

***SYNTHESIS OF DITHIZONE-IMMOBILIZED MAGNETIC ZEOLITE AND  
ITS ADSORPTION STUDY TOWARDS Pb(II) ION***

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**ABSTRACT**

Research on the synthesis of dithizone-immobilized magnetic zeolite and its adsorption study towards Pb(II) ions have been conducted. The study aims to synthesize and characterize magnetic zeolite (ZTM) and dithizone-immobilized magnetic zeolite (ZTM-Dtz), to study parameters affecting adsorption and determine the mechanism of interaction between Pb(II) ions and the adsorbents with sequential desorption approach using various types of solvents, namely double-distilled water, KNO<sub>3</sub>, NH<sub>2</sub>OH·HCl, and Na<sub>2</sub>·EDTA.

Natural zeolite was first activated using 6 M HCl under a reflux process for 4 hours. Magnetic zeolite adsorbent was prepared by the coprecipitation method utilizing a mixture of Fe(II) and Fe(III) ions as precursors in alkaline conditions. Dithizone immobilization on the magnetic zeolite was carried out in an aqueous/alkaline medium using 1.5 M NaOH for 8 hours. The obtained adsorbent was then characterized using FTIR, XRD, and VSM. The adsorption ability of Pb(II) ions was tested in a *batch* system by examining the effect of the pH, adsorbent mass, contact time, adsorbate concentration, and temperature to determine the kinetics, activation energy, isotherms, and thermodynamic parameters of the adsorption.

The results show that ZTM and ZTM-Dtz adsorbents has been formed and dithizone has been successfully immobilized on the magnetic zeolite surface. The adsorption study show that the optimum conditions of adsorption on ZTM and ZTM-Dtz are achieved at pH 6 and 5, the mass of the adsorbent is 20 mg, for contact time is 60 minutes, and the initial concentration of the adsorbate is 80 mg L<sup>-1</sup>. The adsorption kinetics of both adsorbents comply the pseudo-second-order model with the adsorption rate constant ( $k_2$ ) increases along with the increasing temperatures. The activation energies ( $E_a$ ) of ZTM and ZTM-Dtz are 31.51 kJ mol<sup>-1</sup> and 23.84 kJ mol<sup>-1</sup> respectively. The adsorption isotherm follows the Langmuir isotherm model with a maximum adsorption capacity of 8.23 mg/g for ZTM and 39.53 mg/g for ZTM-Dtz. The thermodynamic parameters reveals that the adsorption takes place spontaneously with the value of the change in Gibbs free energy becomes more negative as the temperature increases, occurs endothermically, and is driven by the entropy factor. Based on the results of the sequential desorption, the interaction between the ZTM adsorbent and Pb(II) metal ions is dominated by ion exchange while in ZTM-Dtz are predicted by hydrogen bonds and complexation.

**Keywords:** magnetized zeolite, dithizone, Pb(II) ions, adsorption, desorption