
Defence Seminar

Seminar Title	: Development of a Low-Cost Adsorbent for Removal of Excess Fluoride from Water in Mining Areas.
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Venue	: Seminar Hall, Department of Mining Engineering
Date and Time	: 13 Sep 2024 (10.00AM)
Abstract	: Fluoride is an essential mineral for the body as it helps strengthen the bones and teeth, but exposure to high concentrations has dangerous health effects. Along with the scarcity of water, fluoride contamination is recognized as a major problem worldwide. The source of fluoridation may include naturally occurring minerals, coal mines or anthropogenic action. There are various studies, that used a variety of adsorbents (biomass, rice husk ash, bone char, shale, and low-grade coal) for the removal of fluoride from contaminated water, but none of them were targeted towards the vast quantity that are generated from the coal mines. In this research, Shale, a common waste generated in mining of different ores was used as an adsorbent for fluoride removal from an aqueous solution. Multi-criteria analysis of different fluoride removal processes suggested that adsorption is the best suited method. Along with the defluoridation property, the effect of weathering on the adsorption property of shale was also analyzed using different characterization tests, viz. Proximate analysis, XRD, SEM-EDS, FTIR, BET, and TGA. The maximum efficiency 47.05% was observed by using carbonaceous shale compared 43% removal by ferruginous shale. Heat activation of carbonaceous shale drastically increased the removal efficiency from 47.05% to 85.02% under the same condition, whereas chemical activation using KOH resulted in an enhanced removal efficiency of 90%. The adsorption process was found to follow pseudo-second order kinetic and Freundlich isotherms, indicating the complexity and heterogeneity of the adsorption sites. The desorption and regeneration efficiency results of both shales indicated that carbonaceous shale is better than ferruginous shale in fluoride adsorption without affecting the pH and TDS of treated water. The cost benefit analysis also showed that removal of fluoride by carbonaceous shale is substantially lower compared to ferruginous shales. This research successfully demonstrates the feasibility of using shale, a common mine waste associated with coal and iron ore mines as an effective and low cost adsorbent for removal of fluoride form vast amount of contaminated water.