行政院所屬各機關因公出國人員出國報告書

（出國類別：研究　實習　）

九十二年台德技術合作計畫

土壤及地下水風險評估及整治技術
產源不明廢棄物分類及處理技術

服務機關：行政院環境保護署

出國人　職　　稱：隊長

　　姓　　名：李健育

出國地點：德國

出國期間：九十二年九月三日至九十二年九月十七日

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公 務 出 國 報 告 提 要

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報告名稱:

土壤及地下水風險評估及整治技術以及產源不明廢棄物分類及處理技術研習(經濟部國際合作處派員赴歐研習計畫)

主辦機關: 經濟部

聯絡人／電話:

張玉燕；電話：(02) 23 212200 轉 599

出國人員:

李健育　行政院環境保護署　中區督察大隊　隊長

出國類別: 研究　實習

出國地區: 德國

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分類號/目: G14／環境工程　G14／環境工程

關鍵詞:　土壤及地下水污染整治一般及事業廢棄物

內容摘要: 此次「土壤及地下水風險評估及整治技術產源不明廢棄物分類及處理技術」，研修期間自九十二年九月三日至九十二年九月十七日，主要爲參訪德國徒賓根大學（TUBINGEN UNIVERSITY）了解該校在土壤及地下水風險評估及整治技術的推展，另參訪德國瑞斯曼公司及可寧衛公司各類廢棄物分類廠含廢棄物焚化廠、廢溶劑回收分類場及處理廠、塑膠分類回收廠、紙類分類回收廠、資源廢棄物分類回收廠，以及參訪技術顧問公司了解感染性廢棄物之滅菌處理及爐渣分類處理廠。我國「土壤及地下水污染整治法」於八十九年二月二日制定公布，而對於非法棄置場之清理作業，於八十八年高屏地區非法棄置場陸續浮現後展開清理作業，如今已陸續完成清理。謹以此次赴德參訪心得，提出建議：（一）加強與歐美各國土壤及地下水污染整治技術交流。（二）進行國內地下水使用現況普查建立敏感地區監測網。（三）重新檢視國內事業廢棄物清理體系。（四）推動一般廢棄物「零廢棄」資源回收體系。（五）重新建立事業主對廢棄物清理的責任制度。（六）輔導設置廢棄物分類分選資源回收產業。

本文電子檔已上傳至出國報告資訊網

目錄

九十二年台德技術合作計畫：
土壤及地下水風險評估及整治技術
產源不明廢棄物分類及處理技術

摘要

此次「土壤及地下水風險評估及整治技術產源不明廢棄物分類及處理技術」，研修期間自九十二年九月三日至九十二年九月十七日，主要為參訪德國徒賓根大學（TUBINGEN UNIVERSITY）了解該校在土壤及地下水風險評估及整治技術的推展，另參訪德國瑞斯曼公司及可寧衛公司各類廢棄物分類廠含廢棄物焚化廠、廢溶劑回收分類場及處理廠、塑膠分類回收廠、紙類分類回收廠、資源廢棄物分類回收廠，以及參訪技術顧問公司了解感染性廢棄物之滅菌處理及爐渣分類處理廠。

我國「土壤及地下水污染整治法」於八十九年二月二日制定公布，而對於非法棄置場之清理作業，於八十八年高屏地區非法棄置場陸續浮現後展開清理作業，如今已陸續完成清理。謹以此次赴德參訪心得，提出建議：

（一）加強與歐美各國土壤及地下水污染整治技術交流。

（二）進行國內地下水使用現況普查建立敏感地區監測網。

（三）重新檢視國內事業廢棄物清理體系。

（四）推動一般廢棄物「零廢棄」資源回收體系。

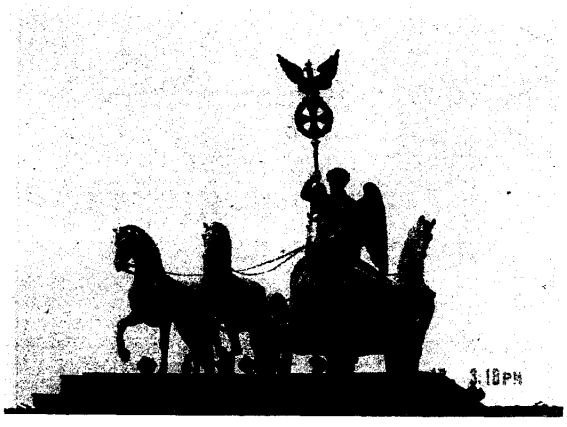
（五）重新建立事業主對廢棄物清理的責任制度。

（六）輔導設置廢棄物分類分選資源回收產業。

壹、出國參訪目的

德國與台灣同屬地狹人稠，石化及化學等高污染工業發達的區域，其所造成之污染場址歷史可超過百年以上，在對土壤與地下水的污染場址的整治策略有不同於美國的思考模式，其因應污染場址所衍生的法規、整治技術的開發、整治的風險評估，甚至所衍生出之產業，皆有值得我國借境學習之處。況且美國之超級基金的應用於場址整治的案例來看不是成功的，我國目前對於土壤及地下水污染場址的整治尚處於起步階段，在國情有所不同下，如何從德國的經驗比較中學習，並實際並引進相關策略與技術應用於我國是急迫的要務。

本次將參訪德國徒賓根大學水文地質研究所了解德國對污染場址整治的過程及相關法規的擬訂及產官學在此領域上的結合現況。另參訪德國瑞斯曼公司及可寧衛公司各類廢棄物分類廠含廢棄物焚化



廠、廢溶劑回收分類場及處理廠、塑膠分類回收廠、紙類分類回收廠、資源廢棄物分類回收廠，以及參訪技術顧問公司了解感染性廢棄物之滅菌處理及爐渣分類處理廠，期以德國經驗為借鏡，以帶動國內相關產業的現況與未來發展性。

貳、行程簡述

第一站為訪問德國徒賓根 Tubingen 大學 Center of Applied Geoscience(ZAG)，主要由該機構相關人員說明並討論目前該機構運作方式，討論議題包含 ZAG 運作現況簡介、德國土壤及地下水污染整治法規及現況、德國自然衰減的立法與應用、歐洲地下水及污染整治資訊系統與 Pd/Zeolite/H2 處理場址中地下水中含氯有機污染物。

第二站由 HA International Envitech 公司安排訪問廢棄物焚化廠及其爐渣回收再利

用作業廠。

第三站參訪德國瑞斯曼(RETHEMANN)公司及相關資源回收及有害事業廢棄物處理工廠之作業狀況，參訪工廠包含廢棄物分類處理、廢溶劑回收處理廠、垃圾分類及資源回收廠。

第四站參訪可寧衛(CLEANAWAY)公司資源回收處理作業情形。

表一　參訪行程表

月	日	參訪內容
9	3-4	由桃園中正機場啟程往德國法蘭克福機場(德國時間 AM6:50 抵達) 至徒賓根大學水文地質研究所及土壤地下水污染場址研習整治技術
9	5-10	由 HA International Envitech 公司安排參訪廢棄物焚化廠及其爐渣回收再利用作業廠。另參訪瑞斯曼總公司 (Lunen、) 資源回收分類廠 (Bochum) 及垃圾焚化廠 (Oberhausen)
9	11-12	參訪廢棄物處理場 (Munster) 廢溶劑處理

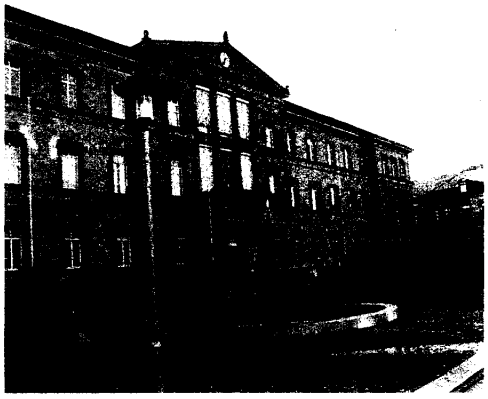
		廠（Branschweig）廢棄物分類處理場 （Brandenburg）
9	13-15	漢堡廢料處理廠
9	16-17	往程法蘭克福由德國法蘭克福機場搭機(德國時間 92.9.17AM11:20 出發）回桃園中正機場

表二 參訪單位連絡表

參訪單位名稱	聯絡地址	主要聯絡人
Tubingen 大學 Center of Applied Geoscience(ZAG)	Sigwarstr.10 D-72076 Tubingen Germany Bjorn Sack-kuhner@uni-tuebingen.de	Bjorn Sack-kuhner
HA International Envitech	Saarbrukerstr 292 66125 Saarbrucken	Hans Hwang
RETHEMANN	Brunnenstrabe 138 D-44536 Lunen	Dr.Arnold Feldmann
CLEANAWAY	Borsigstrabe 13 D-22113 Hamburg	Rainer Hartmann

參、土壤及地下水風險評估及整治技術

徒賓根大學位於德國南方的小鎮大學城，該校水文地質研究所為德國該領域學術地位崇高，該系所成立Center of Applied Geoscience(ZAG)接受來至於歐盟或德國中央或地方政府委託進行土壤及地下水污染整治相關法令與技術建置。



此次參訪行程由ZAG工作人員由BJORN SACK-KUHNER負責安排相關領域議題討論，包含有五項，分述如下：(註：以下內容由此次會同參訪工研院劉沛宏博士撰寫)

一、ZAG運作現況簡介。

二、德國土壤及地下水污染整治法規及現況。

三、德國自然衰減的立法與應用。

四、歐洲資訊系統的整合。

五、利用Pd/Zeolite/H_2處理場址中地下水中含氯有機

污染物。

一、ZAG 運作現況簡介

由 BJORN SACK-KUHNER 負責說明，ZAG 現在包含正職教授 2 人，博士班學生 40 人、碩士班學生共約 60 人及計畫外包人力約 34 人。

目前執行中計畫約有 50 個，主要來源歐盟(European Community)、為德國教育及研究部 (the German Federal Ministry of Education and Research)、德國研究基金(the German Research Fundation)等。計畫類別內容包含從污染調查、法規研擬、地下水污染整治技術開發、污染擴散模式及其他輔助系統的開發等。

運作模式為由該中心名義爭取計畫，並交由中心內部及外包公司執行。而外包公司為該系上畢業之學生，或留任教職但未取得正職教授之人員組成(6 年內

未生等，即需離職)，辦公地點則仍在中心或校區內，類似本院之育成中心。而學校則給予其他研究上的支援，但財務及人員運用上保留相當大的彈性。

目前該中心為德國土壤及地下水領域的執牛耳之地位，並透過與歐盟各國之互動，正推動制定屬全歐洲依至之土壤及地下水污染管制之標準及整治規範，為值得保持聯繫之單位。

二、土水法規及執行現況

（一）現況說明

德國目前對土壤及地下水污染場址整治的需求與規範，依各邦的狀況調整。原則上污染場址的廢棄物並不採用挖除污染物的方式進行，而是看該場址污染的程度及地下水使用的風險度而定，若發現該場址地下水危及使用的居民健康，則進行相關整治工作（包含移除及地下水污染整治），否

則可使用圍堵(CONTAINMENT)方式進行，且近年來已開始考慮使用自然衰減法(Natural attenuation)或加強自然衰減法(enhanced natural attenuation)來進行評估與整治場址的工作。當污染團經驗證範圍不再擴大且該場址具微生物分解現象時，則可考慮使用。目前法規尚無規範，但在歐州其他國家如英國丹麥等皆已有自然衰減定於法規。

產業界或是一些可能衍生污染作業的場所，可投保土地污染險等。一但發生污染相關整治工作，可由保險公司支付且為強制性，此作法可供本國之參考。

對於地下水的水源區域活動的管制，以區域的用途來劃分。水源區域內屬最內圈，在其一定範圍內，不得有任何活動，在較外圈方可有農業活動、更外圈才可居住，在更外圈才可設置工業區等，唯一目的為確保引用水源的

安全性。目前並未發現飲用水有污染現象，各地方政府需定期公告水質監測結果。但在東德及軍方用地的污染則仍尚待調查與評估。

（二）土壤污染保護及污染場址法

德國政府已於1999年7月公告聯邦土壤污染保護及污染場址法(Federal Soil Protection and Contaminated Sites Ordinance)，各邦可依其特殊需要制定更嚴格之標準及規範

法規內容主要分為八個部份及四個附件

(1)法規本文摘要

第一部份 一般規定

第二部份 對可疑場址及可疑污染場址的調查與評估需求

第三部份 有害污染土壤改善及污染場址的復育需求

第四部份 污染場址的補充規定

第五部份 排除條文

第六部份 避免受水侵蝕之有害污染土壤監督補充規定

第七部份 避免有害污染土壤形成的注意事項

第八部份 最後規定

附件一 污染調查所需之採樣分析及品保需求

附件二 行動、預警(trigger)及注意標準值

附件三 復育及復育計畫的調查需求

附件四 可能受水侵蝕污染土壤區域之評估調查的需求

(2)各部分主要內容說明

第一部分 一般規定

表土定義為會受挖掘移動處理的地球表層部分。

第二部分 對可疑場址及可疑污染場址的調查與評估需求

調查時機：

(a) 污染物藉由廢棄物或廢水進入土壤超過一段時間或一定量時。

(b) 因自然洩漏增加土壤中污染物的含量。

(c) 食物或食用植物中污染物量增加。

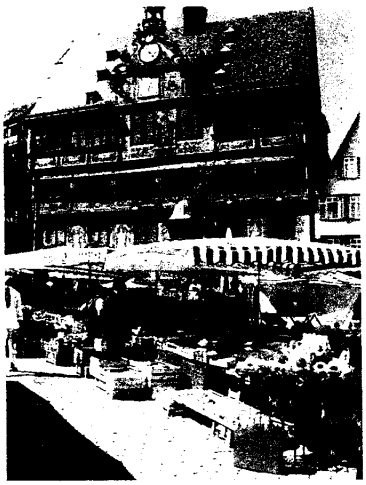
(d) 水成為污染土壤或廢棄物中污染物的載體時。

(e) 水侵蝕或風化作用嚴重時。

評估時機：調查超過預警標準(trigger value)值，皆要進一步針對其影響評估。

第三部分 有害污染土壤改善及污染場址的復育需求復育方法、保護及限制

(a) 基於技術及經濟上可行性來執行，達到環境安全及顯著減低污染，並經主管機關驗證可行。



(b) 安定化的方法必須

要保證污染物會侷限在污染特定範圍內，不會衍生任何危險危害個人或大眾，其方法要主管機關證實可行。

(c) 安定化的方法可以考量以覆蓋或圍阻方式。

(d) 農業或森林的污染則要使用限制及保護措施。

(e) 移除或挖除或處理劑的使用皆要填報於計畫書內。

第四部份 污染場址的補充規定

對復育場所之調查計畫

(a) 調查方法需能顯示復育方法完成後，驗證其成果。

(b) 復育方法要能明確說明方法實施要項及流程避免危及個體或大眾的方法。

(c) 土壤改良劑的引進，到植物根不可吸收部份，要符合法規之規範，包含廢棄物管理法及污泥管理法，避免增加土壤中污染物濃度

附件一 污染調查所需之採樣分析及品保需求

(a)污染途徑調查

採樣調查的範圍規劃，基於初步調查及對污染物的污染路徑之假設及分佈。

對土壤至人類接觸路徑調查，包含

(i) 兒童遊戲場所

(ii) 住宅區

(iii) 公園及休憩區

(iv) 工業區及商業區

對土壤至有用之植物的接觸路徑調查，包含

(i) 農業區及花園

(ii) 草地

對土壤至地下水污染途徑調查則是該區地下水使用狀況決定，包含

(i) 飲用水

(ii) 農用

(iii) 不用

調查時應先建立土壤剖面分佈圖，工業區要調查其污染物量及範圍及污染物種類，廢棄物棄置區要調查土壤氣體及高揮發性污染物及在地下水傳輸的情形。

該地主管機關視狀況調查第表水及第下水污染狀況。更細部調查包含各種傳輸途徑的調查，污染物在污染區內及區外的累積危害性及污染擴散性。採樣是用途提供垂直及平面污染物分布，採樣點位置及深度的決定視其背景資料及用途，採分區採樣。

土壤-人體途徑點決定，包含

(i)區域確實用途如種類頻率及期間。

(ii)可接近的程度。

(iii) 密閉的程度。

(iv)吸入途徑。

(v)其他相關途徑。

採樣深度如下表。

途徑	用途	深度
土壤-人體	兒童遊戲區	0-2 公分(吸入)
	住宅區	0-10 公分(口及皮膚) 10-35 公分(兒童挖掘最深範圍)
	公園及休憩區	0-10 公分(口及皮膚)
	工業及商業區	
土壤-有用植物	農業區	0-30cm(工作可及範圍)
	蔬菜區	30-60cm(根可及範圍)
	草地	0-10cm(根可及範圍 10-30cm

對土壤至地下水的接觸路徑調查，包含樣品需採集不飽和土壤層，並可顯示垂直面的污染狀況。

(b)樣品處理及分析方法

相關前處理及分析方法參見法規補充說明(Annex 1)。

附件二 行動、預警(trigger)及注意標準值

相關管制值依各種污染途徑來建立，其方式不同於國內土水法之管制值制定方式，分數如下表：

1. 土壤與人體直接接觸途徑

	行動值(ng I-TEQ/kgTM)			
污染物	兒童遊戲區	住宅區	公園及休憩區	工業及商業區
Dioxins	100	1000	1000	10000

	預警值(mg/kg TM)			
污染物	兒童遊戲區	住宅區	公園及休憩區	工業及商業區
As	25	50	125	140
Pb	200	400	1000	2000

Cd	10	20	50	60
CN^-	50	50	50	100
Cr	200	400	1000	1000
Ni	70	140	350	900
Hg	10	20	50	80
aldrin	2	4	10	12
DDT	40	80	200	---
Hexachlorobenzene	4	8	20	200
Hexachlorocyclohexane	5	10	25	400
pentachlorophenol	50	100	250	250
PCBs	0.4	0.8	2	40

2.土壤至食用作物途徑

	農作物區，花園(mg/kg TM)		
污染物	方法	預警值	行動值

As	王水	200	--
Cd	硝酸胺	---	0.1
Pb	硝酸胺	0.1	---
Hg	王水	5	---
Th	硝酸胺	0.1	---
Benzo(a)pyrene	---	1	---

	草地(mg/kg TM)
污染物	行動值
As	50
Cd	20
Pb	1200
Cu	1300
Ni	1900
Hg	2
Th	15
PCBs	0.2

3. 土壤至地下水途徑

污染物	預警值(萃取，g/l)
Sb	10
As	10
Pb	25
Cd	5
Cr	50
$CrO4^{2-}$	8
Co	50
Cu	50
Mo	50
Ni	50
Hg	1
Se	10
Zn	500
Sn	40
CN	50
Free-CN	10
F	750
Mineral oil	200

BETX	20
Benzene	1
高揮發性含氯有機化合物	10
Aldrin	0.1
DDT	0.1
Phenols	20
PCBs	0.05
PAH	0.20
Naphthalene	2

三、德國自然衰減的立法與應用

此題目由 Dr. Anita Peter 說明：目前德國對於自然衰減法應用於場址之整治，並無法規上的依據，仍處於研議階段，但在特定場指引永此法的研究，則持續中。原則上會依美國所制定之規範進行。

在歐洲至少已有 5 個國家以立法使用，包含英國、丹麥、西班牙等，歐洲將會推動以同依準則進行。

ZAG 自軍方取得一個合約進行油品洩漏場址的整治，並引用此法進行自然衰減法相關條件的探討。

詳細簡報資料並未取得，但其依據從美國方法來，與本室之前取得資訊差異不大。

四、歐洲地下水及污染場址整治資訊系統(EUGRIS)

此題目由 Dr. Martin Bittens 說明：ZAG 推動此一系統主要是溝通全歐洲在土壤及地下水污染場址領域的做法與斯維模式能夠有一溝通與討論的區域，並藉由此依系統提供歐盟再後續立法上的依據，因此除了相關一提的討論外，相關規範的制定亦可投入此系統中討論，藉以達到共識的目的。

對於歐洲以外的國家或人士若有興趣，亦可加入討論，ZAG 藉此系統希望維持主導性的角色。網址：WWW.EUGRIS.ORG

五、用 Pd/Zeolite/H2 處理場址中地下水中含氯有機污染物

此題目由 Dr. Christoph Schuth 說明：利用將 Pd 植於 Zeolite 上進行含氯有機化合物的氫化反應，以實際應用到東德某一場址的整治。

其設計及使用特點如下：

1. 使用氫氣為還原物。

2. 觸媒置於一套館內，並以灌入氫氣方式進行反應。

3. 未避免含硫化合物造成觸媒活性消失，因此在Zeolite植入親油基，避免水中之硫離子毒化效應，但污染物若含有機硫化合物則仍受影響。

4. 觸媒合成以外購委託製作為主。

5. 對不飽和之含氯有機化合物效果較佳。

（註：以上文字內容由此次會同參訪工研院劉沛宏博士撰寫）

六、參訪心得：

徒賓根大學 ZAG 以其水文及地質學術領域成就，有計畫發展系所在土壤及地下水污染整治技術之研發，除傳授學生未來就業所知，且結合由該系所畢業校友建立產官學合作機制，可為台灣大學院校治校參考。另提出下列幾點建議：

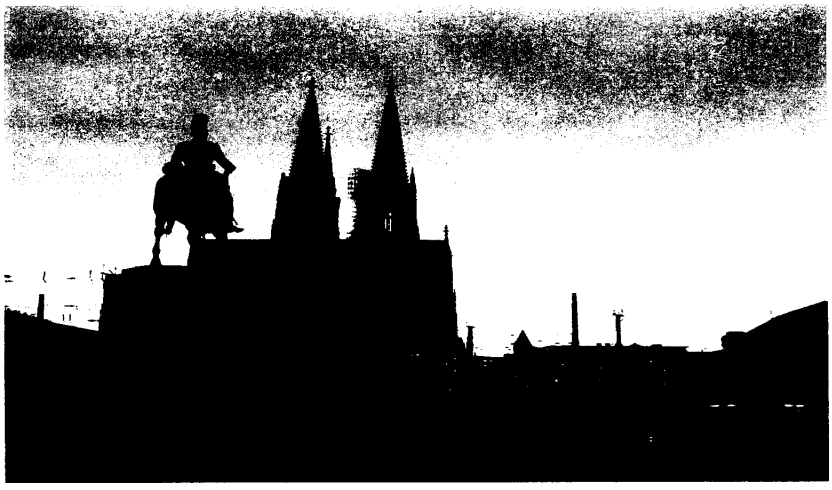
（一）ZAG 有計畫建立歐盟在土壤及地下水污染整治規範，台灣相關領域技術服務機構如能與該機構加強技術交流，可達與歐盟技術同步之效。

（二）由於地下水污染整治所需費用浩大且整治時間長，如何將有限資源運用於刀口上是首要工作，進行台灣地下水使用現況普查，建立敏感地區監測網，為污染場址進行整治必要性的重要背景資訊。

（三）台灣因產業由客廳及工廠逐步發展，工廠混雜於都會區或農業區甚為普遍，造成獨特地區性環境污染問題，推動將工廠集中管理，將有助於解決問題。

七、國外攜回之資料原件

由徒賓根大學攜回之資料原件包含:1.ZAG 簡介資料（英文版），ZAG 土壤及地下水污染整治實績或模場簡報資料。



肆、產源不明廢棄物分類及處理技術

此行所參訪產源不明廢棄物分類及處理廠簡述各廠：

一、Rennbachstrabe 有害事業廢棄物分類處理廠

該廠為收集各產業產生之事業廢棄物，包含各類污泥及含鹵素或不含鹵素液體廢棄物等，經分類後分送至後續處理廠。其處理程序之選定為由產源提出處理需求後，經該廠實驗室採樣檢測及現場確認其類別後，依其性質與類別加以分類，其分類方式參考歐盟的規範分類方式（如附錄四）。

該廠於受理產業廢棄物處理之前，皆須進行採樣分析，經採樣分析確認廢棄物類別後方進行收樣處理。此有別於台灣於實務面較少經採樣分析後方接受處理。另所有清理程序藉由六聯單管控，此與台灣現行採用網路申報管控流程略遜一籌。

德國地方政府許可處理廠的作業，在申請籌設的階段，須經嚴密審核，核可設立之後，經許可項目以每年由政府委託專業機構之專業人員進行現場評鑑，如經評核通過即現場立即通過展延一年，現場稽

查項目包含所有操作、環境維持安全、文件保存及人員測試等。

由於德國嚴格執行土地使用分區規定，該廠設立後周圍土地利用一直維持現況，民眾亦不得未經許可設立農舍，因此不會有工廠緊鄰民宅的現象。另廠區周圍監測，法規未要求設置地下水監測井，但須設置地表水監測點。該廠於周圍設置 5 個監測點，每月需進行監測。另該廠於 1960 年已設置，據廠方說明若依現行規定，將難以設置，因新廠設置須有環境影響評估的程序。

暫存區內的設計設置，以雙層水泥阻隔方式。發生洩漏可阻隔於暫存區內，且廢棄物需分區分類暫存。廢棄物經分類後，依各類別處理方式的不同進行混合與參配，其後續處理方式包含回收焚化、物理化學處理及最終掩埋。

污泥廢棄物分為三類，包含無機性油泥及乳化狀油泥等。無機性以進行酸檢中和後，固體部分掩埋處理。油泥則與有害廢棄物進行參配後，焚化處理。

乳化油泥則進行油水分離作業，再分類處置。

所蒐集廢棄物經分類後依所的之資料進行最有效之回收與處置原則上此部分為該廠之 know-how，以達到最大的經濟效益的操作為依歸。

二、Braunschweg 廢溶劑回收廠

該廠原為傳統化工廠，因類似台灣廢溶劑蒸餾回收廠，但因廠區配置與空間使用得當，廠區並無廢溶劑散發難聞味道。該廠作業方式，採代工蒸餾回收或是自行收購後回收自製產品，主要回收溶劑類別以不含氯有機化合物為主。

三、參訪心得

德國事業廢棄物之清理產業與處理廠之間的關係有別於台灣現況，台灣現況為清理業者設法將其處理廠處理能力儘量擴大，儘量容納產業各類項廢棄物；但德國處理廠僅接受其願意接受者，事業廢棄物無法清理產業要設法與清理業協調，請託處理廠變更許可內容接受清理。而政府核准作業著重在實場管理實務執行能力。另提出下列幾點建議：

（一）台灣事業廢棄物百分之七十以上，採再利用處理，是否確有再利用？有必要重新檢視國內事業廢棄物清理體系。

（二）產源不明廢棄物之處理有賴建立國內優良處理廠商。

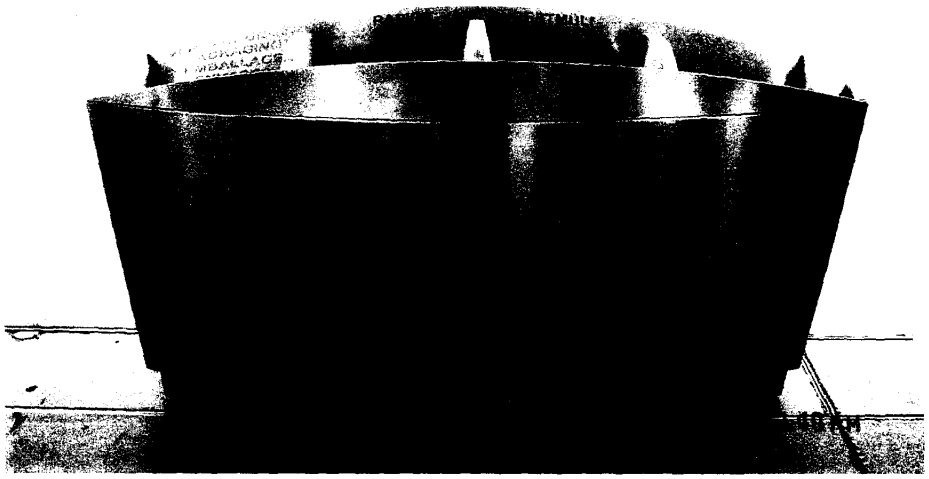
（三）「廢棄物清理法」對於產業委託合法清理機構及取得妥善清理證明文件，即可免除連帶責任，以台灣國人守法度，實有必要檢討，重新建立事業主對廢棄物清理的責任制度。

四、國外攜回之資料原件

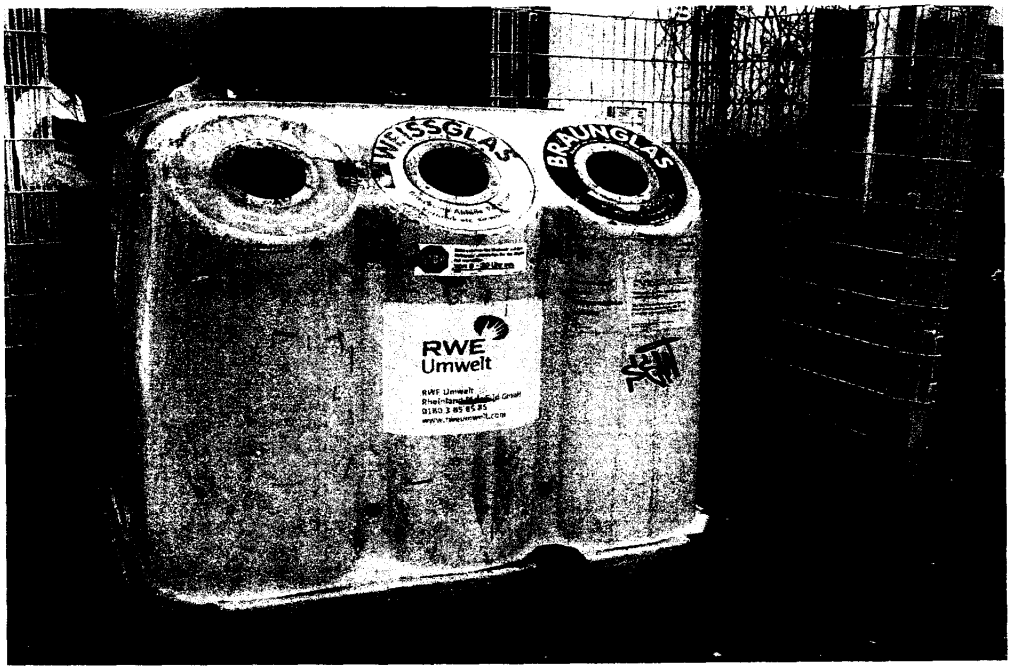
由於參訪地點謝絕拍照，僅由該廠取得歐盟有害廢棄物分類表（英文版）及 DR. WORBS RECYCLING 工廠簡介資料（德文版）

伍、一般廢棄物分類及處理技術

首先介紹德國一般廢棄物分類回收方式，德國於家戶或公共場所皆設置分類回收桶，大抵將垃圾區分為四類：紙類、玻璃類、塑膠（容器）及金屬類、其他類。其處理費率依區域有不同。依照德國法令垃圾須經中間處理後，方可進入垃圾焚化廠焚化處理，因此前述四類垃圾皆須經中間處理，即經過中間分選資源垃圾後送焚化廠。因此，造就德國境內資源回收廠產業發展。




Deutsche Bahn DB
Restmüll
Deutsche Bahn DB
Papier
Deutsche Bahn DB
Verpackung
Deutsche Bahn DB
Glas



此行參訪德國瑞斯曼公司、可寧衛公司及廢棄物焚化廠暨爐渣分類分選回收廠，以下簡述各廠：

一、參訪 RETHEMANN 總公司及廢棄物分選廠

此次拜訪RETHEMANN公司主要了解該公司在德國廢棄物分類回收產業現況。該公司跨國環保產業集團其各類處理場廠有：紙類回收廠、塑膠類回收廠、資源垃圾分選廠、非資源垃圾分選廠、溶劑回收廠、有機污泥堆肥場等等（詳如附錄七）。

二、參訪可寧衛公司分選場

該廠屬於 Cleanaway 都市垃圾分類處理之一環，自都市垃圾分類體系回收之垃圾，以處理其

他類（非資源垃圾）之垃圾為主，其系統類似，但規模較小，分類原理相同。工作人員共 80 人，其中以人工進行分選，操作人員為 40 人，塑膠的分類以人工為主，利用磁選分開鐵及非鐵金屬，每日篩選量為 100 公噸。

三、都市垃圾分選場、焚化爐及爐渣篩選廠

參訪 Zum Heideh 都市垃圾分類處理廠，其為處理其他類(rest)之廢棄物，由地方政府出資 50%，該公司出資 50%共同設立之分類處理場。主要分選出紙類、金屬類、塑膠類及其他有機性垃圾。據該廠表示，其分選後資源垃圾百分比為：金屬類約佔 4%，紙類約佔 2%，有機性垃圾約 50%，巨大垃圾約 8%，剩餘為其他。顯見，德國民眾在垃圾分類上配合良好，塑膠類容器不易流入該類垃圾中，有機性垃圾規劃進行厭氧發酵處理。

該廠營運操作費用由政府與該公司共管每年垃圾處理費率依實際操作營運狀況調整。其合約期限為 10 年，設置時由各家公司提出計畫書，經

市長及委員會審核遴選，並經相關政治團體同意後設置。

參觀 MVA 廢棄物焚化爐該廠自 1972 設廠，該廠由政府及社區出資 51%，瑞斯曼公司佔 49%進行操作，合約為 20 年，共四套爐床實際焚化量為每床 170 頓 ，以 10000kJ/kg，垃圾熱值設計量為 62t/h。政府提供垃圾 60%保證量，其餘廢棄物來源由該公司自籌，自籌廢棄物來源包含工業廢棄物。據該廠操作經驗表示，廢棄物進料平均熱值約 200-400KCAL/KG，焚化後產生爐渣約有 27%，飛灰約 3%。爐渣中金屬含量約 8%，包含鐵及非鐵金屬以每噸 15 元出售。煙道洗滌塔產生之污泥視為有害事業廢棄物處置，發電量為 247.667mwh1，本身操作需電量為 85.229mwh，可賣出但區域供電已足夠。

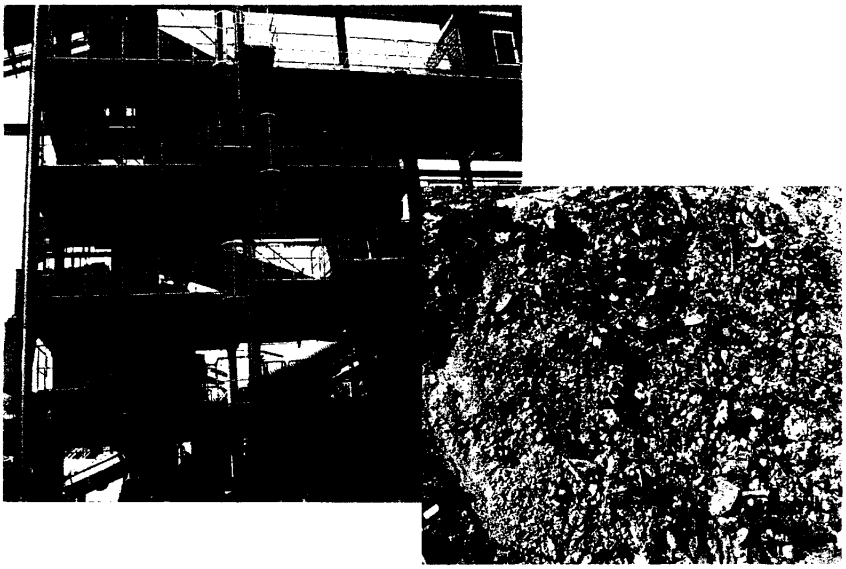
排氣中設置連續監測系統包含下表項目

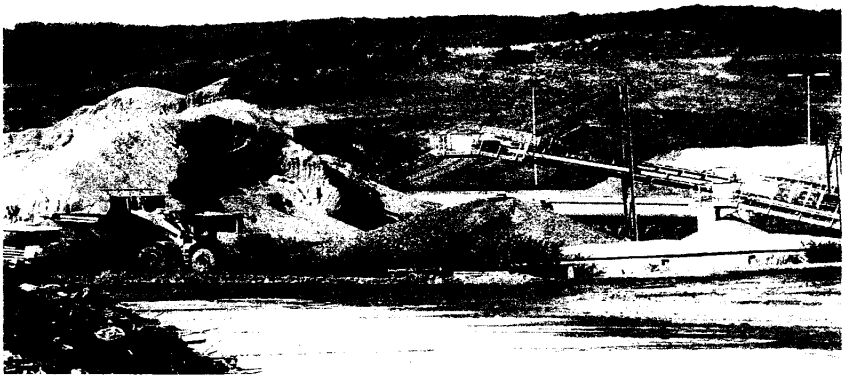
項目	單位	法規值	監測頻率	排放值
HCl	mg/m3	10	連續監測	0.06

HF	mg/m3	1	連續監測	<0.2
SOX	mg/m3	50	連續監測	2
NOX	mg/m3	200	連續監測	150
CO	mg/m3	50	連續監測	10
TOC	mg/m3	10	連續監測	0.16
TSP	mg/m3	10	連續監測	0.6
NH3	mg/m3	5	每年一次	0.03
Dioxine/furan	mg/m3	0.1	每年一次	<0.001
Cd	mg/m3	0.05	每年一次	<0.001
TH	mg/m3	0.05	每年一次	<0.001
Hg	mg/m3	0.05	每年一次	0.002
As	mg/m3	0.5	每年一次	<0.01
PAH(Benzo(a)pyren)	mg/m3	0.1	每年一次	<0.001
苯 benzol	mg/m3	5	每年一次	<0.1

另參訪 AHKW 垃圾焚化廠該廠設立於 1970 年其相較於台灣都市垃圾焚化廠稍嫌老舊。(詳細資料如附錄七)

德國垃圾焚化廠焚化後爐渣普遍採用分選回收鐵、非鐵金屬以及骨材再利用。





四、參訪心得

德國簡易的四種垃圾分類回收以及垃圾不得逕行焚化或掩埋處理，搭配補貼中間分選處理政策，使得該等分選產業發展。台灣適推動以焚化處

理為主，資源回收逐年提升的垃圾處理政策，目標達到「零廢棄」！因此，德國經驗適可為我借鏡。以下提出建議：

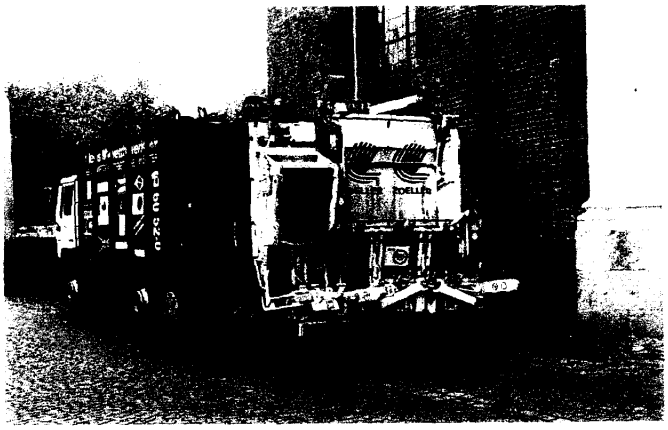
（一）推動一般廢棄物「零廢棄」資源回收體系，即推動垃圾分類以外，所有垃圾須經中間分選資源回收以後，方進入垃圾焚化廠處理。

（二）推動焚化廠飛灰及爐渣再利用，飛灰添加為水泥原料；爐渣分選為骨材之可行性。

（三）輔導設置廢棄物分類分選資源回收產業。

五、國外攜回之資料原件

取得德國瑞斯曼 RETHMANN 公司簡介資料（英文版），AHKW 垃圾焚化廠簡報資料（德文版）以及 RECYCLINGPARK(Brandenburg)分選廠簡介（德文版）。



陸、感染性廢棄物滅菌處理技術

隨著環境污染問題日益嚴重，與民間之環保意識的抬頭，對于醫療院所所排放之廢棄物已成為敏感的問題，因醫療院所收容病患一有疏忽，可能是聚合各種病菌的溫床。在治療過程中所產生的感染廢棄物有可能具有傳染性，該等廢棄物於貯存、運輸、處理過程中亦可能將病菌或病毒等污染帶到醫院外，而造成公害。

德國環保儀器業者以醫療廢棄物在醫院內即消毒完畢，斷絕感染性廢棄物 “周遊全國各地” 的途境，自然能讓其傳染的可能性降低為由，推動院內滅菌。

此行德國HA International Envitech公司介紹該公司感染性廢棄物滅菌設備之特色：

- ●單元式組合使我們的VALIDES 消毒滅菌設備可依需求靈活選用
- ●非焚化爐，市區內亦適合設置並可避免民粹抗爭
- ●顧客可依現地何種制造蒸氣的能源較價廉或保養及操作費高低自行決定是由 廢熱、瓦斯或電力來操作
- ●同時適用于可燃性及不可燃燒性、金屬及非金屬的醫療廢棄物處理(德國 A+B+C型及台灣 黃色容器感染性事業醫療廢棄物)
- ●以飽合水蒸氣加熱，無爆炸的危險
- ●設備經由德國TÜV及德國流行病防疫所Robert Koch

Institute 認可且經多年實際操作驗証產品可靠性

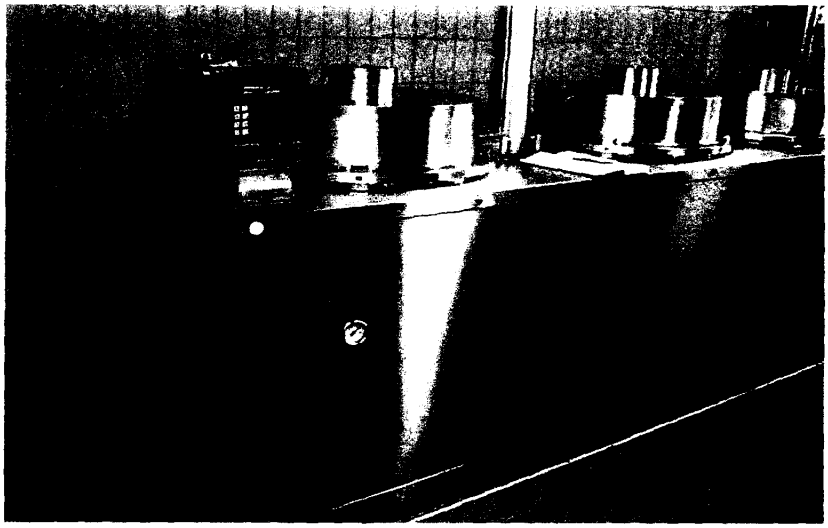
●產品採SS316/DIN 1.4571 不銹鋼材質，經久耐用

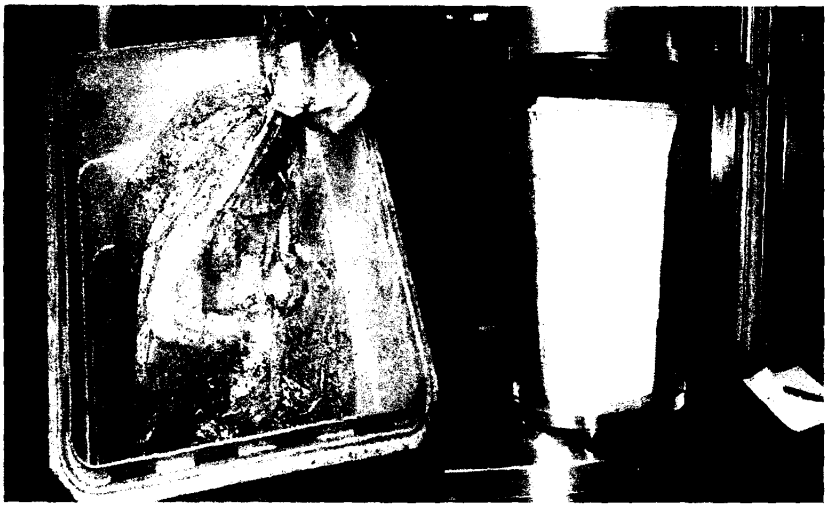
●操作安全，全程監控並有計錄備查

●以標準式測試片供消毒結果証明

●處理後之醫療廢棄物無再污染之虞，可當一般廢棄物處理）

●操作及單位處理費用低廉





柒、建議事項

此次「土壤及地下水風險評估及整治技術產源不明廢棄物分類及處理技術」，研修期間自九十二年九月三日至九十二年九月十七日，主要為參訪德國徒賓根大學（TUBINGEN UNIVERSITY）了解該校在土壤及地下水風險評估及整治技術的推展，另參訪德國瑞斯曼公司及可寧衛公司各類廢棄物分類廠含廢棄物焚化廠、廢溶劑回收分類場及處理廠、塑膠分類回收廠、紙類分類回收廠、資源廢棄物分類回收廠，以及參訪技術顧問公司了解感染性廢棄物之滅菌處理及爐渣分類處理廠。

我國「土壤及地下水污染整治法」於八十九年二月二日制定公布，而對於非法棄置場之清理作業，於八十八年高屏地區非法棄置場陸續浮現後展開清理作業，如今已陸續完成清理。謹以此次赴德參訪心得，提出建議：

（一）加強與歐美各國土壤及地下水污染整治技術交流。

（二）進行國內地下水使用現況普查建立敏感地區監測網。

（三）逐步推動將工廠集中管理。

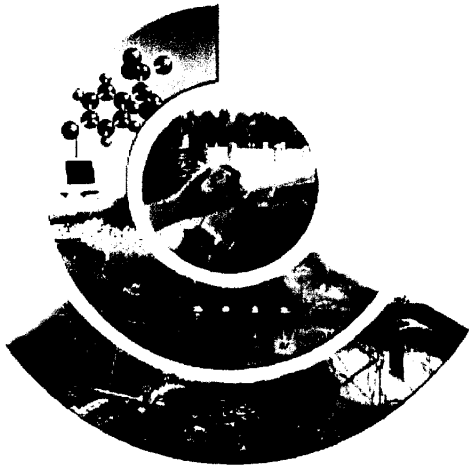
（四）重新檢視國內事業廢棄物清理體系。

（五）推動一般廢棄物「零廢棄」資源回收體系。

（六）重新建立事業主對廢棄物清理的責任制度。

（七）輔導設置廢棄物分類分選資源回收產業。

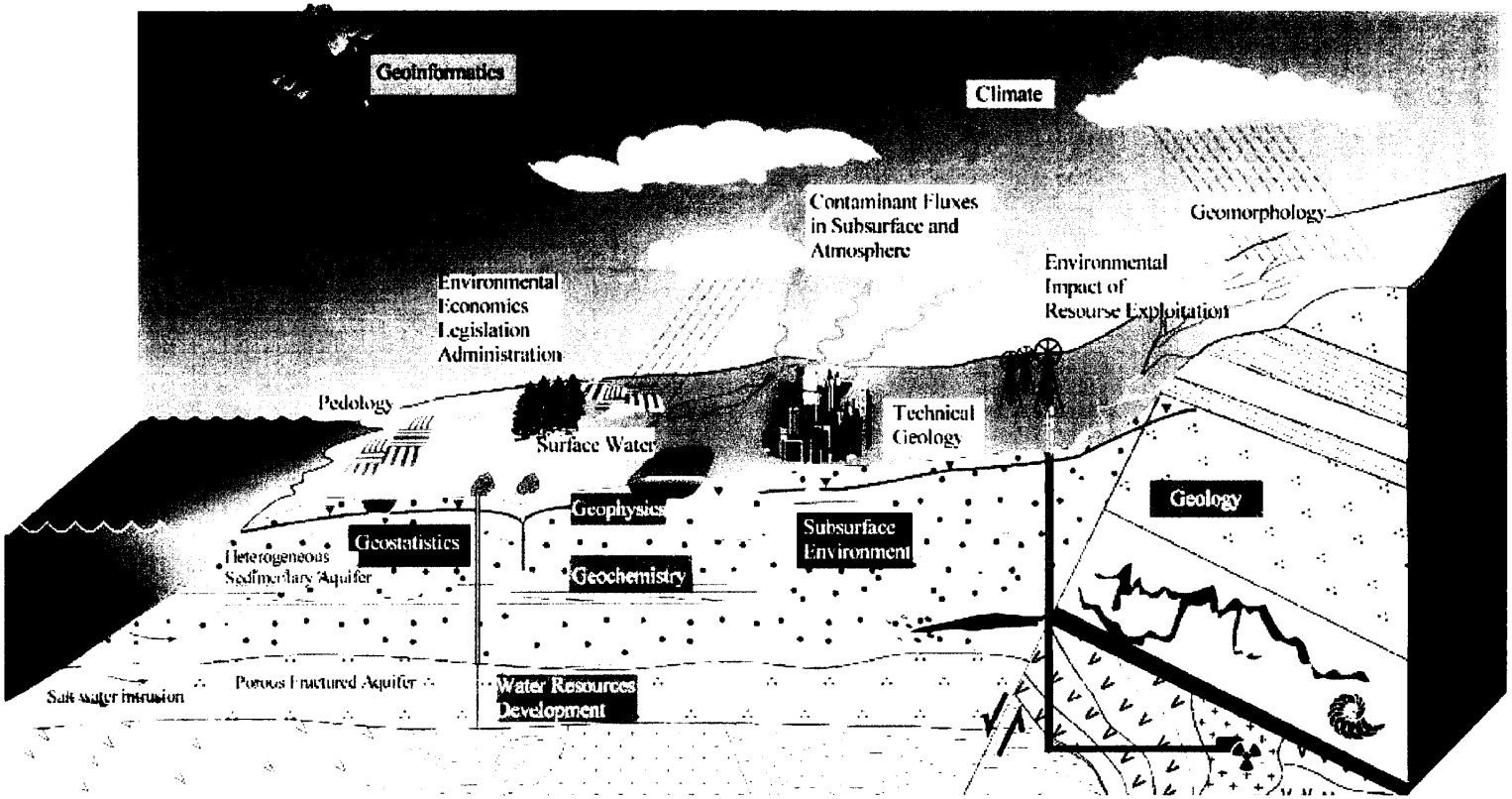
（八）嘗試推動感染性醫療廢棄物院內滅菌處理。



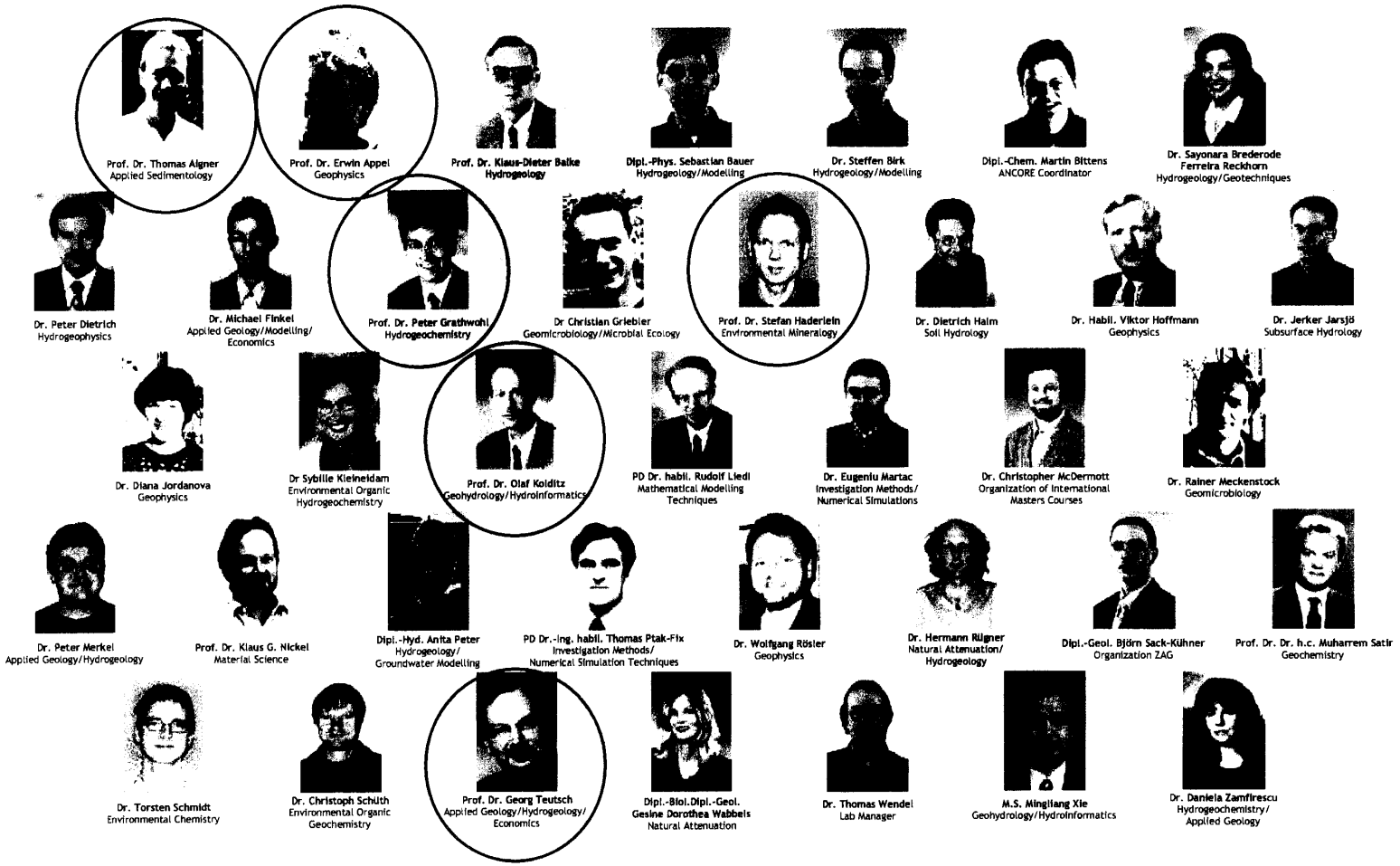
A short Introduction to the ZAG.

September 3rd, 2003 - Tübingen

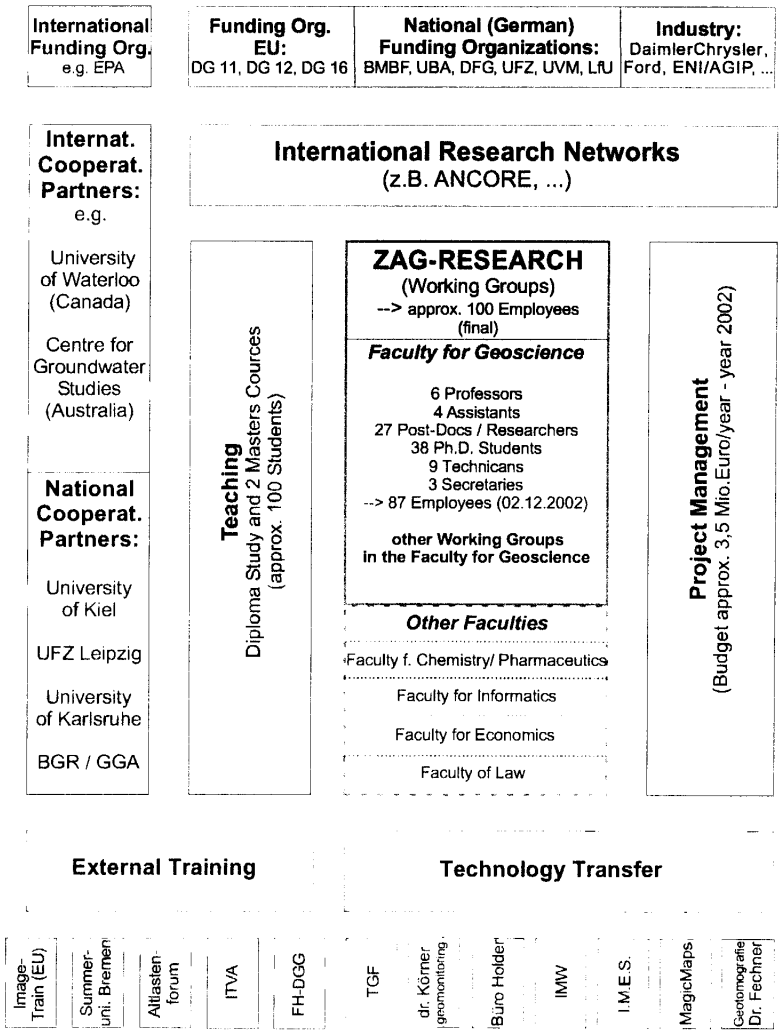
Water Resources Management



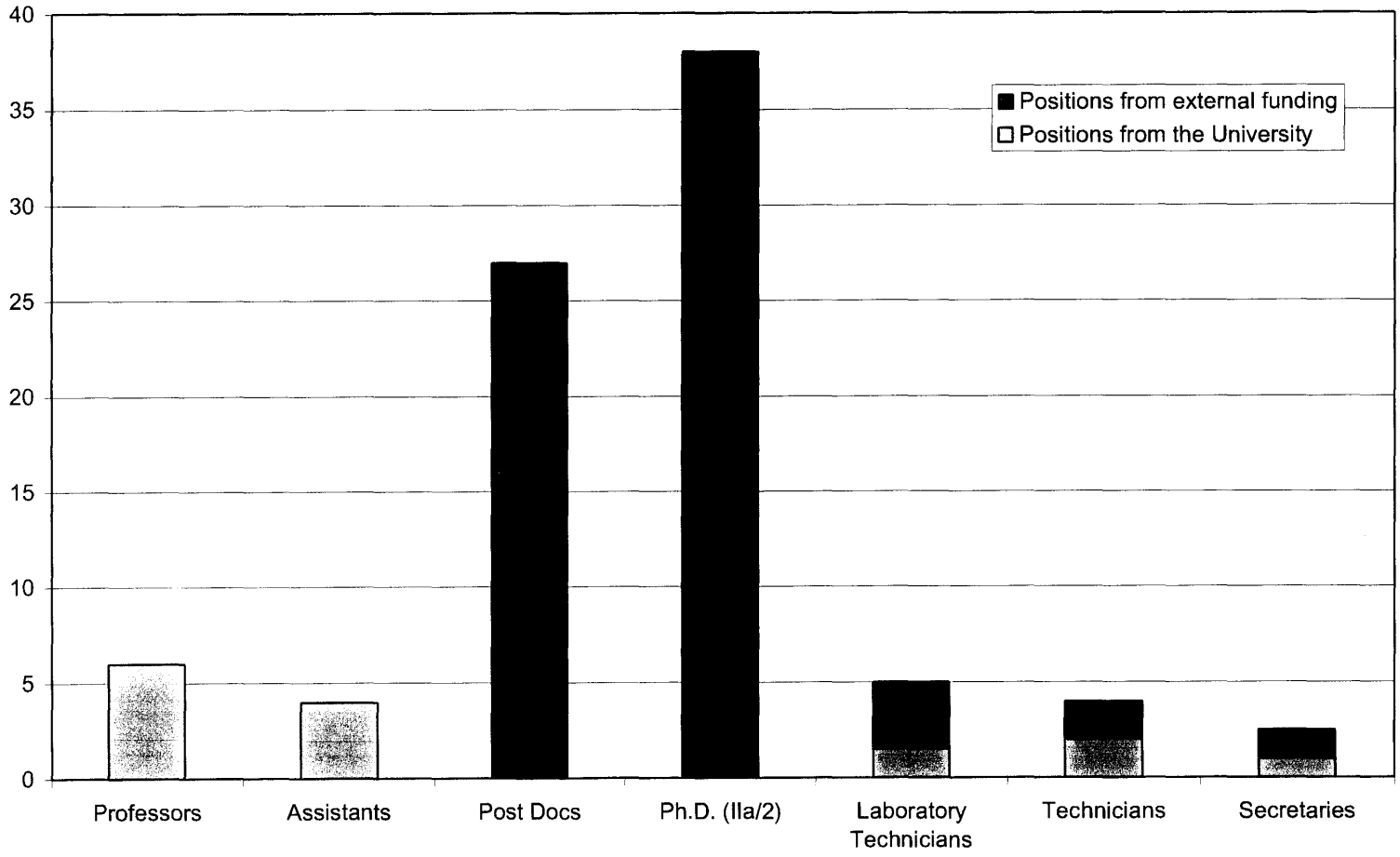
ZAG Staff and Post-Docs



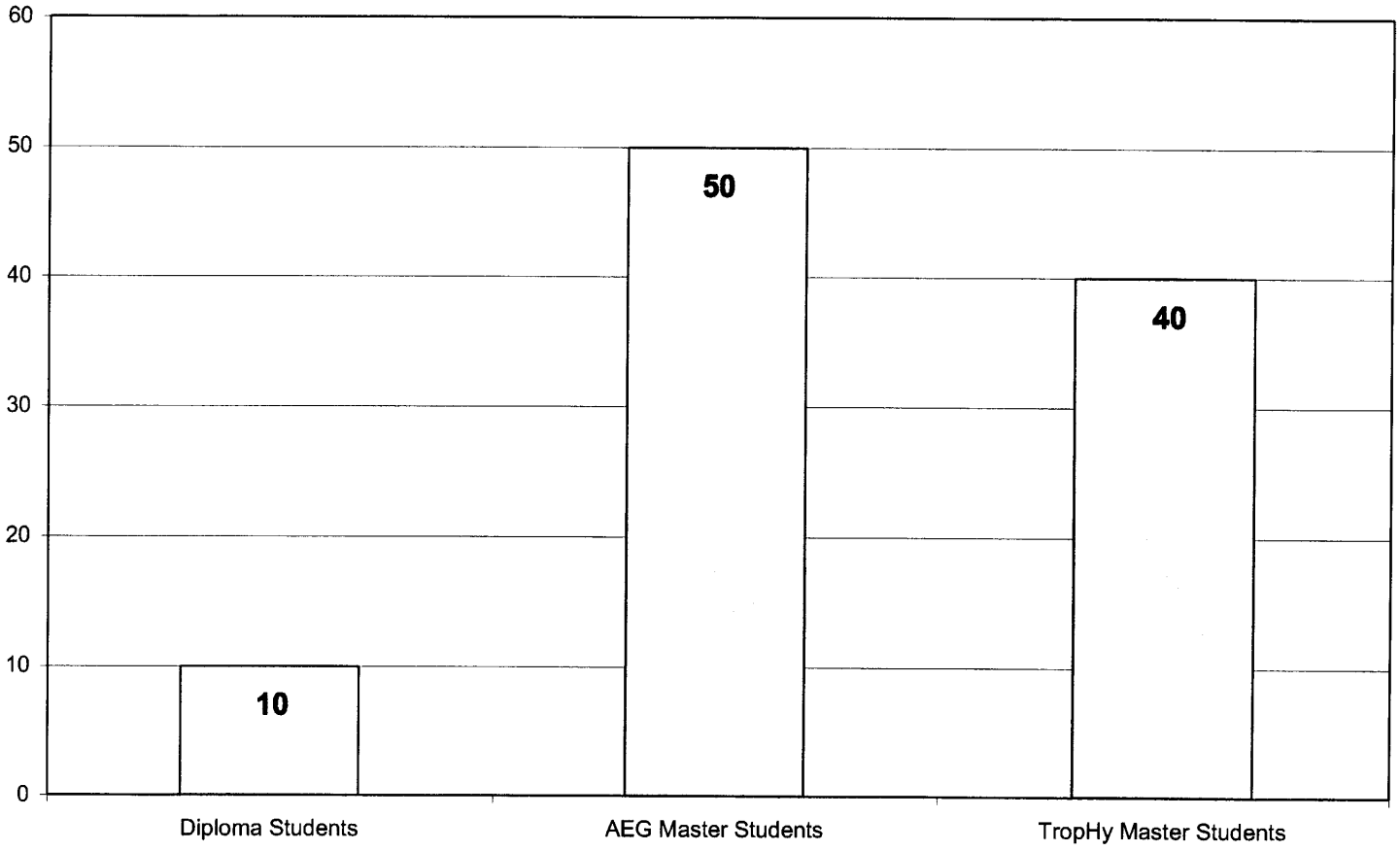
Structure of ZAG



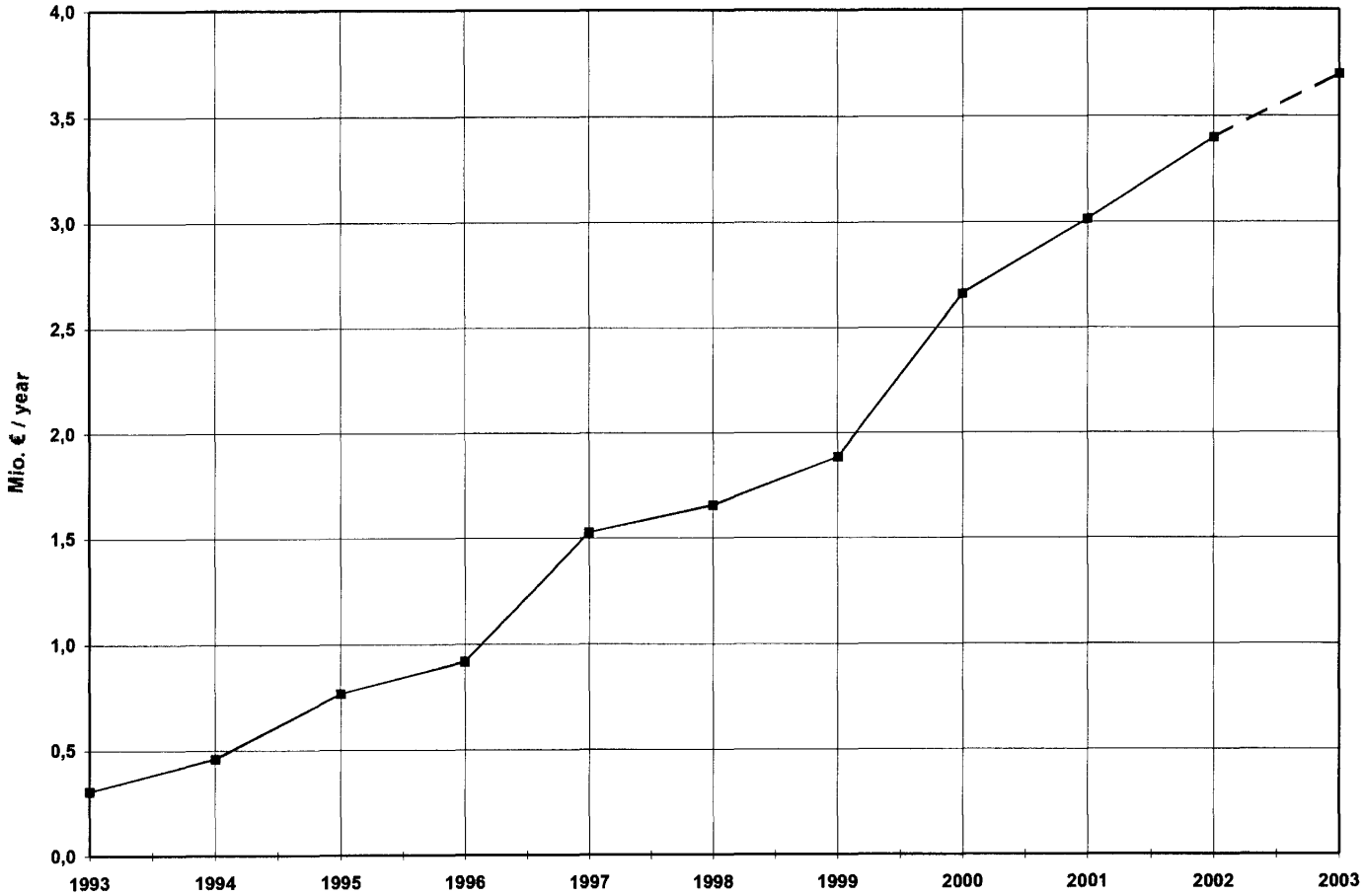
The 87 employees of ZAG



The approx. 100 students



Development of external research support



Running Projects in 2002

- European Commission (EU) – 11 Projects
- Federal Ministry of Education and Research (BMBF) – 20 Projects
- German Research Foundation (DFG) – 14 Projects

- Bundesanstalt für Geowissenschaften und Rohstoffe (BGR) - 2 Projects
- German Aerospace Center (DLR) – 1 Project
- UFZ Centre for Environmental Research – 2 Projects
- State of Baden-Württemberg – 3 Projects

- Other projects for private and public clients

> 60 Projects with a total Budget of 11 Mio. €

Running Projects in 2002

BA	Projekt	Projektträger	Antragsteller	Beginn	Ende	Bewilligung
0883	CORONA	EU	Grathwohl / Ptak-Fix	01.11.01	31.10.04	408.839,00 €
1723	GM-Rhizoremidiation	EU	Teutsch	01.01.02	31.12.04	132.169,00 €
0226	GRACOS	EU	Grathwohl	01.02.00	31.03.03	921.000,00 €
1403	IMAGE-TRAIN	EU	Teutsch	01.09.01	30.08.04	100.521,00 €
0422	INCORE	EU	Teutsch	01.04.00	30.06.03	560.520,00 €
0419	MAGPROX	EU	Hoffmann / Appel	01.03.00	28.02.03	550.000,00 €
1480	WELCOME	EU	Teutsch	01.01.02	31.12.04	308.319,00 €
0575	W-SAHARA	EU	Ptak-Fix	01.04.00	31.10.03	376.500,00 €
1101	Magnetic Proxy Mapping of Anthropogenic Impacts on the low Danube Sediments	EU (Marie-Curie)	Hoffmann	01.11.01	31.10.03	146.000,00 €
3255	KORA ENA: TV 2, Verbund ENA zum Abbau heterozyklischer Kohlenwasserstoffe im Grundwasser -	BMBF	Grathwohl	01.10.02	30.09.04	230.715,00 €
1833	KORA METLEN: TV 1, Projektverbund MTBE - LEUNA als Referenzstandort zur Implementierung des	BMBF	Grathwohl	01.09.02	28.02.07	108.986,00 €
3276	KORA TL: TV 2, Monitoring u. Bewert von stimulierten Selbstreinigungsprozessen im Vergl. zu natürl.	BMBF	Meckenstock	01.12.02	30.11.05	318.257,00 €
1775	KORA: Koordinierung TV 1 - MKW	BMBF	Teutsch	01.04.02	31.03.06	275.579,00 €
0563	RETZINA	BMBF	Teutsch	01.06.00	31.05.03	1.111.139,52 €
0503	RUBIN: Vergleichende techn.-ökonom. Bewertung von In-Situ Reinigungswänden an kontam.	BMBF	Teutsch	01.07.01	30.06.04	273.024,75 €
2867	SAFIRA in situ / Kohle	BMBF	Grathwohl	01.07.99	30.06.02	464.815,45 €
0346	SAFIRA Reaktive Wände / Ökonomie	BMBF	Teutsch	01.04.00	31.03.03	216.634,37 €
2862	SAFIRA Reaktiver Transport	BMBF	Liedl	01.07.99	31.12.02	126.084,58 €
2900	SAFIRA Schadstofffracht	BMBF	Ptak-Fix	01.10.99	31.03.03	216.020,82 €
2823	SAFIRA Wissenschaftlicher Sekretär	BMBF	Teutsch	01.04.99	30.09.02	263.340,88 €
2864	SAFIRA Zeolithisch Katalyse	BMBF	Grathwohl	01.07.99	30.06.02	383.417,78 €
0831	Sickerwasserprognose (Quelle)	BMBF	Grathwohl	01.09.00	31.08.03	198.330,12 €
0777	Sickerwasserprognose (Transport)	BMBF	Liedl / Grathwohl	01.09.01	31.05.04	274.988,11 €
1202	Quantifizierung des mikrobiellen Schadstoffabbaus in kont. Grundwässern (Isotopen)	BMBF / UFZ	Meckenstock	01.01.01	31.12.02	279.407,72 €
1771	Groundwater Modelling - Jordan Valley (GIJP Water Resources)	BMBF / Uni Jena	Kolditz / Sauter	01.06.02	30.09.04	99.590,71 €
0767	HMC-Prozesse in Ton-Bentonit-Systemen (HMC-Modelling)	BMBF / Uni Weimar	Kolditz / Schanz	01.08.01	31.12.04	385.515,61 €
1055	Festgesteins-Aquiferanalog: Experimente und Modellierung (inkl. Verlängerung)	DFG	Dietrich	01.03.01	31.05.04	170.055,68 €
0988	Geodynamik Zentral-Tibets	DFG	Appel	01.12.00	30.11.02	28.000,00 €
1567	Internationales Kontinentales Bohrprogramm (ICDP / KTB)	DFG	Kolditz	01.10.02	31.10.03	60.024,87 €
0811	Langlebige Seen am Südrand des Tibet-Plateaus / Himalaya	DFG	Appel	01.01.01	31.12.02	90.000,00 €
0406	Magnetic field reversals recorded by partial thermomagnetic remanences of pyrrhotit in low grade	DFG	Appel / Hoffmann	01.10.00	30.09.03	125.000,00 €
1424	Nichtisotherme gekoppelte Strömungs- und Deformationsprozesse in teilgesättigten porösen Medien	DFG	Kolditz	01.06.02	31.05.04	169.847,58 €
1756	Prozessbasierte Charakterisierung der dualen Abfluss- und Transporteigenschaften von	DFG	Liedl / Sauter	01.07.02	30.06.04	118.951,00 €
1263	Quartäre Kieskörper: Charakterisierung, Hydrogeologie und Modellierung (C3-Nachfolge)	DFG	Teutsch / Aigner / Appel	01.06.01	31.05.03	213.579,91 €
3288	Sorption-Desorption typischer nichtpolarer organischer Schadstoffe in Geosorbenten	DFG	Grathwohl	01.12.02	30.11.04	97.200,00 €
0476	Sorptionsverhalten organischer Schadstoffe in Böden (Fortsetzung)	DFG	Grathwohl	01.08.01	31.07.02	13.037,94 €
1269	Tertiäre Rotationen um vertikale und horizontale Achsen am Nordrand der Indischen Platte: Oroclinal	DFG	Appel	01.04.01	31.07.02	63.000,00 €
0456	Zyklengenese	DFG	Aigner	01.06.01	31.05.02	81.988,48 €
0343	THM-Prozesse in Ton-Bentonit-Systemen (THM-Modelling)	BGR / Uni Hannover	Kolditz	01.07.01	31.03.03	71.485,51 €
1882	Erfassung schädlicher Bodenveränderungen durch die atmosphärische Deposition von persistenten	BWPLUS	Grathwohl	01.10.02	31.12.04	222.000,00 €
1717	Projektbezogener Wissenschaftleraustausch mit Argentinien (PROALAR)	DAAD	Grathwohl	01.01.02	31.12.03	19.386,24 €
3322	Integrated Protection of Soil and Water in Europe (Reconsile)	DLR	Grathwohl	01.11.02	31.03.03	10.000,00 €
1787	Durchführung von Voruntersuchungen zur Bauwerksauslegung am Standort Leuna	EAWAG / UFZ	Haderlein	01.04.02	31.05.03	138.960,00 €
2015	Reaktionskaskaden an funktionalen Gelen	Land Baden-Württ.	Speiser	01.05.02	30.04.03	6.820,00 €
0647	ZAG	MWK	Teutsch	01.07.00	30.06.03	245.726,88 €
3271	Geothermie-Modell Bad Urach	Stadtwerke Bad	Kolditz	01.11.02	31.10.03	35.829,00 €
3260	Kompendium zum Quantitativen Risk Assessment	UFZ	Teutsch	01.10.02	30.11.03	80.338,71 €
3450	SAFIRA 2	UFZ	Grathwohl	15.12.02	31.08.04	149.928,00 €
						10.940.875,22 €

New Projects 2003

- European Commission (EU) – 2 Projects
- Federal Ministry of Education and Research (BMBF) – 4 Projects
- German Research Foundation (DFG) – 1 Project

- Other projects for private and public clients

> 9 Projects with a total Budget of 1,5 Mio. €

BA	Projekt	Projektträger	Antragsteller	Beginn	Ende	Bewilligung
3370	EUGRIS	EU	Teutsch	01.03.03	31.08.05	141.230,00 €
3323	SOWA	EU	Grathwohl	01.02.03	31.01.05	138.800,00 €
3290	KORA BONA: TV 8, Technisch-umweltökonomische Bewertung und Optimierung der Nutzung	BMBF	Finkel	01.01.03	31.12.05	233.627,00 €
3265	KORA VA: TV 7, Verbund Virtueller Aquifer (VA) - Computergestützte Bewertung von Erkundungs-,	BMBF	Kolditz	01.01.03	30.06.06	491.825,00 €
3264	KORA ZEVA: TV 7, Zeitliche Variabilität der Grundwasserfließbedingungen im Zusammenhang mit der	BMBF	Dietrich	01.01.03	28.02.06	158.762,00 €
folgt	Sickerwasserprognose (Quelle) - Fortsetzung	BMBF	Grathwohl	01.03.03	29.02.04	98.192,00 €
3329	Internationales Kontinentales Bohrprogramm (ICDP / KTB) - Fortsetzung	DFG	Kolditz	01.11.03	31.10.04	74.400,00 €
3330	Endlager / Rockflow: Programmentwicklung zur Untersuchung von gekoppelten thermischen,	BGR / Uni Hannover	Kolditz	01.01.03	30.06.03	31.457,50 €
3277	Herkunft und Bilanzierung des Eintrags des Benzinzusatzes MTBE und seinen Abbauprodukten in	BWPLUS	Grathwohl	01.01.03	31.12.04	105.500,00 €
						1.473.793,50 €

Applications and planned Projects

Projekt (Kurztitel)	Status	Projektträger	Laufzeit (a)	Budget Tübingen in €
Bioverfübgarkeit und Bound-Residue Bildung (HEATFood)	beantragt	EU	3	380.000,00 €
Modelling of natural Attenuation	beantragt	EU (Marie-Curie-Programm)	2	20.000,00 €
SIGMA	beantragt	EU FP 6	5	760.000,00 €
Polare organische Schadstoffe in Grundwasser und Boden	beantragt	DFG (Emmy-Noether-Programm)	4	700.000,00 €
Malm-Projekt (Fortsetzung)	beantragt	DFG Einzelantrag	1	70.000,00 €
Regionaler Georadar	beantragt	DFG Einzelantrag	2	80.000,00 €
Anaerober Aromatenabbau	beantragt	DFG Einzelantrag	3	250.000,00 €
Quartäre Kieskörper: Charakterisierung, Hydrogeologie und Modellierung (Fc	beantragt	DFG Einzelantrag	1	116.000,00 €
Magnetic Pollution Screening (MPS)	beantragt / überarbeitet	DFG Einzelantrag	3	200.000,00 €
Einzelstoff-Isotopenmassenspektrometer	beantragt	HBFG	-	350.000,00 €
Wärme als Mittel zur Grundwassermarkierung und Charakterisierung des Un	beantragt	Uni Tübingen	1	20.000,00 €
Entwicklung hochempfindlicher Isotopenverfahren (Projektförderung für Nach	beantragt	Uni Tübingen	1	30.000,00 €
Einfluss von Schwermetallen auf mikrobielle Eisenreduktion	beantragt	VW Stiftung	3	120.000,00 €
Sorption organischer Stoffe an Mineralien	Skizze eingereicht	DFG Schwerpunktprogramm	3	130.000,00 €
Beurteilung der Filter- und Pufferfunktion von Böden	Skizze eingereicht	Bund/Länder-AG Bodenschutz LABO	1	64.000,00 €
Magnetic Pollution Screening (inkl. EU-Koordination)	in Vorbereitung (06/2003)	EU FP 6		?
INTERPLAN - Evalulerung und Entwicklung von Direct Push-Techniken zur C	in Vorbereitung (2003)	BMBF	2	185.000,00 €
Mehrphasenströmung im Labor und Feldmaßstab	in Vorbereitung (2003)	DFG Forschergruppe	2 x 3	2 x 370.000,00 €
Mikrobielle Eisenreduktion in kontam. Aquferen	in Vorbereitung (2003)	DFG Forschergruppe	3	130.000,00 €
Redoxporozesse in kontaminierten Aquiferen	in Vorbereitung (2003)	DFG Forschergruppe	3	130.000,00 €
Reaktion Grenzflächen / Lösungkinetik aus NAPLs	in Vorbereitung (2003)	DFG Forschergruppe	3	130.000,00 €
Ökologische Relevanz von radikalischen Enzymreaktionen im anaeroben Abl	in Vorbereitung (2003)	DFG Schwerpunktprogramm	3	130.000,00 €
Supporting karst geohazard assessment by simulating void evolution in the s	in Vorbereitung (2003)	DFG Einzelantrag	3	90.000,00 €
Auswirkungen zeitlich variabler Strömungsverhältnisse auf den Stofftransport	in Vorbereitung (05/2003)	DFG Einzelantrag	2	100.000,00 €
Kombinierte Anwendung von Evolutionsstrategien u. Simulationsmodellen zu	in Vorbereitung (2003)	DFG Einzelantrag	2	150.000,00 €
Hydraulische Tomographie in Kombination mit Direct Push	in Vorbereitung (2003)	DFG Einzelantrag	2	125.000,00 €
Reduktive Dehalogenierung	in Vorbereitung (2003)	DFG Einzelantrag	3	250.000,00 €
Integrierte multi-kriterielle technisch-umweltökonomische Optimierung von In	in Vorbereitung (2003)	DFG Einzelantrag oder VW Stiftung	ca. 1	80.000,00 €

5.160.000,00 €

Projekt (Kurztitel)	Status	Projektträger	Laufzeit (a)	Budget Tübingen in €
Reaktion, Stoffübergang organischer Schadstoffe in porösen Systemen	aufgefordert z. Antrag	DFG Forschergruppe	2 x 3	2 x 1.000.000,00 €
AQUATERRA - Integrated Project (IP) im Boden- und Grundwasserschutz	beantragt	EU FP 6 (IP)	5	2.500.000,00 €
SOMAPS - Standardization and Optimization of Magnetic Proxy Screening (ir	beantragt	EU	3	2.670.000,00 €
Bewertung und nachhaltiges Management von Boden- und Wasserressource	in Vorbereitung	DFG Sonderforschungsbereich	3 x 3	3 x 6.000.000,00 €
Umweltinformatik / Environmental Informatics	in Vorbereitung	DFG Graduiertenkolleg	3 x 3	3 x 1.000.000,00 €

13.170.000,00 €

AQUATERRA – an IP in the EU-FP 6

- Soil- and Groundwater-Protection
- Global Budget : 25,0 Mio. €
- EU Budget: 15,5 Mio. €
- Buget University of Tübingen incl. Co-ordination: 2,5 Mio. €
- Period: 5 Years
- IP Co-ordination:
  University of Tübingen (Prof. Grathwohl et al.)
- 46 Partners

Further Informations

www.uni-tuebingen.de/zag

S.A.F.E. Analytik GmbH
Labor + Ingenieurbüro

Présentation et exploitation d'une installation de fermentation selon le procédé de fermentation et de pyrolyse pour la mise en valeur des déchets organiques

Présentation
le
07. 03. 2003
pour
Choucrouterie du Rhin

S.A.F.E. Analytik GmbH
Laboratoire + bureau d'étude

Contenu

- Les entreprises
- Performances et objectifs
- Exposé du concept
- Avantages du procédé
- Marché et emplacement
- Planning

S.A.F.E. Analytik GmbH
Laboratoire + bureau d'étude

Les Entreprises

- Associés
  - Procédé - know how
  - Expérience dans le marchés et les branches
  - Compétences dans la réalisation de projets d'installations d'élimination des déchets.
- Le projet a été explicitement recommandé et encouragé par le ministère de l'environnement
- Exploitations au travers d'associations stratégiques avec des entreprises importantes dans le traitement des déchets pour pouvoir assurer la progression du projet

Prestations

S.A.F.E. Analytik GmbH
Laboratoire + bureau d'étude

Profil des Prestations

Objectifs
- Production énergétique décentralisée par la cofermentation et la pyrolyse
- Planification, construction, exploitation d'autres installation de fermentation

Clients
- Industries
- Communes

Prestations
- Cofermentation des émulsions de lubrifiant de refroidissement et de déchets organiques fermentables en combinaison avec une pyrolyse.
- Utilisation énergétique des gaz de process dans un cogénérateur.
- Utilisation de chaleur perdue par un cogénérateur et une pompe à chaleur

Produits
- Utilisation d'énergies régénératrices
- Fourniture de.
  - Courant
  - Chaleur
  - Froid
  - D'eau industrielle
- Planification, financement, construction et exploitation d'une installation de fermentation.

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Rendements et objectifs

- Cofermentation de déchets organiques directement fermentiscibles et de substances liquides fermentiscibles
- Utilisation raisonnable des boues de sédimentation et des substances solides utilisées
- Post traitement des gaz de pyrolyse dans l'étape anaérobie
- Epuration dans une rozelière des eaux d'écoulement issue de l'aérobie pour être déversées dans le milieux naturel
- Produire un gaz de process avec un pouvoir calorifique suffisant
- Utilisation énergétique des gaz de process dans un co-générateur
- Utilisations des chaleurs perdues dans un co-générateur et/ou une pompe à chaleur

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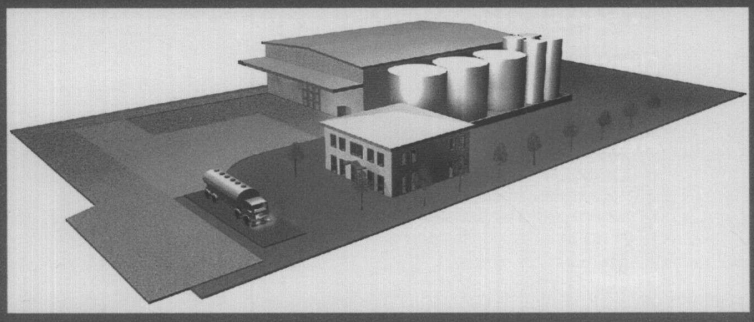
Maquette du site



Besoin en surface d'env. 8000 m² y compris la rozelière

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Le projet

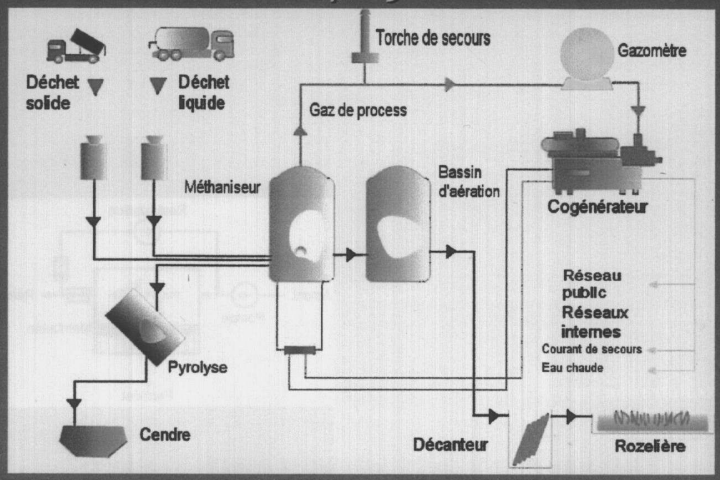

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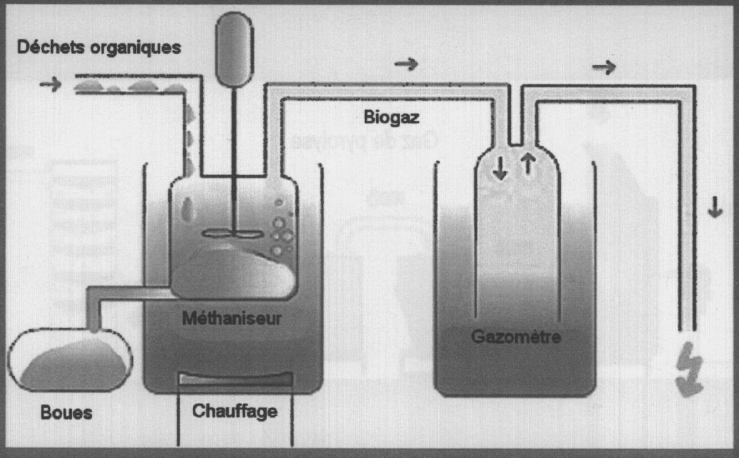
Schéma de la fermentation



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Séparation sûr des boues activées par ultrafiltration
méthode reconnue selon l'état de la technique

La caractéristique de l'**ultrafiltration** est le débordement tangentiel de la membane, le courant transversal est aussi appelé Cross-Flow. La formation de couche obstruante sur la membrane est minimisée par une gravité tangentielle efficace.

La différence fondamentale entre la **micro et l'ultrafiltration** repose sur la taille de pores différentes et dans différentes structures membranaires. Une filtration à travers une membrane de **porosité < 0,1µm** est appelée **ultrafiltration**, tandis qu'une filtration pour un **porosité > 0,1µm** est qualifié de **microfiltration**.

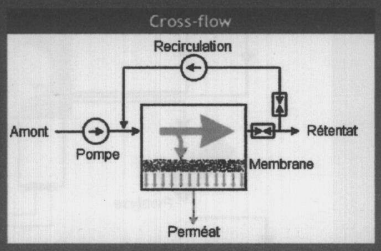

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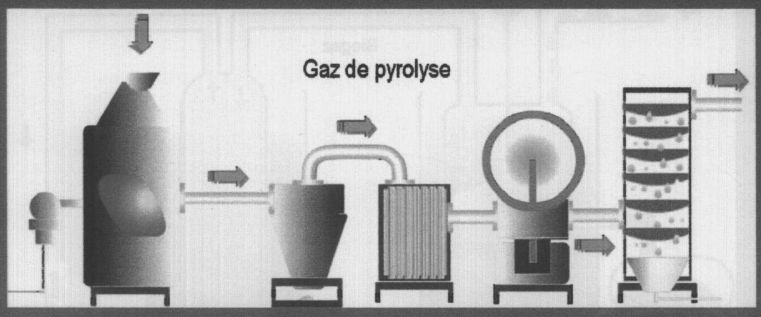
Schéma de la pyrolyse



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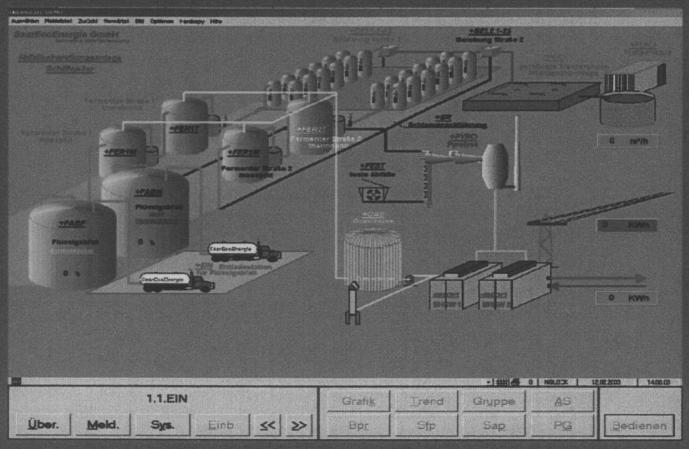
Vue d'ensemble



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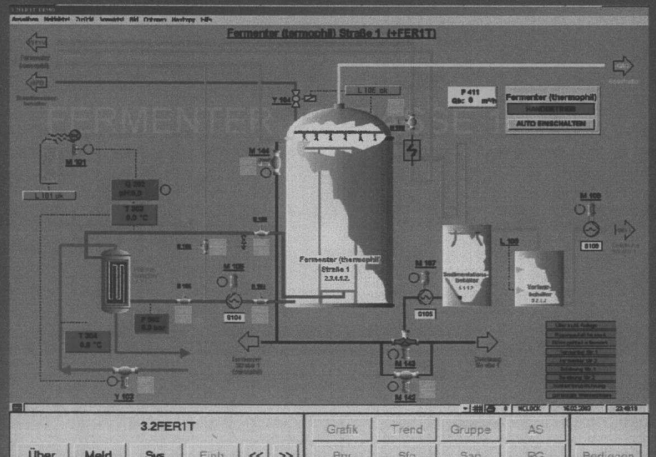
Circulation fermentation



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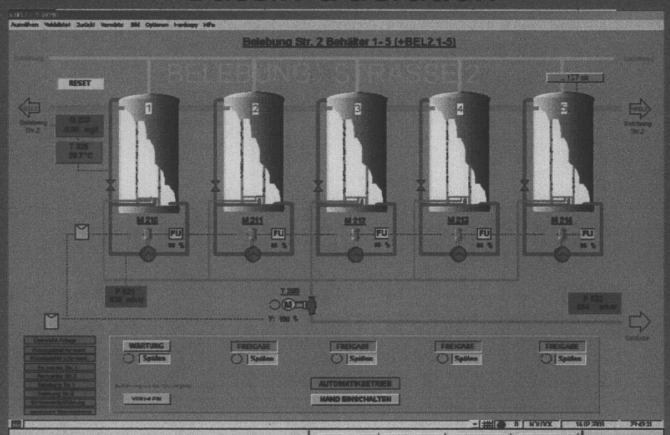
Bassin d'aération



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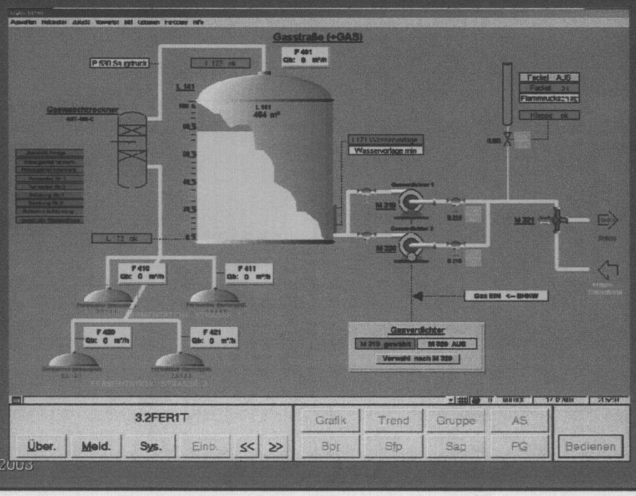
Gazomètre



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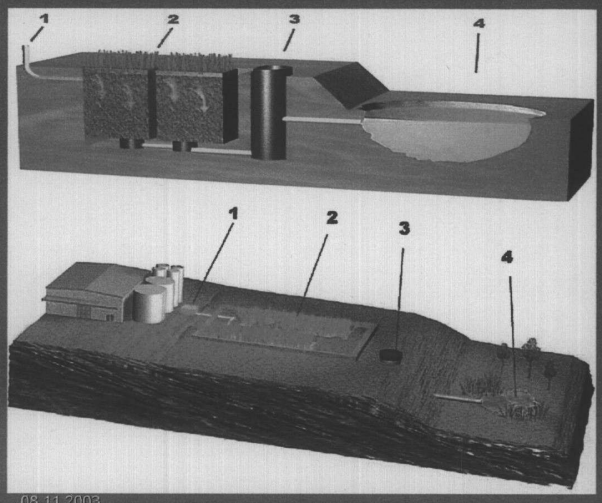
Rozelière



1	Adduction
2	Lit sur gravier
3	Puits de controle et de prélèvement
4	Cours d'eau

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Avantage du procédé

- Utilisation innovatrice et de grande valeur d'émulsions et de déchets organiques solides (§ 52, 2 KrWAbfG)
- Haute rédondance vis à vis des fluctuations de la qualité des substances introduites
- Transformation écologique des gaz de process en électricité et de chaleur par un co-générateur
- Investissement couvert

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Catalogue de produits

02 01	Déchets issus de la production de matières premières.
02 02	Déchets issus de la préparation et du traitement de la viande, du poisson et autres aliments d'origines animales.
02 03	Déchets issus de la préparation et du traitement des fruits, des légumes, des céréales, des huiles alimentaires,du cacao, du café, du tabac et des produits en conserves.
02 05	Déchets issus du traitement du lait.
02 06	Déchets issus de la production de pâtisseries et de sucreries.
02 07	Déchets issus de la production de boissons alcoolisées et non alcoolisées (sans le café, le thé et le cacao).
07 05	Déchets issus de la préparation, la distribution et l'emploi de produits pharmaceutiques.
12 01	Déchets issus du façonnement mécanique.
13 05	Contenu des collecteurs d'eau/d'huiles
13 06	Les déchets d'huiles
16 03	Loupés de fabrications (16 03 02 loupés de fabrication organiques)
20 01	Fractions collectées séparément

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Le procédé est écologique

- Production énergétique neutre de CO2 selon la CEE
- Utilisation écologique de chaleur perdue avec raccordement de chauffage de proximité
- Emissions minimales de gaz et de solide
- Les eaux usées de qualités de déversement direct
- 5-10 poids lourds /jour
- Livraison possible par chemin de fer

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Directive 2001/18/CE

relative à la dissémination volontaire d'organismes génétiquement modifiés dans l'environnement

- Observation des exigences pour les eaux usées et les installations de traitement des déchets
- Elimination complète et sans nuisances des organismes grâce aux différentes étapes du procédé
- Le public accept de plus en plus l'existance de méthaniseur pour le traitement des déchets

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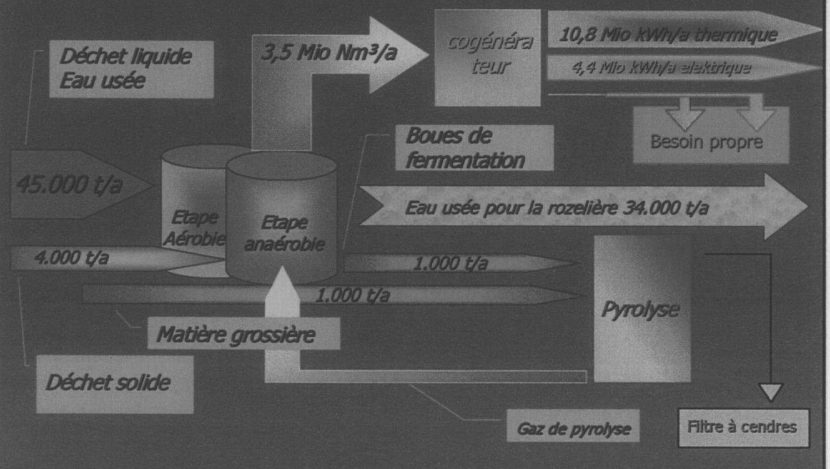
Bilan énergétique et des masses fermentation des déchets liquides



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Bilan énergétique

- Production énergétique brute
  - 7,4 Mio kWh/a électrique
  - 12,8 Mio kWh/a thermique
- Besoins propres
  - 3,0 Mio kWh/a électrique
  - 2,0 Mio kWh/a thermique
- Offre énergétique
  - 4,4 Mio kWh/a électrique
  - 10,8 Mio kWh/a thermique

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La méthode est expérimenté et sûre

- Les installations de référence dans le traitement biologiques travaillent de facon sûres et sans interruption
- Les résultats d'exploitation du pilote confirme le projet
- Les composants de l'installation sont état de la technique
- Haute disponibilité grâce à la rédondance des principaux composants

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Analyse de marché

- Les déchets organiques solides ne peuvent plus être utilisés comme nourriture pour animaux – ESB / fièvre aphteuse
- Les déchets organiques liquides sont traités sans utiliser leurs haut potentiel énergétique
- Les procédés intégrant l'utilisation de courant et de chaleur ne sont pas établies sur ce segment du marché

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Critères d'implantation pour une installation planifiée

- Situation centrale aux marchés ciblés
- Subvention optimale
- Synergies des zones industrielles
- Infrastructures adaptées aux besoins

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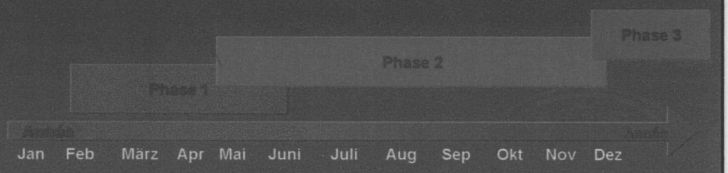
Programme temporel

- *Phase 1*
  - Planification et procédure d'autorisation selon les installations classées
- *Phase 2*
  - Etablissement et mise en marche du méthaniseur
- *Phase 3*
  - Enregistrement des services réguliers
  - Réalisation de projets d'avenir



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Investissements

Plan d'investissement	Euro (€)
Terrain	200.000
Composants ainsi que l'aménagement	1.000.000
Appareil mécanique	3.600.000
Planification / autorisation	750.000
Avance sur frais	200.000
Liquidité pour les affaires courantes	200.000
Somme	**5.950.000**

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Installation de référence : SaarEcoEnergie - Schiffweiler

- www.saarecoenergie.de
- ☎ +49 6821 93160-0
- 🖷 +49 6821 93160-12
- 📠 info@saarecoenergie.de

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Informations supplémentaires

- www.safe-analytik.com
- 📠 info@safe-analytik.com
- ☎ +49 6897 9005 0
- +33 3 87 27 64 91
- 🖷 +49 6897 9005 25
- +33 3 87 27 64 92
- +49 6897 767189

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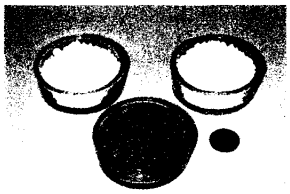
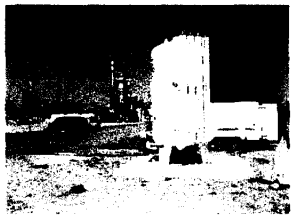
ACHEMA Frankfurt 19.05 – 24.05. 2003

Catalyst technologies for treating contaminated groundwaters

Christoph Schüth *Peter Grathwohl*
University of Tübingen, Center for Applied Geoscience, Germany
Frank-Dieter Kopinke *Robert Köhler*
Center for Environmental Research Leipzig-Halle (UFZ), Germany





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Outline

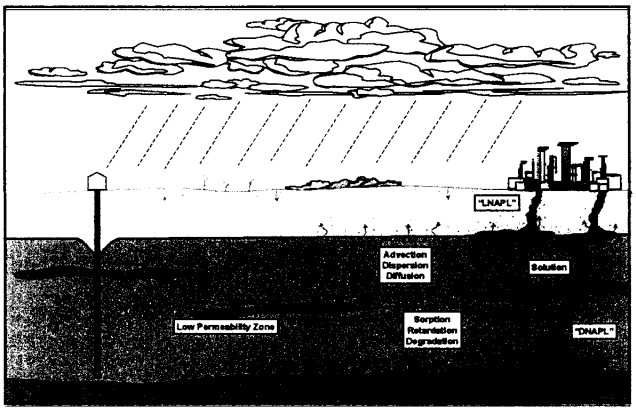
Development of a novel, catalyst based technology for the treatment of chlorinated hydrocarbon compounds in groundwater.

Field application of the technology and limitations.

Modification of the technology to operate in complex groundwater matrices (hollow fiber membrane stripping and catalysis in the gas-phase.

Field applications of the modified technology.

What is the target ???



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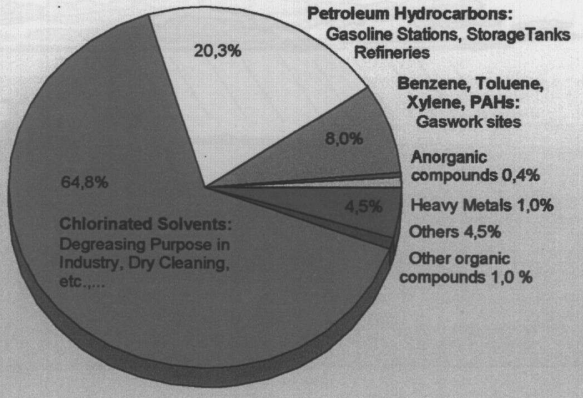
25 most frequently detected groundwater contaminants at hazardous waste sites.
US National Research Council (NRC), 1994.

Rank	Compound	Common Sources
1	Toluene	Unspecified; metal degreasing
2	Lead	Gasoline (prior to 1975); mining; construction material (pipes); manufacturing
3	Trichloroethene	Degreasing; metal degreasing
4	Benzene	Gasoline; manufacturing
5	Carbon	Gasoline; manufacturing
6	Chromium	Metal plating
7	Methylene chloride	Degreasing; solvents; paint removal
8	Zinc	Manufacturing; mining
9	1,1,1-Trichloroethane	Metal and plastic cleaning
10	Arsenic	Mining; manufacturing
11	Chloroform	Solvents
12	1,1,2-Trichloroethane	Degreasing; solvents
13	1,2-trans-Dichloroethene	Transformation products of 1,1,1-trichloroethane
14	Cadmium	Mining; plating
15	Manganese	Manufacturing; mining; occurs in nature as oxide
16	Copper	Manufacturing; mining
17	1,1-Dichloroethene	Manufacturing
18	Vinyl chloride	Plastic and solvent manufacturing
19	Barium	Manufacturing; energy production
20	1,2-Dichloroethane	Metal degreasing agent; solvent
21	Dichloromethane	Plastics and solvent manufacturing; paint removal
22	Nickel	Manufacturing; mining
23	Tetrachloroethene	Metal degreasing
24	Xylenes	Gasoline; manufacturing
25	Phenol	Wood treating; disinfectant

Relevant contaminants in the State of Baden-Württemberg

About 1.900 Reported Cases of Groundwater Pollution in the State of Baden-Württemberg
Landesanstalt für Umweltschutz, Baden Württemberg (1996)



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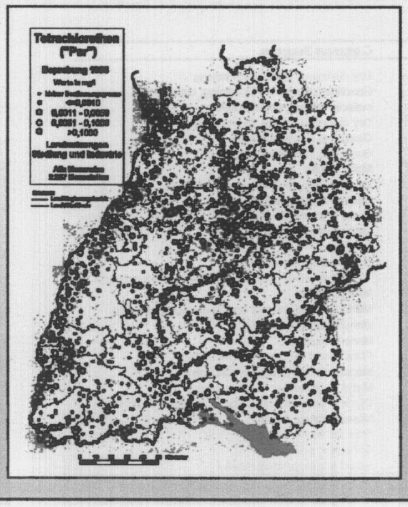
PCE in groundwater in the State of Baden-Württemberg



Tetrachloroethene (PCE)

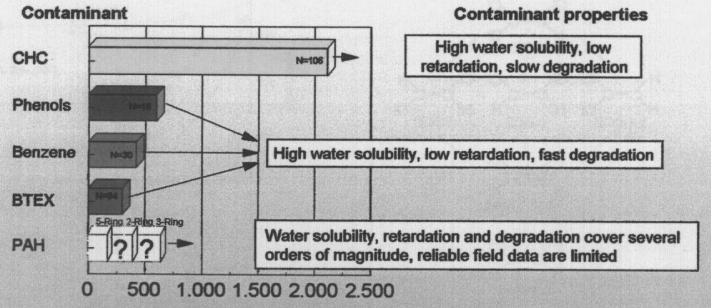
Sampling campaign 1998

Conc. in mg/l

- n.d.
- < 0.0010
- 0.0011 – 0.0050
- 0.0051- 0.1000
- > 0.1000

Source: LFU - Baden Württemberg

Statistics of plume lengths



Field observations of max. plume lengths in meter in 75% of the selected cases

Schiedek et al. 1997

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Target: Chlorinated Hydrocarbon Compounds (CHC)

Why Catalysis ?

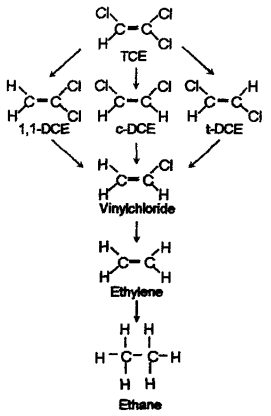
- **Destructive – no secondary waste streams**
- **Reductive – low risk of formation of even more toxic endproducts**
  (Hydrogen has to be added as the reductant)
- **Potentially very fast rates**
- **Potentially broad reactivity**
- **A catalyst is not used up in the reaction**

But ....

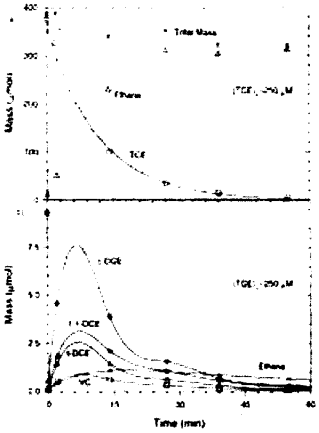
- **Aqueous phase**
- **Temperatures ~ 5°C - 20°C**
- **Ambient pressure**
- **Inorganic and organic constituents in various concentrations**

Reactions – Palladium on Alumina

(batch experiments in H_2 saturated deionized water)



Metallic Palladium – Products



Lowry & Reinhard (1988): *Environ. Sci. Technol.*, 33 (11), 1905–1910.

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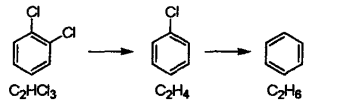
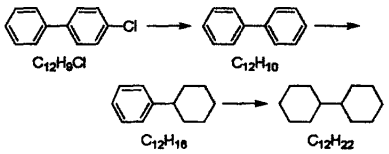
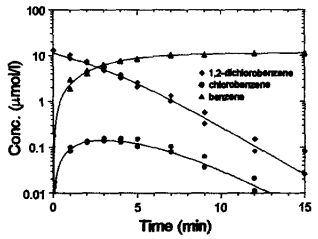
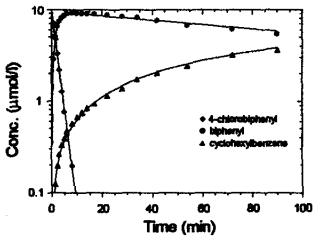
Reactions – Palladium on Alumina

(batch experiments in H_2 saturated deionized water)





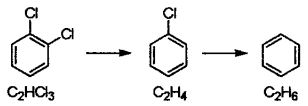




Schüth & Reinhard (1998): *Appl. Cat. B.* 18, 215-221

Rates – Influence of Metals

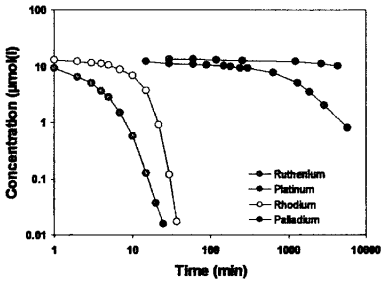
(batch experiments in H_2 saturated deionized water)



Experimental Conditions

for Palladium and Platinum:
0.5g/l catalyst, metalloading 1% uniform

for Rhodium and Ruthenium:
0.1g/l catalyst, metalloading 5% uniform



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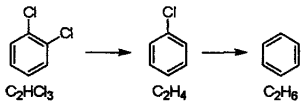
Lessons learned

(batch experiments in deionized water)

- **Catalytic hydrodechlorination with noble metals is very effective in degrading chlorinated compounds to harmless products (aliphatics) or products that are more easily degraded biologically (aromatics).**
- **That even works in aqueous phase under ambient conditions.**
- **Palladium is the moste reactive metal**
- **Unsaturated compounds react much faster than saturated compounds, some saturated compounds do not react (e.g. 1,2-dichloroethane).**

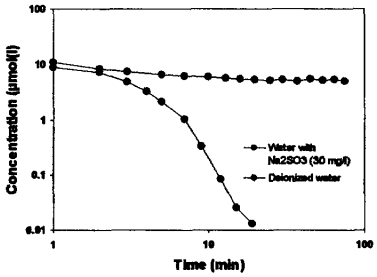
Rates – Influence of water constituents

(batch experiments in H_2 saturated deionized water + 30 mg/l Na_2SO_3)



Experimental Conditions

Palladium on Alumina:
0.5g/l catalyst, metalloading 1% uniform



Especially some sulphur containing ionic compounds can deactivate palladium catalysts in water rapidly.

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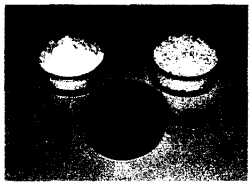
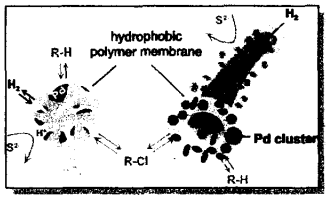
In groundwater, tailored catalysts are needed –

Very hydrophobic support materials to protect the noble metal from ionic species

Hydrophobic zeolites with high Si/Al ratios (Zeolite Y-200) impregnated with palladium. H_2 is added to the water.

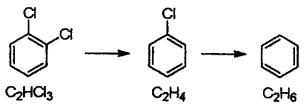


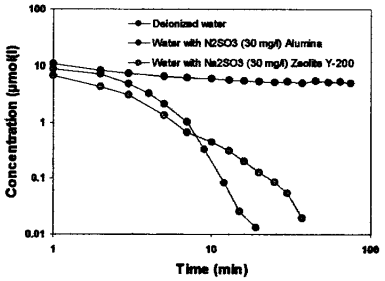
Hydrophobic polymer membranes (Silicone tubes) impregnated with palladium. H_2 is supplied through the inside of the tubes.



Rates – Influence of water constituents

(batch experiments in H_2 saturated deionized water + 30 mg/l Na_2SO_3)





Experimental Conditions

Palladium on Alumina:
0.5 g/l catalyst, metalloading 1% uniform

Palladium on Zeolite Y-200:
0.5 g/l catalyst, metalloading 1% uniform

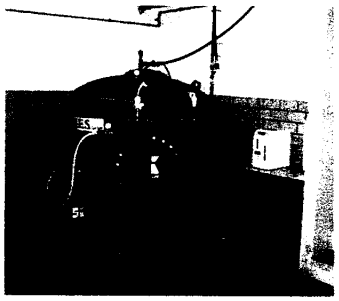
Hydrophobic support materials increase the stability of palladium catalysts in groundwater.

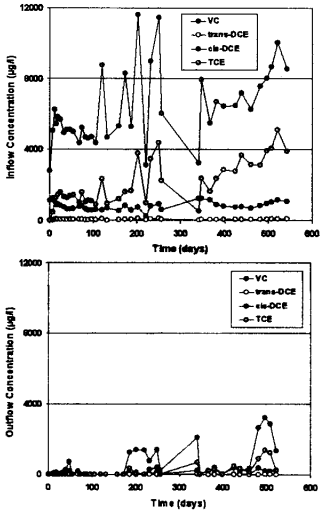
Field Case Backnang

Groundwater contamination with TCE and degradation products.

Remediation using Pd based catalyst with a hydrophobic Zeolite support (Y-200).

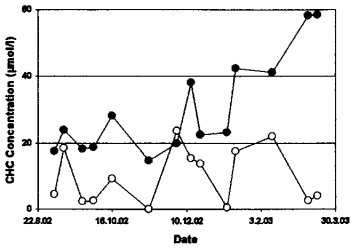
Half lives are in the range of a few minutes.

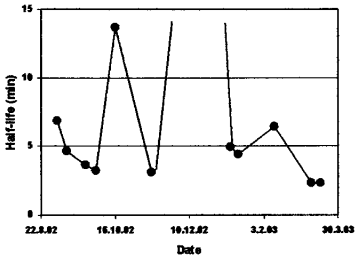




Field Case Denkendorf

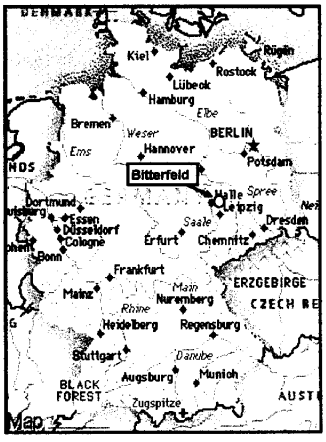
Groundwater contamination with TCE and degradation products.





The Bitterfeld Area

- **For more than 100 years the activities in open cast lignite mining and the related chemical industries have had a serious impact on soil and groundwater quality.**
- **The groundwater has regionally been contaminated over an area of approx. 25 km².**
- **A total volume of approx. 200 million m³ has been heavily contaminated.**



Aerial Photography of the former Bitterfeld Industrial Complex and the City of Bitterfeld

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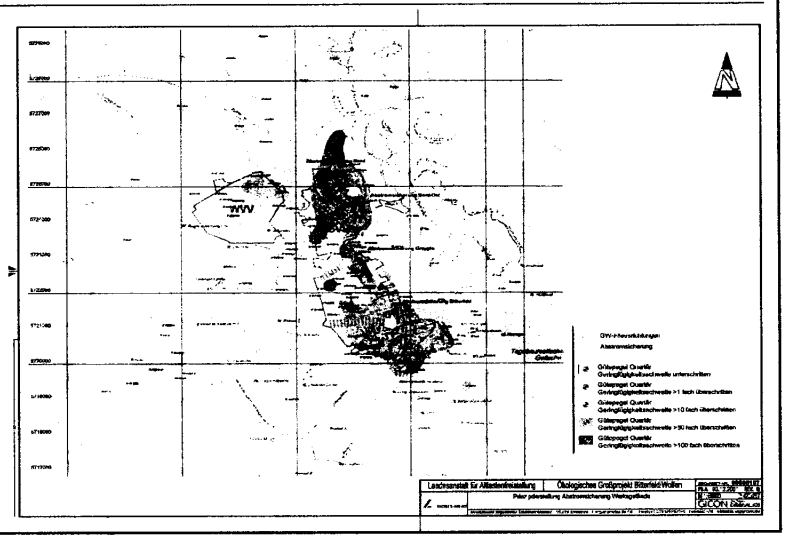

SAFIRA

SANIERUNGS- **F**ORSCHUNG **I**N

REGIONAL KONTAMINIERTEN **A**QUIFEREN

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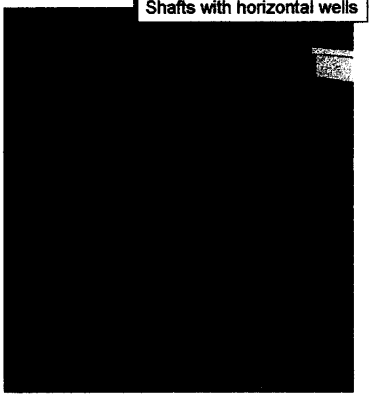
Pilot Plant in Bitterfeld

Site installations

Shafts with horizontal wells



View into one of the five shaft

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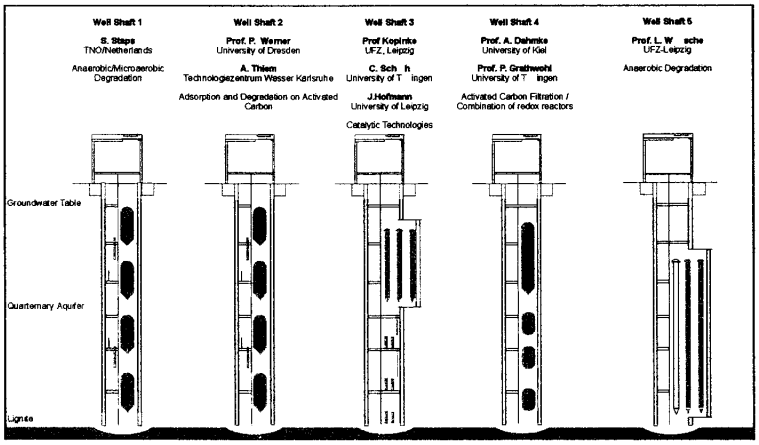
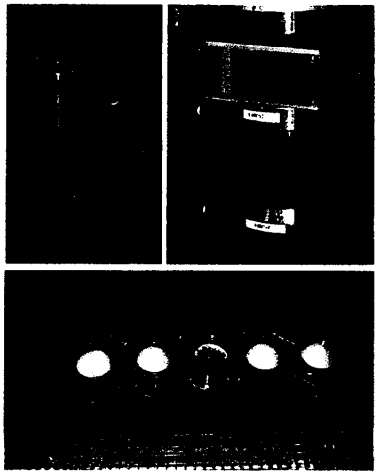
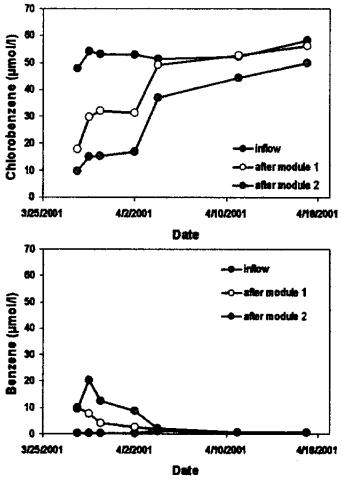
Pilot Plant in Bitterfeld



Pilot Plant in Bitterfeld (main contaminant chlorobenzene)





Pilot Plant in Bitterfeld

Deactivation due to sulfate reduction

Sulfate reducing bacteria produce H_2S.

That might happen in the aquifer, or directly in the catalyst bed due to the supply of the reductant hydrogen.

Strong and fast deactivation

$$SO_4^{2-} + 3H_2 \longrightarrow S^{2-} + 3H_2O$$

$$\Downarrow\Uparrow$$

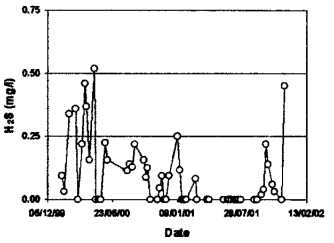
$$HS^-$$

$$pK_A = 7.05 \quad \Downarrow\Uparrow$$

$$H_2S$$

penetrates porous hydrophobic supports and even non-porous membranes

H_2S in the groundwater at the pilot plant

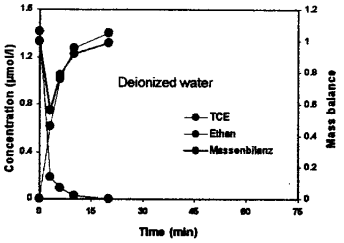


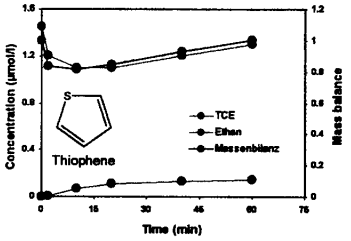
Pilot Plant in Bitterfeld

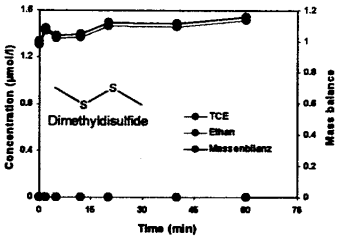
Deactivation due to organic sulphur

Batch-experiments with a Pd / Zeolite Y-200 catalyst and organic sulphur compounds –

Strong and fast deactivation

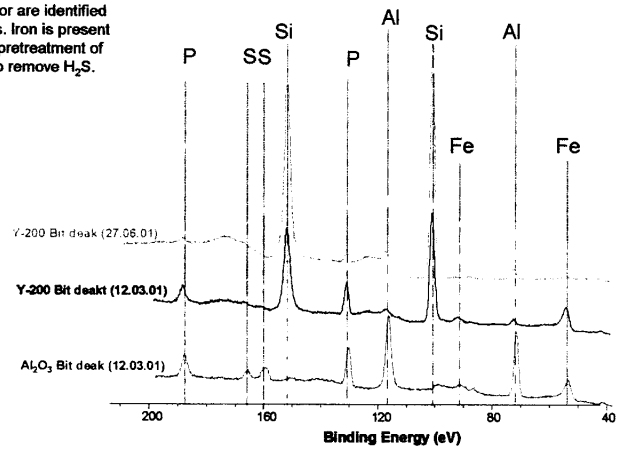


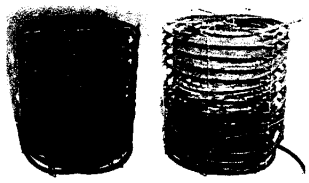




XPS spectra of deactivated catalysts from the Bitterfeld pilot plant

Sulphur and phosphor are identified on the zeolite pellets. Iron is present most likely due to a pretreatment of the water with iron to remove H_2S.





Catalysts after some weeks of operation in the pilot plant

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Catalytic Dehalogenation of Contaminants in Groundwater II

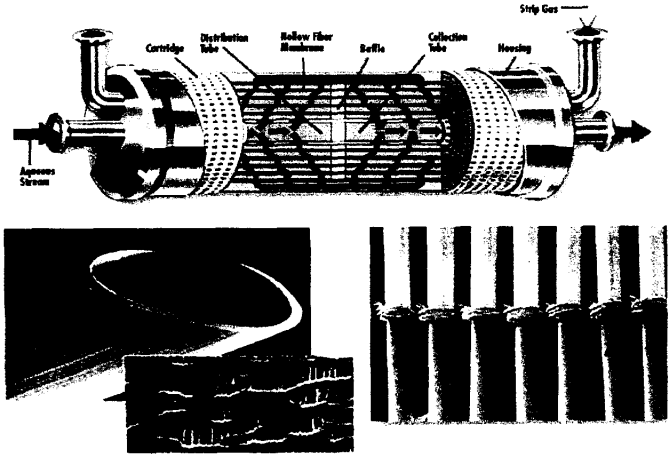
Target: Groundwaters contaminated with volatile to semi-volatile halogenated organic contaminants.

Technology fundamentals: A combination of hollow fiber membrane filtration to transfer the contaminants from the aqueous phase into the gas-phase and catalytic treatment of the gas-phase.

Advantages: A destructive method with low strip gas to water ratios (3:1 to 7:1) and very small footprint.

Catalysis in the gas-phase more reliable and an additional adjustable process parameter (temperature).

Celgard© hollow fiber membrane contactor. The contactor contains thousands of microporous polypropylene hollow fibers knitted into an array that is wound around a distribution tube and a central baffle.



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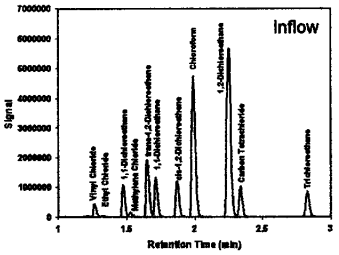
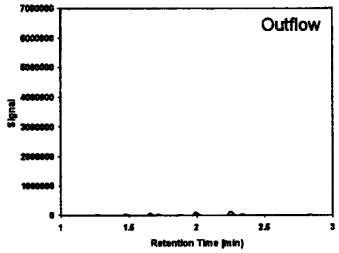
Field case in Southern Italy

Compound	Concentration [mg/l]	Henry's law constant K_H [-]
trans-dichloroethene	9	0.40
1,1-dichloroethane	7	0.23
cis-dichloroethene	8	0.17
chloroform	40	0.15
1,2-dichloroethane	220	0.04
carbon tetrachloride	2	1.2
trichloroethene	3	0.4
1,1,2-trichloroethane	3	0.04

Experimental setup in the lab

Water flow 200 ml/min
Gas flow 1000 ml/min
Pressure 100 mbar





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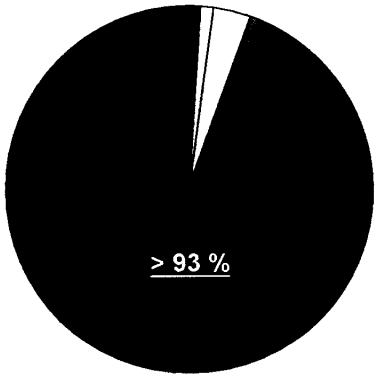
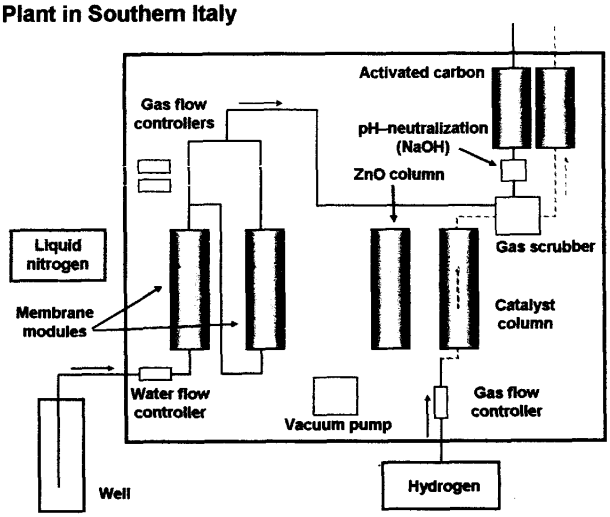
Total Concentration of CHC's in pilot well ~ 1.300 mg/l

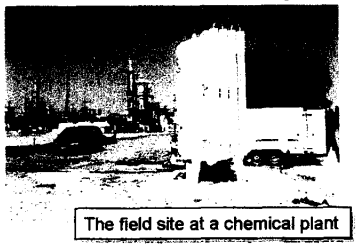


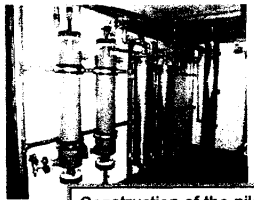
- Vinyl Chloride (C_2H_3Cl)
- trans-Dichloroethene ($C_2H_2Cl_2$)
- cis-Dichloroethene ($C_2H_2Cl_2$)
- Chloroform ($CHCl_3$)
- Carbon Tetrachloride (CCl_4)
- Trichloroethene (C_2HCl_3)
- 1,2-Dichloroethane ($C_2H_4Cl_2$)

Pilot Plant in Southern Italy



Pilot Plant in Southern Italy


The field site at a chemical plant


Construction of the pilot trailer

View into the pilot trailer


On-site analysis

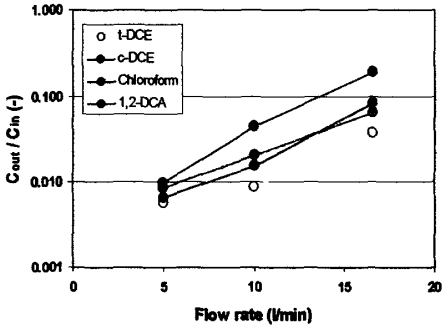
Pilot Plant in Southern Italy

Scaling of membrane modules

Removal efficiencies scale with water throughput.

Experimental conditions:

Strip-gas to water ratio 6:1. Total CHC inflow concentration ~ 1g/l.



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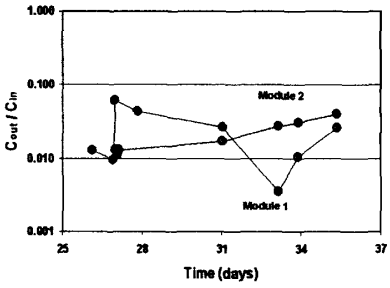
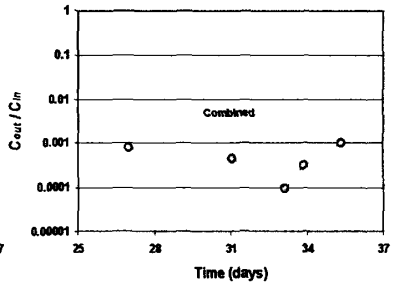
Pilot Plant in Southern Italy

Scaling of membrane modules

If removal effciencies are not sufficient with one module, modules can be run in series to reach the treatment goals.

Water flow (l/h)	Gas flow Mod. 1 (l/h)	Gas flow Mod. 2 (l/h)	Gas/water ratio per module (-)	Pressure mbar (abs.)
450	1.800	1.800	4 : 1	120





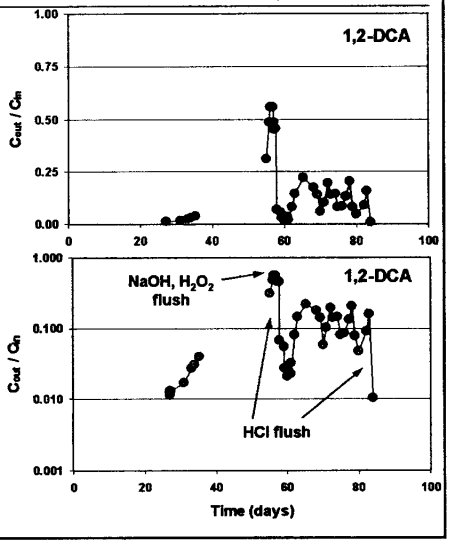
Performance of Module 2

In Phase 1 Module 2 was not operated.

In Phase 2 very good efficien-cies (> 90% - 99 % removal).

However, in the beginning of Phase 3, removal efficiencies dropped to values of about 50%.

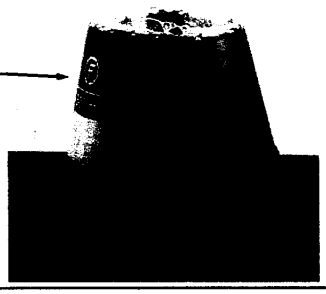
By flushing the module with HCl (3%) it was repeatedly possible to recover all of the initial efficiency.



Beginning of Phase 3

NaOH Flush (3%) of Module 2 (24.03.02)

Effluent from Module 2 during flushing



Field case Greppin (Saxony-Anhalt, Germany)

Compound	Concentration [mg/l]	Henry's law constant K_H [-]
vinylchloride	5	2.3
cis-dichloroethene	20	0.17
trichloroethene	35	0.4
perchloroethene	15	0.7
1,1,2,2-tetrachlorethane	80	0.014
chlorobenzene	1	0.14
H_2S	0.1	0.35 (dep. on pH)

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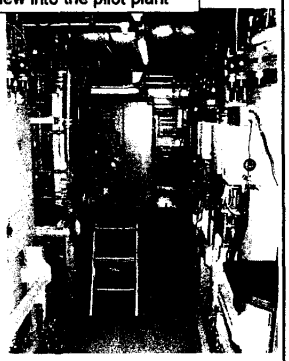
Pilot Plant in Greppin (Saxony-Anhalt, Germany)

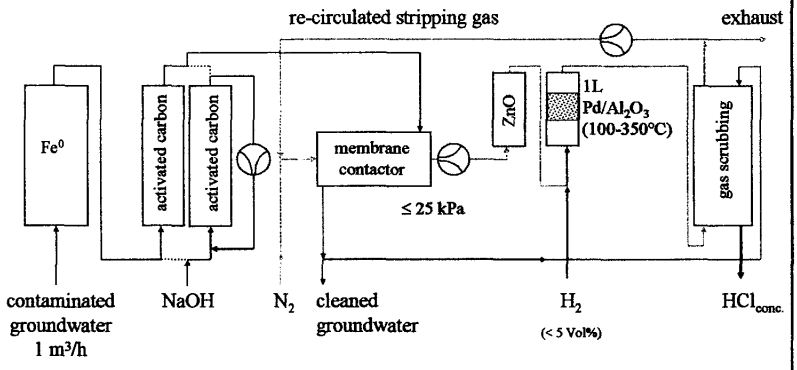
The field site is located next to populated area

View into the pilot plant

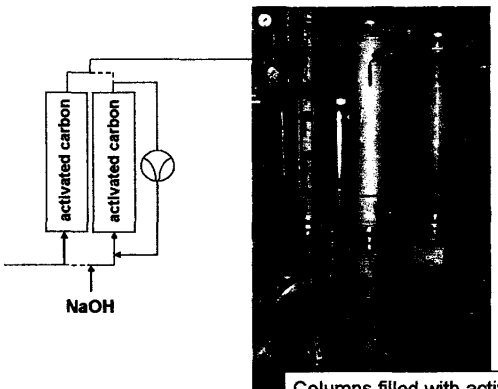


Sampling

Pilot Plant Greppin

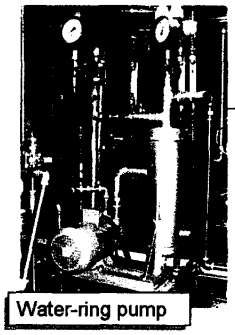


Pilot Plant Greppin Adsorption and Hydrolysis Step

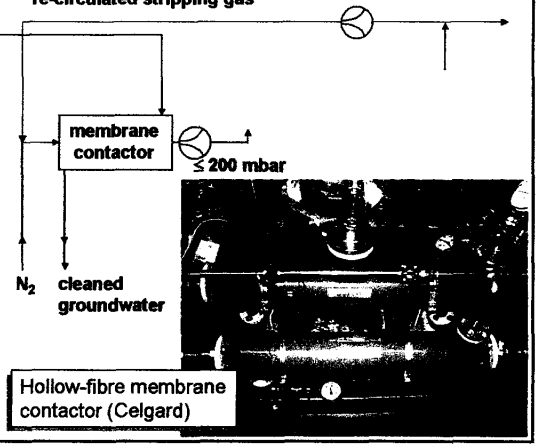


Columns filled with activated carbon for hydrolysis of 1,1,2,2-tetrachloroethane

Pilot Plant Greppin Stripping Step

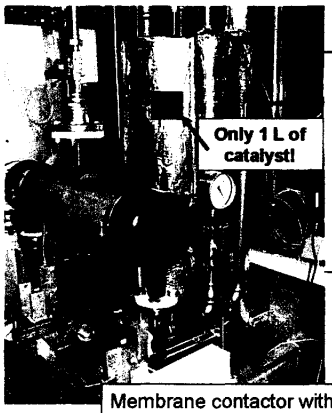


Water-ring pump

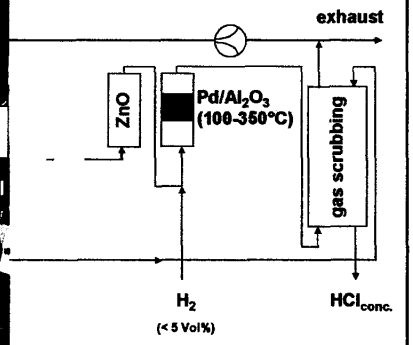


Hollow-fibre membrane contactor (Celgard)

Pilot Plant Catalysis step

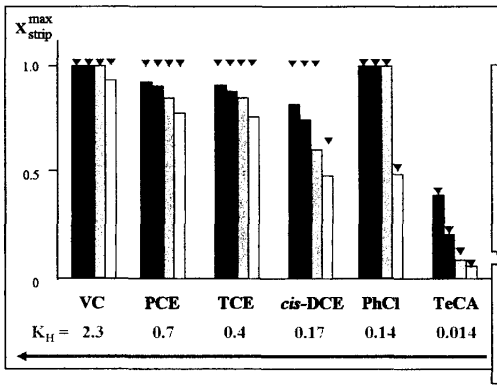


Membrane contactor with insulated catalytic reactor



Pilot Plant Stripping step

$$1 \geq X_{strip}^{max} \leq K_H \cdot \frac{\dot{V}_{gas}}{\dot{V}_{water}} = K_H \cdot \frac{\dot{V}_{gas}\,[NL/h]}{\dot{V}_{water}} \cdot \frac{100\,kPa}{p_{gas}\,[kPa]}$$



Degree of stripping of COCs depending on the strip gas ratio ($\dot{V}_{water}$ = 500 L/h, p = 22.5 kPa, 42 m^2 membrane area)

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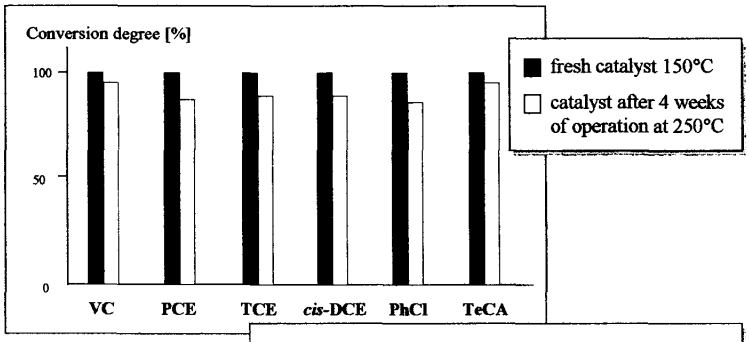
Pilot Plant Catalysis step



Hydrodechlorination of various COCs over Pd/Al_2O_3 (0.5 wt%) at 150 and 250°C (space velocity = 1000 v/vh, input gas composition: ~ 1 vol% COCs, 5 vol% H_2, water saturated, remainder N_2)

Pilot Plant Preliminary results

Hydrolysis step:

- Less volatile COCs can be converted into more volatile COCs by partial dechlorination.
- Activated carbon catalyzes the elimination of HCl from selected COCs.

Stripping step:

- Volatile COCs down to Henry-coefficients of $K_H \geq 0.05$ can be efficiently stripped with a hollow-fiber membrane contactor.
- However, long-term performance of the membrane contactor may be affected by scaling and/or biofouling.

Catalytic step:

- Practically all COCs can be hydrodechlorinated with high reaction rates over Pd catalysts in the gas phase at 100 to 350°C.
- The catalyst is relatively insensitive against sulfur compounds and can be easily regenerated by air treatment.

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Summary and Conclusions

Catalytic hydrodehalogenation with palladium and hydrogen as the reductant can convert many chlorinated hydrocarbon compounds very efficiently into harmless products.

In the aqueous phase, the use of hdrophobic support materials increases the stability of the catalysts against deactivation.

However, if the aqueous phase contains non-ionic sulfur or phosphor compounds, the catalytic step has to be carried out in the gas phase.

This is achieved using a combination of membrane stripping and reductive gas phase catalysis.

Both technologies have been tested successfully in several pilot scale field studys.

Funding for this projects was obtained by the BMBF in the frame of the SAFIRA project and the project RUBINand from IMES GmbH which is greatfully acknowledged.

The UFZ supported the field study in Greppin.

EUROPEAN WASTE CATALOGUE AND HAZARDOUS WASTE LIST

VALID FROM 1 JANUARY 2002

ENVIRONMENTAL PROTECTION AGENCY
An Ghníomhaireacht um Chaomhnú Comhshaoil

Environmental Protection Agency

Establishment

The Environmental Protection Agency Act, 1992, was enacted on 23 April, 1992, and under this legislation the Agency was formally established on 26 July, 1993.

Responsibilities

The Agency has a wide range of statutory duties and powers under the Act. The main responsibilities of the Agency include the following:

- the licensing and regulation of large/complex industrial and other processes with significant polluting potential, on the basis of integrated pollution control (IPC) and the application of best available technologies for this purpose;

- the monitoring of environmental quality, including the establishment of databases to which the public will have access, and the publication of periodic reports on the state of the environment;

- advising public authorities in respect of environmental functions and assisting local authorities in the performance of their environmental protection functions;

- the promotion of environmentally sound practices through, for example, the encouragement of the use of environmental audits, the setting of environmental quality objectives and the issuing of codes of practice on matters affecting the environment;

- the promotion and co-ordination of environmental research;

- the licensing and regulation of all significant waste disposal and recovery activities, including landfills and the preparation and periodic updating of a national hazardous waste management plan for implementation by other bodies;

- implementing a system of permitting for the control of VOC emissions resulting from the storage of significant quantities of petrol at terminals;

- implementing and enforcing the GMO Regulations for the contained use and deliberate release of GMOs into the environment;

- preparation and implementation of a national hydrometric programme for the collection, analysis and publication of information on the levels, volumes and flows of water in rivers, lakes and groundwaters; and

- generally overseeing the performance by local authorities of their statutory environmental protection functions.

Status

The Agency is an independent public body. Its sponsor in Government is the Department of the Environment and Local Government. Independence is assured through the selection procedures for the Director General and Directors and the freedom, as provided in the legislation, to act on its own initiative. The assignment, under the legislation, of direct responsibility for a wide range of functions underpins this independence. Under the legislation, it is a specific offence to attempt to influence the Agency, or anyone acting on its behalf, in an improper manner.

Organisation

The Agency's headquarters is located in Wexford and it operates five regional inspectorates, located in Dublin, Cork, Kilkenny, Castlebar and Monaghan.

Management

The Agency is managed by a full-time Executive Board consisting of a Director General and four Directors. The Executive Board is appointed by the Government following detailed procedures laid down in the Act.

Advisory Committee

The Agency is assisted by an Advisory Committee of twelve members. The members are appointed by the Minister for the Environment and Local Government and are selected mainly from those nominated by organisations with an interest in environmental and developmental matters. The Committee has been given a wide range of advisory functions under the Act, both in relation to the Agency and to the Minister.

European Waste Catalogue and Hazardous Waste List

Valid from 1 January 2002

Environmental Protection Agency
An Gníomhaireacht um Chaomhnú Comhshaoil
P.O. Box 3000, Johnstown Castle Estate, County Wexford, Ireland
Telephone : 053-60600 Fax : 053-60699
Email: info@epa.ie Website: http://www.epa.ie

European Waste Catalogue and Hazardous Waste List

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PREFACE

In 1994, the first European Waste Catalogue[1] and hazardous waste list[2] were published as two separate documents. The lists were used by the Environmental Protection Agency for the compilation of waste data from 1995 and were adopted into Irish legislation by the Waste Management Act, 1996. In 1996, the Environmental Protection Agency published a single list which incorporated both the European Waste Catalogue and the hazardous waste list[3].

The European Waste Catalogue and hazardous waste list are used for the classification of all wastes and hazardous wastes and are designed to form a consistent waste classification system across the EU. They form the basis for all national and international waste reporting obligations, such as those associated with waste licences and permits, the National Waste Database and the transport of waste.

In 2000, a replacement waste list and hazardous waste list[4] was introduced, which comes in to force on 1 January 2002. This replacement waste list has been amended three times[5, 6, 7]. Hence, four documents are required in order to have the complete list. The documents are not always easy to obtain and following the sequence of the amendments can be difficult.

This document represents a consolidated version of all four documents. This consolidated document is designed to ease the task of classifying waste and hazardous waste and understanding the legislation associated with the classification of waste and hazardous waste. It may be used in classifying all wastes and hazardous wastes. Much of the introductory text is reproduced in full from the legislation, with the addition in places of explanatory notes. The source of reproduced text is clearly indicated in each case. Future amendments to the legislation will be incorporated into future editions of this document.

This document does not purport to be and should not be considered a legal interpretation of the EU and Irish legislation on which it is based. Any queries of this nature should in the first instance be addressed to the parent legislation.

Comments on this document are welcome. The User Comment Form provided at the end of the document may be used.

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[1] Commission Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EC on waste.

[2] Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

[3] Waste Catalogue and Hazardous Waste List, EPA, 1996.

[4] Commission Decision 2000/532/EC of 3 May 2000 replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

[5] Commission Decision 2001/118/EC amending Decision 2000/532/EC as regards the list of wastes.

[6] Commission Decision 2001/119/EC amending Decision 2000/532/EC replacing Decision 94/3/EC establishing a list of wastes pursuant to Article 1(a) of Council Directive 75/442/EEC on waste and Council Decision 94/904/EC establishing a list of hazardous waste pursuant to Article 1(4) of Council Directive 91/689/EEC on hazardous waste.

[7] Council Decision 2001/573/EC amending Commission Decision 2000/532/EC as regards the list of wastes.

BACKGROUND INFORMATION

The European Waste Catalogue and hazardous waste list

The European Waste Catalogue and hazardous waste list presented in this document is based on the following EU legislation:

Commission Decision	2000/532/EC	(*OJ L 226, 6.9.2000, p. 3*)
As amended by:		
Commission Decision	2001/118/EC	(*OJ L 47, 16.2.2001, p. 1*)
Commission Decision	2001/119/EC	(*OJ L 47, 16.2.2001, p. 32*)
Council Decision	2001/573/EC	(*OJ L 203, 28.7.2001, p. 18*)

This document will be updated as further amendments are made to the list.

Date of introduction of the new list

The European Waste Catalogue and hazardous waste list presented in this document come into force on **1 January 2002.**

All waste reporting for the year 2002 and subsequent years should use the classifications in this document.

All waste reporting for the year 2001 and earlier should use '*Waste Catalogue and Hazardous Waste List*', published in 1996[8]. The 1996 document will continue to be available from EPA Publications and on the EPA website (www.epa.ie) for a limited time.

Definition of waste

Waste Management Acts 1996 and 2001

Waste is defined in Section 4(1) of the Waste Management Acts 1996 and 2001 as "any substance or object belonging to a category of waste specified in the First Schedule [of the Waste Management Act] or for the time being included in the European Waste Catalogue which the holder discards or intends or is required to discard, and anything which is discarded or otherwise dealt with as if it were waste shall be presumed to be waste until the contrary is proved."

The full text of the definition, including the First Schedule, can be read in the Waste Management Acts 1996 and 2001 (available from Government Publications or on the website of the Attorney General at www.irlgov.ie).

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[8] Waste Catalogue and Hazardous Waste List, EPA, 1996.

Definition of hazardous waste

Waste Management Acts 1996 and 2001

Hazardous waste is defined in Section 4(2) of the Waste Management Acts 1996 and 2001. The hazardous waste list forms an integral part of the definition. Figure 1 illustrates a summary of the definition and the decision sequence to be followed. Figure 1 shows that in order to be classified as hazardous waste, a waste must:

- appear on the hazardous waste list *or* be prescribed under section 4(2)(a)(ii) of the Waste Management Act; *and* also
- display one or more of the properties indicated in the Second Schedule to the Act.

The full text of the definition of hazardous waste can be read in the Waste Management Acts 1996 and 2001. It is also reproduced in full in the National Hazardous Waste Management Plan (available from EPA Publications, Richview, Clonskeagh Road, Dublin 14, tel: 01-2680100, fax: 01-2680199).

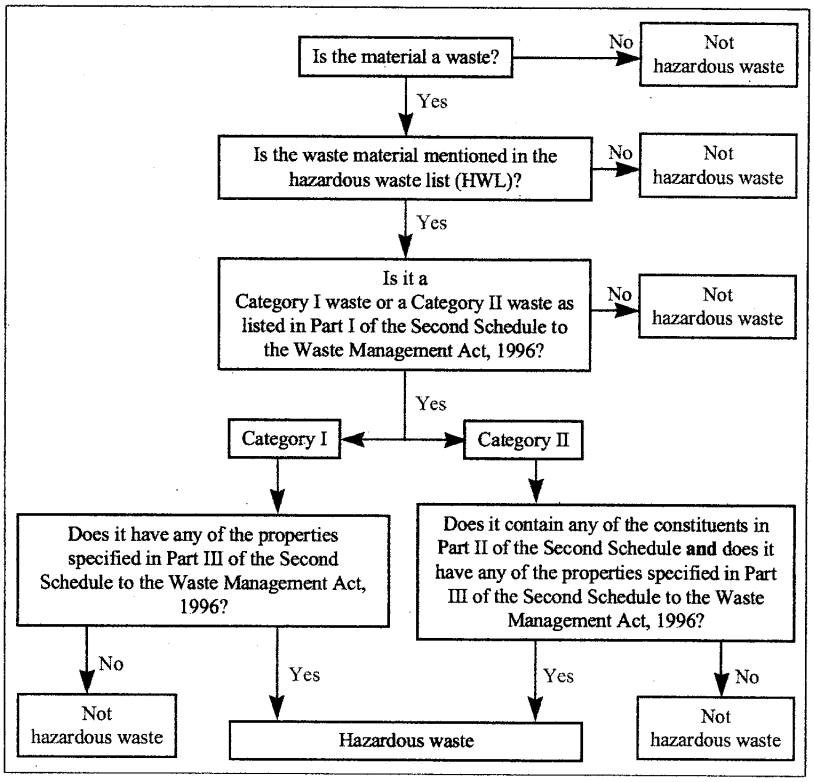

Figure 1 Hazardous waste flowchart

Extract from Commission Decision 2000/532/EC, as amended

Article 2

Wastes classified as hazardous are considered to display one or more of the properties listed in Annex III to Directive 91\689\EEC and, as regards H3 to H8, H10 [9] and H11 of the said Annex, one or more of the following characteristics:

- flash point ≤ (less than or equal to) 55 °C,
- one or more substances classified[10] as very toxic at a total concentration ≥0.1%
- one or more substances classified as toxic at a total concentration ≥3 %
- one or more substances classified as harmful at a total concentration ≥ 25%
- one or more corrosive substances classified as R35 at a total concentration ≥ 1%
- one or more corrosive substances classified as R34 at a total concentration ≥ 5%
- one or more irritant substances classified as R41 at a total concentration ≥ 10%
- one or more irritant substances classified as R36, R37, R38 at a total concentration ≥ 20%
- one substance known to be carcinogenic of category 1 or 2 at a concentration ≥ 0.1%
- one substance known to be carcinogenic of category 3 at a concentration ≥ 1%
- one substance toxic for reproduction[9] of category 1 or 2 classified as R60, R61 at a concentration ≥ 0.5%
- one substance toxic for reproduction of category 3 classified as R62, R63 at a concentration ≥ 5%
- one mutagenic substance or category 1 or 2 classified as R46 at a concentration ≥ 0.1%
- one mutagenic substance of category 3 classified as R40 at a concentration ≥ 1%

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[9] In Directive 92\32\EEC amending for the seventh time Directive 67/548/EEC the term 'toxic for reproduction' was introduced. The term 'teratogenic' was replaced by a corresponding term 'toxic for reproduction'. This term is considered to be in line with property H10 in Annex III to Directive 91/689/EEC.

[10] The classification as well as the R numbers refer to Directive 67/548/EEC on the approximation of the laws, regulations and administrative provision relating to the classification, packaging and labelling of dangerous substances (OJ L 196, 16.8.1967, p. 1.) and its subsequent amendments. The concentration limits refer to those laid down in Directive 88/379/EEC on the approximation of the laws, regulations and administrative provisions of the Member States relating to the classification, packaging and labelling of dangerous preparation (OJ L 187, 16.7.1988, p.14.) and its subsequent amendments.

Extract from Council Directive 91/689/EC on hazardous waste

Annex III

PROPERTIES OF WASTES WHICH RENDER THEM HAZARDOUS

H1 'Explosive': substances and preparations which may explode under the effect of flame or which are more sensitive to shocks or friction than dinitrobenzene.

H2 'Oxidizing': substances and preparations which exhibit highly exothermic reactions when in contact with other substances, particularly flammable substances.

H3-A 'Highly flammable'

- liquid substances and preparations having a flash point below 21°C (including extremely flammable liquids), or
- substances and preparations which may become hot and finally catch fire in contact with air at ambient temperature without any application of energy, or
- solid substances and preparations which may readily catch fire after brief contact with a source of ignition and which continue to burn or to be consumed after removal of the source of ignition, or
- gaseous substances and preparations which are flammable in air at normal pressure, or
- substances and preparations which, in contact with water or damp air, evolve highly flammable gases in dangerous quantities.

H3-B 'Flammable': liquid substances and preparations having a flash point equal to or greater than 21°C and less than or equal to 55°C.

H4 'Irritant': non-corrosive substances and preparations which, through immediate, prolonged or repeated contact with the skin or mucous membrane, can cause inflammation.

H5 'Harmful': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may involve limited health risks.

H6 'Toxic': substances and preparations (including very toxic substances and preparations) which, if they are inhaled or ingested or if they penetrate the skin, may involve serious, acute or chronic health risks and even death.

H7 'Carcinogenic': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce cancer or increase its incidence.

H8 'Corrosive': substances and preparations which may destroy living tissue on contacts.

H9 'Infectious': substances containing viable micro-organisms or their toxins which are known or reliably believed to cause disease in man or other living organisms.

H10 'Teratogenic'[9]: substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce non-hereditary congenital malformations or increase their incidence.

H11 'Mutagenic': substances and preparations which, if they are inhaled or ingested or if they penetrate the skin, may induce hereditary genetic defects or increase their incidence.

H12 Substances and preparations which release toxic or very toxic gases in contact with water, air or

an acid.

H13 Substances and preparations capable by any means, after disposal, of yielding another substance, e.g. a leachate, which possesses any of the characteristics listed above.

H14 'Ecotoxic': substances and preparations which present or may present immediate or delayed risks for one or more sectors of the environment.

Notes

1. Attribution of the hazard properties 'toxic' (and 'very toxic'), 'harmful', 'corrosive' and 'irritant' is made on the basis of the criteria laid down by Annex VI, part 1 A and part II B, of Council Directive 67/548/EEC of 27 June 1967 of the approximation of laws, regulations and administrative provisions relating to the classification, packaging and labelling of dangerous substances[11], *(or by subsequent Commission Directives adapting Directive 67/548/EEC to technical progress - See the* Hazardous Waste Classification Tool *for information on relevant amendments).*

2. With regard to attribution of the properties 'carcinogenic', 'teratogenic' and 'mutagenic', and reflecting the most recent findings, additional criteria are contained in the Guide to the classification and labelling of dangerous substances and preparations of Annex VI (part II D) to Directive 67/548/EEC, in the version as amended by Commission Directive 83/467/EEC[12] *(or by subsequent Commission Directives adapting Directive 67/548/EEC to technical progress - See the* Hazardous Waste Classification Tool *for information on relevant amendments).*

Test methods

The test methods serve to give specific meaning to the definitions given in Annex III.

The methods to be used are those described in Annex V to Directive 67/548/EEC, in the version as amended by Commission Directive 84/449/EEC[13], or by subsequent Commission Directives adapting Directive 67/548/EEC to technical progress *(See the* Hazardous Waste Classification Tool *for information on relevant amendments).* These methods are themselves based on the work and recommendations of the competent international bodies, in particular the OECD.

Extract from Commission Decision 2000/532/EC, as amended

Article 3

Member States may decide, in exceptional cases, on the basis of documentary evidence provided in an appropriate way by the holder, that a specific waste indicated in the list as being hazardous does not display any of the properties listed in Annex III to Directive 91/689/EEC. Without prejudice to Article 1 (4), second indent, of Directive 91/689/EEC, Member States may decide, in exceptional cases, that a waste indicated in the list as being non-hazardous displays one or more of the properties listed in Annex III to Directive 91/689/EEC. All such decisions taken by Member States shall be communicated on a

[11] OJ N L 196, 16. 8. 1967, p. 1.

[12] OJ N L 257, 16. 9. 1983, p. 1.

[13] OJ N L 251, 19. 9. 1984, p. 1.

yearly basis to the Commission. The Commission shall collate these decisions and examine whether the Community list of wastes and hazardous wastes should be amended in the light of them.

Hazardous waste classification tool

The Environmental Protection Agency funded a project under the Environmental RTDI Programme entitled *Procedure for Identification of the Hazardous Components of Waste*. The project was carried out by the Clean Technology Centre, Cork Institute of Technology, Cork. The output of the project is a detailed breakdown of the complex legislation which is used in classifying the hazardous properties of a waste. Where a holder of waste wishes to provide evidence of the presence or absence of hazardous properties of that waste, in accordance with *Article 3* above, the Hazardous Waste Classification Tool provides a mechanism to do this. The project report and the Hazardous Waste Classification Tool are available on the website of the Environmental Protection Agency at www.epa.ie/techinfo. Printed copies may be available from EPA Publications, Richview, Clonskeagh Road, Dublin 14, tel: 01-2680100, fax: 01-2680199.

INSTRUCTIONS FOR USING THE LIST

Extract from Commission Decision 2000/532/EC, as amended

List of wastes pursuant to Article 1(a) of Directive 75/442/EEC on waste and Article 1(4) of Directive 91/689/EEC on hazardous waste.

Introduction

1. The present list is a harmonised list of wastes. It will be periodically reviewed on the basis of new knowledge and, in particular, of research results, and if necessary revised in accordance with Article 18 of Directive 75/442/EEC. However, the inclusion of a material in the list does not mean that the material is a waste in all circumstances. Materials are considered to be waste only where the definition of waste in Article 1(a) of Directive 75/442/EEC is met.

2. Wastes included in the list are subject to the provisions of Directive 75/442/EEC except where Article 2 (1)(b) of this Directive applies[14].

3. The different types of wastes in the list are fully defined by the six-digit code for the waste and the respective two-digit and four-digit chapter headings. This implies that the following steps should be taken to identify a waste in the list.

   3.1 Identify the source generating the waste in Chapters 01 to 12 or 17 to 20 and identify the appropriate six-digit code of the waste (excluding codes ending with 99 of these chapters). A specific production unit may need to classify its activities in several chapters. For instance, a car manufacturer may find its wastes listed in chapters 12 (wastes from shaping and surfacing treatment of metals) 11 (inorganic wastes containing metals from metal treatment and the coating of metals) and 08 (wastes from the use of coatings), depending on the different process steps.

   Note: separately collected packaging waste (including mixtures of different packaging materials) shall be classified in 15 01, not in 20 01.

   3.2 If no appropriate waste code can be found in chapters 01 to 12 or 17 to 20, the chapters 13, 14 and 15 must be examined to identify the waste.

   3.3 If none of these waste codes apply, the waste must be identified according to Chapter 16.

   3.4 If the waste is not in chapter 16 either, the 99 code (wastes not otherwise specified) must be used in the section of the list corresponding to the activity identified in step one.

4. Any waste marked with an asterisk (*) is considered as a hazardous waste pursuant to Directive 91/689/EEC on hazardous waste, and subject to the provisions of that Directive unless Article 1 (5) of that Directive applies.

5. For the purpose of this Decision, 'dangerous substance' means any substance that has been or will be classified as dangerous in Directive 67/548/EEC and its subsequent amendments; 'heavy metal' means any compound of antimony, arsenic, cadmium, chromium (VI), copper, lead, mercury, nickel, selenium, tellurium, thallium and tin, as well as these materials in metallic form, as far as these are classified as dangerous substances.

6. If a waste is identified as hazardous by a specific or general reference to dangerous substances, the waste is hazardous only if the concentrations of those substances are such (i.e. percentage by weight) that the waste presents one or more of the properties listed in Annex III to Council Directive 91/689/EEC. As regards H3 to H8, H10 and H11, Article 2 of this Decision shall

[14] Article 2(1)(b) lists materials that are excluded from the scope of Directive 75/442/EEC.

apply. For the characteristics H1, H2, H9 and H12 to H14, Article 2 of the present Decision does not provide specifications at present.

7. In line with Directive 1999/45/EC, which states in its preamble that the case of alloys has been considered to need further assessment because the characteristics of alloys are such that it may not be possible accurately to determine their properties using currently available conventional methods, the provisions of Article 2 would not apply to pure metal alloys (not contaminated by dangerous substances). This will be so pending further work that the Commission and Member States have taken the commitment to undertake on the specific approach of the classification of alloys. The waste materials which are specifically enumerated in this list shall remain classified as at present.

8. The following rules for numbering of the items in the list have been used: For those wastes that were not changed, the code numbers from Commission Decision 94/3/EC have been used. The codes for wastes that were changed have been deleted and remain unused in order to avoid confusion after implementation of the new list. Wastes added have been given a code that has not been used in Commission Decision 94/3/EC and Commission Decision 2000/532/EC.

CHAPTERS OF THE LIST

01	Wastes resulting from exploration, mining, quarrying, physical and chemical treatment of minerals
02	Wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing, food preparation and processing
03	Wastes from wood processing and the production of panels and furniture, pulp, paper and cardboard
04	Wastes from the leather, fur and textile industries
05	Wastes from petroleum refining, natural gas purification and pyrolytic treatment of coal
06	Wastes from inorganic chemical processes
07	Wastes from organic chemical processes
08	Wastes from the manufacture, formulation, supply and use (MFSU) of coatings (paints, varnishes and vitreous enamels), sealants and printing inks
09	Wastes from photographic industry
10	Wastes from thermal processes
11	Wastes from chemical surface treatment and coating of metals and other materials; non-ferrous hydro-metallurgy
12	Wastes from shaping and physical and mechanical surface treatment of metals and plastics
13	Oil wastes and wastes of liquid fuels (except edible oils, 05 and 12)
14	Waste organic solvents, refrigerants and propellants (except 07 and 08)
15	Waste packaging; absorbents, wiping cloths, filter materials and protective clothing not otherwise specified
16	Wastes not otherwise specified in the list
17	Construction and demolition wastes (including excavated soil from contaminated sites)
18	Wastes from human or animal health care and/or related research (except kitchen and restaurant wastes not arising from immediate health care)
19	Wastes from waste management facilities, off-site waste water treatment plants and the preparation of water intended for human consumption and water for industrial use
20	Municipal wastes (household waste and similar commercial, industrial and institutional wastes) including separately collected fractions

EUROPEAN WASTE CATALOGUE AND HAZARDOUS WASTE LIST

01	**WASTE RESULTING FROM EXPLORATION, MINING, QUARRYING, AND PHYSICAL AND CHEMICAL TREATMENT OF MINERALS**
01 01	**wastes from mineral excavation**
01 01 01	wastes from mineral metalliferous excavation
01 01 02	wastes from mineral non-metalliferous excavation
01 03	**wastes from physical and chemical processing of metalliferous minerals**
01 03 04*	acid-generating tailings from processing of sulphide ore
01 03 05*	other tailings containing dangerous substances
01 03 06	tailings other than those mentioned in 01 03 04 and 01 03 05
01 03 07*	other wastes containing dangerous substances from physical and chemical processing of metalliferous minerals
01 03 08	dusty and powdery wastes other than those mentioned in 01 03 07
01 03 09	red mud from alumina production other than the wastes mentioned in 01 03 07
01 03 99	wastes not otherwise specified
01 04	**wastes from physical and chemical processing of non-metalliferous minerals**
01 04 07*	waste containing dangerous substances from physical and chemical processing of non-metalliferous minerals
01 04 08	waste gravel and crushed rocks other than those mentioned in 01 04 07
01 04 09	waste sand and clays
01 04 10	dusty and powdery wastes other than those mentioned in 01 04 07
01 04 11	wastes from potash and rock salt processing other than those mentioned in 01 04 07
01 04 12	tailings and other wastes from washing and cleaning of minerals other than those mentioned in 01 04 07 and 01 04 11
01 04 13	waste from stone cutting and sawing other than those mentioned in 01 04 07
01 04 99	waste not otherwise specified
01 05	**drilling muds and other drilling wastes**
01 05 04	freshwater drilling muds and wastes
01 05 05*	oil-containing drilling muds and wastes
01 05 06*	drilling muds and other drilling wastes containing dangerous substances
01 05 07	barite-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06
01 05 08	chloride-containing drilling muds and wastes other than those mentioned in 01 05 05 and 01 05 06
01 05 99	wastes not otherwise specified

02	**WASTES FROM AGRICULTURE, HORTICULTURE, AQUACULTURE, FORESTRY, HUNTING AND FISHING, FOOD PREPARATION AND PROCESSING**
02 01	**wastes from agriculture, horticulture, aquaculture, forestry, hunting and fishing**
02 01 01	sludges from washing and cleaning
02 01 02	animal-tissue waste
02 01 03	plant-tissue waste
02 01 04	waste plastics (except packaging)
02 01 06	animal faeces, urine and manure (including spoiled straw), effluent, collected separately and treated off-site
02 01 07	waste from forestry
02 01 08*	agrochemical waste containing dangerous substances
02 01 09	agrochemical waste other than those mentioned in 02 01 08
02 01 10	waste metal
02 01 99	wastes not otherwise specified
02 02	**wastes from the preparation and processing of meat, fish and other foods of animal origin**
02 02 01	sludges from washing and cleaning
02 02 02	animal-tissue waste
02 02 03	materials unsuitable for consumption or processing
02 02 04	sludges from on-site effluent treatment
02 02 99	waste not otherwise specified
02 03	**wastes from fruit, vegetables, cereals, edible oils, cocoa, coffee, tea and tabacco preparation and processing; conserve production; yeast and yeast extract production, molasses preparation and fermentation**
02 03 01	sludges from washing, cleaning, peeling, centrifuging and separation
02 03 02	waste from preserving agents
02 03 03	wastes from solvent extraction
02 03 04	materials unsuitable for consumption or processing
02 03 05	sludges from on-site effluent treatment
02 03 99	wastes not otherwise specified
02 04	**wastes from sugar processing**
02 04 01	soil from cleaning and washing beet
02 04 02	off-specification calcium carbonate
02 04 03	sludges from on-site effluent treatment
02 04 99	wastes not otherwise specified
02 05	**wastes from the dairy products industry**

02 05 01	materials unsuitable for consumption or processing
02 05 02	sludges from on-site effluent treatment
02 05 99	wastes not otherwise specified
02 06	**wastes from the baking and confectionery industry**
02 06 01	materials unsuitable for consumption or processing
02 06 02	wastes from preserving agents
02 06 03	sludges from on-site effluent treatment
02 06 99	waste not otherwise specified
02 07	**wastes from the production of alcoholic and non-alcoholic beverages (except coffee, tea and cocoa)**
02 07 01	wastes from washing, cleaning and mechanical reduction of raw materials
02 07 02	wastes from spirits distillation
02 07 03	wastes from chemical treatment
02 07 04	materials unsuitable for consumption or processing
02 07 05	sludges from on-site effluent treatment
02 07 99	waste not otherwise specified
03	**WASTES FROM WOOD PROCESSING AND THE PRODUCTION OF PANELS AND FURNITURE, PULP, PAPER AND CARDBOARD**
03 01	**wastes from wood processing and the production of panels and furniture**
03 01 01	waste bark and cork
03 01 04*	sawdust, shavings, cuttings, wood, particle board and veneer containing dangerous substances
03 01 05	sawdust, shavings, cuttings, wood, particle board and veneer other than those mentioned in 03 01 04
03 01 99	wastes not otherwise specified
03 02	**wastes from wood preservation**
03 02 01*	non-halogenated organic wood preservatives
03 02 02*	organochlorinated wood preservatives
03 02 03*	organometallic wood preservatives
03 02 04*	inorganic wood preservatives
03 02 05*	other wood preservatives containing dangerous substances
03 02 99	wood preservatives not otherwise specified
03 03	**wastes from pulp, paper and cardboard production and processing**
03 03 01	waste bark and wood
03 03 02	green liquor sludge (from recovery of cooking liquor)

03 03 05	de-inking sludges from paper recycling
03 03 07	mechanically separated rejects from pulping of waste paper and cardboard
03 03 08	wastes from sorting of paper and cardboard destined for recycling
03 03 09	lime mud waste
03 03 10	fibre rejects, fibre-, filler- and coating-sludges from mechanical separation
03 03 11	sludges from on-site effluent treatment other than those mentioned in 03 03 10
03 03 99	wastes not otherwise specified
04	**WASTES FROM THE LEATHER, FUR AND TEXTILE INDUSTRIES**
04 01	**wastes from the leather and fur industry**
04 01 01	fleshings and lime split wastes
04 01 02	liming waste
04 01 03*	degreasing wastes containing solvents without a liquid phase
04 01 04	tanning liquor containing chromium
04 01 05	tanning liquor free of chromium
04 01 06	sludges, in particular from on-site effluent treatment containing chromium
04 01 07	sludges , in particular from on-site effluent treatment free of chromium
04 01 08	waste tanned leather (blue sheetings, shavings, cuttings, buffing dust) containing chromium
04 01 09	wastes from dressing and finishing
04 01 99	wastes not otherwise specified
04 02	**wastes from the textile industry**
04 02 09	wastes from composite materials (impregnated textile, elastomer, plastomer)
04 02 10	organic matter from natural products (for example grease, wax)
04 02 14*	wastes from finishing containing organic solvents
04 02 15	wastes from finishing other than those mentioned in 04 02 14
04 02 16*	dyestuffs and pigments containing dangerous substances
04 02 17	dyestuffs and pigments other than those mentioned in 04 02 16
04 02 19*	sludges from on-site effluent treatment containing dangerous substances
04 02 20	sludges from on-site effluent treatment other than those mentioned in 04 02 19
04 02 21	wastes from unprocessed textile fibres
04 02 22	wastes from processed textile fibres
04 02 99	wastes not otherwise specified
05	**WASTES FROM PETROLEUM REFINING, NATURAL GAS PURIFICATION AND PYROLYTIC TREATMENT OF COAL**

05 01	**wastes from petroleum refining**
05 01 02*	desalter sludges
05 01 03*	tank bottom sludges
05 01 04*	acid alkyl sludges
05 01 05*	oil spills
05 01 06*	oily sludges from maintenance operations of the plant or equipment
05 01 07*	acid tars
05 01 08*	other tars
05 01 09*	sludges from on-site effluent treatment containing dangerous substances
05 01 10	sludges from on-site effluent treatment other than those mentioned in 05 01 09
05 01 11*	wastes from cleaning of fuels with bases
05 01 12*	oil containing acids
05 01 13	boiler feedwater sludges
05 01 14	wastes from cooling columns
05 01 15*	spent filter clays
05 01 16	sulphur-containing wastes from petroleum desulphurisation
05 01 17	bitumen
05 01 99	wastes not otherwise specified
05 06	**waste from the pyrolytic treatment of coal**
05 06 01*	acid tars
05 06 03*	other tars
05 06 04	waste from cooling columns
05 06 99	wastes not otherwise specified
05 07	**waste from natural gas purification and transportation**
05 07 01*	wastes containing mercury
05 07 02	wastes containing sulphur
05 07 99	wastes not otherwise specified
06	**WASTES FROM INORGANIC CHEMICAL PROCESSES**
06 01	**wastes from the manufacture, formulation, supply and use (MFSU) of acids**
06 01 01*	sulphuric acid and sulphurous acid
06 01 02*	hydrochloric acid
06 01 03*	hydrochloric acid
06 01 04*	phosphoric and phosphorous acid
06 01 05*	nitric acid and nitrous acid

06 01 06*	other acids
06 01 99	wastes not otherwise specified
06 02	**wastes from the MFSU of bases**
06 02 01*	calcium hydroxide
06 02 03*	ammonium hydroxide
06 02 04*	sodium and potassium hydroxide
06 02 05*	other bases
06 02 99	wastes not otherwise specified
06 03	**wastes from the MFSU of salts and their solutions and metallic oxides**
06 03 11*	solid salts and solutions containing cyanides
06 03 13*	solid salts and solutions containing heavy metals
06 03 14	solid salts and solution other than those mentioned in 06 03 11 and 06 03 13
06 03 15*	metallic oxides containing heavy metals
06 03 16	metallic oxides other than those mentioned in 06 03 15
06 03 99	wastes not otherwise specified
06 04	**metal-containing wastes other than those mentioned in 06 03**
06 04 03*	wastes containing arsenic
06 04 04*	wastes containing mercury
06 04 05*	wastes containing other heavy metals
06 04 99	wastes not otherwise specified
06 05	**sludges from on-site effluent treatment**
06 05 02*	sludges from on-site effluent treatment containing dangerous solutions
06 05 03	sludges from onsite effluent treatment other than those mentioned in 06 05 02
06 06	**wastes from the MFSU of sulphur chemicals, sulphur chemical processes and desulphurisation processes**
06 06 02*	wastes containing dangerous sulphides
06 06 03	wastes containing sulphides other than those mentioned in 06 06 02
06 06 99	wastes not otherwise specified
06 07	**wastes from the MFSU of halogens and halogen chemical processes**
06 07 01*	wastes containing asbestos from electrolysis
06 07 02*	activated carbon from chlorine production
06 07 03*	barium sulphate sludge containing mercury
06 07 04*	solutions and acids, for example contact acid
06 07 99	wastes not otherwise specified
06 08	**wastes from the MFSU of silicon and silicon derivatives**

06 08 02*	waste containing dangerous silicones
06 08 99	wastes not otherwise specified
06 09	**wastes from the MFSU of phosphorus chemicals and phosphorous chemical processes**
06 09 02	phosphorus slag
06 09 03*	calcium-based reaction wastes containing or contaminated with dangerous substances
06 09 04	calcuim-based reaction wastes other than those mentioned in 06 09 03
06 09 99	wastes not otherwise specified
06 10	**wastes from the MFSU of nitrogen chemicals, nitrogen chemical processes and fertiliser manufacture**
06 10 02*	wastes containing dangerous substances
06 10 99	wastes not otherwise specified
06 11	**wastes from the manufacture of inorganic pigments and opacificiers**
06 11 01	calcium-based reaction wastes from titanium dioxide production
06 11 99	wastes not otherwise specified
06 13	**wastes from inorganic chemical processes not otherwise specified**
06 13 01*	inorganic plant protection products, wood-preserving agents and other biocides
06 13 02*	spent activated carbon (except 06 07 02)
06 13 03	carbon black
06 13 04*	wastes from asbestos processing
06 13 05*	soot
06 13 99	wastes not otherwise specified
07	**WASTES FROM ORGANIC CHEMICAL PROCESSES**
07 01	**wastes from the manufacture, formulation, supply and use (MFSU) of basic organic chemicals**
07 01 01*	aqueous washing liquids and mother liquors
07 01 03*	organic halogenated solvents, washing liquids and mother liquors
07 01 04*	other organic solvents, washing liquids and mother liquors
07 01 07*	halogenated still bottoms and reaction residues
07 01 08*	other still bottoms and reaction residues
07 01 09*	halogenated filter cakes and spent absorbents
07 01 10*	other filter cakes and spent absorbents
07 01 11*	sludges from on-site effluent treatment containing dangerous substances
07 01 12	sludges from on-site effluent treatment other than those mentioned in 07 01 11
07 01 99	wastes not otherwise specified
07 02	**wastes from the MFSU of plastics, synthetic rubber and man-made fibres**

07 02 01*	aqueous washing liquids and mother liquors
07 02 03*	organic halogenated solvents, washing liquids and mother liquors
07 02 04*	other organic solvents, washing liquids and mother liquors
07 02 07*	halogenated still bottoms and reaction residues
07 02 08*	other still bottoms and reaction residues
07 02 09*	halogenated filter cakes and spent absorbents
07 02 10*	other filter cakes and spent absorbents
07 02 11*	sludges from on-site effluent treatment containing dangerous substances
07 02 12	sludges from on-site effluent treatment other than those mentioned in 07 02 11
07 02 13	waste plastic
07 02 14*	wastes from additives containing dangerous substances
07 02 15	wastes from additives other than those mentioned in 07 02 14
07 02 16*	waste containing dangerous silicones
07 02 17	waste containing silicones other than those mentioned in 07 02 16
07 02 99	wastes not otherwise specified
07 03	**wastes from the MFSU of organic dyes and pigments (except 06 11)**
07 03 01*	aqueous washing liquids and mother liquors
07 03 03*	organic halogenated solvents, washing liquids and mother liquors
07 03 04*	other organic solvents, washing liquids and mother liquors
07 03 07*	halogenated still bottoms and reaction residues
07 03 08*	other still bottoms and reaction residues
07 03 09*	halogenated filter cakes and spent absorbents
07 03 10*	other filter cakes and spent absorbents
07 03 11*	sludges from on-site effluent treatment containing dangerous substances
07 03 12	sludges from on-site effluent treatment other than those mentioned in 07 03 11
07 03 99	wastes not otherwise specified
07 04	**wastes from the MFSU of organic plant protection products (except 02 01 08 and 02 01 09), wood preserving agents (except 03 02) and other biocides**
07 04 01*	aqueous washing liquids and mother liquors
07 04 03*	organic halogenated solvents, washing liquids and mother liquors
07 04 04*	other organic solvents, washing liquids and mother liquids
07 04 07*	halogenated still bottoms and reaction residues
07 04 08*	other still bottoms and reaction residues
07 04 09*	halogenated filter cakes and spent absorbents
07 04 10*	other filter cakes and spent absorbents

07 04 11*	sludges from on-site effluent treatment containing dangerous substances
07 04 12	sludges from on-site effluent treatment other than those mentioned in 07 04 11
07 04 13*	solid wastes containing dangerous substances
07 04 99	wastes not otherwise specified
07 05	**wastes from the MFSU of pharmaceuticals**
07 05 01*	aqueous washing liquids and mother liquors
07 05 03*	organic halogenated solvents, washing liquids and mother liquors
07 05 04*	other organic solvents, washing liquids and mother liquors
07 05 07*	halogenated still bottoms and reaction residues
07 05 08*	other still bottoms and reaction residues
07 05 09*	halogenated filter cakes and spent absorbents
07 05 10*	other filter cakes and spent absorbents
07 05 11*	sludges from on-site effluent treatment containing dangerous substances
07 05 12	sludges from on-site effluent treatment other than those mentioned in 07 05 11
07 05 13*	solid wastes containing dangerous substances
07 05 14	solid wastes other than those mentioned in 07 05 13
07 05 99	wastes not otherwise specified
07 06	**wastes from the MFSU of fats, grease, soaps, detergents, disinfectants and cosmetics**
07 06 01*	aqueous washing liquids and mother liquors
07 06 03*	organic halogenated solvents, washing liquids and mother liquors
07 06 04*	other organic solvents, washing liquids and mother liquors
07 06 07*	halogenated still bottoms and reaction residues
07 06 08*	other sill bottoms and reaction residues
07 06 09*	halogenated filter cakes and spent absorbents
07 06 10*	other filter cakes and spent absorbents
07 06 11*	sludges from on-site effluent treatment containing dangerous substances
07 06 12	sludges from on-site effluent treatment other than those mentioned in 07 06 11
07 06 99	wastes not otherwise specified
07 07	**wastes from the MFSU of fine chemicals and chemical products not otherwise specified**
07 07 01*	aqueous washing liquids and mother liquors
07 07 03*	organic halogenated solvents, washing liquids and mother liquors
07 07 04*	other organic solvents, washing liquids and mother liquors
07 07 07*	halogenated still bottoms and reaction residues
07 07 08*	other still bottoms and reaction residues

07 07 09*	halogenated filter cakes and spent absorbents
07 07 10*	other filter cakes and spent sbsorbents
07 07 11*	sludges from on-site effluent treatment containing dangerous substances
07 07 12	sludges from on-site effluent treatment other than those mentioned in 07 07 11
07 07 99	wastes not otherwise specified
08	**WASTES FORM THE MANUFACTURE, FORMULATION, SUPPLY AND USE (MFSU) OF COATINGS (PAINTS, VARNISHES AND VITREOUS ENAMELS,) ADHESIVES, SEALANTS AND PRINTING INKS**
08 01	**wastes from MFSU and removal of paint and varnish**
08 01 11*	waste paint and varnish containing organic solvents or other dangerous substances
08 01 12	waste paint and varnish other than those mentioned in 08 01 11
08 01 13*	sludges from paint or varnish containing organic solvents or other dangerous substances
08 01 14	sludges from paint or varnish other than those mentioned in 08 01 13
08 01 15*	aqueous sludges containing paint or varnish containing organic solvents or other dangerous substances
08 01 16	aqueous sludges containing paint or varnish other than those mentioned in 08 01 15
08 01 17*	wastes from paint or varnish removal containing organic solvents or other dangerous substances
08 01 18	wastes from paint or varnish removal other than those mentioned in 08 01 17
08 01 19*	aqueous suspensions containing paint or varnish containing organic solvents or other dangerous substances
08 01 20	aqueous suspensions containing paint or varnish other than those mentioned in 08 01 19
08 01 21*	waste paint or varnish remover
08 01 99	wastes not otherwise specified
08 02	**wastes from MFSU of other coatings (including ceramic materials)**
08 02 01	waste coating powders
08 02 02	aqueous sludges containing ceramic materials
08 02 03	aqueous suspensions containing ceramic materials
08 02 99	wastes not otherwise specified
08 03	**wastes from MFSU of printing inks**
08 03 07	aqueous sludges containing ink
08 03 08	aqueous liquid waste containing ink
08 03 12*	waste ink containing dangerous substances
08 03 13	waste ink other than those mentioned in 08 03 12
08 03 14*	ink sludges containing dangerous substances
08 03 15	ink sludges other than those mentioned in 08 03 14

08 03 16*	waste etching solutions
08 03 17*	waste printing toner containing dangerous substances
08 03 18	waste printing toner other than those mentioned in 08 03 17
08 03 19*	disperse oil
08 03 99	wastes not otherwise specified
08 04	**wastes from MFSU of adhesives and sealants (including waterproofing products)**
08 04 09*	waste adhesives and sealants containing organic solvents or other dangerous substances
08 04 10	waste adhesives and sealants other than those mentioned in 08 04 09
08 04 11*	adhesive and sealant sludges containing organic solvents or other dangerous substances
08 04 12	adhesive and sealant sludges other than those mentioned in 08 04 11
08 04 13*	aqueous sludges containing adhesives or sealants containing organic solvents or other dangerous substances
08 04 14	aqueous sludges containing adhesives or sealants other than those mentioned in 08 04 13
08 04 15*	aqueous liquid waste containing adhesives or sealants containing organic solvents or other dangerous substances
08 04 16	aqueous liquid waste containing adhesives or sealants other than those mentioned in 08 04 15
08 04 17*	rosin oil
08 04 99	wastes not otherwise specified
08 05	**wastes not otherwise specified in 08**
08 05 01*	waste isocyanates
09	**WASTES FROM THE PHOTOGRAPHIC INDUSTRY**
09 01	**wastes for the photographic industry**
09 01 01*	water-based developer and activator solutions
09 01 02*	water-based offset plate developer solutions
09 01 03*	solvent-based developer solutions
09 01 04*	fixed solutions
09 01 05*	bleach solutions and bleach fixer solutions
09 01 06*	wastes containing silver from on-site treatment of photographic wastes
09 01 07	photographic film and paper containing silver or silver compounds
09 01 08	photographic film and paper free of silver or silver compounds
09 01 10	single-use cameras without batteries
09 01 11*	single-use cameras containing batteries included in 16 06 01, 16 06 02 or 16 06 03
09 01 12	single-use cameras containing batteries other than those mentioned in 09 01 11

09 01 13*	aqueous liquid waste from on-site reclamation of silver other than those mentioned in 09 01 06
09 01 99	wastes not otherwise specified
10	**WASTES FROM THERMAL PROCESSES**
10 01	**wastes from power stations and other combustion plants (except 19)**
10 01 01	bottom ash, slag and boiler dust (excluding boiler dust mentioned in 10 01 04)
10 01 02	coal fly ash
10 01 03	fly ash from peat and untreated wood
10 01 04*	oil fly ash and boiler dust
10 01 05	calcium-based reaction wastes from flue-gas desulphurisation in solid form
10 01 07	calcium-based reaction wastes from flue-gas desulphurisation in sludge form
10 01 09*	sulphuric acid
10 01 13*	fly ash from emulsified hydrocarbons used as fuel
10 01 14*	bottom ash, slag and boiler dust from co-incineration containing dangerous substances
10 01 15	bottom ash, slag and boiler dust from co-incineration other than those mentioned in 10 01 14
10 01 16*	fly ash from co-incineration containing dangerous substances
10 01 17	fly ash from co-incineration other than those mentioned in 10 01 16
10 01 18*	wastes from gas cleaning containing dangerous substances
10 01 19	wastes from gas cleaning other than those mentioned in 10 01 05, 10 01 07 and 10 01 18
10 01 20*	sludges from on-site effluent treatment containing dangerous substances
10 01 21	sluges from on-site effluent treatment other than those mentioned in 10 01 20
10 01 22*	aqueous sludges from boiler cleansing containing dangerous substances
10 01 23	aqueous sludges from boiler cleansing other than those mentioned in 10 01 22
10 01 24	sands from fluidised beds
10 01 25	wastes from fuel storage and preparation of coal-fired power plants
10 01 26	wastes from cooling-water treatment
10 01 99	wastes not otherwise specified
10 02	**wastes from the iron and steel industry**
10 02 01	wastes from the processing of slag
10 02 02	unprocessed slag
10 02 07*	solid wastes from gas treatment containing dangerous substances
10 02 08	solid wastes from gas treatment other than those mentioned in 10 02 07
10 02 10	mill scales
10 02 11*	wastes from cooling-water treatment containing oil

10 02 12	waste from cooling-water treatment other than those mentioned in 10 02 11
10 02 13*	sludges and filter cakes from gas treatment containing dangerous substances
10 02 14	sludges and filter cakes from gas treatment other than those mentioned in 10 02 13
10 02 15	other sludges and filter cakes
10 02 99	wastes not otherwise specified
10 03	**wastes from aluminium thermal metallurgy**
10 03 02	anode scraps
10 03 04*	primary production slags
10 03 05	waste alumina
10 03 08*	salt slags from secondary production
10 03 09*	black drosses from secondary production
10 03 15*	skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities
10 03 16	skimming other than those mentioned in 10 03 15
10 03 17*	tar-containing wastes from anode manufacture
10 03 18	carbon-containing waste from anode manufacture other than those mentioned in 10 03 17
10 03 19*	flue-gas dust containing dangerous substances
10 03 20	flue-gas dust other than those mentioned in 10 03 19
10 03 21*	other particulates and dust (including ball-mill dust) containing dangerous substances
10 03 22	other particulates and dust (including ball-mill dust) other than those mentioned in 10 03 21
10 03 23*	solid wastes from gas treatment containing dangerous substances
10 03 24	solid wastes from gas treatment other than those mentioned in 10 03 23
10 03 25*	sludges and filter cakes from gas treatment containing dangerous substances
10 03 26	sludges and filter cakes from gas treatment other than those mentioned in 10 03 25
10 03 27*	wastes from cooling-water treatment containing oil
10 03 28	wastes from cooling-water treatment other than those mentioned in 10 03 27
10 03 29*	waste from treatment of salt slags and black drosses containing dangerous substances
10 03 30	wastes from treatment of salt slags and black drosses other than those mentioned in 10 03 29
10 03 99	wastes not otherwise specified
10 04	**wastes from lead thermal metallurgy**
10 04 01*	slags from primary and secondary production
10 04 02*	dross and skimmings from primary and secondary production
10 04 03*	calcium arsenate
10 04 04*	flue-gas dust

10 04 05*	other particulates and dust
10 04 06*	solid wastes from gas treatment
10 04 07*	sludges and filter cakes from gas treatment
10 04 09*	wastes from cooling-water treatment containing oil
10 04 10	waste from cooling-water treatment other than those mentioned in 10 04 09
10 04 99	wastes not otherwise specified
10 05	**wastes from zinc thermal metallurgy**
10 05 01	slags from primary and secondary production
10 05 03*	flue-gas dust
10 05 04	other particulates and dust
10 05 05*	solid waste from gas treatment
10 05 06*	sludges and filter cakes from gas treatment
10 05 08*	wastes from cooling-water treatment containing oil
10 05 09	wastes from cooling-water treatment other than those mentioned in 10 05 08
10 05 10*	dross and skimmings that are flammable or emit, upon contact with water, flammable gases in dangerous quantities
10 05 11	dross and skimmings other than those mentioned in 10 05 10
10 05 99	wastes not otherwise specified
10 06	**wastes from copper thermal metallurgy**
10 06 01	slags from primary and secondary production
10 06 02	dross and skimmings from primary and secondary production
10 06 03*	flue-gas dust
10 06 04	other particulates and dust
10 06 06*	solid wastes from gas treatment
10 06 07*	sludges and filter cakes from has treatment
10 06 09*	wastes from cooling-water treatment containing oil
10 06 10	waste from cooling-water treatment other than those mentioned in 10 06 09
10 06 99	wastes not otherwise specified
10 07	**wastes from silver, gold and platinum thermal metalurgy**
10 07 01	slags from primary and secondary production
10 07 02	dross and skimmings from primary and secondary production
10 07 03	solid wastes from gas treatment
10 07 04	other particultes and dust
10 07 05	sludges and filter cakes from gas treatment
10 07 07*	wastes from cooling-water treatment containing oil

10 07 08	wastes from cooling-water treatment other than those mentioned in 10 07 07
10 07 99	wastes not otherwise specified
10 08	**wastes from other non-ferous thermal metallurgy**
10 08 04	particulates and dust
10 08 08*	salt slag from primary and secondary production
10 08 09	other slags
10 08 10*	dross and skimming that are flammable or emit, upon the contact with water, flammable gases in dangerous quanities
10 08 11	dross and skimmings other than those mentioned in 10 08 10
10 08 12*	tar-containing waste from anode manufacture
10 08 13	carbon-containing wastes from anode manufacture other than those mentioned in 10 08 12
10 08 14	anode scrap
10 08 15*	flue-gas dust containing dangerous substances
10 08 16	flue-gas dust other than those mentioned in 10 08 15
10 08 17*	sludges and filter cakes from flue-gas treatment containing dangerous substances
10 08 18	sludges and filter cakes from flue-gas treatment other than those mentioned in 10 08 17
10 08 19*	wastes from cooling-water treatment containing oil
10 08 20	wastes from cooling-water treatment other than those mentioned in 10 08 19
10 08 99	wastes not otherwise specified
10 09	**wastes from casting of ferrous pieces**
10 09 03	furnace slag
10 09 05*	casting cores and moulds which have not undergone pouring containing dangerous substances
10 09 06	casting cores and moulds which have not undergone pouring other than those mentioned in 10 09 05
10 09 07*	casting cores and moulds which have undergone pouring containing dangerous substances
10 09 08	casting cores and moulds have undergone pouring other than those mentioned in 10 09 07
10 09 09*	flue-gas dust containing dangerous substances
10 09 10	flue-gas dust other than those mentioned in 10 09 09
10 09 11*	other particulates containing dangerous substances
10 09 12	other particulates other than those mentioned in 10 09 11
10 09 13*	waste binders containing dangerous substances
10 09 14	waste binders other than those mentioned in 10 09 13
10 09 15*	waste crack-indicating agent containing dangerous substances
10 09 16	waste crack-indicating agent other than those mentioned in 10 09 15
10 09 99	wastes not otherwise specified

10 10	**wastes from casting of non-ferrous pieces**
10 10 03	furnace slag
10 10 05*	casting cores and moulds which have not undergone pouring, containing dangerous substances
10 10 06	casting cores and moulds which have not undergone pouring, other than those mentioned in 10 10 05
10 10 07*	casting cores and moulds which have undergone pouring, containing dangerous substances
10 10 08	casting cores and moulds which have undergone pouring, other than those mentioned in 10 10 07
10 10 09*	flue-gas dust containing dangerous substances
10 10 10	flue-gas dust other than those mentioned in 10 10 09
10 10 11*	other particulates containing dangerous substances
10 10 12	other particulates other than those mentioned in 10 10 11
10 10 13*	waste binders containing dangerous substances
10 10 14	waste binders other than those mentioned in 10 10 13
10 10 15*	waste crack-indicating agent containing dangerous substances
10 10 16	waste crack-indicating agent other than those mentioned in 10 10 15
10 10 99	wastes not otherwise specified
10 11	**wastes from manufacture of glass and glass products**
10 11 03	waste glass-based fibrous materials
10 11 05	particulates and dust
10 11 09*	waste preparation mixture before thermal processing, containing dangerous substances
10 11 10	waste preparation mixture before thermal processing, other than those mentioned in 10 11 09
10 11 11*	waste glass in small particles and glass powder containing heavy metals (for example from cathode ray tubes)
10 11 12	waste glass other than those mentioned in 10 11 11
10 11 13*	glass-polishing and -grinding sludge containing dangerous substances
10 11 14	glass-polishing and -grinding sludge other than those mentioned in 10 11 13
10 11 15*	solid wastes from flue-gas treatment containing dangerous substances
10 11 16	solid wastes from flue-gas treatment other than those mentioned in 10 11 15
10 11 17*	sludges and filter cakes from flue-gas treatment containing dangerous substances
10 11 18	sludges and filter cakes from flue-gas treatment other than those mentioned in 10 11 17
10 11 19*	solid wastes from on-site effluent treatment containing dangerous substances
10 11 20	solid wastes from on-site effluent treatment other than those mentioned in 10 11 19
10 11 99	wastes not otherwise specified
10 12	**wastes from manufacture of ceramic goods, bricks, tiles and construction products**

10 12 01	waste preparation mixture before thermal processing
10 12 03	particulates and dust
10 12 05	sludges and filter cakes from gas treatment
10 12 06	discarded moulds
10 12 08	waste ceramics, bricks, tiles and construction products (after thermal processing)
10 12 09*	solid wastes from gas treatment containing dangerous substances
10 12 10	solid wastes from gas treatment other than those mentioned in 10 12 09
10 12 11*	wastes from glazing containing heavy metals
10 12 12	wastes from glazing other than those mentioned in 10 12 11
10 12 13	sludge from on-site effluent treatment
10 12 99	wastes not otherwise specified
10 13	**wastes from manufacture of cement, lime and plaster and articles and products made from them**
10 13 01	waste preparation mixture before thermal processing
10 13 04	wastes from calcination and hydration of lime
10 13 06	particulates and dust (except 10 13 12 and 10 13 13)
10 13 07	sludges and filter cakes from gas treatment
10 13 09*	wastes from asbestos-cement manufacture containing asbestos
10 13 10	wastes from asbestos-cement manufacture other than those mentioned in 10 13 09
10 13 11	wastes from cement-based composite materials other than those mentioned in 10 13 09 and 10 13 10
10 13 12*	solid wastes from gas treatment containing dangerous substances
10 13 13	solid wastes from gas treatment other than those mentioned in 10 13 12
10 13 14	waste concrete and concrete sludge
10 13 99	wastes not otherwise specified
10 14	**waste from crematoria**
10 14 01*	waste from gas cleaning containing mercury
11	**WASTES FROM CHEMICAL SURFACE TREATMENT AND COATING OF METALS AND OTHER MATERIALS; NON-FERROUS HYDRO-METALLURGY**
11 01	**wastes from chemical surface treatment and coating of metals and other materials (for example galvanic processes, zinc coating processes, pickling processes, etching, phosphating, alkaline degreasing, anodising)**
11 01 05*	pickling acids
11 01 06*	acids not otherwise specified
11 01 07*	pickling bases
11 01 08*	phosphatising sludges

11 01 09*	sludges and filter cakes containing dangerous substances
11 01 10	sludges and filter cakes other than those mentioned in 11 01 09
11 01 11*	aqueous rinsing liquids containing dangerous substances
11 01 12	aqueous rinsing liquids other than those mentioned in 11 01 11
11 01 13*	degreasing wastes containing dangerous substances
11 01 14	degreasing wastes other than those mentioned in 11 01 13
11 01 15*	eluate and sludges from membrane systems or ion exchange systems containing dangerous substances
11 01 16*	saturated or spent ion exchange resins
11 01 98*	other wastes containing dangerous substances
11 01 99	wastes not otherwise specified
11 02	**waste from non-ferrous hydrometallurgical processes**
11 02 02*	sludges from zinc hydrometallurgy (including jarosite, goethite)
11 02 03	wastes from the production of anodes for aqueous electrolytical processes
11 02 05*	wastes from copper hydrometallurgical processes containing dangerous substances
11 02 06	wastes from copper hydrometallurgical processes other than those mentioned in 11 02 05
11 02 07*	other wastes containing dangerous substances
11 02 99	wastes not otherwise specified
11 03	**sludges and solids from tempering processes**
11 03 01*	waste containing cyanide
11 03 02*	other wastes
11 05	**wastes from hot galvanising processes**
11 05 01	hard zinc
11 05 02	zinc ash
11 05 03*	solid wastes from gas treatment
11 05 04*	spent flux
11 05 99	wastes not otherwise specified
12	**WASTES FROM SHAPING AND PHYSICAL AND MECHANICAL SURFACE TREATMENT OF METALS AND PLASTICS**
12 01	**wastes from shaping and physical and mechanical surface treatment of metals and plastics**
12 01 01	ferrous metal filings and turnings
12 01 02	ferrous metal dust and particles
12 01 03	non-ferrous metal filings and turnings
12 01 04	non-ferrous metal dust and particles

12 01 05	plastics shavings and turnings
12 01 06*	mineral-based machining oils containing halogens (except emulsions and solutions)
12 01 07*	mineral-based machining oils free of halogens (except emulsions and solutions)
12 01 08*	machining emulsions and solutions containing halogens
12 01 09*	machining emulsions and solutions free of halogens
12 01 10*	synthetic machining oils
12 01 12*	spent waxes and fats
12 01 13	welding wastes
12 01 14*	machining sludges containing dangerous substances
12 01 15	machining sludges other than those mentioned in 12 01 14
12 01 16*	waste blasting material containing dangerous substances
12 01 17	waste blasting material other than those mentioned in 12 01 16
12 01 18*	metal sludge (grinding, honing and lapping sludge) containing oil
12 01 19*	readily biodegradable machining oil
12 01 20*	spent grinding bodies and grinding materials containing dangerous substances
12 01 21	spent grinding bodies and grinding materials other than those mentioned in 12 01 20
12 01 99	wastes not otherwise specified
12 03	**wastes from water and steam degreasing processes (except 11)**
12 03 01*	aqueous washing liquids
12 03 02*	steam degreasing wastes
13	**OIL WASTES AND WASTES OF LIQUID FUELS** (except edible oils, and those in chapters 05, 12 and 19)
13 01	**waste hydraulic oils**
13 01 01*	hydraulic oils, containing PCBs ([15])
13 01 04*	chlorinated emulsions
13 01 05*	non-chlorinated emulsions
13 01 09*	mineral-based chlorinated hydraulic oils
13 01 10*	mineral-based non-chlorinated hydraulic oils
13 01 11*	synthetic hydraulic oils
13 01 12*	readily biodegradable hydraulic oils
13 01 13*	other hydraulic oils
13 02	**waste engine, gear and lubricating oils**
13 02 04*	mineral-based chlorinated engine, gear and lubricating oils

[15] For the purpose of this list of wastes, PCBs will be defined as in Directive 96/59/EC.

13 02 05*	mineral-based non-chlorinated engine, gear and lubricating oils
13 02 06*	synthetic engine, gear and lubricating oils
13 02 07*	readily biodegradable engine, gear and lubricating oils
13 02 08*	other engine, gear and lubricating oils
13 03	**waste insulating and heat transmission oils**
13 03 01*	insulating or heat transmission oils containing PCBs
13 03 06*	mineral-based chlorinated insulating and heat transmission oils other than those mentioned in 13 03 01
13 03 07*	mineral-based non-chlorinated insulating and heat transmission oils
13 03 08*	synthetic insulating and heat transmission oils
13 03 09*	readily biodegradable insulating and heat transmission oils
13 03 10*	other insulating and heat transmission oils
13 04	**bilge oils**
13 04 01*	bilge oils from inland navigation
13 04 02*	bilge oils from jetty sewers
13 04 03*	bilge oils from other navigation
13 05	**oil/water separator contents**
13 05 01*	solids from grit chambers and oil/water separators
13 05 02*	sludges from oil/water separators
13 05 03*	interceptor sludges
13 05 06*	oil from oil/water separators
13 05 07*	oily water from oil/water separators
13 05 08*	mixtures of wastes from grit chambers and oil/water separators
13 07	**wastes of liquid fuels**
13 07 01*	fuel oil and diesel
13 07 02*	petrol
13 07 03*	other fuels (including mixtures)
13 08	**oil wastes not otherwise specified**
13 08 01*	desalter sludges or emulsions
13 08 02*	other emulsions
13 08 99*	wastes not otherwise specified
14	**WASTE ORGANIC SOLVENTS, REFRIGERANTS AND PROPELLANTS** (except 07 and 08)
14 06	**waste organic solvents, refrigerants and foam/aerosol propellants**
14 06 01*	chlorofluorocarbons, HCFC, HFC

14 06 02*	other halogenated solvents and solvent mixtures
14 06 03*	other solvents and solvent mixtures
14 06 04*	sludges or solid wastes containing halogenated solvents
14 06 05*	sludges or solid wastes containing other solvents
15	**WASTE PACKAGING; ABSORBENTS, WIPING CLOTHS, FILTER MATERIALS AND PROTECTIVE CLOTHING NOT OTHERWISE SPECIFIED**
15 01	**packaging (including separately collected municipal packaging waste)**
15 01 01	paper and cardboard packaging
15 01 02	plastic packaging
15 01 03	wooden packaging
15 01 04	metallic packaging
15 01 05	composite packaging
15 01 06	mixed packaging
15 01 07	glass packaging
15 01 09	textile packaging
15 01 10*	packaging containing residues of or contaminated by dangerous substances
15 01 11*	metallic packaging containing a dangerous solid porous matrix (for example asbestos), including empty pressure containers
15 02	**absorbents, filter materials, wiping cloths and protective clothing**
15 02 02*	absorbents, filter materials (including oil filters not otherwise specified), wiping cloths, protective clothing contaminated by dangerous substances
15 02 03	absorbents, filter materials, wiping cloths and protective clothing other than those mentioned in 15 02 02
16	**WASTES NOT OTHERWISE SPECIFIED IN THE LIST**
16 01	**end-of-life vehicles from different means of transport (including off-road machinery) and wastes from dismantling of end-of-life vehicles and vehicle maintenance (except 13, 14, 16 06 and 16 08)**
16 01 03	end-of-life tyres
16 01 04*	end-of-life vehicles
16 01 06	end-of-life vehicles, containing neither liquids nor other hazardous components
16 01 07*	oil filters
16 01 08*	components containing mercury
16 01 09*	components containing PCBs
16 01 10*	explosive components (for example air bags)
16 01 11*	brake pads containing asbestos

16 01 12	brake pads other than those mentioned in 16 01 11
16 01 13*	brake fluids
16 01 14*	antifreeze fluids containing dangerous substances
16 01 15	antifreeze fluids other than those mentioned in 16 01 14
16 01 16	tanks for liquefied gas
16 01 17	ferrous metal
16 01 18	non-ferrous metal
16 01 19	plastic
16 01 20	glass
16 01 21*	hazardous components other than those mentioned in 16 01 07 to 16 01 11 and 16 01 13 and 16 01 14
16 01 22	components not otherwise specified
16 01 99	wastes not otherwise specified
16 02	**wastes from electrical and electronic equipment**
16 02 09*	transformers and capacitors containing PCBs
16 02 10*	discarded equipment containing or contaminated by PCBs other than those mentioned in 16 02 09
16 02 11*	discarded equipment containing chlorofluorocarbons, HCFC, HFC
16 02 12*	discarded equipment containing free asbestos
16 02 13*	discarded equipment containing hazardous components ([16]) other than those mentioned in 16 02 09 to 16 02 12
16 02 14	discarded equipment other than those mentioned in 16 02 09 to 16 02 13
16 02 15*	hazardous components removed from discarded equipment
16 02 16	components removed from discarded equipment other than those mentioned in 16 02 15
16 03	**off-specification batches and unused products**
16 03 03*	inorganic wastes containing dangerous substances
16 03 04	inorganic wastes other than those mentioned in 16 03 03
16 03 05*	organic wastes containing dangerous substances
16 03 06	organic wastes other than those mentioned in 16 03 05
16 04	**waste explosives**
16 04 01*	waste ammunition
16 04 02*	fireworks wastes
16 04 03*	other waste explosives

[16] Hazardous components from electrical and electronic equipment may include accumulators and batteries mentioned in 16 06 and marked as hazardous; mercury switches, glass from cathode ray tubes and other activated glass, etc.

16 05	**gases in pressure containers and discarded chemicals**
16 05 04*	gases in pressure containers (including halons) containing dangerous substances
16 05 05	gases in pressure containers other than those mentioned in 16 05 04
16 05 06*	laboratory chemicals, consisting of or containing dangerous substances, including mixtures of laboratory chemicals
16 05 07*	discarded inorganic chemicals consisting of or containing dangerous substances
16 05 08*	discarded organic chemicals consisting of or containing dangerous substances
16 05 09	discarded chemicals other than those mentioned in 16 05 06, 16 05 07 or 16 05 08
16 06	**batteries and accumulators**
16 06 01*	lead batteries
16 06 02*	Ni-Cd batteries
16 06 03*	mercury-containing batteries
16 06 04	alkaline batteries (except 16 06 03)
16 06 05	other batteries and accumulators
16 06 06*	separately collected electrolyte from batteries and accumulators
16 07	**wastes from transport tank, storage tank and barrel cleaning (except 05 and 13)**
16 07 08*	wastes containing oil
16 07 09*	wastes containing other dangerous substances
16 07 99	wastes not otherwise specified
16 08	**spent catalysts**
16 08 01	spent catalysts containing gold, silver, rhenium, rhodium, palladium, iridium or platinum (except 16 08 07)
16 08 02*	spent catalysts containing dangerous transition metals ([17]) or dangerous transition metal compounds
16 08 03	spent catalysts containing transition metals or transition metal compounds not otherwise specified
16 08 04	spent fluid catalytic cracking catalysts (except 16 08 07)
16 08 05*	spent catalysts containing phosphoric acid
16 08 06*	spent liquids used as catalysts
16 08 07*	spent catalysts contaminated with dangerous substances
16 09	**oxidising substances**
16 09 01*	permanganates, for example potassium permanganate

[17] For the purpose of this entry, transition metals are: scandium, vanadium, manganese, cobalt, copper, yttrium, niobium, hafnium, tungsten, titanium, chromium, iron, nickel, zinc, zirconium, molybdenum and tantalum. These metals or their compounds are dangerous if they are classified as dangerous substances. The classification of dangerous substances shall determine which among those transition metals and which transition metal compounds are hazardous.

16 09 02*	chromates, for example potassium chromate, potassium or sodium dichromate
16 09 03*	peroxides, for example hydrogen peroxide
16 09 04*	oxidising substances, not otherwise specified
16 10	**aqueous liquid wastes destined for off-site treatment**
16 10 01*	aqueous liquid wastes containing dangerous substances
16 10 02	aqueous liquid wastes other than those mentioned in 16 10 01
16 10 03*	aqueous concentrates containing dangerous substances
16 10 04	aqueous concentrates other than those mentioned in 16 10 03
16 11	**waste linings and refractories**
16 11 01*	carbon-based linings and refractories from metallurgical processes containing dangerous substances
16 11 02	carbon-based linings and refractories fronm metallurgical processes other than those mentioned in 16 11 01
16 11 03*	other linings and refractories from metallurgical processes containing dangerous substances
16 11 04	other linings and refractories from metallurgical processes other than those mentioned in 16 11 03
16 11 05*	linings and refractories from non-metallurgical processes containing dangerous substances
16 11 06	linings and refractories from non-metallurgical processes other than those mentioned in 16 11 05
17	**CONSTRUCTION AND DEMOLITION WASTES (INCLUDING EXCAVATED SOIL FROM CONTAMINATED SITES)**
17 01	**concrete, bricks, tiles and ceramics**
17 01 01	concrete
17 01 02	bricks
17 01 03	tiles and ceramics
17 01 06*	mixtures of, or separate fractions of concrete, bricks, tiles and ceramics containing dangerous substances
17 01 07	mixture of concrete, bricks, tiles and ceramics other than those mentioned in 17 01 06
17 02	**wood, glass and plastic**
17 02 01	wood
17 02 02	glass
17 02 03	plastic
17 02 04*	glass, plastic and wood containing or contaminated with dangerous substances
17 03	**bituminous mixtures, coal tar and tarred products**
17 03 01*	bituminous mixtures containing coal tar
17 03 02	bituminous mixtures containing other than those mentioned in 17 03 01

17 03 03*	coal tar and tarred products
17 04	**metals (including their alloys)**
17 04 01	copper, bronze, brass
17 04 02	aluminium
17 04 03	lead
17 04 04	zinc
17 04 05	iron and steel
17 04 06	tin
17 04 07	mixed metals
17 04 09*	metal waste contaminated with dangerous substances
17 04 10*	cables containing oil, coal tar and other dangerous substances
17 04 11	cables other than those mentioned in 17 04 10
17 05	**soil (including excavated soil from contaminated sites), stones and dredging spoil**
17 05 03*	soil and stones containing dangerous substances
17 05 04	soil and stones other than those mentioned in 17 05 03
17 05 05*	dredging spoil containing dangerous substances
17 05 06	dredging spoil other than those mentioned 17 05 05
17 05 07*	track ballast containing dangerous substances
17 05 08	track ballast other than those mentioned in 17 05 07
17 06	**insulation materials and asbestos-containing construction materials**
17 06 01*	insulation materials containing asbestos
17 06 03*	other insulation materials consisting of or containing dangerous substances
17 06 04	insulation materials other than those mentioned in 17 06 01 and 17 06 03
17 06 05*	construction materials containing asbestos ([18])
17 08	**gypsum-based construction material**
17 08 01*	gypsum-based construction materials contaminated with dangerous substances
17 08 02	gypsum-based construction materials other than those mentioned in 17 08 01
17 09	**other construction and demolition waste**
17 09 01*	construction and demolition wastes containing mercury
17 09 02*	construction and demolition wastes containing pcb (for example pcb-containing sealants, pcb-containing resin-based floorings, pcb-containing sealed glazing units, pcb-containing capacitors)

[18] As far as the landfilling of waste is concerned, Member States may decide to postpone the entry into force of this entry until the establishment of appropriate measures for the treatment and disposal of waste from construction material containing asbestos. These measures are to be established according to the procedure referred to in Article 16 of Council Directive 1999/31/EC on the landfill of waste (OJ L 182, 16.7.1999, p.1) and shall be adopted by 16 July 2002 at the latest.

17 09 03*	other construction and demolition wastes (including mixed wastes) containing dangerous substances
17 09 04	mixed construction and demolition wastes other than those mentioned in 17 09 01, 17 09 02 and 17 09 03
18	**WASTES FROM HUMAN OR ANIMAL HEALTH CARE AND/OR RELATED RESEARCH (except kitchen and restaurant wastes not arising from immediate health care)**
18 01	**wastes from natal care, diagnosis, treatment or prevention of disease in humans**
18 01 01	sharps (except 18 01 03)
18 01 02	body parts and organs including blood bags and blood preserves (except 18 01 03)
18 01 03*	wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 01 04	wastes whose collection and disposal is not subject to special requirements in order to prevent infection (for example dressings, plaster casts, linen, disposable clothing, diapers)
18 01 06*	chemicals consisting of or containing dangerous substances
18 01 07	chemicals other than those mentioned in 18 01 06
18 01 08*	cytotoxic and cytostatic medicines
18 01 09	medicines other than those mentioned in 18 01 08
18 01 10*	amalgam waste from dental care
18 02	**wastes from research, diagnosis, treatment or prevention of disease involving animals**
18 02 01	sharps except (18 02 02)
18 02 02*	wastes whose collection and disposal is subject to special requirements in order to prevent infection
18 02 03	wastes whose collection and disposal is not subject to special requirements in order to prevent infection
18 02 05*	chemicals consisting of or containing dangerous substances
18 02 06	chemicals other than those mentioned in 18 02 05
18 02 07*	cytotoxic and cytostatic medicines
18 02 08	medicines other than those mentioned in 18 02 07
19	**WASTES FROM WASTE MANAGEMENT FACILITIES, OFF-SITE WASTE WATER TREATMENT PLANTS AND THE PREPARATION OF WATER INTENDED FOR HUMAN CONSUMPTION AND WATER FOR INDUSTRIAL USE**
19 01	**wastes from incineration or pyrolysis of waste**
19 01 02	ferrous materials removed from bottom ash
19 01 05*	filter cake from gas treatment

19 01 06*	aqueous liquid wastes from gas treatment and other aqueous liquid wastes
19 01 07*	solid wastes from gas treatment
19 01 10*	spent activated carbon from flue-gas treatment
19 01 11*	bottom ash and slag containing dangerous substances
19 01 12	bottom ash and slag other than those mentioned in 19 01 11
19 01 13*	fly ash containing dangerous substances
19 01 14	fly ash other than those mentioned in 19 01 13
19 01 15*	boiler dust containing dangerous substances
19 01 16	boiler dust other than those mentioned in 19 01 15
19 01 17*	pyrolysis wastes containing dangerous substances
19 01 18	pyrolysis wastes other than those mentioned in 19 01 17
19 01 19	sands from fluidised beds
19 01 99	wastes not otherwise specified
19 02	**wastes from physico/chemical treatments of waste (including dechromatation, decyanidation, neutralisation)**
19 02 03	premixed wastes composed only of non-hazardous wastes
19 02 04*	premixed wastes composed of at least one hazardous waste
19 02 05*	sludges from physico/chemical treatment containing dangerous substances
19 02 06	sludges from physico/chemical treatment other than those mentioned in 19 02 05
19 02 07*	oil and concentrates from separation
19 02 08*	liquid combustible wastes containing dangerous substances
19 02 09*	solid combustible wastes containing dangerous substances
19 02 10	combustible wastes other than those mentioned in 19 02 08 and 19 02 09
19 02 11*	other wastes containing dangerous substances
19 02 99	wastes not otherwise specified
19 03	**stabilised/solidified wastes ([19])**

[19] Stabilisation processes change the dangerousness of the constituents in the waste and thus transform hazardous waste into non-hazardous waste. Solidification processes only change the physical state of the waste (e.g. liquid into solid) by using additives without changing the chemical properties of the waste.

19 03 04*	wastes marked as hazardous, partly ([20]) stabilised
19 03 05	stabilised wastes other than those mentioned in 19 03 04
19 03 06*	wastes marked as hazardous, solidified
19 03 07	solidified wastes other than those mentioned in 19 03 06
19 04	**vitrified waste and wastes from vitrification**
19 04 01	vitrified waste
19 04 02*	fly ash and other flue-gas treatment wastes
19 04 03*	non-vitrified solid phase
19 04 04	aqueous liquid wastes from vitrified waste tempering
19 05	**wastes from aerobic treatment of solid wastes**
19 05 01	non-composted fraction of municipal and similar wastes
19 05 02	non-composted fraction of animal and vegetable waste
19 05 03	off-specification compost
19 05 99	wastes not otherwise specified
19 06	**wastes from anaerobic treatment of waste**
19 06 03	liquor from anaerobic treatment of municipal waste
19 06 04	digestate from anaerobic treatment of municipal waste
19 06 05	liquor from anaerobic treatment of animal and vegetable waste
19 06 06	digestate from anaerobic treatment of animal and vegetable waste
19 06 99	wastes not otherwise specified
19 07	**landfill leachate**
19 07 02*	landfill leachate containing dangerous substances
19 07 03	landfill leachate other than those mentioned in 19 07 02
19 08	**wastes from waste water treatment plants not otherwise specified**
19 08 01	screenings
19 08 02	waste from desanding

[20] A waste is considered as partly stabilised if, after the stabilisation process, dangerous constituents which have not been changed completely into non-dangerous constituents could be released into the environment in the short, middle or long term.

19 08 05	sludges from treatment of urban waste water
19 08 06*	saturated or spent ion exchange resins
19 08 07*	solutions and sludges from regeneration of ion exchangers
19 08 08*	membrane system waste containing heavy metals
19 08 09	grease and oil mixture from oil/water separation containing only edible oil and fats
19 08 10*	grease and oil mixture from oil/water separation other than those mentioned in 19 08 09
19 08 11*	sludges containing dangerous substances from biological treatment of industrial waste water
19 08 12	sludges from biological treatment of industrial waste water other than those mentioned in 19 08 11
19 08 13*	sludges containing dangerous substances from other treatment of industrial waste water
19 08 14	sludges from other treatment of industrial waste water other than those mentioned in 19 08 13
19 08 99	wastes not otherwise specified
19 09	**wastes from the preparation of water intended for human consumption or water for industrial use**
19 09 01	solid waste from primary filtration and screenings
19 09 02	sludges from water clarification
19 09 03	sludges from decarbonation
19 09 04	spent activated carbon
19 09 05	saturated or spent ion exchange resins
19 09 06	solutions and sludges from regeneration of ion exchangers
19 09 99	wastes not otherwise specified
19 10	**wastes from shredding of metal-containing wastes**
19 10 01	iron and steel waste
19 10 02	non-ferrous waste
19 10 03*	fluff-light fraction and dust containing dangerous substances
19 10 04	fluff-light fraction and dust other than those mentioned in 19 10 03
19 10 05*	other fractions containing dangerous substances
19 10 06	other fractions other than those mentioned in 19 10 05
19 11	**wastes from oil regeneration**

19 11 01*	spent filter clays
19 11 02*	acid tars
19 11 03*	aqueous liquid wastes
19 11 04*	wastes from cleaning of fuel with bases
19 11 05*	sludges from on-site effluent treatment containing dangerous substances
19 11 06	sludges from on-site effluent treatment other than those mentioned in 19 11 05
19 11 07*	wastes from flue-gas cleaning
19 11 99	wastes not otherwise specified
19 12	**wastes from the mechanical treatment of waste (for example sorting, crushing, compacting, pelletising) not otherwise specified**
19 12 01	paper and cardboard
19 12 02	ferrous metal
19 12 03	non-ferrous metal
19 12 04	plastic and rubber
19 12 05	glass
19 12 06*	wood containing dangerous substances
19 12 07	wood other than that mentioned in 19 12 06
19 12 08	textiles
19 12 09	minerals (for example sand, stones)
19 12 10	combustible waste (refuse derived fuel)
19 12 11*	other wastes (including mixtures of materials) from mechanical treatment of waste containing dangerous substances
19 12 12	other wastes (including mixtures of materials) from mechanical treatment of wastes other than those mentioned in 19 12 11
19 13	**wastes from soil and groundwater remediation**
19 13 01*	solid wastes from soil remediation containing dangerous substances
19 13 02	solid wastes from soil remediation other than those mentioned in 19 13 01
19 13 03*	sludges from soil remediation containing dangerous substances
19 13 04	sludges from soil remediation other than those mentioned in 19 13 03
19 13 05*	sludges from groundwater remediation containing dangerous substances

19 13 06	sludges from groundwater remediation other than those mentioned in 19 13 05
19 13 07*	aqueous liquid wastes and aqueous concentrates from groundwater remediation containing dangerous substances
19 13 08	aqueous liquid wastes and aqueous concentrates from groundwater remediation other than those mentioned in 19 13 07
20	**MUNICIPAL WASTES (HOUSEHOLD WASTE AND SIMILAR COMMERCIAL, INDUSTRIAL AND INSTITUTIONAL WASTES) INCLUDING SEPARATELY COLLECTED FRACTIONS**
20 01	**separately collected fractions (except 15 01)**
20 01 01	paper and cardboard
20 01 02	glass
20 01 08	biodegradable kitchen and canteen waste
20 01 10	clothes
20 01 11	textiles
20 01 13*	solvents
20 01 14*	acids
20 01 15*	alkalines
20 01 17*	photochemicals
20 01 19*	pesticides
20 01 21*	fluorescent tubes and other mercury-containing waste
20 01 23*	discarded equipment containing chlorofluorocarbons
20 01 25	edible oil and fat
20 01 26*	oil and fat other than those mentioned in 20 01 25
20 01 27*	paint, inks, adhesives and resins containing dangerous substances
20 01 28	paint, inks, adhesives and resins other than those mentioned in 20 01 27
20 01 29*	detergents containing dangerous substances
20 01 30	detergents other than those mentioned in 20 01 29
20 01 31*	cytotoxic and cytostatic medicines
20 01 32	medicines other than those mentioned in 20 01 31

20 01 33*	batteries and accumulators included in 16 06 01, 16 06 02 or 16 06 03 and unsorted batteries and accumulators containing these batteries
20 01 34	batteries and accumulators other than those mentioned in 20 01 33
20 01 35*	discarded electrical and electronic equipment other than those mentioned in 20 01 21 and 20 01 23 containing hazardous components ([21])
20 01 36	discarded electrical and electronic equipment other than those mentioned in 20 01 21, 20 01 23 and 20 01 35
20 01 37*	wood containing dangerous substances
20 01 38	wood other than that mentioned in 20 01 37
20 01 39	plastics
20 01 40	metals
20 01 41	wastes from chimney sweeping
20 01 99	other fractions not otherwise specified
20 02	**garden and park wastes (including cemetery waste)**
20 02 01	biodegradable waste
20 02 02	soil and stones
20 02 03	other non-biodegradable wastes
20 03	**other municipal wastes**
20 03 01	mixed municipal waste
20 03 02	waste from markets
20 03 03	street-cleaning residues
20 03 04	septic tank sludge
20 03 06	waste from sewage cleaning
20 03 07	bulky waste
20 03 99	municipal wastes not otherwise specified

[21] Hazardous components from electrical and electronic equipment may include accumulators and batteries mentioned in 16 06 and marked as hazardous; mercury switches, glass from cathode ray tubes and other activated glass etc.

USER COMMENT FORM

Completed forms to be forwarded to:

European Waste Catalogue and Hazardous Waste List
Environmental Protection Agency
PO Box 3000
Johnstown Castle Estate
County Wexford
Ireland
Fax: 053 60699
E-mail: info@epa.ie Web: www.epa.ie

CONTENTS:

STYLE:

INFORMATION:

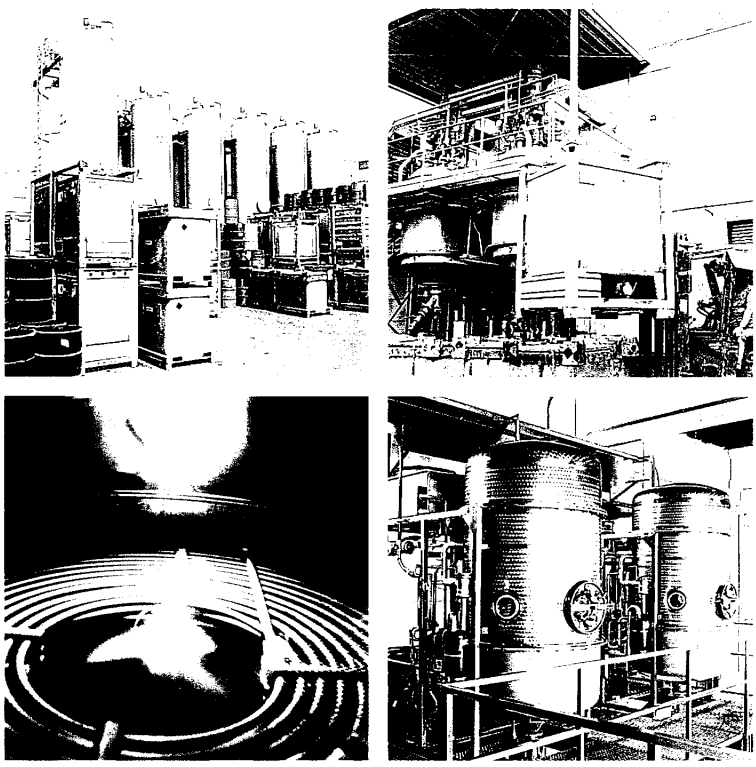
SUGGESTIONS FOR FUTURE REVISIONS:

NAME..... ORGANISATION.....

ADDRESS.....

DATE..... PHONE..... FAX.....

E-MAIL..... WEB.....



DR. WORBS RECYCLING

AUFBEREITUNG UND HERSTELLUNG
VON LÖSEMITTELN

BEHANDLUNG UND VERWERTUNG
VON FOTOGRAFISCHEN BÄDERN

DR. WORBS HOLT IHRE VERSCHMUTZTEN LÖSEMITTEL AB.

Hersteller und Anwender von Lacken und Farben setzen bei der Produktion, Verarbeitung und Reinigung große Mengen an Lösemitteln ein.

DR. WORBS stellt nicht nur Lösemittel her, sondern übernimmt auch verunreinigte Lösemittel und Lösemittel-Gemische zur weiteren Verarbeitung und stofflichen Verwertung.

Transport nach GGVS

Die Übernahme erfolgt in 200 l Fässern , in KTC, (kubischen Tank-Containern mit bis zu 1000 l Volumen) oder bei großen Mengen auch in Tankwagen mit bis zu 25 cbm Fassungsvermögen.
Der Transport unterliegt der GGVS (Gefahrgut-Verordnung Straße), die sowohl eine spezielle Ausrüstung der Behälter und Fahrzeuge umfaßt als auch eine spezifische Fahrerausbildung mit turnusmäßigen Schulungen. Sie erkennen die Fahrzeuge übrigens an dem 30x30 cm großen orangefarbenen Schild; die Behälter sind mit einem auf der Spitze stehenden hellroten Quadrat mit schwarzem Flammensymbol ausgestattet.

Abholung nach Vereinbarung

Die Abholung der verunreinigten Lösemittel erfolgt kundenindividuell je nach Vereinbarung turnusmäßig oder auf Anforderung. Um eine wirtschaftliche Abholung zu gewährleisten, sollten mindestens 2,5 to bereitstehen.

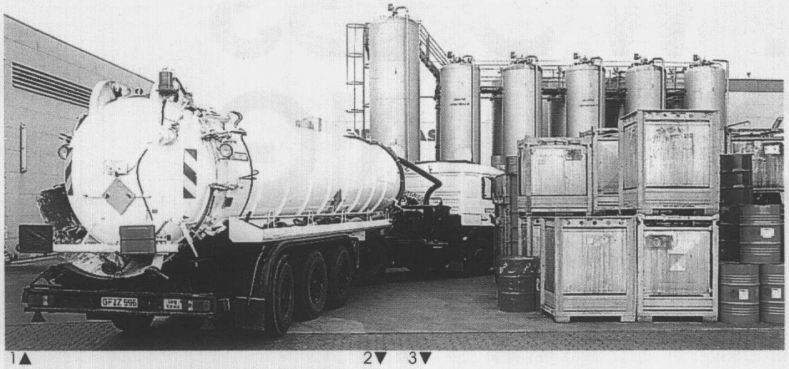
Bilder:

1 Speziell ausgerüstete Tankfahrzeuge mit bis zu 25 cbm Volumen wie das abgebildete, werden direkt in Hochtanks entleert.

2 So wie dieses Faß tragen alle bei DR. WORBS angelieferten verunreinigten Lösemittel eine klare Kennzeichnung.

3 Entladung eines DR. WORBS-eigenen Lastzuges mit Fässern und kubischen Tankcontainern.

4 DR. WORBS verfügt über ein großes Annahmelager für Fässer, KTC und Hochtanks. Damit keine Schadstoffe in das Erdreich gelangen können, ist der gesamte Fahr- und Umschlagbereich, die Weiterverarbeitung und das Fertigwarenlager als oberflächen-gesicherter Bereich ausgebildet.



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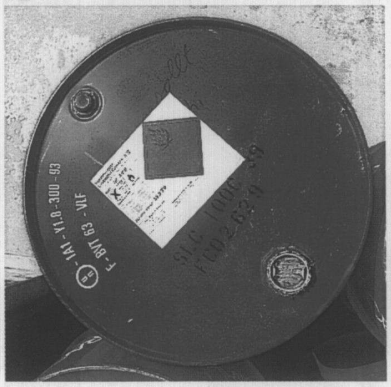

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DR.WORBS REGENERIERT IHRE LÖSEMITTEL.

Egal ob Sie verschmutzte Lösemittel als Lackverdünnung, Reinigungs- oder Waschmittel haben, wir bereiten sie für Sie auf und liefern sie Ihnen gereinigt zurück. Auf Wunsch sorgen wir dafür, daß die ursprüngliche Rezeptur, d.h. Komponentenmischung, wieder hergestellt wird.

Regenerierung durch Destillation

Die Reinigung der verschmutzten Lösemittel erfolgt mittels destillativer Aufbereitungstechnik in zwei unabhängig voneinander arbeitenden Rührwerkkesseln. Hierdurch wird ein hohes Maß an Flexibilität und die Einhaltung von Qualitätsstandarts garantiert.

Umweltschutz wird groß geschrieben

Der Umgang mit Lösemitteln erfolgt in explosionsgeschützten, geschlossenen Systemen. Das gesamte Ablufterfassungssystem ist an eine leistungsstarke, hochmoderne Abluft-Reinigungsanlage angeschlossen. Die Emissionswerte liegen erheblich unterhalb der gesetzlich geforderten Grenzwerte.

Maximales Reststoff-Recycling

Die zähflüssigen organischen Destillationsrückstände („Lackschlamm" usw.) werden künftig thermisch nachbehandelt, d. h. getrocknet und die bislang darin noch enthaltenen Lösemittelreste der Verwertung zugeführt.

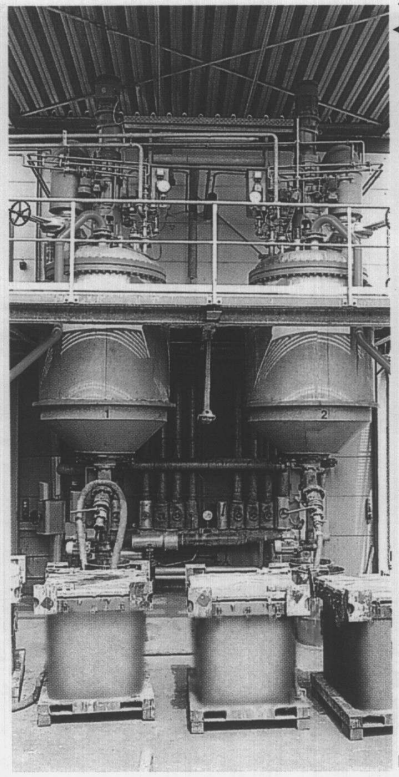
Bilder:

1 Vakuum-Destillationsanlagen mit Rührwerken zur Vermeidung der Verkrustung des pastösen Schlammrückstandes in den Behältern.

2 Anlage zur Kondensation der destillierten Lösemittel, mit jeweils zwei Vorlagetanks für die Redestillate.

3 Die neue Abluft-Reinigungsanlage kann bis zu 250 cbm belastete Abluft pro Stunde verarbeiten. Sie erfaßt allle Arbeitsprozesse bei denen Emissionen in die Atmosphäre entweichen könnten.

4 Künftig werden die zähflüssigen Destillationsrückstände getrocknet. Dadurch wird ihr Volumen reduziert und auch die letzten Lösemittelreste verwertet.



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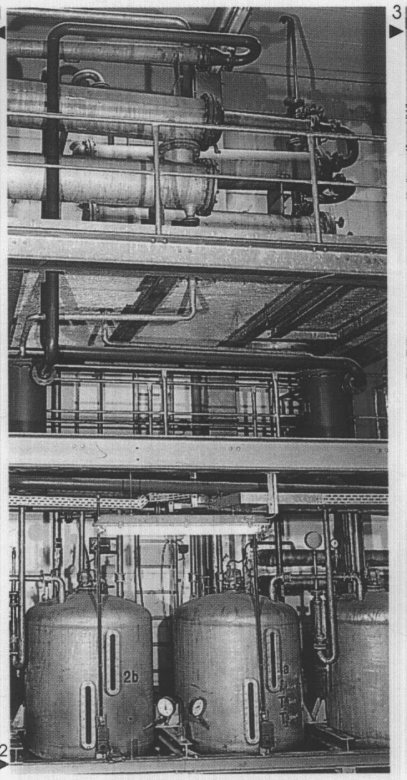

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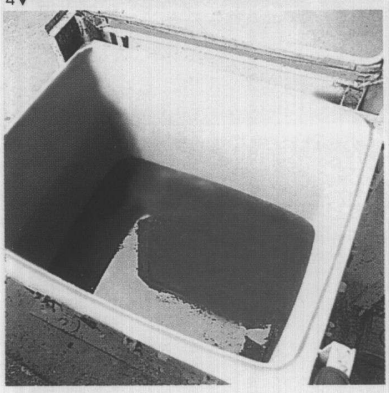


4

DR. WORBS STELLT LÖSEMITTEL HER. ALS EIGENMARKE UND ALS HANDELSWAR

DR. WORBS stellt eine breite Produkt-Palette von Lösemitteln für die verschiedensten Anwendungszwecke her. Dafür haben wir ein umfangreiches unterirdisches Tanklager mit den verschiedensten Lösemittel-Komponenten sowie Misch- und Abfülleinrichtungen für alle handelsüblichen Gebindegrößen.

Laborgeprüfte Qualität und Rezeptur-Entwicklung

In unserem Labor verfügen wir über alle Einrichtungen bis hin zu Gaschromatographen, um die produzierten Qualitäten zu überwachen und um eine gleichbleibende, rezepturgerechte Produktion zu gewährleisten. Aber auch die Entwicklung neuer Rezepturen, die spezifischen Kunden-Anforderungen gerecht werden, gehört mit zu unseren Aufgaben.

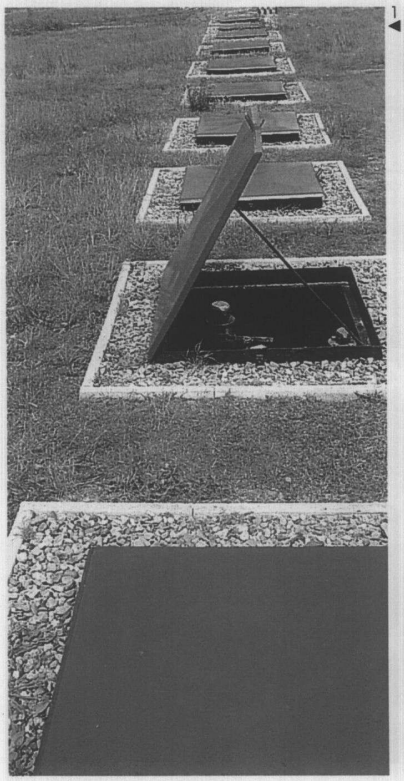
Die DR. WORBS Produkt-Palette

Zu den über 50 Produkten, die wir vom einfachen Pinselreiniger bis zur hochwertigen Lackverdünnung derzeitig herstellen, gehören:

- **Universal - und Kunstharz-Verdünnungen**
- **Reinigungsverdünnungen**
- **Reinigungs-, Löt- und Waschbenzin**
- **Petroleum, Duftpetroleum**
- **Terpentinersatz**
- **Terpentinöl**
- **Aceton**
- **Brennspiritus**
- **Leinöl-Firnis**

aber auch Spezialitäten wie

- **Tiefgrund**
- **Frostschutzmittel für Scheibenwaschanlagen etc.**



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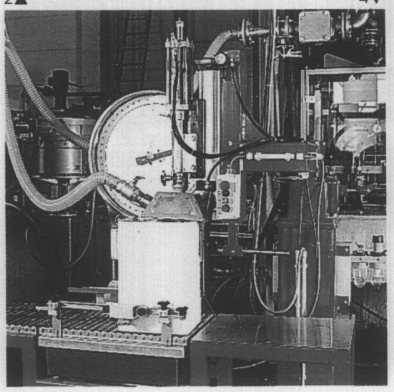


Anwendergerechte Gebinde-Größen

Alle diese Produkte stellen wir in verschiedenen Varianten her und liefern sie in Gebindegrößen von der 500 ml-Flasche über Dosen, Kanister und Fässer bis zur Tankwagenfüllung.

Sie benötigen ein Produkt mit anderen Anwendungsmerkmalen? Kein Problem!
Fragen Sie uns. Wir helfen Ihnen gerne, denn Lösemittel sind unser Metier.

Bilder:

1 Unterirdisches Tanklager für Lösemittel-Komponenten zur Herstellung von DR. WORBS-Produkten und Handelsware.

2 Das DR. WORBS Firmenlabor ist mit allem ausgestattet, was für die Entwicklung, Fertigung und laufende Qualitätsüberwachung von Lösemitteln erforderlich ist.

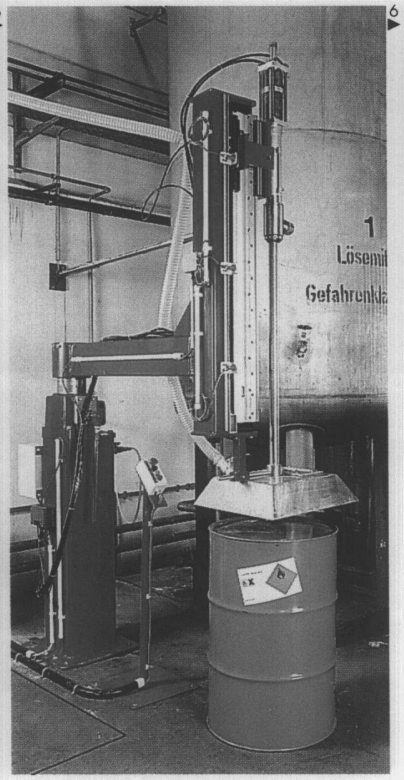
3 Automatische Abfüllanlage für Kleingebinde aus Glas, Kunststoff und Blech von 500 - 1000 ml Inhalt. Die Ausstattung mit einer leistungsfähigen Abluft-Absaugung schützt Personal und Umwelt.

4 Die Befüllung von Kanistern mit 3-60 l Inhalt erfolgt mit leistungsfähigen Halbautomaten.

5 Auch Fässer und kubische Tank-Container (KTC) werden halbautomatisch befüllt. Die Absaugung von Lösemitteldämpfen ist auch hier eine Selbstverständlichkeit.

6 Die Lieferung von DR. WORBS Lösemitteln erfolgt in Gebinden, die von der 500 ml-Flasche über Dosen, Kannen, Kanister und Fässer bis zur Tanklastzug-Füllung reichen. Ein modernes Hochregallager mit 600 Palettenstellplätzen, gewährleistet eine prompte Kundenbelieferung.

5



6

DR. WORBS VERWERTET FOTOGRAFISCHE VAKUUM-VERDAMPFUNG, EIN HOCHMOD

Die Aufbereitung und Verwertung von verbrauchter Fotochemie ist neben der Lösemittel-Regenerierung und -Herstellung ein weiteres Standbein von DR. WORBS.

Die Anlieferung der flüssigen Reststoffe erfolgt in Tankwagen, nachdem vorher bei den Verwendern von Fotochemie eine artreine Erfassung in verschiedenen Behälter-Systemen erfolgt ist. Diese Logistik übernehmen Beteiligungsfirmen unseres Mehrheitsgesellschafters E&R-Holding.

Neue Anlage für umweltgerechte, optimale Verwertung

Für die Fotochemie-Verwertung wurde eine hochmoderne Anlage errichtet und Mitte 1993 in Betrieb genommen. In dem bisher erstmalig in Deutschland angewandten Verfahren erfolgt nicht nur eine Rückgewinnung des in den verbrauchten Fixierbädern gelösten Silbers, sondern auch die Weiterverarbeitung des Kondensats zu destilliertem Wasser. Die Verwertungsquote liegt bei ca. 90% bezogen auf den Materialeingang. Integrierte Wärmerückgewinnungssysteme nutzen darüber hinaus die bei den Prozessen anfallende Überschußenergie.

Silberrückgewinnung, Neutralisation, Vakuum-Verdampfung

Die im Annahme-Tanklager gesammelten Fixier- und Bleichfixierbäder werden im ersten Arbeitsschritt chargenweise entsilbert. Das kathodisch abgeschiedene Silber weist eine Reinheit von über 95% auf. Die entsilberten Lösungen werden anschließend mit Hilfe einer automatisch gesteuerten Dosierstation neutralisiert. Während die Verwertung mit diesem Arbeitsgang normalerweise endet, erfolgt bei DR. WORBS jetzt zusätzlich die Vakuum-Verdampfung der Restsubstanz. Sie wird in einen stichfest eingedickten Kuchen aus Salzen einerseits und destilliertes Wasser andererseits getrennt. Da die Verdampfung im geschlossenen System erfolgt, werden Schadstoffemissionen zuverlässig vermieden.

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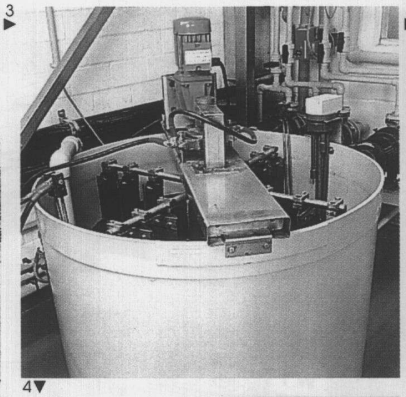
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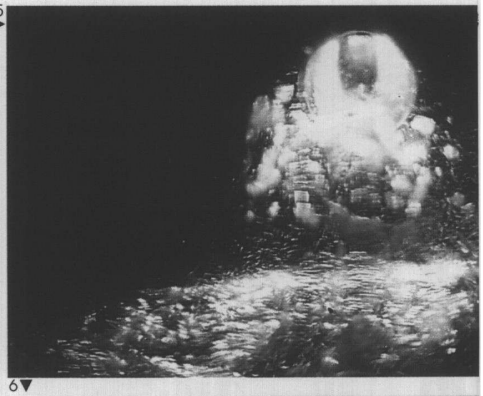
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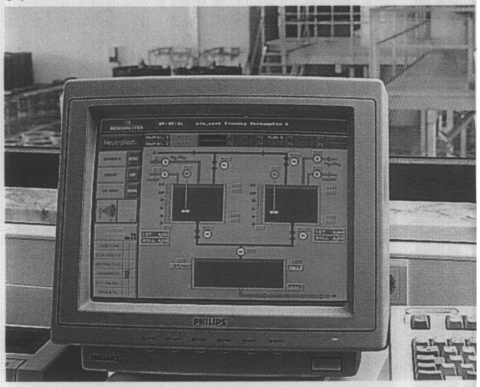

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BÄDER.
RNES VERFAHREN.

Aufbereitung zu destilliertem Wasser

Das bei der Verdampfung anfallende Kondensat wird durch eine dreistufige Umkehr-Osmoseanlage zu destilliertem Wasser weiterverarbeitet. Anschließend erfolgt die Abfüllung und Vermarktung in handelsüblichen Gebindegrößen.

Gezielte Endlagerung der Salz-Rückstände

Die in heißem Zustand noch flüssigen Salzrückstände werden in codierte 200 l Fässer abgefüllt und zur umweltgerechten Endlagerung in unterirdische Salzstock-Deponien gebracht. Dort werden sie wirksam kontrolliert und können eines Tages, wenn eine Nutzungsmöglichkeit entwickelt ist, jederzeit gezielt wieder entnommen werden.

Internationale Produktionsstätten

Die Muttergesellschaft E&R-Holding betreibt ein europaweites Netz derartiger Vakuum-Verdampfungsanlagen. Den Verwendern von Fotochemie wird damit eine ökonomisch und ökologisch zeitgemäße Problemlösung angeboten, die zudem allen gesetzlichen Vorschriften optimal entspricht.

Bilder:

1 Tankfahrzeug in der mit Auffangwanne und automatischer Überfüllsperre ausgerüsteten Annahmestation.

2 Die angelieferte, verbrauchte Fotochemie wird nach einer sofortigen Eingangsanalyse in die entsprechenden Behälter des 500 cbm fassenden Tanklagers gepumpt.

3 Die Elektrolysegeräte sorgen für eine optimale Silberrückgewinnung.

4 Die Aufbereitung mit der Neutralisation in zwei Anlagen mit füllstandgesteuertem Zulauf und ph-Wert-gesteuertem Ablauf im chargenweisen Betrieb.

5 Blick in einen Vakuum-Verdampfer.

6 Der gesamte Aufbereitungsprozeß wird von der Steuerwarte aus per Computer zentral gesteuert und überwacht.

7 Die in Wärmetauschern vorgewärmten, neutralisierten und entsilberten ehemaligen Fotobäder werden in den 12 unabhängig voneinander arbeitenden Vakuum-Verdampfern mit 14.000 jato Kapazität weiterbehandelt.

8 Die bei der Destillation anfallenden Salzrückstände werden in heißem, noch flüssigen Zustand für die derzeitige Endlagerung in codierte Fässer gefüllt.

9 Mehrstufig arbeitende Anlage mit Filterbatterien zur Herstellung von destilliertem Wasser.

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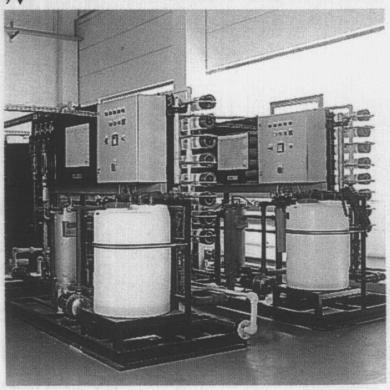


DR. WORBS BIETET SICHERHEIT.

DR. WORBS RECYCLING bietet seinen Kunden neben den verschiedensten Produkten ein Höchstmaß an Sicherheit, wenn es um die Abholung und Aufbereitung von verschmutzten Lösemittel und fotografischen Bädern geht.
Die zunehmend strenger werdenden Umweltschutz-Bestimmungen bergen für jeden Betroffenen ein Risiko in sich, das sich nur durch Einschaltung eines professionellen und seriösen Partners wie DR. WORBS ausschalten läßt.

Wir lösen Ihr Entsorgungsproblem

Nach dem neuen Kreislaufwirtschafts- und Abfallgesetz (KrWG) genießt die stoffliche Verwertung eindeutigen Vorrang vor der Verbrennung. Nach dem Verursacherprinzip wird von Rückstandserzeugern verlangt, vorsorgliche Maßnahmen für eine funktionierende Kreislaufwirtschaft zu ergreifen.
Wir helfen Ihnen, damit auch Sie künftig Ihre Rückstände in den Wirtschafts-Kreislauf gesetzeskonform zurückführen können.

Langjährige Erfahrung und Firmen-Verbund — zwei wichtige Kunden-Vorteil

DR. WORBS beschäftigt sich seit über 4 Jahrzehnten mit dem Lösemittelrecycling und gehört seit Anfang 1992 mehrheitlich zur E&R-Holding, einem Unternehmen der Firmengruppe RETHMANN. Dieses in der Verwertung und Entsorgung unterschiedlichster Rest- und Abfallstoffe führende Unternehmen der Entsorgungswirtschaft mit internationalen Aktivitäten, bietet DR. WORBS zusätzliches Know how, Sicherheit, logistische Vorteile und ein breites, stets aktuelles Technik-Wissen. Zum Nutzen der DR. WORBS Kunden.

Die neben der Herstellung und Verwertung von Löse- und Reinigungsmitteln im Juli 1993 zusätzlich aufgenommene Verwertung von Fotochemie stellt ein zweites völlig unabhängiges Standbein des Unternehmens dar.

Dieser Prospekt ist auf 100% chlorfrei gebleichtem Papier gedruckt.

DR. WORBS RECYCLING GMBH & CO.
HERSTELLUNG UND RECYCLING VON LÖSE- UND REINIGUNGSMITTELN, VERWERTUNG VON FOTOCHEMIE
GROTRIAN-STEINWEG-STRASSE 3 · D-38112 BRAUNSCHWEIG
TELEFON 0531/21031-0 FAX 0531/21031-41

RETHMANN Entsorgungs AG & Co.
Facts and figures

Founding of the family business: 1934

Company based in: Lünen

Supervisory Board:
Dr. Hermann Niehues (Chairman)
Reinhard Lohmann
Klemens Rethmann

Board of Directors:
Ludger Rethmann (Board Spokesman)
Egbert Tölle
Thomas Breitkopf

Organisation structure

RETHMANN Entsorgungs AG & Co.

RETHMANN GmbH & Co. Verwaltungs- und Beteiligungs KG	RETHMANN Recycling GmbH International	RETHMANN Entsorgungswirtschaft GmbH & Co. KG North-Eastern Region	RETHMANN Entsorgungswirtschaft GmbH & Co. KG Southern Region	RETHMANN Entsorgungswirtschaft GmbH & Co. KG Western Region
Based in Lünen	Based in Lünen	Based in Prützke	Based in Munich	Based in Bochum

International locations:

Europe				Asia	Australia/Oceania
■ Austria	■ France	■ Hungary	■ Switzerland	■ Japan	■ Australia
■ Belgium	■ Germany	■ Poland	■ The Netherlands	■ Taiwan	
■ Czech Republic	■ Great Britain	■ Slovak Republic	■ Turkey		

Key figures: Plants

■ Composting	31
■ Construction waste processing	3
■ File and data destruction	15
■ Glass recycling	8
■ Hazardous waste processing	16
■ Paper sorting	34
■ Photographic chemical recycling	14
■ Plastics recycling	5
■ Residual refuse processing, mechanical	3
■ Residual refuse processing, thermal	5
■ Sewage treatment	23
■ Sorting plants for packaging	16

Key figures: Recycling (tonnes/year)

■ Glass	1,051,000
■ Paper/Card/Cardboard	794,000
■ Organic/Green Waste	586,000
■ Construction/Mixed construction waste	515,000
■ Sewage slurry	350,000
■ Toxic waste from former industrial sites	326,000
■ Lightweight packaging	192,000
■ Wood	184,000
■ Scrap metals	150,000
■ Metal slag	119,000
■ Photographic chemicals	46,000
■ Electric/Electronic waste	43,000

Key figures: Production (tonnes/year)

■ RETERRA Compost and soil	410,000
■ RADDiBIN gypsum products	210,000
■ PLANOLEN and PLANOMID Plastic granules	50,000
■ ALUMIN Special chemicals for water management	25,000
■ RESOLVE Solvents (reclaimed materials and fresh chemicals)	16,000
■ Precious metals: Silver	135

Status: 2002

Contents

Four strategic business fields – a single goal: Integrated services

RETHMANN is one of the largest waste management companies with branches, subsidiaries and affiliates in twelve European countries and in Japan, Taiwan and Australia. Based on the tradition of a successful family business with decades of experience, RETHMANN always puts the needs of and benefits for its customers first.
For and with its customers, RETHMANN provides made-to-measure solutions, including complex supply and disposal concepts for municipalities or industry. But what is equally as important as our concepts is our expertise in the form of logistics systems and treatment technologies, which are supported by a network of plants providing blanket coverage.

Public Private Partnerships 6	Company Partnerships 12
Logistics and Plants 18	Recycling and Production 24

Four business fields to serve our customers: Public Private Partnerships and Company Partnerships are not just the names of business sectors – they are also important models for individual packages. It is the task of Logistics and Plants as well as Recycling and Production to ensure that the necessary infrastructure exists.

We accommodate your needs

What is it that makes our customers decide to work with RETHMANN? It is not just what needs to be done. Particularly in the field of waste and water management, that is very often already clearly defined – statutory regulations, production needs, technical requirements, spatial and financial limitations provide a rigid framework.

It is RETHMANN's uncompromising customer-oriented approach and the wide range of options we offer which convinces our customers. Whether it be municipal authorities with a Public Private Partnership or industrial players with a Company Partnership – our customers can always specify which tasks should be carried out by RETHMANN and which they choose to do themselves.

Customer-specific tasks – individual solutions

Just as varied as the initial assignments are the solutions which RETHMANN implements together with the customers. They range from partial solutions to responsibility for the whole supply and disposal system, in which cases, if the customer wishes, RETHMANN can plan, finance, construct and operate plants on the customer's behalf.

RETHMANN presents individual methodologies and implements efficient solutions.

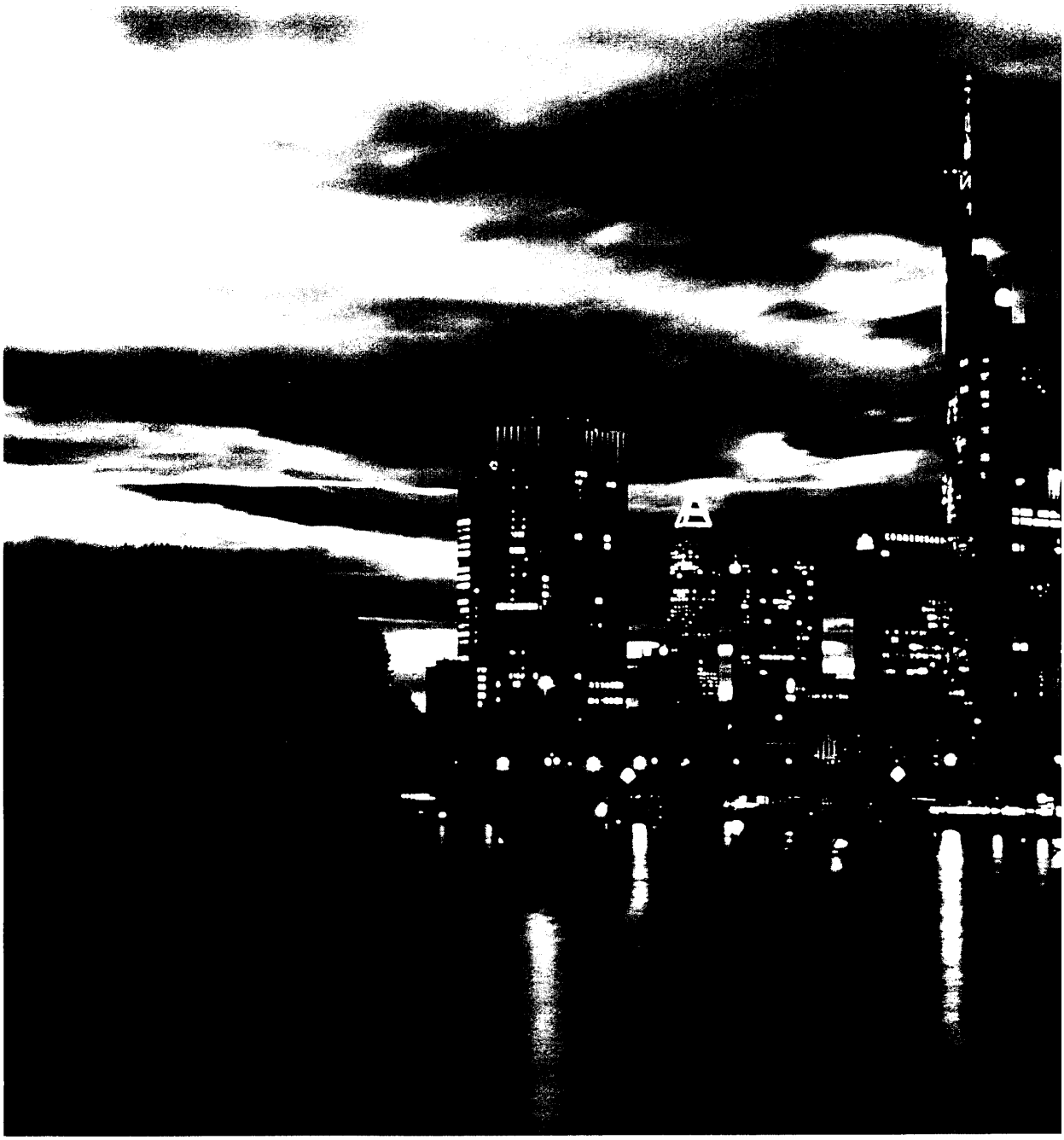
The basis for success

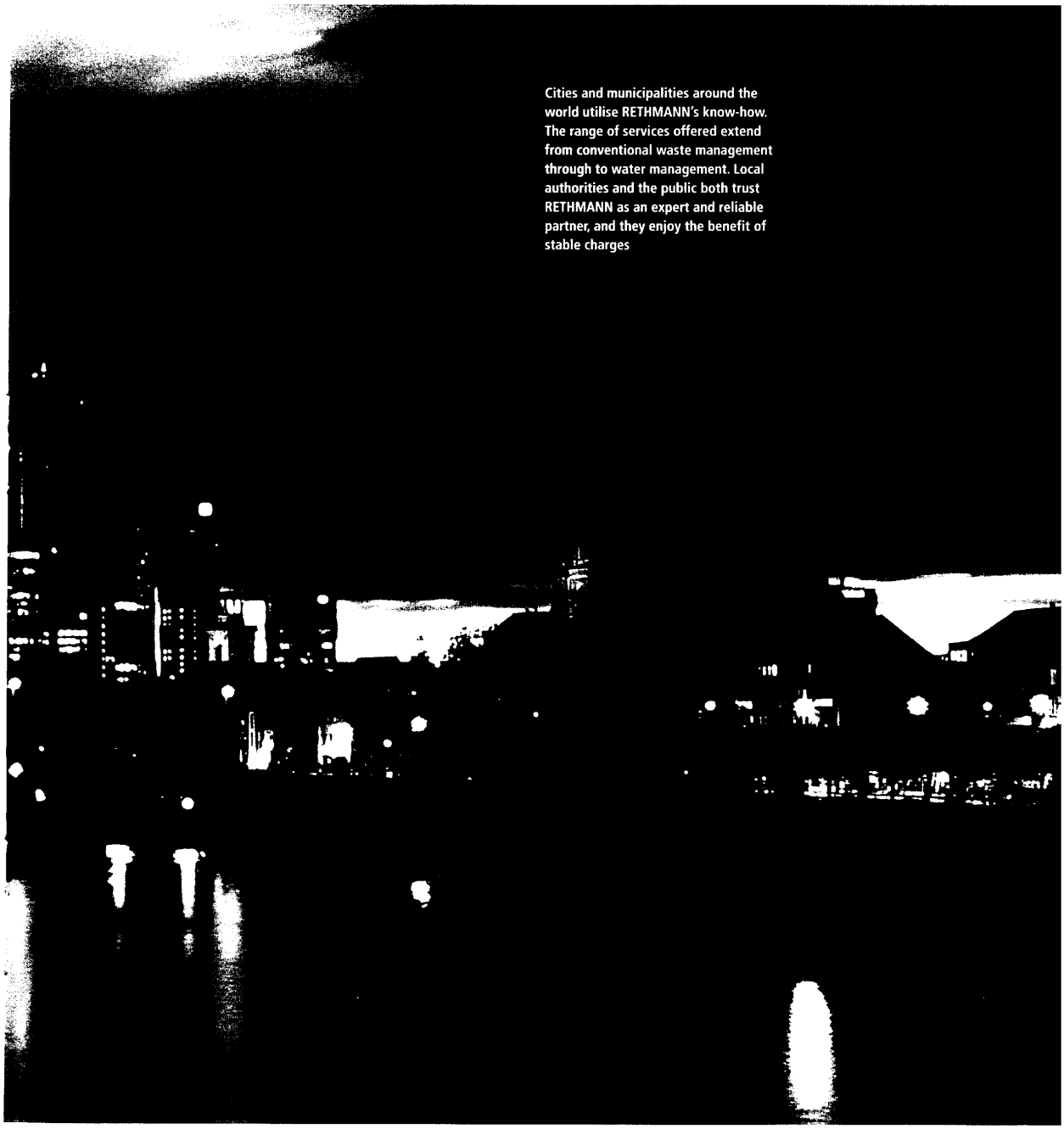
The development of individual models alone is not sufficient, expectations must also be met. To ensure that this is the case, RETHMANN's services are based on a broad range of expertise

- in the field of logistics
- in the planning, financing, construction and operation of plants
- in collection, sorting, pre-treatment and recycling plants
- in recycling and thermal processing plants
- in production plants in which high-quality products in line with market trends are created from secondary raw materials

This means that RETHMANN is able to organise waste streams and guarantee dependable supply and disposal at any time.

Public Private Partnerships.
The concept for continuity



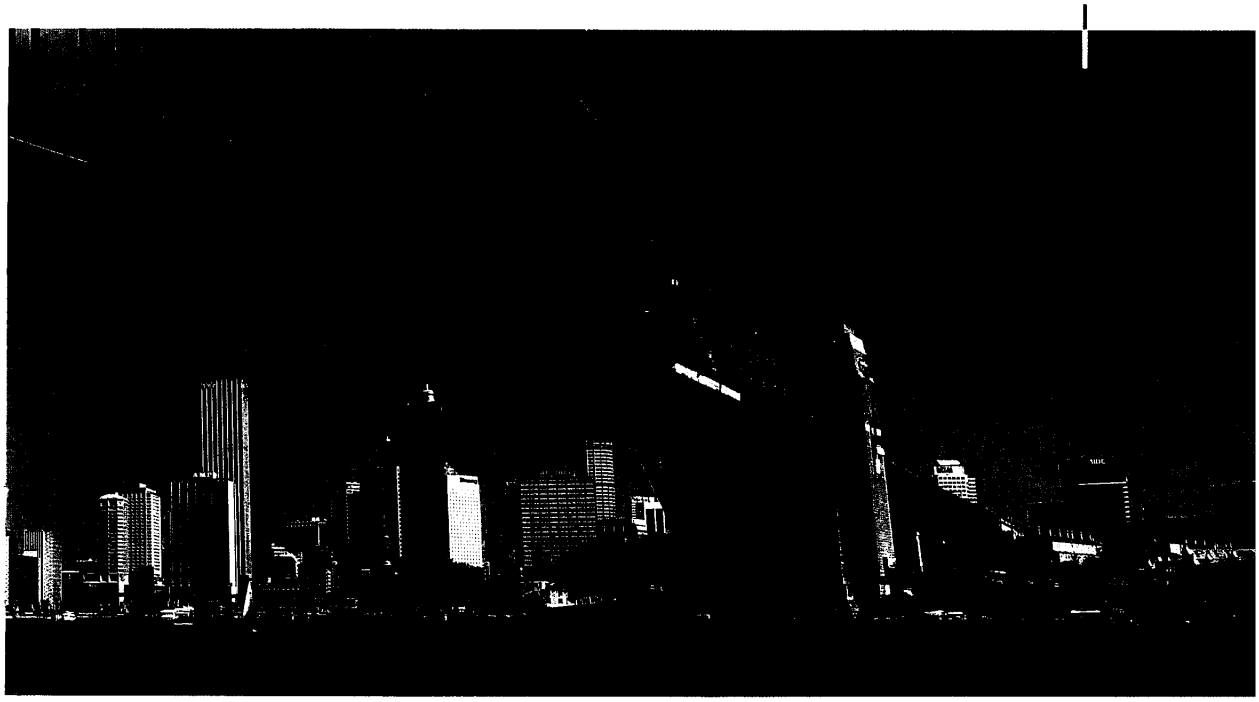


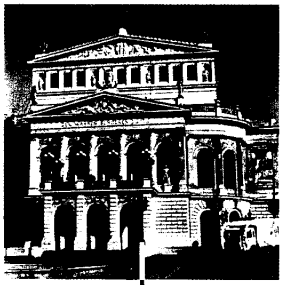
Cities and municipalities around the world utilise RETHMANN's know-how. The range of services offered extend from conventional waste management through to water management. Local authorities and the public both trust RETHMANN as an expert and reliable partner, and they enjoy the benefit of stable charges

Public Private Partnerships for waste management. Recognising opportunities. Utilising scope for action

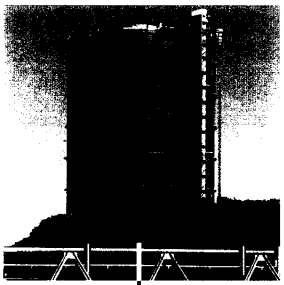
RETHMANN guarantees dependable waste management in the municipal sector for over 9.4 million people world-wide – mainly within the framework of integral Public Private Partnership solutions. With these solutions we are, together with the municipalities, developing and realising concepts which are secured for the future. Concepts which ensure the safe disposal of waste, guarantee stability of refuse charges and secure jobs. In addition, we are opening up new business sectors and thus ensuring long-term viability.

Sydney, Australia: Cities and municipalities the world over are utilising the advantages of a Public Private Partnership with RETHMANN because it enables pragmatic and cost-effective solutions. RETHMANN has been operating in Australia since 1982





Frankfurt am Main, Germany: RETHMANN offers a broad spectrum of services for around 1.4 million residents and numerous industrial, trade and commercial enterprises. Whether it be disposal of household or commercial waste, operation of waste incineration plants or cleaning of public spaces – the Public Private Partnership between the City of Frankfurt and RETHMANN offers many advantages: less burden on the city budget, stable fees and an innovative range of services

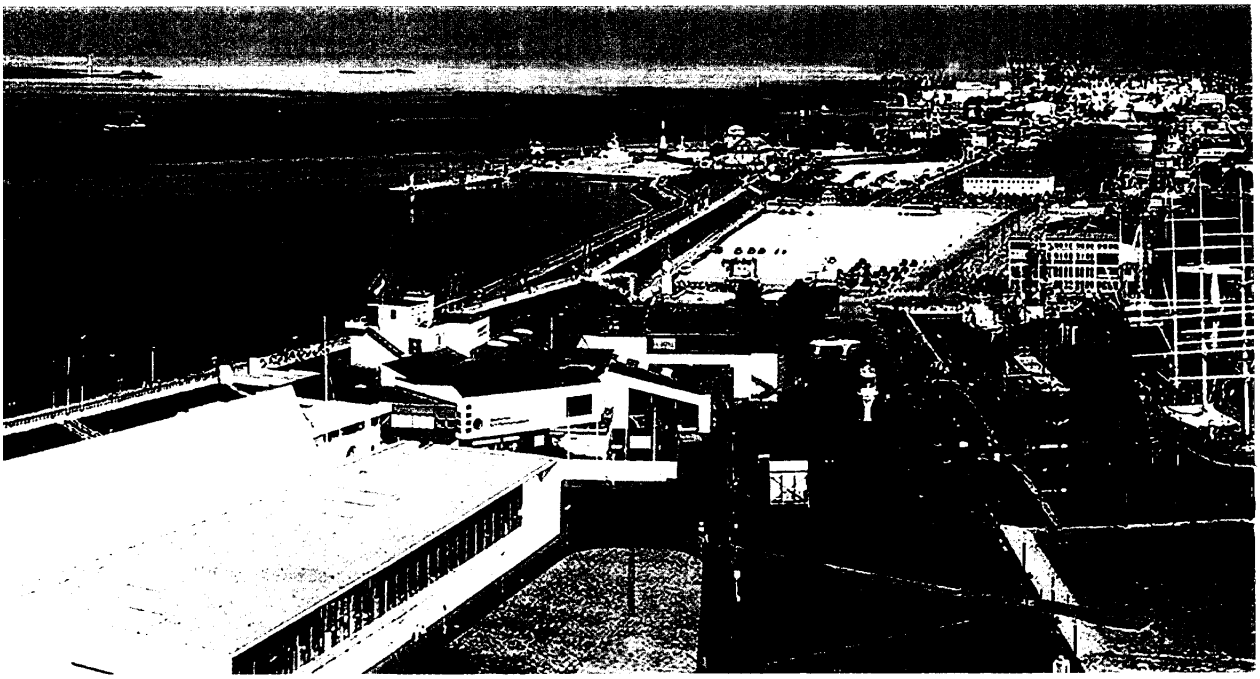


Oberhausen, Germany: 1.2 million residents of Oberhausen and the surrounding areas benefit from the Public Private Partnership solution with RETHMANN. Within the framework of this efficient co-operation a large number of municipal tasks are carried out cost-effectively, from operation of the waste incineration plant, disposal of all waste and sewer cleaning to the maintenance of public parks and gardens

Prague, Czech Republic: RETHMANN is also very active in the Czech Republic and has concluded Public Private Partnership solutions with municipalities there. In the capital city of Prague, RETHMANN has extended its commitment continually over the last few years – as a result of the increasing needs of the city and its people for safe and reliable waste management services

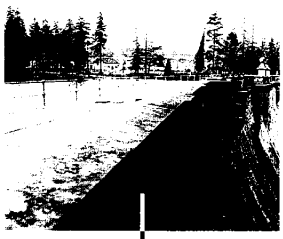
Warsaw, Poland: Many Polish cities have concluded Public Private Partnership solutions with RETHMANN because this enables municipal duties to be carried out with complete efficiency and minimal burden on the public purse. RETHMANN also has a strong commitment in Poland's capital, Warsaw

Public Private Partnerships for water management.
Optimising supply.
Guaranteeing disposal

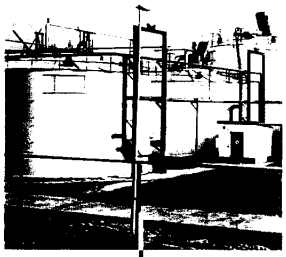


RETHMANN has been involved in municipal water management for over twenty years. The spectrum of services covers the planning, financing, construction, operation and maintenance of water and waste water canalisation networks including the sewage treatment plants, as well as collecting the fees.
In a Public Private Partnership solution with RETHMANN, municipalities have a powerful and competent partner whose expertise ensures that it is in a position to perform the tasks required economically and efficiently.

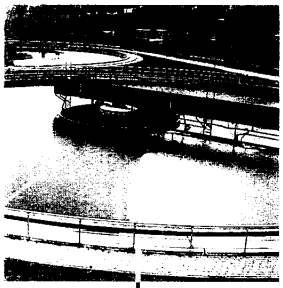
Bremerhaven, Germany: Since the beginning of 2002, the whole waste water management system for the city of Bremerhaven has been operated in form of a Public Private Partnership



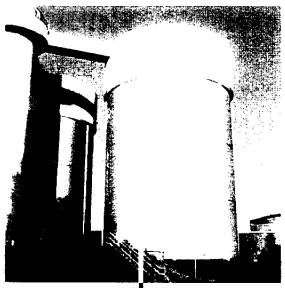
Gotha, Germany: Stadtwirtschaft Gotha GmbH is a company with over 60 years of experience. RETH ANN has been a shareholder in the company since 1999 and has been responsible since then for the entire water supply and sewage disposal system (inhabitant equivalent: 210,000), from operation of the water treatment and sewage treatment plants and the canalisation network to invoicing the final consumers



Genthin, Germany: RETHMANN took over operation of the sewage treatment plant for the city of Genthin in 1992. Here, more than 1.2 million m^3 of waste water is treated every year which includes not only standard household w ste but also industrial pollution. Besides the sewage treatment plant, RETHMANN also operates a biogas plant

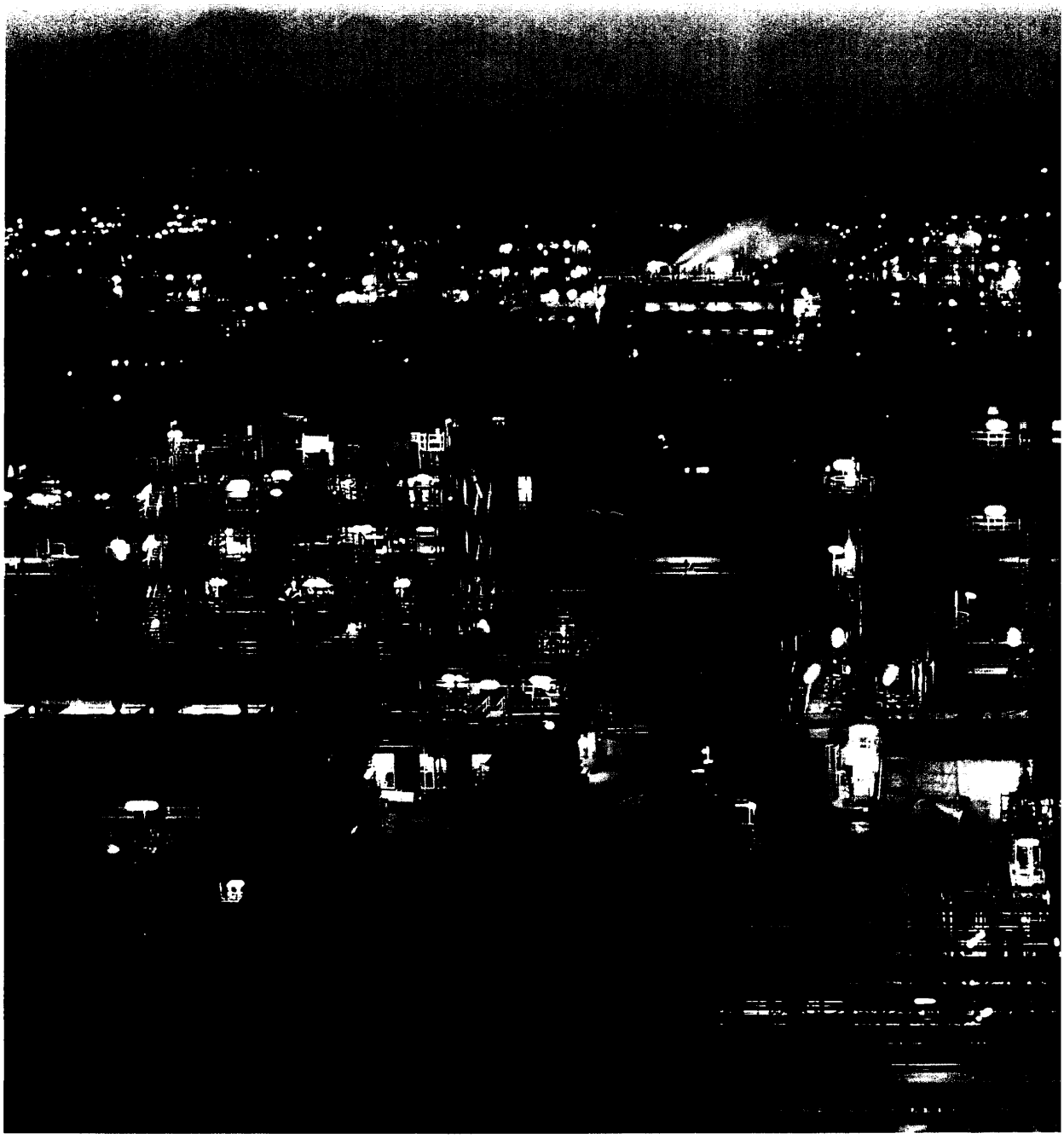


Wesendorf, Germany: The Wesendorf local authorities assigned operation of their sewage treatment plant to RETHMANN in 1982 – one of the first Public Private Partnerships. Since then, over 300,000 m^3 of sewage is treated here each year



Bremerhaven, Germany: In Bremerhaven, RETHMANN is responsible for the safe and economic operation of two sewage treatment plants (inhabitant equivalent: 640,000) and a waste water canalisation network with an overall length of 600 km through which up to 60,000 m^3 of waste water flo s daily

Company Partnerships.
The concept for economic efficiency



Waste management | 14
Water management | 16

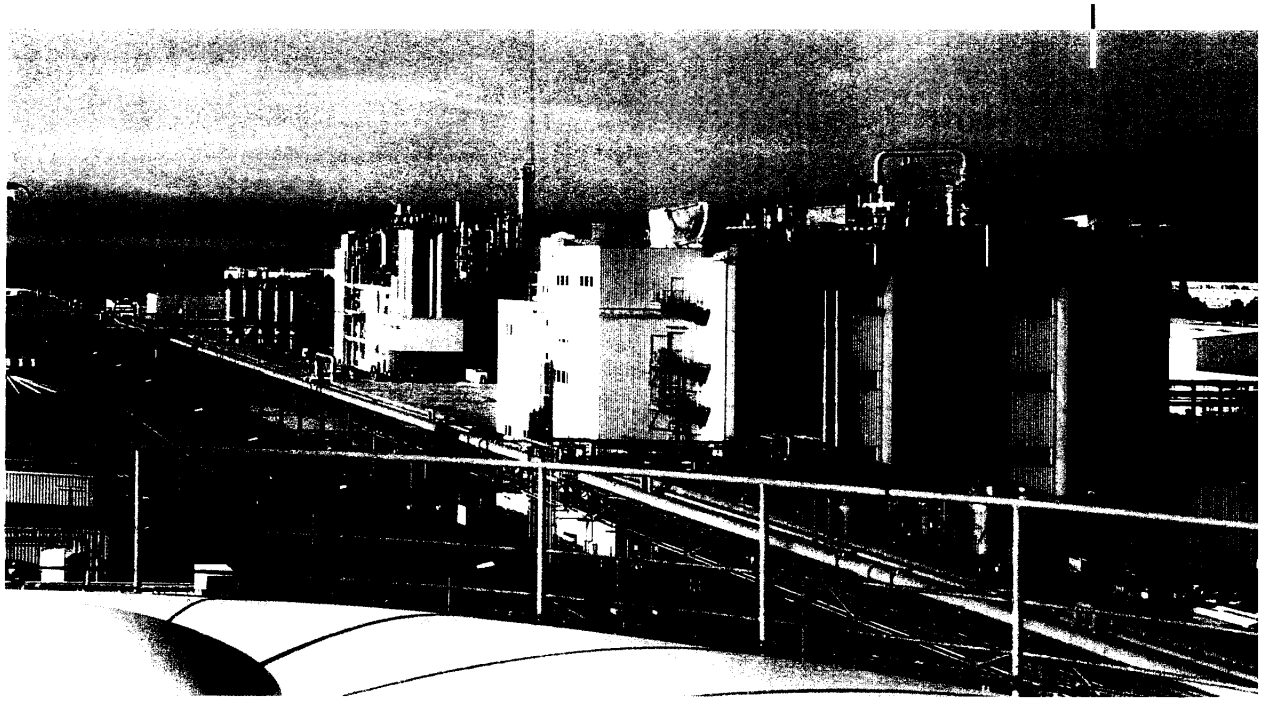
What makes the Company Partnership an interesting business model is, above all, the wide range of design options. For all its waste and water management solutions, RETHMANN provides a one-stop service – whether it be a waste management concept or a supply service; be it systematic service or plant operation – the partner can always decide for himself which tasks he wants to take on – everything else is taken care of by RETHMANN. This means our customers are free to concentrate on their core business

Company Partnership for waste management.

Ensuring productivity. Creating space for customers

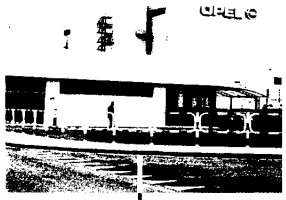
Industrial, trade and commercial enterprises are increasingly looking for integrated concepts for all aspects of waste management that take full account of all their operating processes. RETHMNANN offers appropriate, modern Company Partnership solutions which can firstly cover all the services for the customer on site – from complete waste management for the factory and integrated factory logistics to industrial cleaning. Secondly, we create comprehensive integrated services for waste management at branch locations and take-back systems for the recycling of packaging and products on behalf of trade and industry.

BASF: The Company Partnership with RETHMANN offers BASF many advantages at its locations in Ludwigshafen, Schwarzheide and Münster-Hiltrup. These include improved capacities for the company's own processing and treatment plants. A further priority for RETHMANN on site systematic services is waste management



Frankfurt am Main International Airport, Germany: The FSG (Flughafen Service Gesellschaft), a RETHMANN subsidiary, deals with all waste and recyclable material at the world's seventh largest, and Europe's second largest airport. The waste containers deployed are equipped with bar codes which enable automatic registration of amounts and allocations. The lids of containers on the apron are fitted with an automatic locking device to prevent them being blo n off

Karstadt Quelle: RETHMANN has taken over the take-back and disposal of large household appliances for the department store chain Karstadt Quelle. The service package covers everything from provision of logistic calculation systems and dismantling of the appliances to recycling of the secondary raw materials



Opel works, Poland: In the Opel works in Giliwice, RETHMANN has since 1999 been responsible for the complete management of all production waste, including hazardous waste. RETH ANN is responsible for logistics, runs the collection point on the works premises and provides all the waste disposal staff

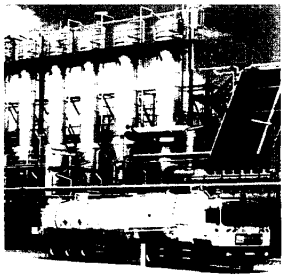
AGFA, Switzerland: RETHMANN Suisse collects, bundles and recycles used photographic materials for AGFA in Switzerland. The aim is to return the reclaimed PET to AGFA, who re-use it in the production of new film – like any form of recycling

Company Partnerships for water management. Improving quality. Reducing costs

Within the framework of Company Partnership solutions for water management, RETHMANN performs all tasks involved in the supply, processing and treatment of water in industrial locations. We have experience in industrial water management gathered over decades which enables us to plan, construct and operate integral solutions to cover every requirement.

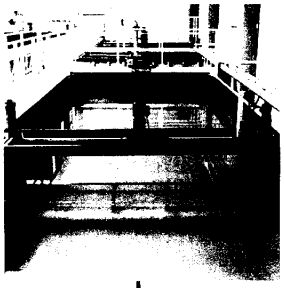
A particular focus of our project management is process development. Here, priority is given to consistently exploiting all cost-saving potentials and, if possible, returning all recyclable materials contained in the waste water to production.

Ruhr-Zink, Germany: On the factory premises of Ruhr-Zink, RETHMANN has set up a modern waste water treatment plant which conforms to the highest standards. RETHMANN has taken over the full management of the project – from conception and financing to commissioning of the system – and has been responsible since then for the efficient running of the plant using its own staff



BREWA, Germany: BREWA, a subsidiary of RETHMANN and the Bremer Woll-Kämmerei, performs all environmental services for the wool processing company Bremer Woll-Kämmerei. In addition, it also operates an extremely modern evaporation and incineration plant where waste water from the production process is treated. In order to ensure the plant is used to full capacity, RETHMANN also treats waste water for third parties

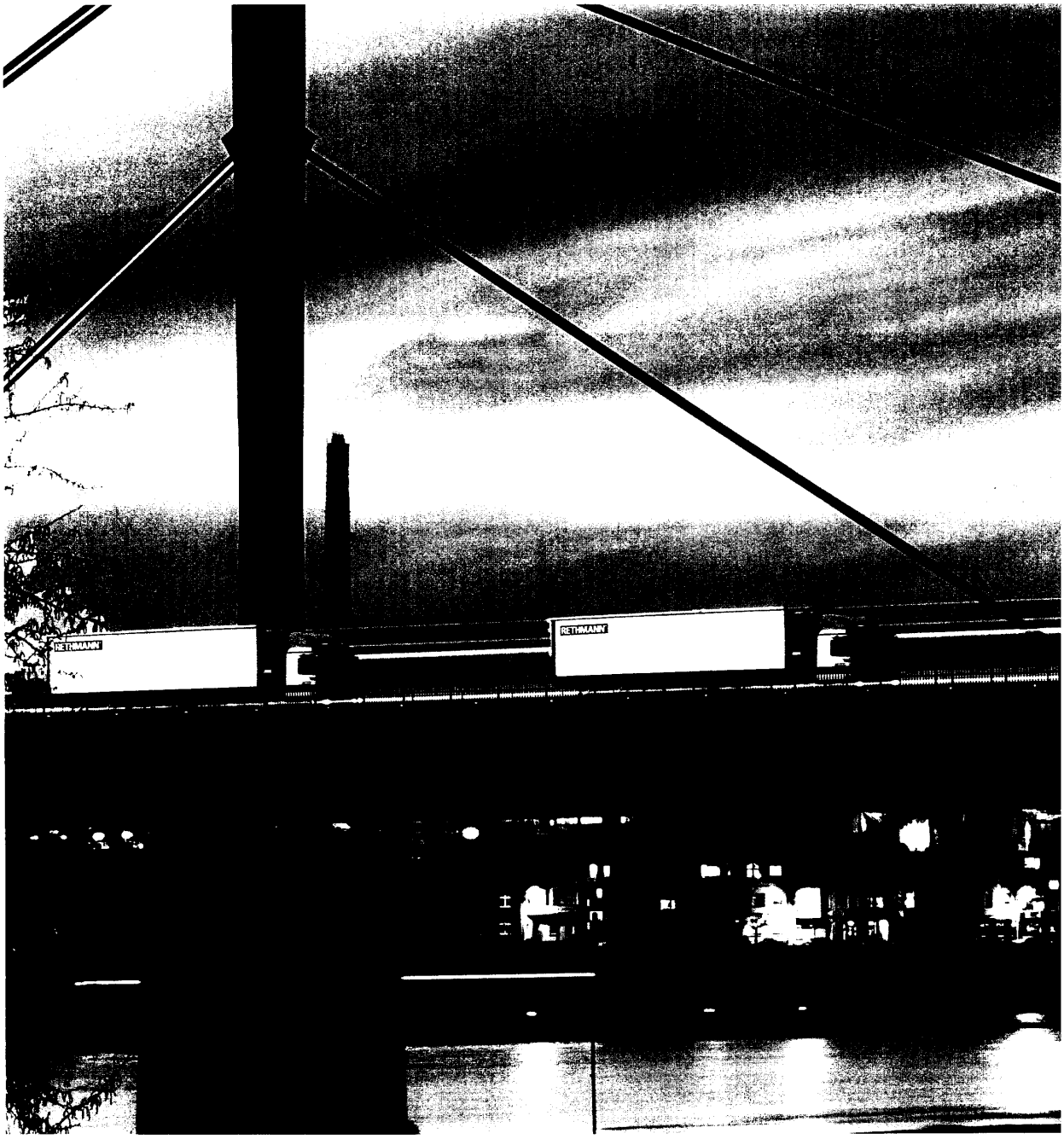
Volkswagen, Germany: RETHMANN has been waste management partner of the Volkswagen Nutzfahrzeuge factory in Hanover for over ten years, dealing with the treatment of production waste water from various areas of production. The four waste water treatment plants on the factory premises treat up to 1,500 m^3 of waste water per month

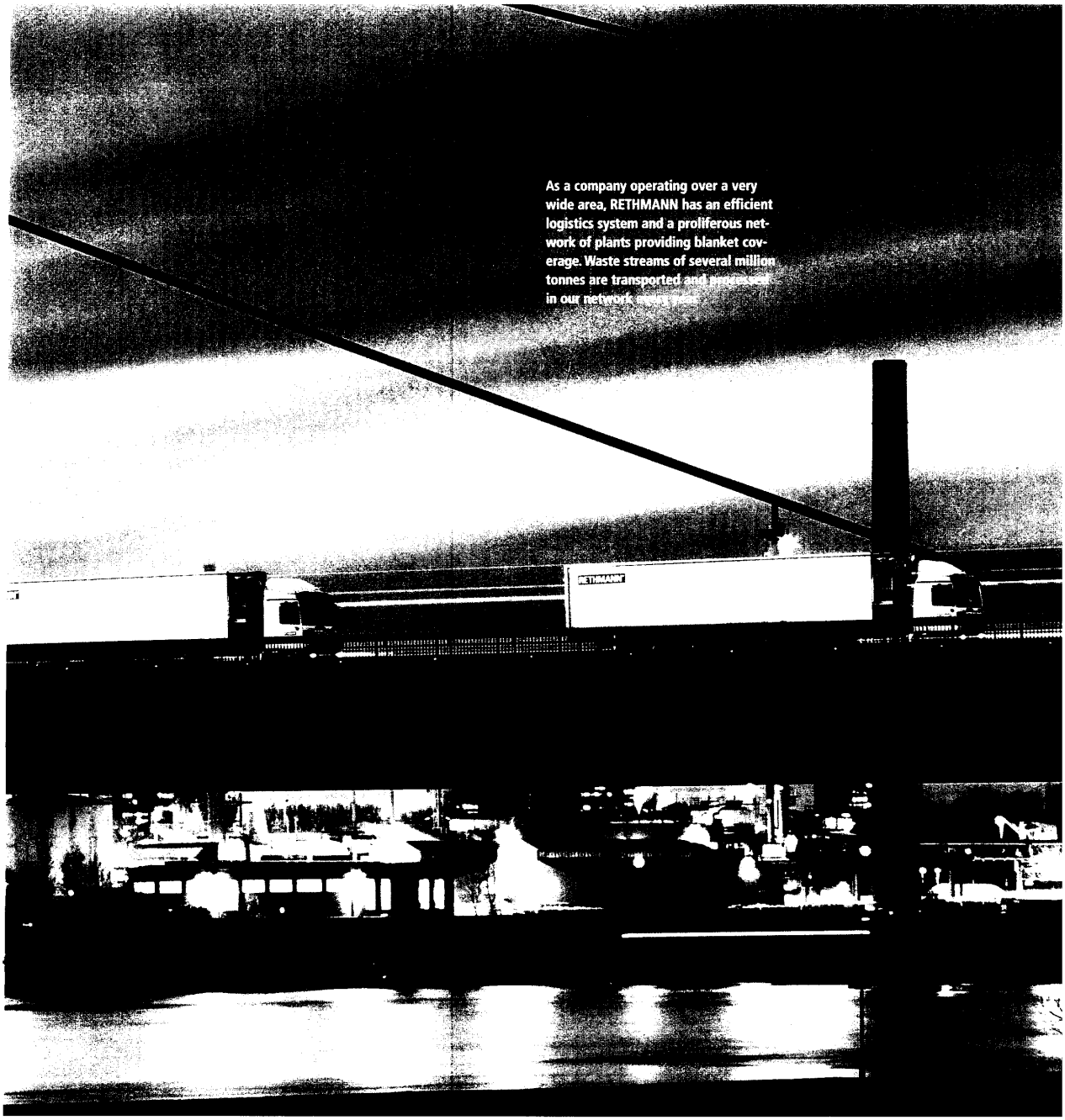


EuroCoin, Germany: The manufacture of blank coins produces very complex waste water. In order to contain and treat this, EuroCoin has concluded a Company Partnership with RETHMANN. RETHMANN has developed the waste water treatment technologies on site further and optimised the processes to such an extent that the reclaimed secondary raw materials can be re-used in the production process

Ruhr Oel, Germany: For the oil refining company Ruhr Oel RETHMANN designed a chemico-physical processing plant in which the oil sludge produced during the refining process is treated. The separated oil flows back into the refining process; the waste water produced is then treated in line with statutory requirements

Logistics and plants.
The network for integrated services





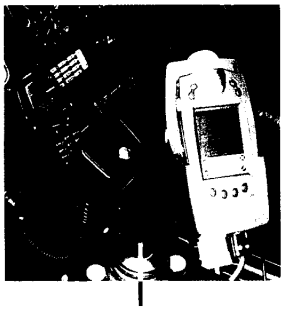
As a company operating over a very wide area, RETHMANN has an efficient logistics system and a proliferous network of plants providing blanket coverage. Waste streams of several million tonnes are transported and processed in our network every year.

RETHMANN logistics.
Disposing of waste. Bundling material flows

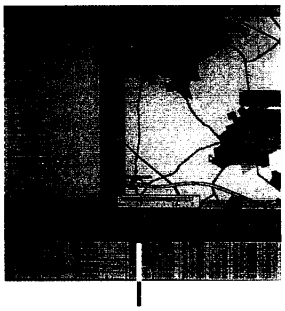
Logistics for RETHMANN means: State of the art technology and constant monitoring of all processes ensure that every waste material is reliably collected from the place where it is no longer needed and taken to where someone is expecting it. That's why our logistics network includes a large number of special vehicles. In addition, RETHMANN is constantly developing and testing new technical procedures to optimise logistics. Examples of these are on-board and identification systems, GPS-controlled route planning and the side loading technology in disposal vehicles, in the design of which RETHMANN played a major role.

Logistics: By using modern technology and highly-motivated staff, RETHMANN can react flexibly every single day to new events and customer requirements, and bundle materials into economically effective material streams to create raw materials from waste, and products from raw materials

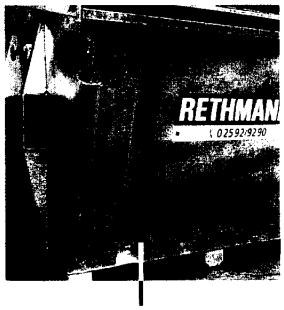
Cost-effectiveness: For RETHMANN, the cost-effectiveness of the logistics system is a major consideration because this is the only way that services can be provided at conditions acceptable on the market. The one-man operation of side-loading and front-loading vehicles also combines cost-effectiveness with greater safety. Moreover, modern vehicle design makes the heavy work easier, thus making jobs more attractive



Innovation: RETHMANN is already investing in the waste disposal and service models of tomorrow and working with the modern technology required: electronic on-board systems in the disposal vehicle enable radio transmission of order information

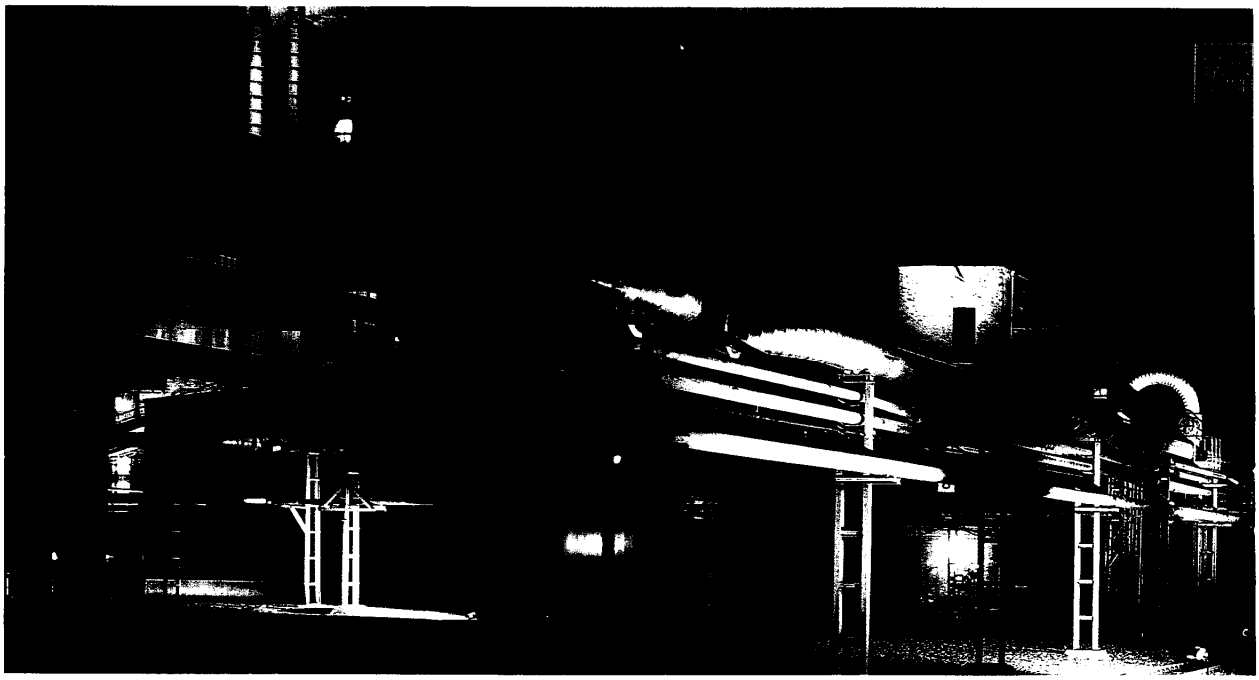


Flexibility: Whether containers are emptied at regular intervals or only when a particular level is reached – every task is reliably completed. For this purpose, the RETHMANN fleet of vehicles is GPS-controlled via satellite and radio. The control centre knows the location of every vehicle at all times and can react quickly and flexibly to new tasks with computer-controlled equipment



Precision: The demands customers make of modern waste disposal systems vary enormously: RETHMANN services and technology fulfil them. For example the identification systems: chips attached to the containers enable automatic recognition of containers by electronic transmission of the container data

RETHMANN plants.
Developing concepts. Realising processes



RETHMANN has been a forerunner in the development of new processing techniques for waste materials and the recovery of raw materials. But RETHMANN also designs, builds and operates the appropriate plants. We offer a complete solution for every waste product or recyclable fraction – whether it falls under the category hazardous waste, organic waste, municipal waste or water management. Our network of plants is not just a technological forerunner but is also a leader in terms of number and variety. A particular focus at the moment is increasing capacities for residual waste treatment in order to be able to intelligently recycle larger and larger amounts.

Plant network: RETHMANN maintains a network of plants which guarantees both a wide range of services and blanket coverage – the processing of large amounts of waste is guaranteed by extensive branching. At the Lünen site on the other hand, there is a concentration of plants which enable special recycling and production processes

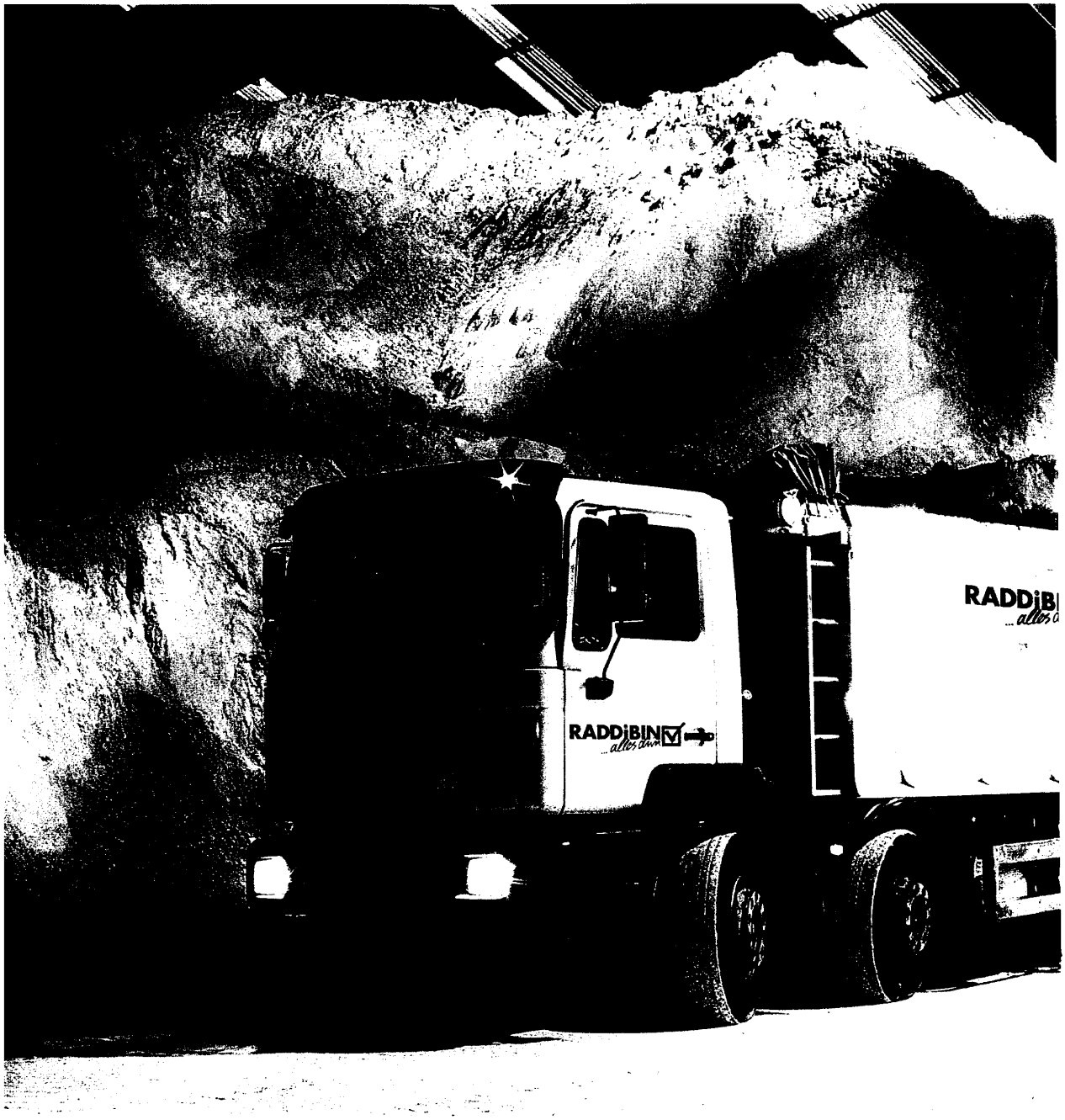
Integrity: RETHMANN has decades of experience with integral plant solutions and provides all the services in-house: planning, financing, construction, operation – regardless of whether the plant is designed as part of the international RETHMANN plant network or for the individual customer

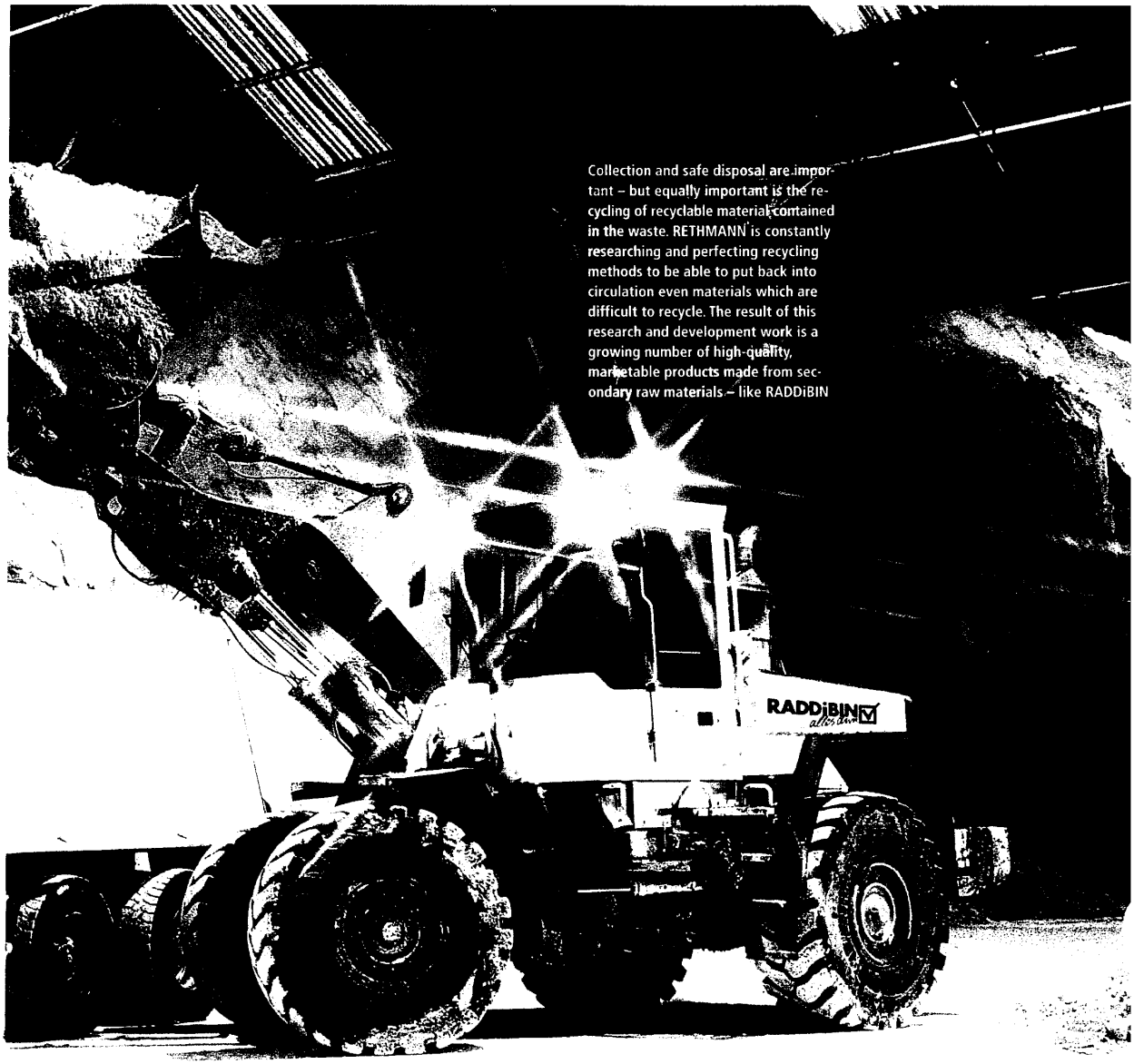
Process technology: Almost all waste contains recyclable material, but often there are no economical or suitable processes for recovering them. For many years RETHMANN has been researching, developing and realising concepts to separate more and more materials from residual waste, to be able to put them back into economic circulation

Internationality: RETHMANN is represented in fifteen nations by its own plants and range of services. In Taiwan RETHMANN operates a PET recycling plant which is the most modern of its kind outside Europe

Future-oriented: RETHMANN has for years been investing in mechanical-biological treatment plants and waste incineration plants. This expansion of the pre-treatment capacities for residual waste means that the strain on landfills will be relieved and waste utilised more usefully

Recycling and production.
The economics of ecology





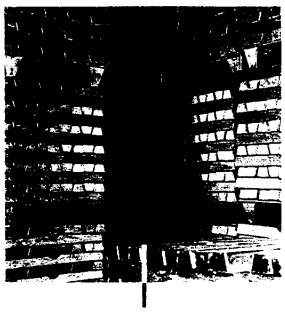
Collection and safe disposal are important – but equally important is the recycling of recyclable material contained in the waste. RETHMANN is constantly researching and perfecting recycling methods to be able to put back into circulation even materials which are difficult to recycle. The result of this research and development work is a growing number of high-quality, marketable products made from secondary raw materials – like RADDiBIN

RETHMANN recycling.
Processing waste.
Supplying secondary raw materials

The German Recycling and Waste Management Law gives priority to the recycling of waste. In order to fulfil this requirement, RETHMANN maintains a comprehensive network of recycling plants in which several million tonnes of recyclable material is recovered from waste every year.

The procedures used are as varied as the waste itself, but the goal is always the same: to recover properly separated raw materials of a precisely defined quality – prerequisites for their return in the form of new high-quality products. Besides producing secondary raw materials of a quality comparable to the primary ones, their certain availability plays the most important role in production. Our disposal and treatment capacities guarantee a constant supply of raw materials.

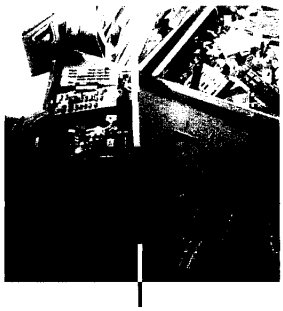
Quality: Paper recycling is an example of effective recycling: the recycling ratio is almost 100 percent. Paper is however not suitable for recycling indefinitely; for this reason an increasingly important issue is the quality of the paper for recycling and how well it is sorted. RETHMANN has concentrated on sorting on the basis of very high qualities and has itself designed and built sorting plants to achieve this



Value: RETHMANN recovers over 135,000 kg of silver in Europe every year from used photographic chemicals and film materials. This valuable metal is delivered to specialist firms for further refinement and is then used, for instance, in the electrical and electronics industry or for the production of jewellery

Sorting techniques: Mixed waste and recyclable materials must be sorted before recycling – this increases the recycling ratio and enables better commercial exploitation. In order to separate the individual fractions RETHMANN uses fully-automatic sorting plants

Quantity: In glass recycling a closed cycle can be achieved because glass can be recycled practically indefinitely. Thus, glass represents RETHMANN's largest recycling fraction at over one million tonnes per year. The sorted and treated glass pieces are the most important raw material in the production of glass containers and form up to 60 % of these products



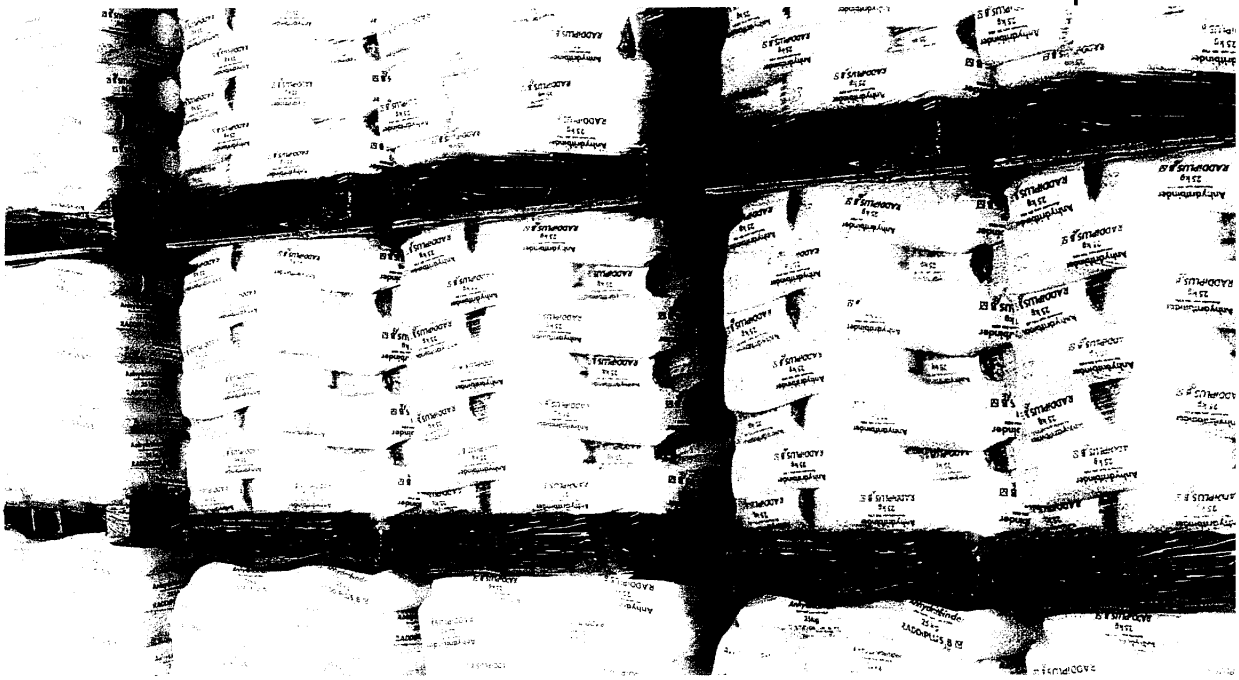
Product recycling: Recycling is not only package recycling – intensified by the German Recycling and Waste Management Law, product recycling is also becoming increasingly important.
RETH Al dismantles worn-out products in its own dismantling centres and separates the individual material fractions for further recycling

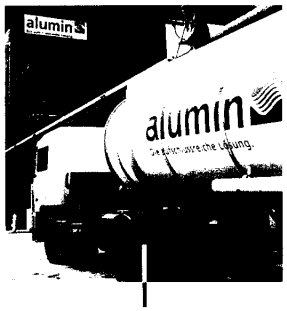
RETHMANN production.
Developing brand names. Opening up markets

In order that – as is the aim of a recycling system – a growing number of products are manufactured from secondary raw materials, there are some prerequisites. There can be no compromise of the quality of the raw materials or the products, because the products must be competitive on the market.

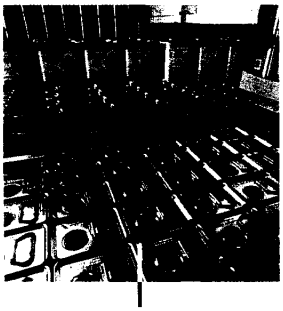
RETHMANN already manufactures a range of products from secondary raw materials – such as plastics, construction materials, chemicals and composts. They are in no way inferior to products made from primary raw materials and are even superior to them in some ways. But the mere manufacture of the products is not enough – RETHMANN also takes an active role in marketing the products.

RADDiBIN: RETHMANN sells a broad range of additives and binding agents under the brand name RADDiBIN. They are all based on gypsum made from secondary raw materials. The quality of RADDiBIN products is comparable in every respect with products made from primary raw materials – this is ably demonstrated by the fact that the products are used in medicine and food products

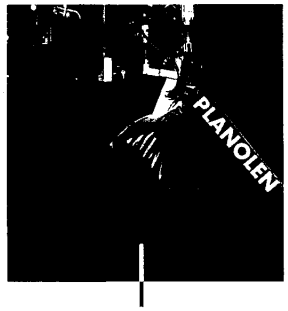




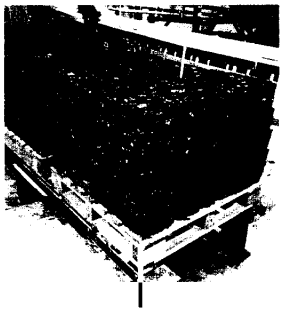
ALUMIN: This is sodium aluminate which RETHMANN obtains during the processing of contaminated salt solution. The products are of such high quality that they easily fulfil all the relevant quality standards. The main uses of ALUMIN are in the treatment of waste water and the processing of drinking water



RESOLVE: Used solvents are distilled and conditioned, the buyers of the reclaimed materials – which are in no way inferior to comparable products made from primary raw materials – are on the one hand industrial players and on the other hand the retailers, for which RETHMANN provides the solvents and cleaning materials in small batches



PLANOLEN/PLANOMID: RETHMANN sells polyethylene and polyamide from plastics waste under the brand names PLANOLEN and PLANOMID. Superior sorting techniques and high quality criteria on the entry side yield products able to fulfil all quality requirements. Areas of application range from the production of plastic foil to highly robust parts for the automotive industry



RETERRA: Reterra is the brand name for RETHMANN composts and similar products such as substrates and mulch. Uses for these quality products made from organic waste and containing a high level of nutrients are in horticulture and agriculture, farming, commercial horticulture and in the houses and gardens of private households

Our goals and our future.
The network for waste stream management

In the future our company will continue to focus on waste stream issues to ensure that today's waste is tomorrow's raw materials. It is our task to ensure that small amounts become large ones

From waste to product.
We are opening up the raw material sources of the future

The bundling of waste streams is essential to the cost-effectiveness of the whole service chain – from disposal and recycling to marketing. The larger the amounts to be treated, the more effectively we can work. That's why we ensure by professional waste stream management that appropriately large amounts are collected.

Consistent waste stream management

RETHMANN is, with ever-increasing regularity, offering process-integrated and waste stream-specific concepts for waste, dangerous waste and recyclable materials. This ensures that in the future there will be recycling techniques for more and more fractions which are technically possible and economically viable.

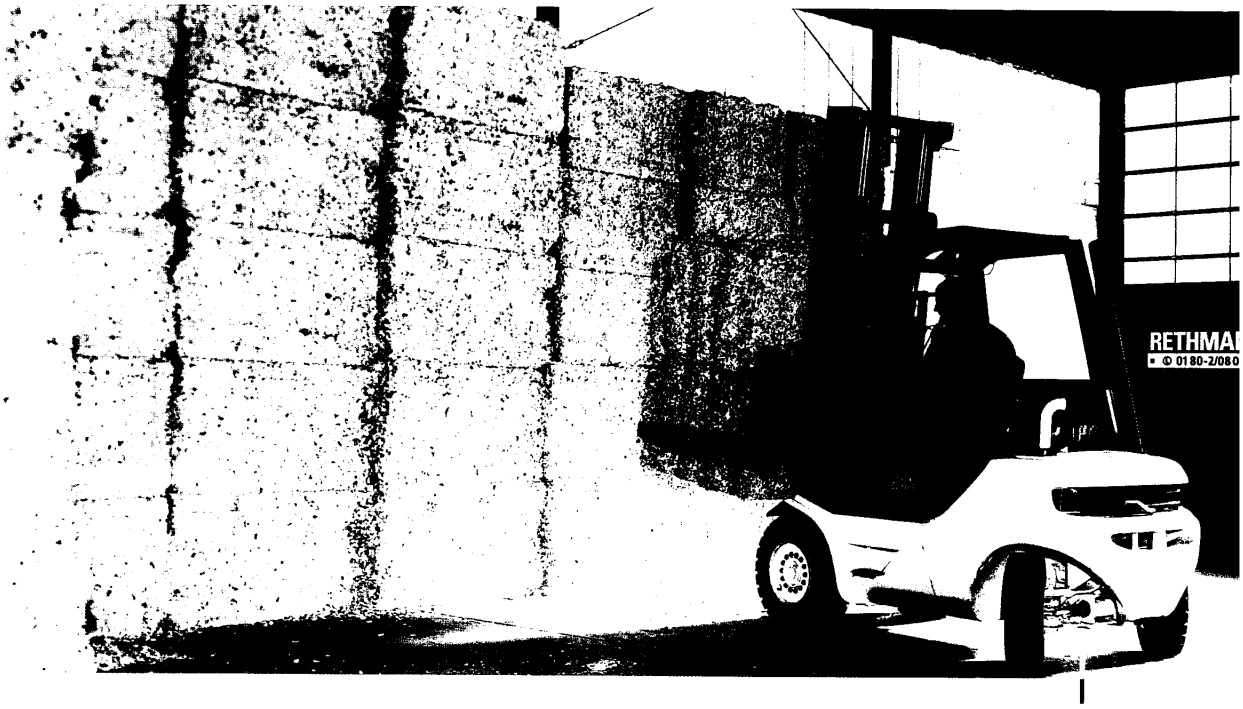
Smooth service chain

It is our goal to consistently cover the whole service chain for more and more materials – from logistics, sorting, pre-treatment and processing right down to marketing. RETHMANN has a logistics and plant network which provides blanket coverage and offers security and a full range of options. Thus we have at our disposal a professional range of instruments to enable us to act quickly and reliably.

Our central tasks today and tomorrow:

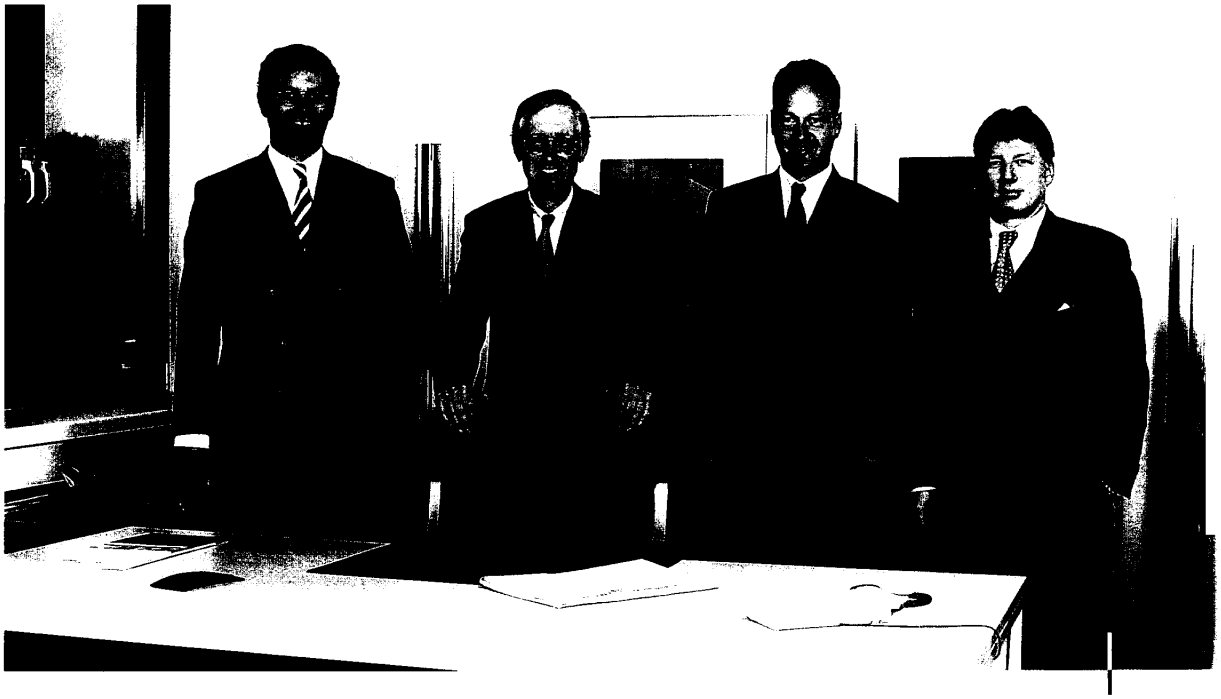
- organise, co-ordinate and optimise supply and disposal
- bundle waste streams, process and recycle materials
- plan, finance, construct and operate plants
- develop, manufacture and market products
- assume responsibility and ensure security of supply and disposal

The decision as to which services or service packages should be used to implement our concepts is made individually for each case.
Thus, each of our customers has at their disposal our full expertise, all our experience and all the components of our service chain.



Goal: Closed material cycles are the priority at RETHMANN – now and in the future

Our approach to reaching the target is systematic. The philosophy of our work



From the left: Ludger Rethmann (Board Spokesman of RETHMANN Entsorgungs AG & Co.), Dr. Hermann Niehues (Chairman of the Board of RETHMANN AG & Co. and Supervisory Board Chairman of RETHMANN Entsorgungs AG & Co.), Thomas Breitkopf and Egbert Tölle (Members of the Board of Directors of RETHMANN Entsorgungs AG & Co.)

Anyone who decides to go their own way need clearly-defined goals and firm principles. RETHMANN thinks and acts according to simple, clear guidelines:

1.| We orient ourselves uncompromisingly according to the needs and wishes of our customers.

2.| We accept the challenges of the market and we make this responsibility our own. We set much store by constant discussion with all involved parties, from the municipal authorities, trade and industry, the craft industry, commerce, science, technology and politics.

3.| Tradition and modern business sense are the two main pillars of our business culture.

4.| We put long-term security and environmental protection above short-term cost issues.

5.| We think in terms of closed material cycles and complete product life-cycles. The preservation of resources through the development of new recycling and marketing methods for basic materials and products is our top priority.

6.| We ensure the competence of our staff through initial training courses and continuous further education.

7.| We always know more than one way to achieve a goal and are there-fore able to carefully weigh up solution methodologies against one another.

Publication details

Publisher:
RETHMANN Entsorgungs AG & Co.
Head Office
Brunnenstraße 138
D-44536 Lünen
Germany
Tel.: +49(0)23 06/106-0
Fax: +49(0)23 06/106-100
www.rethmann.com
info@rethmann.com

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FUP AG Werbeagentur, Essen, Germany

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RETHMANN®

RETHMANN Entsorgungs AG & Co.
Head Office
Brunnenstraße 138
D-44536 Lünen, Germany
Tel.: +49(0)23 06/106-0
Fax: +49(0)23 06/106-100

RETHMANN GmbH & Co.
Verwaltungs- und Beteiligungs KG
Brunnenstraße 138
D-44536 Lünen, Germany
Tel.: +49(0)23 06/106-0
Fax: +49(0)23 06/106-100

RETHMANN Recycling GmbH
International
Lahnstraße 31
D-12055 Berlin, Germany
Tel.: +49(0)30/6 82 82-612
Fax: +49(0)30/6 82 82-619

RETHMANN Entsorgungswirtschaft
GmbH & Co. KG:

- North-Eastern Region
  Regional Office Prützke
  Pernitzer Straße
  D-14797 Prützke, Germany
  Tel.: +49(0)3 38 35/59-000
  Fax: +49(0)3 38 35/59-220
- Southern Region
  Regional Office Munich
  Pasteurstraße 22
  D-80999 Munich, Germany
  Tel.: +49(0)89/8 92 17-0
  Fax: +49(0)89/8 92 17-104
- Western Region
  Regional Office Bochum
  Dieselstraße 3
  D-44805 Bochum, Germany
  Tel.: +49(0)2 34/89 21-0
  Fax: +49(0)2 34/89 21 -111

www.rethmann.com
info@rethmann.com


AHKW
NEUNKIRCHEN


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Geschichte des Werkes

FEUERUNGSTEIL

- Werksgelände ist das Gelände der alten Grube König
- erste Verbrennungslinie war von 1970 bis Juli 1999 in Betrieb
- zweite Verbrennungslinie war von 1977 bis April 2001 in Betrieb
- dritte Verbrennungslinie ging im November 1999 in Betrieb
- vierte Verbrennungslinie geht im Oktober 2001 in Betrieb

RAUCHGASREINIGUNG

- in den siebzigern: nur Elektrofilter für Entstaubung
- 1986: Nasswäsche
- 1996: kombiniertes Rauchgasreinigungssystem (gemäss der 17. BImSchV)

AHKW NEUNKIRCHEN

Technische Daten

ANLAGENDURCHSATZ: 120.000 T/A
IN ZWEI VERBRENNUNGSLINIEN

VERBRENNUNGSLINIE III
(DAMPFKESSEL)

DURCHSATZ	8,5 T/H
DAMPFPRODUKTION	32,5 T/H
DAMPFTEMPERATUR	400°C
DAMPFDRUCK	40 BAR
WÄRMELEISTUNG	20,5 MW

VERBRENNUNGSLINIE IV
(DAMPFKESSEL)

DURCHSATZ	8,5 T/H
DAMPFPRODUKTION	32,5 T/H
DAMPFTEMPERATUR	400°C
DAMPFDRUCK	40 BAR
WÄRMELEISTUNG	20,5 MW

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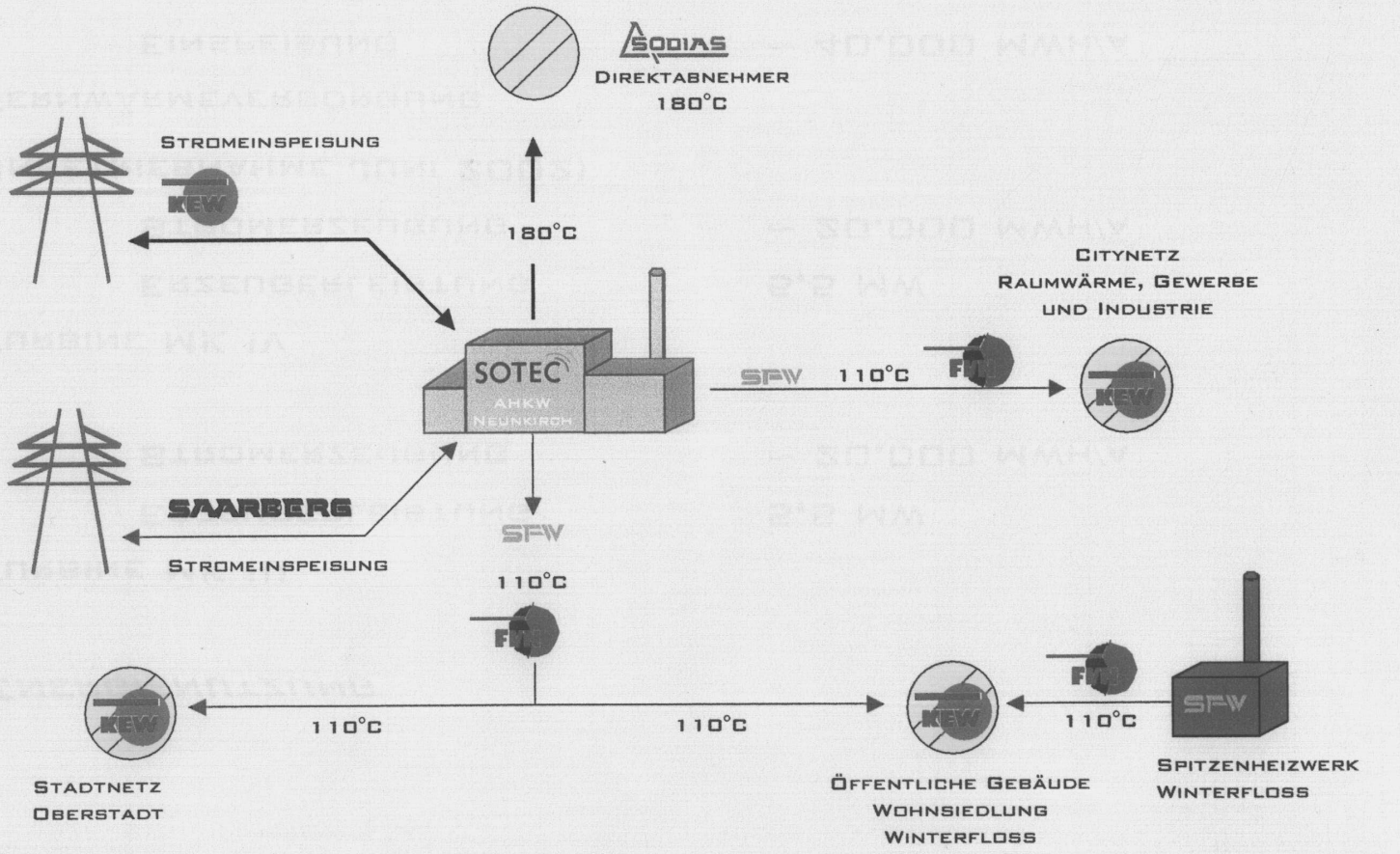
... Technische Daten

Energienutzung

Turbine MK III	
Erzeugerleistung	5,5 MW
Stromerzeugung	~ 20.000 MWh/a
Turbine MK IV	
Erzeugerleistung	5,5 MW
Stromerzeugung	~ 20.000 MWh/a
(Inbetriebnahme Juni 2002)	
Fernwärmeversorgung	
Einspeisung	~ 40.000 MWh/a
Versorgung der Stadt Neunkirchen	

AHKW NEUNKIRCHEN

Strom- und Fernwärmenetz



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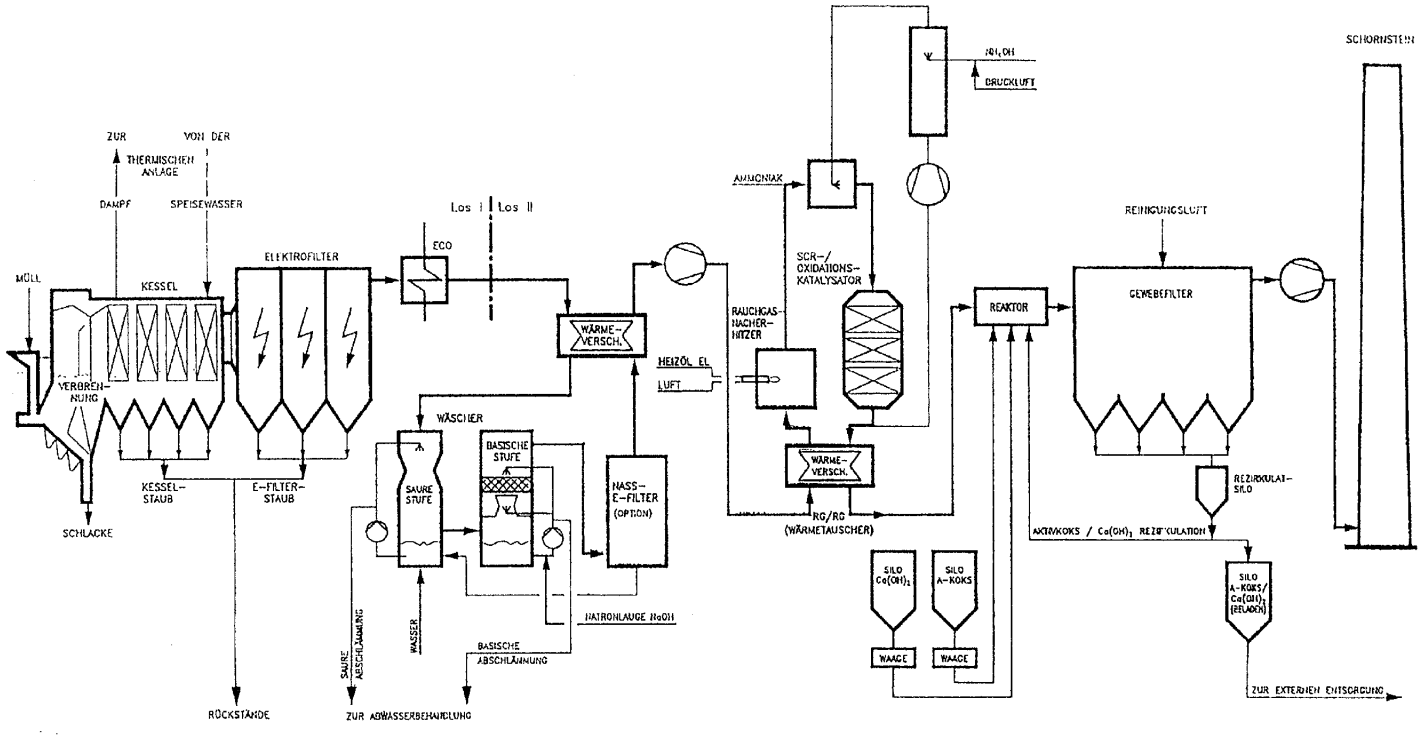
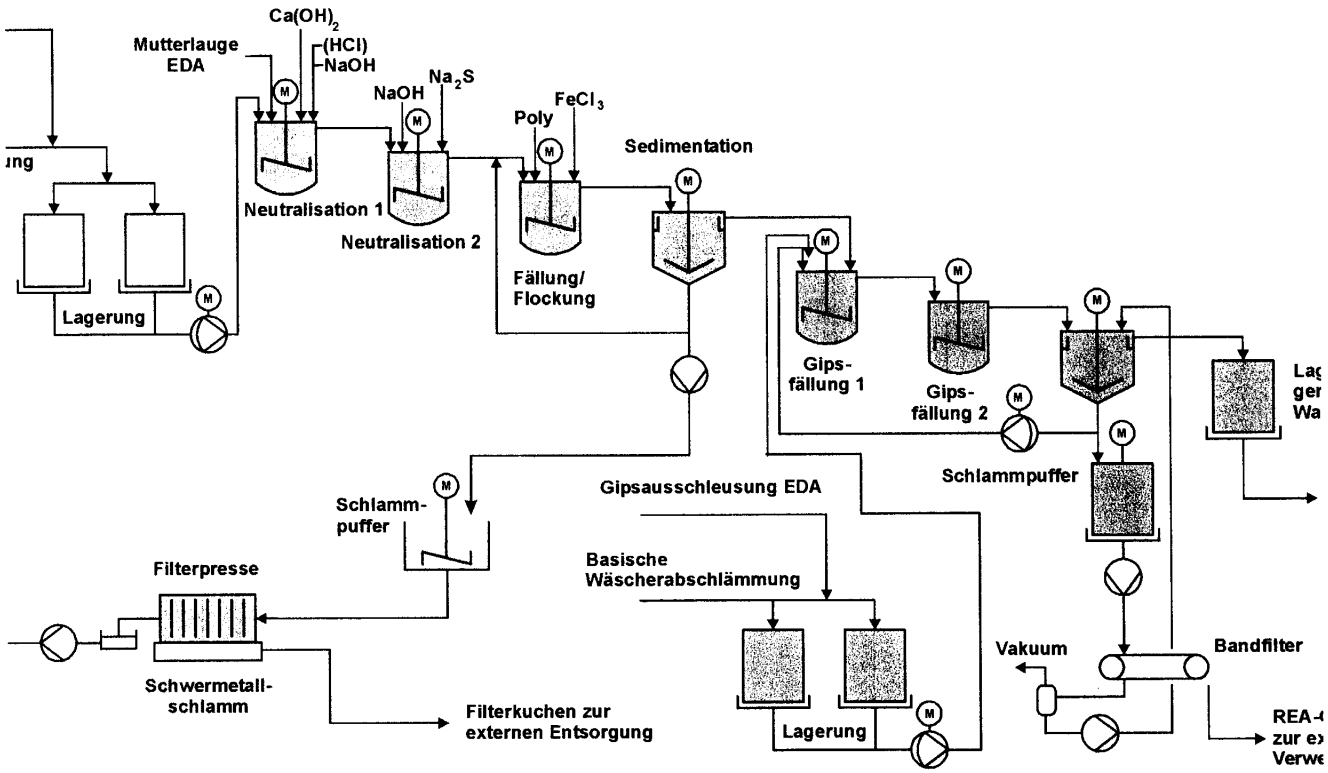
NEUNKIRCHEN

Fließbild Abfallheizkraftwerk



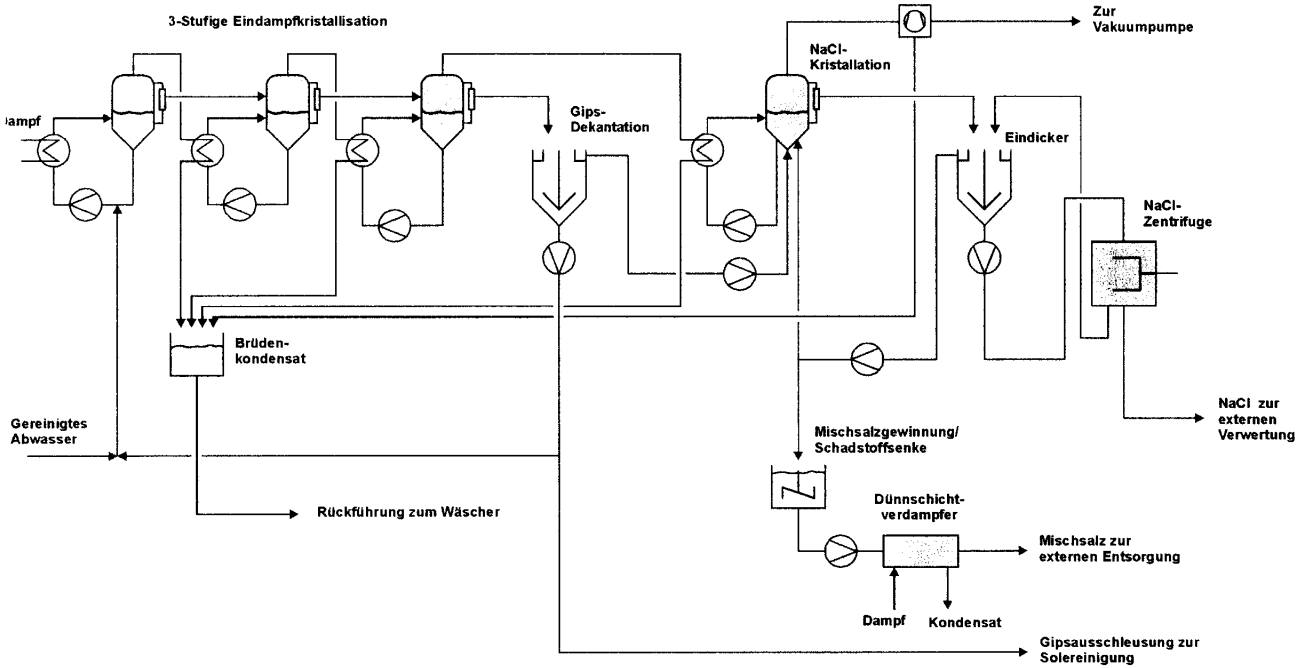
AHKW NEUNKIRCHEN

Prozesswasserbehandlung



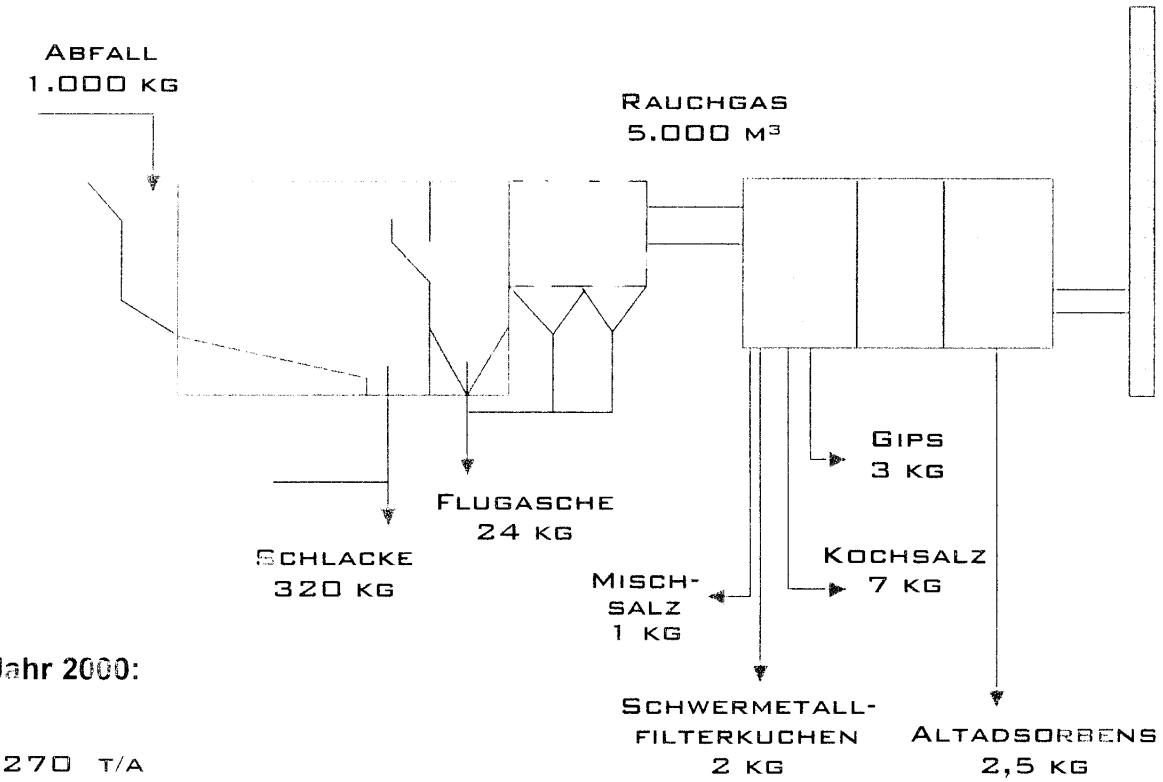
AHKW NEUNKIRCHEN

Eindampfanlage



AHKW NEUNKIRCHEN

Reststoffe

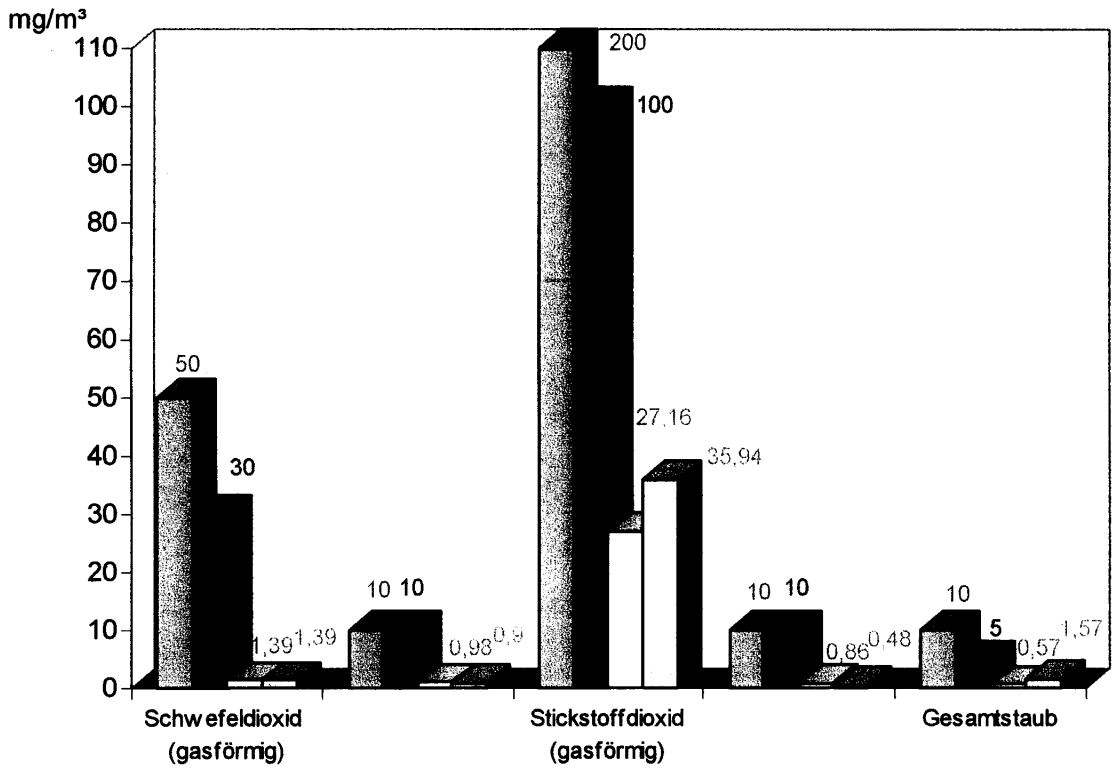


Reststoffe im Jahr 2000:

SCHLACKE:	37.270	T/A
FLUGASCHE:	2.835	T/A
ALTADSORBENS:	300	T/A
GIPS:	336	T/A
SM-FILTERKUCHEN:	184	T/A
KOCHSALZ:	781	T/A
MISCHSALZ:		

AHKW NEUNKIRCHEN

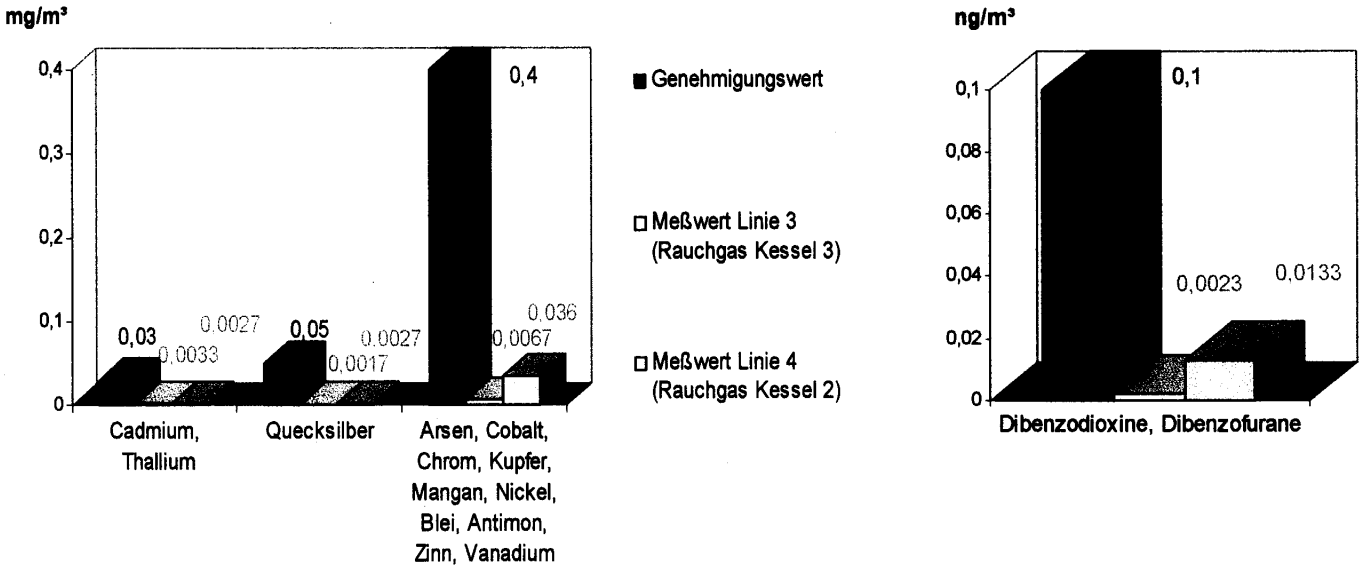
Kontinuierliche Emissionsmessung 2000



□ Grenzwert 17. BImSchV ■ Genehmigungswert □ Meßwert Linie 3 (Rauchgas Kessel 3) □ Meßwert Linie 4 (Rauchgas Kessel 2)

AHKW NEUNKIRCHEN

Diskontinuierliche Emissionsmessung 2000



AHKW NEUNKIRCHEN

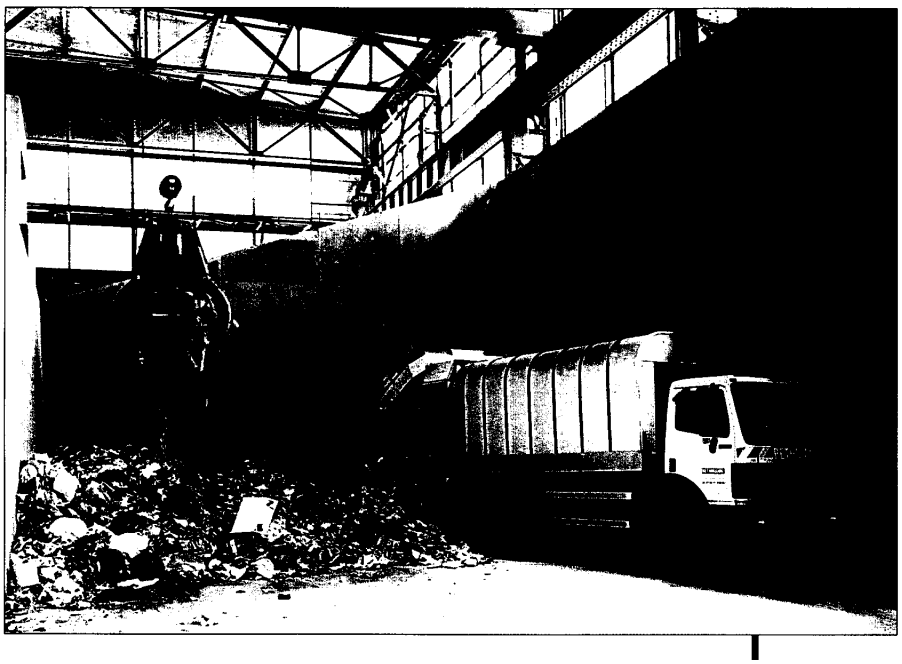
RECYCLINGPARK
Brandenburg

Abfallbehandlung in der Region Mittelmark

Rohstoffe, zum Wegwerfen zu schade

KUNDENINFORMATION RESTABFALLAUFBEREITUNG

Rohmüll



Anlieferung von Hausmüll

Gesetzliche Rahmenbedingungen, spezifische Bedingungen des Landes Brandenburg

Grundlage der Brandenburger Abfallwirtschaftspolitik ist die Zielhierarchie des Kreislaufwirtschaftsgesetzes (Krw-/AbfG), nach der in erster Linie Abfälle zu vermeiden, in zweiter Linie zu verwerten und erst als letzte Möglichkeit zu beseitigen sind. Mit anderen Worten: Vor einer thermischen Behandlung müssen alle Möglichkeiten einer stofflich bzw. energetischen Verwertung ausgeschöpft sein.

Zweitens spielt für die Genehmigung alternativer nicht-thermischer Behandlungsverfahren die Technische Anleitung Siedlungsabfall (TASi) eine wichtige Rolle. Es ist anzunehmen, daß Ausnahmen von bestimmten Grenzwerten und Zuordnungskriterien der TASi gem. Ziffer 2.4 TASi möglich werden und somit zu erwarten ist, daß mechanische Aufbereitungsanlagen (mit / ohne biologischer Komponente) zulässig sind.

Das Abfallwirtschaftsprogramm des Landes Brandenburg unterstützt entschieden diese Sichtweise. Hiernach formuliert der **Brandenburger Weg der Restabfallbehandlung**, daß jede Abfallfraktion mit der für sie geeigneten Methode zu behandeln ist.

Hausmüllsammlung

Die **Kombination aus mechanisch-biologischer Behandlung und einer thermischen Behandlung der heizwertreichen Abfallanteile** stellt hier den ökologisch und ökonomisch sinnvollsten Weg dar.
Mit dem Merkblatt zur Umsetzung der TASi des Landesumweltamtes Brandenburg vom 16.02.1998 werden speziell für die brandenburger Bedingungen Parameter für den Zeitraum vom 01.06.1999 bis 31.05.2005 als Erfüllung der TASI Kriterien beschrieben.

Für die Kompostierung der Bioabfälle aus der Bio-Tonne und für die Option einer biologischen Behandlung des Restmülls (Rotte) favorisieren wir unterschiedliche Behandlungsverfahren, z.B. das Mietenverfahren.

Die Übergangsfristenregelung der TASi in den nächsten 6 Jahren, die begrenzte Restlaufzeit der für Restabfall andienungspflichtigen Deponien - Fohrde, Brück, Treuenbrietzen - sowie zu erwartenende Modifizierungen bestimmter Ablagerungskriterien erfordern ein flexibles Stufenkonzept, das im folgenden anschaulich beschrieben wird.

Brennstoffpellets

Logistische Optimierung der Stoffströme

Das Recyclingzentrum Stahlwerk Brandenburg eignet sich auch aufgrund alternativer Transportwege, wie z.B. Schiene, Wasser, für die Anlieferung der Abfälle sowie den Weitertransport neuer Produkte. Durch diese Anbindung gewinnt der RPB überregional an Bedeutung. So können z.B. problemlos Abfallmengen aus benachbarten Kommunen, wie z.B. aus der Stadt Potsdam oder aus dem Landkreis Potsdam-Mittelmark aufbereitet werden. Im Jahre 2005 ist mit 100.000 t Abfall in der Region jährlich zu rechnen.

Bahntransport

Das Stahl- und Walzwerk Brandenburg hat jährlich ca. 3 Mio. t Güter bezogen bzw. versandt. Der gesamte Werksverkehr erfolgte auf dem Schienennetz, welches entsprechend gut ausgebaut war.

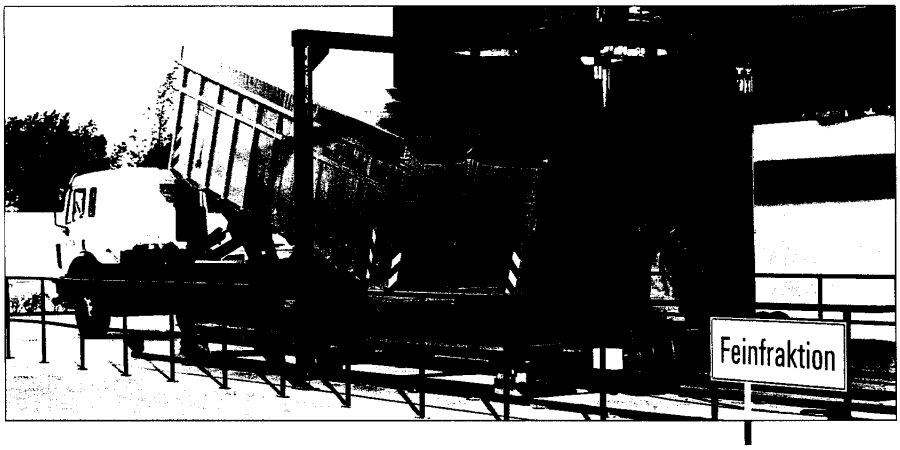
Im Rahmen der Umstrukturierung in einen modernen Industrie- und Gewerbepark wurde das vorhandene Schienensystem erneuert, modernisiert und den Ansprüchen der späteren Nutzer angepaßt.

Ein Verladegleis stellt die südliche Grenze des für das Recyclingzentrum erworbenen Grundstücks dar.

Die Übernahme von Materialien kann sowohl in Form von Schüttgütern als auch durch Umladung von Containern erfolgen. Mittels LKW werden die Stoffe dann in den jeweiligen Annahmebereich gebracht.

Schiffstransport

Die Stadt Brandenburg errichtet derzeit einen modernen, leistungsfähigen Binnenhafen in unmittelbarer Nähe zur Stahlwerkshalle (Entfernung 100 - 300 m).



Anlieferung von Gewerbeabfall

Für überregionale Transporteinheiten mit Waggons bzw. LKW mit Hänger von 20 bis 25 t Ladung, bietet sich eine zentral gelegene Umladestation an. Die Entsorgungsunternehmen liefern die unbehandelten Abfälle zu dieser Umladestation, in der die Abfälle über eine Kippkante in ein überregionales Transportsystem via Stahlwerk Brandenburg verbracht werden.

Die Umschlagstation sowie 1 LKW-Transport, im Falle der LKW-Präferenz durch den Landkreis Potsdam-Mittelmark, kann durch den Abfallwirtschaftsbetrieb Belzig betrieben werden. Wesentliche Investitionen sind nicht notwendig.

Der An- bzw. Abtransport von Materialien und Produkten von oder zum Hafen würde innerbetrieblich per LKW erfolgen.

Ist das Konzept für diese Region tauglich?

Auf jeden Fall.

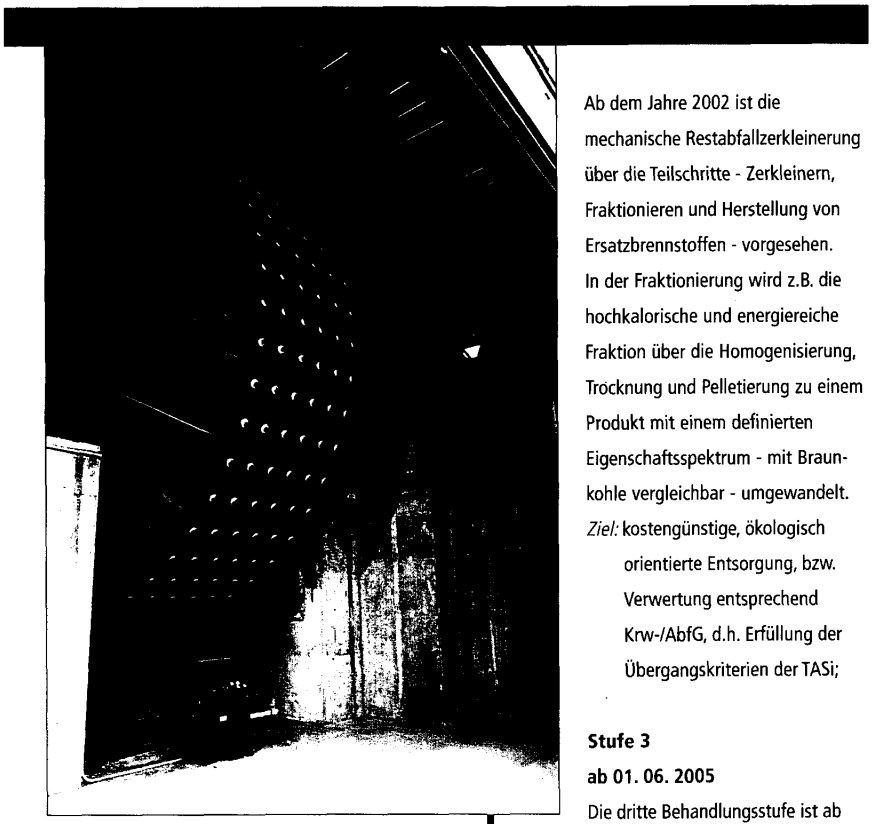
Welche regionalen Vorteile bietet das Konzept des Recyclingparks?

- das Konzept dominiert mit der ökologischen Komponente, d.h.es werden über 80% des Restabfalls in den Wirtschaftskreislauf zurückgeführt;
- die bürgerfreundlichen Abfallgebühren verbleiben in der Region, d.h. Investitionen und Arbeitsplätze werden gesichert bzw. geschaffen;
- in Konsequenz dessen werden Primärenergieträger eingespart;
- die zentrale Lage für den Landkreis Potsdam-Mittelmark;
- die optimale überregionale Anbindung an angrenzende Kommunen;
- RPB ist ein ortsansässiges Unternehmen;
- RPB verfügt über umfangreiche Erfahrungen in der Behandlung von Abfall;
- RPB ist ein Beispiel für den brandenburger Weg in der Abfallwirtschaft.

RECYCLINGPARK
Brandenburg

RECYCLINGPARK
Brandenburg an der Havel GmbH
Peter Bleifuß
August-Sonntag-Straße 3
14770 Brandenburg

Tel: 03 381 - 323 700
Fax: 03 381 - 323 711



Kugelmühle

Die Umsetzung soll in 3 Abschnitten erfolgen:

Stufe 1
01. 06. 1999 bis zur Verfüllung der Deponien (etwa 2005)

Ab 1. Juni 1999 erfolgt bis zur Verfüllung der Deponien des Stadt- und Landkreises etwa im Jahre 2005 eine mechanische Vorbehandlung (Zerkleinerung) des Restmülls. Ziel dieses Verfahrens ist die Erhöhung der Einbaudichte des zu deponierenden Materials. Mit Hilfe einer Kugelmühle wird das Materialgemisch zerkleinert und homogenisiert. Eisen und Nichteisenmetalle werden abgetrennt und gelangen über die Verhüttung erneut in den Produktionskreislauf.

Stufe 2
nach Verfüllung der Deponien ab 2005

Ab dem Jahre 2002 ist die mechanische Restabfallzerkleinerung über die Teilschritte - Zerkleinern, Fraktionieren und Herstellung von Ersatzbrennstoffen - vorgesehen. In der Fraktionierung wird z.B. die hochkalorische und energiereiche Fraktion über die Homogenisierung, Trocknung und Pelletierung zu einem Produkt mit einem definierten Eigenschaftsspektrum - mit Braunkohle vergleichbar - umgewandelt.

Ziel: kostengünstige, ökologisch orientierte Entsorgung, bzw. Verwertung entsprechend Krw-/AbfG, d.h. Erfüllung der Übergangskriterien der TASi;

Stufe 3
ab 01. 06. 2005

Die dritte Behandlungsstufe ist ab dem 1. Juni 2005 vorgesehen. Der Restmüll wird mechanisch auf bereitet. Die entstandenen Ersatzbrennstoffe aus der hochkalorischen Fraktion werden vermarktet, die niedrigkalorische Fraktion kann thermisch verwertet werden.

Ziel: Erfüllung der Kriterien der TASi, eventuell Gleichwertigkeitsnachweis kostengünstige Entsorgungs- und Verwertungsverfahrenskombination Verwertung entsprechend Krw-/AbfG.