NEWRI update

- ISSUE 21 – Aug 2023

A word from the Executive Director

Dear Friends and Colleagues,

I am honoured to share with you our Summer 2023 newsletter which highlights a portion of our major activities. Indeed, it has been a very hectic and productive time for all of us at NEWRI. For me, the first half of 2023 saw tremendous activities, including several travels to destinations I have not been since before the pandemic. A few highlights include a productive trip to China to re-establish collaborations with Tongji University, a visit to JFE Corporate headquarters in Tokyo, the International Water Association's Leading Edge Technology conference in Daegu Korea, the Technology Summit at Monterrey Technological University in Mexico, a meeting with University of Philippines and government officials to kick off a philanthropic project in Manilla, Philippines, among others. Again, my heart goes out to all those impacted by the global pandemic, especially for the lives lost. Thankfully, the global condition is far better today and seeing my friends and colleagues for the first time since the pandemic began brings both joy and promise for a better tomorrow.

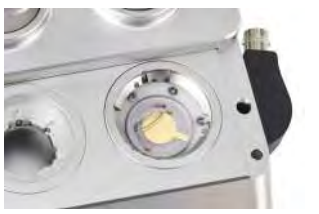
As you will see in this newsletter, the entire NEWRI team has been hard at work and has realized numerous successes. We cannot possibly discuss the entirety of our projects and awards here, but rather, we highlight a few examples and look forward to discussion means for additional collaborations within the NEWRI domains. One thing I have realized during my travels and numerous meetings is that often NEWRI is considered a water institute. While there is no doubt about our strong water research and engineering team, I also want to emphasize that NEWRI has an equally strong resource recovery and circular economy component. In fact, opportunities in resource recovery, including waste to energy and upcycling of waste materials, seems to be growing faster than ever. I do not believe NEWRI has ever seen as much activity in these domains as we do today.

Did you know that NEWRI has one of the only gasification waste- to-energy research facilities (WTERF) in the world? You can take a virtual tour of the facility (Link here). This facility has the capacity to treat essentially 100% of NTU's municipal solid waste, resulting in production of energy and a glass-like slag which can be used similarly to sand in construction materials.

The gasification process at NEWRI's WTERF uses biomass charcoal as an auxiliary fuel to achieve temperatures up to 1600 degrees Celsius, which essentially eliminates bottom ash which remains a challenge for disposal in conventional mass burn incinerators. The gasification slag produced by NEWRI's WTERF has been lovingly been branded as NEWSand, in celebration and recognition of Singapore's highly successful NEWater program for recycled water. In fact, there is a placard on the Singapore government's Environment Building on Scotts road, where 20 tonnes of NEWSand was used in the repaving the concrete plaza at the building. I expect that NEWRI's resource recovery team will continue to grow and see even more successes as we continue to see growth in this domain.

(Continued next page..)

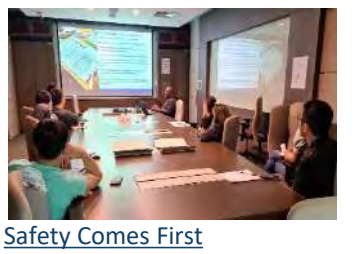
Unlocking the potential of waste-derived materials
Paving the way for more sustainable agricultural practices



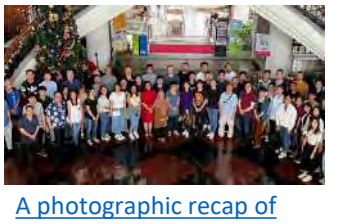
Novel capabilities in air pollution research
Particle/Aerosol generation, cell culture and exposure systems

NEWRI's collaboration with Arkema Pte Ltd
PEBAX® Copolymers VS PVDF-based Nanofiltration Membranes

NEWRICOMM's Call for Proposal a success
More than 30 submissions



Safety Comes First
A quick introduction into NEWRI's safety system



A photographic recap of 2022
Happenings and events of NEWRI that took place in 2022

NEWRI update

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A word from the Executive Director

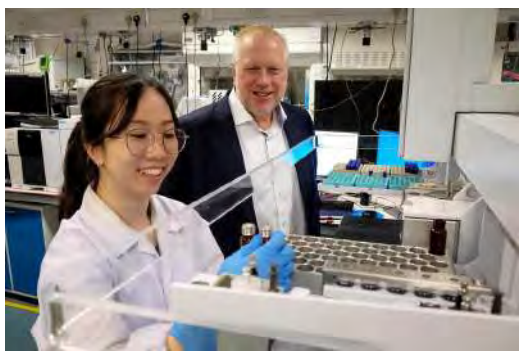
Since the last newsletter, we have gained many new team members. Since NEWRI is over 300 people strong, we are sad to see team members leave but also excited to gain new talent and expertise. This has been especially true as NEWRI evolved into our fourth tranche of funding (TR4). NEWRI has increased its strength of inclusivity and diversity, and we welcome all the new students, faculty, and staff. We continue to seek new talent as well, especially in the recruitment of graduate students. NEWRI is uniquely fortunate to hold a large number of fellowships for MS and PhD students, so please do share our information broadly as we look forward to matriculation of more students in the near future.

However, I sadly mourn the loss of one of our team members who led student matriculation for NEWRI, Ms. Choo Hwee Pin who had joined NEWRI in the past year as a senior executive in charge of education. She passed on in June of this year and is very deeply missed by me and our entire team. Ms. Choo was extremely diligent in her work and one of the friendliest and tenacious people I have ever had the privilege to work alongside. We miss her very much and again extend our deepest condolences to her family and friends.

I was reminded of all the amazing students at NTU fosters during our Convocation in July of this year. Indeed, NTU continues to grow and remains a top-ranked University globally. With approximately 100 graduate students within NEWRI and with the research fellowships to support many more, NEWRI remains an important pan-university institute for education future generations of environmental technology and sustainability leaders. As I have always said, our students are our most important product.

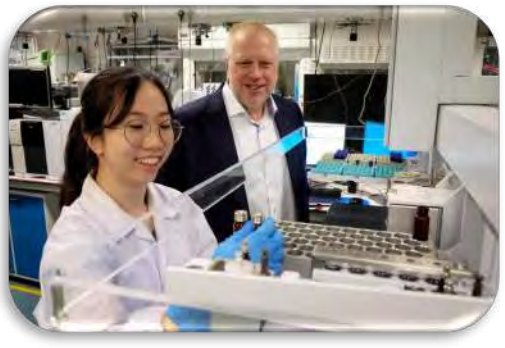
After all, research institutes exist world over in the private and public sectors; however, as a University institute, we have the unique privilege and mission to educate and mentor students and research fellows to help them enter the work force and truly make the world a better place for all of us. As a Professor, there is no greater pleasure in my job than to see my students grow academically and move towards development of their career aspirations. I hope that those of you reading our newsletter will share our opportunities for students widely and come to NEWRI to recruit your own future leaders.

NEWRI is soon to enter year three of our five-year tranche of funding, and already we are beginning to position ourselves for tranche 5 (TR5). We have assembled a new Industrial Advisory Board (IAB), bringing in many new and diverse members from around the world. The NEWRI Governance Committee, composed of NTU Leadership and Singapore Government representatives has met and provided additional guidance and support to better position NEWRI for further success and expansion. We also are preparing for our mid-term review, and in terms of our KPIs we stand at or above where we would be expected at this point of time.



Again, we are able to meet and exceed our goals only through the diligent and relentless work of our entire team. Our staff, students, researchers, and faculty are among the best in the world and create a cross-cutting interdisciplinary team that is able to bring transformative ideas to reality, and into commercialization. I feel fortunate every day to be the leader of this amazing team and look forward to the future of NEWRI. Of course, I also thank all of our supporters from the public and private sectors here in Singapore and from around the world. We already have many new grants, collaborations, and awards you can read about in the next newsletter. For now, thanks again for all the support over my own five over years as Executive Director of this incredibly successful research institute.

Sincerely,
Shane A. Snyder



ST news (source)

Water testing with lab-grown human cells among projects at NTU

A novel testing method that involves lab-grown human cells to detect the presence of new chemical compounds in drinking water is being developed, to be added to national water agency PUB's testing arsenal and act as an early warning system for potential hazards in treated water, including both drinking water and treated used water for industrial use.

(ST article here)

Industry news (source)

Co-creating the Future of Water #AccessToCleanWater

Agilent's global Instrument Manufacturing Vice President and Singapore General Manager, Chow Woai Sheng, Regional Associate Vice President of Sales (Instrument and digital), Dr. Vimala Sreenivasan, and Executive Director of NEWRI in Nanyang Technological University Singapore, Prof Snyder, discuss the way industries are partnering to co-create the future of water in Singapore and beyond.

NTU Service Week 2023 launched by Minister Grace Fu

NTU Service Week 2023 was launched on 25 February by Ms Grace Fu, Minister for Sustainability and Environment. Present were Ms Goh Swee Chen, Board Chair of NTU Board of Trustees, Mr Lo Kien Foh, Chairman of NTU Alumni and Development Committee, Professor Ling San, Acting President and Provost of NTU and other distinguished guests at the Nanyang Executive Centre (NEC).

NTU news

Congratulations to Prof Shane Allen Snyder on receiving National Awards Commendation Medal (COVID-19)

The Commendation Medal (COVID-19) is given to individuals who performed outstandingly in their role during the COVID-19 pandemic.

NTU news

Prof Wang Rong recognized with President's Technology Award

The award recognizes Prof Wang Rong's outstanding contributions to the field of membrane science and technology, which includes the development of novel membranes for use in applications such as energy-efficient desalination, water reclamation and wastewater treatment over the last 14 years at NTU Singapore.

President's Technology Award 2022 video
LinkedIn Post

NTU news

Assoc. Prof Grzegorz Lisak receives appointment from MINDEF to the External Advisory Panel

An external advisory panel comprising 13 members with diverse expertise for environmental sustainability was set up by MINDEF to provide assessments and recommendations on MINDEF and SAF sustainability policies, as well as share knowledge on the latest developments, technologies, and best practices.

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UNLOCKING THE POTENTIAL OF WASTE-DERIVED MATERIALS FOR SUSTAINABLE AGRICULTURE AND CIRCULAR ECONOMY

Contributed by: Liang Lili, Dr Ge Liya, Dr Xin Yang, Asst Prof Grzegorz Lisak

Background

The use of waste-derived materials in sustainable agriculture can play a vital role in reducing environmental pollution and addressing food security challenges.

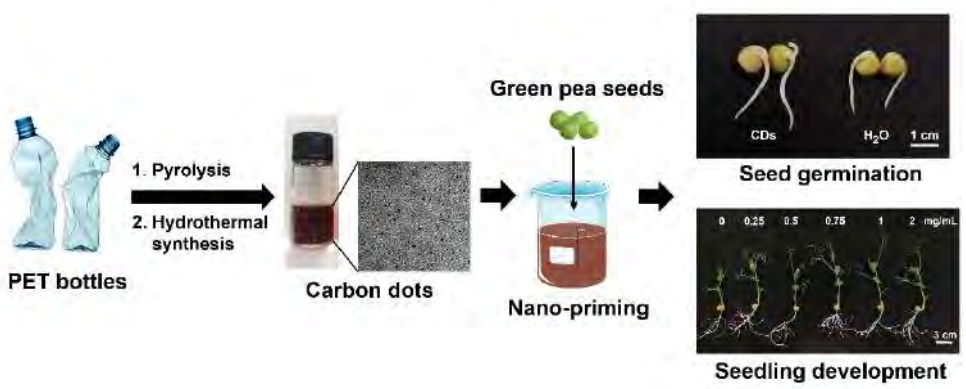
Our recent research achievements have demonstrated the potential of plastic waste derived carbon dots as a promising nanomaterial for seed nano-priming, and the utilization of biochar produced from horticulture waste for cultivating leafy vegetables.

These findings can pave the way for more sustainable agricultural practices and circular economy initiatives.

Improvement of green pea plant growth with plastic waste derived carbon dots via seed nano-priming

Seed nano-priming is a promising technology that uses nanomaterials (NMs) as priming agents prior to sowing to promote seed germination and plant growth in the agronomic field. Recently, researchers from NEWRI validated the positive effects of plastic-derived carbon dots (CDs) on green pea plants via seed nano-priming. Waste polyethylene terephthalate (PET) bottles were used as the carbon source for synthesizing CDs through pyrolysis followed by hydrothermal method.

In the present study, the CD priming significantly promoted pea seed germination and seedling development regarding germination rate, shoot and root length, and biomass accumulation. The underlying mechanism of CD priming was investigated systematically using various characterization techniques. Surface erosion of the seed coat was observed after CD priming, which effectively promoted seed imbibition capability. The CD-plant interaction may stimulate multiple metabolic pathways, resulting in an enhanced antioxidant enzyme system, increased root vigor, chlorophyll content and carbohydrate content. Considering the long-lasting negative impact of non-biodegradable plastics on the environment, the valorization of exhausted plastics into functional CDs offers a sustainable way to reduce waste volume and mitigate environmental pollution. This study provides new insights into the construction of sustainable agriculture and a circular economy through nanotechnology.



Utilization of horticulture waste derived biochar for cultivating leafy vegetables

During the pandemic period, food security has become more severe, with food supply quantity and quality being major concerns. In general, food security is a multi-dimensional issue that can be affected by various factors, including poverty, climate change, conflict, and natural disasters. As a country with high urbanization, Singapore imports variable foods from hundreds of countries worldwide, including 50% from Malaysia, and 30% from China. To meet the challenges of this situation, the government has set a “30 by 30” goal – to produce 30 percent of Singapore's nutritional needs by 2030. Designing a sustainable food system, including vegetable production, is now a top priority. However, there are limited land and other natural resources to produce enough crops. This makes it necessary to pursue alternative technologies with high utilization of resources, e.g., roof agriculture, hydroponics, and substrate culture.

Singapore is famous for its horticulture as a garden country in the world. During frequent maintenance, large amounts of horticulture wastes are generated. With the development of biochar technology, horticulture waste can be pyrolyzed to provide good support for new cultivations. In a project with Bluefield Renewable Energy Pte Ltd (BRE), we designed a high-efficiency agricultural cultivation system with biochar to produce leafy vegetables.

With the application of biochar, lettuce can grow well in local soil with a high yield and rich mineral nutrients. At the same time, biochar can replace a large amount of peat moss to produce lettuce without significant yield loss. Biochar can be very useful in meeting future food challenges.

NEWRI'S NOVEL CAPABILITIES IN AIR POLLUTION RESEARCH

Particle/ Aerosol generation, cell culture and exposure system for Air-Liquid Interface (ALI) cultured cells

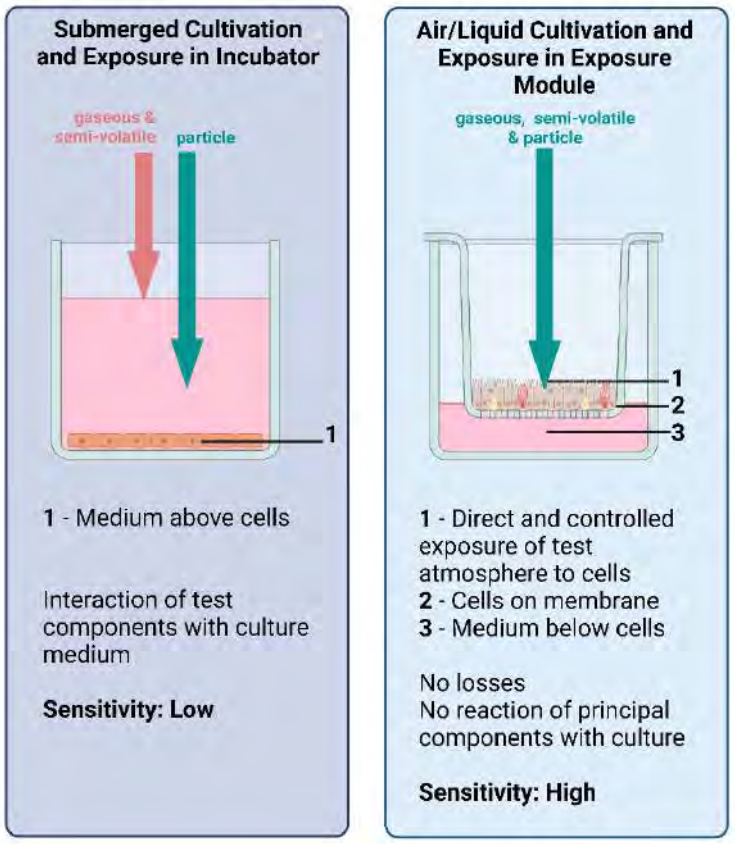
Contributed by: Mauricius Marques Dos Santos , Isaac Law Wai Loon, Prof Shane Allen Snyder

System basics

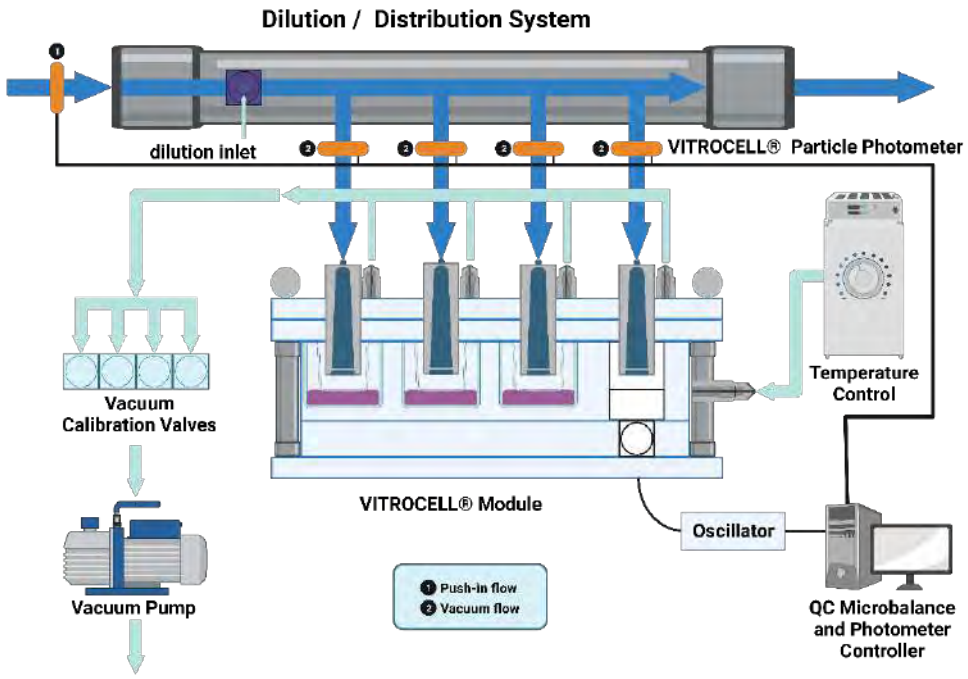
- Exposure Systems designed for the direct exposure of cell cultures to airborne substances such as gases, complex mixtures, nanoparticles and fibers can be optimally researched at the air/liquid interface
- Continuous flow exposure system

Applications

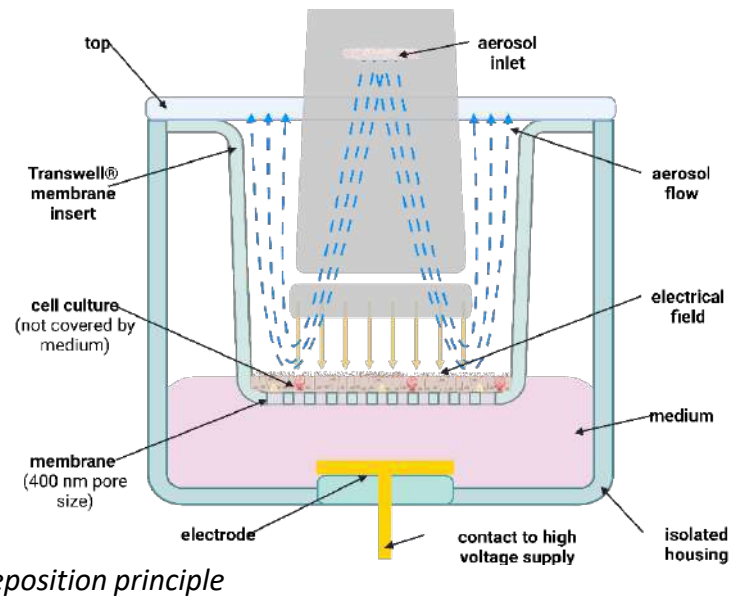
- Engine emission and combustion exhaust
- Pharmaceuticals and liquid aerosols
- Tobacco and electronic cigarettes
- Nanoparticles
- Environmental atmospheres
- Gases and mixtures
- Pharmaceuticals and dry powders
- Pesticides
- Virus research
- Cosmetics
- Household and industrial chemicals
- Indoor atmospheres



Submerged vs. ALI 3D culture models



Distribution and dilution system



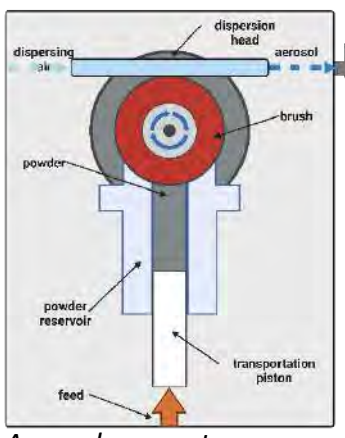
Deposition principle

System configuration - sample generation

- Bioaerosol nebulizing generator. For liquids, proteins, bacteria and microorganisms with minimal sample volume and low flow rates. Particle diameter approx. 0.7 to 2.5 µm.
- Aerosol generator for non-cohesive dry powders. Generation of polydisperse solid aerosols from bulk powder material. Dispersion of non-cohesive powders and dusts. Particle sizes < 0.1 µm to 100 µm.
- Gas mixtures

System configuration - dose monitoring

- Quartz crystal microbalance (QCM). Capable of measuring the deposited mass in the module at a resolution of 10 nanogram/cm2 per second
- Photometer. Online measurements of particle concentrations at the inlets and/or outlets of the aerosol exposure top



Aerosol generator

Bioaerosol generator

QCM sensor

Online photometer

COLLABORATION WITH ARKEMA: ENABLING PEBAX® POLYETHER BLOCK AMIDES AND PVDF-BASED NANOFILTRATION MEMBRANES FOR HARSH ENVIRONMENTS

Contributed by: Goh Kunli, Prof Wang Rong

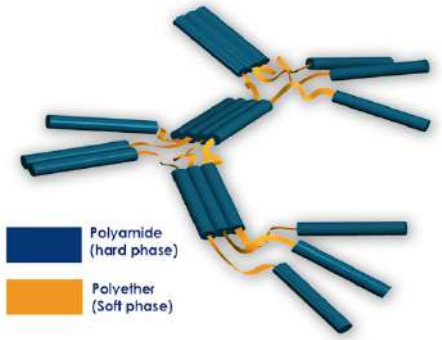
Background

Two separate projects looking at the potential application in membrane technology for two different product portfolios – Pebax® Polyether block amides and Kynar® polyvinylidene fluoride (PVDF) – managed by Arkema Pte Ltd have begun, and NEWRI's Singapore Membrane Technology Centre (SMTC) will work with Arkema Pte Ltd to understand the intrinsic chemical and transport properties of such new materials for the purpose of membrane-based CO_2 separation and nanofiltration in harsh environments. Different processes have been developed to capture and purify CO_2, and membrane-based process (one of the new technologies), has gained immense attention recently. The demand for acid- and solvent-resistant nanofiltration membranes has also fueled this collaboration.

Prof Wang Rong with Dr Goh Kunli met with Arkema Pte Ltd representatives

Objectives

These objectives intend to seek an improved processability of Pebax® Polyether block amides for membrane fabrication by looking into increasing polymer solubility towards common solvents used in membrane processing. It will also try to understand the relationship between solubility, chemical properties and composition of the hard and soft segments of Pebax® Polyether block amides to the CO_2 separation performances of the as-produced membranes. Taking advantage of the intrinsic qualities of Kynar® PVDF, such as its high chemical stability, in the field of nanofiltration would be another key objective to meet the increasingly demanding technical standards of the market



PEBAX® block copolyamides


KYNAR® PVDF polymers

Pebax® Polyether block amides

The project on "Enabling Pebax® material as High-Performance Gas Separation membranes" will bring about a deeper understanding of the effect of chemical constitution of the Pebax® Polyether block amides on the CO_2 separation performance of Pebax® membranes. Making Pebax® Polyether block amides soluble in environmental friendly solvents is not a simple task.

Benefits

Benefits include improving the copolymer's solubility in common solvents and hence its processability for membrane fabrication as well as optimizing the chemical structure of the copolymers – finding a good balance between the hard and soft phases – for high CO_2 separation performance to ascertain the potential of Pebax® Polyether block amides for the gas membrane market.

Kynar® PVDF- based Nanofiltration Membranes

The project on "Developing Kynar® PVDF-based nanofiltration membranes for harsh environments" aims to develop nanofiltration membranes using the polymer for treatment of challenging waste streams that include acidic wastewaters and for organic solvent recovery from chemical-related industries.

Kynar® PVDF is a highly non-reactive thermoplastic fluoropolymer specialty plastic produced by the polymerization of vinylidene difluoride, and is resistance to solvents, acids and hydrocarbons.

Benefits

A successful demonstration of the project will open up new applications and opportunities for acid and solvent resistant nanofiltration membranes, leading to more sustainable use.

ARKEMA

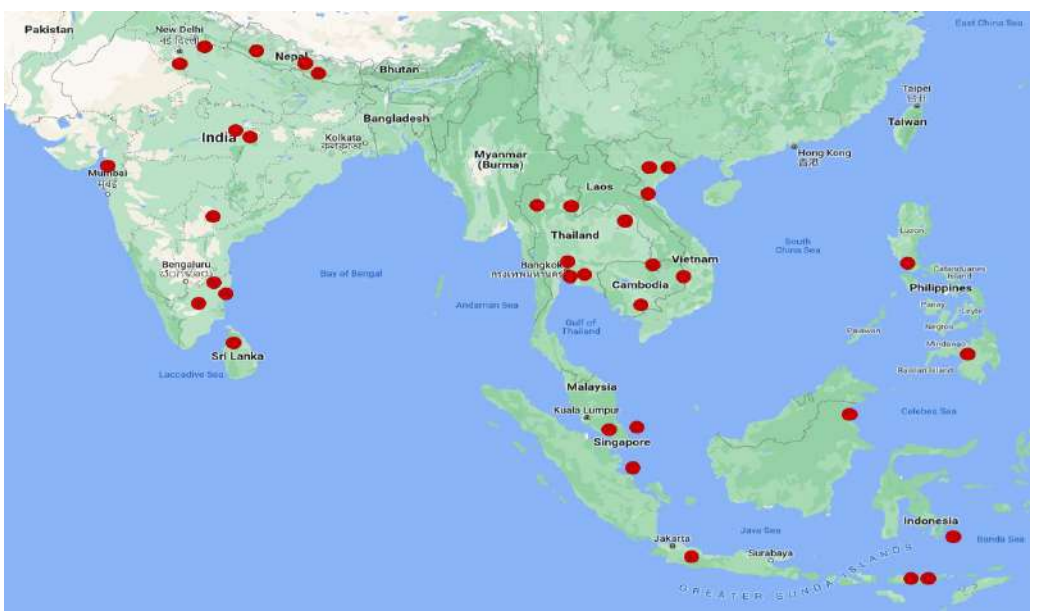
Building on its unique set of expertise in materials science, Arkema designs materials to address the ever-growing demand for innovative and sustainable materials, driven by the challenges of new energies, new technologies, the depletion of resources, mobility, and increasing urbanization.

NEWRICOMM CALL FOR PROPOSAL 2022

Contributed by: Josephine Chow, Moses Chung, Dr Santosh Pathak

According to the United Nations World Water Development Report 2023 released in March, the number of people suffering from water scarcity is set to increase from 933 million in 2016 to 1.7 – 2.4 billion by 2050. Also, 46% of the world's population lack proper sanitation service. In particular, out of the 3.2 billion people who suffered water stress for at least one month per year, 80% of them lived in Asia.

These disconcerting statistics and facts serve as a key impetus for NEWRI Community Development (NEWRIComm) to reach out and collaborate with partners within South and Southeast Asia to explore ways in which underserved communities in their respective countries may receive help to manage their water, wastewater, or other environmentally related challenges.



NEWRIComm selects its community projects through its periodic Calls for Proposal for our unique Lien Environmental Fellowship (LEF) programme, funded by the Lien Foundation to tackle the above-mentioned challenges. As such the latest call was sent out in the last quarter of 2022 (and subsequently closed in December 2022). Over 30 proposal submissions across several countries in South and Southeast Asia, including Malaysia, Indonesia, Thailand, Vietnam, Cambodia, the Philippines, India, Sri Lanka and Nepal were received from various non-governmental organizations, institutions and NEWRI partners. The topics of these proposals range from surface/ ground water treatment and distribution, desalination, agricultural wastewater recycling for irrigation purposes and groundwater recharge, water quality analysis and monitoring to solid waste management and upcycling, targeting communities who are currently suffering from lack of such fundamental solutions.

Taytay River in the Philippines

One such case is the remediation the Taytay River in the Philippines through a community-sized demonstration wastewater treatment facility and solid waste management solutions for the communities of the neighbouring Maningning Creek which has suffered from severe water pollution and flooding due to inappropriate disposal of waste and rapid urbanization.

Other proposal examples include groundwater recharge projects in India and Cambodia, community-sized desalination systems for remote islanders' potable use in Indonesia, river water analysis and treatment for villagers in the highlands of Northern Vietnam as well as plastic waste recycling in Nepal.

Groundwater issues in India

Highlands of Northern Vietnam

Groundwater issues in Cambodia

NEWRIComm will review all these proposals and work closely with the LEF champions as well as NEWRI's own pool of leading scientists to tap on their advanced technology knowledge to provide a platform for innovative, cost efficient and scalable solutions which are replicable and benefiting to both community and the environment. Further information on NEWRIComm new projects will be announced on its webpage in third quarter of 2023.

DISCOVER
MORE philanthropy in NEWRI.
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Our series highlights a few (from the numerous) NEWRI publications because we do not forget our foundation of deep scientific research. NEWRI's researchers and professors from our various Centres of Excellence publish frequently in journals, conferences and keynotes.

Acid-resistant polyamine hollow fiber nanofiltration membrane for selective separation of heavy metals and phosphorus

Yali Zhao, Gwo Sung Lai, Can Li, Rong Wang

The hazardous heavy metals coexisting with phosphorus-containing sewage sludge seriously limit phosphorus recovery. Nanofiltration (NF) membrane, which can selectively separate heavy metals and phosphorus, has a promising potential for recovering high-quality phosphorus from sewage sludge.

In this work, we utilized the undissociated form of H_3PO_4 at pH <2 and customized an acid-stable polyamine NF membrane via interfacial polymerization (IP) for separating phosphorus and heavy metals under acidic conditions. An interlayer formed via co-deposition of tannic acid (TA) and diethylenetriamine (DETA) was firstly coated onto the polyethersulfone (PES) hollow fiber module to assist the spreading of aqueous phase on the substrate surface.

Consequently, a tight and positively charged polyamine layer with a mean pore size of 0.77 nm was successfully constructed on the PES substrate, which is smaller than that of the membrane without interlayer (1.39 nm). This polyamine membrane maintained excellent stability during 15-day acid testing with 0.1 M HCl as feed solution.

Phosphorus (above) can potential be separated from heavy metals using an acid-resistant polyamine

Available at Sciencedirect:
https://www.sciencedirect.com/science/article/abs/pii/S1385894722053049

Keywords: tailored polyamine NF membrane, recovering phosphorus in wastewater, uniform deposition of PEI

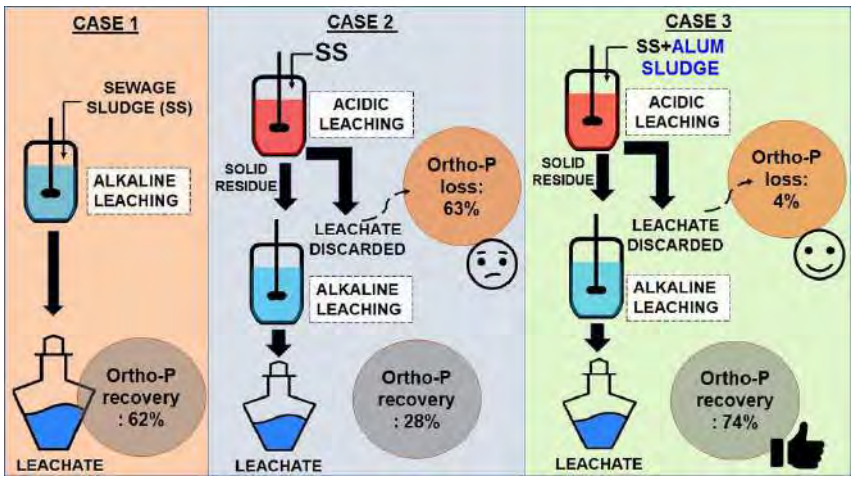
Sequential wet extraction of phosphorus from sewage sludge using alum sludge: reassessing the aluminium–phosphorus speciation using experimental and simulation approach.

Tiwari, Satya Brat , Hooper, Thomas J. N., Veksha, Andrei, Chan, Wei Ping, Fei, Xunchang, Liu, Wen, Lisak, Grzegorz, Lim, Teik Thye

Abstract

Sewage sludge (SS) is a reclaimable phosphorus (P) source and is a potential alternative to the natural phosphate mineral. This study explored the alkaline leaching of P from alum sludge (AS)-amended dry SS, with or without the acidic pretreatment. The highest orthophosphate (ortho-P) alkaline recovery was 74% for the acid-pretreated SS+AS mix. Amending SS with AS averted the loss of ortho-P during the acidic pretreatment by 59% compared to the reference case (unamended SS). Standards Measurements and Testing (SMT) analysis revealed apatite to non-apatite inorganic phosphorus conversion during the acidic pretreatment, especially in the amended SS.

This conversion was due to the dissolution of Ca-P and adsorption of dissolved ortho-P on Al(OH)3 during the acidic pretreatment. Visual MINTEQ modelling, solid-state NMR (31P, 27Al and 31P-1H CP-HETCOR) and Al 2p XPS data indicated the high abundance of Al(OH)3(s), which enhanced the ortho-P adsorption. There was no formation of AlPO4, possibly because the acid-sludge mixture reached the metastable equilibrium and not the true equilibrium during the acidic pretreatment. 31P liquid NMR, SEM, FTIR and XRD provided additional insight into the effects of acidic pretreatment on sludges. Overall, Ca-P to Al-P conversion enhanced the alkaline ortho-P recovery by about 12% compared to the reference case (unamended + non-pretreated). This study demonstrated that P leaching efficiency from SS can be improved (with appropriate process modifications) irrespective of the intrinsic property of SS, thus making alkaline P recovery applicable in many regions globally. Additionally, the chemical co-treatment of SS + AS proposed is a prospective dual waste management strategy.



Keywords: phosphorus recovery, acid-base leaching, MINTEQ, NMR, dry sludge, aluminium hydroxide

Available at SSRN:
https://www.sciencedirect.com/science/article/abs/pii/S1385894723003005
or http://dx.doi.org/10.2139/ssrn.4306073

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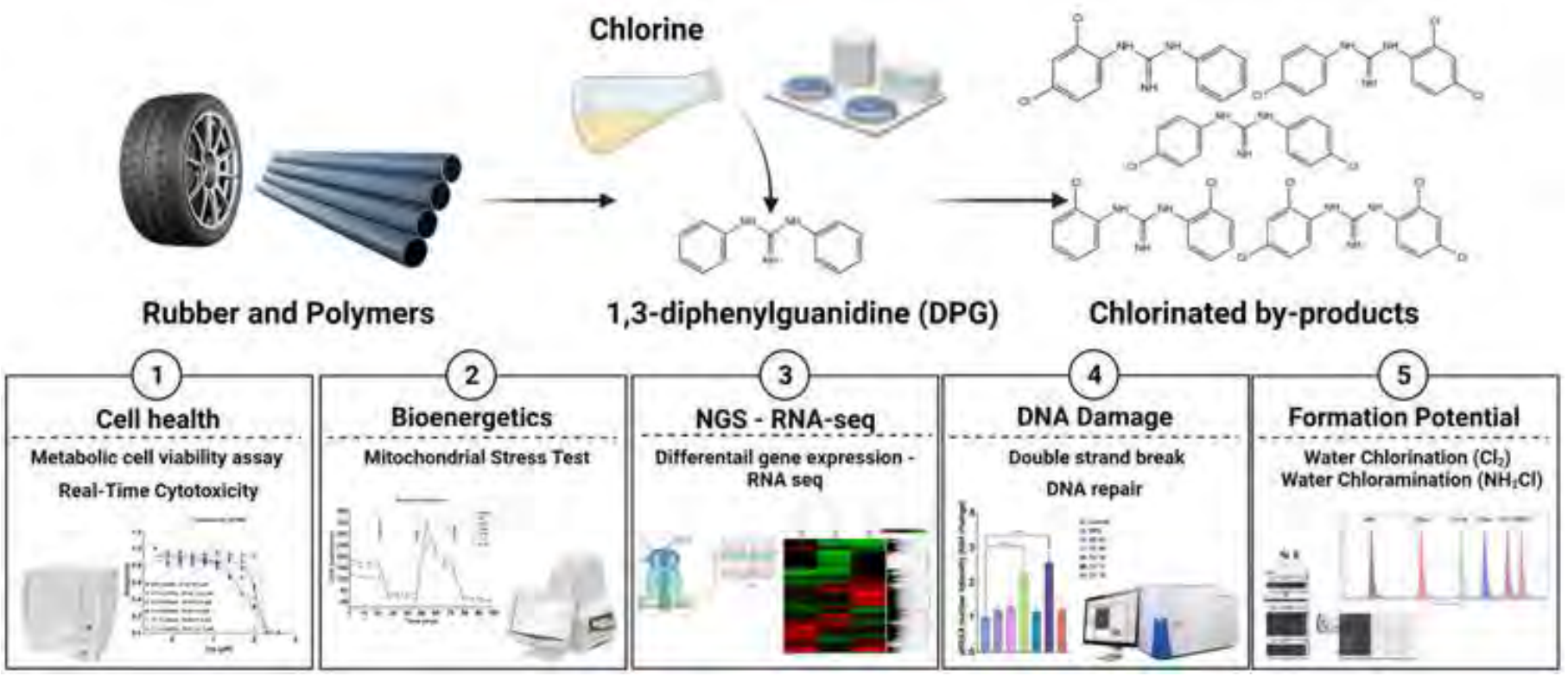
Genotoxic effects of chlorinated disinfection by-products of 1,3-diphenylguanidine (DPG): Cell-based in-vitro testing and formation potential during water disinfection

Mauricius Marques dos Santos, Camille Cheriaux, Shenglan Jia, Mikael Thomas, Herv´e Gallard, Jean-Philippe Crou´e, Pascal Carato, Shane Allen Snyder



1,3-diphenylguanidine (DPG) is a commonly used rubber and polymer additive, that has been found to be one of the main leachate products of tire wear particles and from HDPE pipes. Its introduction to aquatic environments and potentially water supplies lead to further questions regarding the effects of disinfection by-products potentially formed.

Using different bioassay approaches and NGS RNA-sequencing, we show that some of the chlorinated by-products of DPG exert significant toxicity. DPG and its chlorinated by-products also can alter cell bioenergetic processes, affecting cellular basal respiration rates and ATP production, moreover, DPG and its two chlorination products, 1,3-bis-(4-chlorophenyl)guanidine (CC04) and 1-(4-chlorophenyl)□ 3-(2,4-dichlorophenyl) guanidine (CC11), have an impact on mitochondrial proton leak, which is an indicator of mitochondria damage.

Evidence of genotoxic effects in the form of DNA double strand breaks (DSBs) was suggested by RNAsequencing results and further validated by an increased expression of genes associated with DNA damage response (DDR), specifically the canonical non-homologous end joining (c-NHEJ) pathway, as determined by qPCR analysis of different pathway specific genes (XRCC6, PRKDC, LIG4 and XRCC4). Immunofluorescence analysis of phosphorylated histone H2AX, another DSB biomarker, also confirmed the potential genotoxic effects

Available at Sciencedirect:
https://www.sciencedirect.com/science/article/abs/pii/S0304389422009049?via%3Dihub

Keywords: Chemical and Reagents, Chlorinated DPG products synthesis, Chlorinated DPG products

H I G H L I G H T S

- Five chlorination by-products of DPG were synthetized and purified for toxicity evaluation.
- Five chlorinated products show higher cytotoxicity than DPG in long term exposure.
- Two of the chlorinated by-products, CC04 and CC11, show potential genotoxic effects in-vitro.
- Chlorinated products studied represent up to 42% of products formed from of DPG.
- DPG produces more chlorinated byproducts during chlorination than chloramination.

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SAFETY MOMENTS

by Satish

NEWRI is constantly developing and expanding with magnitude as we venture towards our sustainable goals. Along with our dynamic growth, health and safety hazards and risks are exponentially increasing as well. NEWRI health and safety framework takes an essential role in keeping every user and environment safe for research activities. It is our hope that awareness is raised and compliance to our safety management system will keep everyone healthy and safe.

A regular Risk Management briefing to all stakeholders of NEWRI conducted by Mr. Satish

Safety Management System in NEWRI :

1. **POLICY**
   Aligned with NTU, NEWRI OHS policy provides a framework committing to provide safe and healthy working conditions for the prevention of work- related injury and ill health and is appropriate to the purpose, size and context of the organization.

2. **LEGAL AND OTHER REQUIREMENTS**
   NEWRI maintains a list of applicable legal requirements for our work operations ensuring legal and other requirements that affect our operation are being complied with.

3. **OBJECTIVES AND PROGRAMS**
   NEWRI sets objectives and programs considering the following applicable requirements, results of the assessment of OHS risks and opportunities, results of consultation with workers, incident cases, findings from safety audits.

4. **RESOURCES ROLES AND RESPONSIBILITIES**
   NEWRI allocates resources to implement NTU safety procedures and establish relevant localized safety management system where applicable.

5. **EMERGENCY PREPAREDNESS AND RESPONSE**
   Occurrence of unforeseen events may occur and thus emergency preparedness is important to minimize loss of lives and injuries due to such events. NEWRI identifies potential workplace emergencies and ensure procedures are in place.

6. **PERFORMANCE MEASUREMENT AND MONITORING**
   NEWRI performance are being measured and monitored by leading and lagging indicators. NEWRI promotes the use of leading indicators to effectively gauge the safety performance and where necessary augmented by lagging parameters.

7. **COMPETENCE, TRAINING AND AWARENESS**
   OHS training is an important element to cultivate the appropriate OHS competencies in NEWRI to do their jobs. NEWRI has established a minimum requirement for safety training which is as outlined by the safety training matrix to meet requirements but may adopt more stringent requirements base on the needs of our operation.

Introducing Mr. Satish Kumar who is NEWRI's newly appointed Safety Manager. He brings experiences from various industries, specializing in Health & Safety Management, and is tasked to oversee NEWRI's health & safety framework and provide continual improvement of our system on site. He is currently pursuing his Masters in Health, Safety & Wellbeing, keeping pace with current safety knowledge and technologies.

PREPARE & PREVENT INSTEAD OF REPAIR & REPENT

TAKE A GANDER AT NEWRI'S LATEST EQUIPMENT

Bringing the latest technologies to expand the capabilities of NEWRI's research is one of the key focuses of the Analytics Cluster. Introducing LDIR chemical imaging system, as well as the CIC (Combustion Ion Chromatography)

Contributed by:
(Analytic Cluster)
Ms Lam Mei Shan
Mr She Ka Keng
Ms Yuen Jia Wei

LASER DIRECT INFRARED (LDIR) CHEMICAL IMAGING SYSTEM

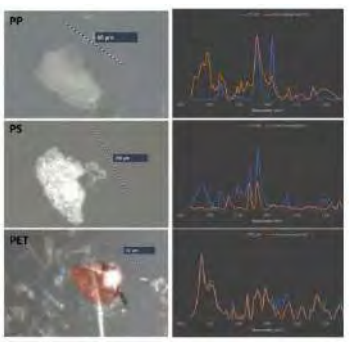
NEWRI's new Laser Direct Infrared (LDIR) provides a sophisticated new approach to chemical imaging and infrared spectral analysis.

Designed to be used by experts and nonexperts alike, the LDIR provides a simple, highly automated approach for obtaining reliable high-definition chemical images of constituents on surfaces. Agilent 8700 LDIR enables more samples, in greater detail, in minutes vs. hours.

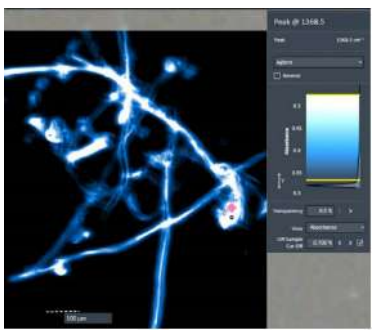
With automated workflows for pharmaceutical tablets and microplastics in environmental samples, as well as capabilities for analyzing tissues, laminates, polymers, and fibers, the LDIR can help to make better, faster decisions in product development, reducing costs and analysis time.

Agilent 8700 LDIR

- Highly automated workflow for characterizing surface distribution of components in pharmaceutical tablets
- Automated chemical imaging workflow for microplastics in environmental samples and drinking water
- Ability to survey and image large sample areas and then interrogate smaller areas of interest in more detail without changing any optics
- Rapidly identify unknowns using either commercial or custom libraries via ATR capabilities
- Quantum cascade laser (QCL) and thermoelectrically cooled detectors eliminate the need for liquid nitrogen, reducing operating costs and simplifying maintenance



Different types of microplastics (PP, PE & PET) detected in water samples by LDIR. (Agilent App Note 5994-2421EN)



The IR single peak image at $\tilde{\nu}$ = 1368.5 cm-1 of the aggregate of the cellulose fibers and natural particles detected by LDIR (Agilent App Note 5994-2421EN)

COMBUSTION ION CHROMATOGRAPHY (CIC)

Metrohm 940 CIC with Autosampler

Combustion Ion Chromatography (CIC) extends the range of ion chromatography to all types of combustible samples. It allows for simultaneous determination of the various halogens and sulfur in widely differing matrices.

The system is ideal for analysis in a variety of fields, as the nature of the sample matrix need not be known nor complicated method development is necessary.

- Total Fluorine, Chlorine and Sulfur in Aromatic Hydrocarbons and Their Mixtures
- Analysis of Halogens in Palm oil, polymer sample
- Total Fluorine in Coal and Coke by Pyrohydrolytic Extraction and Ion Selective
- Electrode or Ion Chromatograph Methods
- Total Fluorine, Chlorine, and Sulfur in Liquid Petroleum Gas (LPG)
- Chlorine, bromine and sulfur in low-density polyethylene (ERM®-EC680k)
- Fluorine determination from Fluorochemicals in fabrics
- Test of basic material for printed circuit boards for absence of halogens
- Analysis of Organic bound fluorine in Ezetimibe (Drug)

DISCOVER
MORE high-end equipment in NEWRI.
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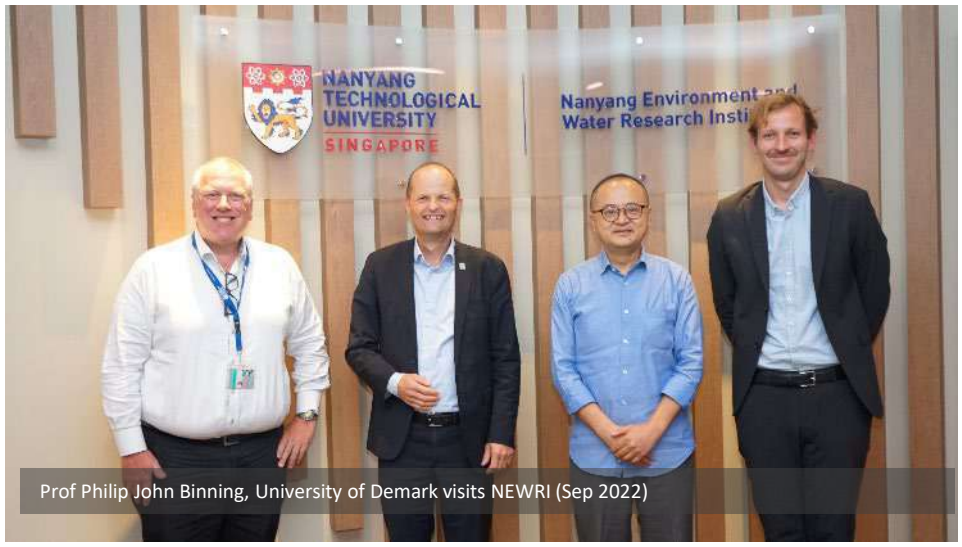
A LOOK BACK @ 2022

NEWRI Year End Get-together @ Seletar Country Club (Dec 2022)

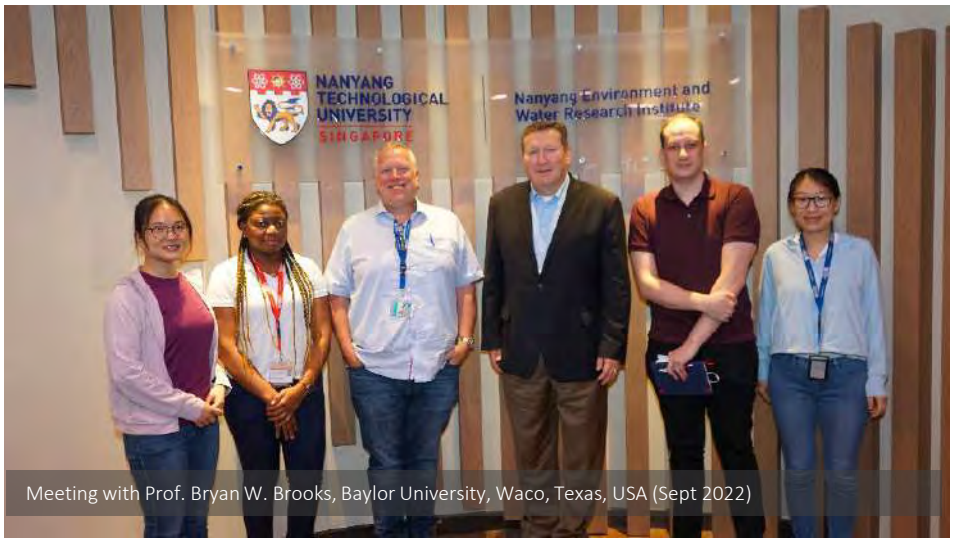
Prof Wang Rong meets with ARKEMA PTE. LTD (Nov 2022)

Meeting with President and delegations from the University of Groningen (Nov 2022)

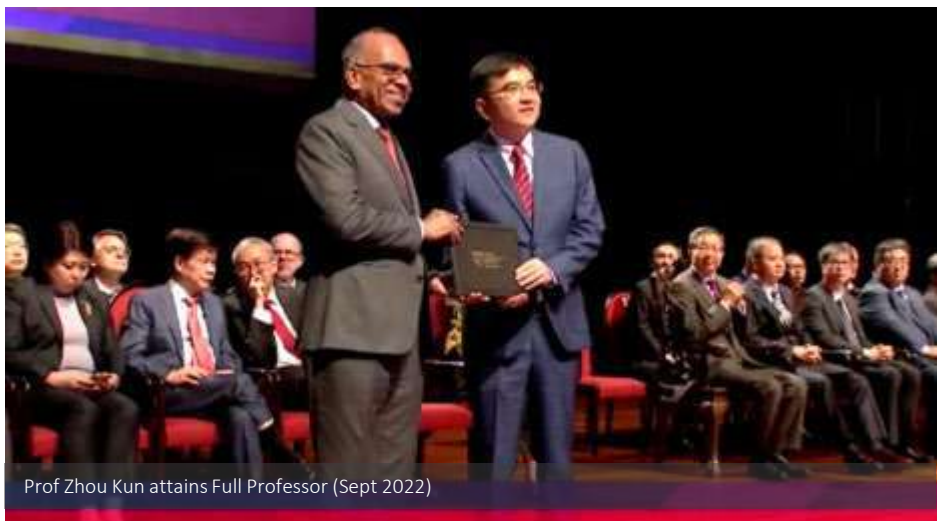
Recipients of the Indonesia International Student Mobility Awards (IISMA) got a chance to visit NEWRI (Sep 2022)



Prof Philip John Binning, University of Demark visits NEWRI (Sep 2022)



Meeting with Prof. Bryan W. Brooks, Baylor University, Waco, Texas, USA (Sept 2022)



Prof Zhou Kun attains Full Professor (Sept 2022)

Meeting with Universitas Nahdlatul Ulama Surabaya, Indonesia (Aug 2022)

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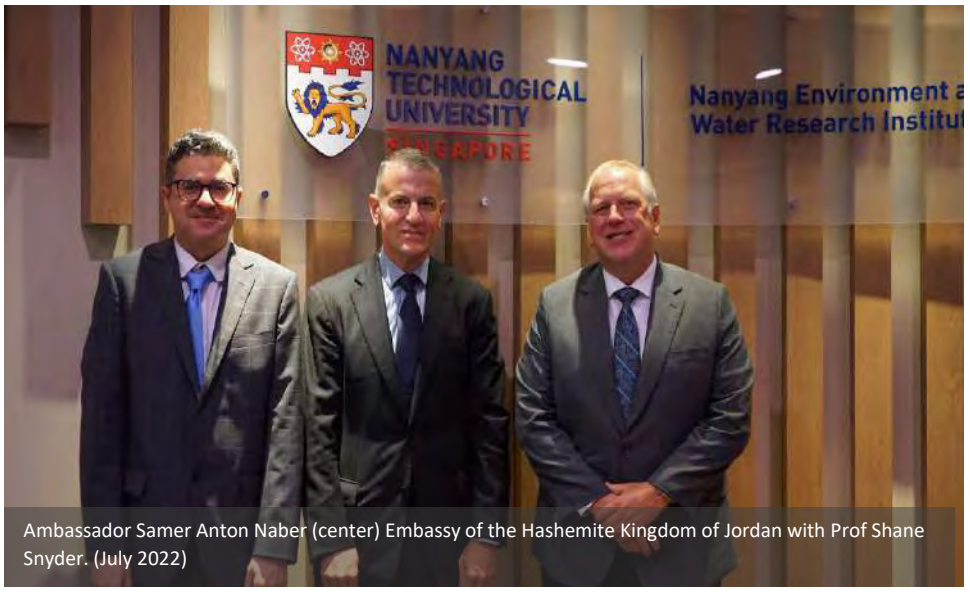
A LOOK BACK @ 2022

Associate Professor Olivier Lefebvre in the Department of Civil and Environmental Engineering, NUS at a seminar in NEWRI (Sept 2022)

(Left to right) Dato Peter Madhavan, Mr Theron Madhavan (Trident) , Mr Nico Barito (Special Envoy of Seychelles) met with Josephine, Prof Shane, Benjamin and Santosh (NEWRI) (Aug 2022)

The 13th Conference of the Aseanian Membrane Society (AMS13), NTU, Singapore (July 2022)



Ambassador Samer Anton Naber (center) Embassy of the Hashemite Kingdom of Jordan with Prof Shane Snyder. (July 2022)

Prof Shane and the local ward representatives and HEAD-Nepal representatives, celebrate the official handover at the Shree Janta Secondary School (June 2022)

Crown Prince Tengku Hassanal Ibrahim Alam Shah with Prof Lam Khin Yong and Prof Shane Snyder at Cleantech One (Mar 2022)

Visitors showed interest in the live hands-on demonstrations @ NEWRI's booth in SIWW2022 (Mar 2022)

Technical tours with international guests organised by PUB Singapore visited NEWRI labs (Mar 2022)

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