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NEWRI Update

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A Word from the Prof...

Dear Colleagues and Friends of NEWRI,

Time flies.

We have already left 2016 and are now into 2017. We did well in 2016 and our research outputs by way of publications, the IPs we have generated, the employability of NEWRI graduates, and our growing links with industry partners are indications of the progress made. With confirmation of NEWRI receiving its Tranche-3 funding, we can now push forward till 2021 before we again bid for core funding.

Last year in July, NTU organized for NEWRI to be formally evaluated. The largely positive evaluation report noted evidence of rapid progress and quality. There was, however, an unexpected observation and discussion made by the Evaluation Panel and this was of NEWRI's uniqueness in terms of its structure and mode of operations. It is this structure and mode of operations which NEWRI is using to bring research outcomes to the community and industry.

NEWRI has now transited into the third phase of its RED (Research-Engineering-Deployment) roadmap. The careful balance of deep research and robust engineering is intended to allow NEWRI to innovate in ways meaningful to the Singapore environmental engineering industry. It is also this balance which has allowed NEWRI to have both an academic profile and an industry profile.

NEWRI, in 2017, is ready to take increasing numbers of its innovations to the industry – i.e. Deployment. As we progress through 2017, we shall undertake activities intended to move NEWRI forward and upwards.

I thank you for your support and I am certain, with you, the best that is yet to be for NEWRI.

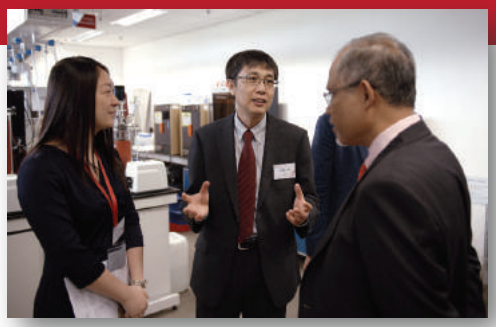
Wishing you a prosperous **RED** rooster year in 2017,

Prof Ng Wun Jern
Executive Director, NEWRI
NEWRIUpdate

IN ONE MINUTE

Dialogue with an Expert

We caught up with Professor Liu Yu (Director) and Assistant Prof Zhou Yan of NEWRI's Advanced Environmental Biotechnology Centre (AEBC) recently to ask about MICROBES, and to find out how it affects the industry at large in our new segment where we get direct with our experts in the field.



Prof Liu Yu (Director) and Assistant Professor Zhou Yan (Deputy Director) of NEWRI's AEBC, seen here in discussion with the Minister for Water and Environment, Mr Masagos Zulkifli (2016)

Interviewer: Thank you for your time, Prof Liu. In your opinion, how is the development of microbes affecting the wastewater industry?

Mixed microbial cultures are the core of various biological processes for wastewater reclamation, i.e. any discovery of new functional microbial species in the natural or engineered system will definitely lead to new thinking and design of biological processes, which in turn impact on the business development of global wastewater industry. For example, the discovery
of Anammox bacteria offers an alternative option for removing ammonia from wastewater at much lower cost.

What are some current difficulties affecting the development of microbes today?

In biological treatment of wastewater, essentially we have never used pure cultures given the highly complex chemical composition of wastewater. Therefore, the key issue here is not about the development of individual species, but a healthy microbial consortium with multiple functions, in which various species can survive and work in a synergistic fashion. For example, many species (e.g. ammonia oxidizer, nitrite oxidizer, denitrifying bacteria, Anammox bacteria etc) are essentially involved in the Anammox process. The main challenge is how to engineer an optimal environment so that these species can all exist in kinetic equilibrium favorable for anamomx reaction.

What are the biggest challenges faced by biological treatment processes? (footprint, CAPEX, sensitive to process variation, microbes behavior etc.)

We celebrated the 100th anniversary of the activated sludge process in 2014. Although the activated sludge process, one of the most remarkable engineering inventions in the 20th century, has made significant contribution to wastewater reclamation, its high energy consumption and the production of extremely huge amount of waste activated sludge pose a serious impact and challenge to the current wastewater industry worldwide, and is also inevitably linked to the issue of global climate change. We thought that substantial improvement in the energy efficiency might not be achievable through further optimization of the activated sludge process. Instead, we should explore novel treatment configurations by adopting emerging technologies in order to turn the wastewater treatment from currently energy-negative to energy-neutral or even energy-positive in future. In the years to come, we have no choice, but have to properly address the wastewater-energy-resource nexus.

What would be the next step for biological treatment processes?

In my opinion, there will be an urgent global need to substantially improve the overall energy efficiency of wastewater treatment plant (WWTP). Theoretically, organics in wastewater should be captured as much as possible for direct anaerobic digestion prior to biological conversion to sludge. This concept may lead to the paradigm shift of the current wastewater treatment practice with the benefits of (i) enhanced energy recovery; (ii) reduced in-plant energy consumption and (iii) minimized production of waste activated sludge. We believe that future WWTP should be designed according to the concept of A-B process for significantly improving the energy recovery potential, while reducing in-plant energy consumption. The AEBC team has been exploring various possible configurations of A-B process. With the advances in environmental microbiology along with recent development in autotrophic ammonia removal, A-B process appears to be a feasible option towards energy self-sufficient wastewater reclamation.

What kind of microbial development/updates can we expect in the next 5 years from NEWRI-AEBC, and any recent emerging trend(s) in biological treatment? how is NEWRI-AEBC positioning itself?

Nowadays, biological treatment of wastewater is centralized towards system integration with multiple microbial functions, without which, discovery of new microbes may not be timely translated into engineering process. We are opined that mainstream Anammox would likely be engineered for large-scale municipal wastewater reclamation in the next 5 to 10 years. In this regards, NEWRI-AEBC has been developing innovative process configurations towards sustainable mainstream anammox. Meanwhile, we are also tackling another challenge that global wastewater industry is facing up, i.e. waste activated sludge generated from biological processes. NEWRI-AEBC has demonstrated that waste activated sludge can be reduced by up to 75% through prior carbon capture in an innovatively designed A-B process.

Describe some of the recent major breakthroughs or projects undertaken by AEBC? Please elaborate on the WW-ART initiative and what is the role of AEBC in this initiative.

NEWRI-AEBC has been working on a broad spectrum of wastewater technologies. For example, the team in NEWRI-AEBC has also developed a novel A-B process in which an anaerobic moving bed biofilm reactor (AMBBR) serves a lead A-stage for COD capture towards biogas production and an integrated fixed-biofilm and activated sludge sequencing batch reactor (IFAS-SBR) employed as B-stage for biological nitrogen removal. About 85% of COD influent wastewater can be removed at the A-stage, while 85% of N-removal was achieved when the stable nitrite shunt was established at the B-stage. More importantly, NEWRI-AEBC has patented an innovatively designed degasser for recovery of dissolved methane from anaerobic effluent, by which 90% of dissolved methane in the A-stage effluent could be removed. Compared to the conventional activated sludge process, the production of waste sludge in this A-B process can be reduced by about 75% due to the efficient COD capture at the A-stage, leading to significant energy savings from aeration for COD oxidation and post-treatment of waste sludge.

Currently, anaerobic digestion of sewage sludge has been commonly adopted for biogas production and solids volume reduction, but it suffers from low process efficiency due to poor hydrolysis of sewage sludge. The NEWRI-AEBC has developed a cluster of IPs relating to enhanced anaerobic digestion of sewage sludge. The selected IPs will be tested out in NEWRI's engineering system – WW-ART with capacity of 10 CMD sludge. Recently, we have developed an integrated online sensing system to simultaneously monitor the hydrolysis and acidogenesis processes, which are the kinetic limiting steps for anaerobic digestion. This development can greatly reduce the analysis procedures and timely feedback to control systems. Meanwhile, we have also developed an engineering approach to produce fungal mash highly rich in various hydrolytic enzymes from food waste, which can be directly applied to ultra-fast hydrolyze both food waste and sewage sludge without the needs for further separation and purification. With this powerful fungal mash, an integrated engineering system for enhanced co-digestion of food waste e and sewage sludge with the focus on resource/energy recovery and solid volume reduction has been successfully demonstrated at laboratory-scale. In this approach, the solids residues produced from food waste hydrolysis with proper NPK will be directly converted to biofertilizer, while only the liquid stream with high soluble COD up to 200 g/L will be directed to anaerobic digester together with sewage sludge for enhance biogas production and solid minimization.

AEBC is a leading unit in the NEWRI's WW-ART initiative, an engineering platform for technology demonstration, which is essential for derisking and deploying technology. Indeed, it is an excellent example of the NEWRI's RED philosophy, i.e. Research, Engineering and Deployment. Definitely, with the unique WW-ART platform in place, NEWRI-AEBC shall be able to engineer and further deploy their IPs into markets in an accelerated pace.

What was the driving force behind WW-ART initiative?

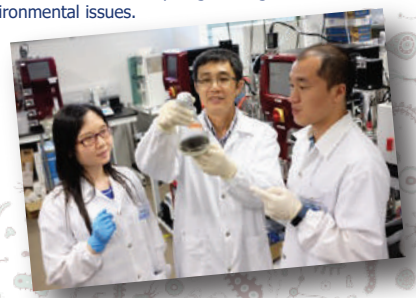
The TRLs of most IPs generated in laboratories are very low, generally below 4. This is becoming a serious hurdle of the IPs deployment and commercialization. We believe that derisking of IPs with low TRL is an essential step towards final technology deployment and commercialization. Precisely, the WW-ART initiative can help to fill up such a gap in technology development between laboratory and industry.

What would your message to potential researchers who intend to pursue this field?

In 2014, when people around the world celebrated the 100th anniversary of the activated sludge process, a fundamental question of what is the next 100 years of wastewater treatment has been raised. In my humble view, to address such a challenging question, we shall need to make sure that deep science must lead to deep engineering in future. Therefore, a future successful researcher should possess adequate scientific and engineering capability in addressing complex environmental issues.

Dr Liu Yu is currently Professor in the School of CEE. He received his Master and Ph.D. degrees from the Institut National des Sciences Appliquees-Toulouse, France. His research interests include biogranulation, biofilms and biological nutrient removal. Together with other three CEE colleagues, he received the Singapore National Technology Award in 2003, and he has published over 110 SCI-tracked journal papers and 5 books. He has been invited as a reviewer for about 40 internatinal journals including almost all top journals in the fields of environmental biotechnology and engineering.

Dr Zhou Yan, Assistant Professor, Deputy Director, Advanced Environmental Biotechnology Centre, Nanyang Environment and Water Research Institute (NEWRI-AEBC)



Prof Liu Yu (Director of AEBC) with researchers from using food waste to produce a cocktail of enzymes, which can in turn convert the waste into glucose.

For more information about microbes and Advanced Environmental Biotechnology Centre (AEBC) kindly visit http://newri.ntu.edu.sg/AEBC

VISITS AND EXCHANGES

KURITA (SINGAPORE) PTE. LTD visits NEWRI on 11 Jan 2017

Invitation to Qatar National Day (6 Dec 2016) at Shangri La Hotel, Dr Mas and Mr Benjamin Moi invitation of HE Ambassador Abdallah Al Hammar.

Contingent from China Energy Conservation and Environmental Protection Group (CECEP) met with Prof Ng on a visit to NEWRI (9th Dec 2016)

Exchange Visit of ASEAN-Korean Media visiting NTU-Hyundai Urban System Centre in NEWRI (21 Nov 2016)

Visit to NEWRI by Nanjing Chemical Industrial Park (21 Nov 2016)

NEWRI in the NEWS


EDB partners Hyflux in efforts to 'future-proof' business operations


Left to Right: Mr Wong Lup Wai (Group EVP & Group COO, Hyflux), Ms Olivia Lum (Executive Chairman & Group CEO, Hyflux), Dr Beh Swan Gin (Chairman, Singapore EDB) and Prof Wang Rong (Professor, NEWRI, NTU) after signing the MoU.

EDB partners Hyflux in efforts to 'future-proof' business operations

"Hyflux signed a Memorandum of Understanding with Nanyang Technological University's Nanyang Environment and Water Research Institute (NEWRI) to collaborate on next-generation water-treatment technologies..."

To view the article, please click here
ST article (20 Nov 2016)

To view the article, please click here
Web Article (Nov 2016)

Professor William Chen headlines Zhejiang University (China) webpage

Professor William Chen, Director of NEWRIEdu and Academic Editor of PLoS ONE, was invited to address the students and lecturers of Zhejiang University of Technology (China) to establish student exhchange with NTU. He was there to give a talk on "Microbial and Metabolic Engineering Platform for Sustainable Biosynthesis". (Nov 2016)


THE STRAITS TIMES

More composting to turn food scraps into fertiliser

More composting to turn food scraps into fertiliser

Dr Victor Chang (deputy director of Residues & Resource Reclamation Centre (R3C-NEWRI), was quoted in an article regarding composting said, "they are broken down by naturally occurring micro-organisms such as bacteria and fungi into finer nutrient-rich particles than can be used to fertilise plants. He also said "to ensure that the composting micro-organisms flourish and emit enough heat, it is important to get the right balance of carbon, nitrogen, and moisture in the compost bin". Other groups that focus on composting, such as Singapore Worm Composting, an online platform started by four students from NTU as an entrepreneurship project in 2010.

To view the article, please click here
ST article (21 Jan 2017)

SPOTLIGHT ON

NEWRI is proud to annouce and introduce, Mr Bill Ho as the Business Development Director of NEWRITech.

A brief introduction to our readers.
Bill Ho is the Business Development Director of NEWRITech, and has been in this role since December 2016. NEWRITech's mission is to provide effective market solutions in various fields, most specifically environment and water. This is achieved by a careful selection of appropriate technologies developed by NEWRI and associated institutions, and subsequently taking these from laboratory-scale to full-scale deployment and commercialisation. NEWRITech works closely with the ART (Applied Research and Translation) units associated with NEWRI, to provide an effective de-risking of these technologies during their transition to higher Technology Readiness Levels.

Background and specialty?
Prior to joining NEWRI, Mr Ho has had extensive regional experience in the environment and water industries, including 5 years driving key projects in China (Shanghai and Dongguan). He has also been CFO of several Singapore listed companies. Recently, he successfully led the public listing of a local company on the Singapore Stock Exchange in 2014. A certified Chartered Accountant in both Singapore and Australia, Mr. Ho's other achievements have been fund raising, financial and business modelling, mergers & acquisition, and most importantly, his ability to return a loss-making company to profitability. Following his graduation from Deakin University in 1994, he joined KPMG Singapore as a financial auditor, followed by stints in US and Australian multi-national corporations.

Comment on NEWRI and the industry?
I believe NEWRI exist because it acknowledges the widespread environmental degradation and severe stress on the world's natural resources, such as a global water crisis has been identified as one of the top ten global risks, reflecting not only the increasing incidence of droughts and floods but also the overuse of groundwater resources and worsening pollution; as well as changes in land-use, unsustainable agricultural practices and food systems, that have had negative impacts on food security.

I see NEWRI has already mapped out its operating model, and is in the process of identifying its niches and strengths, and most importantly execution. NEWRITech is to identify the markets for such technologies, thereby narrowing the gap between industry needs and NEWRI's technology capabilities. Other than commercializing the existing IPs, NEWRITech's primary objective is to gain a strong foothold in the market by providing applicable solutions with engineering know-how, which the most direct method is to co-develop with industry partners. This partnership does not stop once the IP is established, NEWRITech would continue to monetize further, either within NEWRI and/or its spin-off companies, as well as continuous flow of R&D activities.

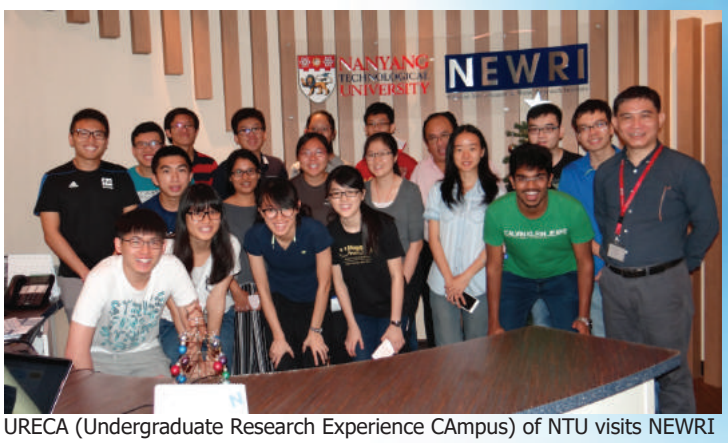
What stands out for you being in NEWRITech?
My contribution is summarised in three key areas:
- Management: this entails internal (within NEWRI) and external factors; Internal factor refers to operational management within NEWRI and NEWRITech to improve its focus on bringing products into the market. External factor refers to managing the expectations from various parties, project /resource coordination, and timely delivery.
- Financial: provide clearer insights and better financial control to stakeholders by means of reliable financial and risk analysis, as well as capital structure.
- Business plans: Co-developing business plans with business / industry partners, thereby building a more sustainable business model.

Where do you see NEWRItech in 5 years, and what role will you adopt?
The next few years is to set the pace so that the current team and researchers are able to appreciate the integration of technologies into the market. With right deployment opportunities, I hope to see NEWRITech members grow in both their enthusiasm and management skills, so that they are able to lead a bigger team, perhaps a younger group to build a more sustainable environment.

SEMINARS, WORKSHOPS & TRAINING

Enhancing staff knowledge and experiences, NEWRI holds regular in-house workshops and seminars by fellow researchers and visiting professors, scientists, institutes, and external visits; allowing knowledge to diffuse throughout the organisation.
Here are some highlights:

NEWRI hosted 13 of the brightest minds who attended the 5th Global Young Scientists Summit, as they spent time getting to know our organisation and see our laboratories. Prsenting NEWRI to these participants were Dr Adil Dhalla and Dr Benjamin Moy. (18 Jan 2017)



URECA (Undergraduate Research Experience CAmpus) of NTU visits NEWRI on 6 Dec 2016, where they got first hand knowledge from our researchers.

Dr Victor Sim conducts the NEWRI Process Design Workshop in NEWRI on 5 Jan 2016.

NEWRI Events

	Recent Seminars / Conference	Dates
1.	Engineering With Membranes (EWM2017) Recent Advances in Membrane Science and Technology (International Conference)	26 – 28 April 2017
2.	Oral Communication Skills – Prof Bill Krantz	21- 22 / 27- 28 February 2017
3.	Global Contamination of the environment, another horror story? – Prof Rainer Stegmann	20 February 2017
4.	Sustainable Landfilling: What is the status and what has to be changed? – Prof Rainer Stegmann	13 February 2017
5.	NEWRI Process Design Workshop – Dr Victor Sim	5 January 2017

Have a Prosperous RED ROOSTER 2017

Chinese New Year Celebration at NEWRI

We celebrated the Chinese New Year at NEWRI on the 9th February 2017 with much joy and smiles. Everyone was entertained by a roving magician, a caricature artist and performances by NEWRI's researchers: Marcus Low, Dilhara Sethunga, Ishara Fernando, Chanaka Withana, Supuli Jayaweera, Gayana Herath, Taniya Perera, Sachindra Cooray, and Sulashi Wijesinghe. Prof Ng welcomed all in his address and Prof Wang Rong made special mention of Dr Fang WangXi, Dr Shi Lei, Dr Chou Shuren, and Dr Laurentia Setiawan for their contribution to research. Hongbao vouchers and lucky draw prizes were presented to the lucky participants, followed by the 'lo-hei' and lunch. Here's wishing all gong xi fa cai!

Breaking Ground

NEWRI'S JOURNALS & PUBLICATIONS

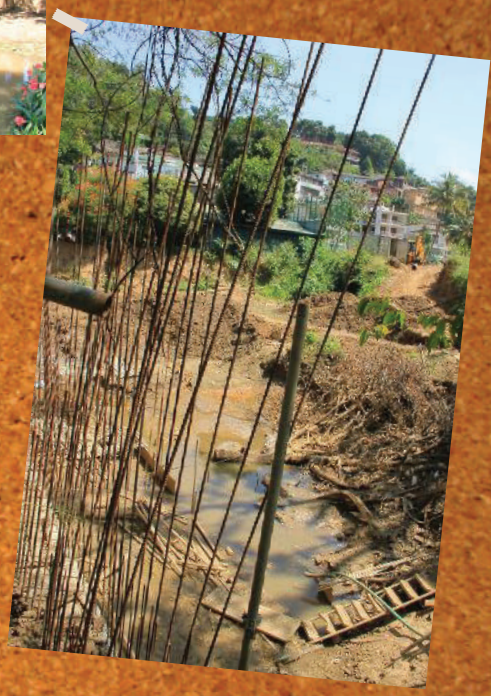
At NEWRI we do not forget our foundation which is deep scientific research. NEWRI's researchers and professors from our various Centres of Execellence publish frequently in journals, conferences and keynotes. To view the catalog of titles, you can log on to the NEWRI webpage on PUBLICATIONS for more information. Link below:

Please click on NEWRI Publications shortcut: **CLICK HERE**

NEWRI's webpage - optimised for your mobile phone viewing!
We have made sure our website has been updated to show more! Have a look! Scan the QR code for those on smart phones.
http://newri.ntu.edu.sg/Pages/Home1.aspx

Significant water and sanitation infrastructure development have been going on in Kandy City, Sri Lanka, following the formal handover of the NEWRIComm project in July 2014.

Desilting activities at the Mahamaya Inlet of Kandy Lake



The most tangible contribution is perhaps the sewage treatment facility installed at the Sri Dalada Maligawa (the Buddha Tooth Relic Temple): "A very challenging job because it is an archeological site… a national treasure… any [harm done to the temple], [report] will go straight to the President", to quote Mr C.W Karunaratna, Secretary General of the Dalada Maligawa. The facility has simplified connection to the main sewer lines under construction. In the meantime, since its commissioning in 2013, the plant has treated wastewater from the temple complex before discharge to Kandy Lake, eliminating the need for gully bowsers.

Main silt traps and drainage canal of the city (Mid-Canal) are undergoing rehabilitation when NEWRIComm visited in January 2017. The city is also constructing sewer lines and a centralized municipal wastewater treatment plant. These are supported by the World Bank and the Japan International Cooperation Agency (JICA).

Local authorities believe the NEWRIComm project has helped to pave the way through research-based recommendations, technology transfer, and capacity building. "Six years ago there was [research done in NEWRIComm project], and ideas came from there." Says Kandy Municipal Council Engineer Mr D.M.D.S Senevirathne.

The project in Kandy was a collaboration between NEWRI, the University of Peradeniya, the National Water Supply and Drainage Board, Kandy Irrigation Department, and the Kandy Municipal Council.

The project centres on the clean-up of Kandy Lake, which discharges to the Mahaweli River, a main drinking water supply for many parts of Sri Lanka. The project encompassed catchment assessment, design, and deployment of solutions including floating treatment wetlands for Kandy Lake, a sewage treatment plant for the Dalada Maligawa, and an environmental education program for the Mahamaya Girls' College.

"When the treatment system was proposed, I thought it was high-tech… I have never seen a sequencing batch reactor (SBR) system applied before that… It has worked well and it has now become a model… [NEWRIComm project] has brought technology to the country… and awareness, even at school level.", said Dr C.S Kalpage from the University of Peradeniya.

The Kandy Municipal Council won the Swarnapura Award (best municipal council) in 2016.

The authorities and project team members believe our project has helped to push forward the developments by establishing track record and experience among the officials.