NEWRI Update

- ISSUE 18, 2020/2021 -

Staying Connected with NEWRI

A word from the Executive Director

Dear Friends and Colleagues,

First, I wish all of you a very Happy New Year! Without question, 2020 was an incredibly difficult and tragic year. I doubt there is anyone among us who has not been impacted by the global pandemic and I know some of you suffered more than others. Within a few weeks, it will be one year since I last stepped foot onto an airplane, thus I have not left Singapore since traveling to Nepal last February for NEWRI Community (see last newsletter for details). While months of isolation at home were necessary to contain the spread of COVID, an incredible amount of productivity was realized. In total, I believe I spent more time in virtual meetings in 2020 than I had in "live" meetings the year before. For the first time in my life, I was able to give seminars and participate in meetings on various continents all within the same week, and sometimes even the same day. However, instead of jetlag I found myself with sleep deprivation as one country watched the sun rise as another watched it set. While I still believe that those human interactions in person cannot be replaced, we had to make do with the virtual communication networks to keep the forward momentum in our quest for environmental technology advancement. Indeed, during the height of the pandemic, we continued our discussions and planning for the evolution of NEWRI into our next tranche of funding. For me 2020 was among the busiest and more challenging years in my professional career and I am very much hopeful for a brighter 2021.

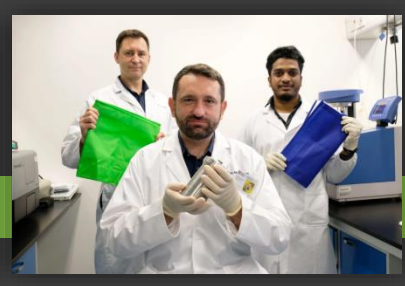
Despite the pandemic, NEWRI continued to make progress in our research, education, and philanthropic programs. We were fortunate to receive a grant from Singapore PUB to conduct wastewater-based epidemiology to trace to prevalence of COVID infections in the population through monitoring of the sewer network. On two occasions, data generated by NEWRI facilitated detection of what was possibly a single case within two different communities. I am proud of our team who tirelessly worked in the laboratory on this vital topic during a highly restrictive time when most of us were limited to working from home. Likewise, our philanthropic team engaged with research fellows in Malaysia, Nepal, Thailand, and Myanmar to develop environmental monitoring programs utilizing remote education and training, such that local communities could continue to be empowered to perform impactful work. Likewise, the NEWRI team had to be adaptable to restricted travel policies that limited our industrial partners access to pilot water treatment facilities in Singapore. Fortunately, through virtual interactions and our teams' perseverance, we were able to commission a new ion-exchange pilot system with already quite positive results. Indeed, throughout NEWRI, our community has well-adapted to the "new normal" and consistently met our key performance indices despite the tremendous challenges.

By working closely with our government, industrial, and academic partners, NEWRI is very well positioned for the future. Our diligent team spent an incredible amount of time working through the details of the funding and administrative programs that will carry NEWRI forward for another five-year funding tranche.

(Continued next page …)

NTU staff donate more than 20,000 days of unused annual leave

Leave donations to raise money for student aid abundant (Pg 3)



Plastic bags more eco-friendly than paper and cotton bags: NTU study

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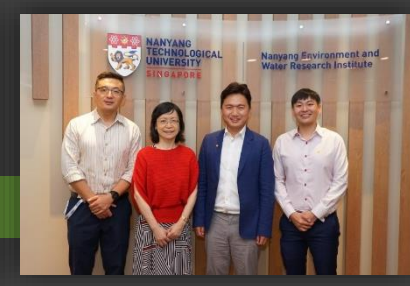
EPMC's new UAV-based remote sensing tech

Remote monitoring for turbidity in coastal waters (Pg 6)



Disrupting the traditional concentration process

Cold concentration of high-value liquid products (Pg 7)

Prof Fei Xunchang awarded 2021 Arthur Casagrande award

1st Asian awarded by ASCE (Pg 12)

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(... *continued from previous page*)

We are close to finalizing a 6-month extension that will allow us and our stakeholders to realign NEWRI's focus to better meet Singapore's national environmental needs, while continuing to engage with local and international companies towards commercialization of NEWRI technologies and co-creation of novel technologies with our partners. Moreover, this extension provides NEWRI time to integrate new infrastructure including the latest generation of mass spectrometers for environmental characterization and the development of bioassays for toxicity screening, areas that are critical as we increase our efforts on resource recovery and circular economy themes. In our fourth tranche of funding (TR4), we are privileged to receive funding support from the Ministry of Sustainability and Environment (MSE) and will have a unique focus on areas of critical need from our MSE agencies, Singapore Public Utilities Board (PUB), National Environment Agency (NEA), and Singapore Food Agency (SFA).

Photo source: NTU

To this end, we were honoured to host a VIP delegation from MSE at NEWRI within the first week of January with Minister Grace Fu, Senior Minister of State Dr. Amy Khor, and the lead technical officers from the three national agencies. In NEWRI TR4, PUB will be the administrator of the core grant to NEWRI with additional programmatic funding from PUB, NEA, SFA. It is an exciting time, and we are delighted to be working hand in hand with MSE and our national agencies as we evolve towards a highly collaborative, inclusive, and interdisciplinary One NEWRI platform. To this end, I am very grateful to my NEWRI and NTU colleagues who have helped make this transition possible and to help breakdown silos as we progress towards a very promising future.

Photo source: NTU

Thus, we enter into 2021 with many new projects and research opportunities, some of which we feature in this newsletter. You will read about some of the notable work and achievements of our faculty, staff, and students. However, I need to also acknowledge our behind-the-scenes core staff, without whom NEWRI could not function. This is especially true as we prepared the detailed budgets and administrate documents necessary for funding of this magnitude. The fact is, NEWRI is more than a sum of its parts. I am deeply appreciative of those who have supported NEWRI over the past year and helped us secure NEWRI's future. Despite the challenges of the pandemic and preparation for a new funding cycle, we were able to work together in unifying our team towards a common goal of success and achievement.

Sincerely,
Shane A. Snyder

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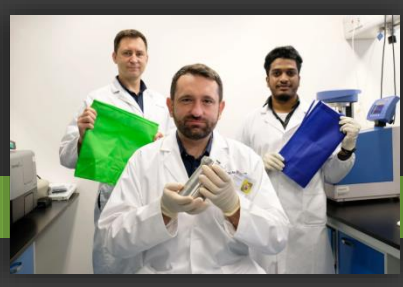

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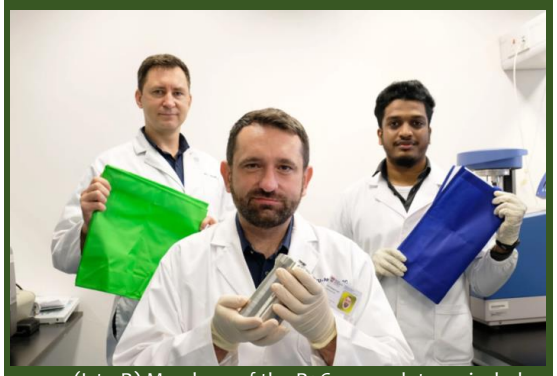


(L to R) Members of the R3C research team include Dr Andrei Veksha (senior research fellow), Asst Prof Grzegorz Lisak (centre director), and research associate Ashiq Ahamed of the Residues & Resource Reclamation Centre (R3C)

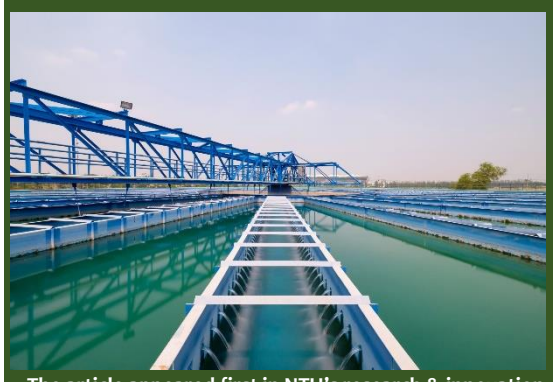
Source: Today online (Oct 2020)

Plastic bags more eco-friendly than paper and cotton bags in countries like Singapore: NTU study

Scientists from Nanyang Technological University (NTU) have found that plastic bags are more eco-friendly than paper and cotton bags, contrary to popular belief. In a study released recently, the research team said that this was true in cities and countries such as Singapore with densely populated metropolitan areas where waste is eventually incinerated.

"*It is essential to evaluate the implications case by case for dealing with plastic waste*," the director of the Residues & Resource Reclamation Centre at the Nanyang Environment and Water Research Institute said.

For the Today online link to article, please click here.



The article appeared first in NTU's research & innovation magazine Pushing Frontiers (issue #17, August 2020).

Wastewater-based epidemiology and surveillance of COVID-19

A key challenge for public health officials during the COVID-19 pandemic is how best to monitor the prevalence of SARS-CoV-2 infection in a population. One promising idea for the early detection of viral outbreaks at the population level is wastewater-based epidemiology.

"By monitoring sewage from various urban areas or complexes such as residential blocks, dormitories or medical facilities, we aim to rapidly identify COVID-19 outbreaks without invasive procedures involving human interactions, and in a very cost-effective manner," says Prof Shane Snyder, Executive Director of NTU's Nanyang Environment and Water Research Institute.

For more of the NTU article, please click here.

Source: CNA In Focus
Photo : Marcus Mark Ramos

IN FOCUS: 'It is not easy, but it can be done' - The challenges of raising Singapore's recycling rate

CNA looks into why Singapore's overall recycling rate has been sticking at about 60% in recent years despite proactive attempts to improve the situation. The "persistently weak global market demand" for plastic recyclables was a key reason for the drop in the plastic recycling rate in 2019, said NEA, adding that it was "developing our local recycling capabilities" to treat post-consumer plastic waste. **Assistant Professor Grzegorz Lisak** (NTU School of Civil and Environmental Engineering and NTU NEWRI) comments on how "Singapore is moving towards more efficient and innovative processes in solid waste management," and talks about the only waste-to-energy gasification plant in Singapore – the Waste-to-Energy gasification plant, as a testbed for new waste-to-energy solutions.

For the CNA link to article, please click here.

Source: PUB/FACEBOOK

Pandan-smelling water from Malaysia has been 'isolated'; local water production ramped up to meet demand: PUB

Singapore ramps up local production of water to meet demand after some water from Malaysia had to be "isolated" following reports about an unusual scent of pandan caused by an organic compound known as tetrahydrofuran (THF), which is commonly used as a solvent in industries. ST reached out to Professor Shane Snyder (NTU NEWRI) for his comment, "*THF is difficult to detect in water, other than by its odour….*"

For the ST link to article, please click here.

NEWRI IN THE NEWS

NTU staff donate more than 20,000 days of unused annual leave to raise money for student aid

Article first appeared in Straits Times
by Jessie Lim
November 2020

SINGAPORE: Employees at Nanyang Technological University (NTU) have donated more than 20,000 days worth of unused leave towards student aid and endowments, said the university on Monday (Nov 23).

The collective 20,145 days of annual leave are worth S$10.25 million, said NTU in its media release.

File photo of The Hive, Nanyang Technological University (NTU)

The donations were made by 1,821 faculty and staff, with each employee contributing an average of 11 days. The highest donation was 15 days of leave.

NTU said the donation exercise was a new initiative that allowed employees to put their unutilised leave "towards a good cause". "As part of the opt-in exercise, all NTU employees were given the option to voluntarily redeem their unutilised earned annual leave value, based on each individual's salary rates, for donation to an NTU fund of their choice," added the university.

On average, NTU employees are given between 21 and 42 days of annual leave depending on their employment scheme and length of service. Another round of the opt-in leave donation exercise will be held in October in 2021. NTU senior vice president (administration) Tan Aik Na said the donations showed how the university's community was invested in the success and wellbeing of its students.

"Everyone has been impacted by COVID-19, but some have been hit harder than others. Some of our students' parents have lost their jobs or have had their income reduced.

"So, it is doubly important during the pandemic for us to rally our support ... to help these students," said Ms Tan.

Dr Babu Narayanswamy who gave 14 of his leave days in cash value, said he planned to donate again next year.

"*I consider myself one of the fortunate ones to have a job that has not been adversely impacted by the coronavirus pandemic*," said the materials scientist and director at the Nanyang Environment and Water Research Institute (NEWRI).

"*While the Government has been doing all it can, I believe this is the time for those of us who can, to pitch in and help in whatever way possible*," said Dr Babu.

Dr Babu Narayanswamy, director in NEWRI

Earlier this year, NTU launched a S$2 million fund to support students affected by the COVID-19 outbreak.

Eligible students are able to receive an interest-free advance of up to S$1,500 which they have to reimburse to the university within two years after graduation. This initiative follows two others launched by the university - the NTU Priorities Fund and the OneNTU Fund - both of which were part of its Covid-19 Relief Package to help students facing financial difficulties.

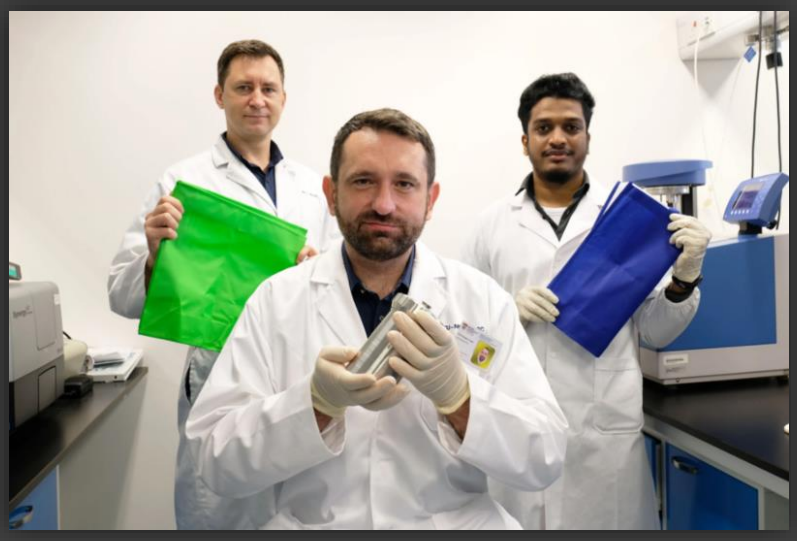
Link to the full ST article here

NEWRI IN THE NEWS

Plastic bags more eco-friendly than paper and cotton bags in countries like Singapore: NTU study

Article first appeared in TODAY online
by Loraine Lee
October 2020

Scientists from Nanyang Technological University (NTU) have found that plastic bags are more eco-friendly than paper and cotton bags, contrary to popular belief.In a study released on Wednesday (Oct 14), the research team said that this was true in cities and countries such as Singapore with densely populated metropolitan areas where waste is eventually incinerated.



(Left to right) Members of the Nanyang Technological University research team include Dr Andrei Veksha, senior research fellow at the Residues & Resource Reclamation Centre at the Nanyang Environment and Water Research Institute, Assistant Professor Grzegorz Lisak, and research associate Ashiq Ahamed.

In a study released on Wednesday (Oct 14), the research team said that this was true in cities and countries such as Singapore with densely populated metropolitan areas where waste is eventually incinerated. The NTU scientists came to this conclusion after carrying out a life-cycle analysis of five types of bags to evaluate their environmental impact associated with its production, distribution, transportation, waste collection, treatment and end-of-life disposal. Reusable plastic bags made from polypropylene non-woven plastic were the most eco-friendly option followed by single-use plastic bags made from high-density polyethylene.

Assistant Professor Grzegorz Lisak, who led the research, said the finding that single-use plastic bags — if treated properly — are less environmentally detrimental was “surprising”. “*It is essential to evaluate the implications case by case for dealing with plastic waste*,” the director of the Residues & Resource Reclamation Centre at the Nanyang Environment and Water Research Institute said.

In the study’s model, both single-use and reusable plastic bags were reported to be less environmentally harmful than paper and cotton bags in cities such as Singapore. Photo: NTU

The study also found that the global warming potential of kraft paper bags are 80 times that of reusable plastic bags, while single-use plastic bags and cotton reusable bags are 10 times. Cotton and kraft paper bags require large amounts of water and natural resources, leaving a bigger environmental footprint, the report stated. In places such as Singapore, where waste is incinerated, the timeline of biodegradation of paper, cotton and other biodegradable materials is irrelevant.

Such bags are suitable for countries that use landfills and regions with higher leakage of waste into the natural environment, the study highlighted. However, the scientists said that these bags could be more environmentally friendly in the future by improving its production method, optimising resource usage and following sustainable practices.

The team recommended fully utilising reusable plastic bags to reduce the consumption of single-use plastic bags. Asst Prof Lisak said that based on 2018 statistics, reducing the single-use plastic grocery bag consumption in Singapore by half could prevent more than 10 million kg-CO_2 emissions a year.

Link to the full TODAY article here

More information about Resource Recovery in R3C, **Click here**

NEWRI IN THE NEWS

NTU United against COVID-19: Wastewater-based epidemiology and surveillance of COVID-19

The article appeared first in NTU's research & innovation magazine Pushing Frontiers *(issue #17, August 2020).*

NTU researchers are using wastewater to track SARS-CoV-2 epidemiology and transmission in communities, backed by large grants

A key challenge for public health officials during the COVID-19 pandemic is how best to monitor the prevalence of SARS-CoV-2 infection in a population. One promising idea for the early detection of viral outbreaks at the population level is wastewater-based epidemiology.

"***By monitoring sewage from various urban areas or complexes such as residential blocks, dormitories or medical facilities, we aim to rapidly identify COVID-19 outbreaks without invasive procedures involving human interactions, and in a very cost-effective manner***," says Prof Shane Snyder, Executive Director of NTU's Nanyang Environment and Water Research Institute.

Prof Snyder is leading the project "Wastewater-based epidemiology of COVID-19 and related markers in Singapore: Novel and cost-effective methods for tracking epidemic and endemic diseases", which is supported by a grant from Singapore's Public Utilities Board.

By harnessing the Institute's expertise in wastewater management and knowledge of Singapore's complex sewage collection system, as well as deploying sensitive PCR assays and studies on the decay of SARS-CoV-2 in wastewater for model optimisation, Prof Snyder hopes to achieve a warning level for SARS-CoV-2 prevalence of 0.001% or better—equivalent to one case per 100,000 residents.

Wastewater surveillance of COVID-19 in the community is also underway at NTU's Singapore Centre for Environmental Life Sciences Engineering (SCELSE). Joining forces with Singapore's National Environment Agency, the team—led by Assoc Prof Janelle Thompson of NTU's Asian School of the Environment—helped set up surveillance methods at the dormitories of foreign workers, some of which became centres of COVID-19 outbreaks. The researchers also support community-wide surveillance at Singapore's four wastewater reclamation plants. Information from this approach has already been integrated into Singapore's COVID-19 response.

The team's new grant, "Sewage-based surveillance for rapid outbreak detection and intervention in Singapore", is supported by the National Research Foundation, Prime Minister's Office, Singapore, under its Campus for Research Excellence and Technological Enterprise (CREATE) programme. Focusing in parallel on SARS-CoV-2 and other viral pathogens, the grant includes SCELSE's Prof Stefan Wuertz of NTU's School of Civil and Environmental Engineering and Asst Prof Monamie Haines of NTU's School of Social Sciences, as well as investigators from the National University of Singapore and the Singapore-MIT Alliance for Research and Technology.

Read the full NTU's Pushing Frontiers article here

UAV-based remote sensing of turbidity in coastal waters

Contributed by: Ms Dawn Pang (EPMC)

Monitoring of turbidity

EPMC has been awarded a 2-year project, **UAV-Based Remote Sensing of Turbidity in Coastal Waters**, by the Singapore Maritime Institute. The Principal Investigator is Professor Law Wing Keung, Adrian from the School of Civil and Environmental Engineering at NTU. The industry collaborator is DHI Singapore who has strong expertise in water quality modelling and field measurements.

The monitoring of turbidity is an essential component of Environmental Monitoring and Management Programmes (EMMP) in Singapore and around the world. EMMP safeguards the water quality of coastal waters, particularly around sensitive locations such as coastal intakes, coral reefs, marine habitats, etc. Traditional turbidity monitoring depends heavily on field samplings and are typically laborious.

The project aims to establish a new remote sensing approach using Unmanned Aerial Vehicles (UAVs) carrying hyperspectral and multispectral cameras. The new approach offers potential cost savings, and can be executed expeditiously on-demand over a wider targeted coastal area.

AI-enabled algorithms shall be developed to process the surface water images and correlate their properties with turbidity concentrations in the water, amid the complex ambient light setting with the presence of currents and waves. A software visualisation platform will also be derived to generate turbidity contour maps based on Convolutional Neural Networks. Extensive field verification of the new approach will then be carried out in the coastal waters of Singapore under different operational scenarios of land reclamation.

EPMC's hyperspectral UAV system

EPMC's (left to right) Duong Thi Kim Cuc (researcher), Dawn Pang (staff), Kieu Trung Hieu (staff), Pak Hui Ying (researcher) with the UAV system sans camera payload.

Further reading / References:

1. A Review of Turbidity Detection Based on Computer Vision. IEEE Access 2018, 6, 60586-60604.

2. Evaluation of Regression Analysis and Neural Networks to Predict Total Suspended Solid in Water Bodies from Unmanned Aerial Vehicle Image. Sustainability 2019, 11, (9).

3. Proposal of a Method to Determine the Correlation between Total Suspended Solids and Dissolved Organic Matter in Water Bodies from Spectral Imaging and Artificial Neural Networks, Sensors 2018, 18, (1), 159.

More information about Modelling & AI @ NEWRI, **Click here**

Disrupting the traditional concentration process

Contributed by: Dr Shi Lei (SMTC)

Cold concentration of high-value liquid products

In Singapore, nearly all of our coffee, tea, juices and milk are directly imported from outside of the island. In order for these products to reach our shores means they would need to endure issues like logistical transportation, and storage contributing to increased cost. Current conventional technology to produce concentrates uses thermal vacuum evaporation which uses a combination of heating under vacuum conditions. Heat when directly applied to the liquid product can alter the aroma and taste by altering temperature-sensitive compounds, in addition to extensive energy requirement.

Enter Aromatec, a Singapore-based company that aims to disrupt the traditional concentration process by utilising its membrane technology in the forward osmosis (FO) process. The FO membrane has the flexibility fine tune their technology to address various demands from different industries. For instance, beverages generally contain huge amount of solid suspension and has high viscosity. Aromatec's FO membranes have three times larger inner diameter than the products of its competitors which requires lesser pre-treatment and reduces operational complexity and maintenance, with test results showing better performance in terms of higher de-watering rate and purer concentrate achieved, with accommodating food processing requirements.

As such, coffee, tea, orange juice, milk and beer have been tested to success using pilot scale modules. Global market for coffee concentrate was valued at U$ 0.5 Billion in 2018 and is growing rapidly at 24 % annually to an estimated U$ 2.3 billion in 2025. The global market for juice and tea concentrate are huge at above U$ 50 Billion in 2018 and expected to reach above U$ 80 Billion in 2026, respectively. (Source: MarketWatch, Statista.) Co-founded in 2018, by Professor Wang Rong and Dr Shi Lei from NTU's SMTC (Singapore Membrane Technology Center), the Aromatec research team was the first in the world to develop "Thin-Film-Composite Forward Osmosis Hollow Fiber Membrane" in 2010. Recently, Aromatec clinched champions in the Singapore Semi-Final of the 2019 Qingdao Tech & Innovation Challenge (https://tinyurl.com/yyshurp8) which is in collaboration with AWS Singapore, Techbridge Ventures to identify suitable collaborators to enter the Chinese market.

The spin-off company shares strong partnerships with De.mem Pte Ltd, NTU and more recently Sunbo Angel Partners, and has already achieved some commercial traction with the sale of a pilot scale system to a multinational from the flavours & fragrances industry at an estimated value of SGD 93,000, and are seeking to scale-up to industrial production. They plan to target more than 10 other flavour companies in Singapore which could use the forward osmosis technology for product concentration, with addition plans to the Korean market.

Please also read
De.mem – poised to enter lucrative FO market for dewatering applications (https://tinyurl.com/y2bu5n8p)

Prof Wang Rong and Dr Shi Lei meeting with Mr YoungChan Choi (CEO, Team building, network) and Mr Mingjin Goh (Investment principle (*far right*)), from Sunbo Angel Partners) at NEWRI, NTU

The pilot system utilising the membrane technology in the forward osmosis (FO) process, developed in NEWRI laboratories.

More information about Membrane Technology in SMTC @ NEWRI, **Click here**

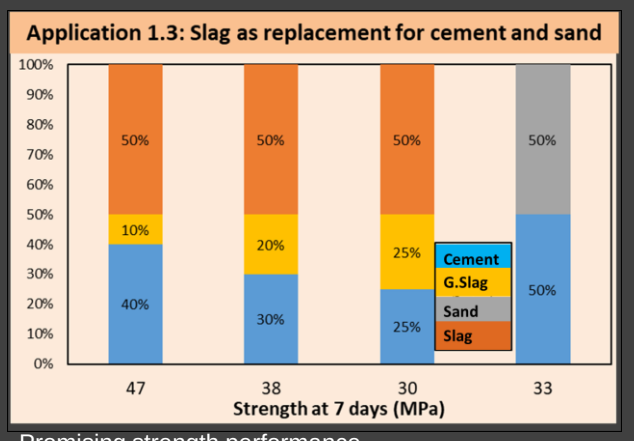
Development of municipal solid waste (MSW) slag as a construction material and its pilot use in concrete footpath

Contributed by: Dr Chan Wei Ping, Dr Phua Zheng Hui (R3C)

Promoting material sustainability and prolonging landfill life expectancy.

Waste-to-Energy Research Facility (WTERF)

Waste-derived slag (or MSW slag)



Promising strength performance

NEWRI-R3C of Nanyang Technological University, Singapore is funded by JTC Corporation and collaborating with JFE Engineering Corporation to explore the use of waste-derived slag generated from the gasification of municipal solid waste (MSW) as a green construction material.

The waste-derived slag (or MSW slag) is a stabilized inert glass-like by-product produced from a high temperature slagging gasification process at the Waste-to-Energy Research Facility (WTERF). These waste-derived slag exhibit good geotechnical properties and high potential as partial replacement of natural resources such as sand and cement for non-structural applications due to their composition.

Preliminary test on the particle size distribution indicated that slag is comparable to concrete sand, suggesting it could be used as an alternative for sand in concrete. Initial leaching results also indicated that most of the heavy metals in MSW slag leachates are within limits and suitable for utilization as construction materials. Compressive strength test also demonstrated that MSW slag can replace 30-60% of cement and/or 60-100% of sand in concrete (or mortar) without obvious strength decrease.

Building up from the promising preliminary results, this study intend to further research on detailed characterization of the waste derived slag, optimizing mix proportion to maximize sand replacement ratio and eventually construct a footpath at a testbed site utilizing waste-derived slag to determine its long-term environmental impacts and structural performance.

Life cycle assessment, cost-benefit analysis and return of investment will be carried out as part of the scope of this study to provide comprehensive understanding on the benefits and impacts on the use of slag-concrete, from both environmental and economical aspects to concurrently reduce reliance on imported construction materials, promote material sustainability and potentially save Singapore's landfill space by closing the waste loop.

Sampling and testing of MSW slag

Further reading / References:
Sustainable construction - A guide on the use of recycled materials. 2008, Building and Construction Authority (BCA) Academy, Singapore.

Hjelmar, O., J. Holm, and K. Crillesen, Utilisation of MSWI bottom ash as sub-base in road construction: First results from a large-scale test site. Journal of Hazardous Materials, 2007. 139(3): p. 471-480.

More information about Resource Recovery in R3C @ NEWRI,
Click here

Launching NEWRI's products into the Market

Contributed by:
Dr Pramodh Vallam
Business Development
(NEWRITech)

Researchers in NEWRI strive to develop new innovations that address various challenges within our environment and water sectors. These innovations provide the foundation for development of novel and in several cases, transformational solutions. This translation from bench to pilot to industry scale starts with efforts to understand the market and consumer needs. This creation of value is the lynchpin for the success of our novel products and services in the wider marketplace. Normally, this transformation is demonstrated by progression through the Technology Readiness Levels (TRLs). However, this forms only one part of the overall journey from lab to market.

When a new product is being developed, the traditional start up processes require concerted efforts to conceptualize a business plan, set up a company, find investors, develop and deploy products in the commercial marketplace. This traditional process is not always suited for today's R&D sector as new innovations and solutions are developed rapidly, often rendering existing products & processes obsolete.

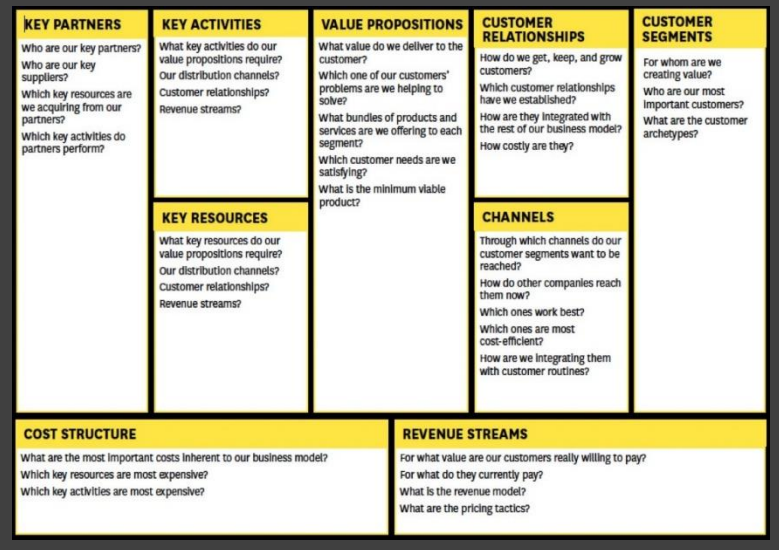


Illustration of BMC, Source: [5]

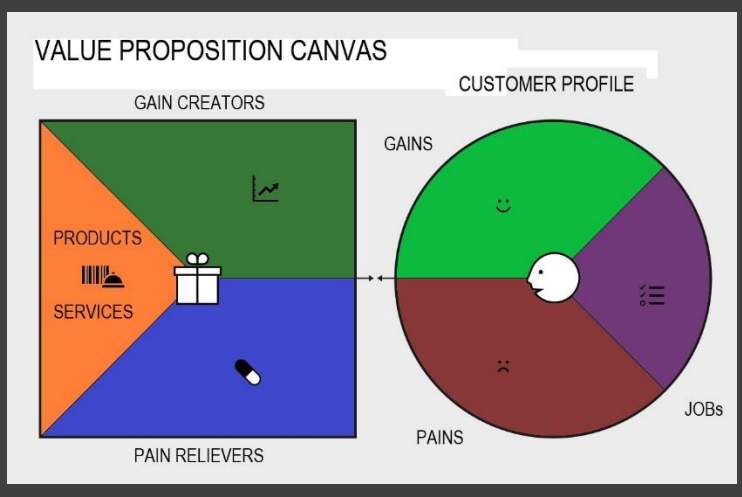


Illustration of VPC, Source: [4]

Hence, to accelerate this process, the concept of lean start-up was developed [3]. This process commences with the identification of the need in the market (or niche). This is exemplified either by unmet customers needs or an improvement of an existing product, which is determined by market analysis of competitors and the business cost structures.

The first step of a lean startup is the creation of a business model, which is a series of hypotheses that are tested to determine if the intended product is technically feasible whilst generating a positive cashflow over time [2]. One of the more popular types of tools is the Business Model Canvas (BMC), a type of lean start-up model. The various components of BMC provide a comprehensive analysis of the offered value proposition, details of the targeted customers (niches or market segments), costing (returns, break-even point, etc.) and infrastructure required for production and distribution of products. Therefore, the primary reason for conducting a BMC is to document the hypotheses, followed by efforts to validate them progressively by meeting with the customers to receive feedback.

The benefits of interacting with potential customers is multi-fold. It allows agility during the development phase, as the potential pain points of customers can be identified early on. Subsequently, the details on pricing, ROI, costs and other financial aspects of the business can be gleaned. Another important contribution of this process is the market positioning of the product. The product might either disrupt other existing competitors or leverage existing functionalities in order to enhance the overall offering. Even if this is not readily achieved, the product would be further improved until it meets the criteria.

One of the important tools to visualize this process is the Value Proposition Canvas (VPC). The VPC comprises a customer profile and a value proposition matrix (on the right). The analysis commences with identifying the jobs or tasks that customers need to perform. The pain points of using the current available products and the gains expected by the customer during the process. This completes the customer profile. The matrix visualizes by listing the products being developed, the gains that customers would accrue and the pain points that are ameliorated. Thus, VPC helps to ensure a seamless transition from development to deployment stage. Therefore, these tools facilitate a re-orientation from innovation driven efforts towards value creation efforts, within NEWRI and beyond.

Contact NEWRITech to find out if your product might be ready for the marketplace!"

Article developed with inputs from:
1. Osterwalder, Alexander; Pigneur, Yves; Clark, Tim (2010). Business Model Generation: A Handbook For Visionaries, Game Changers, and Challengers. Strategyzer series. Hoboken, NJ: John Wiley & Sons. ISBN 9780470876411. OCLC 648031756
2. Materials developed by Prof WONG Poh Kam and the Lean Launchpad Singapore Programme
3. Blank, Steve (2013). Why the Lean Start-Up Changes Everything. Harvard Business Review.
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4. Osterwalder, A., Pigneur, Y., Bernarda, G., Smith, A. (2014). Value Proposition Design: How to Create Products and Services Customers Want, John Wiley & Sons
5. Osterwalder, A. (2013). A Better Way to Think About Your Business Model.
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PUBLICATIONS FOCUS

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.

Homogenization theory with multiscale perturbation analysis for supervised learning of complex adsorption-desorption process in porous-media systems (link here)

Alvin Wei ZeChew, Adrian Wing-Keung Law

Highlights

- *Model adsorption-desorption processes in adsorbers via homogenization theory coupled with multiscale perturbation analysis.*
- *Proposed model encapsulates complexity of adsorption-desorption processes in adsorbers into a reaction rate parameter.*
- *Varying training periods from augmented data pool are used for training and validating model's predictive capability.*
- *Average error deviation of 10% incurred for model's predictive accuracy using optimal training period determined.*
- *Model can be useful to engineers to perform predictive maintenance of adsorbers.*

Abstract

Engineered and natural adsorbers, which undergo both adsorption and desorption mechanisms during operations, are dominant treatment technologies to remove difficult contaminants from influent sources to safeguard supplies of potable water to local communities. The slow net adsorption, i.e. adsorption rate greater than desorption rate, of contaminants over long periods of operational time contributes to chemical clogging inside an operating adsorber which complexity continues to be difficult for engineers to quantify, particularly on the adsorption and desorption processes coexisting during their near-equilibrium concentration state which builds towards its exhaustion stage for maintenance purpose.

In this study, we leverage on the homogenization theory with the multiscale perturbation analysis to develop an engineering model which encapsulates the complex adsorption-desorption mechanics in adsorbers. The desired model contributes towards the primary objective of having the required capabilities to perform predictive maintenance of adsorbers to garner operational benefits, especially for large-scale systems. The hybrid analytical approach systematically derives a unique homogenized representation which contains an unknown reaction rate parameter responsible for the adsorption-desorption processes taking place over a significantly long period of time leading to the adsorber's exhaustion stage. Dimensional analysis is then carried out to express the reaction rate parameter as a function of the known physical parameters to predict the transient variations in an adsorber's effluent concentration during its gradual build-up towards exhaustion.

Measured data from both the literature and our own adsorber experimental runs are then acquired to train and validate the model's predictive capability, via supervised learning methods, which yields an average error deviation of 10 % or less for the optimal training period determined. Finally, we demonstrate quantitatively how the model can be useful to engineers to estimate: (a) the timing for an operating adsorber to reach its exhaustion stage; and (b) the associated Damköhler number, adsorption and desorption coefficients and etc., responsible for the concerned adsorber's effluent concentration profile for the varying types of contaminants removed.

More PUBLICATIONS from NEWRI, click here.

SPOTLIGHT ON

When Wen Yingzhao (Boon Yinn Zhao) graduated and had secured a job in the beginning of the year and thought the transition into the workplace would go smoothly after graduation. She finds out that 2020 had other plans.

Ms Boon Yinn Zhao, who graduated from the Department of Environmental Engineering of Nanyang Technological University, found a job in February this year. The 23-year-old thought she would be able to enter the workplace smoothly after graduation, but she was suddenly notified of the cancellation of her employment contract in April. The sudden news caught her by surprise.

Yinn Zhao, who suddenly lost her job opportunity, felt very panicked and depressed. With graduation approaching, she went to various online recruitment platforms to post 40 resumes, but with little response. Originating from Johor, Malaysia, she recalled going for some interviews, but was faced with rejection with ‘no foreigners are invited for the time being’ as a reason. Without a work permit after graduating in May, she couldn't find any part-time work, and had to wait for assistance from her family. Monthly living expenses amounted to estimated SGD 1000 were borne by her parents in Malaysia, which added a lot of pressure. Fortunately, Ying Zhao's family were supportive of her, despite the economic impact of the epidemic proving to be a great challenge.

In addition to keeping busy looking for work, Yinn Zhao also did not forget to cultivate her interests passing the time with painting and dancing. Using her drawing and design talents to aid her sister's company with freelance design work.

In July 2020, Yinn Zhao received an invitation from her professor to work as a research assistant at NTU. This offered her the relief she sought and said, “At least I worry less, because it takes the pressure off from accepting money from my family, as it is very hard for them to make money. Although they want to support my expenses, the Singapore / Malaysian exchange rate being 1:3, it is a very difficult thing.“

2020 has thrown a lot of setbacks for Yinn Zhao, but it was allowed her to learn how to adapt to new environments, cope with changes, and overcome difficulties, which in turn have made her gain much. She plans to stay in Singapore for 3 years before considering whether to develop in other fields. Yingzhao is currently a research assistant with the Residues and Resource Reclamation Centre (R3C) at NEWRI, NTU.

About the "2020 I graduated" series

This Mediacorp 8 series entitled “Lion City Current Affairs” features young upcoming graduates whom are opening new chapters in their lives, only to face disruption with the COVID-19 pandemic and economic recession around the world. They explore new meaning with life in the city, while putting aside ideals to find a starting point.

To watch the interview (original in mandarin), please click here

AWARDS

Assistant Professor Fei Xunchang of School of Civil and Environmental Engineering, NTU Singapore receives the 2021 Arthur Casagrande Professional Development Award

Asst Prof Fei Xunchang (School of Civil and Environmental Engineering, NTU Singapore) was recently selected by ASCE's Geo-Institute to receive the 2021 Arthur Casagrande Professional Development Award for "*significant contributions to geotechnical engineering research and outstanding promise to advance the disciplines further in pursuit of novel solutions to pressing geoenvironmental problems*." He will officially receive the Award during the Society's International Foundation Congress and Equipment Expo in Dallas, TX, in May 2021.

The Award was established by the Geotechnical Engineering Division (now the Geo-Institute) of ASCE as a memorial to the outstanding contributions of Arthur Casagrande, Hon.M.ASCE, to the teaching, research, and practice of geotechnical engineering. The award is funded by gifts from the many students, colleagues, and friends of Arthur Casagrande. The Award was established in 1989 and awarded to 1-3 winners annually. Thus far, all the 39 winners were based in top U.S. or U.K. universities when awarded. All the winners have become prestigious researchers in the field, a few have been elected to the U.S. National Academy of Engineering. It has never been awarded to a researcher in Asia nor a Chinese. The full list of the past winners can be found here:
https://www.asce.org/templates/award-detail.aspx?id=393&all_recipients=1

NEWRI congratulates Prof Fei on his achievement.

Ma Yunqiao (SMTC-NEWRI PhD student) awarded Best Poster Award of MSA-AGM 2020 (Membrane Society of Australasia, Annual General Meeting)

Ma Yunqiao (SMTC-NEWRI PhD student under the supervision of Prof Chew Jia Wei and Prof Wang Rong) was awarded the Best Poster Award of MSA-AGM 2020 (Membrane Society of Australasia, Annual General Meeting) which took place in November. His poster entry was designed based on the MD simulation conducted for the HAOPs project.

He says the MSA-AGM 2020 was a fruitful experience for him, so much so that he sent a letter of appreciation to the conference chairs, MSA president and the organizing committee for their recognition of the work done. He also mentions that he hopes the pandemic situation can improve in 2021 and looks forward to attending more physical conferences.

NEWRI is proud of Ma Yunqiao and congratulates him on his award.

Awards / Promotions

Promotions

Associate Professor Adrian Law Wing-Keung is promoted to **Full Professor with the title "Professor of Civil Engineering"**

Assistant Professor Chong Tzyy Haur is promoted to **Associate Professor with Tenure**

Ms Isabelle Wong Yuet Mun is promoted to **Senior Assistant Manager, Residues and Resource Reclamation Centre (R3C)**

Dr Goh Kunli is promoted to **Senior Research Fellow, Singapore Membrane Technology Centre (SMTC)**

Dr Liang Yen Nan is promoted to **Senior Research Fellow, Environmental Chemistry and Materials Centre (ECMC)**

Long Service Recognitions

A NEWRI milestone was achieved with Long Service to NTU

Ms Zan Ong Chin Chin
Manager (SMTC)
15 years (Aug 2020)

Ms Li Min
Research Associate (EPMC)
10 years (Aug 2020)

Ms Sim Lee Nuang
Senior Research Fellow (SMTC)
10 years (Oct 2020)

Ms Isabelle Wong Yuet Mun
Snr Asst Manager (R3C)
10 years (Aug 2020)

Mr Michael Gan Wun Hui
Research & Projects Dev Manager
(NEWRI Technology Development)
10 years (Aug 2020)

SGUnited Initiative

NTU announced a relief package to provide financial support for students affected by the pandemic. Additional initiatives were announced to help graduating undergraduates find employment. Under the relief package, NTU has established a S$2 million OneNTU Fund to support Singapore citizen and PR students "who need immediate assistance due to the COVID-19 outbreak".

In light if the current economic uncertainties, and weak job market since 2019, SGUnited Traineeships Programme (SGUT) was initiated. It aims to provide provides traineeship opportunities to those who have recently graduated or will soon be graduating from tertiary education institutes. These traineeships provide eligible graduates with valuable work experience, allowing them to gain a firmer foothold in the job market during the economic recovery.

At NEWRI, we are also contributing and have 10 trainees awarded. We have 1 trainee joining us (beginning in Sep 2020 for SMTC. and 9 others posts pending applications.

https://www.channelnewsasia.com/news/singapore/covid-19-coronavirus-universities-aid-jobs-nus-ntu-graduates-12672154

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