

29 June 2021 (Tuesday)

6.00pm-6.30pm (SGT) (GMT +8)

Poster Session 5

A Comparison Of Real World And Modeled Performance For An Osmotic Brine Concentration System -- Defining The Process Window

A. Al Amoudi, E. G. Beaudry, S. Ihm, J. E. Tracy, N. Voutchkov (United States)

A novel, membrane based water treatment process has been developed and deployed in pilot and commercial projects, based on the principals of osmotically assisted reverse osmosis (OARO). The economics of this process, defined as the combination of process flow capital cost and process flow operating cost, are such that a higher level of water recovery, beyond that of reverse osmosis stages alone, can be justified in many more cases. This paper will study the economics of several operating cases, and offer guidance on the process window within which the technology offers strong value for providing higher levels of fresh water recovery from industrial effluent streams.

A Solution to Cyanobacterial Blooms: Insights from Thousands of Field Applications Using the Lake Guard® Technology

M. Harel. BlueGreen Water Technologies (Israel)

Cyanobacterial blooms are bacterial infections of waterbodies that, when left untreated, as most of them are, can intensify from year to year, destroying the ecological fabric, and contaminating the water to the extent that prevents its safe use. For years, cyanobacterial outbreaks have been regarded as if they were acts of God that cannot be avoided or contained, while they continued to jeopardize the livelihoods and health of hundreds of millions of people by impeding their access to clean water.

Clean Water And Sanitation: Laguna Water's Experience In Ensuring Safe And Reliable Water To 500,000 People In Laguna

M. Alcasid, V. Rivera. Manila Water Company (Philippines)

Eighty percent of World mega cities in Asia are highly dependent on groundwater. In the Philippines, groundwater resources supply the water needs for most households, agricultural activities, and industrial processes, among others. However, even with the abundance of the country's groundwater source, different raw water quality issues still exist. Considering the dependence of most households on groundwater for drinking water, protecting its quality is critical to ensure safe and reliable water supply. In exerting all its effort to provide safe and potable water to almost 500,000 residents of Laguna, Laguna Water, being the largest groundwater service provider in the Philippines, faced various challenges to address raw water quality issues of groundwater sources. This paper focuses on the raw water quality concerns encountered in Prima Casa, Binan and Victoria, both located in Laguna. This also aims to discuss subsequent strategies and technologies including Catalytic Water Filtration and Nanofiltration used by Laguna Water to address these challenges which could help other countries in Asia in coming up with sustainable solutions in the use of groundwater sources.

DeCalon™ Ultimate Solutions For Cooling Water Management

BK. Ng, Innovative Polymers P|L (Singapore)

DeCalon™ (DCI) is a revolutionary approach to eliminating scale, controlling corrosion and bio-fouling in cooling water systems. Through applied electro-chemistry and a patented intelligent controller, DCI removes water hardness from cooling systems without the need for hazardous chemicals. The innovation provides a green solution to scaling and corrosion in HVAC systems and industrial chiller. The DCI system removes existing scale and prevents further scale formation. SiO₂ is also removed along with the hardness. The system ensures heat transfer efficiency is maintained at all times and the requirement for routine shut downs and chemical descaling is no longer required. Water blow-down quantities are also substantially reduced. In addition, Legionella and heterotrophic bacteria counts of less than 10 and 100,000 CFU/ml respectively will be maintained at all times and corrosion for copper of less than 1 mpy (mil per year) and carbon steel of less than 3 mpy can be well controlled.

Demineralization-Remineralization Dynamics In Water

SY. Chew. Pro-health Water Technologies Pte Ltd (Singapore)

Mineralization is a dynamic, complex, lifelong process to control precipitations of inorganic nanocrystals within organic matrices to form unique hybrid structures, for example, hydrogen atoms, oxygen atoms and water molecules. Understanding the process of mineral deposition is important for the developments of treatments for mineralization of water and also for the innovation and development of water. This review provides an overview of the possible mechanisms and the factors implicated as agonists and antagonists of mineralization. Then, the role of calcium, magnesium, potassium, sodium and sulphate ions in the maintenance of health and well-being is described. The new technologies of reversing through demineralization and boosting remineralization in water are discussed. Turning these new technologies to products and practices would improve health care and well-being worldwide.

Disruptive Quantum Water Filtration Technology "QTI"

P. Marconi. Wiracocha (China)

Qti is a new quantum technology of water filtration. No loss of water, no plastic waste, keeps mineral salts, reduces salt and the main pollutants: bacteria, pesticides, endocrin disruptor, heavy metals, arsenic 3 & arsenic 5, antibiotic, tritium and uranium. The refills consist of carbon tube; fill with different component, which are returned to the laboratory for analysis and recycling. See video: Leautus Home tap water testing <https://www.youtube.com/watch?v=fkwT0dtOeKw> Global warming and melting glaciers will cause rising waters and submergence of coastlines and infrastructure. The technology is ready to remove salt from water. This technology can be implemented in different portable or fixed machines, it does not require a connection to the network. It is a mini autonomous filtration station.

Effect Of The Home Improvement Programme On Residential Water Consumption In Singapore

M. Fan, S. Agarwal, E. Araral, Y. Qin, H. Zheng. Lee Kuan Yew School of Public Policy, National University of Singapore (Singapore)

Water efficient appliances play an important role in water conservation in Singapore and worldwide. To evaluate the effectiveness of these appliances, water utilities and researchers alike have mostly relied on small-scale randomized control trials with uncertain external validity. In this paper, we evaluate a nationwide program, the Home Improvement Programme (HIP) with an optional upgrade of toilets and water taps, to provide insights on the effect of the installation of more efficient appliances on residential water consumption.

In Singapore, close to 80% of the population lives in public housing developed and managed by the Housing and Development Board (HDB). There are more than one million HDB flats, some of them built in as early as 1960s. HIP is an upgrading program, introduced in 2007, to resolve common maintenance problems of aging HDB flats. As of December 2019, 55% of all HDB blocks were eligible for HIP, out of which 56% had been or were being upgraded. Using monthly water billing data for all households residing in HDB flats from 2011 to 2019, we will employ a staggered difference-in-difference regression approach to evaluate the average treatment effect of HIP by comparing the monthly water consumption by flats that completed HIP before and after the upgrades with the consumption by flats that are not being upgraded. We will further study the evolution of the treatment effect over time and the heterogeneous effect on housing characteristics and consumption quintiles. Last but not least, we will investigate how the effect of water efficient appliances interacts with climate change and extreme weather events.

Enabling Operational Efficiencies Through Decision Intelligence In The Water Supply Network Of Singapore

M. Iqbal, A. Preis, KC. Lai, SF. Hew, JK. Pang, N. Lim. Xylem (Singapore)

This paper describes how the smart water system has evolved to support two main applications: (i) online management of response to incidents in the pipe network and (2) planning dashboard to assess performance of the network for targeted management. The enabling technology for these two applications is the digital twin of PUB's pipe network. The digital twin incorporates an online calibrated nationwide hydraulic model that allows accurate simulations of operational scenarios (e.g., valve closure, hydrant flushing, and demand change), water age/TRC prediction, water quality source tracing and a framework that assesses the performance of the network from various singular or composite perspectives such as material, age, customer complaints, pipe fatigue due to surges, thereby allowing targeted rectification for day-to-day operations as well as long-term planning.

Field Experiment On SMS And Household Water Conservation

M. Nakajima. Lee Kuan Yew School of Public Policy, National University of Singapore (Singapore)

Information campaigns have long been adopted as a tool to promote water conservation in many countries. Short Message Service (SMS) is a recently emerged tool used in information campaigns which can reach a broad target at a low cost. This study conducts a field experiment to investigate the effect of messages delivered via SMS about one's weekly water use on household's water conservation behavior. By combining the weekly water consumption data with household level data, the analysis can identify how household characteristics affect water conservation through the weekly SMS about water use. The findings from this study can provide valuable insights into the expected effect of information campaigns through mediums like SMS in the field of resource conservation.

Financial District And Seaport Climate Resilience Master Plan: Building A Comprehensive Resilience Strategy For Lower Manhattan

R. Deitz, E. Hutchinson. Arcadis (United States)

In October 2012, Hurricane Sandy hit New York City and exposed Lower Manhattan's vulnerabilities to climate change. To reduce flood risk to the Financial District and Seaport, NYC Economic Development Corporation retained the Arcadis-led consultant Team to study climate adaptation strategies for both neighborhoods. This work is part of the City's broader strategy to invest over \$500 million in capital projects in Lower Manhattan beginning in 2021. Given the unique convergence of climate risk and physical constraints, it is critical to examine both on-land and in-water solutions (i.e., extending the shoreline of Lower Manhattan) to implement a comprehensive resilience strategy. Our presentation will explore (1) the process to develop project alternatives to reduce flood risk -- including sea level rise, coastal storms, and precipitation; (2) key project challenges and solutions, including siting blue-green drainage infrastructure, complex transportation and maritime infrastructure; and, (3) funding and financing strategies, including phasing and governance.

Fully Automated Rapid Microbiology - Basic Considerations Regarding Different Measurement Approaches And Evaluation Of The Enzymatic Measurement Approach.

W. Vogl, J. Koschelnik, I. Dubek. VWMS GmbH (Austria)

A safe and efficient water cycle requires efficient processes and therefore sufficient process control and monitoring. Water quality monitoring is therefore a crucial task throughout the complete water cycle, to effectively control treatment processes and safeguard the water quality throughout the distribution network. The physical and chemical quality of water, unlike the microbiological quality, is automatically monitored by various sensors. While microbiological quality is still being determined by manual, culture-based lab procedures. These evaluations take 24 hours or longer to deliver a result and are therefore not suitable for process control or short-term decision making. Basic considerations regarding possible approaches of rapid microbiological measurements are being presented. One rapid measurement approach, based on direct measurement of enzymatic activity of target organisms, is being evaluated in detail. Effects of different types of disinfection in parallel test series with traditional methods are presented to evaluate advantages and limitations of the enzymatic measurement approach.

IOT Thermodynamic Pump Condition Monitoring System For Maintenance & Performance Management

S. Barrett, MA. Samadi, SC. Cheung, Y. Qin, R. Hale, T. Lam. Public Utilities Board (Singapore)

Real-time pump condition monitoring together with a Decision Support Interface can guide operations personnel to ensure the most efficient pump operations. Real-time monitoring of pump operational parameters such as Pump Head, Input Power, Hydraulic Efficiency, and Flow Rate provide insight to pump performance. Pump with higher hydraulic efficiency can be favored to run more often and remedial action can be taken on pumps with lower hydraulic efficiency. The FREEFLOW system also compares between single pump pumping against parallel pumping (concurrent running of two pumps) to increase pump station efficiency. The system allows monitoring of performance with different pump combinations. Moving forward, data and insights from this project will be used to optimise our pumping station operational and maintenance efficiency

Improved Management Of Legionella Risks Using Rapid On-Site Testing

G. Rankin, M. Connolly. Hydrosense Ltd (United Kingdom)

The widely performed laboratory culture testing method for legionella lacks the required accuracy and speed to properly manage legionnaires' disease risk in the built environment. Factors such as transportation time, lack of biocide neutralisation, exposure to variable temperature and presence of background flora can affect the performance of lab culture results. This research examines the effect of biocide exposure and sample transport time/temperature, on the accuracy of the lab culture method and offers an effective complimentary legionella testing solution which can be used in conjunction with the lab culture method to improve water system management and public safety.

Improved Transparency With Digital Twins Of Urban Drainage Systems

A. Pedersen, M. Borup, A. Brink-Kjær, LE. Christiansen, PS. Mikkelsen. VCS Denmark (Denmark)

VCS Denmark is currently reconstructing its digital twin (DT) to include new and more optimized features. A DT can provide increased transparency throughout the entire utility thereby improving the support of employees for taking better actions. The utility's primary needs are within better models for planning and design as well as improving operational tasks, all with help from the DT environment. Features that need upgrading are identified and replaced with better and more flexible solutions. In the future error diagnostics will be a part of the DT toolbox, in order to reduce model uncertainty and the risk of operational errors. The DT is expected to reduce the environmental impacts from the urban drainage system and to support smarter investments.

Investigating Adsorption Of Natural Organic Matter By HAOPs Via Molecular Dynamics Simulation

Y. Ma, S. Velioglu, MB. Tanis-Kanbur, R. Wang, JW. Chew. Nanyang Technological University (Singapore)

Heated aluminum oxide particles (HAOPs) have been used as dynamic membranes pre-deposited onto the primary membrane to effectively remove natural organic matter (NOM) and thereby significantly diminish the fouling potential. Molecular dynamics (MD) simulations were conducted to compare the performance of HAOPs with the conventional powdered activated carbon (PAC) adsorbent. Results indicate that the mechanisms underlying the effective removal of high molecular weight (HMW) NOM by HAOPs include: (1) higher foulant-HAOPs interaction energy; (2) greater hydration of the HMW NOM; and (3) diminished mobility of the foulant once adsorbed, which deters desorption.

Keppel Marina East Desalination Plant (KMEDP) Design Approach To Energy And Water Sustainability

KP. Chiu, EK. Goh, PT. Tay, TM. Leong, KS. Goh. AECOM (Singapore)

Desalination and water reuse provide circular economy solutions for water-scarce environments. However, seawater desalination draws general concerns on energy consumption and sustainability. Keppel Marina East Desalination Plant (KMEDP) addresses these through a dual-mode solution and other designs. KMEDP is located in Singapore Marina East, near an urban catchment reservoir and the sea, allowing the Plant to feature dual intake from both sources. In dry season, when the water level in the reservoir is low, seawater is desalinated to produce drinking water. In rainy season, the Plant draws water from Marina Reservoir instead, which requires less energy and fewer treatment process steps compared to desalination. Other than the dual mode, KMEDP implements a direct coupling design which significantly reduces the energy consumption. Besides the innovative technologies and process design, the architectural design incorporates environmental friendly elements into its landscaping such as collecting rainwater for irrigating the green roof, supporting the facility's water features and landscaping needs. Its design enhances the overall water and energy consumption efficiency of the plant.

Leveraging Dual Polarimetric X-band Radar Rainfall And Nowcast For Urban Flood Management In Singapore

M. Keem, A. Goedbloed, M. Vierstra. Hydroinformatics Institute (Singapore)

To improve the performance of the X-band radar system nowcasting model operated by PUB, we evaluated new nowcasting models using various distributed advection vectors with the semi-Lagrangian persistence-based extrapolation scheme. The optical flow model shows the best skill scores in predicting rainy area with the lowest computational load. The numerical diffusion and the Lagrangian persistence model without the growth and decay cause the deficiency in accurate rain rate predictions, which will be investigated as a part of this project in the future.

Managing A Structural Improvement Project -- Marrying Structural And Project Management Principle Into Action Plan (Water Treatment Facilities Upgrading Project)

R. Salenga, E. Malahito, MS. Orticio. Maynilad Water Services Inc (Philippines)

Retrofitting works for structures of existing industrial plants are challenging and have tendency to cause major negative impacts on Revenue, Reputation, and Regulatory (the 3 Rs) for stakeholders. For instance, an existing large scale water treatment plant, serving millions city-dwellers, cannot partially or totally shutdown as the shutdown might cause extreme negative impacts such as Revenue (e.g. owner of the plant cannot sell water, resulting loss in revenue); Reputation (e.g. the reputation of the owner decreases as he cannot meet the demand of water daily); Regulatory (e.g. the owner might face business penalty and loose business chance when not meeting the requirement from the regulatory authority).

Pilot Gravity-driven Membrane (GDM) Reactor For Seawater Reverse Osmosis Desalination Pretreatment

B. Wu, S. Lee, TH. Chong. University of Iceland (Iceland)

Seawater pretreatment by a pilot gravity-driven membrane (GDM) filtration system (operated over 500 days) was investigated. This study aims to (1) examine the effects of membrane module and system configurations on the GDM permeate flux and permeate water quality; (2) compare the performances of reverse osmosis (RO) membranes fed with the pilot GDM reactor permeates and full-scale ultrafiltration (UF) permeate. The results indicated that (1) the gravity-driven flat sheet membrane module achieved higher permeate flux than hollow fibre; (2) the GDM reactor produced superior permeate quality than the UF pretreatment, leading to less RO membrane fouling; (3) Integration of a biofiltration process with the GDM system further improved subsequent RO membrane performance.

Portable Rapid Bacteria Detector

L. Lei, CM. Yeo, Z. Wang. Zweec Analytics Pte Ltd (Singapore)

Globally, regulators are increasingly paying attention to the biosafety of the drinking water especially in a pandemic. Real time and direct detection of biological suspensions with high sensitivity and accuracy remains an extremely difficult task in the water monitoring industry. In this work, we developed a revolutionary enzyme-assay based bacteria detection system that can realize rapid bacteria detection with high sensitivity and specificity, and low cost. The innovation is expected to exceed the current detection limit and be able to build up a new water monitoring standard.

Removal Of Organic Micropollutants From Wastewater By Ozone-Activated Carbon Filtration And Porous Cyclodextrin Polymers Adsorption: A Laboratory Batch Study

JP. van der Hoek, C. de Jong, TK. Liu, T. Spit, H. Schijfsma. Delft Univesrity of Technology (Netherlands)

Wastewater treatment effluent contains organic micropollutants. The removal requires advanced treatment technologies. The removal efficiency of ozonation-granular activated carbon (O3-GAC) and porous cyclodextrin polymers (P-CDP) was investigated in laboratory batch experiments. O3-GAC and GAC as single process were very effective, while adsorption by P-CDP lagged behind. However, fast kinetics, selectivity and easy on-site regeneration of P-CDP may make this process potentially more competitive and attractive.

Short-Term Water Quality Prediction Using Tree-Based Classification For Coagulation Control In Drinking Water Treatment Plant To Improve Waterworks Operation Efficiency And Event Detection

P. Cai, V. Sim. Surbana Jurong Consultants Pte Ltd (Singapore)

The SJ Solution harnesses the power of Data Science & Analytics, and Machine Learning/Artificial Intelligence to help water treatment plants maximize efficiency and reduce manpower reliance. The machine learning models perform fault identification via root cause analysis and prediction of anomalies before they happen. This data modelling has set as a precedence to other processes and create a value chain optimization for the future. The solution makes the currently reactive SCADA system more intelligent through descriptive and predictive analytics. Operators will reap the benefits of AI-assisted models that comes with an interactive dashboard and improve the efficiency of operations through diagnostic troubleshooting and assisted decision-making.

Smart Water Model - A Case Study At Anderson Road Quarry Site Development, Hong Kong

H. Lee, HS. Tsang. Government of Hong Kong Special Administrative Region (China)

Like many water utilities around the world, the Water Supplies Department ("WSD") of the Hong Kong Special Administrative Region Government has been facing challenges which include rising water demand due to continuous population and economic growth, diminishing water resource due to impact of climate change, and increasing water loss due to aging of water supply network, etc. WSD has found that use of advanced technologies is a sustainable mean to cope with the challenges and has therefore recently implemented many smart water initiatives such as Grey Water Recycling and Water Intelligent Network ("WIN"). While the application of these smart water initiatives could be constrained by the developed environment of Hong Kong, WSD takes the opportunity of the new Anderson Road Quarry Site Development ("ARQD") and plans to implement various smart water initiatives therein with a view to formulating a Smart Water Model to facilitate the formation of a Smart City.

The Importance Of Designing For The Real-world And Not Just To Meet The Specification

D. Nicklin, L. Rusiecki. Xylem (United Kingdom)

Standards are acknowledged as being beneficial for manufacturers and users alike. They provide a minimum level of performance and conditions a meter must meet in order to become certified as compliant to the standard. However, meeting a specification under controlled test bench conditions may not be the best measure of performance in real-world field deployments. For example, the OIML test designed to examine whether a meter can work within defined error limits should there be upstream and downstream pipe bends and valves, only applies across a very short part of the range -- from 0.9Q3 -- Q3. A meter can easily meet the error bands for that short section to claim compliance but fall rapidly outside the bands for large parts of the range, making it totally inaccurate for a real-world installation. In addition, specifications initially developed to test mechanical metrology do not necessarily provide the best basis for qualifying new solid state meter technologies. Utilities should be sure to consider other factors that are not covered in the standard tests and evaluate whether these may be significant to the how the meter may perform in their network.