Editorial: Water Resource Recovery Modelling

As our infrastructure is transitioning from wastewater treatment to resource recovery, so must our models evolve to address the needs this transition brings. Nutrient recovery, energy production or neutrality, biomass specialization for new conversion pathways, green-house gas mitigation and more stringent effluent limits for water reclamation are driving new model development efforts and increasingly sophisticated applications of modelling. These new needs enlarge the range of biological, physical and chemical mechanisms that we need to consider in our models. Exchanging and capitalizing on these knowledges are key challenges for modellers that will bring benefits to design, operation, teaching and research.

In this issue of *Water Science & Technology*, nine papers were selected that contribute to various aspects of the field of modelling water resource recovery facilities (WRRFs). Seven of these were presented or directly arose from the 5th Water Resource Recovery Modelling (WRRmod; previously known as the Wastewater Treatment Modelling, WWTmod) Seminar held in Lake Beauport, Canada, in March 2018.

A review of outlook and challenges of WRRF modelling is first presented (Regmi *et al.* 2019). This collective paper was produced by a concerted effort of 24 individuals from various sectors of the wastewater industry.

Plant-wide aspects of modelling are then presented in two papers. Very low sludge retention time (SRT) and high rate activated sludge processes to minimize carbon oxidation and maximize organic carbon recovery by considering colloids and flocculation mechanisms are first presented (Hauduc *et al.* 2019a).

A general plant-wide model in which the sulfur and iron cycles were added is then presented and tested (Hauduc *et al.* 2019b).

Biofilm modelling by a zero-dimensional biofilm model (0DBFM) was developed for moving bed bioreactors (MBBRs) (Plattes 2019). Detachment of biofilm and attachment of suspended matter from the bulk liquid are considered in the model.

Inhibitory substances on biological nutrient removal systems motivated the development of a simulation framework using quaternary ammonium compounds (commonly used in industrial cleaners; Conidi *et al.* 2019). Biosorption and biodegradation by nitrifiers and heterotrophic organisms were simulated.

Two papers on process control are then presented. First, online control by prediction of ammonium and nitrate using a stochastic model is presented (Stentoft *et al.* 2019). Resulting improved aeration control was shown to reduce electricity costs and improve resource recovery.

Then, ammonia-based aeration control coupled with SRT (ABAC-SRT) to control ammonia in the activated sludge process is presented (Schraa *et al.* 2019). Energy consumption reduction over 30% can be expected compared with a traditional dissolved oxygen control method.

A compartmental model (CM) was shown to provide more realistic conditions than a conventional tank-in-series (TIS) configuration for the estimation of nitrous oxide production (Bellandi *et al.* 2019). The CM improved hydrodynamic consideration of local conditions and recirculation patterns both under steady state and dynamic conditions versus the TIS approach.

Thermal hydrolysis processes (THPs) can enhance biogas production in anaerobic digestion, reduce viscosity for improved mixing and dewatering, and reduce and sterilize cake solids. A combined energy (thermal heat and calorific) and process model was developed and applied at Blue Plains advanced WRRF (Aichinger *et al.* 2019). It was shown that dynamic effects were responsible for losses in electricity production of up to 29%.

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