Form 2

Dissertation Abstract

Report no.	No. 235 (Dissertation-based)	Name	GANILA NUWAN PARANAVITHANA
Dissertation title	Development of Geomaterial-Based Media for Permeable Reactive Barriers to Treat Leachate from Solid Waste Landfills in Sri Lanka (スリランカ廃棄物処分場における浸出水浄化のための地盤材料をベースとした反応性浸透壁材料の開発)		

Abstract

Solidwaste management is serious environmental problem through out the world. It is in deplorable state in developing countries. It has been found that 95% of all municipal solid waste are disposed in open dumps. The rainwater percolating though waste dumps produce a highly toxic wastewater called leachate, which cause serious environmental damages which need to be properly treated before disposal. There are many technologies developed treat leachate through out the world. Especially in developed countries stringent regulations are introduced to maintain the cleanliness of water resources. But in developing countries such as Sri Lanka there is problem of treating leachate due to high cost associated with the modern treatment practices. The permeable reactive barrier systems are new technology introduced for ground water treatment, which possess potential to leachate as well. Especially if a leachate treatment system can be developed to be economical; it can be utilized for in-situ leachate treatment in Sri Lanka. There are many different mechanisms involved in PRB systems. Adsorption of pollutants is one of the predominant mechanisms, which can be utilized to treat leachate cheaply. The presence of toxic heavy metals in leachate creates health issues and it is difficult to treat by conventional biological treatment mechanisms. Most of the heavy metals present are in cation forms and can be removed by suitable adsorbents. In this research an attempt was made to develop geo-material based media for PRBs to remove a well-known toxic heavy metals Cd^{2+} and Pb^{2+} by adsorption.

There have been researches on utilization of soil as an adsorbent to remove heavy metals such as Cd, Pb, Cr and As from aqueous solutions. Recently, there are more researches on utilizing agricultural waste biochar as agrochemical, cation adsorbents to treat contaminated soil and water. There have been several successful attempts to increase the ability of heavy metal adsorption of soil by mixing with biochar. Based on above recorded literature, we decided to investigate the potential of Sri Lankan soil, coconut shell biochar and coconut shell biochar mixed soil as adsorbents for site specific PRBs for *in-situ* treating of leachate in landfills in Sri Lanka

Initially a separate lab experiments were conducted for selected a suitable soil in Sri Lanka. Thereafter lab experiments were conducted for sandy clay loam soil from Bangadeni

ya, coconut shell biochar and coconut shell biochar mixed soil to investigate the pH, Ki netics and initial ion concentration effects on adsorption. Finally competitive ion adsorp tion experiments were conducted too.

Results of batch experiments indicated that adsorption kinetics of Cd^{2+} and Pb^{2+} onto all adsorbents were fitted by the pseudo second order kinetics model and that adsorption is otherms were well described by the Langmuir model. In the normal pH range $\geq$ 3, perce nt removals of both Cd^{2+} and Pb^{2+} by the tested biochar-mixed soil exceeded 90 %.

Feather, it was estimated that the adsorption capacity of Cd2+ onto coconut shell activat ed carbon is 4 times the adsorption by coconut shell biochar while it is 2times the adsor ption capacity of Pb2+. But the price of biochar in Sri Lanka is 200Rs/kg where as the p rice of activated carbon of 100µm is 1500Rs/kg, which is 7.5 times the price of biochar. Therefore the utilization of coconut shell biochar for Cd2+ and Pb2+ removal is an econ omically viable option over activated carbon.

Further studies, such as ensuring of effective permeability as a PRB media, and durabilit y of adsorption capacity under water flow conditions are needed to develop an applicabl e PRB system. Therefore the standard hydraulic conductivity tests for above tested adso rbents were conducted according to JIS A 1218. After these tests It was concluded that t he hydraulic conductivity of tested geo-material based media not complies with hydrauli c conductivity requirements for permeable reactive barriers. The proposed media needs t o be amended to improve its hydraulic conductivity to satisfy the PRB requirements.