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MODELLING OF THE WASTEWATER TREATMENT PROCESSES IN RECIRCULATING AQUACULTURE SYSTEMS

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Abstract. The paper deals with a biological treatment model of the water in an intensive recirculating aquaculture system, to be used in control purpose. For modelling the recirculating system the interactions between the main components of the system have been analysed: the aquaculture tanks and the biofilter. In order to model the biofilter the equations that describe the aerobic processes within the model ASM3_2N were used. The results obtained through numerical simulation when the biofilter operates in open loop and in recirculating system are also presented.

Key words: Process model, recirculating aquaculture system, wastewater treatment, biofilter, automatic control.

1. Introduction

Modern aquaculture processes are carried out in recirculating systems where an important weight (approximately 90%) of the used wastewater is recycled. A crucial problem of these systems is the efficient treatment of the recirculated water. Synthetically, the main processes that are carried out in the system are: 1) an aerobic decomposition process of the organic substance by the heterotrophic bacteria in more simple organic substances, the final product being ammonium; 2) the nitrification process which consists in ammonium removal. It is achieved in two phases: ammonium is oxidized by the autotrophic bacteria (*Nitrosomonas*) and transformed in nitrites (NO_2^-), and the nitrites are oxidized by another category of autotrophic bacteria (*Nitrobacter*), being transformed in nitrates (NO_3^-); 3) the denitrification process, that leads to the nitrates conversion in nitrites and than the nitrites are transformed in gaseous nitrogen [1]. Of all these processes only the nitrification process can be controlled and its mathematical modelling in order to control this process is a very important issue [2], [3].

Further on a recirculating system of four aquaculture tanks in which the nitrification process is performed in a biofilter of trickling type is considered. The mathematical models that exist in the literature for the nitrification