Anoxic and aerobic values for the yield coefficient of the heterotrophic biomass: Determination at full-scale plants and consequences on simulations

J-M Choubert[1]*, A Marquot[2,3], A-E Stricker[2,4], Y Racault[2], S Gillot[5] and A Héduit[5]

[1] Cemagref, UR QELY, 3 bis quai chauveau – CP 220, F-69336 Lyon cedex 9, France

[2] Cemagref, F-33612 Cestas, France

[3] WTSim SARL, 15 impasse Fauré, F-33000 Bordeaux, France

[4] Environment Canada, 867 Lakeshore Road, Burlington – Ontario L7R 4A6, Canada

[5] Cemagref, F-92163 Antony, France

Abstract

The present study aims at optimising the nitrification and denitrification phases at intermittently aerated process (activated sludge) removing nitrogen from municipal wastewater. The nitrogen removal performance recorded at 22 intermittently aerated plants was compared to the results obtained from the simulations given by the widely used ASM1. It is shown that simulations with a single value for the heterotrophic yield with any electron acceptor over-predict the nitrate concentration in the effluent of treatment plants. The reduction of this coefficient by 20% for anoxic conditions reduces the nitrate concentration by 10 g $N \cdot m^{-3}$. It significantly improves the accuracy of the predictions of nitrate concentrations in treated effluents compare to real data.

Simulations with dual values (aerobic and anoxic conditions) for heterotrophic yield (modified ASM1) were then used to determine the practical daily aerobic time interval to meet a given nitrogen discharge objective. Finally, to support design decisions, the relevance of a pre-denitrification configuration in front of an intermittently aerated tank was studied. It is shown that when the load of BOD_5 is below the conventional design value, a small contribution of the anoxic zone to nitrate removal occurs, except for over-aerated plants. When plants receive a higher load of BOD_5, the modified ASM1 suggests that the anoxic zone has a higher contribution to nitrogen removal, for both correctly and over-aerated plants.

Keywords: activated sludge, denitrification rate, anoxic heterotrophic growth yield, low temperature, modelling