Boron removal from wastewater by using impregnated Palm Oil Mill Boiler (POMB) bottom ash

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Abstract

Boron is extensively used in glasses and ceramic industries for enhancing mechanical strength of tiles. Discharge of boron containing wastewater to the environment causes pollution due to its high solubility in water. The existing methods to remove boron include adsorption, ion-exchange, membrane filtration, precipitation coagulation and wetland treatment. However, these methods are found costly and unproductive to remove boron from the wastewater and hence infeasible for industrial wastewater treatment. Currently, palm oil industry is one of the rapid growing industry, where Malaysia is the largest producer of palm oil products. At the same time, oil palm biomass waste as fuel is a way to reduce the use of fossil fuel. The biomass waste includes the fibres and shells of oil palm, which are the residue of palm oil extraction. Palm Oil Mill Boiler (POMB) bottom ash (Figure 1) is the residue obtained from the burning of biomass waste in the boiler of a palm oil mill. Since year 1997, there were more than 200 palm oil mills with at least 400 boilers were in operation in Malaysia. Thousands of tons of ash are predicted to be produced annually. The POMB bottom ash is disposed through landfill at the mill sites. Thus, the profuse sources of POMB bottom ash at low cost make it to be an economic choice of adsorbent for boron removal in industrial wastewater treatment. In this research, adsorption on POMB bottom ash is proposed for boron removal from wastewater. POMB bottom ash is porous in nature and contains high carbon content which is a natural carbon based adsorbent. The preliminary experiment found that, POMB bottom ash at certain particle sizes is suitable to adsorb boron in wastewater. At optimum operating conditions, boron removal up to 80% can be achieved by batch adsorption. Boron concentration of the treated wastewater were reduced to 3 mg/L which satisfying the Standard B discharge limit required by Department of Environment (DOE), Malaysia. The adsorption isotherm of boron onto POMB bottom ash is in agreement to the Freundlich Isotherm.

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