ISSUE #05

NEWRI UPDATE

STAY CONNECTED WITH NEWRI - YOUR GLOBAL RESEARCH & TECHNOLOGY PARTNER

In This Issue:

Page 1..... *Message from Prof WJ Ng, Executive Director - NEWRI*
Page 2..... *Singapore President Dr Tony Tan Visits NEWRI At CleanTech One*
Page 2..... *Lunar New Year Celebrations With The "Cai Qing" Lion Dance*
Page 2..... *Prof Ng Wun Jern Voted Into Academy Of Engineering*
Page 2..... *Assoc Prof Wang Rong Joins As Editor In Journal Of Membrane Science*
Page 3 ..... *Assoc Prof Lim Teik Thye & Team Won ES&T Award*
Page 3 ..... *Most Cited Articles*
Page 4 ..... *New Developments In Sludge Pre-Treatment*
Page 4 ..... *NEWRI Partners Agilent To Expand Wastewater Treatment Research*
Page 5 ..... *New Partnerships*
Page 5 ..... *NEWRI Spin-off - HydroVision Asia Pte Ltd*
Page 6 ..... *NEWRI Spin-off - Laser Based System That Exposes Pollutants In Water*
Page 7 ..... *Prosper.net Experience*
Page 7 ..... *Opening of ISEH7 - 7th International Symposium On Environmental Hydraulics*
Page 8 ..... *Workshop On Best-Sharing Practices Within NEWRI Family*
Page 8 ..... *List of Seminars*
Page 9 ..... *Feature Article In CEE Res Bulletin-2014*
Page 10 ..... *Viewpoint: "Relevance of Modelling & Simulations" - Prof Adrian Law (DHI-NTU-NEWRI)*
Page 11-14 ..... *NEWRIComm Photo Essay*

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NANYANG TECHNOLOGICAL UNIVERSITY
Nanyang Environment & Water Research Institute
NEWRI ECOSYSTEM
Your Global Research & Technology Partner

MAY
28/14

NEWRI UPDATE

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SMTC


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N.PhD

Dear Colleagues & Friends of NEWRI:

This edition of the NEWRI Update has taken a longer time to prepare as so much has happened since the last update and NEWRI has been kept very busy. We celebrated the Lunar New Year at our CleanTech home again and welcomed the Year of the Horse with a "Cai Qing" lion dance and have had President of Singapore and Chancellor of Nanyang Technological University, Dr Tony Tan Keng Yam, visiting NEWRI. We are also proud to acknowledge colleagues (from SMTC and AEBC) who have gained recognition nationally and internationally for their body of work. In research, we have had no less exciting findings and announcements - our colleagues in ECMG had announced preparation of a new super adsorbent material (a cyrogel) which can also disinfect. This won the ES&T award for the best technology article in late 2013. In the domain of sludge pre-treatment for greater volatile solids destruction and methane production, an AEBC team had announced a suite of new technologies and is in discussion with partners for deployment of these in the industry. Interaction with the industry increases and AEBC/ECMG now works with Agilent to develop analytical methods for environmental sample analysis. NEWRITech spin-off companies have also been active with Hydrovision and WOT announcing new products. Dissemination of information continues via the seminars and larger events (e.g. Prosper.NET and ISEH – 7th International Environmental Hydraulics Symposium). NEWRIComm's activities in Laos has expanded with assistance to the National University of Laos in setting up The Centre of Excellence for Environmental Management therein with the ambition to provide integrated teaching and research via curriculum support and demonstration treatment facilities which are also used to support the resident student community.

This update also provides me with the opportunity to invite friends and colleagues to NEWRI's booth at the June 2014 Singapore International Water Week exhibition. I look forward to personally welcoming you when you visit.

1. SINGAPORE PRESIDENT DR TONY TAN VISITS NEWRI AT CLEANTECH ONE

President Tony Tan Keng Yam, Chancellor of the Nanyang Technological University (NTU), visited the CleanTech Park, Singapore's first business park catering to green firms and research institutes, on 26 November 2013 to understand NEWRI's operations and its relationship with NTU. The President was briefed by NTU President, Professor Bertil Andersson, and NTU management. Thereafter, the President toured NEWRI's research laboratories.



2. LUNAR NEW YEAR CELEBRATIONS WITH THE "CAI QING" LION DANCE

The lion dance is a symbolic act of blessing by the lion - we hope the Year of the Horse will bring much luck and prosperity to all those who work with and in NEWRI.


3. PROFESSOR NG WUN JERN VOTED INTO ACADEMY OF ENGINEERING

Singapore's National Academy of Engineering brings together the most successful engineers and engineer-leaders for a shared purpose; to advance and promote excellence in engineering. These individuals provide strategic analysis and policy support to promote Singapore's national development and work towards improving public awareness and understanding of engineering. Using their international partnerships, they ensure Singapore benefits from international networks, expertise and investment.

Professor Ng Wun Jern, Dean of NTU's College of Engineering and Executive Director of NEWRI, has been honored with election to Fellow Singapore Academy of Engineering.

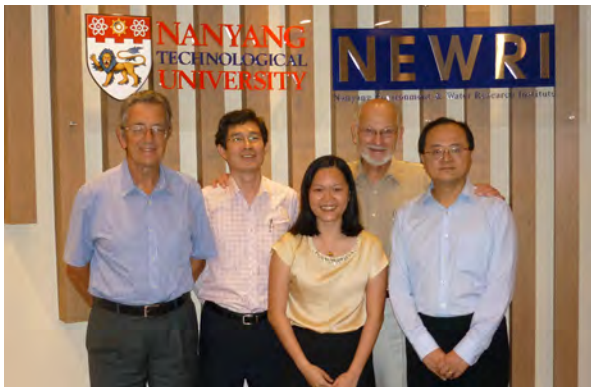
4. ASSOC PROFESSOR WANG RONG JOINS AS EDITIOR IN JOURNAL OF MEMBRANE SCIENCE

Prof Wang Rong, Director of SMTC-NEWRI, shall assume the editor role of Journal of Membrane Science, a leading publication in the field of membranes.

The appointment is acknowledgement of Prof Wang Rong's accomplishments and influence in novel membrane development, hybrid membrane systems and process simulation.

5. ASSOC PROFESSOR LIM TEIK THYE AND TEAM HAS WON THE ES&T AWARD FOR BEST ARTICLE TECHNOLOGY 2013

FEATURED MOST READ ARTICLE IN NATURE PUBLICATION



Environmental Science & Technology (ES&T) published more than 1700 papers on a wide range of topics in 2013. ES&T's Associate Editors and Editorial Advisory Board had nominated papers they felt were of the highest calibre from among these - i.e. papers expected to make a large and long-lasting impact on the field. Assoc Professor Lim Teik Thye and his team's paper titled "Superabsorbent cryogels decorated with silver nanoparticles as a novel water technology for point-of-use disinfection", was chosen the best among the top nominated papers.

Their paper reported preparation of poly cryogels decorated with silver nanoparticles for point-of-use water disinfection. Microbiological contamination of potable water sources is one of the major threats to public health. About 1.8 million people, most of whom are children, die annually from diarrheal diseases. Diarrheal disease risks could be reduced by improving microbiological water quality at the point-of-use and silver nanoparticles have been shown to have excellent antimicrobial properties toward a variety of microorganisms.

This project was also featured in Nature publication as the 'most viewed paper' under the community choice.


RESEARCH HIGHLIGHTS THIS WEEK

COMMUNITY CHOICE

MATERIALS SCIENCE

Dirty water gets squeezed clean

Gels stuffed with nanoparticles could offer a quick, effective way to disinfect drinking water after disasters.

Silver nanoparticles are powerful microbicides, but they tend to clump, limiting contact between bacterial cells and the killing surface. Xiao Hu, Teik-Thye Lim and their colleagues at Nanyang Technological University in Singapore uniformly embedded the nanoparticles throughout a sophisticated, super-absorbent sponge.

They used the flexible, lightweight material to soak up bacterium-contaminated water for 15 seconds, then simply squeezed the water out. Microbe numbers in the recovered water fell by as much as ten million times. The gel can be repeatedly reused and, the researchers suggest, could be developed into a pocket-sized water filter for emergencies.

Environ. Sci. Technol. 47, 9363–9371 (2013)

6. MOST CITED ARTICLES

According to Essential Science Indicators (ESI), the following journal papers generated from AEBC's projects have been ranked as being among top1% and top10% of papers in the domain of "Environment/Ecology" as of May 2014.

TOP 1% PAPER			
AUTHORS	**TITLE**	**JOURNAL**	**WHEN**
Xiong Z.G., Ma J.Z., Ng W.J., Waite T.D. and Zhao X.S.	Silver-modified mesoporous TiO_2 photocatalyst for water purification	Water Research	2011

TOP 10% PAPER			
AUTHORS	**TITLE**	**JOURNAL**	**WHEN**
Xiong Y.H. and Liu Y	Biological control of microbial attachment: a promising alternative for mitigating membrane biofouling	Applied Microbiology and Biotechnology	2010
Maszenan A.M., Liu Y. and Ng W.J	Bioremediation of wastewaters with recalcitrant organic compounds and metals by aerobic granules	Biotechnology Advances	2011
Zhou Y., Oehmen A., Lim M., Vadivelu V., Ng W.J	The role of nitrite and free nitrous acid (FNA) in wastewater treatment plants	Water Research	2011
Lay W.C.L., Zhang Q., Zhang J., McDougald D., Tang C., Wang R., Liu Y. and Fane A.G.	Study of integration of forward osmosis and biological process: Membrane performance under elevated salt environment	Desalination	2011
Xu H.J. and Liu Y.	Control and cleaning of membrane biofouling by energy uncoupling and cellular communication	Environmental Science & Technology	2011
Gao P., Liu J.C., Zhang T., Sun D.D. and Ng W.J.	Hierarchical TiO_2/CdS "spindle-like" Composite with High Photodegradation and Antibacterial Capability under Visible Light Irradiation	Journal of Hazardous Material	2012
Agarwal A., Ng W.J. and Liu Y.	Principle and applications of microbubble and nanobubble technology for water treatment	Chemosphere	2012
Stuckey D.C.	Recent developments in anaerobic membrane reactors	Bioresource Technology	2012
Zhang DQ, Hua T, Gersberg RM, Zhu J, Ng WJ, Tan SK.	Carbamazepine and naproxen: Fate in wetland mesocosms planted with Scirpus validus	Chemosphere	2013
Zhang DQ, Hua T, Gersberg RM, Zhu J, Ng WJ, Tan SK.	Fate of caffeine in mesocosms wetland planted with Scirpus validus	Chemosphere	2013

7.NEW DEVELOPMENTS IN SLUDGE PRE-TREATMENT

AEBC has announced an effective alternative to high pH alkali sludge pre-treatment with a novel anaerobic pre-treatment system. The new process which operates under mildly alkaline conditions results in significant improvement in solids reduction and volatile fatty acids (VFAs) production. Research data indicate much enhanced hydrolysis and acidogenesis and this had been achieved with a microbial consortium which is different from those found in conventional anaerobic systems. In comparison with typical anaerobic digestion , the AEBC process is able to achieve more than 70% volatile solids reduction and 30% more methane production.

Image courtesy of Stuart Miles / FreeDigitalPhotos.net

NEWRI has also developed a none biological pre-treatment method where the advantages of ultrasound are combined with chemical decomposition using alkali. The results have shown synergistic effects resulting in performance of the combined treatment being greater than the sum of the individual methods. Based on previous full-scale ultrasonication application the results would mean that at least 35% increase in biogas and at least 25% solids destruction can be expected. Moreover, the combined treatment is fast, requiring only a few minutes. Similarly, the combination of ozone and ultrasound has been tested to assess improvement in the performance of individual and combined treatments. Prior ultrasonication helped to disperse the biological flocs and enhanced reaction between the ozone and organic solids. The combined ultrasonication-ozonation pre-treatment resulted in enhanced biodegradability which was 35% more compared to the raw sludge. This increase in biodegradability was 7 % more than the sum of biodegradability increase when the ultrasonication (9.9%) and ozonation (17.8%) was individually applied.

8. NEWRI PARTNERS AGILENT TO EXPAND WASTEWATER TREATMENT RESEARCH

Agilent Technologies Inc. is the world's premier measurement company and a technology leader in chemical analysis, life sciences, diagnostics, electronics and communications. In September 2013, NEWRI and Agilent signed a memorandum of understanding which identified several areas for research collaboration.

1. To developed a real-time monitoring system for wastewater treatment
2. To exploit microbes for wastewater treatment

Agilent Technologies Inc. and NEWRI are collaborating on the development of new solutions for the biological treatment of wastewater. In this collaboration, NEWRI will use Agilent's bio-analytical instruments to study the impact of microorganisms, or microbes, in wastewater treatment. NEWRI's researchers led by Prof William Chen will now be able to better monitor microbial metabolic activity, reduce the carbon footprint of wastewater treatment and increase energy recovery. Prof Ng Wun Jern believes new bio-treatment processes have to be developed continuously to address the growing diversity of anthropogenic contaminants, reduce the carbon footprint of wastewater treatment, and to better recover energy and other resources. Agilent's advanced bio-analytical technologies will allow NEWRI to develop a database of contaminants found in wastewaters including exotic or newly discovered ones and compounds which, ironically, may be generated during treatment. This will help NEWRI monitor microbial metabolic activity and their performance in terms of removing various organic compounds. The challenges now facing biological wastewater treatment can be overcome with the new specialised database.

9. NEW PARTNERSHIPS

MOU with University of Kentucky (12 Nov 2013)
The signing of this MOU shall enable SMTC to discuss "Advanced membrane technologies for water environment and bio applications" and for visits by exchange PHD students and researchers.

MOU with ECO-Wiz
This relationship shall enable R3C and Eco-Wiz to investigate R&D and application issues in the area of food waste to energy.

RCA with Hitachi (23 Dec 2013)
NEWRI has expert knowledge on hydraulic phenomena and flow simulation of the water pipe network. Hitachi has domain knowledge on flow anomaly detection technologies based on signal processing and hydraulic analysis. Together, NEWRI and Hitachi embark on the development of a methodology and algorithm to detect flow anomaly in a water reticulation system.

10. NEWRI SPIN-OFF - HYDROVISION ASIA PTE LTD

HydroVision Asia Pte Ltd was incorporated in 2012 as a joint venture of DHI Water & Environment (S) Pte Ltd (Singapore), HydroVision GmbH (Germany) and NTU Ventures Pte Ltd (Singapore). Its core technology is based on ultrasonic measurement principles and the first products are intelligent flow and sediment meters.

The journey started in 2010 when DHI Water & Environment (S) Pte Ltd was awarded a research project by EWI (Environment & Water Industry Programme) with the target to develop new technology for flow and sediment metering. The success of the research project which involved Prof Adrian Law (DHI-NTU Centre) is based on the simulation and modelling strength of DHI and the DHI-NTU Centre in combination with the hardware & ultrasound capabilities of HydroVision Germany. As ultrasound technology has numerous advantages to offer to exploration of flow and sediment profiles, it had been the key technique applied in the research project.

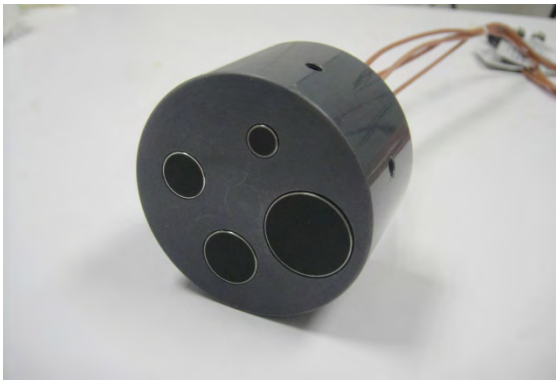
In the project journey, some routes had been dead ends, but there are also those which resulted in inventions, patent applications, and finally in working prototypes. These successful prototypes triggered the incorporation of HydroVision Asia Pte Ltd with the target to further develop, manufacture and market the new products. Five engineers who were in the original project team have joined the start-up company.

The first product in HydroVision Asia Pte Ltd is its flow meter ReVision® which has two key features:

- Very high accuracy of < ±0.15%

- Long straight pipes are not required anymore. Now reliable measurements directly after a disturbance like an elbow are possible.

Recently both features have been successfully certified with TUV SUD in one of their accredited laboratories.



The second core product, the sediment meter, targets the water quality market. To date, there is no measurement equipment available which can determine the amount of total suspended sediments with an online sensor without the need for regular recalibration with actual water samples. Typical turbidity sensors deliver a measurement value which needs to be calibrated and this calibration can change when particle composition change. The new technology overcomes this calibration task and offers therefore a unique product solution.

11. NEWRI SPIN-OFF - LASER BASED SYSTEM THAT EXPOSES POLLUTANTS IN WATER

Water Optics Technology Pte Ltd (WOT) is an AEBC-NEWRI spin-off company led by Prof Liu Aiqun. Specializing in Nanotechnology of water bio-safety monitoring, WOT developed a laser-based system that exposes pollutants in water – the Parasitometer.

	Parasitometer	US EPA 1623
Test volume	10 L	10 L
Test time	1 hour	> 24 hours
Detection range	1-10000 parasites	40 parasites
Mean recovery	71%	45%
Deviation	26%	61%

Parasitometer is a detection device with a optofluidic chip base system that allows ultra-fast detection of *cryptosporidium* in drinking water. It has the ability to detect size and shape and can identify the contaminants in treated water in just an hour, instead of the current two days. This method is eight times cheaper, seven times faster and just as accurate as state-of-the-art filtration method. The device aims lasers through a water channel and the presence of the contaminant distorts the light which will be recorded on a sensor. Microbes are identifiable by knowing their cell shape, diameter and size, and reflective index.

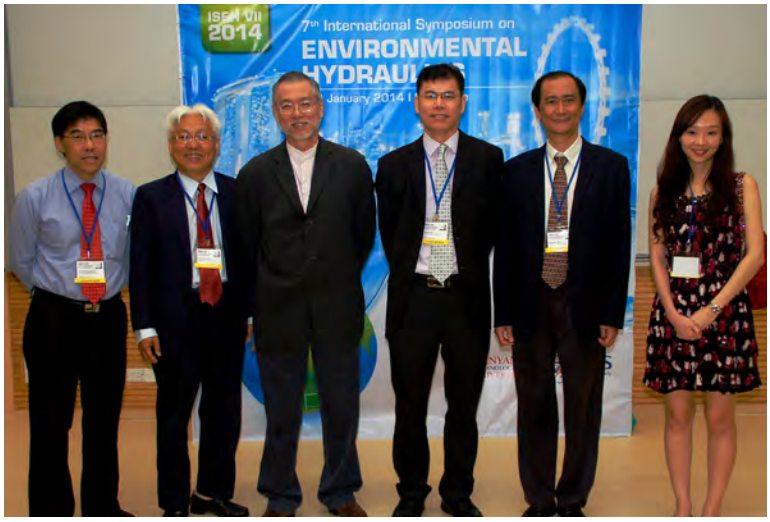
This is the first time it has been demonstrated how light can be manipulated and bent in liquid, through the use of microfluidics. This device is anticipated will help water agencies worldwide when they perform tests and diagnostics on their water supply.

12.PROSPER.NET EXPERIENCE

The East-West Center from the University of Hawaii hosted the ProSPER.Net Leadership Program on November 16-24 (2013) for emerging leaders in the network. The Leadership Program provided opportunities for NEWRI participants to develop inter-disciplinary skills to lead sustainable development initiatives appropriate in the local, regional or global contexts. Participants gained skills in communication and consensual decision-making processes, adaptive leadership, and team project development through problem-based learning cases in the community. The Leadership Program took the team beyond the classroom setting to engage with leaders in Hawaii who are working to address human-environmental concerns. Once on-site, the team observed problems and engaged in dialogue with local leaders. Through conversation, teams shared ideas, relevant experiences and home examples, as well as learned contextual solutions from local leaders. This method engaged the full complexity of multi-stakeholder environmental issues and pushed participants to apply their knowledge. It was designed to simulate real-world challenges in which leaders must often make decisions with limited information under tight timelines.

13. OPENING OF ISEH7-7TH INTERNATIONAL SYMPOSIUM ON ENVIRONMENTAL HYDRAULICS

The 7th International Symposium on Environmental Hydraulics was held in Singapore from January 7–9, 2014. The Symposium was jointly organized by the Nanyang Technological University and National University of Singapore, and sponsored by the International Association of Hydro-Environment Engineering and Research (IAHR). Prof Ng Wun Jern, Dean of College of Engineering; and Executive Director, Nanyang Environment and Water Research Institute, delivered the opening speech. Prof Adrian Law then formally welcomed the delegates as Chairman of the Local Organising Committee.



The symposium was attended by 125 delegates from over 20 different countries. It provided a great opportunity for the community to get together for fellowship, exchange on latest research, and explore the future ahead in the field of Environmental Hydraulics. A total of 5 plenary keynotes sessions with prominent international experts and 27 parallel sessions were held within the three-day events. Two special sessions were also organised, the first on Marine Outfalls organised by the Joint IAHR/IWA Committee on Marine Outfalls, and the second on Oil Spill Modelling organised by the IAHR Oil Spills Committee. All the keynote and contributing papers were published in CD-ROM Proceedings (ISBN: 978-981-07-8047-0).

14. WORKSHOP ON BEST-SHARING PRACTICES WITHIN NEWRI FAMILY



Coordinated by Mr Victor Sim, NEWRI Scientist (Alumni), this workshop is part of NEWRI's initiative to inspire, encourage and equip students with the necessary knowledge to apply for awards/ competitions.

Co-speakers include Laurentia Setiawan (World Future Foundation – WFF award for best thesis), Amir Taheri (European Membrane Society – EMS Travel Award), Loo Siew Leng (Best Poster Award), Shi Lei (Prosper,net-Scopus Young Scientist Award), Lim Jun Wei (Green Talents), Jenny Zhou Jin (Green Talents, The LRET-University of Southampton Research Collegiums, NRG Battle – World Edition).

The format for the workshop involved ability to identify personal strengths, ways to overcome personal weaknesses and to develop a personalized strategy for awards/competitions. Everyone has his/her own unique strategies and the speakers shared their own tried-and-proven approaches.

15. LIST OF SEMINARS

Seminar title	Date	Speakers' profile	Hosted by
NEWRI best-sharing workshop	18 Mar 2014		Mr Victor Sim -NEWRI
Author Workshop	17 Mar 2014	Dean Eastbury, Chemical Engineering: Minerals, Separations & IChemE journals Elsevier, Oxford, UK	SMTC
Oil Spill Processes and Modelling (State of the Art)	17 Mar 2014	Professor Poojitha yapa, Clarkson University Department of Civil and Environmental Engineering	DHI-NTU
Constructed Wetlands for Tropical Applications	7 Mar 2014	Dr Shameen Jinadasa, University of Peradeniya, Sri lanka	NEWRIComm
A Tale of Two Seas Venice Lagoon and the Salton Sea: CA- Can We Ecologically Engineer a Sustainable Future	27 Feb 2014	Professor Gersberg, San Diego State University	NEWRI
Use of a Novel Adsorbent to Greatly Reduce Fouling in a Hybrid Membrane Treatment Process	26 Feb 2014	Professor Mark M. Benjamin, Civil Engineering, University of Washington	SMTC

Professional Ethics Workshop	17 Feb 2014	Professor William Bill Krantz	SMTC
Biogas Production, Research and development in Sweden & Application of Anaerobic Digested Residue as Fertilizer and Biobed as a tool to Reduce Pesticide Pollution	15 Jan 2014	Dr Xinmei Feng, JTI-Swedish Institute of Agricultural and Environmental Engineering	R3C
High-Performance Hydrodynamic Modelling and Applications	14 Jan 2014	Professor Liang Qiuhua, Newcastle University, School of Civil Engineering and Geosciences	DHI-NTU
Gravity Driven Membrane Filtration, Mechanisms and Applications	30 Oct 2013	Wouter Pronk, Department of Process Engineering Eawag, Swiss Federal Institute for Aquatic Science & Technology, Switzerland	SMTC
Engineering Biology in the Real World	28 Oct 2013	Professor Tom Curtis, Environmental Engineering, University of Newcastle	AEBC
Microbial Ecology in Genomics Era, Challenges and Opportunities	23 Sep 2013	Dr Jizhong Zhou, Presidential Professor, Department of Microbiology and Plant Biology	AEBC

16.FEATURE ARTICLE IN CEE RES BULLETIN-2014

Environmental modelling and simulations play a critical role forward to address practical needs in the environment and water industry. They accelerate the conceptualization of new systems through performance predictions, as well as optimize and problem-solve existing systems for material and energy reduction. Most importantly, industry users can adopt the best solutions in terms of environmental friendliness and cost competitiveness, through scenarios playing with the simulation results. The advancement of the environmental modelling tools requires both the scientific depth in terms of physical, chemical and biological understandings, as well as expert knowledge of the usage practicality towards civil and environmental engineering applications.

In the following, two examples are briefly described based on personnel involvement and experience.

(a) The first example involves the hydrodynamic modelling of granular filters, which are extensively used for pre-treatment in the water industry around the world. Empirical practices for the filters management are available in the industry from operational experience, which suffice in typical conditions but not in severe conditions. In addition, these practices do not provide enough quantitative results for optimization. A software has been developed in the Nanyang Environment and Water Research Institute (NEWRI) for the detailed hydrodynamic modelling of the processes inside the granular filters. The predictions by the software are verified through comparison with field data obtained from treatment facilities. With the available tool, it is now possible for the plant operator to seek the optimal strategy to operate multiple filters connected in parallel, as well as to plan ahead for worst scenarios. A case application has been performed for a large water treatment facility overseas.

(b) The second example involves the hydrological modelling of two-reservoir operations. An independent hydro-power developer was to build a hydro-project upstream of an existing one in Laos. Energy production studies were performed to evaluate the amount of energy which could be generated for a power sales contract on the basis of the assumed tariff structures and energy requirements. A software was developed for multiple-reservoir operations/energy production, including the associated reservoir operations rules. In this case, the model predictions show that the construction of the proposed would definitely enhance the energy production of the existing over the long run because of additional upstream storage which can better regulate the flow availability to the existing, however the energy production of the existing would be curtailed during the initial filling and testing/commissioning periods. Most interestingly, conventional wisdom would normally favour the continuous operation of the existing downstream during the filling period of the upstream project. However, the model predictions indicate that it would be far better to shut down the operations of the existing during the filling of the upstream project as the energy production loss would only restrict to about 2 years. Of course, this would also imply the needs to purchase replacement energy for the existing during this period. The above are just two of the numerous examples that can demonstrate the importance of environmental modelling and simulations to the environment and water industry. The future is indeed very exciting with the fast advancement of computer technology, rapid acceleration in the software platforms, as well as availability of big-data from field sensors that are increasingly available.

17.VIEWPOINT: "RELEVANCE OF MODELLING & SIMULATIONS" - PROF ADRIAN LAW (DHI-NTU-NEWRI)

"Environmental modelling and simulations play a critical role in addressing practical needs in the environment and water industry. These accelerate the conceptualization of new technology through performance predictions, as well as optimize and problem-solve existing systems for material and energy reduction. Most importantly, industry users can adopt the most environmental friendly and cost effective solution through scenario playing with the simulation results. Advancement of the tools, both software and hardware, requires detailed physical, chemical, and biological understandings together with analytical and programming skills, and shall be the focus of the Centre in NEWRI Phase II."

~Prof Adrian Law (Director, DHI-NTU-NEWRI)

18. NEWRICOMM PHOTO ESSAY:

Centre of Excellence for Environmental Management in Vientiane, Laos

About NEWRI Community Development (NEWRIComm)

NEWRIComm partners benefactors for social investments for a better shared future in Asia through innovations and holistic solutions in water technologies. Our network of local stakeholders ensures sustainable solutions through ownership and technical knowledge diffusion.

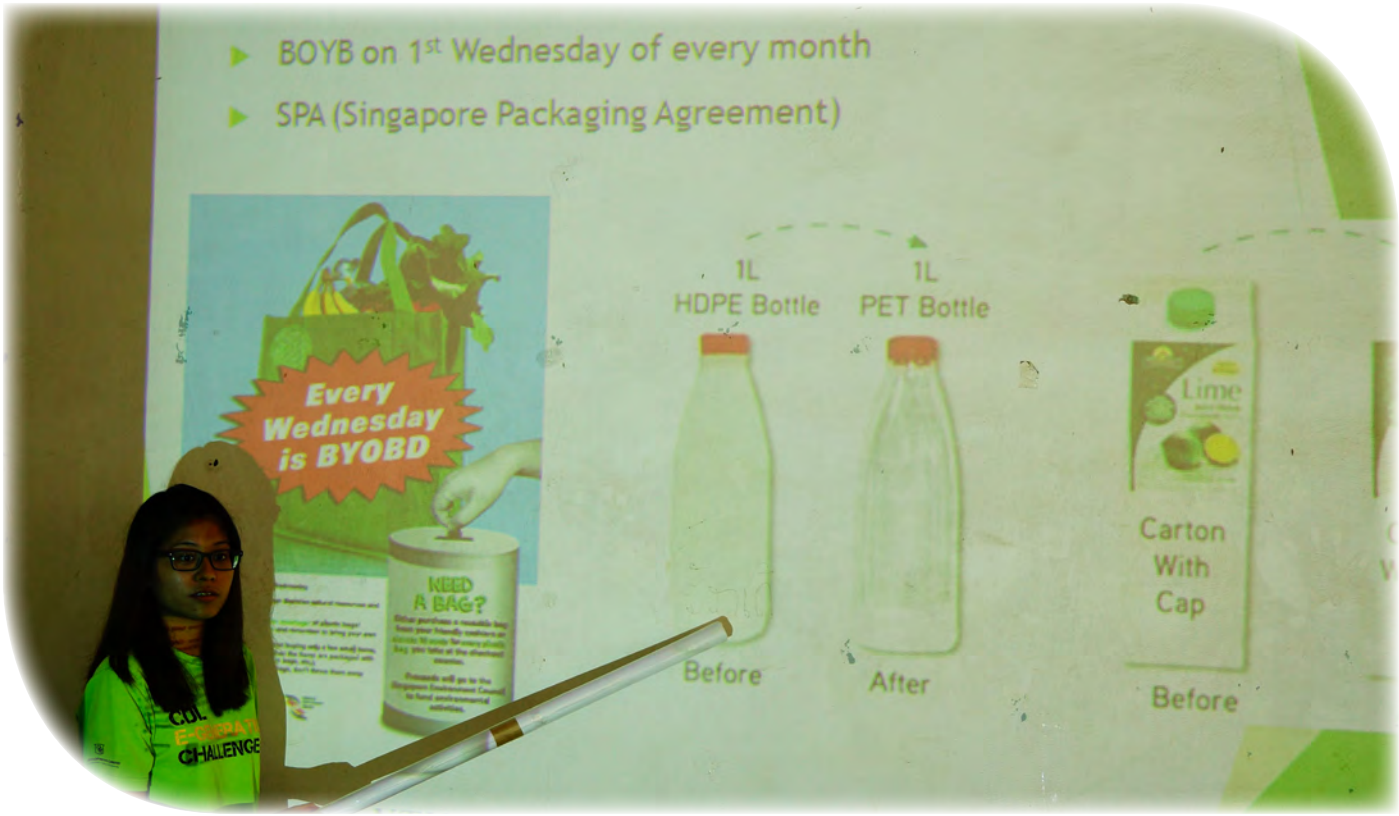
The Centre of Excellence for Environmental Management at the National University of Laos (NUOL) conceptualized as a NEWRICOMM project, is a three-year master plan for an integrated teaching and research centre.

NTU President Professor Bertil Andersson visited NUOL in November 2013 to witness the signing of Memorandum of Understanding (MOU) between NEWRI and the Faculty of Environmental Sciences of NUOL to mark the partnership.

Centre of Excellence for Environmental Management in Vientiane, Laos

Four NTU Earthlink Club students are involved in advising their Laotian counterparts on community education efforts.

Centre of Excellence for Environmental Management in Vientiane, Laos



The NTU Earthlink students shared their experience through workshops and recycling drives.

Centre of Excellence for Environmental Management in Vientiane, Laos

Students from the Social Environmental Education & Development Club of NUOL work with the hostel leaders to lead the community education efforts.

Curriculum planning in environmental management is underway at NUOL.

Till the next update - best wishes,

Prof WJ Ng
Executive Director, NEWRI

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