OCEESA Profile

Overseas Chinese Environmental Engineers & Scientists Association (OCEESA) is a non-profit organization incorporated in the State of Ohio in 1980, it holds tax exempt status under sec 501(c)(3) of IRS Code. OCEESA is devoted to promote academic and professional excellence and networking in environmental science. OCEESA members work and reside throughout the USA, Canada and in many countries of Asia. In 1988, OCEESA became a chapter of the Chinese Institute of Engineers/USA to affiliate with other Chinese American professional organizations.

OCEESA Officers & Board of Directors

President                    Dr. Wei-Yin Chen  陳惟寅  University of Mississippi
Vice President             Dr. Wei-Ping Pan  潘偉平  Western Kentucky University
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Director (2009)

Dr. Huey-Min Hwang  黃惠民  Jackson State University
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Membership: Regular member $25 per year, Student member $15 per year, Corporate member $100 per year.

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OCEESA World Wide Web Homepage:  http://www.oceesa.org
OCEESA MEMBER NEWS (October 2009)

1. We would like to cordially welcome the following new OCEESA members who have recently joined OCEESA:

Dr. Yan Ding 丁剡
Research Assistant Professor,
National Center for Computational Hydroscience and Engineering (NCCHE)
The University of Mississippi
823 Maplewood Drive, (Home)
Oxford, MS 38655
Phone: O: (662) 915-1339, Tel:H: (662) 513-3421Fax : (662)915-7796
Email: ding@ncche.olemiss.edu; frank_yding@hotmail.com,
EX: 12, 08, 20 SP: 1201, 1203, 1204, 2005, 2011
http://www.ncche.olemiss.edu/people/drding

Dr. Qin Qian 錢琴
Assistant Professor,
Department of Civil Engineering
Lamar University
Beaumont, Texas 77710
Phone: (409) 880-7559, FAX: (409) 880-8121,
Email: qin.qian@lamar.edu, qqian1@my.lamar.edu,
EX: 08,11,12,14,20 SP: 1102,1103,1203,1204, 1205,1405,1410,2001,2003

Dr. Kung-Hui (Bella) Chu, P.E. 朱宮慧
Assistant Professor
Zachary Department of Civil Engineering
3136 TAMU, 205G WERC
College Station, TX 77843-3136
Tel: 979-845-1403 Fax: 979-862-1542
E-mail: kchu@civil.tamu.edu
EX: 04,06,09 SP: 0406, 0605, 0904, 1001, 1501/06/09
http://ceprofs.tamu.edu/kchu

2. The 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, was successfully held during April 10-12, 2009, Tianjin, China. The conference was jointly organized by Tianjin Institute of Urban Construction, Tianjin, China, General Secret Office, MTEPC, Shanghai, China, and Overseas Chinese Environmental Engineers and Scientists Association (OCEESA). A total of 3 OCEESA members presented 2 papers at the conference.

Total number of participants at the conference was 59. Number of participants at the conference was 39 from China, 17 from Taiwan and 3 from OCEESA. Number of papers presented was 57 by Mainland, 16 by Taiwan and 1 by OCEESA authors. 3. OCEESA Organizing Committee for
the 2009 Urban Water Environment Symposium, Tianjin, China, April 9-15, 2009, consists of Dr. Clark Chen-Kun Liu, Dr. Wei-Yin Chen, Dr. Pao-Chiing Yuan, Mr. An-Min Liu, and Dr. Yung-Tse Hung.

3. OCEESAA Outstanding Environmental Service Award plaques have been presented to Professor Shihui Zhu, President, and to Professor Liping Sun, Chair, Department of Environmental and Municipal Engineering, Tianjin Institute of Urban Construction, Tianjin, China, for sponsoring 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, Apr. 10-12, 2009, Tianjin, China.

4. Dr. Pao-Chiing Yuan, Dr. Wei-Chi Ying, and Dr. Chein-Chi Chang, OCEESAA members and OCEESAA Past President, are OCEESAA representatives who attended 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, Apr. 10-12, 2009, Tianjin, China.

5. Dr. Pao-Chiing Yuan, OCEESAA Past President in 2009, has presented a keynote speech, Entitled “Non-point source pollution management”, Dr. Wei-Chi Ying, OCEESAA Past President, has presented a keynote speech, entitled “Environmental friendly activated carbon treatment process for removing water pollutants”, at 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, Apr. 10-12, 2009, Tianjin, China.

6. OCEESAA Best Paper Award Committee has accepted the selection of 5 best papers by China Organization Committee from Tianjin Institute of Urban Construction, Tianjin, China, for 2009 Urban Water Environment Symposium Certificates and US$100 per paper (to authors of papers) were presented to authors of 5 best papers during the closing ceremony of conference by OCEESAA delegates, Dr. Pao-Chiing Yuan, Dr. Wei-Chi Ying, and Dr. Chein-Chi Chang, on 4-11-09

7. OCEESAA Best Paper Award Committee for 2009 Urban Water Environment Symposium consists of Dr. Wei-Yin Chen (Committee Chair), Dr. Yung-Tse Hung (Committee Secretary), Dr. Pao-Chiing Yuan, Dr. Wei-Chi Ying, and Dr. Chein-Chi Chang.

8. OCEESAA Outstanding Service Plaque was presented to Dr. Clark Chen-Kun Liu, Past President of OCEESAA in 2009, for his outstanding service to OCEESAA as OCEESAA President in 2008.

9. 2009 Mainland Taiwan Sustainable Water Environment Conference was held in Taipei International Conference center (TICC), Taipei, Taiwan, October 18-22, 2009. The conference was sponsored by Graduate Institute of Environmental Engineering, Taiwan University, MTEPC (Mainland-Taiwan Environmental Protection Conference) Permanent Secretariat Office, and OCEESAA (Overseas Chinese Environmental Engineers and Scientists Association).

10. Consultative Committee meeting of Mainland-Taiwan Environmental Protection Conference was held in Taipei International Conference center (TICC), Taipei, Taiwan, October 19, 2009,
during 2009 Mainland Taiwan Sustainable Water Environment Conference. Dr. Clark Chen-Kun Liu, Dr. Wei-Chi Ying, and Dr. Jeff Jih-Fen Kuo, attended the meeting as OCEESA delegates.

11. The 13th MTEPC will be held at Chongqing University, Chongqing, China, April 23-25, 2010. The conference is sponsored by Chongqing University and is cosponsored by MTEPC Permanent Secretary Office, Tongji University, Shanghai, China and by OCEESA (Overseas Chinese Environmental Engineers and Scientists Association).

12. OCEESA representatives for consultative committee meeting at 13th MTEPC are as follows:
Dr. Wei-Yin Chen 陳惟寅 OCEESA President (Committee Chair)
Dr. Wei-Ping Pan 潘偉平 OCEESA V.P.
Dr. Charles Qun Cheng 程群 OCEESA Secretary-Treasurer
Dr. Clark Chen-Kun Liu 劉成均 OCEESA Ex-Officio
Dr. Yung-Tse Hung 洪永哲 OCEESA Permanent Executive Director (Committee Secretary)

13. OCEESA Nomination Committee of 2009 consists of the following. Election will be held in December 2009. Please contact Dr. Wei-Ping Pan, OCEESA Vice President, Email: wei-ping.pan@wku.edu, if you have questions.

Dr. Wei-Ping Pan, OCEESA VP, committee chair
Dr. Wei-Yin Chen, OCEESA President, committee member
Dr. Charles Qun Cheng, OCEESA Secretary-Treasurer, committee member
Dr. Clark Chen-Kun Liu, OCEESA Ex-Officio, committee member
Dr. Yung-Tse Hung, Permanent Executive Director, committee secretary

14. Congratulations to Dr. Clark Chen-Kun Liu, OCEESA Past President and Professor, Department of Civil and Environmental Engineering, University of Hawaii. Dr. Clark Liu is the recipient of the 2009 Engineer of Distinction Award by the School of Engineering at The University of Mississippi. This is a prestigious award that is annually presented to a graduate of the School of Engineering who has made a significant impact in his profession, community, and/or the university. The award will be presented at the Engineering Awards Banquet on April 16, 2009, at the Inn at Ole Miss.

15. Congratulations to Dr. Clark Liu, Professor, OCEESA President in 2008, who has been appointed as Chair, Department of Civil and Environmental Engineering, University of Hawaii at Manoa, starting July 1, 2009

16. Congratulations to Dr. Zhongli Pan, OCEESA member, who has won the annual You Bring Charm to the World As An Influential Chinese Awards. The awards are co-sponsored by the most influential Chinese media organizations in Chinese mainland, Hong Kong, Southeast Asia and North America, has begun its evaluation process for the year 2008. Like before, the 2009’s event features Awards for ten Influential Chinese and one International Citation of Merit, which are awarded to those prominent Chinese who have made great achievements, thus bearing great impact to the world during the year 2008.
17. OCEESA World Wide Web Homepage: http://www.oceesa.org

EDITOR'S NOTE

OCEESA members are encouraged to email before January 15, 2010, news items and papers with a maximum length of 10 typed pages (single space, letter size 10, put all figures and tables after your text) to: Dr. Yung-Tse Hung, Editor-OCEESA Journal, Professor, 16945 Deerfield Dr., Strongsville, Ohio 44136-6214 USA. Tel (440) 238-0407 FAX: (216) 687-5395 Email: yungtsehung@yahoo.com, yungtsehung@gmail.com. Please also email your complete manuscript in electronic version (as attachment of email) to Dr. Hung before the deadline. Photos and pictures must be scanned and must be put in electronic version. OCEESA World Wide Web Homepage: http://www.oceesa.org

Call for Papers

The 13th Mainland-Taiwan Environmental Protection Conference (MTEPC)

Chongqing, China, April 23-25, 2010

Organizer

Chongqing University, Chongqing, China

Co-organizers

MTEPC Permanent Secretary Office

OCEESA (Overseas Chinese Environmental Engineers and Scientists Association)

The 13th MTEPC will be held at Chongqing University, Chongqing, China, April 23-25, 2010. The conference is sponsored by Chongqing University and is cosponsored by MTEPC Permanent Secretary Office, Tongji University, Shanghai, China and by OCEESA (Overseas Chinese Environmental Engineers and Scientists Association). OCEESA members are invited to submit abstracts for consideration for presentation at the conference. OCEESA members are required to have paid 3 consecutive years OCEESA dues

Theme of conference:
Academic discussions, sharing experience, creating technology, sustainable development

Topics for conference papers

1. Drinking water purification and safety management
2. Water/wastewater treatment and reuse
3. Waste treatment and resource recycling
4. Air pollution control and air quality management
5. Soil and groundwater remediation
6. Regional management, ecological safety, environmental toxicity and disasters assessment and control
7. New energy production technology, Greenhouse effect and greenhouse gas reduction
8. Cleaner production and sustainable development environmental planning, management, protection policy and regulation

Conference schedule:
Conference paper presentations (2 days), post-conference tour (optional)

Important Deadlines (to be received by OCEESA)
1. Abstract, 1 p CV, and preliminary registration form (in Word file) due date (OCEESA): September 10, 2009 (9-10-09)
2. Acceptance letter sent to authors by OCEESA: 10-20-09
3. Full paper (in Word file) due date (OCEESA): 12-20-09
4. Conference dates: 4-23 to 25, 2010

Please email abstract and required files to:

Prof. Yung-Tse Hung
OCEESA Permanent Executive Director
Department of Civil and Environmental Engineering
Cleveland State University, Cleveland, Ohio, USA
16945 Deerfield Dr., Strongsville, Ohio 44136-6214 USA
Tel: Home: 440-238-0407 Fax: 216-687-2596
E-mail: yungtsehung@yahoo.com
PAST OVERSEAS CHINESE ENVIRONMENTAL ENGINEERS AND SCIENTIST ASSOCIATION (OCEESA) PRESIDENTS

海外華人環境保護學會 會長

1. 1980-81 (6-1-80 to 5-31-81)      Dr. Robert Hsi-Lin Howe (Deceased) 侯希臨
2. 1981-82 (6-1-81 to 5-31-82)      Dr. Howard Ju-Chang Huang 黃汝常
3. 1982-83 (6-1-82 to 5-31-83)      Dr. Edward Shing-Ke Chian 錢興格
4. 1983-84 (6-1-83 to 5-31-84)      Mr. Eugene Y. Hsi (Deceased) 席與錚
5. 1984-85 (6-1-84 to 5-31-85)      Dr. Allen Chia-Chen Chao 趙家珍
6. 1985-86 (6-1-85 to 5-31-86)      Dr. Yung-Tse Hung 洪永哲
       (Also Executive Director 6-1-86 to present)
7. 1986-87 (6-1-86 to 5-31-87)      Dr. Charles Chi-Su Chou 周基樹
8. 1987-88 (6-1-87 to 5-31-88)      Dr. James Wen-Chi Ku 谷文琦
9. 1988-89 (6-1-88 to 5-31-89)      Dr. Wei-Chi Ying 應維琪
10. 1989-90 (6-1-89 to 12-31-90)   Dr. Lawrence Kong-Pu Wang 王抗曝
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13. 1993      Dr. Thomas To Shen (deceased 3-26-05) 沈鐸
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16. 1996      Dr. Jen-Tai Yang 楊仁泰
17. 1997      Dr. Shou-Yuh Chang 張守玉
18. 1998      Dr. John Chao-Piao Huang 黃肇鏞
19. 1999      Dr. Oliver Jing-Ching Hao 郝晶瑾
20. 2000      Dr. Chang-Lu Lin 林昌爐
21. 2001      Dr. Tsen-Cheng Wang 王増辰
22. 2002      Mr. Anmin Liu 劉安民
23. 2003      Mr. Edward T. Chen 陳天生
24. 2004      Dr. Chein-Chi Chang 張建祺
25. 2005      Dr. Yung-Sung Cheng 鄭永松
26. 2006      Dr. Francis Hun-I Chang 張恆一
27. 2007      Dr. Pao-Chaing Yuan 袁保強
28. 2008  Dr. Clark Chen-Kun Liu 劉成均
29. 2009  Dr. Wei-Yin Chen 陳惟寅
The 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, was successfully held during April 10-12, 2009, Tianjin, China. The conference was jointly organized by Tianjin Institute of Urban Construction, Tianjin, China, General Secretariat Office, MTEPC, Shanghai, China, and Overseas Chinese Environmental Engineers and Scientists Association (OCEESA). The co-sponsoring organizations include Tianjin Municipal Science Technology Department, Tianjin Municipal Education Department, Tianjin Municipal Environmental Protection Bureau, Bing Hai Gao Hsin District Management Bureau. Table 1 is the call for papers of the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China.

The Chair of the organization committee is Professor Shihu Zhu, President, Tianjin Institute of Urban Construction, Tianjin, China. The Vice Chairs of the organization committee are Professor Liping Sun, Chair, Department of Environmental and Municipal Engineering, Tianjin Institute of Urban Construction, Tianjin, China, Prof. Siqing Xia, Professor of Environmental Engineering, Tongji University, Shanghai, China, and Dr. Peng Wang.

Total number of participants at the conference was 59. Number of participants at the conference was 39 from China, 17 from Taiwan and 3 from OCEESA. Number of papers presented was 57 by Mainland, 16 by Taiwan and 1 by OCEESA authors. Photos taken at the conference is shown in Figure Set 1. There are 9 photos. These include conference participants, OCEESA best paper awards presentations, and OCEESA Outstanding Environmental Services presentation presentation.

A total of 2 OCEESA members presented 2 keynote speeches at the conference. Dr. Pao-Chiang Yuan has presented a keynote speech, Entitled “Non-point source pollution management”, Dr. Wei-Chi Ying, has presented a keynote speech, entitled “Environmental friendly activated carbon treatment process for removing water pollutants”,

OCEESA Best Paper Award Committee has accepted the selection of 5 best papers by China Organization Committee from Tianjin Institute of Urban Construction, Tianjin, China, for 2009 Urban Water Environment Symposium Certificates and US$100 per paper (to authors of papers) were presented to authors of 5 best papers during the closing ceremony of conference by OCEESA delegates, Dr. Pao-Chiang Yuan, Dr. Wei-Chi Ying, and Dr. Chein-Chi Chang, on 4-11-09. Table 2 lists authors and papers of these 5 papers of 2009 OCEESA Best Papers Awards.
The MTEPC consultative committee held meeting on April 11, 2009. The MTEPC consultative committee consists of 10 delegates from China, 10 delegates from Taiwan and 5 delegates from OCEESA. Table 1 is the list of official delegates of consultative committee. There were 14 participants in the MTEPC consultative committee meeting on April 11, 2009. These includes 8 participants from China, including 3 official delegates, 2 participants from Taiwan, including 1 official delegate, and 3 participants from OCEESA, of which no official delegate. The consultative committee meeting participants are listed in Table 3.

The Planning Committee members for the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China, are listed in Table 4. The Academic Committee members for the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China, are listed in Table 5. Table 6 lists 6 keynote speeches presented at the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China.

The China host university, Tianjin Institute of Urban Construction, Tianjin, China, has been most generous with our OCEESA delegates. They have paid all expenses, including international airfare, domestic transportation cost, registration fee and lodging and meal costs for Dr. Pao-Chiang Yuan, who is keynote speaker at the conference. They have paid registration fee and lodging and meal costs for Dr. Wei-Chi Ying and Dr. Chein-Chi Chang, who were OCEESA delegates at the conference.

The conference is a complete success. I would like to take this opportunity to thank Prof. Liping Sun, Chair, Department of Environmental and Municipal Engineering, Tianjin Institute of Urban Construction, Dr. Shao Po Wang, Associate Professor, and Dr. Xuan Zhong, of the same department, for their excellent contribution and hard work in organizing the conference. I am extremely grateful to Dr. Shao Po Wang in spending a lot of time for sending me the information related to the conference for our OCEESA.

Table 1 Call for Papers of the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China

<table>
<thead>
<tr>
<th>Call for Papers</th>
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<tbody>
<tr>
<td>主题及日程概况</td>
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<tr>
<td>专题研讨会主题：保护水环境，创建绿色滨海新区</td>
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<td>Protecting Water Environment，Building A Green New Coastal Area</td>
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<td>分议题：</td>
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<tr>
<td>专题1：城市水环境生态修复（EP01）</td>
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<tr>
<td>专题2：新水源与供水安全保障（EP02）</td>
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<td>专题3：城市及工业水污染控制（EP03）</td>
</tr>
</tbody>
</table>
专题4：水的循环利用及节水（EP04）

专题5：其他相关环境问题（EP05）

本次会议采用大会主题报告和分议题报告的形式进行，主题报告由本领域著名专家阐述滨海新区最新规划进展和水资源与水环境保护研究趋势。然后根据各人专业兴趣对不同分议题进行分组报告探讨。并从投稿论文中选出会议论文集结集出版。

报名方式与论文投稿要求见第二部分报名及征稿通知。

会议活动包括研讨会（2天）和技术参观（1天），具体日程见第三部分议程介绍

投稿须知：

1. 论文提交方式：

本次会议论文直接采用全文投稿方式，英文、中文（繁体或简体）均可，所有论文须用email发至组委会电子邮箱mtepc09@163.com，组委会收到邮件后会回复确认，入选论文集结集正式出版。

2. 论文字数在5000~8000字，页数（含摘要、图表等）在10页以内。

3. 第一作者最多提交3篇论文。

4. 论文提交重要时间：

(1) 2009年1月20日：提交论文摘要（电子版本）
(2) 2009年2月20日：发出论文录用通知
(3) 2009年2月30日：提交论文全文（电子版本）

5. 提交论文具体格式见“会议论文格式要求”，可从http://www.tjuci.edu.cn/mtepc下载；提交论文时请注明文章所属的论文议题的专题编号。

会议语言、文字及原则：

1、中文简体、繁体或英文均可。

2、会议正式语言为普通话及国语。

3、会议任何查功能和不展示有政治性标志，不发表或传播有政治性言论、主张或音像制品。

会议注册事宜：

注册费标准：

10
中方代表：800元人民币/人，海外代表：150美元/人
中方学生：400元人民币/人，海外学生：70美元/人
中方家属：200元人民币/人，海外家属：30美元/人

注册费的交纳：注册费由参会代表在会议开幕前直接在会务组以现金方式交纳。

会议注册费（含论文注册费、会务费，但不包括住宿费、参观旅游），详见会议网址：
http://www.tjuci.edu.cn/mtepc。

注册者请填写mtepc2009会议注册报名表（见附件，也可从http://www.tjuci.edu.cn/mtepc下载），填写后将此表发至组委会邮箱：mtepc09@163.com

联络人 天津城市建设学院环境与市政工程系
钟远 先生，0086-22-23085120，手机：13116003466，z_ynn@126.com
王少坡 先生，0086-22-23085119，手机：13920432636，wsp@tjuci.edu.cn

会议网址：http://www.tjuci.edu.cn/mtepc 附件：注册报名回执表

Table 2  List of 5 Papers and Authors for OCEESA Best Paper Awards at 2009 Urban Water Environment Symposium

1、Study on New PVC Material MBR to Treat Municipal Wastewater
Siqing Xia, Jixiang Li, Shengnan Xu
College of Environmental Science and Engineering, Tongji University, Shanghai, China
Email: siqingxia@tongji.edu.cn, lijixiang-1@163.com, xushengnan1208@hotmail.com

新型 PVC 材料膜生物反应器处理生活污水的研究
作者：夏四清、李继香、徐胜男
同济大学污染控制与资源化研究国家重点实验室，上海 200092

2、Process Parameter Optimization of Newly Built Wastewater Treatment Plant Basing on Simulation*
YAO Chonghua*, WANG Guohua**, TAN Xuejun**, DONG Shanyan*, WANG Wenjia*,
SHEN Changmeng**, ZHANG Chen**
基于仿真的新建污水处理厂工艺参数调试

作者：姚重华* 王国华** 谭学军** 董嫚燕* 王文佳** 沈昌明** 张辰**

*华东理工大学资源与环境工程学院，上海 200237；**上海市政工程研究设计总院，上海 200092

3、Carbon Sequestration by Anabaena sp. CH1 with Solar Energy

Chang-Lin Chiang*，Chi-Me Lee*，Pei-Chung Chen**

* Department of Environmental Engineering, National Chung Hsing University
  Taichung, Taiwan
** Institute of Biomedical Nutrition, Hung Kuang University, Taichung, Taiwan

Email: aquacharlin@hotmail.com, cmlee@dragon.nchu.edu.tw, pcchen@mail.nchu.edu.tw, chenpc@sunrise.hk.edu.tw,

藍綠菌 Anabaena sp. CH1 利用太陽能進行二氧化碳捕捉之研究

作者：江長陵* 李季眉* 陳伯中**

*中興大學環境工程學系，台中，台灣， **弘光科技大學營養醫學研究所，台中，台灣

4. Domestic Wastewater Treatment with a Novel Process of Chemically Enhanced Primary Treatment Using Fly Ash-Based Coagulants and Constructed Wetland

Qing-liang Zhao, Kai Hu, Feng Tang, Ya-qiang Li

School of Municipal & Environmental Engineering, Harbin Institute of Technology, Harbin, China

Email: zhql1962@163.com, uconline148@163.com, ftang68@sohu.com, lyq1031@163.com

作者：赵庆良, 胡凯, 唐凤, 李亚强

哈尔滨工业大学市政环境工程学院, 哈尔滨, China

5、Research on the Influence Factors of Degradation of Pyrimidine with Anaerobic Bacteria

Yi Xuesong, Wang Shaopo, Wu Li, Su Liping

Department of Environmental and Municipal Engineering, Tianjin Institute of Urban Construction, Tianjin, China 300384

Email: cedar401@163.com, wsp@tjuci.edu.cn, mycoolwuli1985@yahoo.com.cn, slpyqs@vip.sina.com,
Table 3 Participants METPC consultative meeting, April 11, 2009, Tianjin China

(A) Participants: Total 14 participants
   (a) Participants from China: 8 participants (incl. 3 official delegates)

*周琪、同济大学环境科学与工程学院, zhouqi@mail.tongji.edu.cn
夏四清、同济大学环境科学与工程学院, siqingxia@mail.tongji.edu.cn,
孙力平、天津城市建设学院, slpyqs@vip.sina.com,
*郭劲松、重 庆 大 学, guo0768@vip.shou.com,
*吕锡武、东南大学能源与环境学院, xiwulu@public1.ptt.js.cn,
赵庆良、哈尔滨工业大学市政环境工程学院, zhql1962@163.com,
周立祥、南京农业大学资源环境学院环, lxzhou@njau.edu.cn
赵文玉, 桂林工学院, wyzhao1009@163.com

NOTE: * official delegate for MTEPC Consultative Committee based on list of 11th MTEPC, Harbin, June 2007
(b) Participants from Taiwan: 3 participants (incl. 1 official delegate)

*骆尚廉、台湾大學環境工程學研究所, sllo@ntu.edu.tw,
李季眉、中興大學環境工程系(所), cmlee@dragon.nchu.edu.tw,
陈伯中、弘光科技大学營養醫學研究所, chenpc@sunrise.hk.edu.tw

(c) Participants from OCEESA: 3 participants (incl. 1 official delegate)

*袁保强, Jackson State University, pcyuan@gmail.com,
张建祺、美国华盛顿特区水务局, cchang@dcwasa.com
应维琪, 华东理工大学资源与环境工程学院, wcying@ecust.edu.cn,

(A) Secretaries (Who are not participants)
秘书：钟远、陈旭、于静洁、王少坡
Table 4  Planning Committee Members for 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China

会议筹备委员会

主任委员：朱世和

副主任委员：孙力平、夏四清、王鹏

委员：

海外华人环境保护学会 (OCEESA)
刘成钧 (Clark Chen-Kun Liu)  刘安民 (An-Min Liu)
洪永哲 (Yung-Tse Hung)  袁保强 (Pao-Chiang Yuan)
陈惟寅 (Wei-Yin Chen)

台湾地区

工业技术研究院：杨致行
中技社：林志森
中山大学：袁中新
中央大学：曾迪华
台湾大学：蒋本基

台湾大学：骆尚廉
交通大学：林志高
成功大学：张祖恩
弘光科技大学：方国权
高雄第一科技大学：樊国恕

大陆地区

同济大学：周琪
清华大学：余刚
浙江大学：陈英旭
南京大学：郑正
东南大学：吕锡武

武汉大学：周培纁
西安交通大学：贺延龄
华东理工大学：姚重华
哈尔滨工业大学：任南琪
重庆大学：郭劲松
Table 5  Academic Committee Members for the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China

学术委员会（以姓氏拼音为序）

主任委员：李玉友（天津城市建设学院/日本东北大学）

委员：

方汉平（香港大学）、季民（天津大学）、李圭白（哈尔滨工业大学）、刘成钧（夏威夷大学）、吕锡武（东南大学）、钱易（清华大学）、曲久辉（中国科学院生态环境研究中心）、任南琪（哈尔滨工业大学）、孙力平（天津城市建设学院）、汤鸿宵（中国科学院生态环境研究中心）、王晓昌（西安建筑科技大学）、杨敏（中国科学院生态环境研究中心）、余刚（清华大学）、张杰（哈尔滨工业大学）、郑正（南京大学）、周琪（同济大学）

Table 6  Keynote Speeches presented at the 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China

议程表

会议报到

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<thead>
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<th>2009年4月9日9:00～18:00</th>
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<tbody>
<tr>
<td>时 间</td>
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地 点  天津鑫茂天财酒店大堂

开幕式

2009 年 4 月 10 日 08:00 ~ 08:40

<table>
<thead>
<tr>
<th>会议地点</th>
<th>天津城市建设学院 现代教育中心 二楼报告厅</th>
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<tr>
<td>08:00 ~ 08:05</td>
<td>主持人  天津城市建设学院 环境与市政工程系 系主任 孙力平教授</td>
</tr>
<tr>
<td>08:05 ~ 08:10</td>
<td>第一项  校长致辞  天津城市建设学院 校长 朱世和教授</td>
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<tr>
<td>08:10 ~ 08:20</td>
<td>第二项  贵宾讲话</td>
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<td>08:20 ~ 08:40</td>
<td>第三项  集体合影</td>
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| 11:30 ~ 12:00 | 第六项  
主题：城市市政污泥和排污河道污泥能源化材料化利用研究进展 |
| 12:00 ~ 13:30 | 工作午餐 |
### 4 月 11 日主题报告

<table>
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<tr>
<th>时间</th>
<th>项目</th>
<th>主讲人及主题</th>
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| 08:30 ~ 09:10 | 第一项 | 曲久辉教授（中国科学院生态环境研究中心主任）
主题：城市水环境与水质的演化及调控 |
| 09:10 ~ 09:40 | 第二项 | 袁保强教授（美国密西西比杰克逊州立大学）
主题：Nonpoint Source Pollution Management |
| 09:40 ~ 10:10 | 第三项 | 周琪教授（同济大学环境科学与工程学院院长）
主题：用水合电子法去除废水中有机氟化物的研究 |
| 10:10 ~ 10:30 | 茶歇   |                                                   |
| 10:30 ~ 11:00 | 第四项 | 李玉友教授（天津城市建设学院 天津市特聘教授/日本东北大学）
主题：日本城市污水处理厂的水质、污泥及 CO₂排放量的统计解析 |
| 11:00 ~ 11:30 | 第五项 | 吕锡武教授（东南大学）
主题：平原地区水源地生态调蓄水库水质改善的实例研究 |

会议地点：天津城市建设学院 现代教育中心 二楼报告厅
主持人：任南琪教授、应维琪教授
| 11:30 ~ 12:00 | 第六项 | 孙力平教授（天津城市建设学院环境与市政工程系主任）
主题：天津滨海污水处理与回用现状及研究进展 |
| 12:00 ~ 13:30 | 工作午餐 |
Figure Set 1 Photos of 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, April 10-12, 2009, Tianjin, China

Photo 1 Participants at 2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, April 10-12, 2009, Tianjin, China

From left to right:

Ms. 王镝 (student), 天津城市建设学院 环境与市政工程系, China
Prof. 陈冠益, 天津大学, China
Prof. 郭劲松, 重庆大学, China
Prof. 骆尚廉, 台湾大学环境工程学研究所, Taiwan
Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Prof. 袁保强  Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Prof. 周琪, 同济大学环境科学与工程学院, China
Prof. 孙力平, 天津城市建设学院 环境与市政工程系, China
Prof. 李季眉, 中興大學環境工程系(所), Taiwan
Prof. 张建祺  Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Prof. 姚重华, 华东理工大学, China
Prof. 李玉友, 天津市特聘教授/日本东北大学, Japan
Prof. 夏四清, 同济大学环境科学与工程学院, China
Prof. 周立祥, 南京农业大学资源环境学院, China
Dr. 赵文玉, 桂林工学院, China
Prof. 陈伯中, 弘光科技大学營養醫學研究所, Taiwan
Ms. 安莹 (student), 天津城市建设学院 环境与市政工程系, China

Photo 2  2009 Urban Water Environment Symposium and Steering Committee Meeting of Mainland-Taiwan Environmental Protection Conference, April 10-12, 2009, Tianjin, China
Keynote speaker, Prof. 应维琪  Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Photo 3  Presenter of OCEESA Best Paper Awards
Prof. 张建祺 Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Photo 4  OCEESA Best Paper Award
From left to right
Left 1  Prof. 张建祺 Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 2  Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Left 3  Prof. 孙力平 (best paper award recipient), 天津城市建设学院 环境与市政工程系, China
Left 4  Mr. 衣雪松 (best paper award recipient), graduate student, 天津城市建设学院 环境与市政工程系, China
Left 4  Prof. 袁保强 Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Photo 5  OCEESA Best Paper Award
From left to right
Left 1  Prof. 张建祺  Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 2  Prof. 夏四清 (best paper award recipient), 同济大学环境科学与工程学院, China
Left 3  Prof. 袁保强 Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Left 4  Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Photo 6  OCEESA Best Paper Award

From left to right
Left 1  Prof. 张建祺  Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 2  Prof. 姚重华  (best paper award recipient), 华东理工大学, China
Left 2  Prof. 应维琪  Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Left 4  Prof. 袁保强  Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Photo 7  OCEESA Best Paper Award
From left to right
Left 1  Prof. 张建祺 Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 2  Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Left 3  Prof. 陈伯中 (best paper award recipient), 弘光科技大学營養醫學研究所, Taiwan
Left 4  Prof. 袁保強 Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Photo 8  OCEESA Best Paper Award
From left to right
Left 1  Prof. 张建祺 Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 2  Prof. 袁保强 Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Left 3  Prof. 赵庆良 (best paper award recipient), 哈尔滨工业大学市政环境工程学院, China
Left 4  Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Photo 9
OCEESA Outstanding Environmental Service Plaque presented to Prof. 孙力平
From left to right
Left 1  Prof. 应维琪 Prof. Wei-Chi Ying, East China Univ of Science and Technology, Shanghai, China
Left 2  Prof. 张建祺 Prof. Chein-Chi Chang, Univ of Maryland, Baltimore County, Maryland, USA
Left 3  Prof. 孙力平 (recipient of OCEESA Outstanding Environmental Service Plaque), 天津城市建设学院 环境与市政工程系
Left 4  Prof. 袁保强 Prof. Pao-Chiang Yuan, Jackson State Univ, Jackson, Mississippi, USA
Abstracts of 5 Papers of OCEESA Best Paper Awards of 2009 Urban Water Environment Symposium, April 10-12, 2009, Tianjin, China

1、Study on New PVC Material MBR to Treat Municipal Wastewater

Siqing Xia, Jixiang Li, Shengnan Xu

College of Environmental Science and Engineering, Tongji University, Shanghai, China
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新型PVC材料膜生物反应器处理生活污水的研究
作者：夏四清、李继香、徐胜男
同济大学污染控制与资源化研究国家重点实验室，上海 200092

ABSTRACT

摘要：利用一套新型PVC材料膜生物反应器，人工配水模拟生活污水，研究了该新型材料膜生物反应器长期运行特性、膜污染阻力分布及膜污染清洗方法。结果表明该新型材料膜生物反应器对主要污染物SS、COD、NH₄⁺-N和浊度等有很好的去除效果，出的去除率分别可以稳定在99%、84%、85%、和99%以上，TN去除率稍有波动，但大部分时间稳定在70%以上，出水水质可达到《城市杂用水水质标准》(GB/T 18920-2002)的要求。通过0.2%次氯酸钠碱洗和1%柠檬酸洗可以有效清除膜污染，使膜纯水通量恢复到新膜水平。膜阻力分布表明泥饼层阻力和浓差极化阻力是膜污染的主要组成部分，占到总阻力的88.59%，膜本身阻力仅占7.76%。

关键词：PVC材料；膜生物反应器；膜污染

2、Process Parameter Optimization of Newly Built Wastewater Treatment Plant Basing on Simulation*

YAO Chonghua*, WANG Guohua**, TAN Xuejun**, DONG Shanyan*, WANG Wenjia*, SHEN Changmeng**, ZHANG Chen**

*College of Resources and Environmental Engineering, East China University of Science and Technology, Shanghai, China 200237
**Shanghai Municipal Engineering Research and Design Institute, Shanghai, China 200092
基于仿真的新建污水处理厂工艺参数调试

作者：姚重华** 王国华** 谭学军** 董姵燕** 王文佳** 沈昌明** 张辰**

*华东理工大学资源与环境工程学院, 上海 200237; **上海市政工程研究设计总院, 上海 200092

ABSTRACT

本文概述了新建污水处理厂工艺参数调试工作中计算机仿真技术的应用，内容涉及建立数学模型、编制仿真程序、模型参数校正及过程仿真实施。我国目前有大量中、小型污水厂待建，利用计算机仿真技术协助这些新建污水厂进行工艺参数的调试，可以达到减少调试时间、降低调试费用的目的。

关键词：仿真，新建污水厂，工艺参数，调试

3、Carbon Sequestration by *Anabaena* sp. CH1 with Solar Energy

Chang-Lin Chiang*, Chi-Me Lee*, Pei-Chung Chen**

* Department of Environmental Engineering, National Chung Hsing University
  Taichung, Taiwan
** Institute of Biomedical Nutrition, Hung Kuang University, Taichung, Taiwan
Email: aquacharlin@hotmail.com, cmlee@dragon.nchu.edu.tw, pcchen@mail.nchu.edu.tw, chenpc@sunrise.hk.edu.tw,

蓝綠菌 *Anabaena* sp. CH1 利用太陽能進行二氧化碳捕捉之研究

作者：江長陵* 李季眉* 陳伯中**

*中興大學環境工程學系，台中，台灣,**弘光科技大學營養醫學研究所，台中，台灣

ABSTRACT

人為二氧化碳排放的主要來源是能源生產和交通運輸的化石燃料燃燒。所有化石燃料是由碳氫化合物組成，燃燒時便會釋放二氧化碳。大氣中二氧化碳含量不斷增加，正是全球暖化的主要原因，目前全球平均溫度的變化，幾乎和二氧化碳含量的變化是同步上升的。為了降低全球暖化的影響，京都議定書要求的二氧化碳減量是世界各國極大的挑戰，卻是必須面對的問題。然而在二氧化碳規劃減量的現實環境中，仍有不可避免的排放量,
因此二氧化碳捕捉與封存（CCS, Carbon Dioxide Capture and Storage）或稱碳隔離（CS, Carbon Sequestration）之減量技術方案遂因應而生，訴求阻絕化石燃料燃燒後的二氧化碳排入大氣，進而降低溫室效應的問題。以微生物進行碳隔離為本研究之目的。利用藍綠菌具有低營養需求、快速生長及固氮作用之特性，以本研究室自行篩選之藍綠菌 Anabaena sp. CH1 於新設計之光反應器內，提供不同濃度之二氧化碳混合空氣做為惟一碳源，觀察其二氧化碳之吸收量及菌體之增殖量，藉以評估二氧化碳捕捉率。在 15%二氧化碳培養環境下，Anabaena sp. CH1 平均二氧化碳捕捉率為 905 mg/L·day，換算每公頃面積每年二氧化碳捕捉量為 312 噸，遠較植樹每年每公頃捕捉量 25 噸多 11.5 倍。另外本研究新設計之光反應器使用冷陰極螢光管 (CCFL) 做為光源，搭配太陽能集光器，利用太陽能轉換為電能提供實驗所需動力，所以可以雙重降低二氧化碳排放（動力來源二氧化碳零排放及捕捉既有二氧化碳），加上菌體生質量可提供做為其他用途，故以藍綠菌進行生物性碳隔離為一具高度潛力之二氧化碳捕捉方案。

關鍵字：全球暖化，二氧化碳捕捉，藍綠菌，光反應器

4. Domestic Wastewater Treatment with a Novel Process of Chemically Enhanced Primary Treatment Using Fly Ash-Based Coagulants and Constructed Wetland

Qing-liang Zhao, Kai Hu, Feng Tang, Ya-qiang Li

School of Municipal & Environmental Engineering, Harbin Institute of Technology, Harbin, China
Email: zhql1962@163.com, uconline148@163.com, ftang68@sohu.com, lyq1031@163.com

作者：趙慶良, 胡凱, 唐鳳, 李亞強

哈尔滨工业大学市政环境工程学院, 哈尔滨, China

ABSTRACT

A combined processes of chemically enhanced primary treatment and constructed wetland were studied, aiming to provide an efficient domestic wastewater treatment method. During the coagulation treatment, a composite coagulant was first made from fly ash, which was one kind of solid wastes largely produced from power generation. When this coagulant was applied for treating domestic wastewater, the removal efficiencies of COD, SS and TP reached 64%, 93% and 91% respectively. The operation of simulated subsurface-flow constructed wetland system under different hydraulic loadings (0.03~0.10 m³/(m²·d)), which received effluents from the previous coagulation treatment, showed that COD might be further removed 77%~64% with final COD lower than 60 mg/L. However, it was also found that the ammonium nitrogen and total phosphors were not effectively removed in the wetland
system. The total phosphors effluent concentration might be as high as that of influent.

**Keywords:** chemically enhanced primary treatment; constructed wetland; fly ash; domestic wastewater; composite coagulant

5. **Research on the Influence Factors of Degradation of Pyrimidine with Anaerobic Bacteria**

Yi Xuesong, Wang Shaopo, Wu Li, Su Liping

Department of Environmental and Municipal Engineering, Tianjin Institute of Urban Construction, Tianjin, China 300384

Email: cedar401@163.com, wsp@tjuei.edu.cn, mycoolwuli1985@yahoo.com.cn, slpyqs@vip.sina.com,

厌氧生物降解乙酰嘧啶的影响因素考查
作者：衣雪松 王少坡 吴立 孙力平
天津城市建设学院环境与市政工程系 水质科学与技术联合实验室，天津 300384

**ABSTRACT**

Anaerobic activated sludge was got from Hybrid Loop Anaerobic Baffled Reactor (HLABR), and then pH, alkaline, concentration of pyrimidine, several irons such as Ca$^{2+}$, Cu$^{2+}$, Fe$^{2+}$ were studied as influence factors in static experiment within 24 days. The results showed as follows: the removal rate of pyrimidine could reach 60% during the pH range 5.5 ~ 9.0 and the pyrimidine concentration of 200 ~ 2000mg/L; Pyrimidine couldn’t be degraded when alkaline over 2000mg/L; Ca$^{2+}$ had no obvious effect on sludge activation, Cu$^{2+}$ led to low sludge activation at the concentration of 10mmol/L; Fe$^{2+}$ coexisted facilitated the removal rate by microbe degradation and the removal rate reached 97.2% at the concentration of 10mmol/L.

**Key words:** pyrimidine ; biodegradation; influence factors
2009 海峡两岸环境保护研讨会
咨询委员会会议纪要

2009 年 4 月 9-15 日，来自海峡两岸和海外的专家学者聚集天津城市建设学院，围绕城市水环境问题进行了学术研讨。会议邀请了汤鸿霄院士、骆尚廉教授、袁保强教授等十余位海内外知名学者做了精彩的学术报告。会议期间，海峡两岸环境保护学术研讨会和海外华人环境保护学会（OCESNA）的咨询委员会召开咨询委员会会议。经充分讨论，达成以下共识：

1、会议听取了重庆大学关于第十三届海峡两岸环境保护研讨会筹备情况的报告，同意举办时间初步定于 2010 年 4 月 14-18 日。重庆大学尽快组建会议筹备组，开展相应的筹备活动。

2、鉴于两岸环境保护学者交流日益频繁，会议建议两次大会之间举行若干次专题性小型研讨会，专题名称与举办时间由申办单位向常设秘书处提出申请。

3、确定在 2009 年 10 月份 IWA 台北会议期间，同时召开咨询委员会会议，台湾大学诚邀各位咨询委员参加。

4、桂林理工大学向常设秘书处正式申请承办第十五届海峡两岸环境保护研讨会。

5、会议建议咨询委员会委员规模可以适当调整。

6、全体咨询委员一致认为此次城市水环境专题研讨会非常成功，天津城市建设学院的师生和志愿者为此付出了很大的努力，咨询委员会对此表示衷心感谢。

海峡两岸环境保护学术研讨会秘书组
2009 年 4 月 11 日
2009 Mainland Taiwan Sustainable Water Environment Conference, October 18 to 22, 2009, Taipei, Taiwan

2009年海峽兩岸永續水環境學術研討會

一、研討會宗旨:

水資源之永續及有效利用為廿一世紀大家所追求的目標與關注的熱點問題，隨著全球氣候的變遷與降雨型態的改變，此問題更顯嚴重，也急待世人共同攜手謀求解決之道。海峽兩岸均為全球經濟發展相對較快之區域，人口密集與水資源人均分配量相對較低；局部地區大量開採地下水，使地下水位持續下降，導致地層下陷、海水入侵、土地鹽鹼化問題；都市與鄉村的生活污水收集系統不完整，妥善處理率不高，加上工廠、礦場、畜牧及各類企業廢水排放控制不理想，非點源污染之逕流水未予妥適控制等，均造成水體環境的污染與水源水質的惡化，進而影響自來水供水之品質與自來水事業之經營管理。面對諸多的水環境問題，兩岸學者專家若能共聚一堂，就永續水環境議題研討，交換彼此經驗與研究成果，攜手併進，必能為兩岸永續水環境的營造創造新機。

二、研討會日期：2009年10月18-22日（包括技術參觀）

三、地點：台北會議中心（TICC）

四、主辦單位：Chinese Taiwan Water Works Association（CTWWA）

台灣大學環境工程學研究所

海峽兩岸環境保護學術研討會常設秘書處

海外華人環境保護學會（OCEESA）

五、協辦單位：台灣自來水公司、台北自來水事業處、環工學會、台灣下水道協會、台灣環境管理協會、台灣環保技術交流協會、馮緜華林清涼環境保護基金會

六、研討會議題(採英文發表方式)：

．New vision, strategies and regulations
Financing water/sewerage projects
Education, training and capacity building
Diffuse (non-point) source pollution and wetland systems
Watershed management and eutrophication
Sewage and industrial wastewater collection, treatment and management
Drinking water quality, treatment and distribution
Small scale treatment systems
Water reuse
Instrumentation and control
Environmental remediation
Environmental sanitation and health related issues
Sludge management and disposal
Advanced oxidation processes
Innovative treatment technologies including membrane and nano-technologies
And other related issues…

七、論文期程：
1. 開始徵稿：2008 年 10 月 1 日
2. 論文摘要截稿：2009 年 2 月 15 日
3. 議程及接受函通知：2009 年 3 月 1 日
4. 辦理大陸學者來台手續：2009 年 5 月 1 日
5. 論文全文截止日期：2009 年 6 月 15 日
6. 印製論文摘要集及論文集光碟完成：2009 年 9 月 30 日
7. 研討會前準備工作完成：2009 年 10 月 16 日
8. 研討會開幕及研討：2009 年 10 月 18-21 日
9. 參觀活動：2009 年 10 月 22 日
八、籌備委員會：
廖宗盛、駱尚廉、許培中、李錦地、陳福田、葉宣顯、黃志彬、曾迪華、謝永旭、
吳陽龍、李丁來、陳榮藏、王文賢、李政宗、呂鴻光、高志明、張廣智、陳曼莉、
張子超、廖榮清、張曉健、楊敏、黃霞。

九、諮議委員會：
海外華人環境保護學會（OCEESA）
劉成均、洪永哲、陳惟寅、劉安民、袁保強

台灣地區
蔣本基、駱尚廉、張祖恩、曾迪華、林志高、袁中新、方國樑、樊國恕、林志森、楊致行

大陸地區
周琪、余剛、陳英旭、鄭正、呂錫武、周培疆、賀延齡、姚重華、任南琪、郭勁松
Photos of 2009 Mainland Taiwan Sustainable Water Environment Conference, October 18 to 22, 2009, Taipei, Taiwan

From left to right: (OCEESA delegates at MTEPC Consultative Meeting, October 19, 2009, Taipei, Taiwan)

Prof. Jeff Jih-Fen Kuo (郭繼汾), Department of Civil and Environmental Engineering, California State University, Fullerton, California, USA

Prof. Clark Chen-Kun Liu (劉成均), Department of Civil and Environmental Engineering, University of Hawaii at Manoa, Honolulu, Hawaii, USA

Prof. Wei-Chi Ying (應維琪), Department of Environmental Engineering, School of Resource and Environmental Engineering, East China University of Science and Technology, Shanghai, China
From left to right: (OCEESA participants and host university professors at 2009 Mainland Taiwan Sustainable Water Environment Conference, October 18 to 22, 2009, Taipei, Taiwan)
Prof. Jeff Jih-Fen Kuo (郭繼汾), Department of Civil and Environmental Engineering, California State University, Fullerton, California, USA
Prof. Shian-Chee Wu 吳先琪, Professor and Director, Graduate Institute of Environmental Engineering, National Taiwan University, Taiwan
Prof. Clark Chen-Kun Liu (劉成均), Department of Civil and Environmental Engineering, University of Hawaii at Manoa, Honolulu, Hawaii, USA
Prof. Wei-Chi Ying (應維琪), Department of Environmental Engineering, School of Resource and Environmental Engineering, East China University of Science and Technology, Shanghai, China
Dr. Pei-Te Chiueh 閔蓓德, Assistant Professor, Graduate Institute of Environmental Engineering, National Taiwan University, Taiwan
時 間：2009年10月19日（星期一）
地 點：公務人力發展中心
主 席：台灣大學蔣本基教授
出席人員：
    OCEESA：郭繼汾教授、應維琪教授、劉成均教授
    大 陸：清華大學余剛教授、重慶大學郭勁松教授
    台 灣：台灣大學駱尚廉教授、東海大學張鎮南教授、中央大學曾迪華教授、
          交通大學林志高教授、成功大學張祖恩教授
結論：
一、 郭勁松教授報告「第十三屆海峽兩岸環境保護學術研討會」籌組情況，並建議
    (一) 技術參觀點為：(1) 重慶微電子工業區、及(2) 重慶台商工業區；
    (二) 旅遊參觀路線為：(1) 大足石刻、及(2) 長江三峽風光；
    (三) 圓桌論壇議題如下：
        (1) 湖泊水庫治理
        (2) 整合式流域管理
        (3) 環境中新興污染物監測與評估
        (4) 溫室氣體調適
        (5) 污水處理廠操作人員訓練
二、 第十四屆至第十六屆「海峽兩岸環境保護學術研討會」主辦學校為：
    (1) 第十四屆：台灣成功大學
    (2) 第十五屆：大陸桂林理工大學
    (3) 第十六屆：台灣東海大學
三、 海峽兩岸環境保護學術合作交流要點：
    (一) 學生教育
        ➢ 環境工程課程規劃
        ➢ 教師講學授課與學術交流
    (二) 學術研究
        ➢ 共同進行專題研究
        ➢ 共同指導博士、碩士論文
        ➢ 共同發表學術論文
（三）專業服務

➢ 連續式教育（CEU）訓練
➢ 舉辦學術研討會、講習會及圓桌座談會議
➢ 舉辦政策管理與工程技術實務論壇

四、研討會訊息，歡迎兩岸同仁報名參加

（1）2010年3月29-30日「國際AOP研討會」；
（2）2010年4月「清華大學建校100週年」，同時舉辦「全球高等環境教育高峰論壇」；
（3）2010年9月11日由台灣大學環境工程學研究所舉辦「第四屆永續能源國際研討會」。
Meeting Minutes of OCEESA Executive Committee, February 21, 2009, San Jose, California

Charles Qun Cheng, Ph.D.

OCEESA Secretary/Treasurer
Project Manager
San Diego Regional Water Quality Control Board, Cal/EPA
9174 Sky Park Court, Suite 100, San Diego, California 92123, U.S.A.
Tel: (858) 627-3930, Fax: (858) 571-6972,
Email: ccheng.oceesa@gmail.com

Place: Doubletree Hotel
2050 Gateway Pl, San Jose, CA, 95110

Time: February 21, 2009, 3:30 pm – 6:00 pm

OCEESA President Wei-Yin Chen called for the executive committee meeting to meet face-to-face and discuss issues and challenges OCEESA is facing, and strategies and tasks the new board and executive committee shall undertake. The meeting is concurrent with CIE/USA 2009 AAEOY Award event and CIE/USE National Council Meeting.

The following officers, board directors and members attended the meeting:

Wei-Yin Chen, President
Wei-Ping Pan, Vice President
Charles Qun Cheng, Secretary/Treasurer
An-Min Liu, Board Director
Huey-Min Hwang, Board Director

John Chao-Piao Huang, member, 1998 President
Chein-Chi Chang, member, 2004 President

The meeting was called to order by President Wei-Yin Chen at 3:30 pm, members introduced to each other, and the following issues were discussed:

1. OCEESA’s role in future MTEPC. Wei-Yin Chen brought to the attention that during the last MTEPC in Kaohsiung, October 2008, OCEESA representatives fought hard to gain seats in the Steering (or Consultative) Committee for planning future MTEPC meetings. There will be two such meeting(s) this year, one in Tianjin in April, and the other in Taipei in November. Wei-Yin Chen suggested that OCEESA should have presence and send representatives to both meetings. Several OCEESA members will attend the 2009 Mainland-Taiwan Water Sustainability Conference in Taipei in November, thus can represent OCEESA at the MTEPC Steering meeting. However, at this time we do not know if there will be
OCEESA members attending the 2009 Urban Water Environment Symposium in Tianjin in April 2009. It was suggested that OCEESA send an officer to the meeting. Huey-Min Hwang will check with Dr. P.C- Yuan about his willingness to attend the meeting. It was also suggested that OCEESA check with the host in Tianjin for videoconference capability.

Action Item:
- Huey-Min to check with Dr. P.C. Yuan about his willingness to attend the meeting.
  (Status: done. Dr. Yuan will be able to attend)
- Wei-Yin Chen plans to check with Tianjin host for videoconference capability.
- The President/Executive Committee/Board to decide whether to send an officer to the meeting if videoconference is not available.

2. Workshop in China. Wei-Ping Pan gave a brief report on the initiatives he is taking on Environmental Health and Water Pollution Management workshop in China, as well as OCEESA’s opportunities.

Action Item:
- Wei-Ping Pan to update the Board for new development.

3. New strategy for OCEESA. Attendees reviewed last board meeting minutes, recognized the increasingly limited role of OCEESA in MTEPC, and echoed the need to identify new strategies for OCEESA.

3.1 Charles Cheng reported that he has contacted the Southern California Chinese American Environmental Protection Association (SCCAEPA) for sharing information among members; it will be an on-going effort. It is also suggested that OCEESA contact SCCAEP for joint meetings and workshops.

Action Item:
- Charles and An-Min will take the lead in this direction and update the Board as appropriate.

3.2. There was a good discussion on OCEESA hosting technical/educational workshops for environmental workers from China and Taiwan. Wei-Ping Pan suggested that OCEESA work with universities to issue training certificates. It is recognized that many OCEESA members are professors, which enables our organization to have unique strength and advantage over other organizations. This direction should benefit OCEESA in many ways: opportunity for members to participate, attraction to new members, stronger connection with China and Taiwan, and potential revenue for our organization. Chein-Chi Chang emphasized that we need good connections to be successful. Charles Cheng suggested that OCEESA first develop viable programs before presenting to China and Taiwan. Based on a quick survey of attendees’ specialties, Wei-Ping Pan recommended that OCEESA consider a water pollution control and management program first.

Action Item:
- Evaluate the possibility and develop viable programs by the Board and concerned members.

3.3. Attendees discussed the need to establish a Technical Committee to identify and organize our members’ expertise according to their specific areas. This resource would
be valuable, for example, in preparing workshop/certification programs. A quick survey was conducted among attendees, with each person be a potential coordinator for that group. It is recommended that OCEESA conduct a survey to update members’ information.

Action Item:
- The Board to establish a Technical Committee.
- The Technical Committee to establish expert groups and coordinators.
- Wei-Yin Chen/Prof Yung-Tse Hung to develop a survey form and e-mail to all members for completion.
- Huey-Min Hwang to help sorting/organizing expert groups when survey forms return.

3.4. Wei-Yin Chen proposed to establish a Strategic Planning Committee. He indicated that Dr. David Shaw expressed great interest and has kindly accepted the challenge. He also suggested that the Communication Committee he originally planned to establish be merged into a single Strategic Planning Committee.

Action Item:
- The Board to establish a Strategic Planning Committee.
- Wei-Yin Chen to contact Dr. Shaw for his leadership of the Strategic Planning Committee.

3.5. The meeting discussed a proposal from the Chinese Society for Environmental Sciences (CSES) to form an association of global Chinese scientists for environmental protection. An-Min Liu and Charles Cheng briefly introduced the organization’s background. It was agreed that it would bring a good opportunity for OCEESA and its members, but there are uncertainties in details, and we need to check out OCEESA’s legal and financial responsibilities. Since OCEESA is a chapter of CIE/USA, we also need to check with CIE/USA for any issues. This issue is recommended to the board for consideration.

Action Item:
- John Huang to check with CIE/USA for any issues. (Status: done. John spoke with Lin Wen (one of the few founding members of CIE/USA still remaining as an NC advisor); it is not known whether a chapter can become a founding member of another organization, but should be able to become an associate member. Chein-Chi Chang checked and reported that CIE/USA’s by-law does not contain provisions about chapter's association with other organizations).
- An-Min and Charles to discuss the new venture with CSES representatives in LA and report back to the board for further action and resolution. (Status: continuous. An-Min and Charles have spoken to CSES reps in LA (Prof. Fang & Dr. Lu). The following are some key points: a founding member will participate in establishing the bylaws; will automatically retain seat(s) in the governing board; if CIE/USA has issues with the name “founding member”, OCEESA can use the name “associate member” and still be treated as “founding member” as long as it joins the union during the first round, because in Chinese it is “发起人”, really means “original organizing member”; so far, the response is very positive in USA, numerous organizations have agreed to be founding members, there is an intent to limit founding members to 15; if OCEESA is interested in the new
venture, we need to respond to them before 3/11 since the reps will report to China by then, so our board needs to vote quickly, and Wei-Yin Chen needs to send them a response letter).

- Wei-Yin Chen/Charles Cheng to send out a motion to board members for voting via email.
- Wei-Yin Chen to prepare a response letter to CSES pending on board’s voting result.

3.6. It is discussed that there is a need to improve our website to be more current and more attractive to members. This issue will be further discussed in a later time by the Strategic Planning Committee.

4. Financial status. OCEESA has four separate accounts; the executive committee currently has access to two accounts. All attendees strongly request that OCEESA’s accounts and statements be transparent; the executive committee shall review all account information. It is recommended that the two accounts in Seattle be closed and transferred to the Memphis account.

Action Item:
- An-Min Liu to obtain a new signature card from the LA office for new OCEESA officers.
- Wei-Yin Chen to contact Dr. Clark Liu to close and transfer Seattle’s AAEOY account.

5. 2007 AAEOY report and 2006 CIE/USE yearbook. An-Min Liu reported that OCEESA is responsible for producing the aforementioned documents. It was resolved that OCEESA send out emails to CIE/USA chapters to request 2-page photo and write-up for the yearbook. Wei-Yin Chen indicated that the completion of the 2007 AAEOY final report is the goal of all OCEESA members. He urges a collaborative and transparent effort in accomplishing this goal.

Action Item:
- An-Min Liu and John Huang to prepare the 2006 CIE/USE yearbook.
- Dr. Francis Chang/Dr. P.C. Yuan/Dr. Clark Liu/An-Min Liu/Wei-Yin Chen to prepare the 2007 AAEOY report.
- Dr. Pao-Chiang Yuan to prepare an OCEESA local chapter report for 2007 CIE/USA Year Book.
Photo 1  OCEESA members attending OCEESA Board Meeting on 2-21-09, San Jose, California
Sitting from left to right:
Dr. John Chao-Piao Huang, Dr. Wei-Yin Chen, Dr. Wei-Ping Pan, Dr. Charles Qun Cheng;
Standing left to right:
Mr. An-Min Liu, Dr. Chein-Chi Chang, Dr. Huey-Min Hwang
E-Waste Management in Developing and Developed Countries

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Abstract

A changing life style has made the computer and several other electronics a part of our daily lives. They play a vital role in the way we do business, keep in touch with our family, bring up our children, and entertain ourselves. Integrated -electronic waste (e-waste) or Waste Electrical and Electronic Equipment (WEEE) is defined as a waste type consisting of any broken or unwanted electrical or electronic appliance. Urbanization & the booming Information Technology market have lead to an enormous E- waste burden. E-Waste contains different substances and chemicals, which are toxic and create a serious problem for the environment and human health if not handled properly. This presentation discusses how the Asian and other countries manage the computers’ waste; especially India, China, Singapore, Hong Kong, and other countries in the world. The United States’ lack of support for the Basel Convention on the Trans-boundary Movement of Hazardous Waste reduces many manufacturers’ responsibilities and lets hazardous materials into several developed and developing markets.

Keywords: E-waste, Basel Convention, brominated flame retardants (BFRs), WEEE

Introduction

Electronic Waste is different from traditional municipal waste a) they are not biodegradable b) If you bury them in the landfill, they may contaminate the groundwater c) they contain precious metals and also d) most of them can be recycled, reused and recovered. If you burn them, they may generate dioxin, the worst chemical for the world. In the past two decades, the e-waste stream has grown exponentially. It has drawn attention from the world community. The European Union’s WEEE (Waste Electrical and Electronic Equipment) came first in January 2003 leading the law and policy for e-waste, a policy in which the other world powers would compare. All IT was committed to reducing their environmental impacts and to take more responsibility for their products. It is estimated that the US alone has as many as 40 million personal computers that become obsolete every year, due to innovative technology and falling prices. It was once said that a new generation of computers comes every 3-5 years; however more recently, that has been lowered to 1-3 years. More than 1.5 million tons of e-waste (TVs, monitors, computers, cell Phones, batteries, etc) is thrown into American landfills and incinerators every year. According to the USEPA (United States Environmental Protection Agency) report, only 10% of computers were recycled, and 70% of the heavy metals in landfills come from e-waste. Simply put, there are 100,000 computers that become obsolete in the U.S per
day. I believe there are more obsolete computers inside warehouses, attics, storages, homes, and businesses around the country. E-waste has become an attractive commodity for developing countries because of their low incomes, and their lack of environmental laws and enforcements.

**Why are we concerned?**

E-waste consists of several hundred components, which contain heavy metals and are manufactured with more than 1000 chemicals. There is a great risk when these products are produced and dismantled. These materials can cause environmental pollution and health problems. The following pictures show the inside of a monitor – Cathode Ray Tubes (CRT). Major chemicals include lead, beryllium, mercury, cadmium, barium, plastic and brominated flame retardants. Table 1 shows the chemicals found in different parts of a computer system and Table 2 shows health effects caused by toxins.

**Computer Waste in Different Countries**

The Basel Convention is a global treaty to control and reduce trans-boundary movements of hazardous waste. Currently, 165 countries have signed. However, Haiti, the United States, Canada, Australia and Afghanistan have not. %0-80% of e-waste that comes from the US was shipped out of the country to a third world nation, due to cheaper labor, lack of environmental standards and because the export of e-waste is still legal in the United States. Strict domestic laws in Europe and North America prohibit the disposal of computer waste in landfills, while recycling operations are too expensive. Exporting to Asia and Africa has become the easiest option. 80% of the e-waste finds its way to developing countries, such as Nigeria, Ghana, China, India and Pakistan. Even now, we are not sure where some of the e-waste has been exported to in the Middle East.

Table 1 Where the toxins are located

<table>
<thead>
<tr>
<th>Locations/Toxins</th>
<th>Pb</th>
<th>PVC</th>
<th>BFR</th>
<th>Hg</th>
<th>Be</th>
<th>Cd</th>
<th>Cr</th>
</tr>
</thead>
<tbody>
<tr>
<td>Locations</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Monitor</td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Glass Funnel</td>
<td>X</td>
<td></td>
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<td></td>
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<tr>
<td>Frit</td>
<td>X</td>
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<tr>
<td>Circuit Board</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Phosphorscent Coating on Interior of Faceplate</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Glass Panel</td>
<td>X</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Plastic Casing</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>CPU</td>
<td></td>
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<tr>
<td>Plastic Casing</td>
<td>X</td>
<td>X</td>
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<td>Switch &amp; Relays</td>
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<td>Mother Board Connectors</td>
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<td>Cable &amp; Wires</td>
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<tr>
<td>Plastic Stabilizer</td>
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<tr>
<td>Chip Resistor, Infrared Detectors, Semiconductors</td>
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<td>X</td>
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<tr>
<td>Circuit Boards</td>
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<td>X</td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Hardening &amp; Corrosion Protection in Metal Housing &amp; Plate</td>
<td></td>
<td></td>
<td>X</td>
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</tr>
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</table>

Table 2 Health Effects Caused by Toxins

<table>
<thead>
<tr>
<th>Target Organ/Toxins</th>
<th>Pb</th>
<th>PVC</th>
<th>BFRs</th>
<th>Hg</th>
<th>Be</th>
<th>Cd</th>
<th>Cr</th>
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<tbody>
<tr>
<td>Kidney Damage</td>
<td>X</td>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
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<td>X</td>
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<tr>
<td>Liver Damage</td>
<td></td>
<td>X</td>
<td></td>
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<tr>
<td>Lung Cancer</td>
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<td>X</td>
<td>X</td>
<td></td>
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<tr>
<td>Asthma Bronchitis</td>
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<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Reproductive System Damage</td>
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<td></td>
<td></td>
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</tr>
<tr>
<td>Impair Child's Mental Development</td>
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<td></td>
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<td></td>
<td></td>
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<tr>
<td>Thyroid Damage</td>
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<td>X</td>
<td></td>
<td></td>
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<tr>
<td>Harm Fetal Development</td>
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<td>X</td>
<td></td>
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<tr>
<td>Incineration, Dioxin</td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Brain Damage</td>
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<td></td>
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<td>X</td>
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<tr>
<td>Harmful for Developing Fetus</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>X</td>
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<tr>
<td>Carcinogen and Bone Damages</td>
<td></td>
<td></td>
<td></td>
<td></td>
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<td>X</td>
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<tr>
<td>Carcinogen, Beryllium Dust and Lung Disease</td>
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</tr>
</tbody>
</table>

**Computer Waste in Different Countries**

The Basel Convention is a global treaty to control and reduce trans-boundary movements of hazardous waste. Currently, 165 countries have signed. However, Haiti, the United States, Canada, Australia and Afghanistan have not. 80% of e-waste that comes from the US was shipped out of the country to a third world nation, due to cheaper labor, lack of environmental standards and because the export of e-waste is still legal in the United States. Strict domestic laws in Europe and North America prohibit the disposal of computer waste in landfills, while recycling operations are too expensive. Exporting to Asia and Africa has become the easiest option. 80% of the e-waste finds its way to developing countries, such as Nigeria, Ghana, China, India and Pakistan. Even now, we are not sure where some of the e-waste has been exported to in the Middle East.

1) **United States of America**

   Environmental laws concerning E-Waste are still in the developmental stage. States involved in the setting of codes in electronics are Florida, California, and Massachusetts. The main focus is on the CRT, due to their heavy metal content. The only current regulation for electronic disposal, addresses volume discards. Businesses and Agencies with more than 220 pounds per month (or at one time) of computer or television monitors must treat them as
hazardous waste. Typically, this regulation goes un-enforced and is frequently ignored by states, local governments, institutional agencies and businesses by auctioning or donating discarded electronic equipment. According to Computer Take Back Campaign, there are 22 states working on laws related to e-waste. In the United States, 9 States have Producer Take-Back Bills that are pending now. In Washington state, they adopted a producer’s responsibility and product stewardship program. In California, they charge the advanced recycling fee. The state of Maine, they passed a producer responsibility system. Finally in the state of Maryland, they established a County Recycling Program.

2) European Union

On the February 17, 2003 in Brussels, Belgium the European Union (EU) recognized the scope and urgency of e-waste. They recently approved two laws dealing with these important issues. The two main pieces of legislation are, “Waste from Electrical and Electronic Equipment (WEEE)” and “A Directive on the Restrictions on the Use of Certain Hazardous Substances in Electrical and Electronic Equipment”. Under the WEEE laws, authorities will have until August 13, 2005 to introduce free take back of waste goods by final owners to ensure that equipment producers are responsible for financing the collection, treatment, recovery and disposal of all waste. Individual firms will be financially responsible for their own goods marketed after August 13, 2005, and collectively responsible for recycling all waste generated by products put on the market before the date. Under the Hazardous Substances in Manufactured Equipment (ROHS) law, manufacturers will have to cease using lead, mercury, cadmium and hexavalent chromium, and brominated flame retardants, in products marketed from July 1, 2006.

3) Taiwan

Taiwan is the third largest producer of Information Technology (IT) related products. Its products have been recycled since July 1998, and it has accomplished an 85% recycling rate, making Taiwan the first nation to order compulsory recycling of IT products. Due to Taiwan’s high population density, waste management has been a serious problem. The Taiwan Environmental Protection Administration (EPA) established the Recycling Management Fund (RMF) Board. This system joins people in communities, recycling management companies, and local governments to promote all aspects of waste recycling including IT products. An EPA public announcement on January 3, 2003, indicated in the year of 2002, the fund paid incentives to recyclers who handled computer waste.

4) Japan

The basic law for establishing a “recycle” based society was enacted May 2000 under the supervision of the Ministry of Environment. Two key phrases for the program were “Discharge Person’s Responsibility” and “Extended Producer Responsibility”. This means a person that discharges wastes, or who will discharge waste takes responsibility for recycling and disposal of waste, and a business that produces and/or sells things bearing a certain responsibility until even after the things become waste. These responsibilities will apply on E-waste.

5) Vietnam
The Vietnam Environmental Protection Agency, a subsidiary of Natural Resources and Environment, Decree No. 12/2006/ND-CP, prohibited the import of second-hand products including electronics, May 2006.

6) Hong Kong

Hong Kong’s Environmental Protection Department has announced an industry-funded, territory-wide e-scrape recycling program, with a goal of recovering 50,000 pieces of discarded computer equipment annually. Hong Kong has been a transit of e-waste though the government has allegedly been making an effort to stop the trans-boundary trade of the waste associated with Hong Kong. The Environmental Protection Department (EPD) in 2003 noticed that used computer monitors disguised as “for re-sale” were being shipped through Hong Kong to a small village in China. Under the Basel Convention, the EPD altered other countries such as Japan, South Korea, Malaysia, Thailand, and Canada and stopped illegal shipment. It is now liable to a possible fine of HKD 200,000.00 and six months in Jail. (13 cases in 2003 & 24 cases in 2004)

7) China

The Electronic Waste Environmental Pollution Prevention and Management Law passed on September 2007 and it was implemented starting in February 2008. China now produces more than a million tons of e-waste each year. China’s Ministry of Information Industry developed the “Management Methods for Controlling Pollution caused by Electronic Information Products”. Recently enacted, China will no longer allow the “Dumping” of electronic scrap.

8) India

- 1.38 million PCs will become obsolete technology from the business sector and individual households.
- Around 1,050 tons of electronic scrap is being produced by manufacturers and assemblers in a single calendar year
- In a single month, there is a reported case of the importation of 30 metric tons of e-waste at Ahmedabad port.

9) Thailand

The amount of electronic waste in the Kingdom is projected to increase at a rate of 12% each year. An estimated 3.6 million pieces of electronic waste will be produced in 2007. In 2005, more than 265 thousand tons of used electronics entered the country from Japan, Hong Kong, Korea, and Singapore. Now all used monitors are prohibited without exception into Thailand.

10) Singapore

The country acceded to the Basel Convention to fulfill the obligations and proceeded to enact the following laws; The Hazardous Waste Act and Regulation (Control of Export, import & Transit). E-waste recycling companies will collect and recover the precious metals found in e-waste.
Other valuable metals or plastics generated from e-waste recovery/recycling process are exported to other countries for further recovery

11) Korea

The generation of E-waste in Korea has been rapidly increased due to economic growth and the shortened life span of products. It is estimated that in 2010, Korea will generate 9,455,000 tons. In 2003, Korea established the “Extended Producer Responsibility System,” in which a producer should recycle E-Waste for themselves and report the results to the government. The local government bears the responsibility to collect wasted products. The proposed act for Resources Recycling of Electrical/Electronic Products and Automobiles, will probably begin enforcement in 2008. There are five recycling centers that are currently operating across the country.

12) Australia

Electronic scrap is defined as a hazardous waste under the Australian Hazardous Waste Act 1989. Exporting of this waste to other countries for recycling are legal only after the exporter has applied for and been granted an export permit by the Department of the Environmental Heritage. Historically, very large volumes of electronic scrap have been exported from developed countries. The Department of Environmental and Heritage estimate in 2005, 2.5 million units were discarded, 1.4 million of which were computers

13) Philippines

The country allows the importing of hazardous materials for recycling or reprocessing despite the fact it has ratified the original Basel Convention. Because of the lack of proper measures for E-waste disposal, the discarded technology is incinerated, dumped in landfills, or end up with backyard recyclers, exposing workers, poor communities, and the environment to poisonous heavy metal and halogenated substances and PVC.

14) Kenya

The government of Kenya has designated three permanent e-scrape processing sites in the African nation at a cost of $31.2 million. The largest site measures roughly 200 acres, while the other two are located on 35 acres.

**Extended Produce Responsibility (EPR)**

EPR is a concept that makes electronic manufacturers responsible for their products beyond the point of sale. They are also responsible for what is in them and where they go at the point they become waste. This means manufacturers and importers will take full responsibility over their products. They are several countries that have adopted this idea and been successful such as: Switzerland, Denmark, Netherlands, Norway, Belgium, Sweden, and Germany.

Advanced Recycling Fee (ARF)—consumers and taxpayers to pay fees. Disadvantages: (a) will not promote products with Environmental Friendly designs. (b) Pay for products that have been
manufactured previously, no consideration for new environmentally friendly products, (c) How much you are going to charge. Advantages: a) Psychologically, the consumer will feel like they have helped the environment.

Conclusion:

There is no doubt that the amount of e-waste will continue to grow and increase until we find new materials to manufacture with less of an environmental impact. There are several techniques that we can adopt to properly dispose of e-waste. For name brand products: (1) Charge a disposal fee when consumers purchase it, (2) Charge the consumer when a product is returned to a seller when it has become obsolete. For non brand name products: (3) For a system put together by a consumer - this material needs a recycler to collect them and to charge to consumer for this collection (4) The government should set a collection center, and set collection and disposal fees.

We are a member of the global community, it is everyone’s responsibility to protect our environment and save our precious natural resources. Let us work together and achieve our goal.

Biography:


A Step-Wise Approach to Assess the Significance of Subsurface Petroleum Vapor Intrusion to Indoor Air

Chawn Y. Jeng¹, Steven Hariri², and Rebecca Shain-Yue Chou³

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ABSTRACT

A step-wise approach was used to assess the potential significance of subsurface petroleum vapor migration into residential and commercial buildings near an oil refinery. Previous environmental investigations indicated that soil and groundwater underlying the refinery have been impacted by petroleum-related chemicals, and elevated levels of methane and gasoline vapors, including benzene, are present in the subsurface at some residential and commercial properties adjacent to the refinery.

To determine if mitigation measures are necessary to prevent indoor air exposures due to subsurface vapor intrusion, a step-wise approach was developed: 1) comparison of shallow soil gas data with health-based screening criteria to identify selected residential and commercial buildings indicating high potential for subsurface vapor intrusion; 2) collection of indoor and outdoor air monitoring data from the candidate residences; 3) collection of subslab soil vapor data beneath foundations of the selected commercial buildings; and 4) assessment of indoor air, ambient air, and soil gas data for the significance of subsurface vapor intrusion considering contributions from various sources for organic vapors, including building materials, household products and ambient air background.

To assess the significance of subsurface vapor intrusion into residential homes, indoor and outdoor air concentrations along with shallow soil gas data collected from the residences were plotted for five key chemicals (methane, benzene, toluene, ethylbenzene, and xylenes). While the soil gas concentrations show a decreasing trend with increasing distance from the suspected source area, the corresponding indoor air data are relatively constant among these homes and comparable with outdoor air data in most cases. This suggests that the indoor air quality is not affected at any significant level by elevated soil gas vapors beneath the homes, and may be influenced by the ambient air background instead. Ratios of indoor air and soil gas concentrations (“apparent” attenuation factors) of the key chemicals in each residence were also compared with the attenuation factors predicted by a screening-level vapor intrusion model (Johnson and Ettinger, 1991). The apparent attenuation factors for some of the chemicals differ by two to three orders of magnitude in the same house, and do not agree with the model prediction showing that these chemicals should have similar attenuation factors. Based on the above analyses, it was concluded that subsurface vapor intrusion does not have a significant effect on indoor air quality in these homes.
**Key Words:** vapor intrusion, indoor air quality, soil gas, ambient air background, petroleum hydrocarbons, benzene, methane, Johnson and Ettinger model

**INTRODUCTION**

Previous environmental investigations at an oil refinery located in southern California identified that soil and groundwater underlying the refinery was impacted by petroleum-related chemicals. Since the mid-1980s, investigation and remediation of soil and groundwater contamination has been ongoing under the direction of the state regulatory agencies. In response to a recent complaint of a strong odor in the garage of a residence near the refinery, initial soil vapor and indoor air sampling was conducted in this residence and surrounding residences to evaluate the presence and source of any hazardous soil vapors and determine if immediate response was warranted. The initial investigation determined that methane and gasoline-type vapors, including benzene, were present in the soils beneath some residences and commercial buildings near the refinery and that concentrations detected in soil vapors could pose a potential threat to human health and therefore required additional study.

This paper describes a step-wise approach on assessing the potential significance of subsurface petroleum vapor migration into residential and commercial buildings. To determine if mitigation measures are necessary to prevent indoor air exposures from subsurface vapor intrusion, the following activities were performed: 1) comparison of shallow soil gas data with health-based screening criteria to identify candidate commercial and residential buildings indicating high potential for subsurface vapor intrusion; 2) collection of subslab soil vapor data beneath foundations of the selected commercial buildings; 3) collection of indoor and outdoor air monitoring data from the selected residences; and 4) assessment of indoor air, ambient air, and soil gas data for the significance of subsurface vapor intrusion considering contributions from various sources for organic vapors, including building materials, household products and ambient air background. The remaining sections discuss the work that was conducted to support the individual components of the approach.

**COLLECTION AND EVALUATION OF SOIL GAS DATA**

More than 200 soil gas samples were collected from 116 locations in and around residential and commercial buildings adjacent to the refinery to determine the lateral and vertical extent of hazardous vapors in soil. Soil vapor points were installed at 5 and 15 feet below surface and sampled after a minimum of 48-hour waiting period. The samples were collected using 6-liter Summa canisters following proper purging and leak test procedures accepted by the State of California [1]. All samples were analyzed for methane and volatile organic compounds (VOCs) using the USEPA Methods TO-3 and TO-15, respectively, by State-certified laboratories.

The principal constituents detected in the soil gas samples were methane and benzene. Methane distribution in soil gas was very similar to benzene generally. The source of methane was likely due to the biodegradation of petroleum hydrocarbons in soil, groundwater, and residual non-
aqueous phase liquid (NAPL) smear zone. Ethylbenzene, toluene, and xylenes were also detected but generally at lower concentrations than benzene.

To determine the need for additional study for selected buildings, the soil gas data was compared with California Human Health Screening Levels (CHHSLs) for shallow soil gas. The CHHSLs are conservative health-based screening criteria at an excess lifetime cancer risk of one-in-a-million ($10^{-6}$) and a hazard quotient of 1 for noncancer health effects. Table 1 shows the ranges of soil gas sampling results and the CHHSLs for the key chemicals detected in soil gas. Because methane does not cause major adverse health effects (no CHHSL values are available), 10% of its lower explosion limit (LEL) was used for the comparison with methane concentrations in soil gas [2].

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Soil Gas Concentration</th>
<th>Residential CHHSL</th>
<th>Commercial CHHSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane (ppmv)</td>
<td>ND – 500,000</td>
<td>5,000*</td>
<td>5,000*</td>
</tr>
<tr>
<td>Benzene (ppbv)</td>
<td>ND – 160,000</td>
<td>10</td>
<td>44</td>
</tr>
<tr>
<td>Ethylbenzene (ppbv)</td>
<td>ND – 6,200</td>
<td>98</td>
<td>330</td>
</tr>
<tr>
<td>Toluene (ppbv)</td>
<td>ND – 9,700</td>
<td>36,000</td>
<td>100,000</td>
</tr>
<tr>
<td>o-Xylene (ppbv)</td>
<td>ND – 1,200</td>
<td>73,000</td>
<td>200,000</td>
</tr>
<tr>
<td>m/p-Xylene (ppbv)</td>
<td>ND – 4,700</td>
<td>73,000</td>
<td>200,000</td>
</tr>
</tbody>
</table>

ND – Nondetect; *10% of methane LEL

Nine residential homes and four commercial buildings were selected for subsequent sampling and evaluation, based on elevated shallow soil gas concentrations relative to the screening levels. Additional subslab vapor or indoor/ambient air data were collected in these buildings, and their results are discussed below.

**COLLECTION OF SUBSLAB VAPOR DATA FOR COMMERCIAL BUILDINGS**

A total of eight sub-slab soil vapor probes (two per building) were installed in the four commercial buildings that were selected for further study based on the soil gas data screening results. It should be noted that indoor air sampling was not recommended in this case because industrial and laboratory chemicals containing VOCs were regularly used in these buildings. These VOC sources could not be removed prior to the sampling, thus introducing bias to indoor air sample collection and difficulty in interpretation of results.

Figure 1 shows construction detail of a typical sub-slab soil vapor probe. The subslab vapor probe tip was generally installed approximately 3-4 inches below the concrete slab. Because probe installation inside a building was not feasible inside some buildings, some of the probes were installed near the perimeter of the building beneath the concrete slab footings.
The sub-slab vapor probe sampling followed the same procedures used in the soil gas sampling described above. All samples were analyzed for methane and VOCs using the USEPA Methods TO-3 and TO-15 by State certified laboratories. Table 2 summaries the results of sub-slab vapor sampling for the key chemicals:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Sub-Slab Vapor Concentration</th>
<th>Screening Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane (ppmv)</td>
<td>1 – 4.9</td>
<td>5000*</td>
</tr>
<tr>
<td>Benzene (ppbv)</td>
<td>ND – 1</td>
<td>4.3</td>
</tr>
<tr>
<td>Ethylbenzene (ppbv)</td>
<td>All ND</td>
<td>37</td>
</tr>
<tr>
<td>Toluene (ppbv)</td>
<td>ND – 0.59</td>
<td>11,000</td>
</tr>
<tr>
<td>o-Xylene (ppbv)</td>
<td>ND – 1.5</td>
<td>23,000</td>
</tr>
<tr>
<td>m/p-Xylene (ppbv)</td>
<td>ND – 2.5</td>
<td>23,000</td>
</tr>
</tbody>
</table>

ND – Nondetect; *10% of methane LEL

The screening levels for sub-slab vapor samples were derived using the indoor air CHHSLs for commercial and industrial land use with an adjustment factor of 100 to account for attenuation through foundation slab and dilution in buildings [3]. Because the sub-slab vapor concentrations beneath these commercial buildings are significantly lower than the screening levels, indicating that the potential for subsurface vapor intrusion was unlikely, no subsequent action was recommended.

**COLLECTION OF INDOOR AIR DATA FOR RESIDENTIAL BUILDINGS**
The indoor air quality assessment of nine homes was performed in accordance with regulatory guidance [3], and included the following work elements prior to air sample collection: (a) inspection and survey of all homes to understand the building characteristics that could affect air flow and to identify potential indoor air sources for VOCs; (b) removal of potential VOC sources (e.g., air refreshers, perfumes, nail polish, paints, and bathroom/kitchen cleaners) from each residence and attached garage to the extent possible; and (c) maintenance of normal building operations with the furnace/air conditioning systems and avoiding other potential interference (e.g., no use of fireplaces or smoking inside the building) at least 24 hours prior to sampling.

Up to four indoor air samples (including one duplicate sample) were collected from commonly occupied areas (i.e., central living area and bedroom) and potential VOC infiltration points (bathroom or kitchen) in each residence. At least one ambient air sample was also collected outside of each residence. All indoor and ambient air samples were collected 3 to 5 feet above ground level (breathing zone height) using 6-liter Summa canisters over an 8-hour period. The samples were analyzed for methane and VOCs using the USEPA Methods TO-3 and TO-15 by laboratories certified by the State. Table 3 summaries indoor and ambient air sampling results for the key chemicals:

<table>
<thead>
<tr>
<th>Chemical</th>
<th>Indoor Air Concentration</th>
<th>Ambient Air Concentration</th>
<th>Residential CHHSL</th>
</tr>
</thead>
<tbody>
<tr>
<td>Methane (ppmv)</td>
<td>ND – 32</td>
<td>ND - 87</td>
<td>500*</td>
</tr>
<tr>
<td>Benzene (ppbv)</td>
<td>ND – 1.8</td>
<td>ND – 1.5</td>
<td>0.03</td>
</tr>
<tr>
<td>Ethylbenzene (ppbv)</td>
<td>ND – 2.2</td>
<td>ND – 1.7</td>
<td>0.22</td>
</tr>
<tr>
<td>Toluene (ppbv)</td>
<td>1.4 – 13</td>
<td>0.97 – 2.9</td>
<td>81.8</td>
</tr>
<tr>
<td>o-Xylene (ppbv)</td>
<td>ND – 0.85</td>
<td>ND</td>
<td>166</td>
</tr>
<tr>
<td>m/p-Xylene (ppbv)</td>
<td>ND – 4.2</td>
<td>ND – 3.1</td>
<td>166</td>
</tr>
</tbody>
</table>

ND – Nondetect; *1% of methane LEL (a CHHSL value is not available for methane)

For methane, toluene, and xylenes, the indoor air concentrations are all significantly less than their respective indoor air CHHSLs for residential land use. Some benzene and ethylbenzene concentrations in indoor air are higher than the residential CHHSLs, but are comparable to the range of ambient air concentrations.

Because the key constituents present in soil gas were also found in most indoor air samples, additional data analyses were performed to evaluate potential significance of subsurface petroleum vapor migration into these residences. Results of these analyses are discussed in the next section.

**EVALUATION OF POTENTIAL VAPOR INTRUSION AT RESIDENTIAL HOMES**

To assess the significance of subsurface vapor intrusion into residential homes, several techniques were used to evaluate the data sets (soil gas, indoor air, and ambient air) collected from nine residences. Because potential sources of VOCs measured in indoor air include ambient air and indoor sources besides subsurface vapor intrusion, these techniques were used to provide
multiple lines of evidence to reject the hypothesis that vapor intrusion is occurring (i.e., looking for signs that indoor air quality is not affected significantly by vapor intrusion, if any).

First, indoor air data from these homes were compared with regional and site-specific ambient air results for any significant difference from subsurface vapor intrusion or other factors. As shown on Table 3, the indoor air concentrations for all key chemicals are comparable to the range of ambient air concentrations measured outside these residences, with the exception of toluene in the three samples collected from one residence (11 to 13 ppbv). While the source of toluene in this case is unknown, the three samples also exhibited elevated levels of tetrachloroethylene (PCE; 3.7 to 4 ppbv) even though no PCE was detected in shallow soil gas near this residence. It is possible that not all VOC sources were removed during the building preparation. Nonetheless, the toluene levels found in this home are significantly lower than the risk-based CHHSL, and therefore do not pose a health risk. The indoor air concentrations in these nine homes are also consistent with typical background levels of these chemicals found in indoor air in North America (mean background value: benzene 1.5 ppbv, ethylbenzene 1.4 ppbv, toluene 6.7 ppbv, o-xylene 1.1 ppbv, and p/m-xylene 2.9 ppbv [4]). Additionally, indoor air samples were collected from several homes outside the soil vapor plume area, and their results are also comparable with the indoor air concentrations of the nine homes within the soil vapor plume area. Based on these comparisons, the indoor air concentrations at these nine homes are consistent with ambient and indoor air quality in typical residences, and do not appear to be affected to any significant level by the soil gas plume present in this area.

Second, indoor air, ambient air, and soil vapor concentrations collected from each residence were plotted to examine spatial relationship among the data sets. Figures 2a through 2f present the spatial data plots for the six key constituents found in soil gas:
As shown on these figures, while soil gas concentrations are generally lower in the homes that are farther away from the suspected source area (near Residence 1), the corresponding indoor air data does not follow a decreasing trend and is relatively constant among the nine homes for most chemicals. In fact, the indoor air concentrations typically match well with ambient air data, indicating that ambient air may have a strong influence on the indoor air quality at these homes. Slightly elevated levels of methane and/or benzene were detected in Residences 4, 6, and 9, which could be attributed to indoor sources (natural gas leaks from stoves and water heaters were reported in these homes).

Finally, ratios of measured indoor air and soil gas concentrations (also known as “apparent attenuation factors”) were calculated in order to compare with the attenuation factors predicted by the Johnson and Ettinger model [5], which is a screening-level heuristic model for evaluating subsurface vapor intrusion into buildings. Table 4 shows the apparent attenuation factors of the key constituents in several residences.

**Table 4  Apparent Attenuation Factors for Select Residences**
<table>
<thead>
<tr>
<th>Residence #</th>
<th>Methane</th>
<th>Benzene</th>
<th>Toluene</th>
<th>Ethylbenzene</th>
<th>m/p-Xylenes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.0E-5</td>
<td>2.7E-5</td>
<td>1.8E-2</td>
<td>7.8E-3</td>
<td>1.7E-3</td>
</tr>
<tr>
<td>3</td>
<td>3.8E-5</td>
<td>9.5E-4</td>
<td>1.9E-2</td>
<td>5.3E-3</td>
<td>5.1E-3</td>
</tr>
<tr>
<td>5</td>
<td>1.2E-3</td>
<td>5.0E-1</td>
<td>1.1E+0</td>
<td>1.9E+0</td>
<td>9.7E-1</td>
</tr>
<tr>
<td>7</td>
<td>9.2E-2</td>
<td>1.8E-3</td>
<td>1.9E-1</td>
<td>9.1E-1</td>
<td>3.5E-1</td>
</tr>
<tr>
<td>9</td>
<td>9.5E+0</td>
<td>2.9E-2</td>
<td>2.0E-2</td>
<td>7.8E-2</td>
<td>3.2E-2</td>
</tr>
</tbody>
</table>

*Average of apparent attenuation factors in each residence

It should be noted that these apparent attenuation factors are specific to individual residences (i.e., affected by differences in building structures and ventilation among the residences), but are expected to be comparable for the key constituents within the same residence because these chemicals have similar physical and transport properties. For example, the attenuation factors for the five key constituents predicted by the Johnson and Ettinger model are less than one order of magnitude difference. However, the apparent attenuation factors among these chemicals differ by two to three orders of magnitude in the same house (Table 4) and do not agree with the model prediction. Furthermore, many of the apparent attenuation factors are significantly higher than typical attenuation factors reported for shallow soil vapor intrusion (0.01 or less) [3,6]. In fact, some values are close to or even exceeding one, which is the theoretical upper bound for vapor intrusion (i.e., the indoor air concentration is approaching the soil vapor concentration). Therefore, it is unlikely that vapor intrusion is occurring at a significant level at these homes and the measured indoor air concentrations are likely attributed to sources not related to the soil gas plume (e.g., ambient air and/or indoor sources).

**SUMMARY**

A step-wise approach was used to assess the potential significance of subsurface petroleum vapor migration into residential and commercial buildings near an oil refinery. The data sets collected from these buildings were analyzed and several techniques were used to assess the significance of subsurface vapor intrusion into residential homes. First, indoor air data were compared with regional and site-specific ambient and indoor air results for indication of significant vapor intrusion into indoor air. Second, indoor air and soil vapor concentrations collected from the residences within the soil vapor plume were evaluated for spatial relationship among different homes analyzed. Finally, ratios of indoor air and soil vapor concentrations were compared with the attenuation factors predicted by the Johnson and Ettinger Model for key chemicals. It was concluded that subsurface vapor intrusion does not have a significant effect on indoor air quality in these homes based on the multiple lines of evidence from these analyses.

**ACKNOWLEDGMENTS**

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Cleaner Production, Circular Economy, and Sustainable Development in China

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Abstract: Cleaner Production (CP) is a strategic measure for maximizing the material utilization efficiency and minimizing pollution discharge in production processes. It represents a symbol of new industrial revolution that together with circular economy (CE), i.e. the abbreviation of closing material cycle economy, can meet the principle of sustainable development for the countries in the new century.

Keywords: CP, CE and sustainable development

1. Introduction
A Cleaner Production cooperation project was initiated by the Chinese and Canadian governments in 1994. Preparatory work and the project definition took place in 1995. The goal of this multi-year and multi-million dollar project was to promote environmentally sustainable development in China by enhancing its capacity to manage its environment. The strategic context was a shift in the environmental protection policies in PRC from a focus on “end of pipe treatment” to the more sustainable objectives of “pollution prevention” (CP), and the efficient use of raw materials and energy (CE). China was in the unique position of being compelled to modernize its aging, inefficient, polluting, industrial sectors and being faced with an opportunity to become a major player in the global market place. With a national industrial strategy that was from a central planning approach to become more influenced by globalization of economy, China decided to encourage globally competitive enterprises that employ technologies, cleaner and more efficient in their use of material resources. This orientation drove the project design and implementations.

The implementation approach focused on collaborative effort among Chinese-Canadian counterparts, designed to support the achievement of China’s CP goal at all levels, from policy and legislation through to implementation at the factory/plant. Capacity building and information sharing and awareness raising efforts were designed to promote the sustainability and widespread dissemination of the results. One unique component of the Project was the joint stakeholder decision to create a “locally-hired expert group” which was directly involved in project activities in order to maximize the relevance of the assistance to the Chinese context. Under the guidance of the Party and its government, China is devoting all its effort to build a well-off society in an all-around way. It has been realized that the key point for maintaining rapid economic growth while sustaining social stability is to change the traditional pattern of growth. In late 90th, the new concept of circular economy (CE) was introduced. On the Global Environment Facility Meeting 2002, a manifesto was declared “Sustainable development can only be achieved through

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the way of circular economy based on utilizing the resources with maximum efficiency and environmental protection”

As an eco-economy in essence, CE requires that all human activities be guided by ecology rule in stead of mechanical rule. The difference between CE and the traditional linear economy is that the latter is a superposition of separate linear material flows. In industries, it implies an open-flow pattern of “resource-production-consumption-disposal”, whereas CE is based on a close-loop system with the addition of “secondary resource” to the above pattern. It requires that materials and energy be exchanged in an integrated way to achieve the goal of “Low exploitation, high utilization and low pollution”. CE, under the guidance of ecology, can offer an overall thought to optimize the interaction among different parts of human economic activities, and give a strategic theory for the transition from the traditional economy to industrialization and sustainable development. It will, therefore, harmonize the long conflict between environment and growth. CP and CE are urgently needed in China. As comparing with industrialized countries, there is a deep gap in the aspects of utilization efficiency with resources and energy. For example, the produced GDP for kg energy, equivalent of oil, for China is 0.7 US$, while USA is 3.4 $, Germany, 7 $, and Japan 10.5 $. Energy consumption of main industrial products in China is also higher than that of developed countries. These facts indicate that China has to pay more attention to CP while facilitating water reuse and recycling, and put the reduction of resources use and waste generation on the top of sustainable industrialization.

2. Implementation of CP and CE in Chinese Industries and Societies

As mentioned the goal of the CP Project is to promote environmentally sustainable development in China by enhancing its capacity for managing. The purposes of the Project are:

- To assist China in implementing CP in priority industrial sectors consistent with China’s Priority Programs for Agenda 21 by:
  - strengthening the institutional capacity of relevant departments to promote Implementation of CP in priority sectors;
  - supporting governmental agencies, industries and enterprises to apply CP in these sectors.
- To foster cooperation between Chinese and Canadian counterparts; and
- To increase awareness of gender issues and increase support for women’s full participation in the workforce.

Canadian government approach “Results Based Management” was used in the management and implementation of the Project. Its design was therefore based on a set of clearly defined expected results, set out in a Logical Framework Analysis that was agreed upon by all stakeholders. Aside from goal and purposes, the expected results include:

- The developmental impacts at the goal level:
  - government pronouncement and national directives in support CP;
  - adoption of policies, regulations and guidelines in support of CP and related gender equality;
  - increased awareness of CP in the public societies.
- The developmental outcomes at the purpose level:
  - improved-capacity of government agencies in areas of policy and regulations, CP development plans, CP training and awareness raising, and CP information systems;
  - illustration of benefits of CP management practices, technologies, policies, regulations and guidelines through CP implementation processes in selected enterprises;
  - the promotion of relationship involving both parties technology facilities, professional, and
enterprise associates;
- improvement in women’s technical skills and knowledge, improved working conditions in factories and increased awareness of gender issues.

The promotion of CE is a task with great comprehensiveness. The cooperation and coordination between different government sectors and industries is necessary. The action on the integration of three dimensions: economy, society and environment should be materialized and promoted. The CP project built CE in selected demonstration industrial sectors; ecological parks; and between production and consumption in three different levels:
- minor cycle: in the individual factories;
- meta cycle: for the ecological industrial parks; and
- macro cycle: between production and consumption.

It has been recognized that CP is the cornerstone of CE, and while CE is the extension of CP. In concept they share the same background and origin from the theory of ecology; in practice, they have interlinked implementation paths, and should be integrated. The raise of both CP/CE concepts are based on the demand of the time. China’s ecological fragility is well below the worth’s average. With the population ascending to its peak, many experts forecasted that the first 20 to 30 years of the 21st century will be a “bottleneck and narrow way” for the development in China. Facing the real danger and crisis to livelihood, CP and CE will be only choice to surmount the unfavorable factors for reaching sustainable development in China.

Considerable effort was taken for the explanation and introduction of CP/CE to the management levels of the factories which were selected as demonstrated sites for the Project. Both are important components under the industrial ecology’s framework as decision makers of the plant and societies were told. Both share the same target and implementation pathways though difference existing. At the plant level CP is the minor cycle of CE. In practice, when implementing CE, many technical problems will be encountered and needed to solve. CP can provide essential technical support.

3. Results and Case Studies

During the tenure of the CP Cooperation Project from 1996 to 2006, work breakdown structures (WBS) divided the project into four major parts, and through which activities were implemented. The WBS are briefly described below with a summary of the primary development results that they helped to achieve.

(1). WBS 100: Policies and regulations for CP.

The most important of result is assisting the government agency to draft the “CP Promotion Law” which, after discussion and refinement, was presented to the National People’s Congress. The Law was passed in 2003, and has a significant and positive effect on CP implementation throughout the country. The Project also made major contributions to additional initiatives such as the beneficial CE policy. Capacity building and sustainability of results were maximized by engaging Chinese experts to do the policy oriented work, which resulted in a core of committed, knowledgeable professionals capable of carrying forward and conducting the results.
WBS 200: CP solutions and technical development plans for priority sectors/enterprises. Six priority sectors were identified and guidelines/regulations to be developed. The sectors selected were: nitrogen-fertilizer; pulp/paper; PVC chemical plant; brewery, nickel/copper smelters in the non-ferrous metal industry; and oil drilling processes. For all six sectors, CP solutions were implemented in demonstration plants, selected and recommended by the Chinese authority and enterprise associations. The following cases illustrate individual CP implementations and results.

Nitrogen-based fertilizer plant: The selected plant is located in Anhui province and is one of the typical small to medium plants (with a production capacity less than 30,000 tons per annual) which have more than 1000 in China. It had NH₃ fugitive emission causing air pollution and also losses to the sewer. In addition, sulfur handling system was inadequate and the liquid stream was discharged to the sewer and responsible for about 25% of the pollution load due to the losses of ammonia to the sewer. The Canadian expert team of the Project, after in-depth studies and testing at the site, designed the CP implementation steps, equipment procurement/installations, provided the viable CP solutions. The benefits are as follows:

**Environmental and Economical Benefits from the CP Solutions**

<table>
<thead>
<tr>
<th>No</th>
<th>Description of CP Items</th>
<th>Saving</th>
<th>RMB/Unit</th>
<th>1,000RM B/Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Reduction in NH₃ losses in the sewer</td>
<td>264 tons/year</td>
<td>1400</td>
<td>370</td>
</tr>
<tr>
<td>2</td>
<td>Reduction in water consumption (estimated flow rate)</td>
<td>20,000 tons/yr.</td>
<td>3.5</td>
<td>70</td>
</tr>
<tr>
<td>3</td>
<td>Increase in Energy Consumption</td>
<td>15kw/hr</td>
<td>0.35</td>
<td>-42</td>
</tr>
<tr>
<td>4</td>
<td>Reduction in raw material consumption</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Increase in steam consumption</td>
<td>1.0 ton/hr</td>
<td>60</td>
<td>-480</td>
</tr>
<tr>
<td>6</td>
<td>Sulfur recovery</td>
<td>550 tons/hr</td>
<td>900</td>
<td>500</td>
</tr>
<tr>
<td>7</td>
<td>Labors</td>
<td>4</td>
<td>10,000</td>
<td>-40</td>
</tr>
<tr>
<td></td>
<td><strong>TOTAL</strong></td>
<td></td>
<td></td>
<td><strong>378</strong></td>
</tr>
</tbody>
</table>

The CP solutions and prepared guidelines were disseminated to other similar fertilizer plants across the province and nationwide to take actions for environmental and economic benefits.

Pulp/paper sector: Although, as in the case of nitrogen fertilizer sector, the Chinese government ordered the closing of small-size plants (10,000 tons/yr), the existing number was still over thousands. These factories with obsolete facilities and backward technology/knowledge became major polluters for the environment. Most without, or primitive, water treatment equipment, and discharged effluent directly into water systems and caused serious problems concerned. It was a natural choice by the Chinese government as another priority industrial sector considered for the development of national industrial water pollution control standards for these mostly “town and village” plants which were major employers and had a significant contribution to local economy. Canadian expert team members spent a
considerable time at the demonstration plant, also located in Anhui province, CP solutions were provided among them including: installation of 4 vacuum washers; a black liquor extraction press; insulation of pulp line digesters; and implemented a range of recommended solutions with varying cost. Results are estimated as: reduction of 1,780 tons COD/yr; a saving of 643,500 cubic meter of water/yr representing 161,000 RMB; and a saving of 5,400 tons of coal/yr or 1,400,000 RMB. By organizing a study tour to Canada, 8 pulp/paper plant managers learned the first hand information on P/P industry management, and acted swiftly upon returning. CP guidelines were also used by a great number of plants for implementing CP.

- Chlor-alkali/PVC sector: The demonstration plant is in Zhejiang province. It is a major chemical manufacturer with many production lines and a number of products for domestic and export consumptions 21 CP solutions were proposed and 7 were chosen by the plant management for immediate implementation. The results is a saving of 800,000 RMB/yr from recycling process water and recovery chlorine from the sewer worth 400,000RMB/yr in addition to environmental benefits. An introduction of complete programs was executed for health and safety aimed at reducing workers’ exposure to toxic fugitive emissions.

- Bwerey: The demonstration is located in Shandong province. It is one of hundreds typical medium-size breweries in China. Total of 43 CP solutions were identified for: raw materials, process; bottling; utilities and waste water treatment. The saving amounts 40 million RMBs/yr.

- Nickel/copper smelters for non-ferrous metal industry. The plant selected for demonstration is located in Jinchong city (known as the nickel capital of China), Gansu province. It has the most important smelter operation in China, and causing serious air pollution due to SO2 emission. Four alternative applications of Canadian technology for its management were studied by the joint team. Decision was reached and equipment installed, and the situation has been vastly improved. Six other CP solutions were identified, developed, and implemented for health/safety, and water reuse/conservation. Later the plant management informed the Project Joint Office that Jinchuan Group made a decision to found a CP Institute, and it would extend CP work to include wider regional consideration with the city, demonstrating sustainability of results.

- Oil and gas extraction process: The site chosen is at the Lun Nan Oil Field in Korlo Distract, southern desert area of Xinjiang Autonomous Region. A total of 11 CP solutions were identified, and Canadian engineers trained Chinese counterparts in using of fugitive emission monitoring technology. A Qicktext software developed in Canada was identified as an important tool for this sector. After successful testing in oil fields, Petro-China subsequently purchased and identified the software being implemented for its field operations.

(3). WBS 300 Training and awareness: More than 1500 training placements: industrial managers, government official and decision makers being trained in CP, and having an increased awareness of CP. Training knowledge books and materials have been produced and disseminated for a variety of targeted audiences, from the general public to plant workers.
Awareness of CP, environment and gender equality issues has been raised including schools, plants, government agencies and within the NGO community.

Guidelines, in addition for the six demonstration sectors, were prepared, as requested, for other priority industrial sectors were prepared including: steel, electro-plating, chromic salt, battery, and coal industry as assessment indicator framework of CP.

(4). Information system: The project web site, both Chinese and English, significantly improved the input and retrieval of CP information by government/environmental agencies, and industry. The site received more than 3.75 million page requests, and made CP information available to the main target users in China and worldwide. Computing equipment provided to Chinese side and plants is facilitating CP implementation.

For more details of the Project, please refer to the website: WWW.Chinacp.org.cn.

For CE, in addition to introducing and implementing for plants as a minor cycles e.g. waste recycling, and inner-company material cycle. The World Business Committee of Sustainable Development (WBCSD) members take economic benefits as their principle objectives. It advises that the “3R” principle be adapted to “3R” manufacturing code., and the well-known Dupont Co., USA, example was reviewed and studied. In general, the cycle within a company following: (1) Retrieve the lost material to the process; (2). With certain treatment, retrieve production waste to the process as raw materials; and (3). With certain treatment, waste of production can be reused as raw material for other manufacturing process within the company. Notable examples are found in all demonstrated plants, especially in nickel/copper smelt, and chlor-alkali/PVC sectors.

As per “meta cycle pattern facing symbiosis companies in industrial parks, the celebrated Karlonberg, Denmark, case was illustrated. Besides, the Burnside Eco-Industrial Park in Halifax, Canada was also used as an example to explain its multi-year, multi-discipline, and multi-institutional study; cooperative partnership among academic, 3 level government, owners, developers and tenants; and phases/retrofitting and planning. Meta pattern for the eco-industrial park has raised two challenges to traditional business management: (1). The company lays all emphasis on sales and ignore other problems such as waste and environment to secondary sectors; (2). Tradition management is keen on market competitiveness. However, industrial ecology needs a management system be established beyond the limits individual companies. In China a number of such parks has existed and grown, and anticipated to into a new era of industrial development.

Regarding the “Meta cycle”, the successful examples in Japan and Germany are well known. In many Chinese cities, e.g. Shanghai, Guangzhou, provinces, Jiangsu, Zhejiang, Liaoning, all have tried to establish the cycle in the whole society. Many problems, however, exist and require to develop regulations to meet the challenge in new millennium.
Effects of Thermophilic Digester Temperature on Formation of Various Sulfur Compounds in Digester Gas

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ABSTRACT

Soon after the Hyperion Treatment Plant (HTP) of the City of Los Angeles began to produce Class A biosolids in October 2002, the plant started to experience unusually high concentration of methyl mercaptan in the digester gas. The level of methyl mercaptan was high enough to cause serious odor problems and to violate air quality permit limits. The plant lowered the operating temperature of primary and batch digesters to from 135 degree F to 128 degree F immediately after realizing the extra ordinarily high methyl mercaptan level might have been caused by relatively high digester operating temperature. Although the methyl mercaptan concentration was brought under control in just a few days later with reduced digester operating temperature, it was no longer possible for the plant to meet the Federal Rule 40 CFR 503.32 – Alternative 1 for producing Class A biosolids. Since it is the plant’s best interest to produce Class A biosolids which will comply with the Federal Rule 40 CFR 503.32 – Alternative 1, the plant initiated a test project in early February of 2003 to determine the optimum digester operating temperature for the anaerobic digesters to produce Class A biosolids without significantly increasing the sulfur compounds concentrations in the digester gas. During the test, only one of the existing sixteen primary digesters was used for this testing purpose. The temperature of the test digester was raised incrementally at one degree Fahrenheit at a time starting at the original level of 128 degree F while other operating parameters such as feed rate and feed composition were kept at constant level. Once the temperature was raised, it was held constant for a month to ensure that the digestion process was at steady state condition. For the duration of the test period, the digester gas from the test digester was tested for various sulfur compounds on a daily basis. The testing continued until any of the individual sulfur compounds, except hydrogen sulfide, reached 5 ppmv or higher in the digester gas.

This paper provides valuable data linking the formation of odor causing sulfur compounds with the digester operating temperature. The plant has utilized the data to set the optimum digester operation temperature to produce Class A biosolids which has complied with the Federal Rule 40 CFR 503.32 – Alternative 1 while meeting the air quality permit limits.
The test project was designed based on the experience gained by the coordinated efforts of engineering, operations and laboratory staffs operating thermophilic digesters since July 2000. In order to minimize impacts to the current digestion process, only one of the existing sixteen primary digesters was used for this test. The temperature of the test digester was raised incrementally at one degree Fahrenheit at a time starting at the original level of 128 °F while other operating parameters such as feed rate and feed composition are kept at constant level. Once the temperature was raised a degree, it was held constant for a month to ensure that the digestion process was in a steady state condition. For the duration of the test period, the digester gas from the test digester was tested for various sulfur compounds on a daily basis. The testing program was scheduled to continue until any of the individual sulfur compounds, except hydrogen sulfide, reached 5 ppmv or higher in the digester gas or 135 °F was reached. Moreover, the ferric chloride injection rate in the raw sewage stream and ferrous chloride injection rate in the raw sludge line were varied independently during the test in order to study the impact of ferric and ferrous chloride on suppression of generation of odor causing sulfur compounds.

The test provided valuable data linking the formation of odor causing sulfur compounds with the digester operating temperature.

TEST OBJECTIVE AND SETUP

The objective of this test project was to determine the optimum operating temperature for the HTP anaerobic digester to produce Class “A” biosolids, which will comply with Federal Rule 40 CFR 503.32 – Alternative No. 1 without significantly increasing the sulfur compounds concentrations in the digester gas.
HTP utilizes Advanced Primary Treatment to maximize primary treatment removal efficiency; chemicals are added to the influent sewage to facilitate the removal of settleable solids. At HTP, ferric chloride followed by an anionic polymer solution is injected into the influent to facilitate coagulation and flocculation of solids. The ferric chloride is injected upstream of the Headworks, and flocculation occurs in the Aerated Grit Basins. Raw sludge from the primary tanks is fed to 16 first-stage digesters. Figure 1 shows the schematic diagram of the test setup. In this test, only one digester was used for the test. For the duration of the test, the primary sludge flow rate to the test digester was intentionally kept steady at 170,000 gallons per day. Ferrous chloride was added to the raw sludge before it was pumped to the digesters to reduce hydrogen sulfide levels in the digester gas.

At HTP, Waste Activated Sludge (WAS) from the Final Sedimentation Tanks is thickened, with the use of a polymer, from approximately 0.5 percent to about 6 percent solids. The thickening process is carried out in solid bowl, counter-current type centrifuges. During the test, Thickened Waste Activated Sludge (TWAS) was then pumped to the test digester at the rate of 45,000 gallons per day for the duration of the test, and the rest of the flow was equally distributed to the remaining 15 primary digesters. Normally, Raw Sludge from primary settling tanks and TWAS...
are pumped to sixteen first stage egg shaped digesters and digested thermophilically at 128 °F for about 12 days. The digested sludge from the first stage digesters then flows to four second stage batch digesters for further digestion lasting 24 hours. The digested sludge is then pumped into the Digester Screening Facility. Hair, fibers, rags, grit, and other impurities that may cause potential plugging problems are removed before it is sent to the dewatering facility. Screened sludge then gravity flows to a wet well. Diluted polymer solution is injected at the downstream side of the wet well pump where the sludge and the polymer solution are mixed through an in-line static mixer before the mixture is fed to the centrifuge. The egg-shaped digesters are equipped with mechanical mixers, and are heated to 128 °F by direct steam injection. Digester gas consisting of 64% methane was produced at an average rate of 7.5 million cubic feet per day (MCFD). A majority of the digester gas produced in the digestion process is sent to a nearby Power Generating Plant to produce electricity. From 2/10/2003 to 3/10/2004, the test digester, 1D1, was operated according to the following conditions. These conditions were verified frequently throughout the twelve test periods:

- Raw sludge flow rate was maintained at 170,000 GPD and TWAS flow rate was 45,000 GPD.
- The detention time was approximately 11.5 days.
- The digester temperature was raised at the rate of one degree per month from 128 to 135 °F.
- Total solids concentration in feed sludge and scum was about 4% by weight.
- Typical volatile solids content in the feed sludge was about 65%.
- Total solids concentration in digested sludge was about 2% by weight.
- Volatile solids destruction rate was typically 55%.
- Digester gas samples were taken daily and tested for hydrogen sulfide, carbonyl sulfide, methyl mercaptan, ethyl mercaptan, dimethyl mercaptan, carbon disulfide, 2-propyl mercaptan, 1-propyl mercaptan, and dimethyl disulfide. Carbon dioxide and methane were tested twice per week.
- Digested sludge samples were taken twice a week and tested for ammonia and dissolved sulfate.
- During the first ten days of each test period, volatile acids, alkalinity, pH, total solids and volatile total solids were tested daily. For the remainder of each test period, they were tested twice per week.

RESULTS AND DISCUSSION
Figure 2: The chart seemed to indicate that both the volatile acid and alkalinity levels dropped as the digester temperature was raised above 134 °F. However, the drops in volatile acid and alkalinity levels were due to a reduction in solids loading in the test digester. Although the primary sludge and thickened WAS flow rate to the test digester was maintained at a steady rate, the concentration of the feed sources could not be maintained. The chart shows that concentration of both the volatile acid and the alkalinity decreased as the mass loading to the digester decreased.
Figure 3 represents the volatile acid level in both 1D1 and 2D1 digesters. During the test periods, the mass loading to both digesters were held at exactly the same rate. The temperature in 2D1 digester was held steady at 128 °F while the temperature in 1D1 was varied from 128 to 135 °F. The chart shows that the volatile acid level in both digesters did not vary much from each other during the test period. From this chart, it is safe to conclude that the operating temperature of the test digester had no or minimal impact on volatile acid level provided that the operating temperature of the test digester was kept below 135 °F.
Figure 4 represents the alkalinity level in both 1D1 and 2D1 digesters. During the test periods, the mass loading to both digesters were held exactly the same. The temperature in 2D1 digester was held steady at 128 °F while the temperature in 1D1 was varied from 128 to 135 °F. The chart shows that the alkalinity level in both digesters did not vary much from each other during the test period. From this chart, it is difficult to find a correlation between alkalinity level and the digester operating temperature. As stated previously, the changes in alkalinity level in both digesters were due to changes in mass loading rather than changes in temperature.
The results of sulfur compound analysis in digester gas are summarized in Figure 5. With the exception of hydrogen sulfide, methyl mercaptan, and dimethyl sulfide, other sulfur compounds in digester gas remained undetected throughout the test periods. The hydrogen sulfide level increased with the increase in digester temperature. However, the hydrogen sulfide concentration could be prevented from increasing further by increasing the ferric and/or ferrous dosages. When the ferric chloride injection was increased from 6,300 lbs/day to 8,700 lbs/day, the hydrogen concentration in the digester gas decreased from 140 ppm to 120 ppm. The digester operating temperature was maintained at 132 ºF and ferrous chloride dosage at 1,500 lbs/day during this test period. The reduction in hydrogen sulfide gas concentration took place 2 to 3 days after the ferric chloride increase. In general, about 10% increase in ferric chloride dosage resulted in 5% reduction in hydrogen sulfide in digester gas. No changes in methyl mercaptan and other sulfur compounds concentration in the digester gas were observed when ferric chloride dosage was varied. The ferric chloride injection test was repeated at the digester operating temperature of 135 ºF and ferrous chloride dosage was set at 2,400 lbs/day. This time when the ferric chloride dosage was reduced from 11,000 lbs/day to 5,000 lbs/day, the hydrogen sulfide concentration increased from 180 ppm to about 300 ppm. Again, no changes in methyl mercaptan and other sulfur compounds concentration in the digester gas were observed.

While holding the ferric chloride dosage steady at 6,000 lbs/day and digester temperature at 134 ºF, the ferrous chloride dosage was increased from 1,700 to 2,700 lbs/day. This increase in ferrous chloride dosage caused the hydrogen sulfide level to drop from 250 to 130 ppm. The test
was repeated at a digester temperature of 135 ºF. When the ferrous and ferric chloride dosages were increased from 2,500 to 3,800 and 5,000 to 6,400 lbs/day respectively, the hydrogen sulfide level dropped from 290 ppm to 90 ppm. The test showed that hydrogen sulfide levels in the digester gas could be prevented from surging if proper dosages of ferric and ferrous chloride were added to the system. The test indicates that the hydrogen sulfide concentration could be maintained below 120 ppm with a ferric dosage of 6,000 lbs/day and a ferrous dosage of 2,700 lbs/day at the digester operating temperature of 134 ºF. However the ferrous dosage had to be increased to 3,800 lbs/day in order to maintain the hydrogen sulfide level below 120 ppm while the digester was operating at 135 ºF. The methyl mercaptan concentration did not respond to the increase of either the ferric and ferrous chloride dosage. The methyl mercaptan level was only brought to an acceptable level by lowering the digester temperature to 133 ºF.

Figure 6:

Effect of Ferrous Chloride Dosage on Hydrogen Sulfide

CONCLUSION AND SUMMARY
In order for the HTP anaerobic digesters to produce Class “A” biosolids, which will comply with Federal Rule 40 CFR 503.32 – Alternative No. 1 without significantly increasing the sulfur compounds concentrations in the digester gas, the first-stage thermophilic digesters should be operated at 133 °F or lower in order to minimize the chance of producing odorous sulfur compounds in digester gas. However, ferric and ferrous chloride needs to be dosed appropriately to the raw sewage and sludge respectively.

The concentrations of both volatile acids and alkalinity in the digester were not affected by the gradual increase in the digester operating temperature, at least to 135 °F. The hydrogen sulfide level increased with the increase in digester temperature. However, by raising the ferric and/or ferrous dosage, we were able to prevent the hydrogen sulfide concentration from increasing further.

As long as the digester temperature was maintained steadily at 133 °F or lower, no increase in concentrations of various sulfur compounds in the digester gas, with the exception of hydrogen sulfide, was noted. When the digester operating temperature was raised to 135 °F, abrupt increases in the methyl mercaptan and dimethyl sulfide concentrations were observed. Although fairly large amounts of ferric and ferrous chloride were added to raw sewage and primary sludge respectively, the increase in methyl mercaptan and dimethyl sulfide concentration could not be controlled when the digester was operated at a constant temperature of 135 °F. These compounds were brought under control only after the digester operating temperature was lowered to 133 °F.
Estimating Henry’s Law Constants of Volatile Organic Water Pollutants

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Abstract: The empirical methods of ratio of vapor pressure to water solubility, the HENRYWIN program methods and a simple experimental method for estimating the Henry’s Law constant (HLC) of a volatile organic compound (VOC) in water samples are presented. Based on the HLC definition, simple and fast test runs of measuring the equilibrium liquid phase concentration of the close system partially filled with the VOC solution provide the data for calculating its HLC of the test conditions. The experimental HLCs of MTBE, benzene, toluene, ethyl benzene, xylene, nitrobenzene, and TCE are in good agreements with the HENRYWIN estimates. The simple experimental method of this study is very attractive since the equilibrium liquid phase concentration of a small capped bottle is the only data required for estimating the HLC of the VOC in water samples of different temperature and composition.

Key words: Henry’s Law constant, water solubility, vapor pressure, VOC, MTBE

1. Introduction
Volatile organic compounds (VOCs) present in contaminated groundwater and soil are often lost due to volatilization during the remediation operations. The degree of volatilization loss of a VOC may be estimated from its Henry’s Law constant (HLC). There are indeed available HLCs for most common VOCs; however, large differences are found for some of them and that many others were reported for specific temperature, initial concentration, ionic strength, solution composition, making it difficult to choose the best HLC for the case of interest. The experimental procedures given in the literature are often complicate and time consuming. The paper presents the available empirical methods and a simple experimental method of this study for estimating HLC of VOCs in water samples

2. Empirical methods for HLC estimation
2.1 Ratio of vapor pressure to water solubility
The ratio of vapor pressure to water solubility of a VOC is a recognized simple estimation of its HLC\cite{1,2}. The vapor pressure and water solubility may be obtained from the MPBPWIN\cite{3} program and WATERNT\cite{4} program components, respectively, of the free EPI Suite v3.20 (Feb. 2007), a collection of 13 estimation programs, downloadable from the the United States EPA website\cite{5}, for HLC calculation as shown in Table 1. Alternatively, the calculated HLC can be obtained using the Yaws program\cite{2,6}.

2.2 HENRYWIN estimates
The HENRYWIN program\cite{7} is another component of EPI Suite v3.20 for estimating the HLC over the temperature range of 0 to 50 °C; it also includes a large HLC database of 1650 compounds. HLC may be estimated by calculations employing two separate empirical methods (the bond contribution method\cite{8} and the group contribution method\cite{9}) or based on the experimental values contained in the database. The HENRYWIN Bond and Group methods
produce values of LWAPC (log water-to-air partition coefficient) which is the logarithm of the reciprocal dimensionless HLC. The bond method estimated LWAPCs for the 345-compound data set were well correlated with the experimental values \( r^2 = 0.94 \); it has been further validated for a set of 74 diverse and structurally complex compounds that were not included in the least-square analysis \( r^2 = 0.96 \).

### 3. The simple experimental method for HLC estimation

#### 3.1 Principle

The HLC \( (H, \text{atm-m}^3/\text{gmol}) \) of a VOC in a close liquid-vapor system at equilibrium is defined by:

\[
p = H \times S = H \times \left( \frac{C_i}{\text{mw}} \right)
\]

According to the Ideal Gas Law,

\[
p = C_v \times \frac{RT}{\text{mw}}
\]

\[
H = \frac{C_v}{C_l} \times \frac{RT}{(V_v/V_l)}
\]

from conservation of mass for the VOC:

\[
C_i \times V_l = C_v \times V_v + C_1 \times V_1
\]

Therefore,

\[
H = \frac{(C_i/C_l - 1) \times RT}{(V_v/V_l)}
\]  \( (1) \)

where:

- \( p \) - partial pressure of the VOC, atm;
- \( S \) - molar concentration, mole/\text{m}^3;
- \( \text{mw} \) - molecular weight;
- \( R \) - the ideal gas constant, 8.21E-5 \text{atm-m}^3/\text{mole-K};
- \( T \) - absolute temperature (\( K = 273 + ^\circ\text{C} \));
- \( C_i, C_l \& C_v \) - initial and equilibrium concentrations of the liquid phase, and equilibrium concentration of the vapor phase, respectively, \text{mg/L};
- \( C_v/C_l \) - dimensionless HLC; \( V_v, V_l \) - volumes of the vapor and liquid phases, respectively, L.

\( H \), the experimental HLC, can be calculated by \( C_i \) and \( C_l \) measured for each test run \( (H_1) \) or by \( C_i \) of multiple \( V_v/V_l \) test runs \( (H_2) \) employing the slope method of statistical treatment. If the test runs are conducted using a newly prepared VOC solution, the theoretical \( C_i \) may be employed to obtain the estimated HLC \( (H_0) \) without measuring the initial concentration.

#### 3.2 Experimental estimation of HLC for several VOCs

Aqueous solutions of methyl-tert-butyl ether (MTBE), benzene, toluene, ethyl benzene, o-xylene, nitrobenzene, and trichloroethylene (TCE) were prepared using de-ionized and distilled water. The test runs employed single solute solutions of 20\text{mg/L} for estimation of HLC of the VOC and bi-solute solutions of 20\text{mg/L} of each component for estimating its HLC in the mixture. The test runs employed three series of small (42ml) glass bottles which were filled with 10, 20 and 30ml of the test solutions \( (V_v/V_l = 3.2, 1.1 \text{ and } 0.4) \) and capped immediately after filling. The bottles were shaken for 20 min in a rotating drum \( (10 \text{ rpm}) \) and then left in a temperature controlled environment for 2h or longer to establish the equilibrium condition for the liquid-vapor system of the capped bottles. All test runs were conducted in duplicate. The final liquid phase concentration was then measured by UV (benzene, toluene, ethylbenzene, xylene and nitrobenzene) or GC (MTBE and TCE). The experimental HLCs were calculated according to Eq. 1. \( H_1 \) is the average of all duplicates of 3 \( V_v/V_l \) series, and \( H_2 \) is calculated from the slope of statistic treatment of the averages of duplicates of 3 \( V_v/V_1 \) series. \( H_0 \) is obtained in the same manner as \( H_1 \) using the theoretical initial concentration.

### 4. Results and discussion

#### 4.1 Comparisons of HLCs of this study \( (H_1 \& H_2) \) with for HENRYWIN estimates \( (H_{\text{Bond}} \& H_{\text{Ref}}) \)

Table 1 presents molecular weight, vapor pressure, water solubility, empirical and experimental HLCs for the 7 common volatile water pollutants. There are indeed significant
differences among the estimated HLCs of the four empirical calculation methods and the experimental HLCs of two databases, literature reports and this study\textsuperscript{[1,2]}. Those obtained from calculations by the bond contribution method (H\textsubscript{Bond}) and the HENRYWIN database (H\textsubscript{Ref}) are considered the most accurate empirical and experimental HLCs, respectively; when reliable experimental data are available, H\textsubscript{Ref} is usually better than H\textsubscript{Bond} as an estimate of the actual HLCs\textsuperscript{[7]}.

Figure 1 shows the good correlations of the experimental HLCs of this study (H\textsubscript{1} & H\textsubscript{2}) with the HENRYWIN estimates (H\textsubscript{Bond} & H\textsubscript{Ref}). H\textsubscript{1} & H\textsubscript{2} are equally well correlated with H\textsubscript{Ref} (r\textsuperscript{2} = 0.89) and that H\textsubscript{2} has a better correlation with H\textsubscript{Bond} (r\textsuperscript{2} = 0.85). The reasonably good agreements of the results of this study with others is further illustrated in Table 2 with the estimated HLCs of this study (H\textsubscript{0}, H\textsubscript{1} & H\textsubscript{2}) and H\textsubscript{Ref} for 4 VOC at different temperatures (5, 25 and 40°C). Both sets show much higher HLCs at the higher temperatures since the VOC’s vapor pressure increases while its water solubility decreases with increasing temperature. As experimentally determined values, the results of this study are better estimates of the actual HLCs at 5 and 40°C than those of H\textsubscript{Ref} since they are calculated from the 25°C estimates using empirical correlations. The closeness of H\textsubscript{0} with H\textsubscript{1} & H\textsubscript{2} for those runs employing newly prepared VOC solution has validated using the theoretical initial concentration for calculation of HLC (Eq. 1).

<table>
<thead>
<tr>
<th>VOC/MW</th>
<th>Vapor pressure\textsuperscript{[3]} (mmHg)</th>
<th>Water solubility\textsuperscript{[4]} (mg/L)</th>
<th>Empirical</th>
<th>Experimental Database &amp; literature</th>
<th>Experimental this study</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>VP/WS\textsuperscript{a}</td>
<td>Yaw\textsubscript{s}\textsuperscript{[2]}</td>
<td>H\textsubscript{Bond}\textsuperscript{[8]}</td>
</tr>
<tr>
<td>MTBE</td>
<td>88.15</td>
<td>250</td>
<td>5.69  E-4</td>
<td>2.02 E-3</td>
<td>1.44 E-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>51000</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Benzene</td>
<td>78.11</td>
<td>94.8</td>
<td>5.44  E-3</td>
<td>5.57 E-3</td>
<td>5.39 E-3</td>
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<tr>
<td></td>
<td></td>
<td>1790</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Toluene</td>
<td>92.14</td>
<td>28.4</td>
<td>6.55  E-3</td>
<td>6.37 E-3</td>
<td>5.95 E-3</td>
</tr>
<tr>
<td></td>
<td></td>
<td>526</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Ethylbenzene</td>
<td>106.17</td>
<td>9.6</td>
<td>7.94  E-3</td>
<td>8.04 E-3</td>
<td>7.89 E-3</td>
</tr>
<tr>
<td>Oxylene</td>
<td>106.17</td>
<td>6.61</td>
<td>5.19  E-3</td>
<td>4.18 E-3</td>
<td>6.56 E-3</td>
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<tr>
<td>Nitrobenzene</td>
<td>123.11</td>
<td>0.245</td>
<td>1.90  E-5</td>
<td>2.13 E-5</td>
<td>4.45 E-5</td>
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<tr>
<td></td>
<td></td>
<td>2090</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 1 Summary of empirical and experimental HLCs for VOCs at 25°C (atm-m\textsubscript{3}/mole)
4.2 Comparisons of calculated and experimental HLCs for VOCs

The HLCs calculated from the ratio of vapor pressure to water solubility (VP/AS and Yaws of Table 1) are generally better estimates of the experimental HLCs of the two database (H_{Ref} and USEPA\textsuperscript{[10]}) than those of H_{Group} and other experimental results\textsuperscript{[11,12,13]}, therefore they can be used for a quick estimation of HLCs for a specific case. A major reason for most of the higher than H_{Ref} experimental HLCs is due to the fact they were measured in the presence of a much higher concentration of methanol (H_{Ref} = 4.55E-6) which was employed as the solvent for preparing the VOC solutions\textsuperscript{[11,13]}. Figure 2 shows that HCLs of 4 VOCs in bi-solute solutions are higher than in the respective single solute solutions.

<table>
<thead>
<tr>
<th>TCE</th>
<th>69.0</th>
<th>9.32</th>
<th>1.17</th>
<th>2.30</th>
<th>1.86</th>
<th>9.85E-3</th>
<th>1.17E-2</th>
<th>1.03E-2\textsuperscript{[11]}</th>
<th>7.44</th>
<th>8.69</th>
</tr>
</thead>
<tbody>
<tr>
<td>131.39</td>
<td>1280</td>
<td>E-3</td>
<td>E-2</td>
<td>E-2</td>
<td>E-2</td>
<td>2</td>
<td>2</td>
<td>E-3</td>
<td>E-3</td>
<td></td>
</tr>
</tbody>
</table>

a. VP/WS = VP (mmHg)/760 / WS (mg/L)/mw.

Figure 1 Correlations of HLCs of this study with the HENRYWIN estimates
L to R. nitrobenzene, MTBE, benzene, xylene, ethylbenzene and TCE.
Conclusions

HLCs calculated from the ratio of vapor pressure and the Bond contribution methods are adequate for most VOCs present in single solute solutions. HLCs of VOCs in single or multi-solute solutions may be estimated simply from the equilibrium liquid phase concentration of a partially filled and capped bottle; the average of four or more replicate samples or duplicate samples of 2 or more V/V1 series will produce adequate estimates for most VOCs. Although HLC is not dependent on V/V1 of the close system, the capped bottle should be <50% filled to assure attainment of the equilibrium state. The HLCs of several VOCs obtained by the simple experimental method of this study are fairly close to the HENRYWIN database estimates; HLCs of both sets increase with the temperature of the test systems. The HLCs of VOCs in bi-solute solutions are higher than the respective HLCs of the single solute solutions. The simple experimental method of this study is very attractive since the equilibrium liquid phase concentration of a small capped bottle is the only data required for estimating the HLC of the VOC in water samples of different temperature and composition.

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References


Activated Carbon Adsorption for Wastewater Treatment

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ABSTRACT
Activated carbon has been used in wastewater treatment. Its absorption capacity depends on surface area, molecular surface attraction and the concentration of contaminants in the waste. There are two types of treatment which include powdered activated carbon and granulated activated carbon. This paper discusses the method of activated carbon use in waste water treatment. Case studies are reviewed. First case study discusses by using PACT, and GAC we can reduce effluent concentration 800 pounds to 12 pounds in Niagara Falls Wastewater Treatment. Second case study discusses the Millard H. Robbins Reclamation Facility provides biological, tertiary treatment to average daily wastewater flow of 24 MGD.

Key Words: Activated carbon, PACT, GAC, Wastewater treatment.

I. INTRODUCTION
Activated carbon, also called activated charcoal or activated coal, is a form of carbon that has been processed to make it extremely porous and thus to have a very large surface area available for adsorption or chemical reactions. The word activated in the name is sometimes substituted by active. Due to its high degree of micro porosity, just one gram of activated carbon has a surface area of approximately 500 m², as determined typically by nitrogen gas adsorption. Sufficient activation for useful applications may come solely from the high surface area, though further chemical treatment often enhances the adsorbing properties of the material. Activated carbon is usually derived from charcoal (1).

Historically, the use of activated carbon has been limited to treatment applications for drinking water. In the past two decades, more attention has been given to the potential Use of activated carbons for wastewater treatment. The interest in such a process has stemmed from the growing concern over the quality of rain water from which we get our potable water. Concern exists for the protection of both surface and groundwater supplies throughout the nation. In 1974, the United States Environmental Protection Agency (US EPA) identified a total of 154 organic compounds in drinking waters (1). The identification of these organic pollutants, along with an unknown number of inorganic pollutants in receiving waters, has placed an emphasis on effluent water quality. In the past decade, effluent water qualities from all sources have been placed
under increasingly stringent effluent quality guidelines by the US EPA. Specific reference must be made to the Safe Drinking Water Act of 1974 (2). Finding an appropriate yet cost effective treatment solution for reducing organic contaminants in receiving waters represents an interesting challenge in treatment technology. As stated previously, the use of activated carbons for additional treatment has continued to rise since its introduction into the treatment scheme.

Adsorption of a wide range of pollutants using granular activated carbons (GAC) has been found to be successful; however, the use of GAC technology is often accompanied by increased capital and operating costs. An available alternative to GAC adsorption exists without sacrificing any of the latest technology at a much reduced price tag; that is, the addition of powdered activated carbon (PAC) to existing treatment schemes. This chapter focuses on the use of PAC for treatment of both water and wastewater (2). Before undertaking further discussion, it is imperative to first address the physical characteristics and the method by which activated carbon removes pollutants. All activated carbons act on a principle called adsorption, which is an adherence of a substance to the surface of the activated carbon. The attraction of a substance in a solution (adsorbate) to an activated carbon particle (adsorbent) occurs in three distinct steps (2):

1. The adsorbed molecule must be transferred from the bulk phase of the solution to the surface of the adsorbent particle. In so doing, it must pass through a film of solvent that surrounds the adsorbent particle. This is called film diffusion.
2. The adsorbate molecule must be transferred to an adsorption site on the inside of the pore.
3. The adsorbate must become attached to the surface of the adsorbent. This is the actual Adsorption step (1).

Adsorption may be characterized as either physical or chemical. Physical adsorption consists mainly of van der Waals forces and is reversible. This occurs when the molecular forces of attraction between the adsorbent and the solute are greater than the forces of attraction between the solvent and the solute. Chemical adsorption, as the name implies, involves a chemical reaction between the adsorbent and the adsorbate. Physical adsorption is generally a much stronger type of adsorption and is often times irreversible. Recently developed applications of activated carbon to wastewater treatment involve the addition of PAC to conventional activated sludge aeration tanks. The combination of PAC with biological process is often times referred to as the PACT or PAC-activated Sludge process. The PACT process has attracted a great deal of interest because it is a method by which the performance of a waste treatment facility may be improved in various areas. Technical advantages that can potentially be achieved by adding PAC to biological reactors include (3):

1. Provides system stability against shock loading, temperature changes, etc.
2. Improves removal of no biodegradable organics.
3. Removes color.
4. Improves the removal of compounds on the EPA priority pollutant list.
5. Resists biologically toxic substances in the wastewater.
6. Improves the hydraulic capacity of existing plants.
7. Improves nitrification.
8. Suppresses foaming in aerators.
9. Improves settling, thickening, dewatering of sludge.
10. Reduces sludge bulking.
II. CASE STUDIES

(A) CASE STUDY 1
The Niagara Falls Wastewater Treatment Plant has been operating as a physical chemical activated carbon secondary treatment facility since 1985. With a design average daily flow capacity of 48 MGD, it is the largest municipal physical-chemical activated carbon waste water treatment plant in operation in the United States. The treatment process consists of chemically assisted primary sedimentation, granular activated carbon adsorption, oxidation, and disinfection. The influent pH can be adjusted to compensate for industrial discharge. The current average daily flow is 35 MGD. Industrial flow to the plant is approximately 17 percent of the total flow. The activated carbon system at NFWTP includes 28 carbon beds which are 17.3 feet width by 42 feet long. Each carbon bed is approximately 8.5 feet in depth contains 180,000 pounds of carbon. Primary effluent percolates downward by gravity through the GAC bed. Each carbon bed provides chemical adsorption of pollutants from the wastewater, physical filtration of solids, and biological degradation from the incidental anaerobic activity that occurs within.

The carbon beds at NFWTP operate in parallel. During dry weather, there are typically 17 carbon beds in operation with a primary effluent application rate of approximately 2.2 gpm/sq.ft. During wet weather, additional beds are placed in operation. All beds are operated at an application rate of approximately 3 gpm/sq.ft. Backwash of the carbon beds is based based on headloss. Regeneration of the spent carbon is performed onsite in multiple earth furnaces. Each filter bed is separately removed from service and emptied of carbon. The carbon is fed to the furnace at a rate of about 2,000 lbs/hr. The regenerated carbon is kept in storage until empty bed becomes available. Normal operating losses, with average 5.5 percent, require the addition of virgin carbon to maintain inventory levels. At present, the four month regeneration process to regenerate all of the carbon is performed once per year.

Three storage tanks are used during onsite regeneration. The spent carbon storage tank has a capacity 2.5 carbon beds. The regenerated carbon storage tank can hold 1.5 beds of carbon and the virgin carbon storage tank has a capacity of one carbon bed. Carbon is moved about the plant in slurry through an educator system. With GAC adsorption, the NFWTP has achieved very low effluent organic compound concentrations. On a daily basis, the facility receives approximately 800 pounds of influent priority pollutants which are reduced by the treatment process to 12 pounds in the effluent to the Niagara River. The effluent discharge permit issued to NFWTP by the New York State Department of Environmental Conservation includes effluent limitations for volatile compounds, acid compounds, base compounds, base/neutral compounds, pesticides, metals, and cyanide (4,5).

(B) CASE STUDY 2
The Millard H. Robbins Reclamation Facility provides biological, tertiary treatment to average daily wastewater flow of 24 MGD. Industrial flow to the plant is approximately 10 percent of the total flow. The treatment process consists of primary sedimentation, conventional activated sludge with nitrification, lime addition for phosphorous removal, clarification, two-stage recarbonation, flow equalization, multimedia filtration, GAC adsorption, post filtration, and disinfection. The MHRRF discharges its effluent to Bull Run which flows in to the
Occoquan Reservoir. The Reservoir serves as raw water storage for the potable water supply to portions of northern Virginia.

The activated carbon system at MHRRF includes 32 upflow carbon columns which are 10 feet in diameter and 40 feet tall. Each column has a capacity of 1 MGD and contains approximately 75,000 pounds of carbon. Flow is pumped through the columns by a pump station which also serves the multimedia filters and postfiltration system. Post filtration provides following the GAC columns to remove carbon fines from the effluent to maintain the Virginia Pollutant Discharge elimination system permit requirement for turbidity 0.5 NTU. The carbon columns at MHRRF are operated in parallel. During average daily flow periods approximately 24 columns brought on line during daily peak flow periods. During wet weather, flows in excess of 32 MGD are stored in a 90 million gallon pond.

Regeneration of the spent carbon is performed onsite in a multiple earth furnaces. The regeneration process takes place 8 to 10 weeks to regenerate approximately one-third of the carbon in all 32 columns and is performed twice each year. Consequently, it takes approximately 18 months to regenerate the total quantity of carbon in the columns. Spent carbon is removed from the bottom of each column and transported to the regeneration furnace through an educator system. The regenerated carbon is then added at the top of each column. The cost for onsite regeneration at MHRPF is approximately $.35 per pound. Normal operating losses, which average require addition of virgin carbon to maintain inventory levels. Most of the carbon attrition occurs during the regeneration with approximately 10 to 12 percent of the total carbon regenerated lost during regeneration process.

GAC adsorption is utilized at MHRPF to remove non-biodegradable, soluble organics. COD is used as the surrogate indicator of non-biodegradable organics removal by the GAC columns. Currently, the Virginia pollutant Discharge Elimination Systems discharge permit limit for COD is 10 mg/l. Following GAC regeneration, effluent COD concentrations range from 6 to 7 mg/l, which corresponds to approximately 50 percent removal of COD. As the GAC in the columns becomes exhausted, the percentage removal of COD declines to approximately 25 percent. When the effluent COD concentration has increased to 9 mg/l, GAC regeneration is initiated (4,5).

(C) CASE STUDY 3

Dyes are widely used in industries such as textiles, rubber, paper, plastics, cosmetics etc. to color their products; these dyes are invariably left in the industrial wastes. Dyes even in low concentrations effect the aquatic life and food web. Since many organic dyes are harmful to human beings, the removal of color from process or waste effluents becomes environmentally important. Due to the large degree of organics present in these molecules and the stability of modern dyes, conventional physicochemical and biological treatment methods are ineffective for their removal. The adsorption process is one of the efficient methods to remove dyes from effluent In India Textiles industries using sawdust and rice husk to remove dyes from waste water (6).

The Kaduna river is so highly polluted by textile waste that the river water is blue-green most of the year and the self-purifying capacity of the river has been exceeded. For many miles, evidence of pollution was obvious from the color of the river water and pollution build-up on the
river banks (7). These discharges had variable pH, range 6–11.48 pH, soapy to touch and when left to decay, gave off a choking smell of bisulphate/ammonia (8). A potential health hazard existed because people around it use the water for aesthetic and domestic purposes. At the height of acute water scarcity, people in the environ sand domesticated animals resort to drinking the water. Dyestuff was a potential carcinogen and chemical dyes were toxic (9). The conventional dyestuff wastewater treatment methods remove only settleble floating solids and biodegradable organic matter. The dye removal efficiency was about 50-85% (10). It was arguable whether up to 10% of dyestuffs were removed from Kaduna textile waste water which used sand filters, activated sludge and bio degradation processes. This type of system for treating cotton fabric waste water was popular but rarely removed much of the color adequately (11). The state-of-the art-technology in Nigeria was far from adequate as it was difficult to mount a full scale physic-chemical and biological treatment of textile waste. This study reports on the use of incineration and semi-activated agricultural wastes carbon to remove pollution into Kaduna river (6,12).

REFERENCES

Trickling Filter for Wastewater Treatment

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ABSTRACT
A trickling filter consists of a bed of highly permeable media on whose surface a mixed population of microorganisms is developed as a slime layer. The trickling filter has 2 main goals, first to remove organism, the second one is nitrification and denitrification. There are 3 basic types of use of trickling filter: individual residential or rural sewage treatment, municipal sewage treatment and industrial waste water treatment. This paper discusses the types of trickling filter, the use of trickling filter, the medium used for trickling process and the types of bacteria.

Keywords: trickling filter, types, microorganisms, medium.

1. INTRODUCTION
A trickling filter consists of a fixed bed of rocks, gravel, slag, polyurethane foam, sphagnum peat moss, or plastic media over which sewage or other wastewater flows downward and causes a layer or film of microbial slime to grow, covering the bed of media. Typically, a trickling filter is followed by a clarifier or sedimentation tank for the separation and removal of the sloughing. Other filters utilizing higher-density media such as sand, foam and peat moss do not produce a sludge that must be removed, but require forced air blowers and backwashing or an enclosed anaerobic environment. The terms trickle filter, trickling biofilter, biofilter, biological filter and biological trickling filter are often used to refer to a trickling filter. These systems have also been described as roughing filters, intermittent filters, packed media bed filters, alternative septic systems, percolating filters, attached growth processes, and fixed film processes. The treatment of sewage or other wastewater with trickling filters is among the oldest and most well characterized treatment technologies.

II. DESIGN OF TRICKLING FILTER
The first step in the design of a trickling filter is to pick the right packing or media. Over the years many different materials have been used for trickling filters but today, the best packing is structured media. Structured media is composed of sheets of rigid PVC that are corrugated and glued together to form blocks.
One of the advantages of structured media is its flexibility and ease of use. Structured media can be used to build a convenient biofilter without a vessel. Since the vessel is typically the major cost of a biofilter, a biofilter with no vessel can be a real money saver. Structured media can be stacked on a framework or any flat surface. It can be located over a culture tank or have its own water collecting sump. No sides are required because the packing is self-supporting. The most important requirement in the design of any trickling filter is a good water distribution system at the top. There are two common ways to do this. A pressure spray system with splash guards at the top is probably the simplest. The only drawback is the additional pressure drop required to operate the nozzle. The other system involves the construction of a shallow water distribution pan with several gravity flow target nozzles in the bottom of the pan. Here are some typical arrangements for a "vessel-less" trickling filters.

III. CASE STUDY
(A) Case study 1 - Ink-production factory

The ink-production factory produces printing ink using powder coloring agents, organic solvents, and resins. The factory produces 12 t/month of special painting inks. The production process consists of mixing the raw materials, grinding them followed by blinding with solvents according to a set proportion and the product is then packed before it is ready for distribution. The main source of wastewater (3 m³/day) is mainly from washing process of the mixing ingredients vessels. The wastewater is directly discharged into the public sewage network. Wastewater from the factory is subjected either to chemical treatment by chemical coagulation alone or biological treatment and/or biological treatment followed by chemical treatment.

(a) Wastewater characteristics

Analysis of the end-off-pipe showed that the wastewater contains high concentrations of COD and BOD, which reached 8,490 and 3,000 mgO₂/l, with average values of 4,656 and 1,750 mgO₂/l. The total suspended solids ranged from 287 to 538 mg/l with an average value of 470 mg/l. The final effluent was slightly alkaline in nature, the pH varied between 7.5 and 8.5. The high concentration of COD compared with the low content of TSS indicated the soluble nature of the major part of the pollutants. The wastewater contains considerable amount of oil and grease (576 mg/l) with an average value of 481 mg/l. This value did not represent oily matters only since the method of the analysis includes all the extractable matter by chloroform, like dyes, which used as a coloring agent. Also, the results showed average values of 64 mg N/l and 12 mg P/l for TKN and phosphorous, respectively. These values meet the regulatory standard and provide sufficient amounts of nitrogen and phosphorous for anaerobic removal of COD and BOD.

(b) Chemical treatment

Chemical treatment of the end-off-pipe via chemical coagulation-sedimentation using ferric chloride aided with calcium oxide to break down emulsions was investigated. The results showed that the quality of the treated effluent did not comply with the national regulatory standards for wastewater discharge into public sewage network. These results might be attributed to the soluble nature of the pollutants, which is hardly removed by chemical coagulation.

(c) Biological treatment using anaerobic digestion
Batch anaerobic digestion was carried out at a retention time of 2 days. Total anaerobic sludge concentration introduced to the digester was 26 g VSS/l. Figure 2 shows the characteristics of the treated effluent. Average residual values of COD and BOD were 1,893 and 780 mgO2/l with corresponding average removal values of 50 and 58%, respectively. The average residual value of oil and grease was 69 mg/l with 74% corresponding removal value. The quality of the treated effluent still did not comply with the national permissible limits, and thus chemical treatment as post treatment can be considered.

(d) Anaerobic treatment followed by chemical treatment
The chemical treatment process via coagulation followed by sedimentation was chosen as a post treatment for the anaerobic effluent to enhance COD and BOD removal. The investigated coagulants were ferric chloride aided with calcium oxide. The optimum pH value and coagulant dose were determined. The calcium oxide was used to raise the effluent pH value to 10, then lowering the pH to 8 by using ferric chloride. The optimum doses were ranged from 250 to 320 mg/l for the calcium oxide and 550–600 mg/l for ferric chloride. Analysis of the treated effluent was carried out after 1-h sedimentation. The average values of COD and BOD concentrations of the treated effluent from the anaerobic treatment followed by chemical coagulation, were 825 and 420 mgO2/l with 78% total removal efficiency for both COD and BOD. The average residual value of suspended solids was 78 mg/l with a total removal value of 73%. The removal efficiency of oil and grease was 85% with a residual value of 41 mg/l. Thus the characteristics of the treated effluent were within the permissible limits for wastewater discharge into sewage network.

(e) Design of the treatment system
Based on the laboratory results a final biological treatment process via septic tank followed by chemical coagulation, sedimentation was developed. The system consists of two treatment parts one for anaerobic treatment and the other for the chemical coagulation. The anaerobic biological treatment unit consists of one fermentation part and followed by sedimentation part for solids removal. The chemical treatment unit contains flash mixing part and followed by flocculation and sedimentation part. The units are linked together parts by PVC connection.

(B) Case study 2 - Confectionery production factory (1)
This factory is defined as a medium-sized enterprise (45 employees). It produces 4 t/day of chocolates, gum and lollipop. The raw materials are cocoa butter, powdered milk, starch, sugar, flavors and coloring compounds. The process of the production consumes 30 m3 of freshwater daily and discharges 25 m3 wastewater. The wastewater finds its way into the public sewage network without any treatment. Two scenarios were applied to comply with the Egyptian permissible limits. Management and control of wastewater were investigated by applying two different approaches namely; pollution prevention at the source or treatment of the end-off-pipe without the application of in-plant control.

(a) Wastewater characteristics
Analysis of the final effluent indicated that the wastewater is acidic in nature; the pH range was 4.6–5.0. The average value of the chemical oxygen demand was 3627 mg O2/l, 62% of this organic matter is biodegradable indicated by BOD value (2,071 mg O2/l). Despite the higher
values of the COD and BOD, the average value of the TSS was only 187 mg/l, which indicates the soluble nature of the pollutants.

(b) Biological treatment using trickling filter

The constituents of raw wastewater is mainly organic matters such as sugar and starch as indicated by the high concentrations of both COD and BOD. However, there was a deficiency in both nitrogen and phosphorous, which were compensated by adding a mixture of urea and ammonium monohydrogen phosphate. The trickling filter was operated for a period of 20 days using domestic sewage to enhance the growth of the biofilm. After the growing period, industrial wastewater supplemented with the macronutrients replaced domestic sewage as a source of feed to the trickling filter. Two experimental runs with different organic and nitrogen loading rates were investigated. Domestic sewage was used for the dilution of raw industrial wastewater in the second run. The organic and nitrogen-loading rates of the first run were 0.45 kg BOD/m3.day and 0.03 kg N/m3.day, respectively. The corresponding values of the second loading rate were 0.28 kg BOD/m3/day and 0.02 kg N/m3.day. The selected two organic loading rates lie in the range of the intermediate rate recommended by Metcalf and Eddy (2) for the operation of the trickling filter. The hydraulic loading rate during the two experimental runs was 0.31 m3/m2.day.

Treatment efficiency was studied using two organic loads. The residual values of COD and BOD were 466 and 141 mg O2/l for the first load and 207 and 34 mg O2/l for the second load. The percentage removal values were 87 and 89% for the COD at the organic loading rates of 0.45 and 0.28 kg BOD/m3 day (5.6 and 9 g BOD/linear meter of media per day), respectively and 93 and 97% for the BOD removal efficiency, respectively. The removal values were better than the reported range (84–87%) for the trickling filter treating squid processing wastewater at organic loading rate of 3 and 4.7 g BOD/linear meter of media per day.

The process of nitrification was reduced by reducing the organic load as indicated by the concentration of oxidized nitrogen in the effluent. The average TKN removal was 75 and 66% in the two successive runs with residual values of 44.6 and 31.3 mg N/l in the high and low load, respectively. This actually means that the TKN removal decreased by 40% from 410 mg N/day to 244 mg N/day. The complete nitrification rates were 23.5 and 20.3 mg N/day which equivalent to 0.012 and 0.010 g N/m2 .day in the two successive loads. These values are lower compared to what obtained by Shnel et al. (3) who stated that complete nitrification rate in the trickling filter treating effluent of recirculating intensive tilapia culture was around 0.16 gN/m2 day. In our study we used trickling filter mostly for the removal of organic matter not for the removal of nitrogen. Shnel et al. (3) used the trickling filter as final nitrification step for the effluent form intensive tilapia aquaculture system after primary treatment in a treatment train including sedimentation, fluidized bed reactor and icro-screening. On the same trend, the process of nitrification as indicated by the concentration of the oxidized nitrogen (nitrite and nitrate) was reduced by 33%, whereas the concentration of the total oxidized nitrogen represented, 55 mg N/day using the high organic load and 37 mg N/day using the low organic load. These results may be attributed to the increase in the thickness of the biofilm and/or accumulation of organic matters leading to limitation of dissolved oxygen to reach the inner part of the biofilm. The organic matter accumulation in the filter might cause anoxic pockets and hence poor nitrification capacity of the filter.
Nitrite formation (ammonia oxidation) and nitrite oxidation (nitrate formation) were decreased by 47 and 14%, respectively. This might propose the non-homogeneity distribution of the Nitrosomonas (ammonia oxidized microorganism) and nitrobacteria (nitrite oxidizing microorganism) within the biofilm. This indicates that nitrobacteria were less affected which might propose its Superficial location on the biofilm. Total sludge analyses accumulated within the sedimentation tanks showed that 155 and 37.1 mg N/day was accumulated within the detached sludge. These values represented 39 and 15% from the TKN removal. The TSS was 2.6 g/day at organic load of 0.45 kg BOD/m3.day, which is equivalent to 13 kg dry sludge weight for the total wastewater discharge from the factory (25 m3/day). This detached sludge represents 0.27 g/g BOD removal.

REFERENCES


OCEESA MEMBERSHIP APPLICATION (Please type)

Name: ____________________________________________________________________________

Last                First        Middle

Chinese Name (in Chinese): _________________________ Sex: □ Male □ Female

Membership Status: □ Regular □ Student □ Corporate

Title (Job Title): ____________________________________

Department: __________________________

Organization: _______________________________________

Business Address: ____________________________________________________________________

Street  City  State       ZIP

Home Address: _______________________________________________________________________

Street  City  State       ZIP

Office Phone: ___________________  Office Fax: __________________

Home Phone: ____________________  Home Fax: __________________

Office Email: __________________  Home Email: _________________

Occupation: □ Private Practice/Consulting □ Educator □ Industry □ Laboratory

□ Federal Official □ State Official □ Local Official □ Retired □ Other: ____________

Birth Date: ____/____/____    Birth Place: _____________________________

Month  Day Year  City              State                  Country

Professional Engineer License: ______________________

Other License (please specify): ______________________

B.S. Degree: _______________________________________________________________________

Degree            Major             Year                   Institution

M.S. Degree: ________________________________________________

Degree            Major             Year                   Institution

Ph.D. Degree: _______________________________________________________________________

Degree         Major             Year                   Institution

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Major Fields of Expertise (list 3 from 2-digit code in Table 1): _________________________

Major Fields of Expertise (list 3 from topics of category in Table 1): _______________________

Areas of Specialization (list 5 from 4 digit codes in Table 2): ____________________________

Additional Areas of Interests (list 3 areas): ______________________________________________

Professional Experience: ______________________________________________________________

Signature: ________________ Date: ________________

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Table 1 and Table 2 OCEESA Expertise and Specialty

Note: Expertise (2 digits)   Specialty (4 digits)

01 AIR POLLUTION CONTROL PROCESSES

0101 Absorption

0102 Adsorption
0103 Combustion
0104 Electrostatic precipitation
0105 Particle filtration
0106 Gravity settler
0107 Inertial separator
0108 Scrubbers
0109 Source modification
0110 Biofiltration

02 ANALYTICAL METHODS

0201 Aerosol analysis
0202 Bioassay
0203 Chromatography, gas
0204 Chromatography, liquid
0205 Electron microscopy
0206 Elemental analysis
0207 Inorganic analysis
0208 Mass spectroscopy
0209 Organic analysis
0210 Quality control
0211 Sampling
0212 Solids analysis
0213 Spectrophotometry
0214 Taste and odor
0215 Toxicity

03 ATMOSPHERIC CHEMISTRY AND AIR QUALITY

0301 Acid deposition
0302 Aerosols
0303 Chlorofluorocarbons
0304 Clouds chemistry and physics
0305 Gas-phase reactions
0306 Greenhouse gases
0307 Heterogenous reactions
0308 Indoor air quality
0309 Nitrogen oxides
0310 Ozone
0311 Photochemical reactions
0312 Smog
0313 Sulfur dioxides
0314 Transport
0315 Visibility

04 BIOLOGICAL TREATMENT

0401 Activated sludge
0402 Biofilm process - aerobic
0403 Biofilm process - anaerobic
0404 Composting
0405 Denitrification
0406 Kinetics
0407 Lagoons - aquatic macrophytes
0408 Lagoons - stabilization
0409 Methanogenesis
0410 Nitrification
0411 Phosphorus removal
0412 Septic tanks
0413 Sludge digestion
0414 Sulfate reduction

05 CHEMICAL AND PHYSICAL TREATMENT PROCESSES FOR WATER AND WASTEWATER

0501 Adsorption
0502 Chlorination and dechlorination
0503 Coagulation/flocculation
0504 Disinfection
0505 Filtration
0506 Flotation
0507 Gas transfer
0508 Ion exchange
0509 Irradiation
0510 Membrane processes
0511 Ozonation
0512 Precipitation
0513 Sedimentation
0514 Mixing

06 DRINKING WATER QUALITY

0601 Chemicals - inorganic
0602 Chemicals - organic
0603 Disinfection by-products
0604 Disinfection residuals
0605 Microbiological
0606 Stability
0607 Tastes and odors

07 ECOLOGY

0701 Aquatic
0702 Microbial
0703 Soil
0704 Terrestrial
0705 Toxicology

08 GEOLOGICAL SCIENCES

0801 Erosion
0802 Geology
0803 Geophysics
0804 Hydrogeology
0805 Mineralogy
0806 Sediment transport
0807 Soil classification

09 GROUNDWATER QUALITY
0901 Aquifer restoration
0902 Colloid transport
0903 Inorganic geochemistry
0904 Microbiology
0905 Monitoring
0906 Multiphase systems
0907 Organic geochemistry
0908 Radionuclides
0909 Sorption
0910 Transformation reactions

10 HAZARDOUS MATERIALS
1001 Biological treatment
1002 Characterization
1003 Chemical treatment
1004 Exposure and risk
1005 Incineration
1006 Intermedia transport
1007 Land disposal
1008 Management
1009 Physical treatment
1010 Reuse, recycling, recovery and source reduction
1011 Solidification
1012 Storage and transportation

11 HYDROLOGY
1101 Evaporation/precipitation
1102 Groundwater movement
1103 Groundwater/surface water interactions including recharge
1104 Land use
1105 Meteorology
1106 Seepage
1107 Water circulation
1108 Well analysis and design

12 HYDROMECHANICS
1201 Coastal hydraulics
1202 Cold regions
1203 Flooding
1204 Fluid mechanics
1205 Hydraulics
1206 Hydromechanics
1207 Open-channel flow
1208 Pumping
1209 Sedimentation
1210 Waves

13 MANAGEMENT/POLICY
1301 Air basins
1302 Economics and finance
1303 Environmental impact Assessment
1304 Laws and regulations
1305 River basins
1306 Utilities
1307 Water allocation
1308 Water conservation
1309 Water-quality standards

14 MATHEMATICAL MODELING
1401 Air-pollutant transport
1402 Atmospheric chemical reactions
1403 Chemical kinetics and equilibrium
1404 Groundwater movement
1405 Groundwater solute transport
1406 Ocean outfalls
1407 Pipe networks
1408 R isle
1409 Stochastic processes
1410 Surface water quality
1411 Systems analysis
1412 Treatment processes and Facilities

15 MICROBIOLOGY
1501 Aerobic
1502 Algae
1503 Anaerobic
1504 Disinfection
1505 Groundwater
1506 Kinetics
1507 Marine
1508 Pathogens
1509 Soil
1510 Toxicology
1511 Viruses

16 PUBLIC HEALTH
1601 Communicable diseases
1602 Dose response
1603 Epidemiology
1604 Enteric bacteria
1605 Giardia
1606 Risk assessment
1607 Viruses

17 RADIOACTIVE MATERIALS
1701 High-level radioactive wastes
1702 Low-level radioactive wastes
1703 Radiation physics
1704 Radiotracers
1705 Radon
1706 Stable radionuclides

18 SLUDGE HANDLING AND DISPOSAL
1801 Aerobic digestion
1802 Anaerobic digestion
1803 Composting
1804 Conditioning
1805 Dewatering, centrifugal
1806 Dewatering, Filtration
1807 Dewatering, evaporative
1808 Incineration
1809 Land disposal and agricultural Use
1810 Marine disposal
1811 Thickening

19 SOLID-WASTE MANAGEMENT
1901 Biological treatment
1902 Co-disposal
1903 Incineration
1904 Landfilling
1905 Recycling and recovery
1906 Volumetric reduction

20 SURFACE-WATER QUALITY
2001 Dissolved oxygen
2002 Drinking-water supply
2003 Eutrophication
2004 Fisheries
2005 Land-use control
2005 Mixing zones
2007 Non-point sources
2008 Pathogens
2009 Photo processes
2010 Recreation
2011 Sedimentation
2012 Waste load allocation

21 WASTEWATER COLLECTION
2101 Characterization of wastewaters
2102 Corrosion control
2103 Maintenance and construction
2104 Odor control
2105 Sewerage systems
2106 Storage or retention

22 WATER CHEMISTRY
2201 Acids and bases
2202 Complexation and chelation
2203 Corrosion and material degradation
2204 Kinetics
2205 Organic transformation
2206 Oxidation/reduction reactions
2207 Photochemistry
2208 Precipitation and dissolution
2209 Sorption
2210 Thermodynamics and Equilibrium

23 WATER DISTRIBUTION
2301 Bacterial growth
2302 Construction and maintenance
2303 Corrosion
2304 Disinfectant residual
2305 Reservoirs and storage tanks
2306 Tastes and odors
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New Job Title | New Employer’s Name

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New Office Tel. No. | New Office Fax No. | New Office Email Address

New Home Address

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New Home Tel. No. | New Home Fax No. | New Email Address

Alternate Email Address | Effective Date Change