

## Fluoride removal in water using Kaolin and Eggshell powder blend adsorbents

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Fluoride contamination in water has emerged as a significant global concern due to its adverse health effects when consumed in excess. This study is focused on developing an eco-friendly, cost-effective adsorbent for fluoride removal using eggshells and kaolin. Adsorbent blends were prepared by mixing kaolin and eggshell powder in six different ratios, namely; 100:0, 80:20, 65:35, 50:50, 35:65, and 20:80. Cylindrical-shaped pellets were produced from each of the blends and subjected to the thermal treatment at 950 °C. Fluoride adsorption capacities of the pellets were investigated at different pH conditions (from pH 2 to pH 10) for a 5 ppm fluoride solution with 1 g of adsorbent dosage and 60 minutes of contact time. Pellets with a 50:50 ratio (CKE<sub>3</sub>) were found to be the most effective adsorbent considering the adsorption capacity and stability at all the studied pH conditions. At pH 6, CKE<sub>3</sub> showed an adsorption capacity of 0.06 mg/g in comparison to 0.02 mg/g of kaolin-only pellets. XRD analysis indicated that CaCO<sub>3</sub> in the adsorbent has converted to CaO after the calcination. Further batch experiments were carried out with CKE<sub>3</sub> for adsorbent dosage, pH, contact time, and initial fluoride concentration. An adsorbent dosage of 4 g was capable of resulting a 53% removal of fluoride for a 5 ppm solution after 60 minutes of contact time. The pseudo-second-order kinetic model exhibited the best fit in the kinetic study. The isotherm data were studied for Langmuir and Freundlich models and the results were satisfactorily fitted with Langmuir isotherm.

**Key words:** Adsorption, Fluoride removal, Eggshell, Kaolin

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