30 June 2021 (Wednesday)

6.00pm-6.30pm (SGT) (GMT +8)
Poster Session 6

Degradation Of Carbamazepine By UVA-LED/WO3/peroxydisulfate Process: Effects Of Light Wavelength And Water Matrix

D. Han, J. Hu. National University of Singapore (Singapore)

Carbamazepine (CBZ), a widely used prescription drug for seizure treatment, has been frequently detected in effluents from wastewater treatment plants due to its high recalcitrance to conventional wastewater treatment processes. In this study, an advanced oxidation process -- UVA-LED/WO3/peroxydisulfate process -- was applied to degrade CBZ. The effects of light wavelength and water matrix on CBZ degradation was investigated. The results of this study indicated that UVA-LED/WO3/PDS process was a powerful and promising process for CBZ degradation.

Design Features And Initiatives At Tuas Water Reclamation Plant

ZE. Lim. Public Utilities Board (Singapore)

The Tuas Water Reclamation Plant (WRP) will be the largest Membrane Bioreactor (MBR) treatment facility in the world, treating up to 800,000m3/day of used water with a 30% more compact footprint compared to conventional WRPs. Domestic and Industrial used water will be treated in two separate liquids treatment modules and further purified to NEWater and Industrial Water respectively. Sludge produced will be treated in a common Biosolids treatment facility. With the adoption of MBR technology, higher treated effluent quality can be produced and discharged via near shore outfall in a responsible manner. The Tuas WRP will be co-located with the National Environment Agency's Integrated Waste Management Facility (IWMF) to harness potential synergies in the water-energy-waste nexus. This paper focuses on highlighting the Tuas WRP Process Design and its co-location synergies along with the SMART initiatives which leverage on technology enabling tools to improve performance of used water treatment.

Design Methodology for Next-Generation Smart Water Quality Analyser System in Water Supply Network

D. Yong, MH. Teh, KK. Toh, CW. Lim, ZY. Ye. PUB (Singapore)

Water quality, pressure and flow monitoring has historically been conducted by constructing permanent sensor installations. There is a need for mobile instrumentation units to support transient, short-term operations and monitoring purposes for the Water Supply Network island-wide. This will drive agnostic decision support capabilities. PUB and Flotech Controls have entered a joint collaboration to develop a comprehensive island-wide mobile instrumentation scheme covering a suite of monitoring capabilities integrated with the smart water grid. The mobile instrument station was designed to overcome operational challenges by addressing design objectives on reliability, mobility and application. Experimental results show that key design considerations in sensor selection, station configuration and panel design allow for a robust integration of the mobile stations to the smart water grid. A successful program for storage, deployment and sustainable use in the field has allowed PUB to conduct real-time ad-hoc monitoring of water quality across the entire Water Supply Network.

Developing A Novel Non-Invasive Method For Imaging Of Flow Profile Using Ultrasonic Flowmeters

Q. Yi, MH. Teh, RA. Ooi, MR. Mohd Akip. PUB (Singapore)

Ensuring good flowmeter accuracy is an important tenet in PUB Water Supply (Network)'s Non-Revenue Water (NRW) management strategy to allow for accurate accounting and for mass balance. Two important factors to ensure flowmeter performance are its site installation conditions and a well-developed ideal flow profile similar to that encountered in the calibration test-rig. This project has developed a novel non-invasive method of investigating and classifying flow profile characteristics within the pipeline which can be used to determine impacts on flowmeter accuracy. Using multi-path data from clamp-on ultrasonic flowmeters (USFM), mathematical algorithms were designed to determine the type of flow profile within a pipeline. An application was then developed using these algorithms to allow the user to obtain important flow characteristics and visualise possible flow profiles.

Development Of 3D Visualization Platform For Compound Flooding and Transport Resiliency In Coastal Cities

P. Yang, AW. Law, F. Zhu, H. Ho, VST. Sim, X. Wu, Y. Liang, JH. Loh, H. Chan, D. Chitwatkulsiri, KN. Irvine. Nanyang Technological University (Singapore)

Coastal cities around the world are increasingly facing the threats of compound flooding, caused by intense rainfall events due to global climate changes coupling with extreme storm surges and sea level rise. Direct visualization of the predicted impacts due to compound flooding can provide useful insights to effective flood resiliency solutions for city planners and government officers. In this project, a 3D visualization platform is developed which integrates the layers of assessment data, including coastal storm surges and sea level fluctuations, inland flood simulations and transportation processes in order to assist non-experts with an authentic view of the urban infrastructure alternatives and enable real-time operational decision-making and evacuation activation with flood control strategies. The usefulness of the platform is demonstrated in two ASEAN study sites, the first in the province of Samut Prakan, Thailand and the second at Vung Tau, Vietnam.

Direct-coupling UF-RO Desalination Plant; A Keppel Marina East Desalination Plant Perspective

AL. Lim, F. Knops, PT. Tay, EK. Goh, YX. Chua, CL. Lee. Pentair Water Asia Pacific Pte Ltd (Singapore)

The Keppel Marina East Desalination Plant (KMEDP) is the first desalination plant in Singapore to adopt direct-coupling UF-RO (DC-UF/RO) design. While DC-UF/RO plants have existed in plants in Europe, Middle-east and Australia, it is uncommon for East and Southeast Asia. This poster aims to provide a comparison of DC-UF/RO desalination against conventional UF/RO desalination plant design from the perspectives of KMEDP. It will compare the pros and cons of DC-UF/RO in general; and the decision of adopting DC-UF/RO design at KMEDP. The startup and operational challenges of DC-UF/RO coupled to the dual feed source operations at KMEDP is discussed. Lastly, recommendations are made on the use of DC-UF/RO design for future plants based on the KMEDP experience.

Integrated Anaerobic Fixed-Film MBR-Reverse Osmosis-Chlorination Process: An Environmentally Sustainable Approach For Reclamation Of Municipal Used Water

S. Wang, Y. Liu, H. Liu, J. Gu, M. Zhang. Nanyang Technological University (Singapore)

Nowadays, the reclamation of municipal used water to high-grade water (e.g. NEWater) has been widely accepted as a feasible alternative to achieve water sustainability. However, there may be some room to further improve the current NEWater production line in terms of energy consumption and excess sludge production. To address these emerging issues, an integrated anaerobic fixed-film MBR (AnfMBR), reverse osmosis (RO) and chlorination process was developed for producing high-grade product water from municipal used water. It turned out that the product water could meet typical NEWater quality in terms of TOC, ammonium, phosphorous, chlorine and other major ions, with net energy consumption estimated to be 0.30 kWh per m3 product water. Consequently, this study may open a new window for reclamation of municipal used water to high-grade product water with reduced energy consumption and negligible excess sludge production.

Macro-patterning Of Micro-crumpled Nanofiltration Membranes By Spacer Imprinting For Low-scaling Desalination

C. Shang, S. Zhang. National University of Singapore (Singapore)

Surface patterns provide a chemical-free approach to reduce fouling by mimicking nature, and are yet limited by their complicated fabrication procedures. Here we develop readily scalable methods to create sub-micrometer- and millimeter-scale patterns on membrane surfaces for low-scaling desalination, with a focus on the anti-scaling mechanism. Specifically, a robust polyethylene (PE) lithium battery separator prepared from melt casting and stretching has been used as the support for nanofiltration (NF), giving micrometer-scale crumples on the surface. Then the PENF membrane is imprinted by permeate spacer during tests, leading to millimeter-scale patterns. A comparison of the impact of different feature sizes on scaling, ranging from smooth-, nm-, µm- and mm-levels, was given through no-stirring dead-end and crossflow tests. Results indicate that µm-scale patterns are resistant to scaling through both spatial and hydrodynamic effects, and mm-scale patterns are also effective in reducing scaling solely due to hydrodynamic effects.

Maximizing RO Recovery At The World's Largest Potable Reuse Plant

M. Boyd, M. Plumlee, H. Gu, J. Lozier, M. Hwang. Desalitech (United States)

The Orange County Water District (OCWD) Groundwater Replenishment System (GWRS) is the world's largest potable reuse plant, treating secondary effluent to produce purified water for groundwater recharge as a drinking water supply augmentation and for injection into coastal wells that form a barrier to prevent seawater intrusion. Currently the GWRS has a production capacity of 100 million gallons per day (MGD), with the existing three-stage, 85% recovery reverse osmosis (RO) system generating 18 MGD of RO concentrate that is discharged to the ocean. Upon completion of the final GWRS plant expansion in 2023, full production capacity will increase to 130 MGD while the RO concentrate flows will increase to 23 MGD. To further increase GWRS purified water production, OCWD has been pilot testing CCRO for two years to recover additional water from the RO concentrate and generate a new water supply for the region. This paper summarizes the long-term results.

Polyamide Thin Film On PTFE Hollow Fibres For Nanofiltration

JY. Chong, G. Yang, H. Yi, L. Du, R. Wang. Nanyang Technological University (Singapore)

Polytetrafluoroethylene (PTFE) is an excellent material for membrane applications due to its highly inert property. However, it is still challenging to produce PTFE membranes with small pore size (<1 nm) for nanofiltration. In this study, nanofiltration PTFE hollow fibres were successfully synthesized by coating a polyamide thin film layer on the inner surface. Surface modification was first carried out to improve the hydrophilicity of the PTFE substrates, followed by the synthesis of polyamide through interfacial polymerization. This simple coating method can effectively transform commercially available microfiltration PTFE substrates to high value nanofiltration membranes. The prepared polyamide-PTFE composite membranes showed good permeability for both water and organic solvents, and had a small MWCO of ~350 Da in water. This highly stable membrane can potentially be used in applications involving harsh conditions such as organic waste treatment and organic solvent nanofiltration.

Regional Water Security Study (RWSS): Defining No-regret Measures And Investments To Sustainably Improve Water Security In The Short And Medium Term In The Yangon Region In Myanmar

T. Huizer, R. Steijn, J. de Groot, D. Spaans, H. Nandar Aye. Arcadis (Netherlands)

Yangon Region, the former capital and fast-growing economic engine of Myanmar is facing various water related challenges. Coastal and riverine flooding, saltwater intrusion and insufficient water supply for public, commercial, industrial, and agricultural use jeopardize sustainable future growth of the area. As part of the Regional Water Security Study (RWSS), three interlinked investment programs were developed that aim to secure the future water security in the Greater Yangon Region. The regional water system was analyzed with the use of a specially developed hydrodynamical model (Delft3D FM), which also served to study the cumulative impact of proposed or new measures. The programs with measures are focusing on Weakest Link Strengthening (hotspots for embankment improvements and flood protection), Freshwater Supply in the rural areas and Drainage System Improvement.

Strategy For Phosphorus Recovery And Wastewater Treatment In Amsterdam

M. Amosov, JP. van der Hoek. Organic Village (Netherlands)

The wastewater chain in Amsterdam offers an opportunity to recover up to 100% of phosphorus (P) per year, versus 47% currently recovered. For water boards, like Waternet, it is difficult to scale-up centralised, decentralised or hybrid P-recovery solutions. Because widely-used methods like Total Cost of Ownership, Mass Flow and Life-Cycle Analysis are limited in providing systemic assessment of risks and propagation among linked stakeholders e.g. municipalities, customers. The Multi-Domain Mapping Model was applied to evaluate risks propagated by four scales of P-recovery solutions - city, block, house, hybrid - onto infrastructure, stakeholders and resources in the region. Change Propagation Indicator showed that centralised solution creates a system where Waternet is the Top-Absorber of risks/costs; and customers are Multipliers. Scenario with house-scale solution shifted risks from Waternet, indicating potential value models with other actors e.g. utilities, biotech startups, citizens, business. Scenario comparison allowed deriving system-wide patterns and change management strategies for identified actors. The developed toolkit allows integration - analysis of new data.

WOW! - A New Business Approach For Resource Recovery From Sewage

S. Venditti, J. de Best, G. Kolisch, A. Christen, J. Hansen, K. Bijl. Regional Water Authority Vallei en Veluwe (Netherlands)

Did you know that even used toilet paper can get a second life? Sewage contains valuable substances that could be used as circular raw materials for biobased products. The WOW! project aims to capitalise on these opportunities and work towards a more circular approach. We do this by a) demonstrating the technical feasibility for recovery & upcycling techniques for cellulose, lipids and PHA from sewage, b) Investigating the market potential and creating five high potential value chains for raw materials and c) addressing policy barriers for the circular uptake of raw materials from sewage. Preliminary results are promising. So far we successfully produced biobased products from sewage and are currently upscaling the pilots. Furthermore, current market potential shows that the markets for biobased alternatives for conventional products are increasing. Current national and European legislation however doesn't always permit the reuse of raw materials from sewage.