Abstract

Wastewater treatment plants (WWTPs) are systematic facilities for treatment of wastewater to restore wastewater to a desirable quality. The main objective of WWTP is compliance with the local regulations on effluent discharge. The processes in a WWTP exhibits a trade-off between energy consumption and effluent quality. The burden on WWTPs is increasing with the immense rise in wastewater generation and water scarcity throughout the world. The trade-off between effluent quality and operational costs inspires the economical operation of the plant. This involves minimizing the operational cost without violating the regulations corresponding to effluent quality.

This work addresses the implementation of constraint adaptation (CA) for real-time optimization of the steady state operation of WWTP. The CA technique is implemented on a plant adopted from Benchmark Simulation Model No. 1 (BSM1). A reduced-order model is used for making predictions and solving the optimization problem. Steady state plant measurements are incorporated into the optimization framework to deal with plant-model mismatch. CA guarantees constraints satisfaction upon convergence while minimizing the operational cost. Moreover, the fast CA technique that uses transient plant measurements and can converge in a single settling time is also implemented. The proposed control and optimization techniques are found to reduce the pumping and aeration energy by around 20%, as compared to that adopted in BSM1.