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NITROGEN TRANSFORMATION IN A PILOT FOUR-STAGE ON-SITE FLOOD AND DRAIN CONSTRUCTED WETLAND SYSTEM EMPLOYING ALUM-SLUDGE AS MAIN SUBSTRATE

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ABSTRACT: Dewatered alum sludge cake (DASC), a residual by-product of potable water treatment process, was used as main substrate in a pilot on-site constructed wetland (CW) system treating agricultural wastewater for 18 months. The purpose of this study is to develop a mathematical model, which permits dynamic simulation of nitrogen transformation in a flood and drain CW system. This study also investigated a mass-balance transformation of nitrogenous pollutants using STELLA dynamic software. The system consists of four flood and drain wetland cells operated with a hydraulic loading rate of 0.29m3/m2, hydraulic retention time of 4 hrs and resting time of 4 hrs in each wetland cells which consists of 3 cycles per day. Earlier experimental results and performance evaluation from February 2009 to December 2009 show that the range of mean monthly influent concentration of water quality parameters such as BOD5, COD, TN and NH4-N were 41.2-694.4, 407.0-1297.5, 43.0-221.9 and 37.9-176.2 mg/l, respectively, whereas the removal rates (in g/m2d) ranging from 7.1-149.8 (BOD5), 49.8-253.8 (COD), 7.1-47.0 (NH4) and 0.9-38.3 (TN). The model considered organic nitrogen (ON), ammonia nitrogen (NH3) and nitrate nitrogen (NO3-N) as the major forms of nitrogen involved in the transformation chains. Ammonification, ammonia volatilization, nitrification, denitrification, plant uptake, plant decaying, uptake of inorganic nitrogen by algae and bacteria were considered in this model. pH, dissolved oxygen, temperature, precipitation, solar radiation, nitrogen concentrations were considered as forcing functions in the model. The predicted values of nitrogen concentrations in effluents as simulated by the developed and calibrated model, had a good agreement with the experimental results. To summarize, the results imply that the fate of nitrogen transport process in a flood and drain CW system can be simulated using a conceptually simple object-oriented simulation model.

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