ABSTRACT

SUPERVISORS: Joan García Serrano and Jaume Puigagut Juárez
AUTHOR: Ferran Baqué Viader

Constructed wetlands are extensive wastewater treatment systems. Despite the short period of experience compared to conventional intensive technologies, these systems are gaining importance as an attractive option for wastewater treatment of small urban communities, mainly due to their lower costs of operation and maintenance. However, a major problem of such systems is the accumulation of solids (sludge), which prompts clogging of the granular medium, consequently reducing the efficiency and lifespan of the wetland.

The aim of this work was to study the biodegradability of sludge accumulated in constructed wetlands, to help defining management strategies to minimize clogging of these systems.

To this purpose, the biodegradability of solids accumulated in the granular medium of a wetland from the wastewater treatment plant (WWTP) of Verdú (Lleida, Catalonia) was studied. Anaerobic and aerobic biodegradability assays were carried out with sludge from sampling points near the inlet and outlet of the wetland. Anaerobic biodegradability of primary and secondary waste sludge from the WWTP of Gavà-Viladecans (Barcelona, Catalonia) was also analyzed, in order to compare the biodegradability of the sludge from either systems (extensive vs. conventional). All samples were analyzed for chemical oxygen demand (COD), total solids (TS) and volatile solids (VS), both initially and at the end of each assay.

A method was developed for the study of anaerobic biodegradability, based on the measurement of methane production through the degradation of sludge incubated at 20ºC. Vials of 45 ml capacity were used for this assay and optimal conditions determined in terms of sample volume and organic loading. It was found that sample volume was not critical, as long as a minimum amount of 100 g VS was added to the vials.

The results show that anaerobic biodegradability of sludge is around 3 times higher in samples from the inlet compared to those from the outlet. Maximum methanogenic activity rates (around 2,5 mg DQO/g VS·day) were also obtained with samples from the inlet. Furthermore, sludge accumulated on principal water circulation paths is more biodegradable.

Aerobic biodegradability was determined by means of biochemical oxygen demand (BOD) of the same sludge samples. The results indicate that aerobic biodegradability of sludge accumulated near the inlet is some 20 times higher than that from the outlet.

The comparison between aerobic and anaerobic biodegradability suggests that aerobic biodegradability is always higher than anaerobic biodegradability, both in samples from the inlet and outlet. However, biodegradable organics are only a small proportion of the total oxydisable materials, as shown by COD values.

Finally, it was concluded that anaerobic biodegradability of sludge accumulated in the wetland is much lower than that of primary and secondary waste sludge from conventional WWTP. According to the results, anaerobic biodegradability of primary and secondary sludge are 3 and 2 times higher, respectively, than anaerobic biodegradability of wetland sludge.