*"Gheorghe Asachi" Technical University of Iasi, Romania*

# EXTENSION OF ACTIVATED SLUDGE MODEL NO 1 WITH TWO-STEP NITRIFICATION AND DENITRIFICATION PROCESSES FOR OPERATION IMPROVEMENT

## George Simion Ostace[*], Vasile Mircea Cristea, Paul Şerban Agachi

*Babes-Bolyai University, Faculty of Chemistry and Chemical Engineering, 11 Arany Janos,*
*400028 Cluj-Napoca, Romania*

## Abstract

The present paper presents an enhanced Activated Sludge Model No. 1 in which nitrification and denitrification are modelled as two-step processes. The nitrification process is considered as a sequence of two steps carried out by two distinct genera of bacteria, with nitrite as an intermediate product. For the denitrification process a parallel approach was used that considers nitrate and nitrite to be directly reduced to molecular nitrogen. The new model is compared to the original Activated Sludge Model No. 1 using the Benchmark Simulation Model No. 1. In order to make the simulation model more realistic the secondary settler was considered to be reactive. The new modelling approach showed different dynamics for the autotrophic biomass and the growth substrate of the heterotrophic biomass, enhancing the agreement with the real process behaviour. The last part of the paper presents the investigation of finding the optimal set-point for a cascade control scheme based on the Model Predictive Controller at the outer control level and three PI controllers at the inner level. The control architecture is designed to keep the nitrate nitrogen level at the end of the aerated zone at predefined set-points. The wastewater treatment plant performance is evaluated using the operational costs criteria. The simulation results show that noteworthy costs can be saved using this control strategy.

*Key words:* ASM1, BSM1, MPC, two-step nitrification, reactive secondary settler

*Received: February, 2011; Revised final: May, 2011; Accepted: May, 2011*

---

[*] Author to whom all correspondence should be addressed: e-mail: george.ostace@ubbcluj.ro; Phone: +40-264-593.833 int.5659; Fax: +40-264-590818