污染預防及減廢

愛荷華州立大學土木環工系環境工程組各教授之研究主要是朝向工程及自然環境中物理、化學及生物基礎原理之通曉，同時各研究主題皆強調實際應用。實驗研究規模從實驗室規模 (bench-scale)、模廠 (pilot-scale) 到實廠 (field-scale) 皆十分強調。甚至

於電腦規劃模擬亦有所專長。愛荷華州立大學土木環工系認爲研究工作爲工程教育中重要且特有之優點，因此該系非常重視教授與研究生與業界或其他組織單位之產學合作，以追求研究技術之創新。本人心得爲本校或本系之師資及研究專長應該具有合縱連橫，相輔相成之特色與思維，以更能符合目前國際學術及產業界之潮流與改變；同時更應重視基本學術理論，強化產官學間之合作與交流，使的教師與學生皆能學以致用，卓越創新，使此才能更向頂尖大學或學系(研究中心) 之路邁進。

2. Iowa Energy Center- Biomass Conversion Center 介紹

愛荷華能源中心 (Iowa Energy Center, IEC) 之主要任務及功能爲經由研究、教育與示範以促進愛荷華州之能源使用效率以及開發可再生能源(Renewable Energy)。目前該中心所投入之資源都以追求愛荷華州未來能源之穩定供應爲主，並且透過一致性之願景與具研究基礎及平衡概念之資訊傳播，IEC 都能持續地補助愛荷華州社區、商業及個人。IEC 所補助之人員及計畫正使愛荷華州之現在及未來產生很大的改變，同時該中心所補助之計畫將可使居民瞭解如何使家庭生活更舒適而且這些是居民都能身體力行的。該中心剛開始時主要是在幫助愛荷華州之商業及工業在能源使用方面更具效率，以提高生產力及獲利。愛荷華能源中心亦位於愛荷華州的安姆斯 (Ames) 市，臨近愛荷華州立大學，主要任務包括：

(1) 追求能源使用效率之提昇

(2) 成爲政府單位致力於減少能源進口及非可再生能源依賴之典範

(3) 引導及支助能源效率及節約能源之研究

(4) 引導及支助可再生之替代能源發展研究

(5) 協助居民評估能源效率及替代能源生產之技術

(6) 支持實行能源效率及替代能源生產之教育與示範計畫

生質物 (biomass) 泛指由生物產生的有機物質，例如木材與林業廢棄物如木屑等；農作物與農業廢棄物如黃豆莢、玉米穗軸、稻殼、蔗渣等；畜牧業廢棄物如動物屍體；

都市廢棄物及污泥；工業有機廢棄物如有機污泥、廢塑橡膠、廢紙、造紙黑液等。生質能就是利用生質物經轉換所獲得的電與熱等可用的能源。生質能是一種新能源，與風能、太陽能一樣具有取之不盡、用之不竭的特性。與其他新能源比較，生質能因使用材料爲廢棄物，故兼具廢棄物的回收處理與能源生產的雙重效益。然而，由於近年來國際原油價格不斷上漲，各國已經轉向尋找替代能源，包括從玉米及甘蔗等糧食原料提煉生質能源以代替石油，但也因此造成糧食價格飆升，各國均擔心糧食短缺危機因而接踵而至。因此，愛荷華能源中心正積極開發第二代生質燃料，亦即非糧食性質之生質能源材料。本人心得爲本校或本系更應致力於可再生綠色能源之研究與開發，發展經濟且可行之生質物能源化技術，以達環境保護、二氧化碳減量與能源再生之多重目的。對於降低溫室氣體排放量及開發生質能源之技術及研究亦需給予支持、鼓勵及協助。

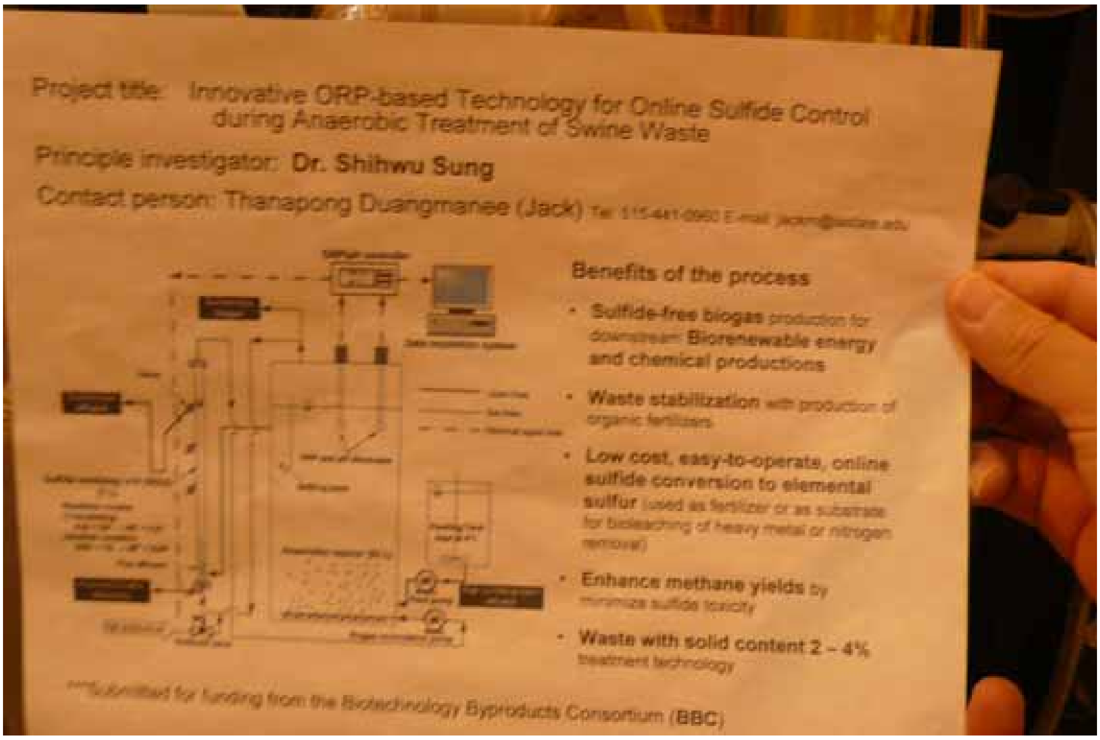
3. 兩校未來國際研究合作議題及方向

本次藉由美國愛荷華州立大學進行國際學術及產學合作交流參訪土木環工系系重點實驗室參觀導覽，瞭解國外優質大學之研究軟硬體設備及環境之優點及特色。同時，藉由國外環境工程產業界實廠參觀，瞭解環境工程產業界之特色及動態，並與業界廠商 (International Industries, Inc.) 討論交流與產學合作機會，並收集並帶回相關研究資料 (如附錄二)。而在愛荷華州立大學土木環工系教授與研究生之專題演講及講座，充分瞭解國外學術研究重點以及未來研究合作之發展方向。經與愛荷華州立大學土木環工系教授暨環工組召集人 Dr. Shihwu Sung 溝通討論後，本校與該系已共同提出國際產學合作計畫書構想書--整合式豬糞尿資源化處理系統，預計申請美國或台灣相關部會之研究計畫經費補助。同時目前仍在洽談共同合作進行「合成氣 (Syngas) 發酵產丁醇及有機酸回收」之研究計畫。另一方面，Dr. Shihwu Sung 洽談後，對方已答應願意自 2011 起雙方系所互相交換學生及教師以進行學術研究交流合作。毫無疑問本校與該系的雙方交流正在積極全面的擴展中，其成就是指可待的。

附錄一、成果照片

照片 1. 愛荷華州立大學土木環工系 Micro-Aeration for Sulfide Removal Bioreactor (1)

照片 2. 愛荷華州立大學土木環工系 Micro-Aeration for Sulfide Removal Bioreactor (2)



照片 3. 愛荷華州立大學土木環工系 Micro-Aeration for Sulfide Removal 概念圖

照片 4. 愛荷華州立大學土木環工系 Temperature-phased anaerobic digesers for wastewater sludge (bench-scale)

照片 5. 愛荷華州立大學土木環工系畜牧廢棄物厭氧消化槽廠址 (field-scale)

照片 6. 愛荷華州立大學土木環工系畜牧廢棄物厭氧消化槽 (field-scale)

照片 7. 愛荷華州立大學土木環工系畜牧廢棄物厭氧消化槽之廢氣回收處理系統 (field-scale)

照片 8. 愛荷華州立大學土木環工系畜牧廢棄物厭氧消化槽之污泥餅 (field-scale)

照片 9. Ames Water Pollution Control Facility 廢水生物處理單元

照片 10. Iowa Energy Center- Biomass Conversion Center

附錄二、國外攜回之相關資料

Innovative Sequencing Batch Aerated Lagoon Process

Study Background

This study was conducted at the City of Dunlap WWTF, IA. The City was issued one construction permit in May 2006 to install 10 units of the Aqua-Vac air inductors into the two lagoon cells. Each cell has the same storage volume of approximately 9.5 million gallons not counting the bottom two feet. The maximum operational depth is 7 feet. The population of Dunlap in 2007 was 1112. The purpose for installing the Aqua-Vac air inductors was to enhance the evaporation rate of wastewater in the lagoon cells. The Dunlap WWTF could not comply with IDNR's 180 days storage requirement as a controlled discharge lagoon. The City did their own study and found out the storage volume could be increased through the operation of the Aqua-Vac air inductors. Through reviewing the submitted documents, Iowa DNR issued one construction permit for a two-year trial period. The 10 units of 3-hp Aqua-Vac air inductors were installed in September 2006.

Each 3-hp air inductor is composed of one 2-hp air blower and one 1-hp submersible pump. The pump draws low D.O. water from the lower pond bottom. Air is introduced into the air inductor, which is a narrow passage tube, and creates a negative pressure in the air tube. This design allows all of the air produced by the blower to be transferred into the air inductor and mixed with the low D.O. wastewater at the emulsion tube. The schematic of the Aqua-Vac air inductor is shown in Figure 1.

The performance of this new installation was closely monitored. Michael Chyi (IDNR Wastewater Engineering Section) visited the treatment site at the end of September 2007. This was his first visit after the installation. The liquid level and effluent structure were checked. The operator Tony Warnock was at the site when Michael Chyi visited.

Nothing really happened until March 2008. The manufacturer of the Aqua-Vac air inductor, Don Frankl, DNR Michael Chyi, and the City of Dunlap decided to study the evaporation rate by isolation of one lagoon cell beginning from the predetermined liquid level. Before the evaporation began, we also measured the D.O. profiles in both lagoon cells beginning on March 23, 2008. All of the Aqua-Vac air inductors had been shut down since the end of the fall drawdown in 2007. They were all turned back on March 23, 2008 after the measurement of D.O. profiles was finished. The results of the six-time D.O. profiles are in the appendix A.

The First Testing

The inter-cell valve was completely closed on April 28 as the necessary preparation for the evaporation study. For the convenience of starting the two lagoon cells, the primary cell is named South Cell and the secondary cell is named North Cell. In addition, since each cell is operated individually, it is not appropriate to use primary and secondary cell. The North Cell finished drawdown on May 13th and the waste feeding was alternated from the South Cell to North Cell. Accordingly, the South Cell was isolated beginning on May 13th. Samples were taken near the effluent structure by Tony Warnock (WWTF operator) from the South Cell and they were sent out to the certified lab. The results of ammonia are shown in Table 1.

Date	Ammonia (mg/L)
5/13/08	13
5/20/08	4.8
5/27/08	<0.2

The South Cell had reached very low ammonia concentrations and could be discharged at any time. The South Cell was kept running for the evaporation study. At that time, the concept of this new process had not been developed yet. We had no idea that this process could achieve. E. Coli below 100 # org./100 ml.

The June flooding this year had forced us to adjust the plan because the South Cell had accumulated rainfall more than one foot in one week. We decided to discharge the South Cell and isolate the North Cell for the evaporation study. The South Cell finished its drawdown on August 1. During the South Cell drawdown, the waste feeding was entering into the South Cell to allow the evaporation study using the North Cell. The North Cell was isolated on July 1. We did not take samples during the South Cell drawdown for the ammonia test because rainfall had greatly diluted the treated wastewater. Besides, we had tested the ammonia concentration when the South Cell was isolated.

The Fall Drawdown Testing

Don Frankl brought up the possibility for the compliance with E. Coli limits using this process. After discussion, measurement of E. Coli was included in this study. We also wanted to know what the total nitrogen removal this process could achieve. The North Cell was ready to discharge in October when the South Cell was reaching the full liquid level. The North Cell started drawdown on October 10. A pre-drawdown sample was taken on September 29. The results of the three samples are shown in Table 2.

Table 2

Date	Ammonia	Nitrate+Nitrite	TKN	E. Coli	$CBOD_5$
9/29/08	<0.2			<10	17
10/13	<0.2	0.2	7.7	<4	
10/20	<0.2			22	23

The 10/20/08 sample was taken when the liquid depth was less than 2 feet. It is possible that the E. Coli number at the bottom of the pond is higher than the E. Coli number in the liquid. The data has shown that the process can produce very low E. Coli numbers in the effluent at the fall drawdown. The total nitrogen in this study was less than 8 mg/L.

The Third Testing

The North Cell finished the drawdown process on 10/21. We decided to isolate the South Cell on 10/31 and alternate the waste feeding to North Cell on 10/31. Three samples were taken from the South Cell after the isolation had begun. Table 3 shows the results of the different parameters.

Table 3

Date	Ammonia	Nitrate+Nitrite	TKN	E. Coli	$CBOD_5$
11/3/08	<0.2	0.67	7.7	1390	19
11/13	<0.2			37	
11/20	<0.2			10	

These samples were taken after the South Cell had been isolated. Based on the results, the South Cell could discharge the effluent at any time after November 20th and comply with the most stringent ammonia and E. Coli limits. The South Cell is planned to be discharged at the end of January and the North Cell will be isolated beginning early February.

The Fourth Testing

We could discharge the South Cell after November 13, 2008 but we did not do that because we left the South Cell full for the evaporation study. We started the drawdown process of the South Cell on January 16, 2009. Table 4 shows the results of different monitoring parameters.

Table 4.

Date	Ammonia	Nitrate+Nitrite	TKN	E. Coli	$CBOD_5$
1/6/09	<0.2				19
1/19	<0.2	<0.2	5.3	<10	15
1/26	0.5	<0.2			10

The sample taken on 1/6/09 was the pre-drawdown sample. These results indicate the ammonia and E. Coli in the effluent have been very consistent. The drawdown of South Cell was completed on January 28th. The North Cell was isolated on January 30th.

The Fifth Testing

The North Cell was isolated on January 30th. Ammonia and E. Coli were monitored. The first sample was taken on February 3rd. The results are shown in Table 5.

Table 5.

Date	Ammonia	Nitrate+Nitrite	TKN	E. Coli	$CBOD_5$
2/03/09	18.2			13,000	
2/10/09	16.1			4,800	
2/17/09	15.2			970	
3/2/09	14.2			11,600	
3/9/09	13.9			69.0	
3/23/09	14.3			67.2	7
3/30/09	12.5			15.0	
4/6/09	10.4			N/A	
4/14/09	7.9			N/A	29
4/21/09	6.26			N/A	
4/24/09	7.7			N/A	
4/27/09	6.37			< 2	17
4/29/09	4.5			N/A	
5/1/09	1.0			N/A	
5/4/09	0.6	0.39	14.9	< 2	42

It took 38 days for E. Coli to get down 69 #org./100 ml after the North Cell was isolated on January 30th. The ammonia concentration reached 1 mg/L on May 1. Based on the data, the North Cell could not be discharged until May 1 in order to comply with the most stringent ammonia limit of 1.9 mg/L in May. The ammonia drop in March was stagnant. It is indicated that the system had lost nitrifying ability through winter. It is well known that nitrifying bacteria is slow growing organisms. The nitrification rate was slowly coming back beginning end of March. However, we did not see the ammonia drop rate consistently increase through the month of April. It could be the reason that ammonia being hydrolyzed from the bottom sludge increased as the weather became warmer. The nitrification rate was significantly increased after April 24th. It was dropped 3.5 mg/l from April 29 to May 1.

The North Cell started drawdown on April 24th due to the high water level in the South Cell. Samples were taken during drawdown. From the drawdown samples, the ammonia dropped down to 1 mg/L on May 1. This information indicates that the spring discharge has to be hold until early May. Results of E. Coli during drawdown were all less than 2 #org./100 ml.

The Sixth Testing

The South Cell was isolated on May 6, 2009. Ammonia and E. Coli were monitored. The first sample was taken on May 11th. The results are shown in Table 6.

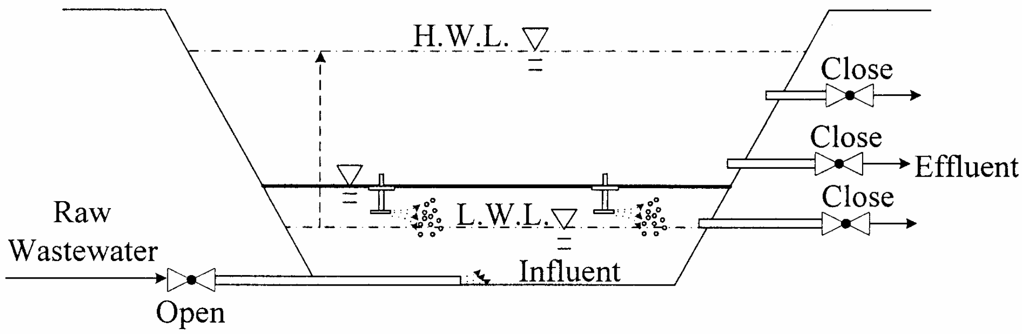
Table 6.

Date	Ammonia	Nitrate+Nitrite	TKN	E. Coli	$CBOD_5$
5/11/09	10.3			27	
6/01/09	< 0.5			19	

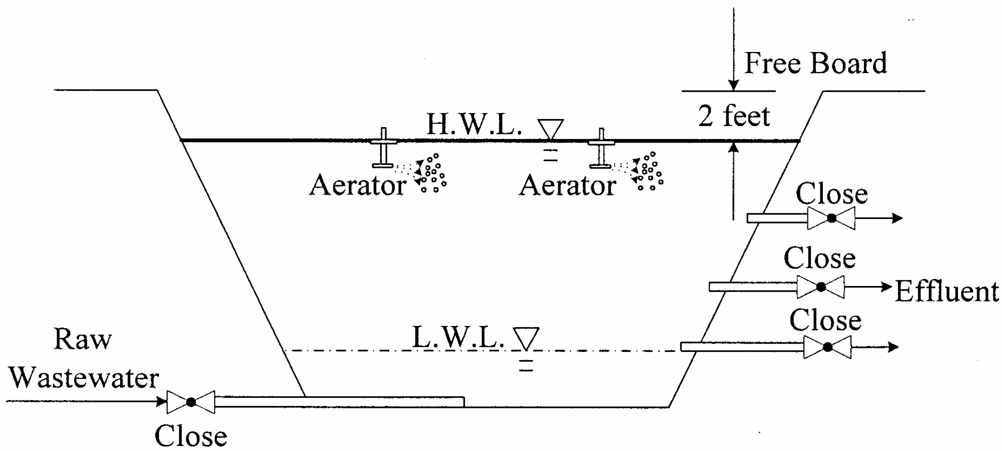
Description of SBAL Process

The present invention provides an sequencing batch aerated lagoon process for the treatment of municipal wastewater carried in a minimum of two lagoon cells. The following description is based on a two lagoon cell system; cell A and cell B. Only one lagoon cell accepts wastewater from the raw wastewater feeding line at any given time. The biological reactions occur under aerobic conditions in the liquid and anoxic conditions in the bottom sludge. Each lagoon cell is operated on a fill-draw basis in a sequencing manner. When municipal wastewater is entering into the cell A, the cell B is at a predetermined liquid level condition. Waste feeding into the lagoon cell A continues until it is filled to a predetermined liquid level. The lagoon cell B at the predetermined liquid level begins to discharge under the condition that the liquid level of lagoon cell A is close to its predetermined full liquid level. The drawdown of the lagoon cell B continues until a predetermined lowest liquid level is reached. The raw wastewater is then alternated to enter into the lagoon cell B. The steps of filling the lagoon cell B, discharging the lagoon cell A, and alternating waste feeding from the lagoon cell B to lagoon cell A occurs in the next cycle. Air is provided by either a surface mechanical aeration system or a diffused bubble aeration system. The aeration system is shut down during the drawdown mode when the liquid level does not allow the aeration system to operate. The air is turned back on during the filling mode when the liquid level allows the aeration system to operate. The capacity of the lagoon system depends on the flow records of the wastewater treatment plant.

If the system has more than two lagoon cells, each lagoon cell will go through fill mode, full liquid mode, and drawdown mode in a sequencing order of all lagoon cells.

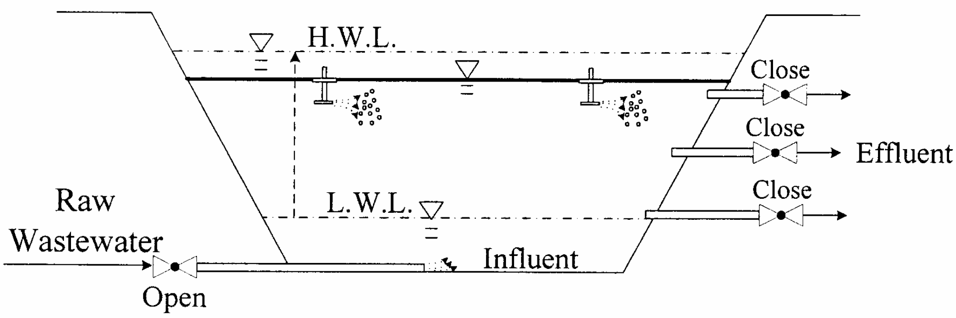


Cell A, Filling Mode

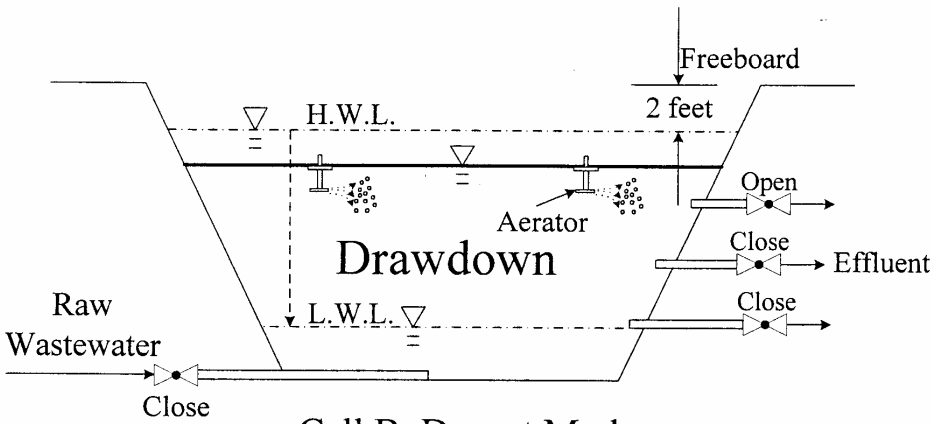


Cell B, Full Mode

Figure 2. Cell A Starts Filling When the Cell B Is Full.



Cell A, Filling Mode and Reaching the H.W.L



Cell B, Decant Mode

Figure 3. Cell B Starts Decanting When the Cell A Is Getting Full.

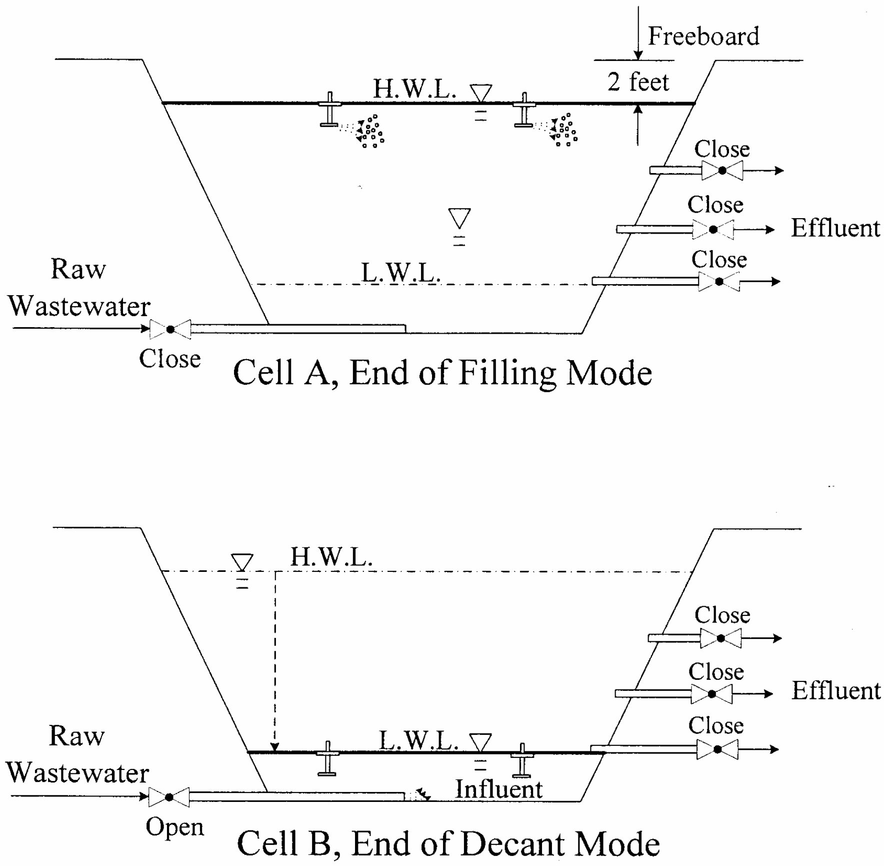
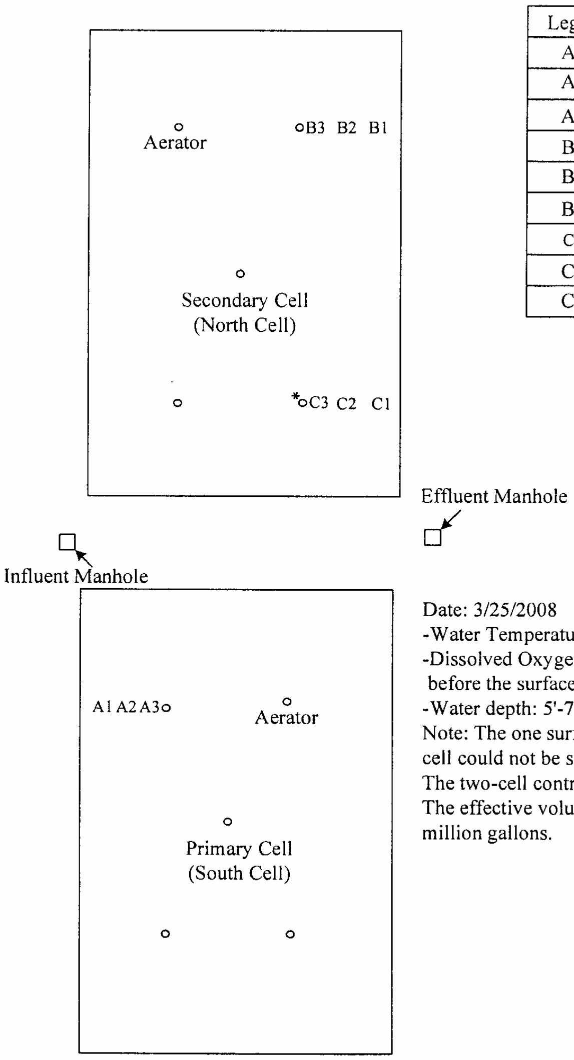


Figure 4. Cell B Is Ready for Filling When the Cell A Is Full.

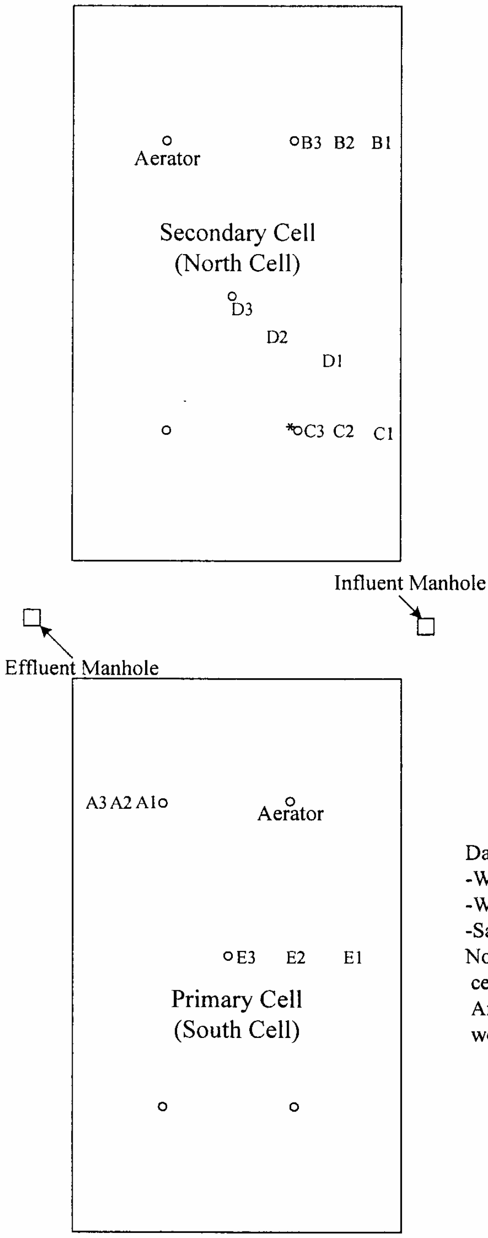
Appendix A

D.O. Profiles of Dunlap WWTF



Legend	1 foot	2 feet	3 feet	4 feet	5 feet
A1	0.68	0.55			
A2	0.58	0.45	0.4	0.4	0.4
A3	0.51	0.41	0.39	0.39	0.39
B1	2.2	1.88			
B2	2.04	1.93	1.87	1.84	1.78
B3	1.89	1.81	1.73	1.68	1.66
C1	1.43	1.14			
C2	1.25	1.08	1.04	0.94	0.94
C3	1.22	1.02	0.97	0.87	0.86

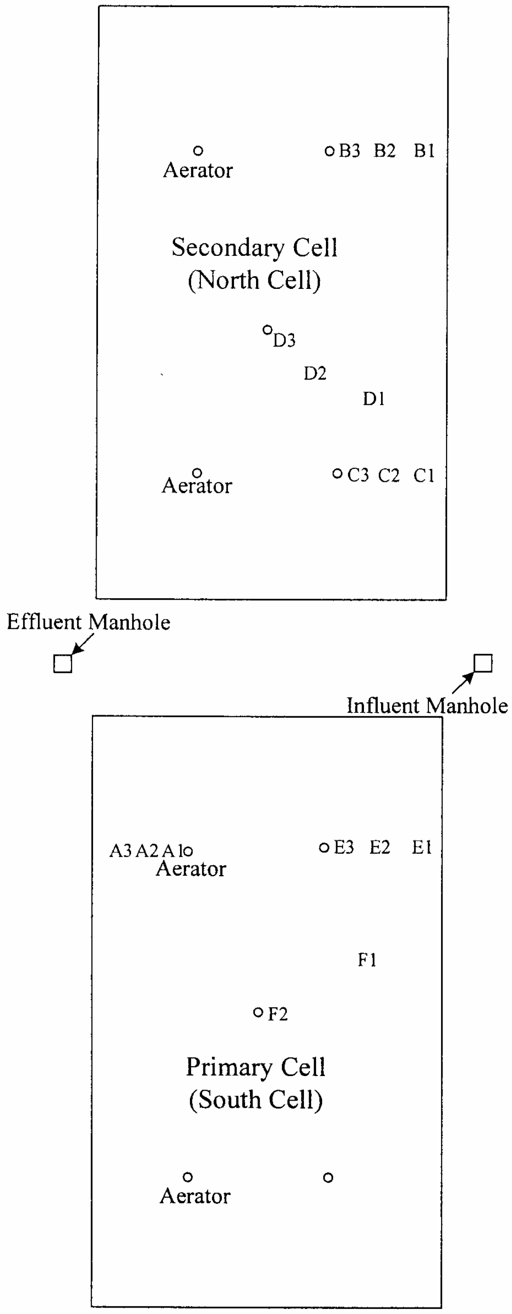
Date: 3/25/2008
-Water Temperature: 6.5 °C (43.7 °F)
-Dissolved Oxygen measurements from the water surface before the surface aerators were turned on.
-Water depth: 5'-7"
Note: The one surface aerator as marked * in the secondary cell could not be started after the D.O. measurements were done. The two-cell controlled discharge lagoon has the same volume. The effective volume from 2 feet to 6 feet is approximately 15.4 million gallons.



Legend	1 foot	2 feet	3 feet	4 feet	5 feet
A1	1.31	1.08			
A2	0.93	0.87	0.85	0.81	0.8
A3	1.3	1.03	1.06	0.88	0.81
B1	15.71				
B2					
B3					
C1	15.8	15.8			
C2					
C3					

Legend	1 foot	2 feet	3 feet	4 feet	5 feet
D1	15.5	15.68	15.8		
D2	16.24	16.08	16.07	15.73	15.7
D3	16.13	16.3	16.2	15.51	15.3
E1	0.95	0.84	0.7	0.67	
E2	0.88	0.81	0.75	0.7	0.72
E3	0.95	0.87	0.83	0.81	0.77

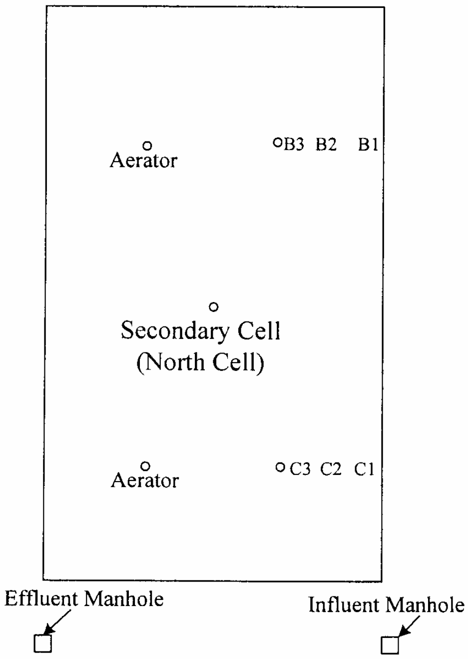
Date: 4/2/2008
-Water Temperature: 7.1 °C (44.8 °F)
-Water depth: 5'-11"
-Saturated D.O.: 12.17
Note: The one surface aerator as marked * in the secondary cell was not on after the last D.O. measurements. Another surface aerator's pump, as marked ^, was not working during this visit.



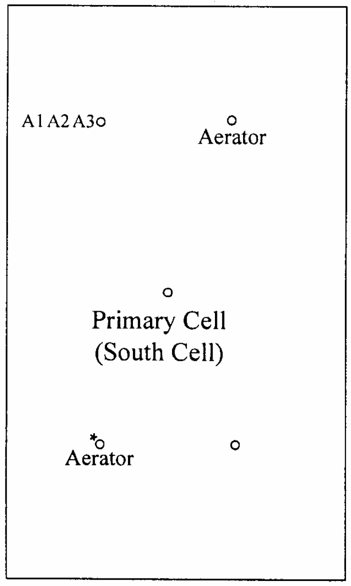
Legend	1 foot	2 feet	3 feet	4 feet	5 feet
D1					
D2					
D3					
E1	0.93	0.83			
E2	0.72	0.65	0.6	0.6	0.6
E3	0.67	0.6	0.52	0.49	0.47
F1	0.58	0.51	0.48	0.47	
F2	0.82	0.65	0.5	0.43	0.4

Legend	1 foot	2 feet	3 feet	4 feet	5 feet
A1					
A2					
A3					
B1	9.25	9.3			
B2	9.14	9.04	9.04	8.98	8.97
B3	9.48	9.27	9.9	8.82	8.67
C1					
C2					
C3					

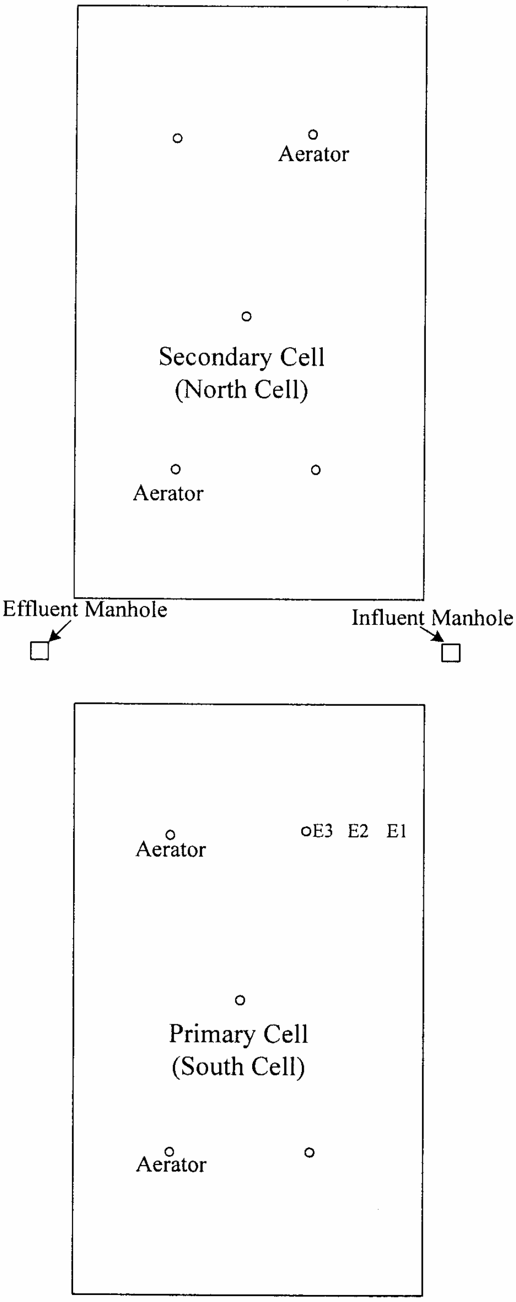
Date: 4/09/2008
Water Temperature: 9.7 °C ((49.4 °F)
Water depth: 6'-2"
Saturated D.O.: 11.39



Legend	1 foot	2 feet	3 feet	4 feet	5 feet	6 feet
A1	6.06	6.0				
A2	6.18	5.84	5.79	5.68	5.81	5.8
A3	6.08	5.93	5.93	6.0	5.91	5.9
B1	15					
B2						
B3						
C1	15					
C2						
C3						

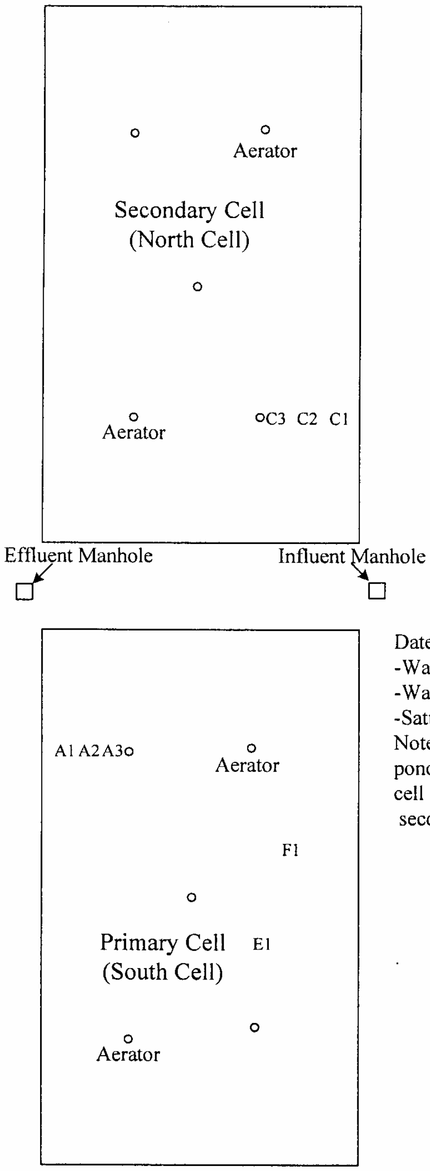


Date: 4/16/2008
-Water Temperature: 11.4 °C (52.5 °F)
-Water depth: 6'-4"
-Saturated D.O.: 10.9
Note: The one aerator as marked* was not working during the visit due to the super wind on 4/15. The blower was back to function but the pump was missing the nozzle. The pump could not be turned on. The secondary cell were not measured in the cell because the D.O. are already saturated.



Legend	1 foot	2 feet	3 feet	4 feet	5 feet
D1					
D2					
D3					
E1	11.24				
E2	11.37	11.49	11.43	11.01	11.02
E3	11.80	11.60	11.50	11.53	11.60
F1					
F2					

Date: 5/13/2008
-Water Temperature: 60.2 °F (15.6 °C)
-Water depth: 6'-5" in the primary cell,
2' in the secondary cell (end of drawdown)
-Saturated D.O.: 10.05
-Waste feeding was alternated from the primary cell to secondary cell. The primary cell was isolated. No waste was entering into the primary cell.



Legend	1 foot	2 feet	3 feet	4 feet	5 feet
A1					
A2					
A3	6.2	5.6	4.5	2.67	2.42
E1	5.3	4.7	4.1	3.2	2.99
E2					
E3					
F1	4.01	3.76	2.7	2.4	2.39
F2					

Date: 6/20/2008
-Water Temperature: 24.9 °C
-Water depth: Primary Cell – 5'-6", Secondary Cell - 5'
-Saturated D.O.: 8.36
Note: The secondary cell is over saturated except close to the pond bottom. The D.O. close to the pond bottom ot the secondary cell was around 5. The raw wastewater has been fed into the secondary cell since May 13, 2008.