28 June 2021 (Monday)

6.00pm-6.30pm (SGT) (GMT +8)
Poster Session 4

An Effective Measure For Evaluating Sewer Condition: UAV Screening In Comparison With CCTVs And Manhole Cameras

H. Ikeda, Y. Inagaki, PK. Takeuchi, Y. Yato. NJS Co., Ltd. (Japan)

NJS has searched for a way to inspect sewer pipes efficiently and considered a focus on UAV (Unmanned Aerial Vehicle) to be beneficial. However, one that could stably fly through a confined space, such as a sewer, did not yet exist. Hence, NJS decided to develop a UAV for this purpose. To evaluate the performance, an actual sewer section has been inspected. The result shows that the UAV is capable of inspecting more than 1,000 m a day without personnel needing to enter a manhole. The team has also inspected the same section by CCTV and manhole camera to compare the inspection speed, operator's safety and the reliability of data. From the obtained result, it can be said that UAV is an effective screening method to efficiently conduct CCTV inspection, in other words, to prioritize the sections that need a detailed inspection.

An Integrated Countercurrent Two-stage Adsorption And Membrane Separation Process For Decontamination Of Radioactive Iodide Water

X. Zhang, Y. Liu, G. Zhang, P. Gu. Tianjin University (China)

Nowadays, radioactive iodine has been widely employed in medical diagnosis and treatment, which may enter the aqueous environment after such medical applications. In addition, radioiodine has been detected in surface water, drinking water, and seawater in Japan after the accident of the Fukushima nuclear power plant. Faced to such an emerging situation, innovative technology for quickly and adequately treating radioactive iodine-contaminated water is urgently needed, and strategically it should serve as a technology reserve. Therefore, an integrated countercurrent two-stage adsorption and membrane separation process was developed by combining the advantages of enhanced adsorption of soluble radioiodide and membrane filtration for solid-liquid separation. For this purpose, a novel tailored-designed adsorbent was prepared and used. It turned out that about 90% of radioiodide ions could be removed in the integrated system, with less generation of radioactive waste. It is expected that this study may provide a promising technological approach for handling radioactive iodide ions present in various kinds of radioactive waters.

Automated Micro-invertebrate Detector

L. Lei, Y. Du, M. Tay. NM3 Tech(s) Pte Ltd (Singapore)

Micro-invertebrates such as copepods, cladocerans, nematodes, rotifers and chironomids etc. are ubiquitous in raw water and these micro-invertebrates are monitored as part of the water quality programme by PUB. The monitoring for these micro-invertebrates are usually done through manual analysis under the microscope and requires trained and skilled expertise. An automated micro-invertebrate detector with image analytics capabilities is developed to meet this monitoring requirement. This system provides a new approach to achieve automated, continuous online monitoring with the advantages of being manpower-saving, lower cost, faster, accurate and potentially able to monitor chironomid larvae.

Case Study For The Implementation Of A Digital Solution To Optimise Wastewater Treatment Plant Operations

CMJ. Hui, WPA. Yuen, M. Wu, SZ. Goh, M. He, E. Leow. Sembcorp Utilities Pte Ltd (Singapore)

Virtual Brain (VB) is an intelligent operations management system for process prediction and troubleshooting. Developed by Sembcorp, it allows for centralised monitoring and control of Sembcorp's water facilities around the world. This paper provides an overview of the different modules that make up the product, as well as the implementation efforts in multiple wastewater treatment plants in a timeframe of six months. These digital initiatives allow for efficient management of existing and future assets and optimise monitoring capabilities. Using machine learning and data science modelling, predictive accuracy of up to 80% is achieved. This has also been implemented across all Sembcorp China and Singapore water and wastewater treatment plants in 2019.

Conserving Freshwater From Existing Cooling Tower Water System Via Indirect Supplemental Seawater Cooling

BS. Ee, L. Ng, CK. Eu. Petrochemical Corporation Of Singapore (Singapore)

The Company applied its initiative of supplemental seawater cooling via a cascade loop to cool the hot returning cooling water of its existing cooling tower water system to reduce the evaporative loss of fresh water. This retrofitting project does not require any change in the existing heat exchange equipment as the same cooling tower water is flowing through the existing equipment. It not only conserves substantial quantity of fresh water in making-up to the cooling tower, but also eliminate the concern of metallurgy of using seawater to the existing facilities. The same model can be applied to other similar cooling tower water systems whether large or small that has accessed to seawater. The conservation in fresh water by this initiative will translate to less investment in energy intensive desalination facilities for carbon savings. The main hurdle will be the investment in the once-through seawater supply and return-back-to sea infrastructures.

Effect of Data Quality on AI Prediction Capability in WWTPs

E. Ekklesia, A. Sipila, T. Koskinen, S. Pattanayak. Ramboll (Singapore)

Most wastewater treatment plants (WWTPs) adopt reactive approach towards process abnormalities. An artificial intelligence (AI) based preventive tool is being developed for accomplishing proactive operations and decision making in WWTPs. The Platform is based on prediction-solution-guidance structure. Initial trials have found that typical WWTP data are suitable for the Platform algorithm. Moreover, the developed algorithm was able to predict targeted next-day effluent quality parameters, such as phosphorus, ammonia, chemical oxygen demand (COD), nitrate, and sludge volume index (SVI), with promising accuracy. An Early Warning Index (EWI) has been developed for the Platform to evaluate effectiveness of the prediction algorithms to prevent discharge limit violations.

Estimating The Cost Of Climate Change To Water Utilities In Victoria, Australia

K. Karunaratna. Marsden Jacob Associates (Australia)

Climate change has a significant influence on the operations of Victorian water corporations. Victoria's climate has become drier and warmer over the past few decades and water corporations were severely impacted by the recent Millennium Drought. This study provides a consistent approach that can be used by water corporations to quantify the cost of climate change under the BAU pathway. Understanding the cost of climate change for BAU pathway allows water corporations to make investment decisions and select suitable adaptation pathways that are more economically efficient than BAU. The framework; * focuses on financial costs incurred by the water corporations, * considers costs in short, medium and long term, * identifies the BAU expenditure pathway and current climate scenario, * identifies suitable climate change scenarios to be tested as per the guidelines developed by CSIRO, * provides a risk based approach for quantifying the costs of climate change, adapted to suit water corporation activities; * identifies a consistent approach for establishing the levels of service delivered

Green Deep Eutectic Solvents For Pulp And Papermaking Industry

LY. Ee, S. Li. National University of Singapore (Singapore)

The study into preparation and characterization of cellulose prepared by deep eutectic solvents (DES) facilitate a deeper understanding of their favourable characteristics such as low cost of preparation, environmentally-friendly and high degree of cellulose dissolution that show great potential as cost-effective and sustainable solution in the pulping process for papermaking industries. Herein the conference paper, we compare the effectiveness of biomass fractionation using alkaline treatment to shadow kraft process and using prepared choline chloride (ChCl)/urea binary DES. The treated cellulosic fibers are then characterized with Fourier-transform infrared spectroscopy (FT-IR), X-ray diffraction and Scanning Electrion Microscopy (SEM) to investigate possible difference in their physicochemical properties. From the study, it was found that molar ratio of 1:2 for ChCl/urea DES was most suitable for the treatment of biomass due to its lower viscosity and hence ease of mixing that would lower cost in industrial scale.

High Recovery RO In Potable Reuse Applications

U. Erdal, Z.Erdal. ARCADIS (United States)

Reducing RO concentrate flows generated from RO based advanced treatment facilities has become a major interest of agencies located in inland areas where a surface discharge of RO concentrate is not possible. To meet this objective, many agencies are considering incorporating a high recovery RO concept into the design. However, depending upon nature of secondary treatment provided at the wastewater treatment plants, high recovery RO may pose challenges to satisfy nitrogen discharge limits in certain potable reuse projects. The findings of this paper are highly valuable for agencies, regulatory agencies, consultants and individuals who are considering a high recovery concept while meeting very stringent nitrogen limits in IPR via reservoir augmentation projects.

Improvements In Ceramic MBR System For Industrial Used Water To Achieve Higher Operational Stability And Energy Efficiency

SC. Lee, N. Hiroshi, Q. Yin, T. Xia, T. Niwa, W. Lay, SC. Chua, L. Yu, SL. Lim, MJ. Nassir, G. Tao, C. Gudipati, ST. Ooi, A. Dhalla. Meiden Singapore (Singapore)

Performance tests for new-type of membrane, new-design cassette, new MC regime and mew membrane aeration methods were carried out by using two cassettes in a membrane tank of the 1-MGD MEMO plant at JWRP. New-type membrane has new active layer with higher water permeability. Tubing between permeate pipe and membrane was removed and they were directly connected for the new-design cassette. Larger permeate pipe was also used for new design. Intermittent dosing of hype was used for new MC regime, which resulted in lower chemical consumption with longer soaking time. Intermittent membrane aeration was tested to reduce energy. Stable operation was achieved for these new items and methods. It was estimated that more than 30% of operating condition can be reduced with new items and methods.

Inactivation of methicillin-resistant *Staphylococcus aureus* by Chlorination, Chloramination, UVC irradiation , and UVC based advanced oxidation processes

S. Ghosh, L. Wang, Y. Chen, S. Peng, Q. Cai, and J. Hu. Department of Civil and Environmental Engineering, National University of Singapore (Singapore)

The extensive application of antibiotics around the world is fostering the development of antibiotic-resistant bacteria (ARB) and antibiotic-resistant genes (ARGs). Presence of ARB and ARGs in the drinking water treatment system has been identified by various researches. Therefore, removal of ARB and ARGs at drinking water treatment plants has become a significant issue to protect human health. This study assessed the removal efficiency of three commonly used disinfectants (free chlorine, mono-chloramine, and UVC) to inactivate E. coli TOP10 carrying sulfonamide resistant sul1 genes. The inactivation rate was faster for UVC whereas the chloramine was the least efficient among the three treatment methods. This study also evaluated the impact of various operating conditions such as pH, turbidity and natural organic matter (NOM) on disinfection performance. An effort has been made to develop the disinfection kinetics for chlorination and UVC for ARB removal.

Inter-Basin Water Transfer - Planning To Implementation Solution To Water Crisis In India

U. Joshi. Xylem Water Solutions India Pvt. Ltd. (India)

Year 2019 is a going to be a very critical and decisive year for India in terms of their water infrastructure. We will see many water related problems in different parts of India that have a geographical dis-advantage. Sixty percent (60%) of the population will live in urban areas by 2030, which will greatly increase the stress on water resources. The solution to various issues depicted above is to have a Smart Basins (smart, inter connected, sustainable water network) which serves the growing needs of the nation, with drinkable water at the taps and abundant water for agriculture and urban living. There are three phases to create smart basins. 1. Planning, 2. Execution and 3. Maintenance (Sustainability). The planning phase include the understanding the changes in geographic area over the years, Changes in Rain fall patterns, negotiated catchment area depiction, etc. The execution phase will be critical where rejuvenation and creation on basins, connectivity, creating buffer zones will be part of this challenge. The maintenance phase will ensure sustainability of solution.

Management Of Anion Exchange Spent Brine Through Secondary Products Creation: Humic Substances And NaCl

E. Vaudevire, J. Post, W. van der Meer, I. Daniel. PWNT (Netherlands)

This paper highlights the main discoveries from six years of R&D effort toward developing a treatment solution for a waste brine from a drinking water plant using anion exchange for natural organic matter (NOM) removal. Due to the nature of NOM in the brine i.e. humic (HA) and fulvic acid (FA), which find a number of applications in the agriculture industry, their recovery as a secondary product was assessed on pilot scale; in addition to the recovery of monovalent salts for onsite recycling. The research considers the technologies for secondary product extraction, the potential application of HA and FA and the regulatory quality requirements.

Phytoplankton Monitoring Based On Deep Learning

H. Liu, Y. Wang, H. Liu, S. Hu, Y. Peng. Zweec Analytics Pte Ltd (Singapore)

Phytoplankton, or planktonic algae, are the main primary producer in water bodies, and their quantity, species, and distribution have a decisive influence on the aquatic ecosystems. Regular monitoring of phytoplankton in terms of identification and enumeration is an important means for the diagnosis and maintenance of aquatic ecosystem's health. However, currently, the frequency and timeliness of such monitoring by manual microscopic examination method are limited severely by a shortage of algae identification professionals. Harnessing the recent progress Deep Learning, we are developing an intelligent planktonic algae recognition and counting system using microscopic images from the Yangtze river basin as a training database. The preliminary training and test on 6 common freshwater algae genera reached a recognition accuracy of 76%, which proved that the deep learning-based phytoplankton monitoring is practical and can evolve to solve the manpower problem in this field.

Potable Water Reuse: Communication As A Policy Instrument

C. Tortajada, I. Bindal. Lee Kuan Yew School of Public Policy, National University of Singapore (Singapore)

All over the world, there is an increasing demand for water available in the necessary quantities and qualities for growing numbers of uses and users. Water resources, however, are every time scarcer, and more polluted, mismanaged and misgoverned, limiting the amount of water that can be provided for any use. With extreme events resulting from climate variability and change, coupled with population growth, the availability of water has become a serious concern globally. Based on several case studies, this presentation discusses the potential of reused water for potable purposes to become a feasible source of water supply for domestic use.

Process Intensification By Using Hybrid Integrated Fixed Film - Membrane Bio Reactor (IF-MBR) For Treatment And Reuse Of Refinery Wastewater

SK. Chee, G. Wu, KP. Chiu, K. Khoo, C. Koh, HQ. Li, SK. Woon. AECOM (Singapore)

Refinery wastewaters can be difficult to treat due to the inherent variability of the inlet streams which contain difficult to treat compounds. The conventional processes typically require a large footprint and suffer from operational problems leading to environmental non-compliances. The Hybrid Integrated Fixed Film Membrane Bio Reactor (IF-MBR) combines the benefits of both IFAS and MBR into a more compact and robust treatment process. The IF-MBR process can achieve a high resistance to organic and hydraulic shock loadings due to the fixed film process and provides process flexibility with total solids retention with the membrane system, all within a much smaller footprint than a standalone MBR or IFAS-Clarifier process. A pilot plant is currently being operated to validate the concept using actual wastewater from the refinery. The results are expected to validate the main design parameters of the IF-MBR system.

Project Implementation And Strategies For Design, Procurement And Implementation For Upgrading Of Online Large Scale Water Treatment Plants Development Projects

R. Salenga, N. Lethan, S. Moore. Maynilad Water Services Inc (Philippines)

This work focuses on development of project management strategies, methods, and tools to be applied for rehabilitation, retrofitting and process improvement of large scale water treatment plants. We emphasize on the application and implementation of asset management approach in examining the plant's condition and performance and development of risk management tool to monitor risks in all project's phases. We define the entire project duration into three phases: Engineering Phase is the phase when conditional assessment of plant's assets is conducted that serves as input for generating conceptual reference design; Procurement Phase is duration of tendering and selection of prospective bidders; Construction Phase is phase when detailed design work done by the selected Contractor shall be realized and subsequently put into physical installation and construction works.

Rethinking Urban Resilience: The Impact Of The COVID-19 Pandemic On Urban Water Resilience

P. Dircke, D. de Weerd. Arcadis (Netherlands)

COVID-19 has brought into sharp focus how unprepared cities around the world were for the impact of a pandemic. There currently is a window of opportunity to use the COVID-19 pandemic experiences to rethink urban resilience. To maximize this opportunity this paper depends on a throughout literature review and the expertise and experiences of Arcadis consultants from around the world. From this various important new and reaffirmed insights can be gained with regards to urban resilience in general and urban water resilience. While in recent years water resilient cities approaches and water sensitive design (both climate resilience related) have already gained momentum both in academia and in practice, the pandemic reaffirms their importance. The pandemic has highlighted the importance ensuring urban water resilience through appropriate sensitive urban design to prevent crisis-on-crisis situations, provide public shared blue-green space, and to bring back the balance between natural and engineered processes.

Soft Sensing Of Water Depth In Combined Sewers Using LSTM Neural Networks

R. Palmitessa, M. Borup, PS. Mikkelsen, WKA. Law. Nanyang Technological University (Singapore)

We investigate the efficacy of LSTM neural networks as a soft sensing tool to perform gap filling in scenarios of missing or limited antecedent observations. Particularly, we compare the prediction accuracy of different LSTM networks: i) without knowing the antecedent water depth, ii) with different gaps in the antecedent observations and iii) with different amounts of training data. We present and discuss results obtained from a large set of real observations from a combined sewer in Copenhagen, Denmark. The results showed that the prediction error significantly decreased when the antecedent observations of water depth were used as input. For gaps longer than 30 min, the LSTM neural network was capable of exploiting the rainfall data to generate a better prediction than a naïve model. When the model relied solely on the rainfall data, longer learning periods improved the prediction accuracy.

Wet Chemical Analyzer With Minimum Reagent Consumption

F. Honold, M. Rosenauer, P. Rauch, R. Schuhmacher, U. Franke, N. Leiprecht. Xylem Analytics Germany GmbH (Germany)

Sensors and analyzers are essential for providing information on monitoring and treatment of water. Devices like optical oxygen sensors do not consume reagents. But there are parameters like phosphate and others, which require a wet chemical analyzer in order to convert the interesting molecules into a detectable measurand. So far bigger and unwieldy amounts of chemicals were needed to operate such instruments. A new type of analyzer has been developed which reduces the reagent volume down to 5 µL and daily consumption to less than 1 mL. Additionally lifetime of reagents could be improved up to two years simplifying the handling for users distinctly. Also the amount of waste is minimized and its collection and orderly disposal is possible now. Small bags enable harmless handling of reagents.