Municipal Solid Waste Biochar to remediate its own waste; Removal of dissolve organic carbon and volatile organic compounds in landfill leachate

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Various organic pollutants detected in leachate from landfills such as dissolved organic compounds (DOCs) and volatile organic carbons (VOCs) are of environmental concern. Humic acids (HAs) are DOCs and toluene and benzene are VOCs which cannot easily be removed by conventional landfill leachate treatment. HAs and other types of DOCs are present in very high concentrations in landfill leachates from Municipal Solid Waste (MSW) dump sites. Benzene and Toluene are considered carcinogenic pollutants and are the most frequently detected VOCs in landfill leachate.

Hence, this study focuses on remediation of HAs, Benzene and Toluene using biochar produced from organic fractions of municipal solid waste (Municipal Solid Waste BioChar, MSWBC) by the pyrolyzer at the Gohagoda landfill site, Kandy, Sri Lanka to understand the potential of waste to be reused and recycled for pollution remediation. Batch experiments were performed based on different pHs, isotherms and kinetic experiments. VOCs for the landfill leachate were analyzed using head space GC-MS facility while HAs were quantified using UV-Vis Spectrophotometer at 254 nm. In addition, the physiochemical characteristics of MSWBC were determined.

The elemental analysis of MSWBC showed a high degree of carbonization during the production process of biochar. Adsorption of HAs onto MSWBC was found to be pH dependant and maximum sorption was achieved in the pH range of 5 to 6. The Hill and DR equation were the best fitting sorption isotherm models suggesting a cooperative chemical adsorption process. The maximum HAs adsorption capacity of MSWBC was 278 mg/g. Adsorption was found to reach equilibrium levels within 12 hours. The batch experiments indicated that benzene adsorption was dependent on solution pH with percentage removal becoming higher above pH 7 and the highest adsorption of 42.71 µg/g being observed in 24 hours. Maximum saturated sorption capacity of MSWBC for benzene was 224.96 µg/g.

The results revealed that MSW biochar can be successfully used to remove the HA, benzene and toluene in landfill leachates. The waste can be exploited to produce MSWBC, which can then be utilized as a material to remediate its own waste.

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