Recovery of waste cooking palm oil as a crosslinker for inverse vulcanized adsorbent to remove iron (Fe^{3+}) ions

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Abstract. Gas and oil reservoirs around the world leave megatons of unused elemental sulfur as industrial byproducts which has been successfully used in inverse vulcanization. We reported the successful application of inverse vulcanized porous adsorbent from waste cooking palm oil (WCO) to remove ferric (Fe^{3+}) ions. Sodium chloride (NaCl) acted as a porogen to get the porous polysulfide. The removal of Fe^{3+} was observed through the atomic absorption spectroscopic (AAS) technique. The effects of pH (3,7, and 11) and initial concentration (35, 40, 45 mg/L) of Fe^{3+} solution, and dosage (10, 15, and 20 g/100mL) on Fe^{3+} adsorption were studied to determine the best removal condition. Later, fixing the best parameters (pH 3, 40 mg/L, 20 g/100mL), Langmuir and Freundlich equations were used to study the adsorption isotherm. Adsorption kinetics were described using linear and nonlinear pseudo-first and second-order reactions. The Freundlich isothermal model and linear pseudo-second-order kinetics fit best for the removal process. The comparison between the pre and post-adsorption analyses using FTIR, SEM-EDX, and the isothermal model confirmed the physisorption of Fe^{3+}. The current study concluded with some further scopes of the adsorbent for diverse removal applications.

Graphical abstract

Keywords:
Inverse vulcanization; polysulfide adsorbent; iron removal; heavy metal; waste cooking palm oil; Reaction kinetics

1. Introduction

With the ongoing industrial revolution with civilization, environmental pollution is becoming a burning question. Heavy metals are considered one of the key contributors to environmental damage. Generally, the earth's crust is their prime source and they are also non-biodegradable (Renu et al., 2017). Iron (Fe^{3+}) is one of the most toxic heavy metals which can damage human health through food, water, and air. Although iron plays a pivotal role in plant growth and human metabolism, an excessive amount of iron is responsible for human health (Bhatt et al., 2022). Ferric ion helps to grow certain micro-organisms that lead to the bad odor of drinking water, discoloration, clogging and fouling of plumbing fixtures (Armand et al., 2018; Ohimain et al., 2014) Mining activities, household activities, and