NEWRI update

- ISSUE 20 – Sep 2022

Prof Shahe with the students of Shree Janta Secondary School

ARTICLE ON Pg 4

From the Executive Director

Dear Friends and Colleagues,

I am delighted to share with our friends and colleagues the NEWRI summer 2022 newsletter. Since we last shared NEWRI updates, a tremendous amount of activity has transpired. While we are still battling the COVID pandemic, most of the world has opened and it has been wonderful to reunite with family, friends, and colleagues around the world. However, we are facing new and increasing challenges with changing climate, an energy crisis, and uncertainty in the global economy. Despite these shifting sands, I am optimistic that our combined efforts will help induce positive change in the domains of water, resource recovery, and circular economy.

Here in Singapore, we are very grateful to the Singapore Government, which has recently allocated an **additional S$220 million for research in sustainability**. These funds include the NEWRI Tranche 4 (TR4) renewal, which will provide resources for our institute **through 2026**. Additionally, the government has provided priority research areas, which include lowering the energy requirements for ocean desalination, reduction and upcycling of municipal sludge, and various themes related to resource recovery and protecting water quality. Beyond the core funding to NEWRI, our faculty and staff continue to be very successful in **attracting additional funding from various government and private sector entities**. Since the start of TR4, NEWRI has **secured over S$20M in additional grants** with approximately S$10M more awaiting decision. By working together as an interdisciplinary/cross-cutting research team, NEWRI continues to see large-scale successes that are leading to new innovations and improvements in the water and waste domains.

In April of this year, NEWRI was elated to participate in the Singapore International Water Week (SIWW). Rescheduled due to the COVID pandemic, SIWW 2022 was an incredible success! Literally at the front end of easing travel and distancing restrictions, SIWW and the co-located CleanEnviro Summit attracted more than 11,000 delegates. This year, SIWW offered tours of NEWRI, which was separated into two groups because of the demand. Many of those who participated in the SIWW tours of NEWRI went on to establish non-disclosure agreements and are well on their way to collaborative projects with our institute. (... **Continues next page)**

E-newsletter highlights

New centre to research textile recycling

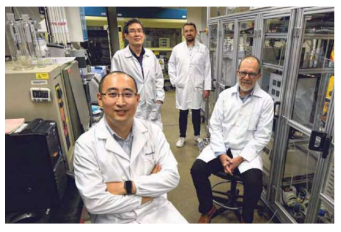
A new $6 million research centre in NTU with Royal Golden Eagle (RGE) is targeted to be the nation's first textile recycling pilot

Converting plastic waste into low-carbon hydrogen fuel

potentially power vehicles and power grid contributions in as soon as three years

Scientists discover potential 'cure' for asthma in dust

Chemical compounds in dust that are responsible for protection against asthma in children.



NTU team finds way to turn waste into building materials

Using ash generated to capture carbon emissions and convert into construction materials.

Emissions from ships up 123% during pandemic in S'pore: NTU Study

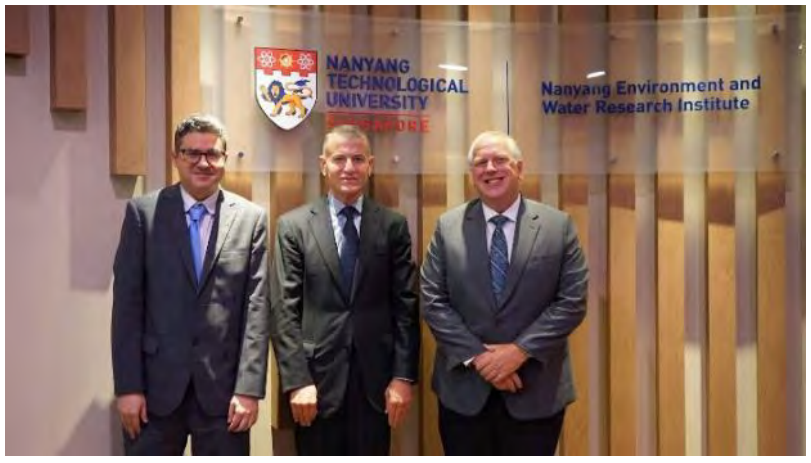
Pollutant emissions from shipping more than doubled during the pandemic

The opening of travel also facilitated NEWRI Community to advance our philanthropic work, particularly in **Nepal and Thailand**. I also had the honour of presenting NEWRI Communities activities to the Lien Foundation Board of Directors, who are keen to learn about our latest projects and future projections. In fact, NEWRI Community is now releasing our first call for proposals since the COVID pandemic began. We again, we are seeking local champions who are interested in working with NEWRI for novel and sustainable environmental solutions, particularly in water and sanitation.

(Read more here)

Photo: The clean water facility at the Shree Janta Secondary School was officially handed over to the school management on Wednesday, 15 June 2022, at a ceremony attended by NTU Singapore's Professor Shane Snyder (5th from left), Executive Director of NEWRI, and HEAD-Nepal representatives.

Earlier this year, we had the privilege of hosting some very distinguished guests in NEWRI, paving talks to potential future collaborations. We were very honoured to have received these guests; including Ambassador Samer Anton Naber from Jordan and members of the Royal Family of Pahang, Malaysia. In both cases, follow-up discussions are leading to finite collaborations between NEWRI and our colleagues in Jordanian and Malaysian research institutions.



Ambassador Samer Anton Naber, Ambassador Extraordinary and Plenipotentiary of the Hashemite Kingdom of Jordan to the Republic of Singapore,

Tengku Hassanal Ibrahim Alam Shah ibni Al-Sultan Abdullah Ri'ayatuddin Al-Mustafa Billah Shah – Crown Prince of Pahang

As we continue to move forward, NEWRI continues to evolve. We have said goodbyes to some of our faculty and staff who moved on to new careers, but also welcomed new team members who bring novel ideas and unique expertise that will help NEWRI grow in key new areas. As we are coming towards the end of 2022, I am thankful to have been reunited with many friends and colleagues at SIWW, the International Water Association World Congress, and in just a few weeks, the WEFTEC conference in New Orleans, USA.

Despite the global challenges, we should all be thankful that due to modern science in the development of safe and effective COVID vaccines, along with cautious measures in reducing exposures, we are quickly regaining the ability to be together and share our common passion for environmental research. Of course, my heart goes out to those who suffered and lost loved ones during the pandemic. I wish all of you a safe and successful Fall, our next newsletter will come in early 2023.

Sincerely,

Shane Snyder

NEWRI IN THE NEWS

NEWRIComm helping with Nepal's water woes

Scientists from NTU Singapore and Nepal have constructed a clean water facility for children at the Shree Janta Secondary School and their communities.
Catch the CNA coverage here

New centre to research textile recycling

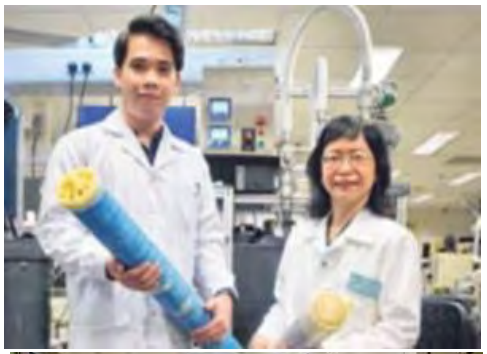
A new $6 million research centre in NTU together with Royal Golden Eagle (RGE) is targeted to be the nation's first textile recycling pilot plant to support 8760 tonnes of fabric waste recycling per year. (Aug 2022)
Catch the CNA episode here or read the ST article here

CNA - 3D Nation - S1E8: Building Our Tomorrow

A 3D printing concrete specialist is working towards building the residential blocks of the future. A professor breaks new ground in construction by 3D printing with recycled materials. (Aug 2022)
Catch the CNA episode here

NEWRI @ SIWW2022 – This time its physical

As the covid situation lightened in Singapore, the Singapore International Water Week (SIWW2022) finally kicked off in April at Marina Bay Sands from its 2-year hiatus. NEWRI participated with a physical booth that drew international audiences, with technical tours for guests to NEWRI. Photo gallery in the link. (April 2022)
Article here



Straits Times Science:

New Membranes could enhance efficiency of desalination process

National water agency PUB trials new technology , if successful, will boost water and energy security as nation cuts reliance on fossil fuels. Working with NEWRI, PUB aims to develop membranes enhanced with aquaporin proteins or synthetic bio-molecules that help improve their permeability. (April 2022)

Straits Times

NTU scientists find way to convert plastic waste into low-carbon hydrogen fuel

Scientists from NTU have found a way to convert plastic waste into low-carbon hydrogen, which is considered a cleaner fuel than natural gas. This could potentially power vehicles and power grid contributions in as soon as three years. This method, a high temperature chemical process known as pyrolysis, can convert waste to energy that can potentially power up to 1000 five-room apartments for a year. (April 2022)
Watch the CNA interview here

Business Times

S$220m to go towards research in water technologies, sustainable resources

The allocated S$220 million is to drive new initiatives in water technologies and resource circularity - that is, reusing and recycling resources - under the urban solutions and sustainability domain of the national Research, Innovation and Enterprise 2025 plan (RIE2025). The funds will support such R&D at the Nanyang Environment and Water Research Institute (NEWRI) and the Separation Technologies Applied Research and Translation (START), both part of PUB's Centres of Excellence (CoE) programme. (Mar 2022)

NEWRI IN THE NEWS

… also looking back @ 2021

CNA - Collaborate to Innovate - S1E1: Winning Together

In the recent CNA forum presented on 31 Mar 2022, organisations honoured with Singapore International Chamber of Commerce (SICC) awards for collaboration, share their ambition and the actions they took by working together to realise their visions. One of the four SICC awards was won by CEE Prof Harianto Rahardjo and his collaborators, Jernice Kew (HDB) and Chua Yuan Shen (Hocklim Engineering Pte Ltd). (March 2022)

Short brief by Prof Harianto Rahardjo

Feature: 'BBC Unlocking Science – Trash to Treasure'

Thinking more responsibly about what we consume and how we dispose of it, raises questions about what is actually recyclable. A university in Singapore is looking at ways to build innovation from what many consider garbage.

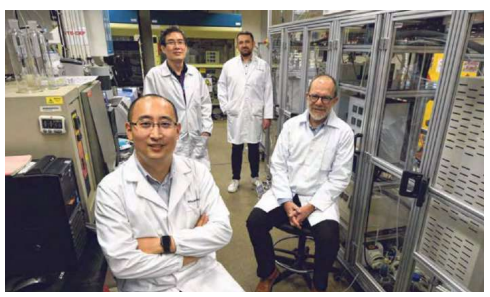
Straits Times

Scientists discover potential 'cure' for asthma in dust

Scientists from Singapore's Nanyang Technological University (NTU) took the research a step further and identified the precise chemical compounds present in dust that are responsible for protection against asthma in children.

Link to the full ST article here

Click here to go to write up



NTU team finds way to turn waste residue into building materials

Researchers from Nanyang Technological University (NTU) have found a way to turn trash into resources - using ash generated from its waste treatment facility to capture carbon emissions and convert then into, for example, construction materials.

Excerpt here

Prof Shane Snyder receives 2021 NWRI Clarke Prize

FOUNTAIN VALLEY, Calif. – National Water Research Institute (NWRI) is pleased to announce that the 2021 Clarke Prize Laureate is Dr. Shane Snyder, Professor, School of Civil and Environmental Engineering, Nanyang Technological University (NTU) in Singapore, and Executive Director at NEWRI, in recognition of researchers that solve real-world water problems.

Interview here

Catch Channel News Asia's Tomorrow City (S1E3: Water)

In Channel News Asia's series on sustainability and the cities of tomorrow, Prof Shane Snyder (NEWRI) and other experts were interviewed in the episode. Watch this compelling episode that shows how Singapore must secure its water supply for future generations. (Aug 2021)

Watch the episode (click here)

Straits Times

Emissions from ships up 123% during pandemic in S'pore: NTU Study

Pollutant emissions from the shipping sector have more than doubled during the pandemic in Singapore, with increases also seen in other major international seaports. (Nov 2021)

Excerpt here

NEWRIComm helping with Nepal's water woes

Scientists from NTU Singapore and Nepal have constructed a clean water facility for children at the Shree Janta Secondary School and their communities

Excerpts contributed by Ms Josephine Chow

Sourced NTU article here

Nepal, home to over 30,000,000 people is rich with culture, heritage and natural water resources is now suffering from inadequate clean water access and waste management due to rapid urbanisation, pollution and climate change. Bagmati River which is also known as the Holy River to the Hindus and Buddhists is one of such rivers in Nepal which deteriorated quickly into a septic river in the last 50 years. Municipal waste and sewage are directly discharge into the river without penalties up till 2011 when policies were formed to prohibit such practices. However, these rules are still largely ignored due to unchanged mindset and lack of enforcement. As such, community activist group such as Clean Up Bagmati River Campaign are formed by passionate local champions to drive change and awareness in the local community through weekly volunteer clean up session at the Bagmati River. These campaigns are recorded through social media to gain awareness in the mass Nepalese community.

Bagmati River which is also known as the Holy River to the Hindus and Buddhists alike. The *Pashupatinath Temple* (photo) sits directly in front of the river)

In efforts to continue NEWRI Community's dedication to alleviate clean water and sanitation issues during the Covid19 pandemic, NEWRIComm embarked on a river sampling exercise to understand the environmental crisis plaguing the Bagmati River by conducting surveillance of the river's water quality through tracing of organic contaminants. The two-year study employs cell-based assays and PCR-based pathogen detection assay to assess whether the environmental samples could potentially cause adverse effects in animals or human being. Cytotoxicity assay is used to examine whether the samples could induce cell death, while targeted cell assays are used to examine combined effects of specific types of chemicals of concern including estrogenic compounds and glucocorticoids. We are also setting up real-time quantitative PCR assays to check animal and human faecal contamination in these environmental waters. The assessment will not only provide recommended solutions for restoration of Bagmati River but also allow NEWRI to impart technical knowledge and training to budding scientists in Nepal remotely during the travel restriction period.

NEWRI scientists sampling the river water

Surveillance of the river's water quality through tracing of organic contaminants in the Bagmati River.

Dr Makhan Maharjan collecting samples to assess the water quality of the Bagmati River.

The NEWRI team led by **Prof Shane Snyder** (Exec Dir, NEWRI-NTU) with **Dr Makhan Maharjan,** Programme Director of the Health and Environment Development, Nepal (HEAD-Nepal) and representatives, accompanied by members of the press from Singapore. The project was supported by the **Lien Environmental Fellowship (LEF)**

Prof Shane Snyder (Exec Dir, NEWRI-NTU) with Ms Sanjana Chaudhary, local ward representatives and HEAD-Nepal representatives, celebrate the official handover at the Shree Janta Secondary School (June 2022)

Arsenic-free potable water is now accessible to students in Shree Janta

In Nawalparasi district of Nepal, NEWRIComm concluded its second demonstration of an arsenic treatment facility using iron nails as filter in a local community school. The iron nails are exposed to air and water, resulting in rust that produces ferric hydroxide particles. Studies have shown that ferric hydroxide (iron rust) is an excellent adsorbent for arsenic. When arsenic-containing water gets poured into the filter, surface complexation reaction occurs, and arsenic is rapidly adsorbed onto the surface of the ferric hydroxide particles. The arsenic-loaded iron particles are then flushed into the sand layer below. Because of the very small pore space in the fine sand layer, the arsenic-loaded iron particles will be trapped in the top few centimetres of the fine sand layer. As a result, arsenic is removed from the water. This simple and versatile setup can be easily replicated by other schools and households. The handover event was graced by the Deputy Mayor of Nawalparasi, Ms Sanjana Chaudhary, local ward representatives, NEWRI's Executive Director, Prof Shane Snyder, members of HEAD-Nepal and Singapore's press and media.

In June 2022, NEWRIComm is honoured to receive tremendous coverage by Singapore local news agencies such as Channel News Asia (CNA), Straits Times Singapore, Lian He Zaobao and Ch 8 Digital News. These articles covered detail stories of NEWRI Community's effort in Nepal on Bagmati River and Arsenic affected communities.

Click here to watch the coverage by CNA and NTU's summary

Emissions from ships up 123% during pandemic in S'pore: NTU Study

One reason could be longer turnaround times due to Covid-19-related delays

Sourced from ST article link here

Excerpt:

Pollutant emissions from the shipping sector have more than doubled during the pandemic in Singapore, with increases also seen in other major international seaports. In Singapore, shipping emissions increased by 123 per cent during the Covid-19 pandemic, according to analyses from modelling. Emissions doubled in Los Angeles, increased by almost two-thirds (65 per cent) in Long Beach, California, and rose by over a quarter (27 per cent) in Hamburg, Germany. **On average, emissions in all four ports have increased by 79 per cent.** - findings were announced by researchers from Nanyang Technological University (NTU) which compared ship pollutant emissions from July 2020 to July this year during the pandemic with the whole of 2019. The findings contradict the idea that the freeze in industrial processes and human activity arising from the pandemic resulted in generally lower air pollution.

Professor Adrian Law from NTU's School of Civil and Environmental Engineering, who led the study, and Ms Liu Jiahui, a PhD student from the school, who was the study's first author. PHOTO: NTU

"One reason could be the prolonged turnaround times due to pandemic-related delays in operations, resulting in extended "hotelling" time at the berth and anchorage areas. Lockdown measures and other Covid-19 restrictions have significantly affected the operating patterns of maritime trade, leading to the computed... significant increase in pollutant emissions in the seaports in our study" said **Professor Adrian Law** from NTU's CEE and director of NEWRI-EPMC, who led the study.

Ms Liu Jiahui, a PhD student from NTU's School of Civil and Environmental Engineering, who was the first author of the study, said: "*Though dry bulk carriers typically spend less time at ports, they experienced the biggest increase in pollutant emissions due to heightened precautions at ports and the increased demand for raw materials in the second half of 2020 as industrial activity resumed*." This research could be applied to other sectors, such as aviation, but changes will need to be done so that the model is tailored to the specific industry. Ms Liu added: "*The Covid-19 pandemic has accelerated the development and uptake of digitalisation in the shipping industry, which could also help to accelerate automation of port clearance processes to reduce port turnaround time in the future."*

Article also appeared here:
The Straits Times / Institution of Engineering and Technology (UK), 17 Nov / Manifold Times (Singapore), 17 Nov / Maritime Gateway (India), 17 Nov / ScienceDaily (US), 17 Nov
Click here to watch Prof Law's interview on CAN and Singapore Today, CNA 938

Article appeared in ST, reported by Clara Chong (Nov 2021)

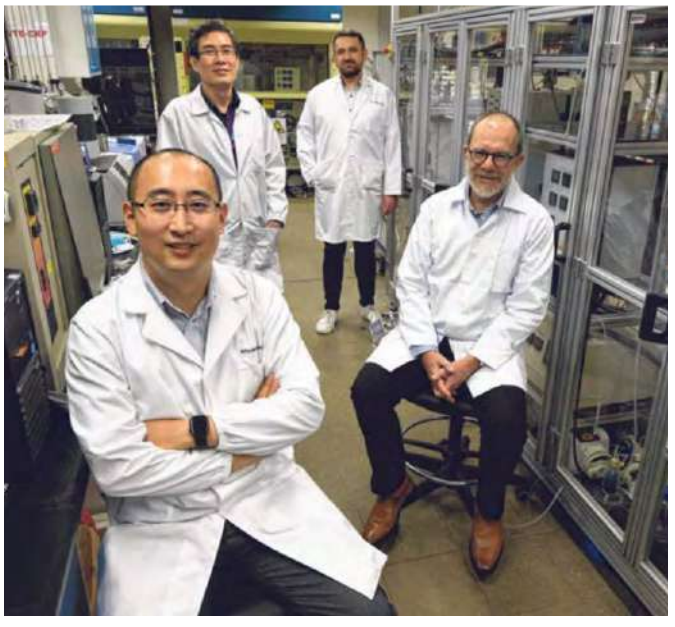
NTU team finds way to turn waste residue into building materials

Ash generated from waste treatment facility is used to capture carbon emissions and turn these into resources

Sourced from ST article

Excerpt:

Researchers from Nanyang Technological University (NTU) have found a way to turn trash into resources - using ash generated from its waste treatment facility to capture carbon emissions and convert then into, for example, construction materials. The project was one of 12 awarded a combined $55 million in grants under the national Low-Carbon Energy Research Funding Initiative, which seeks to reduce carbon dioxide emissions. One way is to capture carbon - for storage underground or to convert it into useful products. **Assistant Professor Paul Liu** of NTU's School of Chemical and Biomedical Engineering, principal investigator of the study, said that as Singapore does not have many natural resources to be utilised for capturing carbon - one way is to turn to waste residues such as ash. *"We found that by selecting the right type of ash and performing the right treatment, we were able to develop very a high-performance CO2 capture material at relatively low cost."* said Prof Paul Liu.



Left: The NTU team includes (clockwise from lower left} Assistant Professor Paul Liu from the School of Chemical and Biomedical Engineering; Professor Lim Teik Thye from the School of Civil and Environmental Engineering; Assistant Professor Grzegorz Lisak, director of the Residues, Resource and Reclamation Centre at the NEWRI; and Professor Simon Redfern, dean of the College of Science.
ST PHOTOS: NG SOR LUAN

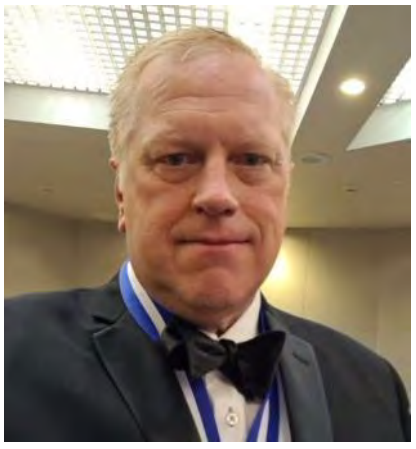
Lead scientist Asst Prof Liu, from NTU's School of Chemical and Biomedical Engineering and NEWRI, said the ash generated from NTU's Waste-to-Energy (WtE) facility contains up to 80 per cent calcium, making it an effective material for absorbing carbon from the flue gas generated by the gasification.

Samples of sustainable construction materials made from waste residue. Nanyang Technological University's project was one of 12 awarded a combined $55 million in grants under the national Low-Carbon Energy Research Funding Initiative, which seeks to reduce carbon dioxide emissions.

Article appeared in ST (Nov 2021)

Prof Shane A Snyder is the 2021 recipient of the NWRI Clarke Prize

The Athalie Richardson Irvine Clarke Prize is recognized by the International Congress of Distinguished Awards as one of the most prestigious water awards in the world.



Prof Shane during the 2021 Clarke Prize lecture that is posted on the National Water Research Institute (NWRI)

FOUNTAIN VALLEY, Calif. – National Water Research Institute (NWRI) is pleased to announce that the 2021 Clarke Prize Laureate is Dr. Shane A. Snyder, Professor, School of Civil and Environmental Engineering, Nanyang Technological University, Singapore (NTU Singapore) in Singapore, and Executive Director of NTU's at Nanyang Environment and Water Research Institute (NEWRI). NWRI presents the annual $50,000 prize to recognize researchers that solve real-world water problems.

"*Dr. Shane Snyder personifies the qualities that the Athalie Richardson Irvine Clarke Prize for outstanding achievement in water science and technology was designed to recognize*," said NWRI Executive Director Kevin Hardy. "*His contributions to the water community exemplify a Clarke Prize laureate*."

While Dr. Snyder's scientific, technical, and leadership accomplishments are remarkable, the Clarke Prize Executive Committee noted that, "Dr. Snyder is known as a compassionate and personable character that always enjoys sharing his knowledge."

Excerpts of the interview Prof Snyder gave with Mr Nimesh Modak (MD of ImagineH2O Asia) as below:

Q: Congratulations on being conferred the 2021 Clarke Prize! As the 2021 laureate, you join a long list of past luminaries who have been recognised for their achievements in water science and technology. How do you feel about winning this prestigious award?

I am tremendously honoured to receive the 2021 Clarke Prize and to join the previous Laureates, all of whom I deeply respect. All of the Clarke Prize Laureates are extremely well-known within the water science domains; thus I am humbled to now join this distinguished group of leading experts in the field.

Q: We were told that your love affair with Singapore started during the inaugural SIWW in 2008! Care to tell us how you eventually landed onto the leadership position within NTU's Nanyang Environment and Water Research Institute (NEWRI)?

During the 2008 SIWW, I became increasingly impressed by the depth and ingenuity of Singapore's PUB, the local Universities, and the diversity of private sector firms located in Singapore. I came to learn of the Visiting Professor Program (VPP) and was very pleased to be offered a VPP position at the National University of Singapore in 2011, a position I continued until the end of 2017. In February 2018, I became a full-tenured Professor at Nanyang Technological University, Singapore (NTU) and to also lead the Nanyang Environment & Water Research Institute (NEWRI) as the Executive Director of the institute. I was further blessed to be granted a permanent residency (PR) status in Singapore and I continue to enjoy the wonderful research and social environment of Singapore.

Q: A key ethos of the Nanyang Environment and Water Research Institute (NEWRI) which you helm, is to address Singapore's national priorities in water and environmental needs through the building of technology bridges. This means fostering a NEWRI ecosystem that interacts across a multi- and inter- disciplinary platform of 'Research-Engineering-Deployment (RED) activities. What are some upcoming plans and research focus areas for NEWRI in the coming years?

NEWRI is a large pan-university institute that is fortunate to have a diverse multi-disciplinary group of faculty, staff, researchers, and students. NEWRI has unique strengths in biotechnology, green chemistry, membrane technologies, resource recovery, and environmental modelling and sensing, among others.

NEWRI has now entered its 4th tranche (TR4) of funding, which will continue for the next five years. During the transition to TR4, NEWRI was able to procure new equipment that expands our capacity in areas such as bioassays to measuring mixture toxicity, the latest generation of mass spectrometers for identification and quantification of environmental contaminants, and genomics platforms for pathogen tracking and bacteria flora identification in biotechnologies.

Beyond these new areas of exploration, NEWRI remains focused on means to reduce the energy needed for desalination, to recovery valuable materials from brines and other waste streams, water treatment processes to reduce sludge volume, and various technologies to recover resources from sludge. NEWRI will also continue to expand our research in solid-waste treatment and waste upcycling. Our Waste to Energy Research Facility (WTERF) continues to operate using essentially 100% of the solid waste from the NTU campus and we have recently been awarded several grants that utilise this facility to increase energy and hydrogen yields, among others. Thus, we can expect NEWRI to continue our RED journey and to focus even more on areas of national interest, yet with a global outlook as far as the impacts of the technologies we develop.

Q: Singapore positions itself as the global hydrohub for water technology and solutions. Having lived and worked here for the last few years, what do you think makes the water ecosystem in Singapore work?

It is hard to believe that I first came to Singapore over 13 years ago, and I have lived in Singapore full-time since the summer of 2017. Singapore has created a unique and highly successful ecosystem for water technology development and deployment. First, Singapore has a long history of recognizing and addressing the delicate nature of water sustainability on a rather small geography with very high urban density. Singapore is unique in their investments into modern technologies and management approaches. This is especially true for an academic like me, whereby there are many opportunities to conduct research and to commercialise the resulting technologies.

Beyond Singapore, the country is in a strong position to collaborate with numerous private and public sector entities within Southeast Asia. While SEA continues to grow rapidly, there are critical water sustainability needs in the region where Singapore is already positioned in a leadership position. I very much appreciate the strong support from the Singapore government as well as the private sector, which has empowered NEWRI to meet and exceed all the key performance indicators (KPIs) set forward in our core institute funding.

The Clarke Prize award was a career goal for me, and I am humbled to stand among the numerous Laureates who have already received this prestigious and generous award. I absolutely owe a debt of gratitude to Singapore's PUB, other Singapore agencies, National University of Singapore, and NTU who enabled my ability to have a far more global view on water reuse and water quality issues. Without question, the move to Singapore was a great choice and likely influenced the outcome of this year's Clarke Prize.

Related media releases

Prof Shane A. Snyder receives 2021 Clarke Prize for his outstanding contributions to water science and technology

WaterWorld, 15 Oct / Scienmag, 21 Oct / Waterworld, 23 Oct

SINGAPORE INTERNATIONAL WATER WEEK 2022

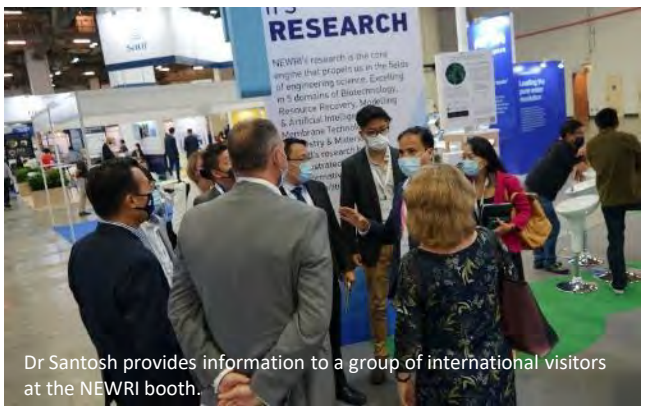
The global platform to share and co-create innovative water solutions

Contributed by: Alvin Goh, Santosh Pathak (Dr)

With covid restrictions beginning to be eased in Singapore, one event stood out for Nanyang Environment and Water Research Institute (NEWRI) to participate in. After a gap of four years, the Singapore International Water Week (SIWW) was held in person at the Sands Expo and Convention Centre, Marina Bay Sands Singapore from 17-21 April 2022 that featured over 300 exhibitors, 14 country/regional pavilions, and three new thematic Pavilions providing a one-stop marketplace for buyers looking for innovative urban water solutions

This highly anticipated event was met with great vigor, as members of NEWRI community presented their collection of research outcomes and ideas through vibrant posters, sample exhibits and colourful imagery. The participation in SIWW gave NEWRI a platform to reflect the ongoing theme of the four pillars of its foundation i.e., Research, Innovation, Education, and Community, within its 90 sqm booth. Visitors from academia, industries, government agencies, NGOs etc. congregated at the booth to learn more about the ongoing activities in this water and environment institute of international repute.

Amongst the many faces both new and rekindled, many were drawn to the posters and live demonstrations of products/technologies showcased in the booth and were particularly interested in understanding their application in solving real-world problems. Divided into 4 sections, the Research and Innovation sections exhibited projects ranging from hydrogel uses, APQ beads, portable FO filtration, use if UAVs to monitor coastal turbidity, and concrete derived from waste. The Education section featured past and present graduates who were a part of NEWRI's institution and now in a myriad of industries. Whilst in the Community section, philanthropic endeavours in Nepal, Myanmar and Sumedang-Indonesia, were displayed demonstrating NEWRI's reach in Southeast Asia where under privileged communities benefitted from NEWRI's know-how.



Dr Santosh provides information to a group of international visitors at the NEWRI booth.

Prof Shane speaks to some guests who were interested in NEWRI's philanthropic efforts

Dr Shi Lei presenting the portable FO technology at the Exhibitors Showcase.


Visitors whom came to the booth showed much interests in the live hands-on demonstrations prepared


'Live' demonstration exhibits at NEWRI's booth gave visitors a good look at the technologies developed in NEWRI


Technical tours organised by PUB Singapore were hosted by Prof Shane Snyder and Dr Adil Dhalla saw guests from countries like Kenya, Netherlands, France and USA.


Visitors on the technical tours organised to both NEWRI and START laboratories to see their innovations

Visitors got a better understanding with live demos of the Evapoporometer

One of the highlights was an Exhibitor Showcase organised by SGMEM that brought innovators on stage to showcase new technology to the masses. In a TED-talk like environment, presenters shared insights about their inventions and innovations to eager audiences. Presenters like Dr Shi Lei (CTO of Aromatec), whom shared his knowledge of how the portable FO technology could revolutionise transport cost of goods. Along with SIWW programmes, there were other external activities PUB and organisers planned such as the technical visits to sites such as the Keppel Marina East Desalination Plant, Changi Water Reclamation Plant/Deep Tunnel Sewerage System/Sembcorp NEWater Plant, Marina Barrage, Sembcorp Tengeh Floating Solar Farm, Choa Chu Kang Waterworks and not forgetting NEWRI and Separation Technologies Applied Research and Translation Centre (START). Visitors from as far away as the Netherlands, Texas-USA, Kenya and South Asia, were treated to a in-person site tour of NEWRI and STARTs' laboratories to see how our technologies are being developed.

From high-level plenaries, panel discussions, to networking sessions, product showcases and technical site visits, attendees had an enriching time in Singapore expanding on conversations and networks formed to drive climate action and advance the global water scene. The next SIWW is stated for June 2024.

To view the range of images captured during SIWW 2022, please click here.

Advancing the development and demonstration of decentralised waste management solutions for a zero-waste nation

An Industry Collaboration Project (IAF-ICP) and collaborating with Bluefield Renewable Energy Pte Ltd (BRE) through the RIE2025 Industry Alignment Fund

Contributed by: Asst Prof Grzegorz Lisak, Prof Law Wing-Keung, Adrian, Dr Ge Liya, Dr Andrei Veksha, Dr Chan Wei Ping.

2019 was designated as the Year Towards Zero Waste for Singapore to build a national consciousness to care and protect the environment. The following years to come saw a growing emphasis on the importance for Singapore to become a sustainable, resource-efficient, and climate-resilient nation. In February 2021, the Singapore Green Plan was announced that charts concrete targets over the next 10 years; plans include reducing waste sent to our only Semakau landfill per capita per day by 20% by 2026, with the goal of reaching to 30% by 2030.

To achieve this goal, one of the most important considered solutions is to explore effective value-adding to waste management strategies, develop flexible and complementary decentralised approaches, maximize creation and retention of the waste to resource in a circular economy.

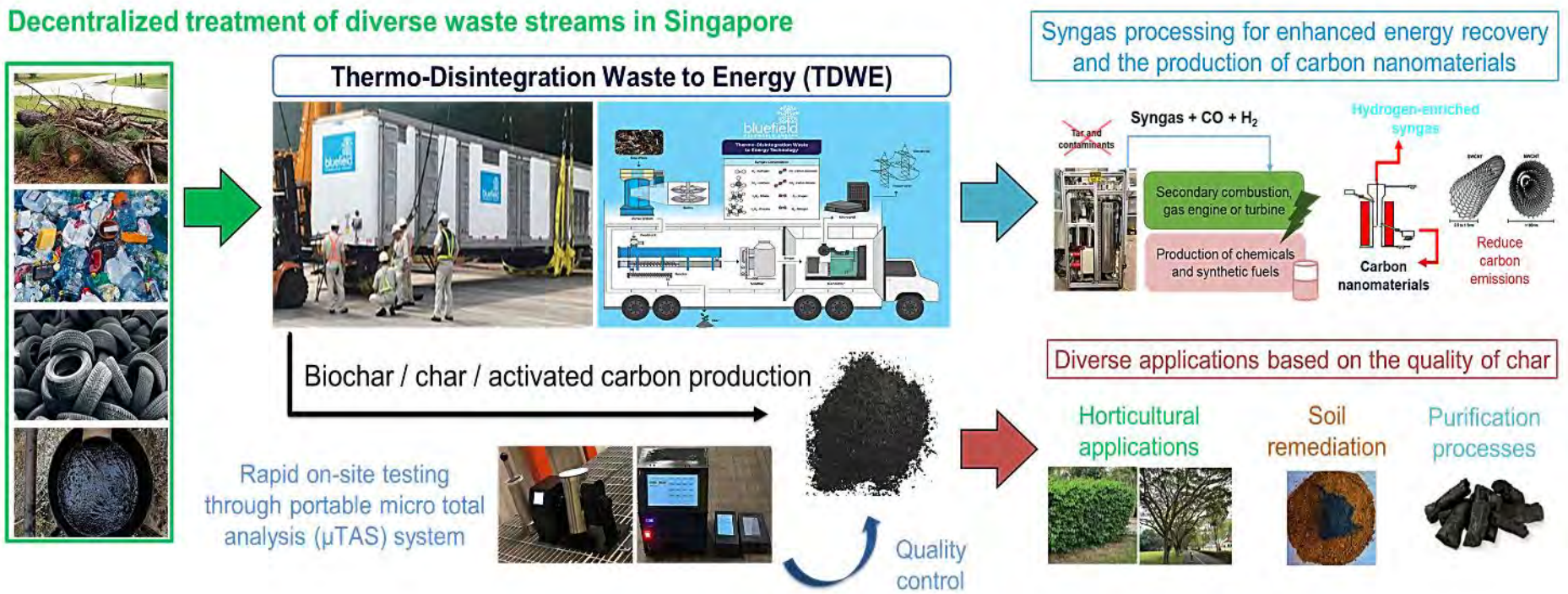
NEWRI, NTU Singapore through the RIE2025 Industry Alignment Fund – Industry Collaboration Projects (IAF-ICP) was granted funding by A*STAR (S$ 7 million for 3 years (October 2021 to September 2024)). In addition to a collaboration with Bluefield Renewable Energy Pte Ltd (BRE) through an industry research collaboration agreement (S$ 10.5 million) to develop, demonstrate and optimize a unique decentralised waste management strategy for Singapore, with Asst Prof Grzegorz Lisak (PI), Prof Law Wing-Keung, Adrian, Dr Ge Liya, Dr Andrei Veksha, Dr Chan Wei Ping (Co-PIs).

Today, municipal solid waste (MSW) and most of the non-recyclable wastes are currently incinerated in Singapore for energy recovery. The ash residues generated, and the non-combustible wastes are disposed off at the Semakau Landfill, which is estimated to be full by Year 2035 at current landfilling rates. Additionally, various types of specialized waste streams, including food wastes, plastics, tires, oil sludge, and medical wastes are also included, which presents significant and complicated challenges on effective management and value creation (instead of destruction, through incineration and landfilling) from these waste materials.

waste streams by converting the wastes into high quality char and syngas, through the first-of-its-kind exploration in Singapore for effective decentralised waste management in a city.

The TDWR system is a containerized, mobile, modular, stackable and scalable system. It is capable of decentralising waste management and processing diverse waste streams at high temperatures (650-1000°C), and generating char and syngas, which can be applied directly or upgraded for many applications, ranging from green renewable energy, chemicals synthesis, horticultural application and the production of carbon nanomaterials.

In this project, TDWR system will be upgraded and optimised to further extend this garden city into a high-tech char generating city, exporting biochar to agricultural industries and modified char, activated carbon and carbon nanomaterials for chemicals and manufacturing industries, worldwide.



Further reading / References:

- Gold-silver nanoparticles modified electrochemical sensor array for simultaneous determination of chromium(III) and chromium(VI) in wastewater samples (2021). Chemosphere, 281; 130880.
- A hot syngas purification system integrated with downdraft gasification of municipal solid waste (2019). Applied Energy, 237; 227-240.
- Conversion of non-condensable pyrolysis gases from plastics into carbon nanomaterials: Effects of feedstock and temperature (2017). Journal of Analytical and Applied Pyrolysis, 124, 16-24.
- Comprehensive characterisation of sewage sludge for thermochemical conversion processes – Based on Singapore survey (2016). Waste Management. 54, 131-142.

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NTU osmotic tensiometer for high matric suction measurement in unsaturated soils

Analyzing engineering properties of unsaturated soils and plant growths in soil sciences

Contributed by: Mr. Liu Hengshuo, Prof Harianto Rahardjo (EPMC)

Matric suction is a stress state variable required to analyze the engineering properties of unsaturated soils and also affects plant growths in soil sciences. Matric suction is caused by the capillarity of soil particles on pore-water as well as the physicochemical interactions between the soil particles and the pore-water. The value of matric suction is usually defined as the difference between the pore-air pressure and the pore-water pressure. Conventional water-filled tensiometers are widely used to measure matric suction in the field but have a limited measuring range up to 100 kPa due to the cavitation problem.

One objective of the project "New soil-water management technologies for sustainable urban greenery" granted by National Parks Board, Singapore and supervised by Prof Harianto Rahardjo is to explore new technologies to realize fast and high matric suction measurement. For this purpose, polymer-filled osmotic tensiometers (OTs) were studied and developed. The prototype of the OT is shown in Figure 1.

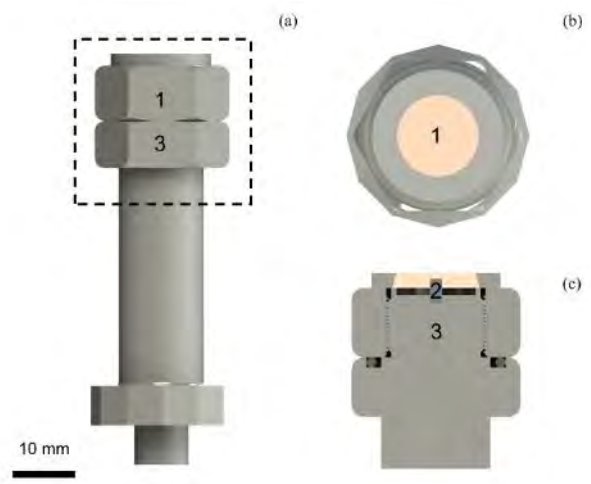


Figure 1: Prototype of the OT developed in this project:
(a) front view of the OT;
(b) top view of the OT;
(c) cross-section of the OT in the dashed-line box in (a). (components of the OT: 1. ceramic disk cap; 2. polymer chamber; 3. pressure transducer)

Crosslinked super water-absorbent polymers (e.g., polyacrylamide, sodium polyacrylate, and polyvinylpyrrolidone) were used for the development of OTs due to their high water absorbency capacities. When filling the dry polymer into the chamber of OT and placing the OT in distilled water, water would enter the chamber of the OT through the ceramic disk. The polymer absorbed water and became soft hydrogels to fill up the whole chamber.

Simultaneously, the osmotic pressure of the water would be improved significantly. The measuring range of OT is equal to the osmotic pressure of water inside the OT. This would avoid the cavitation problem that appeared in conventional tensiometers. When placing the OT in contact with the soil specimen to measure its matric suction (Figure 2 (a)), the suction of the soil will induce a drop in the osmotic pressure of the water in the polymer chamber of OT and this drop at equilibrium is the value of matric suction of the soil (Figure 2 (b)).

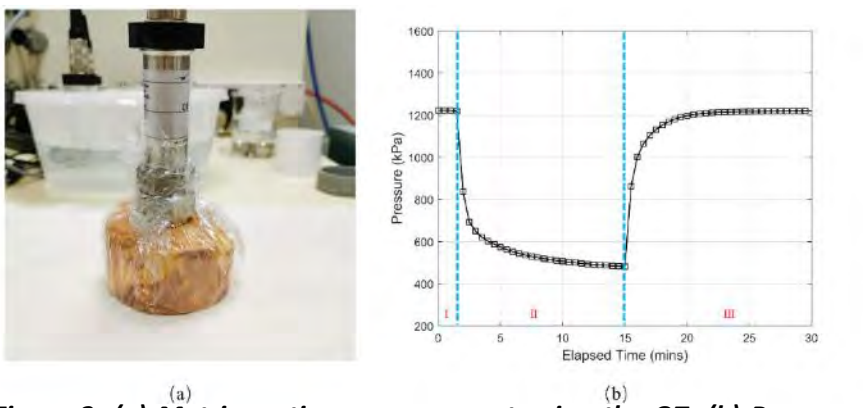
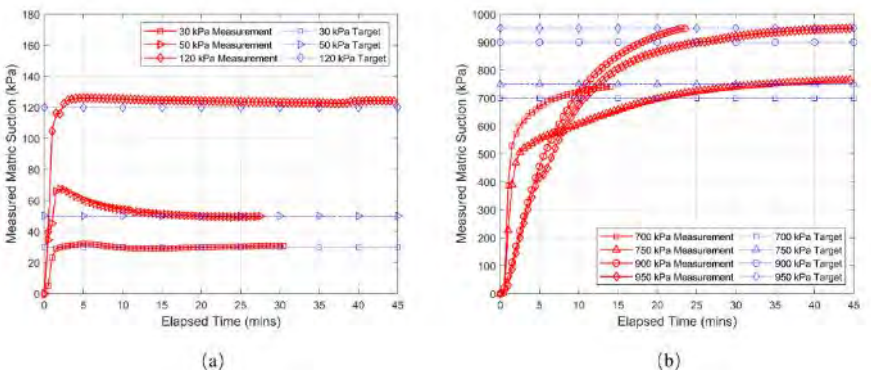


Figure 2: (a) Matric suction measurement using the OT; (b) Pressure change of the OT during the measurement process.

Figure 3 shows the good performance of developed OT in matric suction measurement: the OT responds fast to the change of suction once it is in contact with the soil. At equilibrium, the OT presents the suction of the soil with high accuracy. The OT not only has comparable performance to the conventional tensiometer in the range from 0 to 100 kPa but extends the measuring range higher than 1000 kPa.



Besides the development of OT, the mechanism of pressure decay that appeared in OT was validated and some approaches were proposed to realize a long-term stable measurement over several months.

The developed NTU OT will contribute to the high matric suction measurement in the field and the application in slope stability monitoring and automatic greenery management.

Further reading / References:

- Liu, H., Rahardjo, H., Satyanaga, A. & Du, H. (2021) Use of synthesised polymers for the development of new osmotic tensiometers. Géotechnique. DOI: 10.1680/jgeot.21.00108.
- Rahardjo, H., Shen, Y., Tsen-Tieng, D. L., Ramos-Rivera, J., Nong, X.-F. & Hamdany, A. H. (2021) New Osmotic Tensiometer Development. Geotechnical Testing Journal 44(3):722-740.

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 real-time / digital PCR instruments, as well as the Automated High-throughput Screening (HTS) Platform (customed design)

Contributed by:
Dr Li Cai Xia
Mr Mauricius Marques Dos Santos
(Analytic Cluster)

QuanstudioTM 7 Pro real-time PCR system and QIAcuity One digital PCR system

In real-time PCR, the amplification of targeted DNA molecule is monitored in real-time, with which targets can be quantitatively/semi-quantitatively analysed.

Applied Biosystems' Quanstudio (QS) 7 Pro allows standard and fast cycles with exceptional reproducibility and application versatility. Digital PCR is a refinement of conventional PCR where each sample is split into partitions of nanolitres prior to PCR.

Digital PCR is quantitative and a more precise method than conventional PCR. Qiagen's QIAcuity One is a fully integrated digital PCR system that offers flexible sample throughput and advanced multiplexing capabilities.

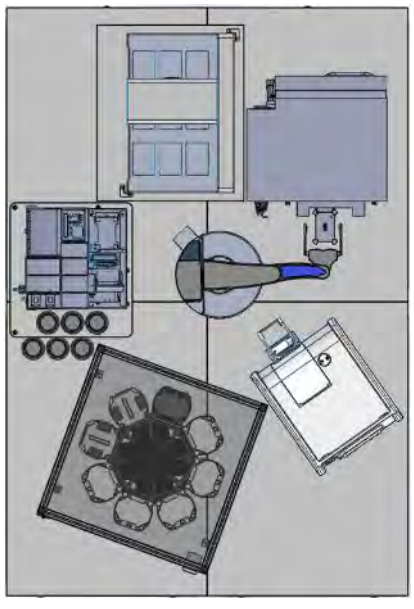
QuantStudio™ 7 Pro Real-Time PCR System

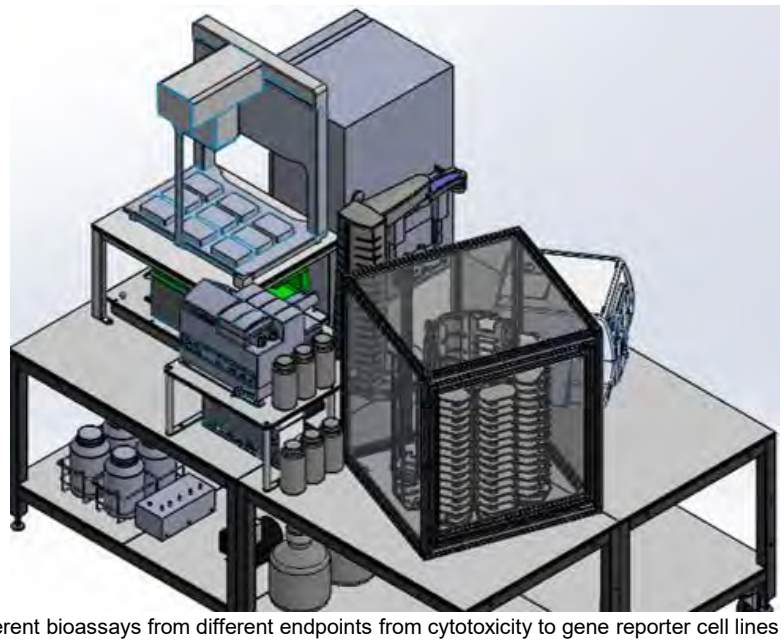
- Six decoupled excitation and emission filter channels with 21 filter combinations
- Multiplex of 5-6 targets
- Interchangeable block system
- Temperature range is 4-99°C and uniformity is 0.4°C
- Up to 6 different temp zones across 96-well block
- Detect changes down to1.5-fold in single-plex reactions and obtain 10 logs of linear dynamic range.

QIAcuity One Digital PCR system

- Up to 26K partitions
- Absolute quantification without the need of standard curves
- Multiplex up to 5 dye channels
- With an independent reference channel
- Allows re-cycling and re-imaging
- Time to result 2-3 hours

Automated High-throughput Screening (HTS) Platform





NEWRI's automated High-throughput Screening (HTS) Platform is designed for cell-based assays, automated cell culture and biochemical assays. It can handle all steps of cell-based protocols from cell seeding to microplate reading or imaging.

Automated incubator allows for long time experiments and the processing of different assays at the same time.

Comprehensive liquid handling devices are used for sample processing, dilution and dosing into 96, 384 or 1536 well plate formats starting from 11 pL.

- Start to end assay automation of different bioassays from different endpoints from cytotoxicity to gene reporter cell lines endpoints (e.g., estrogen receptor - ERα, glucocorticoid receptor - GR, CYP1A1, NFkB and AP1)
- Generation and long-term culture of 3D cell structures (spheroids, tumoroids) with gentle media exchange module
- Automation of biochemical assays including ELISA, also capable of magnetic beads handling
- Advanced liquid handling for digital titration, combinatorial studies, plate randomization and volume normalization
- Compatible with 96,384 and 1536-well plate formats with up to 44 incubated plates for a total of more than 60,000 tests processed simultaneously
- ThermoFisher's Momentum™ Workflow Scheduling Software for process monitoring and scheduling with intelligent data-driven decision-making capabilities

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DISCOVER

MORE of the myriad high-end equipment located in NEWRI. **CLICK THE BROCHURE**

Congratulations to our CEE faculty members for receiving the Inaugural College of Engineering Awards 2022

Sourced from CEE on: May 2022

CoE Innovator (Entrepreneurship) Award
Special Mention: Professor Wang Rong

CoE Research – Young Faculty Award
Runner-Up: Associate Prof Grzegorz Lisak

CoE Research Award
Special Mention: Associate Prof Zhou Yan

Prof Shane Snyder awarded the National Water Research Institute Clarke Prize 2021

Source NTU, published Oct 2021

Professor Shane Snyder was awarded the Clarke Prize by demonstrate excellence through their continuous contributions to the body of knowledge related to protecting, maintaining, treating, and reclaiming water resources. The Athalie Richardson Irvine Clarke Prize, or “Clarke Prize”, is awarded annually by the National Water Research Institute (NWRI) of Fountain Valley, California, for demonstrating excellence in the fields of water science and technology. It recognizes the highest contributions by an individual engaged in the discovery, development, improvement, or understanding of the issues associated with water quality, quantity, technology, or public policy.

“I am tremendously honored to have been selected as the 2021 Clarke Prize *Laureate, and to join this league of the world’s most influential water researchers…”

Interview here

Congratulations to Assoc. Professor Zhou Yan awarded the 2021 L'Oreal Singapore For Women in Science National Fellowship Award (Physical and Engineering Sciences)

Released Feb 2022

L’Oréal Singapore For Women in Science National Fellowship programme was established in 2009 and the National Fellowship awards two researchers yearly in the field of Life Sciences and Physical and Engineering Sciences, who have shown scientific excellence in their career to date and in turn, become role models for the younger generation. More information here

Congratulations to Associate Professor Grzegorz Lisak on his promotion

Released Mar 2022

Assistant Professor Grzegorz Lisak is promoted to Associate Professor with Tenure

Ms. Juhi Singh, President of SWE@NTU, presenting the certificate to Ms Silvia

Society of Women Engineers @NTU reSHEarch Showcase

Released Apr 2022

Excerpt:

NEWRI student Ms Rochelle Silva was placed runners-up in the recently held "SWE@NTU reSHEarch Showcase", an event which celebrated the breadth of NTU student research across multiple engineering disciples. The event was organized by the Society of Women Engineers @NTU which aims to create a community of passionate individuals at NTU who will work together to advance future women engineers. It serves as a platform for budding women engineers to connect with future employers, professionals, and academics by interfacing with other SWE affiliates in Singapore and globally.

She presented a poster on "*Non-equilibrium potentiometric sensors integrated with metal modified paper-based microfluidic solution sampling substrates for determination of heavy metals in complex environmental samples*". The research work was performed in collaboration with Dr. Ashiq Ahamed, Dr. Yi Heng Cheong, Mr. Ke Zhao, Dr. Ruiyu Ding and Assoc. Prof. Grzegorz Lisak.

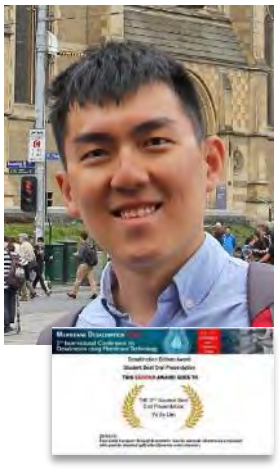
Singapore 100 Women In Tech (SG100WIT) 2021 – Congratulations to Prof Wang Rong

Sourced from CEE, published Oct 2021

Excerpt:

Prof Wang Rong has been listed in the latest Singapore 100 Women In Tech (SG100WIT) 2021. SG100WIT recipients needed to demonstrate tech expertise, leadership and vision, and community advocacy. Their achievements and contributions to the tech industry are impactful, influential and, above all, inspiring.

Organised by the Singapore Computer Society (SCS), in partnership with SG Women in Tech and Infocomm Media Development Authority (IMDA), the list recognises and celebrates women based in Singapore who have been inspiring and have made significant contributions to the tech industry. It seeks to highlight the rich diversity of roles and spotlight the role models in Singapore's dynamic ICT sector, in the hope of inspiring girls and women to pursue a career in STEM (science, technology, engineering and mathematics).
(More on Prof Wang in the NISTH newsletter)



Lim Yu Jie awarded 2nd award of the "Student Best Oral Presentation"

Published Nov 2021

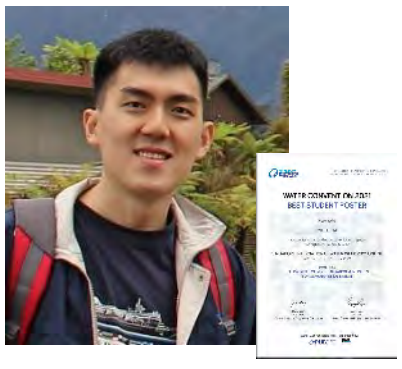
NEWRI-SMTC's Lim Yu Jie has done it again winning the 2nd award of the "Student Best Oral Presentation" at the 5th International Conference on Desalination using Membrane Technology. Our heartiest congratulations.

Rochelle Silva, emerged as the winner of the 3MT NTU Finale 2021

Published Aug 2021

IGS-Sustainable Earth student, Rochelle Silva, emerged as the winner of the 3MT NTU Finale 2021 competition for presenting her research thesis on '*Ion Selective Electrodes*'. The top three winners represent NTU at the 3MT Singapore Finals 2021 hosted virtually by NUS Singapore in August.

NTU's Graduate Student Association organised the virtual 3-Minute Thesis (3MT) NTU Finale 2021 on 30 June on Zoom, where 16 PhD students who are finalist pitched their research idea succinctly to a non-specialist audience in just three minutes.



Lim Yu jie
SMTC (Singapore Membrane Technology Centre)
NEWRI, NTU Singapore

Wang Si Yu
IGS (Interdisciplinary Graduate School), NTU Singapore
AEBC (Advanced Environmental Biotechnology Centre), NEWRI, NTU Singapore

Lim Yu Jie and Wang Si Yu awarded Best Student Poster at Water Convention 2021

Sourced from SIWW, published Aug 2021

Lim Yu Jie and Wang Siyu was awarded won the Best Student Poster at Water Convention 2021, organised as part of the SIWW2021 Online. Lim Yu Jie's entry entitled "*The promises of next-generation membranes for seawater desalination*", and Wang Siyu's "*Integrated anaerobic fixed-film MBR-reverse osmosis-chlorination process: An environmentally sustainable approach for reclamation of municipal used water*" were 2 of the 5 winners at the competition.

The Water Convention (organised as part of Singapore International Water Week) is a platform for gathering professionals and technology providers from around the world to share their knowledge, practical experiences and novel technologies to address the current and emerging water challenges.

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