28 June 2021 (Monday)

4.00pm-5.30pm (SGT) (GMT +8)
Session 3.10 – Advanced Modelling, Sensing & Control II - Inside the Fence

Session Chair(s): Andrew Shaw, Black & Veatch (USA)

The Implementation Of A Whole Plant Digital Twin Simulation For Changi WRP

B. Johnson, YP. Mak, KYA. Tan, J. Curl, R. Kadiyala. Jacobs International Consultants (Singapore)

Currently, a whole plant dynamic simulation model, called "Digital Twin" is being developed for CWRP. The Digital Twin intends to fully integrate the individual hydraulic, process and control aspects of CWRP into a single integrated model with predictive capabilities to forewarn operators of potential process deviations and poor effluent quality. The model development will include real-time data integration, analytics and validation for model use. Sumo© by Dynamita is used for process simulation, while REPLICA™ is used for control system and hydraulic modelling. The integrated model will also have machine learning component to automatically adjust model calibration within defined ranges to better match the observed performance. The model is expected to assist in simulating various operational scenarios of the treatment system to enhance water quality, optimize energy and chemical consumption of the plant.

Building A Smart Water Reclamation Plant

L. Tai, KM. Phua, K. Koh, G. Tao, WJ. Chan, J. Ng. PUB, Singapore's National Water Agency (Singapore)

PUB commissioned the Integrated Validation and Demonstration Plant (IVP) in August 2017 to test and validate process technologies and automated plant operations for the future Tuas Water Reclamation Plant (TWRP). Riding on the existing infrastructure, the Smart WRP project seeks to further enhance the capabilities of IVP through the implementation of various Industry 4.0 technologies identified in PUB's technological roadmap to achieve our mission in 4 key strategic aims: energy efficiency, effluent quality, workforce productivity and personnel safety & plant security. This includes the incorporation of commercially available products within the existing plant, such as wireless process sensing, wireless equipment condition monitoring, advanced process control, facial recognition for access controls and a real-time location and safety monitoring system. Simultaneously, through the R&D project, PUB seeks to co-develop and validate the usefulness of novel and emerging solutions such as autonomous robot for sample collection, augmented reality glasses for operations and maintenance work, digital twin for simulations and machine learning for video-based water quality monitoring.

Using Advanced Real Time Analytics to Optimize the Energy Usage at WWTP

D, Mak, J. Gebhardt, A. Nink. Xylem (United States)

EWE WASSER wanted to optimize the operation of the Cuxhaven Wastewater Treatment Plant (WWTP) to reduce energy consumption, improve safety, and increase the certainty of regulatory compliance. To do this, it went beyond static setpoint controllers (such as PIDs) and implemented a control system based on how to best treat the particular wastewater coming into the plant at that moment. The BLU-X Treatment system was used to build models using Neural Networks (NN) of the carbon-, nitrogen- and phosphorous-elimination processes based on the data from the existing SCADA system. With this information, the system then created an optimization strategy for reducing aeration energy use within the WWTP based on the plant's needs at that moment and in the near term future. Implementing this solution reduced the aeration energy consumption by 26% (1.1 million kWh annually) while continuously maintaining regulatory compliance since its installation in 2017.

Sustainable And Efficient Aeration Control -- Improved Quality And Energy Savings With Next Generation Of Self-learning AI Process Controller

H. Hermann, M. Charatjan. Binder GmbH (Germany)

The main challenges in aeration control are stable control results independent of changing load situations and other interferences. Standard PI- or PID-controllers work well in static systems, but the aeration process is subject to load changes and requires a dynamic adjustment. A smart advanced aeration controller was developed especially for this application. It was tested and used in several plants, using air flow rate beside DO-concentration as the control variable. Based on a PID-controller, the static P-part was changed to a self-learning and self-adjusting type, considering in each control step the remaining offset of last steps. In addition, a multiple I-part looking at near and distant past was introduced to improve the dynamic behaviour. Considering further process parameters e.g. water temperature, salinity and others to damp/ amplify the control result, results are automatically adjusted to actual load. Configuration of the controller can be done for best control accuracy or lowest energy costs or a compromise of both.