

Effect of Wastewater Quality and Process Parameters on Removal of Effluent Organic Matter (EfOM) During Soil Aquifer Treatment

Gary Amy, UNESCO-IHE, Institute for Water Education, Delft, The Netherlands

Coauthors: Saroj K Sharma and Alex Katukiza, UNESCO-IHE Institute for Water Education, Delft, The Netherlands

ABSTRACT

Soil Aquifer Treatment (SAT) is an emerging treatment technology, which in combination with other available wastewater treatment technologies could produce effluent of acceptable quality for indirect potable reuse. It is a low cost and appropriate option for wastewater reclamation in developing countries that ensures sustainability of both surface water and groundwater sources within the context of integrated water resources management.

Several studies have been carried on removal of effluent organic matter (EfOM) and its transformations during SAT of conventional wastewater treatment effluents, however very little is known about organic matter removal characteristics of SAT for non-nitrified primary effluent. Furthermore, pertinent information on organic matter removal by SAT systems under different process and hydro-geological conditions is lacking yet it is essential for rational design of SAT systems and to predict the degree of purification provided by SAT at various sites. This study focused on analyzing the potential and suitability of SAT technology for removal of EfOM from wastewater effluents under different process conditions.

The study was carried out by conducting soil column and batch tests at laboratory-scale under different process conditions using primary and secondary effluent from a wastewater treatment plant in The Netherlands. The DOC concentrations of primary and secondary effluents were 35-37 mg/l and 12-15 mg/l respectively. Silica sand of size 0.8-1.25 mm was used as a filter media. For soil column studies, filtration rate varied from 1.25 m/day to 2.5 m/day. DOC, UVA, SUVA, oxygen and nitrogen profiles along the depth of the column were monitored.

In column studies, it took about 30 days to reach steady state (i.e. acclimation) with respect to DOC removal. This can be attributed to the development of a biofilm on the filter media. DOC removal was 46-54% for settled primary effluent compared to 15-30% for secondary effluent. The effluent DOC concentration of the primary effluent increased from 15.2 mg/L to 18.4 mg/L when the hydraulic loading rate was increased from 1.25 m/day to 2.5 m/day but there was no significant change in DOC removal with secondary effluent. A linear correlation between biomass TOC and DOC removed was found for the top part of the soil column while that for lower depth had a scattered distribution for both primary and secondary effluent.

The DOC removals from non-settled primary effluent based on batch tests were 49% and 58% under anoxic and aerobic conditions, respectively. For primary effluent, the DOC concentration after SAT under aerobic conditions with both soil column and batch tests averaged around 15 mg/l although the biodegradation time with batch tests was three times that with soil column tests. In the case of soil batch tests with primary effluents, the DOC removal was higher by about 10% under aerobic conditions as compared to anoxic conditions. The DOC removal behavior followed first order kinetics and a three parameter model was fitted for both batch and soil column experimental data. As expected, data fitting of the model showed that primary effluent had a higher biodegradable DOC component than secondary effluent. It was concluded that extending the limits of SAT from secondary to primary effluents was feasible.