

## Removal of Heavy Metals from Municipal Wastewater Using Constructed Rhizofiltration System

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**Abstract :** Wastewater discharged from municipal treatment plants contain an amalgamation of trace metals. The presence of metal pollutants in wastewater poses a huge challenge to the choice and applications of the preferred treatment method. Conventional treatment methods are inefficient in the removal of trace metals due to their design approach. This study evaluated the treatment performance of a constructed rhizofiltration system in the removal of heavy metals from municipal wastewater. The study was conducted at an eThekwni municipal wastewater treatment plant in Kingsburgh - Durban in the province of KwaZulu-Natal. The construction details of the pilot-scale rhizofiltration unit included three different layers of substrate consisting of medium stones, coarse gravel and fine sand. The system had one section planted with *Phragmites australis* L. and *Kyllinga nemoralis* L. while the other section was unplanted and acted as the control. Influent, effluent and sediment from the system were sampled and assessed for the presence of and removal of selected trace heavy metals using standard methods. Efficiency of metals removal was established by gauging the transfer of metals into leaves, roots and stem of the plants by calculations based on standard statistical packages. The Langmuir model was used to assess the heavy metal adsorption mechanisms of the plants. Heavy metals were accumulated in the entire rhizofiltration system at varying percentages of 96.69% on planted and 48.98% on control side for cadmium. Chromium was 81% and 24%, Copper was 23.4% and 1.1%, Nickel was 72% and 46.5, Lead was 63% and 31%, while Zinc was 76% and 84% on the on the water and sediment of the planted and control sides of the rhizofilter respectively. The decrease in metal adsorption efficiencies on the planted side followed the pattern of Cd>Cr>Zn>Ni>Pb>Cu and Ni>Cd>Pb>Cr>Cu>Zn on the control side. Confirmatory analysis using Electron Scanning Microscopy revealed that higher amounts of metals was deposited in the root system with values ranging from 0.015mg/kg (Cr), 0.250 (Cu), 0.030 (Pb) for *P. australis*, and 0.055mg/kg (Cr), 0.470mg/kg (Cu) and 0.210mg/kg, (Pb) for *K. nemoralis* respectively. The system was found to be efficient in removing and reducing metals from wastewater and further research is necessary to establish the immediate mechanisms that the plants display in order to achieve these reductions.

**Keywords :** wastewater treatment, *Phragmites australis* L., *Kyllinga nemoralis* L., heavy metals, pathogens, rhizofiltration

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