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SMTC'S PROF WANG RONG SCORES ANOTHER WIN



Prof Wang Rong, Chair of CEE, Director of NEWRI's SMTC, and Prof Anthony G. Fane (absent) were presented the Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW) by the UN Secretary-General Mr Ban Ki Moon and Prince Khaled Bin Sultan Bin Abdulaziz (Far left) and the Minister of Water, Environment and Agriculture, Mr Abdul Rahman Al-Fadli (far right) (Page 2)



NEWRI is no stranger to global visitors, as we hosted the Islamic Republic of Iran's Public Relations Office who sent a delegation from various representatives. More inside (Pg 4)



NEWRI's website is given a new breath! Do stop by and have a look around. NEWRI @ NTU

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ISSUE 1

A Word from the Prof...

Dear Colleagues and Friends of NEWRI,

2016 is fast coming to a close and what a year we have had.

With December closing in, it would be good to have a review of 2016 and all its glorious happenings. Throughout the year, NEWRI saw many MoUs being signed and potential partnerships forged. One significant collaboration saw the Chongqing Hualong Group – STSE Engineering Services and NEWRI coming together for an MoU opening doors to Western China. NEWRI also saw a milestone carved in R&D efforts with NTU and Hyundai Engineering & Construction officially opening the NTU-Hyundai Urban System Centre in NEWRI.

Mid-year was another very exciting time for us as the Minister for Environment and Water Resources Mr Masagos Zulkifli paid NEWRI and its laboratories a visit, coupled with the officially opening of the ST-ART centre set up to test and scale-up 'separation technologies' such as large scale advanced membranes. It was as exciting as our participation in this year's 7th Singapore International Water Week 2016 at the Sands Expo and Convention Centre (Marina Bay Sands) which saw the Waste-to-Energy Research Facility (expected to be commissioned soon) launched at CESS 2016. NEWRI at SIWW saw several MoUs and collaborations agreed with new partners, like Kiat Lee Landscape & Building, Ceraflo (Singapore) and Ramboll Environ Singapore, signalling the beginnings of our spinoffs.

Over the course of the year, NEWRI had news appearances, a bevy of official visits from various organisations, universities and agencies globally, as well as our seminars a staple for staff and students. But our heartiest congratulation to Prof Wang Rong and Prof Fane on receiving the Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW).

Our work continues as we enter Tranche 3 with renewed vigour, renewed direction and purpose. Speaking of revamps, we do hope you drop by our refreshed NEWRI webpage. Comments welcomed.

Last but not least, we wish you season's greetings and have a great festive holiday! We will see you again in 2017!

Prof Ng Wun Jern Executive Director, NEWRI NEWRIUpdate

NANYANG TECHNOLOGICAL UNIVERSITY



INDUSTRY UPDATES



We caught up with Professor Wang Rong, Chair of CEE and Director of NEWRI's Singapore Membrane Technology Centre (NEWRI-SMTC) recently, after beating 31 nominations from more than 20 countries (195 nominations from 65 countries in total). Prof Wang Rong attained the **Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW)**. This is the first team from Singapore to win the Prize. NEWRI congratulates Prof Wang Rong on this achievement.

Interviewer: Congratulations on your recent Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW).

Prof Wang Rong: Thank you.

Its understood that there were 32 nominations from more than 20 countries and this is the first time a team from Singapore to win the prize? How was that accomplished and how does it feel to be recognised as the first?

The PSIPW is a leading global scientific award for innovative and pioneering research in water-related fields. I am excited and am truly honoured to have been selected as the award recipient amongst other competitive nominees.

What were the factors that contributed to this award?

This award is accorded to our work on novel forward osmosis membrane done at NEWRI-SMTC, NTU. Forward osmosis is an emerging technology that can lead to water reclamation and recycling at lower energy intensity. Our research is driven by the need for solutions so as to reduce reliance on inadequate conventional water resources.

Could you tell us the developments so far of the novel forward osmosis hollow fibre membrane? My colleagues and I developed the first thin film composite FO hollow fibre membrane, and thereafter improved it with anti-scaling and anti-internal concentration polarization capacity to provide enhanced FO performance. This development has made it possible to combine FO with existing technologies such as reverse osmosis (RO), membrane bioreactor and membrane distillation, to create novel hybrid membrane systems which allow for the wide-ranging applications of the technology. Recently, a novel PRO membrane developed by my team has been identified by PUB as one of the projects seeking translation partners and funding in a request-for-proposal to accelerate the implementation of the PRO technology into a real-world solution for salinity-gradient energy recovery, minimizing RO brine disposal impact and making use of NEWater brine.

Can you share with us some of its recent applications in the industry?

FO/PRO is a new industrial technology with numerous potential applications. For example, a company has worked with us to demonstrate that our FO membranes can be used to reduce produced water injection volumes in the gas fields. One company is exploring to use our FO membrane for beverage application.

Could you tell us about NEWRI-SMTC and its role in the membrane development?

SMTC is a research centre NEWRI to spearhead Singapore's R&D efforts in fundamental and applied membranes technology. The NEWRI-SMTC research activities are mainly directed towards membrane technology for Sustainable Water and Environment.

Recently it was reported that De.Mem (NEWRI Spin-off) in collaboration with NEWRI-SMTC, plans to test new membranes modules in real world usage in its plants. Are there plans to commercialize or scale-up to full industrial production? Recently De.Mem licensed our novel low pressure nanofiltration (NF) membrane technology, and intended to scale up for mass production. NEWRI-SMTC is happy to provide support to De.Mem for this effort.

Are there other new types of novel membranes in development from NEWRI-SMTC?

In addition to novel FO/PRO and low pressure NF hollow fiber membranes, NEWRI-SMTC has developed high performance aquaporin based biomimetic membrane for water reuse and desalination, and superhydrophobic membrane for oil/water separations. We are in the process of discussing with industrial partners to scale up the production for practical applications.

What does winning this award mean to NEWRI-SMTC?

We have both worked very hard to build up the NEWRI-SMTC to be a global leader in membranes and sustainable water. This prize is great recognition of these efforts.

Thank you Prof Wang for your insight.

(Interview on 31 October 2016)

Professor Wang has over 20 patents for novel membrane fabrication. She is the Editor of the Journal of Membrane Science, a top journal on membranes. She is also the founding President of the Membrane Society in Singapore.





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For more information about the presentation of award, please <u>click here</u> For more information about FO membranes and Singapore Membrane Technology Centre (SMTC), kindly visit <u>SMTC homepage</u>

INDUSTRY UPDATES

At NEWRI, innovation and enterprise are achieved through collaboration and partnerships. Seeking opportunities for commercial and research alliances, NEWRI continues to push into valued-added solutions, defining our journey towards our goals of enterprise and contributing to global sustainable economic values.



Earlier in July, Prof Ng and Dr Shi Lei of NEWRI visits the Foshan Industrial Technology Research Institute, Chinese Academy of Sciences and were introduced to their research (31 July 2016)



NEWRI recently played host to several delegates from various sectors in the Guangdong Province. The Chinese delegates were briefed about the work NEWRI is capable of by Prof Liu Yu. (20 Oct 2016)







Prof Ng Wun Jern giving the opening plenary session of the Indonesian Science & Technology Festival at the new Indonesia Convention Exhibition (ICE), Serpong, Indonesia. (3 – 5 October 2016)

Prof Ng Wun Jern was recently invited to speak at the opening plenary session of the Indonesian Science & Technology Festival at the new Indonesia Convention Exhibition (ICE), Serpong, Indonesia. The festival was graced by the Indonesia's Minister for Research, Technology, and Higher Education, Prof Muhammad Nasir, is an annual event organised by the Indonesian Institute of Sciences (LIPI), Indonesia's national research institute and authority for science and research which ran from 3 to 5 October 2016. The event housed eight parallel international conferences dedicated to various scientific disciplines ranging from theoretical physics to sustainable energy engineering and green technology value chain.

In the session, Prof Ng spoke about changes which have been investigated and are beginning to be implemented in wastewater, sludge, and agro-industrial wastes management which are more environmentally benign, such as improved anaerobic digestion. He drew on examples from the historical development of wastewater treatment to illustrate the premise that pollution control itself may not be entirely free from adverse impact on the environment if considered from a more holistic perspective, such as large energy requirement for aeration and excess biosludge which require safe disposal so as not to pose environmental and health hazard.



Visit by Ms Juliet Bell, Executive Manager, International, CSIRO and Ms Carolyn Atkinson, Innovation Counsellor, Australian High Commission (10 Oct 2016)



Meeting with Hiroshima University's Yasuhiro Isobe-san at NEWRI (19 Sept 2016)



Fresenius Medical Care R&D Team meets with NEWRI (10 Aug 2016)



Visit by Cranfield University's Prof Sir Peter Gregson (Vice Chancellor and Chief Executive), Prof Simon Pollard (Pro-Vice Chancellor, School of Water, Energy and Environment), Prof Philip John (Pro-Vice Chancellor, School of Aerospace, Transport and Manufacturing), Prof Iain Gray (Director of Aerospace, School of Aerospace, Transport and Manufacturing) to NEWRI (30 September 2016)



Visit to NEWRI by Prof. Arthur Mol (Rector Magnificus) of Wageningen University and guest (15 Aug 2016)



Environment Technology Office (ETO) of NEA (National Environment Agency) held a proposal sharing session at NEWRI (22 Aug 2016)



Islamic Republic of Iran's Public Relations Office sent a delegation from various representatives: (Tehran Water and Wastewater Company, South Khorasan Provice, Ardebil Provice Water and Wastewater Company, Alborz Provice Water and Wastewater Company, Ghazvin Provice Water and Wastewater Company, Lorestan Provice Water and Wastewater Company, Hamesan Provice Water and Wastewater Company, Kashan Provice Water and Wastewater Company and UNESCO Regional Centre on Urban Water Management) to visit NEWRI (30 Sept 2016)

NEWRI In the News

Prime Minister Lee Hsien Loong, speaking at an event to promote environmental awareness highlighted the challenges that come with climate change. Prof Ng Wun Jern (NEWRI) said the 'save water' message has filtered through to the public. But added that there is a need to continue with ongoing efforts in education and increasing water efficiency

> To view the article, please click here Straits Times article (6 Nov 2016)





"Water companies should invest in new technologies to venture into brownfield projects instead ... " quoted Prof Ng Wun Jern in an article released in The Edge Singapore (Article by Trinity Chua. The Edge Singapore, Aug 2016)

> To download the article, please click here The Edge, Singapore



Use less water, PM reminds as reservoir dries up Sent Sing Press Holding publication

The Brain-gain Game NEWRI gets a mention by NTU President Prof Bertil Anderson in the article by Annabel McGilvray of Nature: International Weekly of Science (Sept 2016)

yflux sees better revenue, weak earnings koands into consumer and lifestyle space

To view the article, please click here **Nature**



required for water treatment by membrane processes.

Prof. Wang Rong & Prof. Anthony G. Fane

Winners of the Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW

Congratulations to Prof Wang Rong, Chair of CEE and Prof Anthony G. Fane, (NEWRI) for winning the Alternative Water Resources Prize at the 7th Award of the Prince Sultan Bin Abdulaziz International Prize for Water (PSIPW) for their development and application of novel forward osmosis hollow fibre membranes. Their work combines forward osmosis with a reverse osmosis (RO)-like inner selective layer and a novel and previously undiscovered positively charged nanofiltration (NF)-like outer selective layer. This novel structure provides enhanced performance by reducing the effects of scaling and flux losses caused by internal concentration

polarization. These membranes promise to be a key factor for the reduction of the energy

To view the article, please click here

Alternative Water Resources Prize at the 7th Award of the PSIPW



NEWRI is mentioned in PUB's publication "Innovation in Water Singapore" that gives a good overview on its current efforts in water research carried out in Singapore.

NEWRI and PUB's development of a pilot water recycling plant that uses a multimedia filter.

activated carbon filter, and reverse osmosis to remove total organic carbon, suspended solids, ions and other impurities from the used water stream, and a more cost-effective ion exchange system for another stream of water with low total dissolved solids was featured.

To view the document, lease click here PUB's Innovation in Water Singapore Vol 8

Mooncakes, lanterns and mirth, as NEWRI staff and students celebrated the Mid-Autumn Festival complete vith games and feasting. (15 September 2016)











upcoming Events

NEWRI constantly seeks to enhance staff knowledge and experiences. Regular in-house workshops and seminars by fellow researchers and visiting professors, scientists and institutes allows knowledge to diffuse throughout the organisation. Here are some highlights:

	Upcoming Seminars / Conference	Dates
1.	Engineering With Membranes (EWM2017) Recent Advances in Membrane Science and Technology (International Conference)	26 – 28 April 2017
2.	Sulfur Cycle-based Biological Process for Co-Treatment of Wet Flue Gas Desulfurization (FGD) Wastes with Freshwater Sewage	24 November 2016
2.	Systems Thinking for Sustainable Homes	17 November 2016
	Past Seminars	Dates
	NEWRI Water Works Design Workshop	October
	PUB'S grant call and technology information sharing session	
3.	NEWRI Researcher and Senior PhDs Seminar Series	September
	Safe, Robust and Rapid Construction Method of Underpass for Roads and Railways in Operation & Hyundai E&C Newly Developed	August
	Technologies for the Optimization of TBM Excavation and Operation	
	NEWRI Best-Sharing Workshop and NEWRI Design Workshop	
i.	Steam Gasification of Lignocellulosic Biomass and Catalytic Tar Reforming Seminar	
΄.	INES workshop "Upscaling the Production of Innovative Membranes" in Singapore (NTU)	July
	Fungal Biomes and Diversity and Human Health Implications (@ CEE)	
).	Prospective of denitrifying anaerobic methane oxidation (DAMO) process in wastewater treatment	
0.	The Reinvention of Sanitation Services	
1.	From Waste Treatment To Valuable Products Production	June
2.	ZeeLung: A new membrane-aerated biofilm reactor for low energy wastewater treatment	May
3.	Microbial functional diversity predicts groundwater contamination and ecosystem functioning	
4.	Microbial Feedbacks Mediates Vulnerability of Permafrost Carbon to Climate Warming	April
5.	DEWATS- Rising technical challenges & Bridging the gap from Lab to field studies	
6.	Microstructure Optical Fibers, 3D Scaffold and Biofilm Engineering	March
7.	Conjugated Oligoelectrolyes for Biochemical applications	
8.	Antibiotic Resistant Genes as an Emerging Environmental Contaminant	
9.	Biofilm Sloughing in Integrated Fixed-Film Activated Sludge (IFAS) Systems	
0.	Organic Pollutants in the Water Cycle Workshop	February
1.	Some Recent Advances in Research of Dense Jets	
2.	Strategies for biosynthesis of polyhydroxyalkanoates (PHAs) using excess activated sludge	January
23.	Art of Grantsmanship – Prof Wang Kuan (Taipei Medical University)	
24.	Stochastic Processes in microbial community assembly and Succession	
5.	Removal of Intermediate Aromatic Halogenated DBPs by Activated Carbon Adsorption: A New Approach to Controlling Regulated	
	Tribalomethanes and Haloacetic Acids in Chlorinated Drinking Water	





28 August 2016 - NEWRI Best-Sharing Workshop and NEWRI Design Workshop by Dr Victor Sim

28 August 2016 - NEWRI Best-Sharing Workshop by Zhao Jie (PhD student of NEWRI-SMTC)



13 Oct 2016 - PUB's grant call and technology information sharing session

AWARDS / ACCOLADES / ACHIEVEMENTS

NEWRI has sporting talent! Our congratulations to the following for their achievements.



To know more about the Green Talents Awardees 2016, please click here Green Talents 2016

Congratulations to SMTC's Research Fellow, Dr. She Qianhong on being selected for one of the 25 outstanding young scientists our expert jury selected to be the winners of the Green Talents Competition 2016!

The German Federal Ministry of Education and Research (BMBF) invites young researchers from all over the world every year to take part in the "Green Talents - International Forum for High Potentials in Sustainable Development". The winners are awarded for their creative and intelligent solutions to the pressing questions of our time. The BMBF seeks to intensify the global exchange between young researchers in the field of environmental and sustainability research with this programme. The programme strives to intensify international R&D cooperation in sustainable development, especially with threshold and developing





Yuan Guoan, Zhang Jingbo, formed a joint team with School of Physics and Mathematics Sciences (SPMS) for the NTU Staff Table Tennis Tournament, and managed a 4th position. Zhang Jingbo secured a Second Runner-up position in the Women's Singles tournament. This has not stopped the plucky Ms Zhang, as she went on to received 3rd Runner Up position in the NTU women's team (Out of 7 players, 3 are NEWRI staff) for the Singapore Public Service Staff Table Tennis tournament. (17th October 2016)







From left to right of the badminton team: Harish Venkatakrishnan (NEWRI), Teh Kong Leong (CEE), Dr Chen Huimei (CEE), Wu Yuanyuan (CEE), Prof Chu Jian (CEE), Luo Qing (NEWRI) 1st row: Li Tian (NEWRI), Isabelle Wong Yuet Mun (NEWRI), Dr Zhou Qingji (CEE)



Hera Adam (NEWRI) and Fransiskus Xaverius Ivan (NTU's Biomedical Informatics Lab) has managed a 3rd place in the mixed doubles at this year's NTU Open Championship held in SRC.

Only 10 pairs joined the tennis mixed doubles, the pair went to semi-final but lost to the first seed, however, fought and beating the younger players, 6-0, 6-3, winning the bronze prize. (20 October 2016)



JOURNALS & PUBLICATIONS

At NEWRI we do not forget our foundation which is good science. NEWRI's researchers publish frequently in journals. You can log on to the following website for more information on articles.

Please click on Journal link: Click Here

NEWR

We've given the NEWRI webpage a upgrade and hope you can stop by for a visit! NEWRI's website has been updated to show more! Have a look! http://newri.ntu.edu.sg

(Click above)





NEWRICOMM Photo-essay



Two of Dr Khin's students who have graduated were also with the team to help out with translation of the training materials and to demonstrate results of quality tests of the water.

One of them is an Inle native and was able to give his presentation in the local dialect which was more easily understood by the community.



In July 2016, NEWRIComm and Dr Khin Lay Swe conducted a training on slow sand filter for the Laethit community. It was a basy time for the farmers at Inle as it was planting time. Nevertheless, the community was supportive and 20-30 youths came to attend the session. The Laethit Monastery hosted the session.



Dr Khin Lay Swe and the Laethit Monastery chief monk inspecting the slow sand filter

Village volunteers removing slow sand filter media for cleaning

The training covered the appropriate context of when a slow sand filter can be useful, and when it must be used in tandem with other treatment method, components of a slow sand filter, and operations and maintenance.

A slow sand filter helps to remove particles, and if properly done and run, some bacteria, but not all. The bacteria test shows visually to the community that clear water does not always mean safe water. After slow sand filtration, water should still be boiled before drinking.

The sand filter in Laethit have been cleaned by the community independently twice since the project team last visited in November 2014.



The project team have also noticed that potable water (RO/UV/ ozone-treated) is now sold in nearby Nyaungshwe town, However, these are still considered expensive to many in Inle. Certainly, over time the community's expectation on "good water" would change, and so must solutions evolve along with that.

Dr Khin's students showing the results of bacteria test to the training participants





Some of the villages now have electricity access, and mobile telecommunication have greatly improved. This can potentially expand the range of solutions that can be viable in Inle Lake.





Nanyang Environment & Water Research Institute

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NEWRI is helmed by top global leaders in Environmental Engineering. NEWRI's research innovations and collaborations with industry partners worldwide have led to several spin-off companies, technology licenses and coporate social responsibility projects.

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Within 6 months of graduation, more than 90% of our students have found work in established orgnixsations in Singapore and around the world. Our students are highly sought after by the industry as they are prepared to meet the needs of our industry partners.

Eligibility Criteria

Bachelor's degree from a reputable local/overseas university (2nd class upper and above or equivalent) in Engineering and Science (ie; Top 5% to 10% of your cohort)

Good graduate record examinations (GRE) & Test of English as a foreign language (TOEFL) or International English Language Testing System (IELTS) Sf you haven't heard of **NEWRI** yet, then now is your chance. Tucked away in Clean Tech One, at the edge of **NTU's** green fence, Bits a research institute that works in the water and environment domain, Unique in its structure, versatile in its make-up, all set for the industry's gain.



Ranked as one of the top research institute with some of the finest brains in the industry, Developing innovations and engineering solutions with guiding RED philosophy, Not just research, but de-risking and monetizing IPs and bridging commercial entities, United with our units, NEWRITech, NEWRIEdu and NEWRIComm (those are but only three)

What is RED, our guiding philosophy', you say? St is my pleasure to explain. From Research, to Engineering and Seployment commercially, add to our contiguous value chain, AEBC, SMTC, EPMC, R3C and ECMC form the 5 Centres of Excellence, each a vertical of mastery, Sf you look at our brochure (pg 1), it will show you where they form the foundation of the NEWRI tree.

AEBC or Advanced Environmental Siotechnology Centre looks at environmental microbiology, Not to mention Siosolid management and energy/resource recovery. SMTC (Bingapore Membrane Technology Centre) is collaborating with industry and universities, they are entrenched a cross-disciplinary specialty area of membrane technologies.

EPMC is our Environmental Process Modelling Pentre. (previously DHI-NTU repositioned) Focusing on the development of high performance hydrodynamic system modelling and simulations. R3C or Residues and Resource Reclamation Pentre looks at Waste-to-Materials and Waste-to-Energy, Not to mention thermal upcycling, and contaminated site remediation, solutions and technologies.

Eastly but not least, ECMC (Environment Chemistry and Materials Centre) with world class capabilities, From Environmental Chemistry to Environmental Materials, to Water Chemistry and Cechnology. Not forgetting ST-ART, WW-ART and WtE-ART - Applied Research and Cranslation - the bridging three, Coupled with NEWRI's many spin-offs, such as De.Mem, Aquaporin Asia, Hydrovision and Anaesys PD.

We thank you for the stopping by and reading our NEWRI page, Sives us a fine opportunity to show you what we have and what we can stage, Sf you have more questions, queries and quotes, we are always ready to lend a listening ear, To answer your ponders, resolve your reservations, and respond to your questions all through the year.

A verse by Alvin Goh, 2016

Till the next update Merry Christmas and Happy New 2017!



www.ntu.edu.sg/NEWRI