Title: ASM model-based applications for better MBR design, operation and control

Authors: Maere, T.; Nopens, I.

Abstract: The applicability of activated sludge models (ASM) for communal and industrial membrane bioreactor (MBR) applications is nowadays largely acknowledged. Differences with conventional activated sludge (CAS) systems do exist, but can be accounted for. BIOMATH has focused its research on the use of ASM models for MBR optimisation.

A benchmark simulation model (BSM-MBR) was created to test and design control strategies with the focus on biology. Hereto, a dedicated aeration model was developed that can take the differences between coarse and fine bubble aeration into account as well as the adverse effects of high sludge concentrations on oxygen transfer efficiency. The aeration model allows an accurate prediction of aeration cost, which still forms the major part of total MBR operational costs.

The benchmark simulation model concept was also used to investigate the potential of operating MBRs in a hybrid configuration, i.e. CAS and MBR combined. Three different hybrid layouts (in series, parallel, integrated) were constructed and tested through dynamic simulations for operational costs and effluent quality. Especially the influent partitioning ratio between the MBR and CAS lanes proved influential.

The effect of MBR design and operational choices on capital and operational expenditure was investigated through a model-based life-cycle cost analysis. Dynamic ASM simulations coupled to dedicated cost models were used to calculate the effect of, *inter alia*, design contingency, membrane lifetime, buffer tank size, sludge retention time on the net present value (NPV) calculated over 30 years. The exercise showed promising routes for MBR design and operation.