

Red mud reuse for phosphate adsorption via zirconium modification: performance, kinetics, and mechanism

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ABSTRACT

The reuse of zirconium-modified red mud (Zr-RM) as a phosphate adsorbent for wastewater treatment was assessed herein. The physicochemical properties and phosphate adsorption performance of Zr-RM were investigated, revealing a single-layer adsorption pattern according to the Langmuir isotherm model. The adsorption rate followed a pseudo-second-order model. The maximum phosphate adsorption capacity was 33.14 mg/g and was positively correlated with temperature and initial phosphate concentration, and negatively correlated with the solution pH. In a solution containing fluoride and sulfate ions, due to competitive adsorption, the adsorption capacity of phosphate decreased. The material and wastewater treatment costs of Zr-RM are 0.99 and 61.3 \$/kg of P, respectively. This study showed a potential method for using RM with high value for environmental protection.

Keywords: Red mud; Zirconium modification; Phosphate removal; Adsorption; Waste reuse

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