Sequence Batch Reactors (SBR)
Wessex Water
Dorset

The Weymouth Sewage Treatment Works (STW), operated by Wessex Water, is based on SBR technology. The STW is located in an underground structure near Chesil beach.

Figure 1: Surface Floating Decanters Weymouth SBR

The effluent enters into the lane of the SBR (fill stage) and is then aerated (aeration stage). The reactor then changes its function from treatment to separation, and the aerated mixed liquors are allowed to settle as an activated sludge blanket (settle stage) before the supernatant is removed by floating decanters (decant stage). At the same time, a pump removes some of the Surplus Activated Sludge (SAS) from a return sump.

MMI was asked to investigate the potential of improving the simplicity, robustness and hydraulic capacity of the process, by converting it to a continuous fill, intermittent discharge SBR. This meant that the aeration, settle and decant stages would occur simultaneously with fluid entering the SBR.

A transient CFD process model of the SBR was developed, with the sludge phase modelled using the drift flux method [1]. The free settling velocity and free settling parameter for the Tákacs hindered settling model were obtained from experimental results with the SBR sludge. The rheology of the fluid-solids mixture was modelled according to standard methods [2]. In order to determine the effluent soluble biological oxygen demand, soluble organic matter was modelled as an inert scalar. A deforming mesh was used to enable the water level to rise up and down in keeping with the process boundary conditions.

It was found that given an appropriate inlet arrangement, the use of a baffle to prevent soluble material short circuiting to the outlets and suitable process conditions, i.e. average mixed liquor suspended solids concentration, the SBR could be converted to a continuous fill type operation. Figure 2 shows contours of solids concentration at the end of the decant stage during continuous fill.

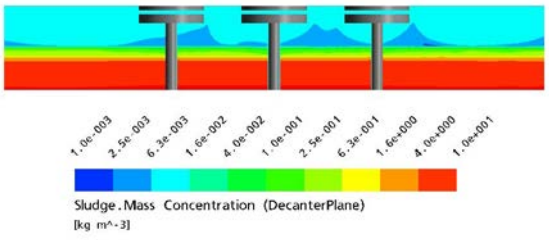

Figure 2: Solids concentration at the end of the decant stage. Log scale 1 to 10,000 mg/l

Value Added

MMI was able to assess the adequacy of the process sequence prior to any on-site changes. In this case, CFD was used to select the most appropriate inlet and baffle arrangement, as well as the best process sequence to provide greater hydraulic capacity. The model also demonstrated the robustness of the continuous fill system to soluble Biochemical Oxygen Demand (BOD) at effluent.

References

Burt, D.J. and Gilbertson, M.A. “Extended drift flux models for waste water sludges”. In Particulate Systems Analysis, PSA2005, Stratford-upon-Avon UK, Sept 2005

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