Specialist Group on Wetland Systems for Water Pollution Control

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CONTENTS

EDITORIAL

Dear friends and colleagues,

It is already one year since when Guenter and me started with our duties for coordinating and representing our Specialist Group. As usual, it has been a great pleasure to meet several of you in the numerous events in which the wetlands community has been involved this year (i.e. the excellent workshops in Třeboň and Leipzig and the very successful WETPOL2013 in Nantes).

I take the occasion, for this second issue of the year of the SG newsletter, for briefly resuming the main activities and results obtained in these last months. The first result has been the approved change of the name from "Use of macrophytes for water pollution control" to "Wetland systems for water pollution control". I strongly hope that all the current 571 members of the SG have become aware of this change and that they will be able to identify their favourite SG with the new name in the list of the renewal form for the membership 2014.

Some help in facilitating the name transition is surely coming from the social media, even though both the Facebook page (http://www.facebook.com/IWAWetlands) and group (http://www.facebook.com/groups/IWAWetlands/) have still a lower number of subscriptions comparing to the SG potentialities (so please be active and promote both in your circles). The SG Water Wiki page is still active and I invite you all to visit it (for instance all the very interesting material produced during the Leipzig workshop are available there).

The proactive Management Committee is nowadays still refining a proposal for a new Constitution of the SG. We mainly are trying to define an efficient method for the Leaders and the MC elections as also for improving the process for scheduling and localising the biennial conferences around the world; in a few months more we should be able to have the new document approved by the MC and submitted to IWA HQ.

In the frame of reinforcing the links with the other IWA SGs we have accepted the invitation from the Assessment and Control of Hazardous Substances in Water SG Chair to participate in proposing a workshop for the next IWA World Water Congress in Lisbon in 2014. The proposed title is "*Advanced processes for the removal of micro-pollutants. Lessons learnt from full-scale plants and remaining issues*." Everyone in the SG which is dealing with studies on the fate of persistent organics and heavy metals or in advanced microbiology in wetland systems is encouraged to participate to this event, if and when it will be approved by the organisers.

After that I have participated to the IWA SG Leaders Forum in Valencia (7-8 November 2013), aimed to empower the SGs and enhance the cross-linking actions and initiatives, the MC is now evaluating the inclusion of our SG into the IWA clusters (http://www.iwahq.org/205/communities/clusters.html) and the linked Thematic Programs (http://www.iwahq.org/2h/themes.html). I am personally convinced that our group could be proficiently involved in 3 of the 4 clusters, but this is requiring some resources in terms of work hours and efforts to be put in following the several activities, which means that we will go further with our engagement if and when we'll have a positive response from some of our SG members with the formation of specific internal working groups.

All this should be enough already for keeping our minds in action, and instead there is a last long term project going on, still based on volunteer efforts of some proficient MC members, that is the tentative to add chapters about wetlands systems, written and elaborated by the SG via an internal Task Group, to the main engineering and sanitation related textbooks new editions.

I really wish to thank all the very active and motivated volunteers that are helping Guenter and me in coordinating and promoting the SG activities and strategies and I hope to assist in the next periods to an enlargement of the "involved members" platform. The IWA HQ short and long term strategies are very well fitting the approaches based on sustainability of water management that are typical for the wetlands systems sector, so a larger participation in the ongoing activities is now essential for us for disseminating in the most efficient way the impressive amount of knowledge produced by our SG in the last 25 years and for having a direct role in the transfer of the scientific and technological discovers into effective policies.

Wish you all the best and a fantastic 2014!

Fabio Masi

RECENT AND UPCOMING SG ACTIVITIES

by Günter Langergraber, Secretary of the SG

This part of the newsletter shall inform you about 1) SG activities since our last newsletter was published and 2) future activities.

1) Events interesting for the wetland community

IWA events

- *3rd IWA Development Congress & Exhibition, 14-17 October 2013, Nairobi, Kenya (*http://www.iwa2013nairobi.org/*):*

  About 1000 delegates participated in the 3rd IWA Development Congress in Nairobi. Our SG organised the workshop "*Prospects and challenges for constructed wetlands in developing countries*". About 80-90 people have been present during the workshop in which the following presentations have been made:

  - Günter Langergraber (BOKU, Austria): Introduction to Constructed Wetlands Technology
  - Markus Lechner (EcoSan Cub Austria): Constructed Wetlands for Wastewater Treatment in Uganda

  It has been shown that such general presentations are highly needed at the large IWA events as most participants of the session have not been familiar with constructed wetlands. Both presentations are available for download from the ***SuSanA library*** at http://susana.org/lang-en/library/library?view=ccbktypeitem&type=2&id=1861. And will be available soon also from the ***Wetland Systems SG IWA water wiki page*** at http://www.iwawaterwiki.org/xwiki/bin/view/WorkGroup_SG+on+The+Use+of+Macrophytes+in+Water+Pollution+Control/WebHome

- *11th IWA Conference on Small Water & Wastewater Systems and Sludge Management, 27-30 October 2013, Harbin, China (*http://www.iwasmallwater2013.org.cn/*):*

  This conference was support by our SG and the SGs on Resources-Oriented Sanitation and Sludge Management, respectively. According of IWA the Harbin conferences was the first co-organised by four SGs.

  During the first day of the conference, Günter Langergraber held a keynote presentation entitled "*The role of constructed treatment wetlands in resources-oriented sanitation systems*". Wetland papers have been presented during 2 sessions on Monday.

Non-IWA events on wetlands

- *8th International workshop on "Nutrient Cycling and Retention in Natural and Constructed Wetlands", 17-22 May 2013, Třeboň, Czech Republic:*
  See report of Jan Vymazal on page 19.
- *"UFZ Wetland Workshop", 12-14 June 2013, Leipzig, Germany:*
  See report of Jaime Nivala on page 21.
- *SWS European Chapter Meeting on "Wetland Systems: Ecology, Functioning and Management", 1-4 September 2013, Padova, Italy.*
- *5th International Symposium on "Wetland Pollutant Dynamics and Control (WETPOL 2013)", 14-17 October 2013, Nantes, France:*
  See report of Florent Chazerenc on page 22.

2) Planned events and activities of the Wetlands SG

The following events and activities are planned by the SG for 2014.

- *IWA World Water Congress, 21–26 September 2014, Lisbon, Portugal (*http://www.iwa2014lisbon.org/*):*
  Our SG was involved in submitting a joint proposal with several other SGs for a workshop on fate of micro-pollutants.
- *14th IWA Specialized Group Conference on "Wetland Systems for Water Pollution Control", 12-16 October 2014, Shanghai, China (*http://www.iwawetland2014.org/*):*
  After the IWA Small Systems conference in Harbin, I visited Tongji University in Shanghai to discuss specific aspects regarding our conference next year. I am sure that our Chinese colleagues will organise a great event that will fulfil our social and scientific expectations. The website of the conference is already online, the deadline for submission of abstracts (31 January 2014) is approaching, and we hope to meet many of you in Shanghai next year. The call for abstracts is included in the Newsletter.

4) Non-IWA events interesting for the wetland community:

Finally, I would like to draw your attention to two non-IWA events that might be interesting for the wetland community:

- the next SWS meeting will be held from to be held from 18-23 May 2014in Portland, Oregon, USA.
- the 6th International Symposium on "*Wetland Pollutant Dynamics and Control (WETPOL 2015)*" will be organised by Gabriela Dotro from 14-19 June 2015 in York, UK (see http://www.wetpol.org/2015/).

PAPERS FROM ICWS2012 PUBLISHED IN WATER SCIENCE AND TECHNOLGY

by Günter Langergraber, Secretary of the SG

After our last SG conference in Perth the conference organisers pre-selected 67 papers to be submitted for publication to *Water Sci Technol*. Out of the 67 papers, 21 papers have not been submitted to the journal by the authors and 1 paper was withdrawn after submission. From the 46 papers reviewed, 28 have been accepted for publication (42 % success rate) and 16 have been rejected (1 paper is still under review).

The following table lists the 28 accepted papers and represents the Table of Contents of the "**virtual special issue of *Water Sci Technol* from the Perth 2012 conference**".

Papers already published

#	Paper and Authors	Issue	Pages
1	Multı-stage constructed wetlands systems for municipal wastewater treatment *F. Masi, S. Caffaz and A. Ghrabi*	67.7	1590–1598
2	Are constructed treatment wetlands sustainable sanitation solutions? *Guenter Langergraber*	67.10	2133–2140
3	Experiences with pre-precipitation of phosphorus in a vertical flow constructed wetland in Austria *Robert E. Lauschmann, Markus Lechner, Thomas Ertl and Guenter Langergraber*	67.10	2337–2341
4	Sustainable biodegradation of phenolic endocrine-disrupting chemicals by Phragmites australis-rhizosphere bacteria association *T. Toyama, T. Ojima, Y. Tanaka, K. Mori and M. Morikawa*	68.3	522–529
5	Management and treatment of landfill leachate by a system of constructed wetlands and ponds in Singapore *C.H. Sim, B.S. Quek, R.B.E. Shutes and K.H. Goh*	68.5	1114–1122
6	Tech-ia floating system introduced in urban wastewater treatment plants in veneto region - Italy *Anna Mietto, Maurizio Borin, Michela Salvato, Paolo Ronco and Nicola Tadiello*	68.5	1144–1150
7	Reconstruction of a constructed wetland with horizontal subsurface flow after 18 year of operation *Tereza Tereza Hudcová, Jan Vymazal and Michal Kriška Dunajský*	68.5	1195–1202
8	Treatment of domestic wastewater by a subsurface vertical flow constructed wetland system planted with umbrella sedge and vetiver grass *Suwasa Kantawanichkul, Somsiri Sattayapanich and Frank van Dien*	68.6	1345–1351
9	Effects of a saturated layer and of a recirculation on nitrogen treatment performances of a single stage Vertical Flow Constructed Wetland (VFCW) *S. Prigent, J. Paing, Y. Andres and F. Chazarenc*	68.7	1461–1467
10	Design and performance of hybrid wetland systems for high-content wastewater treatment in the cold climate of Hokkaido, northern Japan *Kato, T. Inoue, H. Ietsugu, H. Sasaki, J. Harada, K. Kitagawa and P. K. Sharma*	68.7	1468–1476
11	Performance and behaviour of planted and unplanted units of a horizontal subsurface flow constructed wetland system based on a four-year study *Jocilene Ferreira da Costa, André Cordeiro de Paoli, Martin Seidl and Marcos von Sperling*	68.7	1495–1502

Papers already published (cont'd)

#	Paper and Authors	Issue	Pages
12	Short-Term performance analysis of sludge- treatment reed beds *Renato Iannelli, Steen Nielsen, Eleonora Peruzzi, Francesca Piras, Martin Støvring and Grazia Masciandaro*	68.7	1520–1528
14	Performance of a single stage vertical flow constructed wetland system treating raw sewage in Brazil *L.C.O. Lana, D.C. Moraes, M. von Sperling, M.L.N. Morato, G.R. Vasconcellos, M.O. Paraense and T.P.A. Moreira*	68.7	1599–1606
15	Empirical Regression Models for Estimating Nitrogen Removal in a Stormwater Wetland during Dry and Wet days *Heidi B. Guerra, Kisoo Park and Youngchul Kim*	68.7	1641–1649
16	Relationship between operational parameters and the survival of indicator microorganisms in a stormwater wetland *Jing Cheng, Siping Niu and Youngchul Kim*	68.7	1650–1656
17	Stormwater Nitrogen removal performance of a Floating Treatment Wetland *Karine E. Borne, Chris C. Tanner and Elizabeth A. Fassman-Beck*	68.7	1657–1664
18	Organic matter stabilization in reed bed systems: Danish and Italian examples *Eleonora Peruzzi, Steen Nielsen, Cristina Macci, Serena Doni, Renato Iannelli, Mario Chiarugi and Grazia Masciandaro*	68.8	1888–1894
19	The Malabugilmah subsurface horizontal flow wetland system- Construction, maintenance and performance *Lise M.W. Bolton and Keith G.E. Bolton*	68.9	1920–1925
20	Improving the reliability of closed chamber methodologies for methane emissions measurement in treatment wetlands *Clara Corbella and Jaume Puigagut*	68.9	2097–2102

Papers accepted but not yet published

#	Paper and Authors	Planned issue / time
21	Performance assessment of pilot scale horizontal subsurface-flow constructed wetlands for diesel removal from wastewater by *Scripus grossus* (Israa Al-Baldawi*)	68.10
22	Physical-chemical characterization of solid materials sampled from a partially flooded vertical flow constructed wetland (M. Gautier*)	68.10
23	Performance characterisation of a constructed wetland (Isri R. Mangangka*)	68.10
24	Material selection for a Constructed Wetroof treating wastewater (Maribel Zapater-Pereyra*)	68.10
25	Temperature, Plant Species and Residence Time Effects on Nitrogen Removal in Model Treatment Wetlands (Otto R. Stein*)	Dec 2013
26	French vertical flow constructed wetlands: a need of a better understanding of the role of the deposit layer. (Pascal Molle*)	Jan 2014
27	Stabilisation and Mineralisation of sludge in reed bed system after 10-20 years of operation (Steen Nielsen*)	Jan 2014
28	Fate of hydrocarbon pollutants in source and non-source control SUDS systems (Georgios Roinas*)	Feb 2014

* corresponding author

the international water association

Call for abstracts

14th IWA International Conference
Wetland Systems for Water Pollution Control

ORGANISED BY:

SPONSORED BY:

SPECIALIST CONFERENCES

12th-16th October 2014
Shanghai, China

The Organisers

This conference is jointly organised by:

College of Environmental Science and Engineering at Tongji University
School of Urban Construction and Environmental Engineering at Chongqing University.

Welcome and Invitation

Prof Brian Shutes. PhD, M.A., M.Tech, CBiol, FSB.

Emeritus Professor of Ecotechnology, Middlesex University, London.
Vice-Chair, IWA Wetland Systems for Water Pollution Control Specialist Group, 1996-2008

On behalf of the Scientific Committee of the International Water Association (IWA) 14th International Conference on Wetland Systems for Water Pollution Control (ICWS), I am delighted to welcome participants to attend the 14th ICWS, Shanghai, China, 12-16 October 2014. It is twenty years since the 4th ICWS conference was held in Guangzhou and it is appropriate, following the considerable advances in the global use of wetland systems that our biennial conference should return to China. Historically, China has been both an innovator and a leader in the use of natural, sustainable and ecologically harmonious systems for water recycling and agricultural production and the relatively recent development of constructed wetland systems owes much to this legacy.

Prof Qi Zhou. PhD, M.A.

Professor of College of Environmental Science and Engineering, Tongji Unversity, Shanghai
Chairman of Conference Organizing Committee

On behalf of the Organising Committee of the Conference and the College of Environmental Science and Engineering, Tongji University, I warmly welcome wetland scientists, researchers, engineers and policy makers from all over the world in Shanghai. Shanghai is the most modern city in China that offers the visitors fascinating history, splendid architecture, modern public transportation, access to the most recent technological advances and the old-fashioned hospitality. Shanghai will offer our distinguished guests sincere friendliness and unique attractions. We are here to review the advances in understanding wetland processes, to exchange ideas and to discuss future challenges in wetlands for water pollution control. I look forward to meeting you all at the conference.

14th IWA International Conference Wetland Systems for Water Pollution Control

There is increasing pressure to reduce the global demand for water and energy while providing low cost systems for water pollution treatment and recycling. Constructed wetlands fulfil these requirements and provide flexible and adaptable systems in a range of designed types and sizes for treating domestic, industrial, agricultural and mining wastewater and urban storm water.

This 14th ICWS conference will provide an international platform for the presentation of recent research and developments and the exchange of ideas between environmental scientists and engineers, policy makers, industrialists, entrepreneurs and research students who share a common interest in the use of wetland systems for water pollution control.

The conference will also provide an opportunity to experience the warm welcome and excellent hospitality that is given to visitors to China as well as the exciting environment of Shanghai, a global megacity.

Conference Language

The official language of the conference will be English. There will be oral and poster presentations, with pre-printed abstracts of conference papers.

Conference Venue

The conference will take place in Yifu Building and Sino-French Center on the campus of Tongji University. Yifu Building is used as the meeting area, with lecture halls that can accommodate up to 350 people and 180 people theatre style, and with an auditorium that can accommodate up to 80 people. Sino-French Center is a first-class conference center, which offers a 600-seat conference hall, and several medium to small scale meeting rooms.

Conference Themes

1. **Process dynamics**: Hydrology, Biochemistry, Kinetics, Plants and their futures, Substrate, Microbiology, Biotechnology, Biodiversity benefits, Enhanced/active aeration
2. **Treatment performance of wetlands for water pollution control**: Organics, Nutrients, Suspended solids, Heavy metals, Persistent/toxic organic pollutants, Micro-organic pollutants, Sludge dewatering/stabilization
3. **Design criteria and operation**: Hydraulics, Sizing criteria, Vegetation management, Modelling and optimisation, Regulations, Pollutant loading
4. **Application**: Municipal wastewater, Industrial wastewater, Agricultural and animal wastewater, Landfill leachates, Mine water, Stormwater, Combined sewer overflows, Effluents from secondary treatment, Water reuse, Eco-sanitation, Onsite bioremediation, Non-point source control, Riparian buffer zones, Wetland restoration, New application and possibilities, Lesson learned
5. **Landscaping**: Green roofs, Vertical farming, Sustainable urban and agricultural drainage, Recreational concepts for wetlands, Functional landscaping
6. **Hybrid, floating, algal systems**
7. **Economics**: Investment costs, Operation and maintenance costs, Biomass production and benefits, Ancillary benefits
8. **Environmental issues**: Greenhouse gases, Life cycle assessment, Ecological value and biodiversity, Clean development mechanism, Policies
9. **CW components**: New materials, Hydraulic devices, Innovative concepts, Plants, Maintenance tools

Key Dates

First announcement and call for abstracts	**September 2013**
Deadline for abstract submission	**30 January 2014**
Date for notifying successful authors	**30 April 2014**
Deadline for full paper submission	**31 August 2014**
Early registration before	**1 September 2014**
Conference takes place	**12-16 October 2014**

Registration fees

	Before 1 September 2014	After 1 September 2014
IWA member (HIC)	CNY 3200/Euro 400	CNY 4000/Euro 500
IWA non-member (HIC)	CNY 4000/Euro 500	CNY 5500/Euro 650
IWA member (LIC)	CNY 2400/Euro 300	CNY 3200/Euro 400
IWA non-member (LIC)	CNY 3200/Euro 400	CNY 4000/Euro 500
YWPs/Students/Retired (IWA member)	CNY 1200/Euro 150	CNY 1500/Euro 200
Students/Retired (IWA non-member)	CNY 2000/Euro 250	CNY 2500/Euro 300

HIC: high income country, LIC: low income country, YWPs: young water professionals

Technical Tour

The Dongtan Wetland Park on Chongming Island boasts beautiful intact wetland scenery, and is home to more than 140 bird species and 180 plant species. The 30,000-hectare wetland appraised as the National Natural Reserve of Birds, has been designated as a major wetland in the world by the “Convention on Wetlands by United Nations”.

Programme Outline

Sunday, 12 October 2014	Monday, 13 October 2014	Tuesday, 14 October 2014	Wednesday, 15 October 2014	Thursday, 16 October 2014
1. Registration 2. Poster set-up 3. YWP workshop 4. Welcome reception	1. Welcome and inaugural session 2. Plenary session 3. Parallel sessions 4. Specialist group meeting	1. Plenary session 2. Parallel sessions 3. Gala dinner	Conference technical tour	1. Parallel sessions 2. Plenary session 3. Conclusive remarks 4. Workshops

Organising Committee

Qi Zhou, Tongji University (Chair)
Qiang He, Chongqing University (Co-chair)
Zhenbin Wu, Chinese Academy of Science (Co-chair)
Shuiping Cheng, Tongji University (Co-Chair)
Tao LI, IWA China Regional Office
Jun Zhai, Chongqing University
Zifu Li, University of Science and Technology Beijing
Yaqian Zhao, University College Dublin, Ireland
Baixing Yan, Chinese Academy of Science
Guodong Ji, Peking University
Yuansheng Pei, Beijing Normal University
Gabriela Dotro, Cranfield University, UK
Yue Wen, Tongji University
Bin Xu, Tongji University (Secretary)

Programme Committee

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Fabio Masi (Italy)
Akintunde Babatunde (UK)
Florent Chazarenc (France)
Gabriela Dotro (UK)
Michal Green (Israel)
Tom Headley (Oman)
Suwasa Kantawanichkul (Thailand)
Jamidu H.Y. Katima (Tanzania)
Gunter Langergraber (Austria)
Heribert Rustige (Germany)
Otto R Stein (USA)
Chris Tanner (NZ)
Jan Vymazal (Czech Republic)
Silvana Audrá Cutolo (Brazil)

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John Bavor (Australia)
Maurizio Borin (Italy)
Jacques Brisson (Canada)
Hans Brix (Denmark)
Jie Chang (China)
Stewart Dallas (Australia)
Tjasa Griessler Bulc (Slovenia)
Margaret Greenway (Australia)
Hongying Hu (China)
Miklas Scholz (UK)
Poh-Eng Lim (Malaysia)
Ranka Junge (Switzerland)
Robert Kadlec (USA)
Ülo Mander (Estonia)
Pascal Molle (France)
Jamie Nivala (Germany/USA)
Scott Wallace (USA)
Zhenbin Wu (China)
Xiaochang Wang (China)
Lei Yang (Chinese Taipei)
Qi Zhou (China)
Joan García (Spain)
Peter Kuschk (Germany)

Keynote Speakers

Brian Shutes (UK)
Fabio Masi (Italy)
Qi Zhou (China)
Hans Brix (Denmark)
Gunter Langergraber (Austria)
Linda Strande (Switzerland)
Jie Chang (China)
Jan Vymazal (Czech Republic)
Scott Wallace (USA)
Zhenbin Wu (China)
Karin Tonderski (Sweden)

Call for papers

Oral presentation and poster presentation will be considered. Authors are invited to submit an abstract (maximum 300 words), indicating the preference as oral or poster presentation and the topic contribution, before **30 January 2014**. The procedure as well as the template for submission will be available on the conference website. The Scientific Committee will evaluate the abstract and give the acceptance notification by **30 April 2014**. Authors of both oral and poster presentations will be required to submit the full papers by **31 August 2014**.
A poster competition will be held. The poster session winners will be announced in the closing ceremony. The manuscripts will be reviewed and selected papers will be recommended for publication in **Water Science and Technology** (SCI journal).

WWW.iwawetland2014.org

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INTERVIEWING JOAN GARCÍA PHD

by Frank van Dien
ECOFYT, The Netherlands

1966: born in Barcelona, Spain
1991: M.Sc.in Biology (University of Barcelona, UB)
1996: Ph.D in Biology (UB)
1996: Constructed first treatment wetland
2008: Professor of Environmental Engineering at the Universitat Politècnica de Catalunya-BarcelonaTech

Probably most people know you as one of the leading people in the Constructed Wetland world. At least as the Spanish connection! Personally I remember you from the Conference in India where you told me about an excellent wine coming from an area where a winery was only possible because the use of treated wastewater as irrigation water. And then, laughing: "But no credits for the treatment plant, it would stop the selling of that wine!".
Maybe now it is time for even more people to find out a little more about you. For starters, I wonder:
Where in your life did things definitely turn in the direction that resulted in your role in world of constructed wetlands?

Oh, this question brings back good memories. It was in the early nineties, while working on my PhD on high rate algal ponds for wastewater treatment (sorry my friends, there is life beyond wetlands!). I came across Hans and Bob, in a course that I attended about the wetlands in the Mediterranean Agronomic Institute of Zaragoza, Spain. These guys were the main professors. They are always inspirational people!

What has kept you working on wetland systems?

Throughout my professional career, I have worked in the field of water quality and sanitation, and constructed wetlands are an important technology in this field, aren't they?

What do you prefer as a "name": Constructed Wetland or Treatment Wetland?

I really do not have a preference. Both sound fine to me. Who cares anyway?

The next question that comes up is: do you see these wetlands as an ultimate solution for domestic/ municipal waste water? And if so, in general or just occasional, i.e. when no sewer system is available?

No, I do not see wetlands as the ultimate solution. Other technologies are also suitable in a great variety of situations. Each project should have an appropriate alternative analysis. Though I have to say that in many situations wetlands are the most favourable technology, but as I said, this has to be carefully studied and justified. Of course, if your expertise resides only on planning, designing, building and operating wetlands, or wetlands are the distinctive feature of your company, then no doubt they are the ultimate solution.

What does this world need most at the moment?
Overcoming social, economic and environmental inequalities.
What does the water clean-up world need most at the moment?
Solutions that do not involve technological dependence.

Haha, even then I think one should maintain enough distance and objectivity, just like you (and most other interviewees) exposed. Can you tell me: what do you do, besides wetlands, what are your other interests?

I play football regularly, and I very much enjoy going hiking in the Pyrenees when I have the chance. I also like to share a good meal with family and friends. And every so often I give lectures at University for fun and, in addition to wetlands, I work on other subjects like algae systems, anaerobic digestion, water reuse, etc…ja, ja, ja!

What is the most promising application area for wetland systems, besides domestic/municipal wastewater?

In many countries, domestic and municipal applications are still needed and there is a huge potential market for this. Industrial wastewater applications will increase in the near future, but it really depends on each particular situation. For example, in Spain, industrial applications will be strongly limited by the land price.

Is there, to your knowledge, a Treatment Wetland that is an example for us all? Or just one that you can bring to our attention, for some specific reason?

Let me propose as example the 7 ha surface flow wetland in Empuriabrava, Girona, Spain, that was built 1998. We visited the system in the Wetpol in 2009. It is a very successful project, with thousands of visitors each year.
http://www.ccbgi.org/docs/jornades_wetpol_09/aiguamolls_23_setembre_2009-ccb.pdf

What is the most needed area of further research and study for treatment wetlands?

At present we only have a fuzzy picture of the functioning of wetlands. This is due to its complexity, variability and randomness. Each system studied in each paper is almost a particular case! For instance, of the many studies on plant effects carried out over the years, I bet we cannot find two of them that have obtained the same results. And so it is basically that what prevents us from making significant advances in the understanding of the general processes that, of course, should occur in all systems. A decrease on the number of variables in our empirical studies may contribute to improving our knowledge on these systems. Consider an example from basic physics that most of us known from school: If you drop a feather and a lead ball from the balcony of your house, the ball reaches the ground first and so we could conclude that Aristotle was right. If you repeat the same experiment in a vacuum environment,

The two type of wetlands researchers looking at their local world. More cooperation will be highly productive.

the two objects will reach the ground at the same time and Galileo will be our ally. I of course prefer Galileo. In this simple example, the variable distorting the output of our experiment is air friction.

So, in our wetland studies, if we don't get rid of distorting variables, we will not be able to make real advances and we'll keep groping blindly. Therefore, in my opinion we need more fundamental research to understand more general processes, to build a solid knowledge basis to start from in each "particular" case. I am of the opinion that, in general, experimental and theoretical (modeller) wetland researchers should work closely to achieve common objectives. I have enclosed two drawings that came to mind this summer when reading books, and that describe what happens sometimes: we only open the eyes to our narrow and local world, and forget the sense of totality.

Oh, great! I hope you set a trend here, with adding such novelties and 'art'! How we could get to more cooperation in research? Would you have an answer to that?

The most important thing is that each one has to realize that, to make significant progress requires the knowledge an!d talent of many people. Cooperation requires strategic planning and this in turn requires time. Keep in mind that you will have to invest time into actions that will have results in the long term. The next coming EU program Horizon2020 will have excellent tools for collaboration, in particular for demonstration projects.

Thank you very much for your time and elaborated answers! My last question is: who would you like to be interviewed next time?

I truly admire the work that Peter Kuschk and his colleagues keep carrying out at UFZ.

Okay, then that will be our next guest!

INTRODUCING THE SWINGS PROJECT

SWINGS is a cooperation project aimed at implementing integral domestic wastewater treatment and reuse using constructed wetlands and solar driven disinfection technology

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Hanhu Liu[1], Jun Zhai[2]

Safeguarding water resources in India with green and sustainable technologies (SWINGS) is a three year cooperation project, financed under the umbrella of the joint EU-India call for "EU-India cooperation in water technology and management: research and innovation initiative"; Where the funding is provided by the FP7 program and the Department of Science and Technology of the Government of India (DST) and aimed at implementing state of the art constructed and wetland and disinfection technology for the treatment of domestic wastewater and reuse of the treated waters. The consortium includes 20 partners 10 of which are European and 10 from India and in Europe is coordinated by AIMEN from Spain, while in India Aligarh Muslim University (AMU) is responsible for the coordination. Figure 1 presents the geographical location of the partners. The consortium includes research institution, SMEs, NGOs as well as local municipal bodies that will guarantee the participation of all the sectors of society.

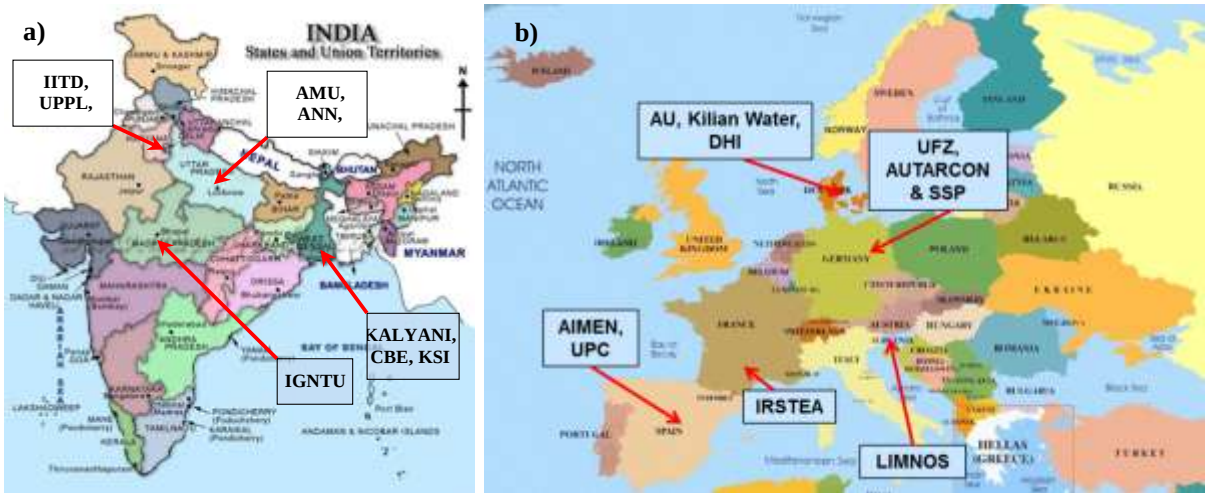

Figure 1. a) Indian partner and their geographical location b) European partners and geographical location (Modified from Alvarez J.A. *et al.*). A list with the complete names of the partners is provided at the end of this document.

The objective of the project is to develop low cost optimized treatment schemes employing state of the art wastewater management to make full use of water resources while maximising energy savings (high methane production and low excess sludge) mainly at community level. Additionally, the project aims at combining available "green" and sustainable technologies that can produce treated wastewater to be reuse in productive activities such as irrigation, nutrient supply, soil enrichment and aquaculture activities, while assuring no risk due to pathogen exposure to the population and complying with all the national discharge standards.

The consortium met in India at AMU in April 2013, to launch the project and present the development plans for the next three years that the project will last, the meeting was attended by all the partners, as well as national and local environmental authorities. The Kick off meeting included the presentation of the project to the national authorities, followed by discussions about the implementation plans, the design and the participation of all the partners. Following the discussions the group visited the University as well as the site where the AMU plant will be placed. Additionally, two technical visits were done one to the wastewater treatment plant at Dhandupura and the second to the water purification plant at Agra.

Figure 2. a) Oficial picture of the Kick off meeting with the presence of Indian national officials and the memeberss of the consortium. b) Official picture of the visit to Dhandupura wastewater treatment plant. (Pictures courtesy of Dr. Nadeem Khalil)

The project will design, install and test infrastructure in the sites as follows: two complete wastewater treatment and reuse units that are being projected and constructed at the campuses of Indian Institute of Technology (IITD), and AMU, disinfection units testing different technologies at Indira Gandhi National Tribal University (INGTU) and University of Kalyani (KLYUNIV). Two treatment systems that will be built at IITD and AMU respectively and are designed to provide full wastewater treatment by establishing wastewater treatment trains of pretreatment, primary treatment followed by secondary treatment and disinfection units. The pretreatment will be achieved using conventional systems such as bar racks, primary treatment will be achieved using anaerobic treatment, and secondary treatment will be achieved using combinations of horizontal and vertical flow constructed wetlands. For the disinfection of treated water and to allow the reuse three processes will established, including solar driven technology using UV, anodic oxidation and disinfection lagoons. The treated water will be reuse for agricultural and for irrigation purposes in the sites.

The system in IITD in Delhi will treat wastewater generated at the campus from a students' dorm that houses around 600 PE. The raw wastewater will be intercepted and conducted to the plant that is projected to be built in adjacent field. The system pre-treatment is achieved using an anaerobic digester follow by a two steps of constructed wetlands. The first step will comprise of vertical flow constructed wetlands using the French technology; made of three beds that are to be dosed sequentially. The next step has two parallel horizontal flow

constructed wetlands beds. The systems will be planted with native plants. Following the constructed wetlands three disinfection system will be tested. The first disinfection unit will evaluate the UV passive disinfection potential using a pond that is being designed by Solar Spring (SSP). The other two disinfection units use solar power to run technical systems. The first technical system is solar driven UV disinfection unit built by Solar Spring (SSP), while the second technical disinfection unit is based in anodic oxidation technology being built by AUTARCON. It is expected that the three systems will provide an effluent with water quality sufficiently high that will allow direct reuse of the water in the campus. Additionally, landscaping and beautification has been taken into consideration instead of building rectangular shapes commonly used in treatment wetland, the actual establishment design for the IITD system has the shape of a Lotus flower (Figure 3). The design also included the possibility of sampling at the different steps to monitored performance.

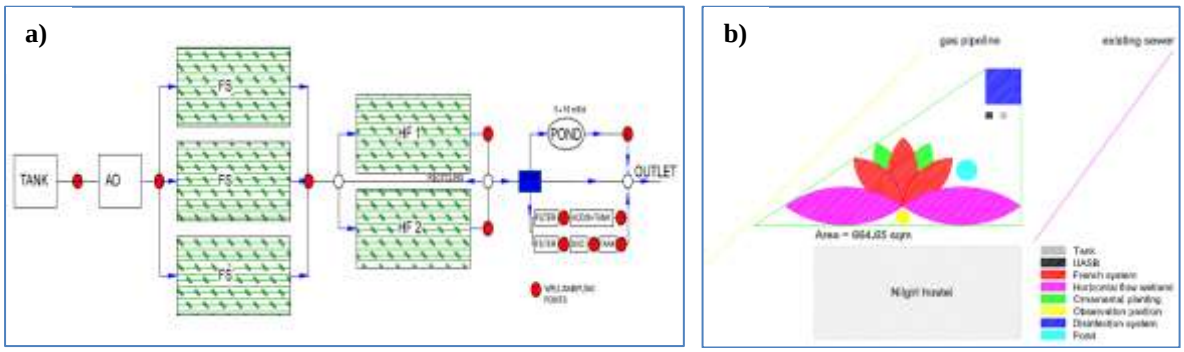

Figure 3 Design of IITD and a) Conceptual design of the plant to be established at IITD; b) Landscaping design of the system.

The wastewater plant at AMU will treat wastewater for 1000 PE, generated at the Campus. The system comprises the construction of a combination of anaerobic primary treatment, CW system and a disinfection unit. The primary treatment will be achieved with a two stage system a hydrolytic-acidogenic reactor followed by a methanogenic reactor with a capacity of 50 m3/d. The secondary treatment consists of two parallel CWs treatment lines, with a combination of unsaturated vertical flow constructed wetlands, followed by horizontal subsurface flow constructed wetlands. The systems will be planted with local species. The design also includes flexibility in the operation and is fitted with alternatives, for recirculation of treated effluents to the different treatment stages to permit different operational options and exploitation strategies. Following the CWs the system is fitted with a solar driven UV disinfection unit installed by SSP that sill produce 10 m3/d of effluent for the irrigation of the adjacent agricultural fields as well as providing water to supply the needs of the treatment plant itself.

Figure 4 Conceptual design of the system to be established at Aligarh the green areas correspond to the vertical flow constructed wetland while the yellow diagrams correspond to the HF CW.

Two more disinfection research sites are currently being established. The first unit is being established at IGNTU, were AUTOCORN is installing a solar driven anodic oxidation system. The infrastructure needed implies building a tower were the solar cells and the necessary

equipment will be mounted (Figure 5). The second disinfection unit is being installed at KALYANI, were a natural UV light system and a pond for aquaculture are implemented. Additionally, the possibility of establishing a bank filtration unit for the improvement of water quality at the site is being evaluated.

Figure 5. Construction of the building to house an Anodic Oxidation Unit (picture courtesy of Mr. Philipp Otter.)

Once all the projected systems at the sites are established and running, will serve as a model for the treatment and reuse of wastewaters generated at single households and small communities. We expect the model could be replicated not only in India but in other tropical countries of the region. The approach developed and the technical concepts implemented by the SWINGS project, with the active participation of both European and Indian Know-How benefit the local community as well as the partners. Additionally, the SWINGS project aims for the research and implementation of reuse of treated water at low cost that can produce water free of pathogens. The implementation of the technology minimizes risks associated to human health and can help mitigate water scarcity in dry or arid regions of India and the neighboring countries.

Besides testing and validation of the technology operating under the harsh Indian climatic conditions, the SWINGS project, along with the other EU-DST parallel projects currently running in India, will serve to demonstrate appropriate and affordable technology that can improve water quality and increase life quality in India.

Table 1 Consortium participants and their acronyms.

European Partners		Indian partners	
Acronym	**Institution Name**	**Acronym**	**Institution Name**
AIMEN	AIMEN Technology Centre	**AMU**	Aligarh Muslim University
AU	Aarhus University	**ICEE**	International Centre for Ecological Engineering
UPC	Universitat Politècnica de Catalunya	**CBE**	Centre for Built Environment
UFZ	Helmholtz Centre for Environmental Research	**IGNTU**	Indira Gandhi National Tribal University
IRSTEA	National Research Institute of Science and Technology for Environment and Agriculture.	**IITD**	Institute of Technology Delhi
AUTOCORN	AUTARCON GmbH	**AARVEE**	AARVEE Associates
KILIAN WATER	Kilian Water ApS.	**URBAPLAN**	URBANPLAN
LIMNOS	Limnos	**KLYUNIV**	University of Kalyani
SSP	SolarSpring GmbH	**UPJN**	UPJN
DHI	Denmark Hydraulic Institute	**ANN**	Aligarh Nagar Nigam

For more details: http://www.swingsproject.eu/

REPORT ON THE 8th TŘEBOŇ WORKSHOP, 17-21 MAY 2013

by Jan Vymazal

On May 17-21, 2013, the 8th workshop „*Nutrient Cycling and Retention in Natural and Constructed Wetlands*“ was held at Třeboň, Czech Republic. The program consisted of two days of presentations and two days of field trips. The presentations were aimed on both natural and constructed wetlands as the seminars organizers have always believed that the exchange of knowledge between groups dealing with natural and constructed wetlands is beneficial for both groups. The workshop was attended by 29 participants from 15 countries.

List of papers presented at the 8th Třeboň workshop:

- *Jan Květ* : Plants suitable for cultivation in temperate wetlands
- *Hana Čížková, Jana Rychterová, Libuše Hamadejová, Karel Suchý, Jan Květ, Neil O. Anderson* : Production in permanent wet grasslands dominated by *Phalaris arundinacea*
- *Ellen Herbert, Laura Trice, Anya Hopple, and Christopher B. Craft*: Quantifying the Impacts of Long-Term Nutrient Enrichment on the Greenhouse Gas Emissions and Water Quality Improvement Functions of a Tidal Freshwater Wetland
- *Siobhan Fennessy, Denice Wardrop, Jessica Moon* : The Cycling and Retention of N and C in Riverine Wetlands across a Gradient of Ecological Condition
- *John Bavor and Batdelger Shinen:* Assessment of biological availability of iron phosphate-nanoparticle immobilised metals in wetland sediments.
- *Jacob M. Bannister and Christopher B. Craft:* Spatial Variability in Soil Properties and Processes in an Alluvial Floodplain Forest
- *Annu Kaila:* Use of natural and restored peatlands as buffer areas in reducing sediment and nutrient transport from forested catchments
- *Katja Klančnik and Alenka Gaberščik:* Plant traits that shape leaf "spectral signatures" differ in plants growing over water/land gradient
- *Ülo Mander, Teele Sildvee, Marika Truu, Jaak Truu, Jaan Pärn, Sergey Egorov, Järvi Järveoja, Martin Maddison, Kaido Soosaar, Kristjan Oopkaup and Alar Teemusk:* Spatial patterns of denitrification and its functional genes in peatlands
- *Andreas Schönborn, Petra Kunz, Claudius Boesiger, Markus Kneubühl, Margie Koster and Harrie Besselink:* Estrogenic activity in drainage water: a field study on an intensively managed Swiss cattle pasture"
- *Hanna Hurynna, Petra Hesslerová and Jan Pokorný:* Comparison of solar energy distribution in agricultural landscape and wet meadow
- *Petra Hesslerová and Jan Pokorný:* Surface temperature, wetness and vegetation dynamic in agriculture landscape – comparison of cadasters with different types of wetlands
- *Karin S. Tonderski, Pers, C. and Thorén, A.-K.:* Estimating the impact of wetlands on N and P transport from Swedish catchments - a critical evaluation
- *Charlote Kjærgaard: C*onstructed wetlands targeting agricultural drainage discharge
- *Carl Christian Hoffmann:* First results from subsurface flow wetlands - horizontal and vertical - with mixed matrixes of mussel shells and woodchips”
- *Ketil Haardstad and Anne-Grete Blankenberg:* Agricultural runoff in Norway - what is the problem, what is the regulations and what is the role of wetlands?
- *Miloš Rozkošný, R. Pavelková Chmelová, M. Dzuráková, I. Konvit, H. Hudcová, J. Frajer and P. Pavka:* The use of abandoned ponds for creation of wetlands and small water bodies intended for nutrient elimination in agricultural landscape

- *Roger Samsó and Joan García:* The cartridge theory: a conceptual approach to horizontal-flow wetlands' functioning
- *Günter Langergraber:* Results from the first full-scale implementation of a new 2-stage vertical flow constructed wetland design
- *Fabio Masi, Riccardo Bresciani, Miria Bracali:* A new concept of Multi-Stage Treatment Wetland for winery wastewater treatment: long-term evaluation of performances
- *Adam Sochacki, Joanna Surmacz-Górska, Olivier Faure and Bernard Guy:* Tertiary treatment of electroplating wastewater in microcosm upflow treatmeent wetlands
- *Georges Reeb and Etienne Dantan:* Relationship between filtering material, nitrification and age of CWs treating raw wastewater.
- *Hanna Obarska-Pempkowiak and Magdalena Gajewska:* Single family treatment wetlands progression in Poland
- *Hanna Obarska-Pempkowiak, Magdalena Gajewska, Marzena Stosik and Ewa Wojciechowska:* Treatment wetland for overflow storm water treatment – the impact of pollutants particles size
- *Katarzyna Kołecka,Hanna, Obarska-Pempkowiak and Janusz Pempkowiak:* Managemant of wastewater in rural areas for the Baltic Sea water improvement
- *Gabriela Dotro:* Nutrient removal with constructed wetlands at a Major UK water company
- *Diederik Rousseau:* Using vertical gardens for grey water treatment
- *Jan Vymazal:* Does the presence of weedy species affect the treatment efficiency in constructed wetlands with horizontal subsurface flow?

The papers presented during the seminar will be published in the book "Role of Natural and Constructed Wetlands in Nutrient Cycling and Retention on the Landscape" published by Springer in 2014.

Participants of the 8th Třeboň workshop

REPORT ON THE UZF WETLAND WORKSHOP, 12-14 JUNE 2013, LEIPZIG, GERMANY

by Jaime Nivala

UFZ hosted a three-day workshop in Leipzig, Germany from 12-14 June 2013. The purpose of the workshop was to foster discussion and collaboration between research institutions, private sector, and other supporting organizations working in the field of treatment wetlands.

The format of the workshop was different from that of a traditional conference. The first and third days were broken into 90-minute blocks of time (eight blocks in total over the two days) where we had the opportunity for a 30-minute presentation followed by a 60-minute discussion session on a specific topic. Each session was chaired by 2 – 3 people who were asked to give an overview of the current state-of-the-art for the specified topic and facilitate fruitful discussion. The second day of the workshop contained technical visits to two UFZ treatment wetland research sites. The first site visit was to Langenreichenbach, where 15 small scale eco-technologies are being assessed for the treatment of domestic wastewater. The second site was to the Leuna industrial facility where the UFZ has a pilot scale industrial treatment wetland. This system has been designed to effectively treat organic contaminants (BTEX, MTBE) in the local groundwater.

Technical tour of the UFZ research facility in Langenreichenbach, Germany. Photo courtesy Iztok Amersek.

The workshop included the following sessions:

- Session 1: Research & Industry
- Session 2: Industrial Applications
- Session 3: Effective Sanitation in Developing Regions
- Session 4: Intensified and Modified Designs
- Session 5: Solids and Clogging
- Session 6: Combined Sewer Overflow
- Session 7: Microbiology
- Session 8: Modeling

The closing session for the workshop included a discussion of the workshop outcomes, including:

- pdf-files of presentations and transcription of each session discussion, which is located on the ***Wetland Systems SG IWA water wiki page***: http://www.iwawaterwiki.org/xwiki/bin/view/WorkGroup_SG+on+The+Use+of+Macrophytes+in+Water+Pollution+Control/WebHome
- The summaries of the sessions will be published in the on-line journal ***Sustainable Sanitation Practice*** (http://www.ecosan.at/ssp) in Januray 2014.

REPORT ON THE 5TH INTERNATIONAL SYMPOSIUM ON WETLAND POLLUTANT DYNAMICS AND CONTROL (WETPOL 2013)

by Florent Chazerenc

The 5th International Symposium on Wetland Pollutant Dynamics and Control has been held in Nantes, France, last October 13-17 2013 and was a follow up of the previous meetings: 2005 in Gent (Belgium), 2007 in Tartu (Estonia), 2009 in Barcelona (Spain) and 2011 in Prague (Czech Republic). This edition was organized by Ecole des Mines de Nantes, and the GEPEA Laboratory. At Ecole des Mines de Nantes, GEPEA laboratory (Process Engineering for Environment and Food), leads research works dealing with environmental engineering for air and water treatment.

The conference took place in the heart of Nantes at "La Cité Nantes Events Center" where plenary, parallel and poster sessions have been performed. For this edition, 5 keynote speakers have been invited:

- Bill Mitsch, USA, "Protecting the Florida Everglades Wetlands with Wetlands - Can stormwater phosphorus be reduced to oligotrophic conditions?"
- Jacques Brisson, Canada, "Ecoystem services of wetlands: does plant diversity really matter ?"
- Lars Duester, Germany, "Wastewater, examples on new organic contaminants, upcoming metal(loid)s, nanomaterials & the transfer/transformation in wetlands"
- Joan Garcia, Spain, "The Cartridge Theory: a Conceptual Approach to Horizontal-Flow Wetlands' Functioning"
- Kela Weber, Canada, "The role and characterization of microbial communities in wetlands for water pollution control".

Additionally, 3 invited speaker session have been performed, during which three experts did manage a short presentation followed by a group discussion on elected topics such as:

- Dirk Esser, France, "30 years of CWs research in France"
- Sylvie De Blois, Canada, "Global change and Wetlands"
- Chris Tanner, New Zealand, "Wetlands to control diffuse pollution at catchment scale"

All together more than 130 oral presentations have been delivered and 40 posters have been presented.

Two conference tours have been organized while one was bringing WETPOLS's delegates in northern direction of Nantes to the famous salt marches of Guérande, followed by a visit of the constructed wetlands of "Bouvron"; the second one went to the beautiful natural lake of Grand-Lieu, the largest lake in France in winter, classified as a Local Nature Reserve, followed by the visit of the constructed wetland of "La Chapelle Rousselin".

Apart from enabling delegates to enjoy the great gastronomy of Nantes (especially its sea food and "crèpes et galettes" - meals) **WETPOL 2013** enabled about 200 scientists from more than 35 countries to share news ideas and the latest development on the dynamics of pollutants in wetlands with many contributions in the field of "Behaviour of priority and emerging pollutants in wetlands" followed by the field of "N-P cycle in wetlands" and "Molecular and microbial advances related to pollutant fate, disposal and removal in

wetlands". This symposium was supported by Nantes European Green Capital 2013. For its next edition, 6th WETPOL Symposium will be organized in York, UK, June 2015, by Gabriela Dotro from Cranfield University.

Participants of WETPOL2103.

On behalf of the organizing Committee, I would like to thank all the delegates, keynote and invited speakers and the partners of this event.

NEWS FROM THE CONSTRUCTED WETLAND ASSOCIATION

Gabriela Dotro (Cranfield University), Clodagh Murphy (ARM), and Rick Hudson (Cress Water Solutions)

In line with the Constructed Wetland Association's mission, this year we have been busy spreading the word about the technology both within the UK and abroad. This included refreshing the look of the website with enhanced functionality making it now possible for members to access the CWA's database of constructed wetlands online; sponsoring the 5th edition of WETPOL in Nantes, France and joining with the 6th edition of WETPOL in 2015 in the UK; hosting the 9th CWA Annual Conference in Cardiff; and introducing the new Travel Grants, open to all members who want to attend a wetland event in the world.

The CWA database was first developed in 1996, containing details of 154 wetland sites primarily belonging to Severn Trent Water, with some performance information. Significant effort was put in to bring the database up to date, deleting obsolete information and adding functionality by making the database now accessible through the CWA's web site, making it easier to search by wastewater type, type of wetland system, and designer. The new database also allows downloading of information in excel format for researchers and practitioners to be able to better use the available data. Members are encouraged to submit new site

information to keep the database a useful resource both within and outside the UK. To date, there are 934 sites amounting to 1425 individual wetland cells – and counting!

The 9th CWA Annual Conference was entitled "Wetlands for Water Management" and took place at Cardiff University on the 26th and 27th of June 2013. The conference consisted of 1.5 days of technical talks and half a day of visits to constructed wetlands in the vicinity. The speakers included a mixture from academics, practitioners and research students discussing a variety of topics ranging from wetlands delivering catchment management strategies to innovations in wetland technology to the often-forgotten but critical operation and maintenance aspects of treatment wetlands. Like in the previous edition of the event, there were posters on display from academic institutions worldwide competing for a cash prize which was awarded to Anna Guittonny-Philippe from IMBE Aix-Marseille University for her poster "Conception of constructed wetlands to reduce metallic and organic mixed pollution from industrialised catchments in aquatic Mediterranean ecosystems". The technical visits were very well received by the delegates as they offered an opportunity to experience first-hand the two-fold effects of a lack of a routine maintenance regime on vertical flow wetlands in the area and overestimating loadings at Visitor Centres, in spite of the best intentions of the designer. Delegates were also taken to see a 15-acre surface flow system designed for capturing ochre from mine drainage – a requirement that will never go away! For details on the speakers and their presentations and the upcoming 2014 Conference, please check our website at www.constructedwetland.co.uk.

In addition, this year the CWA has decided to launch its new Travel Grant scheme. This scheme allows any CWA member to apply for up to £500 to contribute towards co-funding attendance at an international wetland-related event. On top of the General Travel Grant, we have also created a Student Travel Grant, which enables our student members to apply for free registration to the Annual CWA Conference. For more information, contact us at info@constructedwetland.co.uk.

Finally, the CWA has reinforced support to the WETPOL series of conferences, starting with sponsoring the recent WETPOL 2013 event held in Nantes (France) and, notably, by joining up the annual CWA conference with the 6th edition of WETPOL, which will take place in York in June 2015 and is being organised by Cranfield University. In line with current membership benefits, CWA delegates will have access to significantly discounted registration fees. Further details can be found on the event web site: www.wetpol.org/2015.

ANNOUNCEMENT: PHD OPPORTUNITY IN NEW ZEALAND

PhD opportunity:
Improving the performance of decentralised land treatment systems
University of Waikato, Hamilton New Zealand.

We are seeking a motivated and energetic PhD student to undertake research on engineered land treatment systems for on-site and decentralised wastewater management. The research will bring together knowledge on constructed wetlands, reactive filters/ bioreactors and soil application to develop integrated treatment systems capable of advanced treatment. The work aims to develop systems appropriate to the needs of small communities and rural facilities in New Zealand, in particular the needs and aspirations of Maori (indigenous peoples of New Zealand). .

The University of Waikato and National Institute of Water and Atmospheric Research (NIWA) has available a 3-year PhD fellowship for a student to examine approaches to improve the performance of decentralised land treatment systems. Preferred candidates will have strengths in at least one of biogeochemistry, hydraulic properties, and/or processes engineering integration with an MSc or BSc (hons).

Funding for the PhD includes a 3-year scholarship of $25,000 (NZD) per annum, plus study fees and research costs. For further information or to apply, please email or send letter of application, contact details for 2 referees, and CV to:

Professor Louis Schipper, Schipper@waikato.ac.nz, Earth and Ocean Science, Private Bag 3105, University of Waikato, Hamilton, New Zealand. The research will be jointly supervised by Dr Chris Tanner, Principal Scientist at NIWA.

Background on Schipper's research team can be found at **www.waiber.com**. Screening of candidates starts December 2013 until position filled.

USING WETLANDS TO TREAT MAORI MARAE GREYWATER IN NEW ZEALAND

James Sukias[1], Chris C. Tanner[1], Andrew Dakers[2], Darcel Rickard[3] and Rebecca Stott[1]

[1] *NIWA – National Institute of Water and Atmospheric Research Ltd.*
[2] *ecoEng Ltd, Christchurch*
[3] *Tainui Awhiro*

Marae wastewater challenges

Marae are the ancient traditional communal meeting/dwelling places of Māori, New Zealand's indigenous population. Within a modern context, marae perform a range of important roles for Māori and associated communities, acting not only as community meeting places (Fig 1), but also variously as homes, offices, early childhood teaching facilities (kohanga reo), health clinics, and sometimes local civil defence centres. They may host small events such as meetings (hui) for a few people, or less frequent educational gatherings (wānanga), funerals (tangi) or weddings where several hundred people may be present for 2-3 days. This range of event sizes can place considerable strain on existing wastewater systems, particularly where treatment is on-site. In addition, the water and sanitation infrastructure of many marae are outdated, undersized and in poor condition requiring significant upgrades.

Figure 1: A typical Maori marae wharenui (meeting house). The marae will also include separate buildings for cooking and eating (wharekai), ablutions (wharepaku) and other functions.

Upgrading of facilities must not only reduce health and environmental risks, it must also conform to Māori cultural protocols, which prohibit discharge of human wastes to water. Rather faecal wastes must be treated via a land application system for them to be considered spiritually cleansed. Thus marae wastewater treatment and dispersal systems typically consisted of septic tanks draining to soil infiltration fields. However, these can struggle when exposed to shock-loads which exceed normal flows by several fold. Marae communities generally have limited options available to help them adapt and cope particularly with large events.

Solutions

At a coastal marae of the Tainui Awhiro hapu (extended family group), the existing wastewater system (septic tank and infiltration field) was discovered to be undersized, particularly during larger events held at the site. The hapu did not want to connect to the nearby town WWTP because it discharged effluent directly into the mouth of the harbour adjacent to their ancestral lands. Instead, they chose to reduce the hydraulic loading to their existing wastewater facilities with low/dual flush toilets (see Fig 2) and by diverting greywater (showers and hand basins only) to a newly constructed separate land-based waste treatment system (Fig 3). Low flow shower heads were also retrofitted as part of a commitment to operate in as sustainable manner as possible.

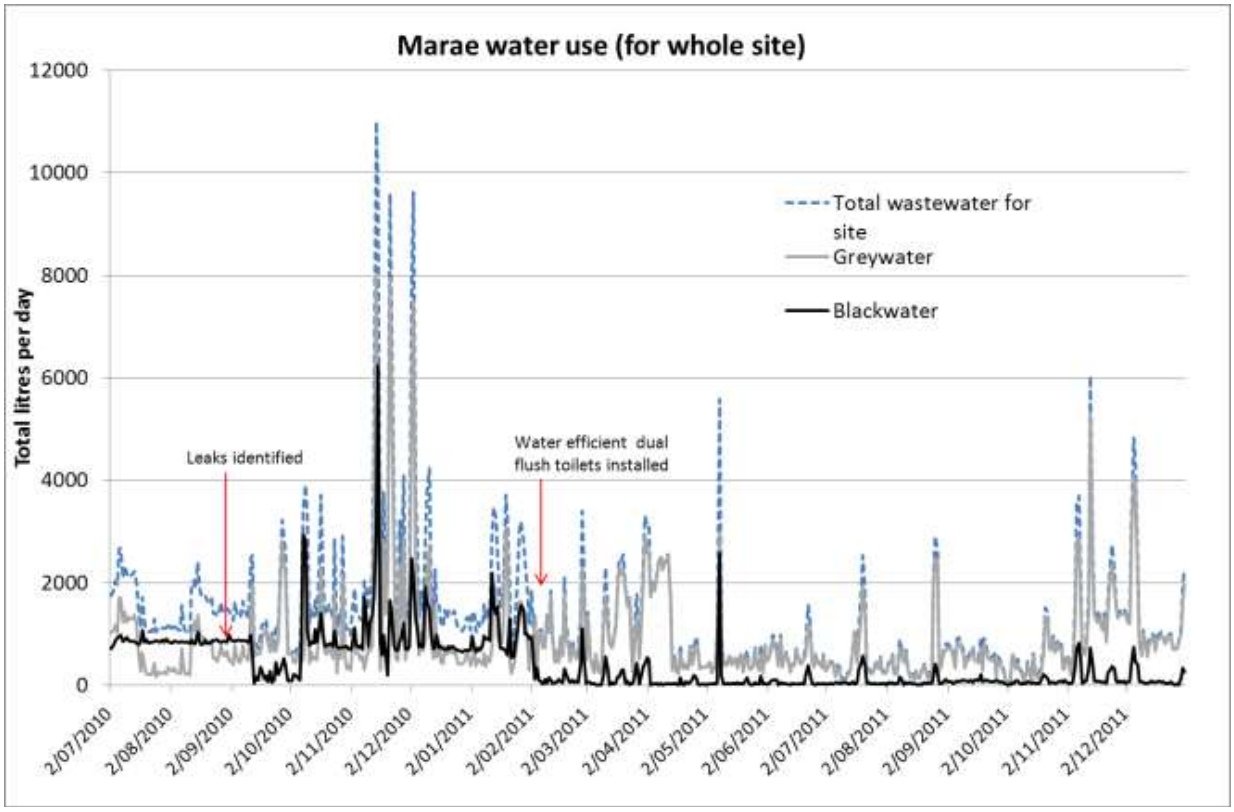

Figure 2. Example of annual water use on a Marae. Note benefits associated with low flow showers and dual flush toilets.

With significant hapu and community involvement, a secondary greywater treatment system comprising a gravel-bed wetland followed by an infiltration swale was constructed. The wetland was sized to accommodate the anticipated volume of events (3 days) commonly held at the site.

The wider marae and local community were involved in all stages of construction from excavation to planting. The wetland was planted with a mixture of native vegetation (*Carex secta, C. virgata* & *Cyperus ustulatus*). Plant species were selected by the local elder (James "Tex" Rickard), choosing species that had previously been common in the area but were now much less common due to urban and rural developments within the catchment. The native harakeke (*Phormium tenax*) which has many traditional uses in Maori culture was planted along the infiltration swale.

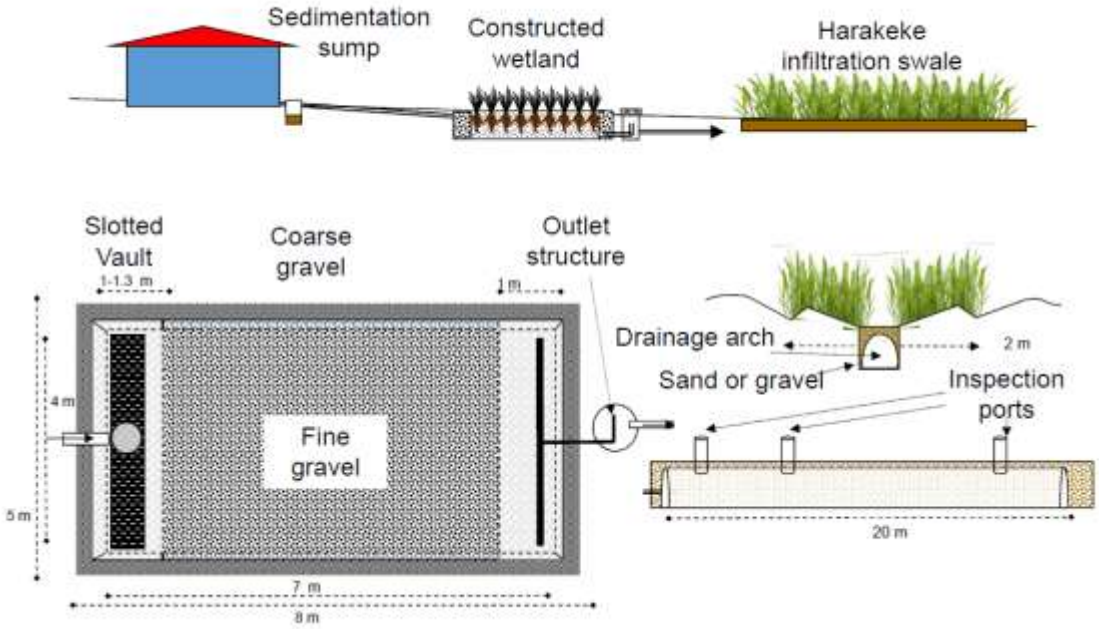

Figure 3. Conceptual layout of Marae greywater treatment system

Benefits

The reduced loading on the existing system (now treating mainly blackwater) means the old system is now able to consistently meet specific discharge volume criteria even with large events. Use of a sub-surface flow design throughout reduced the likelihood of direct human contact with wastewaters

Table 1. Typical results from event monitoring of constructed wetland treating Marae greywater: Feb 2012 (summer)

	EC µs cm^{-1}	TURB NTU	SS g m^{-3}	*E. coli* MPN 100mL^{-1}
Inflow	1,227 ± 702	19 ± 17	54 ± 38	530,000 ± 7,070,000
Outflow	479 ± 32	8 ± 7	6 ± 3	1,260 ± 5,680
% Removal	61%	58%	89%	99.8%

	NH4-N g m^{-3}	NO3-N mg m^{-3}	TN g m^{-3}	DRP g m^{-3}	TP g m^{-3}
Inflow	117 ± 113	17 ± 36	136 ± 103	5.8 ± 4.0	7.0 ± 4.5
Outflow	0.08 ± 0.15	1 ± 2	0.75 ± 0.22	0.3 ± 0.3	0.4 ± 0.3
% Removal	99.9%	94%	99.4%	95%	94%

The new greywater wetland is being monitored for removal efficacy of key contaminants including BOD, SS, nutrients, microbes and emerging contaminants (PCPs). Automatic samplers are used to collect samples from the inflow and outflow of the constructed wetland during events. Preliminary performance data from one summer and one winter event showed that the wetland portion on its own significantly improves water quality notably faecal microbes (~3 log reduction), nitrogen (98% removal), phosphorus (>90% removal) and SS (90% removal). The wetland is able to capture the whole flow from most events and then treat it during intervening periods so performance is very high. The infiltration swale has been able to readily accommodate the discharge from the wetland, with minimal measureable effect on groundwater concentrations. This early performance data will be combined with future monitoring to give additional understanding of the performance of constructed

wetlands treating greywater and a better understanding of wetlands for sustainable and improved management of wastewaters for marae communities.

Constructed wetlands appeal to marae communities due to their utilisation of natural processes, low maintenance requirements, ability to cope with fluctuating loads and ability to be built and maintained by communities themselves. The collaborative process facilitated the incorporation of design features to improve the culturally acceptability of the technology. Involving Māori in the construction and application of the technology, and situating it in Māori space is hoped to promote greater engagement and "ownership", and support the spread to other Māori communities.

Figure 3. Involvement of Maori community in construction of the greywater treatment wetland at the Kokiri Centre, Whaingaroa, Raglan, Waikato, New Zealand

FREE WATER SURFACE CONSTRUCTED WETLAND SYSTEM FOR WASTEWATER TREATMENT IN CANAANLAND COMMUNITY, OTA, NIGERIA.

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INTRODUCTION

Constructed wetlands (CW) are now widely used as an accepted method of treating wastewater (Rousseau et al, 2008) and are cheaper than traditional wastewater treatment plants. In the tropics, CW is appealing to developing nations due to the high rate of plant growth. Two categories of constructed wetlands are considered for wastewater treatment depending on whether they are free water surface, FWS system or subsurface flow, SSF system. Free water surface, FWS, Constructed Wetland is used in the treatment of wastewater generated in Canaanland, Ota, Southwest corner of Nigeria. The Canaanland Community includes the Living Faith Tabernacle, Ramot Estate and the residential Covenant University. Sewage treatment site is located at the westernmost wing of the Covenant University campus remote but opposite to Daniel Hall Hostel. This location is indicated as WWTP in Figure 1. The waste treatment plant was initially for both solid and liquid wastes. They were separated after some years. Faeces and toilet wastes are treated at the waste treatment plant through a biological process.

Figure 1. Google Map of Canaanland, indicating the WWTP Location

ESTIMATION OF SEWAGE CAPACITY FOR THE WASTE WATER TREATMENT PLANT

Sewage Disposal Tankers evacuate sewage from the toilets of the Living Faith Tabernacle premises every week. A total of between 10 and 15 tanker trips are recorded per week. Each Disposal Tanker has a capacity of 10,000litres. This implies that some 12,000 to 18,000 litres of sewage is generated every week within the Church premises.

Wastewater generated per day by the University community was considered based on the rate of water supplied per day on the campus. There are a total of 8 boreholes in operation on the campus together with 4 service reservoirs. Although there are no data for water consumption rate, the rate of refilling of the reservoirs was given as 4 refills per day. The capacities of the tanks put together was given as 1,054,000 litres on daily basis, thus the water consumed/day

can be estimated as 4,216m^3/day. It should be noted that this consumption included water use in the laboratories, workshops, gardening and other uses such as some possible construction works on the campus. Of this 4,216m^3/day water consumption, 80% is considered to return as wastewater.

SEWAGE FLOW AND LAYOUT OF THE CONSTRUCTED WETLAND WITHIN THE WASTE WATER TREATMENT PLANT

Maintaining wetland in urbanized areas has a lot of considerations. Isiorho, (2006) discussed challenges of maintaining urban wetlands. Sewage can be monitored through existing Inspection Chambers around the sloppy road to Daniel Hall on the University campus. It will then flow by gravity into the underground Septic tank, where complex organic materials are anaerobically decomposed to simple organic molecules and fermentation gases. When the build up gets to a specific level it begins to spill into the constructed wetland by gravity. The operating principle is the same as that of the septic tank flowing into the soak-away chamber. Effluent from this tank is treated by passing it through a series of constructed wetland to discharge into a canal which empties into River Atuara, at the confluence to River Iju, some 60km from Lagos lagoon.

A sketch of the treatment plant is as presented in Figure 2. The effluent is discharged through the concrete lined open channel leading to the canal where it is disposed into River Atuara.

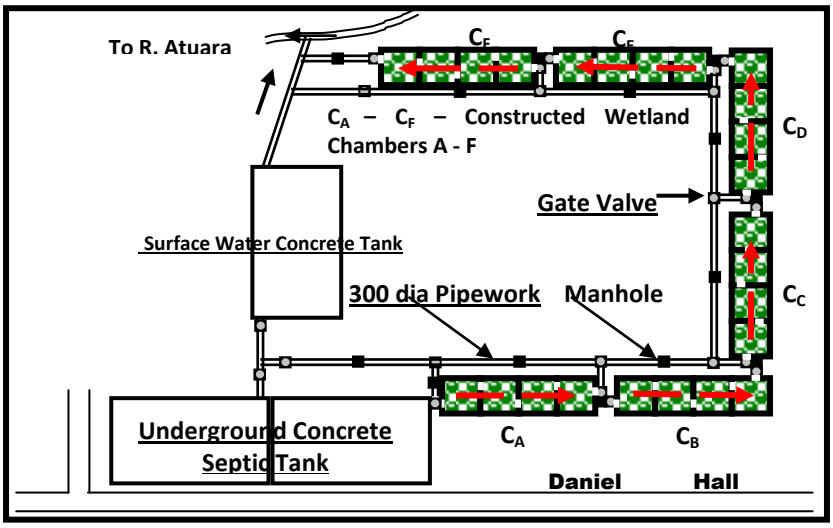

Figure 2: Layout of Canaan Land Sewage Treatment Plant

The layout of the Constructed wetland is U-shaped consisting of series of six constructed wetlands / chambers of water hyacinth plants (*Eichhornia crassipes*). Each chamber consists of four cells.

The length and width of each chamber are 20m and 5m respectively. Each wetland / chamber consists of four cells of 5m long. The total length of the wetland is 120m. The layout of one the chambers is shown in Figure 3.

Figure 3. Layout of one the Constructed Wetland Chambers

PERFORMANCE OF THE TREATMENT FACILITY

The wetland treats wastewater generated largely by the Canaanland community whose population can get to 300,000 during some special religious activities. An assessment of the facility by Isiorho and Oginni, 2008 showed the system to be effective in reducing and removing solids and dissolved solids from the wastewater. The pH ranged between 6.6 and

6.8, conductivity from 530 to 600, and total dissolved solids (TDS) ranged from 360 – 400 ppm. The data obtained indicated that some modifications need to be made as the waste water treatment system is not very efficient in reducing the amount of TDS and nutrients.

The flow rate within the wetland was considered to be very high from cell to cell, thereby not allowing time for the plants and microbes to reduce the TDS efficiently. It is suggested that some method be devised to slow down the flow rate to allow the plants and microbes to work on reducing the TDS. However preliminary result of bacteriological analysis along the constructed wetland indicates that the wetland was able to remove the contaminants efficiently. Further study are being undertaken in this area.

CONCLUDING REMARKS

There is no doubting the ability of the constructed wetland to remove solids, dissolved solids, nutrients, and pathogens. Stakeholders are more interested in the effectiveness of the facility. This free water surface constructed wetland has been found to be effective in the removal of solids and dissolved solids from the waste water. However, there is that need to increase the residence time of the waste water within the constructed wetland to give more time for the macrophytes and microbes to act thereby enhancing the quality of the treatment. This can be achieved by the introduction of sand and gravel in the chambers. More research can also be carried out to demonstrate the response of the quality of treatment on the residence time.

Results of bacteriological analyses will soon be published by the Authors to determine the effectiveness of the constructed wetland.

Since increase in the community population would lead to an increase in waste generation. The size and design of any wetlands will depend on the volume and type of wastewater to be treated. Work has reached an advanced stage in modelling removal of microbiological contaminants along the constructed wetland. More revelations are expected to generate more ideas at reaching perfection towards solving scientific problems.

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PERFORMANCE EVALUATION OF A CONSTRUCTED WETLAND SYSTEM IN NIGERIA

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ABSTRACT
The practice of collecting and treating municipal wastewater at low cost prior to its disposal is continually gaining attention in developing countries. This is because the consequences due to its poor management have become enormous while solutions are being proffered at various quarters. Among the current processes used for wastewatere treatment, constructed wetlands have attracted interest as the unit process of choice for its treatment due to their low cost and efficient operation in tropical regions. The aim of this study is to assess the efficiency of a constructed wetland [water hyacinth reed bed (WHRB)] and to investigate the impact of the hydraulic structures on the treatment system. This study also involves determining the efficiency of water hyacinth in polishing biochemical oxygen demand (BOD), chemical oxygen demand (COD), total suspended solids (TSS), phosphate, magnesium, zinc, nitrate, chloride, sulphate, potassium, pH and fecal coliform. Two samples each were collected and tested from the six WHRB reactors available at Covenant University. The wetland achieved a performance of 70% of BOD-, 68% of COD-, 41% of Total Solids (TS)-, 100% of zinc, 30% of nitrate, 38% of chloride, 94% of sulphate, and 2% of potassium-removal, respectively. The result also shows a 6%, 29% and a significant increase, in pH, phosphate and magnesium, respectively. The study shows that constructed wetlands are capable of polishing wastewater generated in a community and the data obtained would also allow the sustainability of the technology to be assessed.

INTRODUCTION
The safe disposal of wastewater has been a great concern in developing nations, most especially in Nigeria. It is well known that most of the projected global population increases will take place in the third world countries that already suffer from land, water, food and health problems. In 2008, estimated population of Nigeria was 151.5 million (UN, 2008) yielding an average density of 151 persons per sq km covering an area of 923,768 sq km (356,669 sq miles). The population is projected to grow to 206 million by 2025. With this continual increase in population, the greatest challenge in the water and sanitation sector over the next two decades would be the implementation of low cost wastewater treatment that would at the same time permit selective reuse of treated effluents for agricultural and industrial purposes (Navaraj, 2005). In most developing countries, especially in Africa, wastewater is simply too valuable to waste (WHO, 2000). Its water and nutrients (nitrogen and phosphorus) are needed for crop irrigation and fish culture (Ghosh, 1996; Mara, 2001). However, the construction cost for conventional wastewater treatment plant has been a major barrier for the implementation of conventional technologies by local authorities in many African countries and particularly in Nigeria (Olukanni and Aremu, 2008). Although, these technologies are very effective, they are expensive to build and maintained, coupled with the fact that they also require skillful personnel and technical expertise to be operated. Consequently, while water borne diseases such as cholera and diarrhea have persisted because of inadequacies in wastewater treatment systems, developing nations are unable to incorporate these technologies as part of a wastewater treatment master plan. It is therefore imperative that a treatment system that is economical and sustainable be put in place.

As a result of this development, decision makers are looking for alternatives that could be used as complementary methods to reducing treatment costs. Among the current processes used for wastewater treatment in tropical regions, constructed wetland has attracted interest as the unit process of choice for wastewater treatment due to their low cost in energy consumption, low maintenance, high level sustainability, efficient operation and being an ecosystem that uses natural processes. Some of the different wastewater treatment processes which are in use globally are; activated sludge, biological filter, oxidation ditch, aerated lagoon, waste stabilization Pond (WSP) and Constructed wetlands. In developing countries, the number of choices may be higher as a result of the more diverse discharge standards encountered. Wetlands serve thousands of communities around the world. They are effective in wastewater treatment and offer potentials for resources recovery through the production of biomass, which can be used as human and animal foods. The growing interest in wetland system is due in part to recognition that natural systems offer advantages over conventional systems.

Various wetland systems incorporate the use of different plants as a source of nutrient and pathogenic organisms' removal. Wetland plants have the ability to transport atmospheric oxygen and other gases down into the root to the water column. Within the water column, the stems and roots of wetland plants significantly provide the surface area for the attachment of microbial population. Water hyacinth (*Eichhornia crassipes*) and Duck weed (*Lemna* spp), *Spirodela* spp, *Wolffia* spp, totora and cattails, among others are plants that are very efficient in removing vast range of pollutants, from suspended materials, BOD, nutrients, organic matter to heavy metals and pathogens. *Eichornia crassipes* can be distinguished from others by its highly glossy leaves. Water hyacinth has demonstrated that it is an excellent pollutant removal for wastewaters (Maine, 2006; Skinner, 2007). This study is aimed at assessing the efficiency of the constructed wetland that uses water hyacinth [water hyacinth reed bed (WHRB)] as pollutant removal in Covenant University and to investigate how the system can be improved in necessitated.

METHODS

Covenant University, within Canaan land in Ota town, is in close proximity to the city of Lagos, Nigeria. The institution has undergone an increasing population since its inception in 2002 with a current population of over 9,000 people. Wastewater from septic tanks in isolated locations within the Canaan land is taken by water tankers (Plate 1) for discharge into a primary clarifier which subsequently flows into a secondary clarifier and then into the CW (water hyacinth reed bed). The geometry of the primary clarifier was measured to have a volume of 720 m^3 i.e. 15 x 13.7 x 3.5 meters. The secondary clarifier has an area of 261 m^2 i.e. 17.41 m x 15 m and a depth of 5m. These tanks functions like anaerobic ponds within which the biochemical oxygen demand (BOD) and total solids are substantially reduced by sedimentation and anaerobic digestion before the partially treated effluent enters a diversion chamber. It is from this point that the wastes are fed into the hyacinth beds (Plate 2).

The constructed wetland is a Free Water Surface (FWS) type. As shown in Figure 1, the reed beds consist of six units of concrete facultative aerobic tanks 1.2m deep and each partitioned into four cells with an internal surface area 5.70 m by 4.80 m with influx of wastewater into each cell at alternate ends of the partition walls (Plate 3). The effective depth of each cell is about 0.9 m and has a volume of 23.16 m^3 with a free board of 0.30m. The final effluent discharges into an outfall (Plate 4) that is about 8m long and empties into a perennial stream that drains the campus and forms a tributary that discharges into River Atuara, a few kilometers from the Campus.

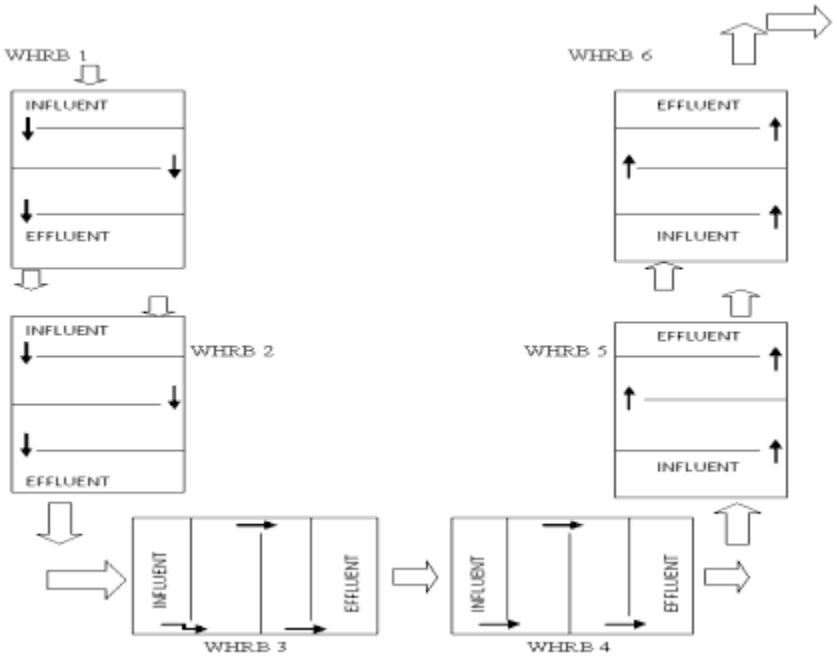

Figure 1: Layout of the Constructed Wetland [Water Hyacinth Reed Beds (WHRB)] in Covenant University and the wastewater collection points.

Plate 1: Tanker desludging wastewater into the treatment chamber

Plate 2: Water hyacinth reed beds showing baffle arrangement at opposing edges

Plate 3: Water hyacinth treating wastewater

Plate 4: Effluent discharging through the outfall into the thick vegetation valley

Grab samples of the raw influent and treated effluent from the existing water hyacinth reed bed were collected and analyzed in the laboratory for its BOD_5, Faecal coliform, pH, temperature, COD, Suspended Solids, Total Solids, Nutrients and Heavy Metals. Variation of influent and effluent parameters (physical, chemical, bacteriological and physico-chemical characteristics) was determined.

RESULTS AND DISCUSSION

Table 1 shows the performance evaluation of the constructed wetland. There was a significant reduction in turbidity level with a performance of 40 % reduction. Higher turbidity levels are often associated with higher levels of disease-causing microorganisms such as viruses, parasites and some bacteria. There was an increase in the pH value which range from 6.16-6.59 with a constant temperature of 27^0C across all the reactors. Though optimum pH for bacteria to function is between 7.5 and 8.5 but most treatment plant are able to effectively nitrify with a pH of 6.5 to 7.0. The Total Suspended Solids (TSS) was reduced by 56% at the outlet of the final reactor. However, this does not meet with the Federal Environmental Protection Agency (FEPA) now named "National Environmental Standards and Regulations Enforcement Agency" (NESREA) standard, recommending a limit of 30 mg/L for TSS. This means that the TSS concentration in the system is high and should be further reduced. The TSS includes silt, clay, plankton, organic wastes, and inorganic precipitates.

The treatment plant had little effect on the total dissolved solids (TDS). Though the TDS concentration is way below the standard limit given by FEPA, 2000 mg/L, it's composition in the effluent can still be reduced. It can also be deduced that most of the TDS concentration has been treated in the primary and secondary clarifiers. The Total Solids (TS) which was considerably reduced. Though there is no specification to the amount of solids expected in wastewater. The treatment system gave a significant performance on reducing the total solids by 41.18% in pollutant level. A 37% reduction in chloride concentration was achieved by the treatment system. However the effluent chloride concentration is way below the 600 mg/L standard recommended by FEPA. It is a known fact that the chloride content of wastewater usually increases as its mineral contents increases and vice versa. The phosphate concentration increases very slightly but it is way under the 5mg/L recommendation. The slight increase in phosphate concentration could be as a result of the dead and decayed water hyacinth plant in the reactors.

The nitrate and sulphate content was reduced by 30% and 90%, respectively, an amount that is acceptable for discharge into natural water bodies. The BOD and COD ratio reveals the treatability of wastewater, so if the ratio is above 0.5 the wastewater is considered to be highly biodegradable and if lower than 0.3 the wastewater is deemed to undergo a chemical treatment before the routine biological treatment. For the University treatment plant, the BOD to COD ratio is 0.85. Therefore it is concluded that the wastewater generated in the campus is highly biodegradable.

The CW and its associated water hyacinth plants were considered to have little or no effect on the concentration of magnesium and potassium. In fact, a highly significant increase in the magnesium content was observed in the wastewater. Magnesium and potassium content could slow down the COD removal at certain concentration but a fair decrease in their level could rapidly enhance COD removal. Though the magnesium content increases, it is still way below the 200mg/L limit in wastewater as recommended by FEPA. The zinc element in the CW system was effectively removed in the wastewater.

Table 1. Overall performance of treatment between influent into WHRB 1 Influents and WHRB 6 Effluents on the Parameters tested.

Parameters	WHRB 1 Influent	WHRB 6 Effluent	Percentage (%) increase	Percentage (%) decrease
Turbidity	136	82		40
pH	6.2	6.6	6	
Total Solids mg/L	255	150		41
Total Suspended Solids mg/L	168	74		56
Total Dissolved solids mg/L	870	76		13
Chloride mg/L	260	162		37
Phosphate mg/L	0.11	0.15	29	
Nitrate mg/L	0.04	0.03		30
Sulphate mg/L	0.20	0.01		94
Chemical Oxygen Demand mg/L	330	105		68
Biochemical Oxygen Demand mg/L	298	90		70
Magnesium mg/L	9.0	26.0	188	
Zinc mg/L	0.04	ND		-
Potassium mg/L	25.4	24.7		3

CONCLUSION AND RECOMMENDATION

The Constructed Wetland with hydrophytes (water hyacinth plant) is capable of removing pollutants and the hydrophytes have shown its ability to survive in high concentration of nutrients with significant nutrient removal. It has reliable nutrient stripping value for the removal of the trace elements tested for in the study. The use of water hyacinth plant aquatic system can help reduce eutrophication effects in receiving streams and also improve water quality. It would be recommended that more reactors are added to the treatment plant to enhance further settling of solids and give the wastewater more exposure to bacteria and water hyacinth, so that more nutrients are removed from the wastewater. Improvement can also be possible by increase in retention time of the wastewater in each compartment of the constructed wetland and possible means of aeration at the final discharge point.

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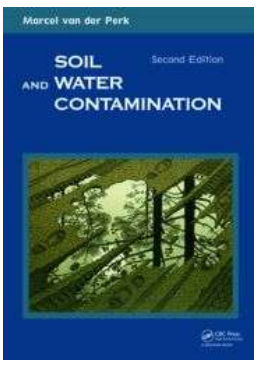

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Chemistry of Ozone in Water and Wastewater Treatment
From Basic Principles to Applications

Clemens von Sonntag and Urs von Gunten

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Even though ozone has been applied for a long time for disinfection and oxidation in water treatment, there is lack of critical information related to transformation of organic compounds. This has become more important in recent years, because there is considerable concern about the formation of potentially harmful degradation products as well as oxidation products from the reaction with the matrix components. In recent years, a wealth of information on the products that are formed has accumulated, and substantial progress in understanding mechanistic details of ozone reactions in aqueous solution has been made. Based on the latter, this may allow us to predict the products of as yet not studied systems and assist in evaluating toxic potentials in case certain classes are known to show such effects. Keeping this in mind, **Chemistry of Ozone in Water and astewater Treatment: From Basic Principles to Applications** discusses mechanistic details of ozone reactions as much as they are known to date and applies them to the large body of studies on micropollutant degradation (such as pharmaceuticals and endocrine disruptors) that is already available. Extensively quoting the literature and updating the available compilation of ozone rate constants gives the reader a text at hand on which his research can be based. Moreover, those that are responsible for planning or operation of ozonation steps in drinking water and wastewater treatment plants will find salient information in a compact form that otherwise is quite disperse.

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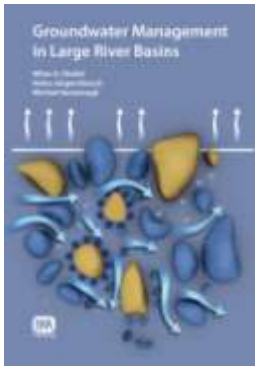

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Carlo Sessa
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Sustainable Water Ecosystems Management in Europe examines the anthropogenic deterioration of water ecosystems, in particular in coastal areas. It proposes a new approach to enhance connectivity between research and policy-making. The book exploits the concept of integrated adaptive ecosystem management, by engaging scientists, policy makers and the public (the latter including both stakeholders and lay citizens/water users) in comparable case studies. Emphasis is given to the role of the public to enlarge the concept of organisational learning to the wider concept of social learning.

The EC 7th Research Framework Program funded project AWARE engaged a panel of randomly selected citizens living in three different coastal areas of Europe – in a pilot experience of knowledge brokerage with water scientists and decision makers focused on coastal waters quality. Results and lessons learned from the project are summarized in this volume, and recommendations are made for this pilot's replication and transferability to different coastal areas and sustainable water management tasks - and beyond to other sustainability research and policy issues. This book is a must-read for water managers and policy makers looking to effectively organize citizen and stakeholder participation in river basin and coastal water planning, as required by the EU Water Framework Directive.

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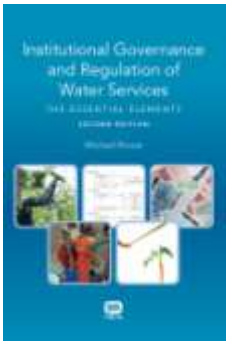

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Institutional Governance and Regulation of Water Services aims to provide the key elements of policy, governance and regulation necessary for sustainable water and sanitation services. On policy matters, it covers important aspects including separation of policy and delivery, integrated planning, sustainable cost recovery, provisions for the poor, and transparency. Regulation and Regulatory Bodies are presented in their various forms, with discussion of why some form of independent scrutiny is essential for sustainability.

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