ABSTRACT

Calibration of an Activated Sludge Model No. 3-based Wastewater Treatment Plant Simulator

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Modeling the activated sludge processes from a municipal Wastewater Treatment Plant (WWTP) is a very important task, because a calibrated model can be used to study and to teach the process, to improve and to implement different control strategies, respectively to investigate and to develop improved operational efficiency. Model calibration is absolutely necessary in every specific case because only a few of the variables and parameters can be determined directly at the WWTPs.

Activated Sludge Model No. 3 (ASM3) describes the organic carbon removal, nitrification and denitrification, distinguishing the importance of storage microorganisms. ASM3 includes three types of microorganisms (heterotrophs, autotrophs and organic carbon accumulating organisms) and introduces some improvements to the Activated Sludge Model No. 1 (ASM1).

This research is a case study of Cluj-Napoca municipal Wastewater Treatment Plant, which has an anaerobic-anoxic-aerobic (A2O) configuration. The measured and available data was collected, analyzed, and then used in the dynamic WWTP simulator. The WWTP model was implemented in Matlab software and the Simulink graphical extension. The equations of the biological, biochemical and physical processes were written in C programming language and were implemented in the Simulink environment by S-function blocks. The built and calibrated WWTP model is composed of a primary settler based on the Ottherpohl and Freund's clarifier model, 5 bioreactors which core is the ASM3 and a secondary settler where the double-exponential function proposed by Takács *et al.* is applied for the calculation of settling velocity. 5 influent variables (Inert soluble organic material, Readily biodegradable organic substrates, Inert particulate organic material, Heterotrophic organisms, Nitrifying organisms), 3 process parameters (Saturation constant for the cell internal storage product of heterotrophic organisms, Saturation constant for nitrates and nitrites, Autotrophic maximum growth rate of nitrifying organisms) and 3 secondary settler's parameters (thickening area parameter, clarification area parameter, non-settleable solids fractions) were selected to calibrate the WWTP model. The model calibration was performed by optimization using classical algorithms and for steady state. The objective function was defined as the sum of the absolute differences of the average measured data and the obtained simulated values for the soluble COD (Chemical Oxygen Demand), the nitrogen fractions and the total suspended solids from the effluent. The results were tested by dynamic simulations.

Using the values obtained from the optimization of the selected parameters and for steady state, the simulated effluent data is almost equal to the average measured effluent data from the municipal WWTP. In dynamic state, the curves of the simulated effluent nitrates and the effluent soluble COD are comparable with the measured data at the real WWTP. The calibration of the WWTP Simulator based on the Activated Sludge Model No. 3 was accomplished successfully and the calibrated model can be used for further studies.