2nd INTERNATIONAL WORKSHOP
ADVANCES IN CLEANER PRODUCTION
"KEY ELEMENTS FOR A SUSTAINABLE WORLD: ENERGY, WATER AND CLIMATE CHANGE"

Evaluation of the Pollutant Removal Mechanisms of a Reed Bed System: Biochemical Parameters

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Abstract

This study was aimed to evaluate the key biochemical mechanisms that occur within a reed bed system or constructed wetland during the treatment of landfill leachate. Soil respirations, dehydrogenase activities and urease activities within a horizontal subsurface flow reed bed were extensively examined to determine these mechanisms. Variations in biochemical parameters because of change in space and leachate applications were investigated. Correlations among the biochemical parameters and between biochemical parameters and pollutant removal efficiency were undertaken.

No biochemical activities showed any horizontal variations across the reed bed. For both preloading and during-loading conditions, soil respirations and dehydrogenase activities did not have any vertical variations whereas urease activities at 5cm depth were significantly higher ($P<0.001$) than those at 50cm and 90cm depth. When during-loading conditions were compared with preloading conditions, soil respirations showed no variation at any depth, whereas significant reductions were observed at 50cm ($P=0.034$) for dehydrogenase activities and at 50cm ($P=0.018$) and 90cm ($P=0.004$) depths for urease activities. A modest correlations ($r= 0.474$, $P=0.023$) between soil respirations and dehydrogenase activities was observed. A strong correlation ($r=0.777$, $P<0.001$) was found between dehydrogenase activities and urease activities. No correlation existed between the biochemical parameters in the reed bed soil and the pollutant removal efficiencies for chemical oxygen demand (COD) or total kjeldahl nitrogen (TKN). Aerobic microbial activity showed equal potential for the degradation of pollutants in the wastewater which suggests the importance of creating suitable conditions for aerobic microbes within the root zone in the reed bed. Significant reduction of total microbial activities at the middle depth suggests that it was influenced more by heavy metals due to more exposure to leachate. The top layer reed bed soil needs to be properly utilised to maximise the reduction of nitrogenous pollutants from leachate. A biochemical activity can be utilised to predict another biochemical activity but not the removal of COD and TKN.

Keywords: Reed beds, leachate, respiration, dehydrogenase, urease