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Investigation of Lead and Copper Removal from Synthetic Sewage Sludge of Sungun Copper Plant Using Hematite Adsorbent

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Abstract: There are several methods including physical, biological, and chemical procedures to remove heavy metals from water and wastewater. Adsorption is recognized as low cost and simple method with the high performance of heavy metals elimination from aqueous solution. Heavy metals removal by adsorption using iron oxides has always been a matter of interest due to the availability and low cost. In the present study, the feasibility of Pb and Cu removal from synthetic wastewater using hematite were investigated. Moreover, the effects of parameters including pH, dosage of adsorbent, dosage of contaminates, and removal time were studied. In this study, hematite was prepared using chemical precipitation method. The properties of the adsorbed compounds were determined using XRD analysis. Firstly, the adsorption process was investigated to remove lead and copper from simulated wastewater, then the attempt was to remove the mentioned metals from the original sewage sludge of Sungun factory. The optimal pH for the Pb and Cu removal was around 6. The maximum removal percent of Pb and Cu using hematite was determined as 94% and 90%, respectively. The adsorption process of Pb and Cu was in accordance with the pseudo-second order model. Further, the results revealed that the removal process of both cations were in accordance with the Langmuir isotherm model.

Keywords: Adsorption, Heavy metals, Hematite, Cu, Pb.

INTRODUCTION

Mining activities may be caused serious negative impacts on surface water quality due to release of heavy metals. Presence of heavy metals in aquatic systems could be dangerous due to their toxicity and non-biodegrability properties [1]. Thus, the removal of heavy metals from aquatic systems is considered as crucial issue. There are several methods for heavy metals removal from solution. However, adsorption is considered as one of the low cost method to eliminate heavy metals from aqueous phase [2]. Due to presence of heavy metals in Sungun copper factory wastewater, discharge of it to the environment could

have serious negative impacts on the environment. Thus, in the present study the removal of copper and lead from simulated wastewater of Sungun copper factory was studied. The hematite was selected as adsorbent due to its high capability to ion exchange.

METHODS

The hematite was synthesized using precipitation methods and characterized through the XRD pattern. Simulated wastewater cotained Pb and Cu was used to removal procedure. Effect of pH, initial concentration, and contact time was studied. Moreover, isotherm and kinetics models were applied to interpret the obtained data.

FINDINGS AND ARGUMENT

Figure 1 presents the XRD patterns of synthesized hematite. It indicates that the synthesized adsorbent is hematite in accordance with the previous studies [3].

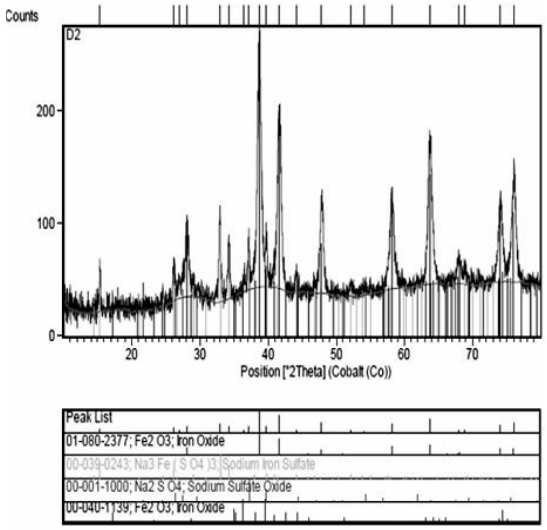

Figure 1. XRD patterns of the synthesized hematite

Based on the investigation of the effect of pH, it could be found that the the optimum pH value is around 6 for the adsorption process of Pb and Cu. Moreover, results of the kinetcs models revealed that the adsorption process of both Cu and Pb was in accordance with the psudue-second order model (Figure 2).

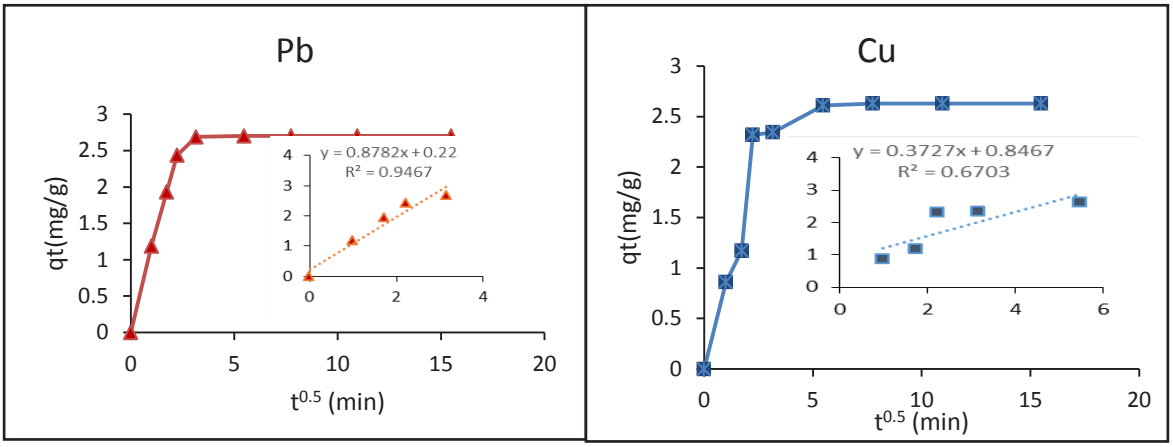

Figure 2. Kinetcs model for the adsorption of Cu and Pb

Results of interparticle diffusion model revealed the multi-linearity of the adsorption process for both Cu and Pb. The first stage indicated the difussion process and the second stage exhibted the equilibrium phase (Figure 3).

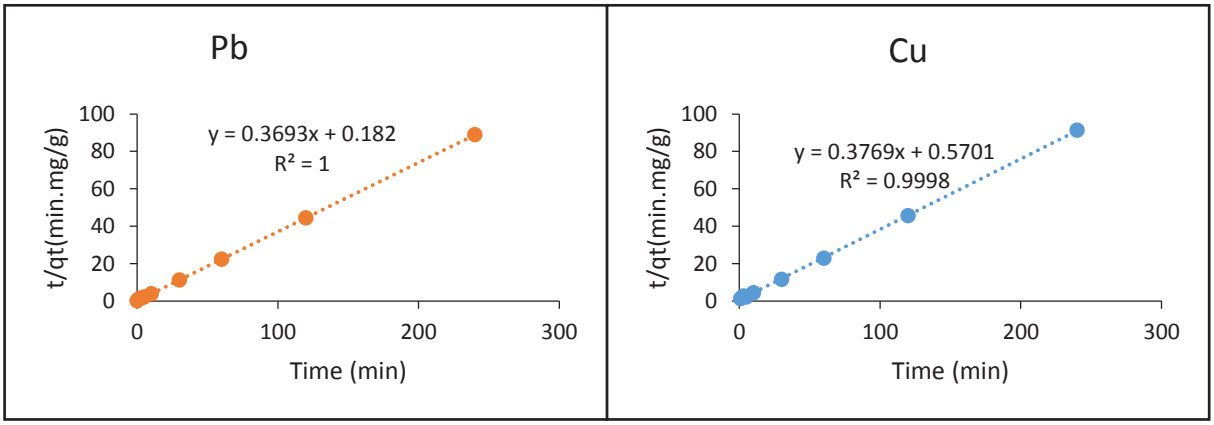

Figure 3. Interparticle diffusion model for the adsorption of Cu and Pb

Morover, results of the isotherm study indicated that the adsorption process of Cu and Pb was in accodance with the Langmuir isotherm model.

CONCLUSIONS

Results of the present study revealed that the adsorption process could be the well advanced treatment method for the removal of heavy metals from Sungun copper factory sludge. The fast removal of Cu and Pb with the high performance (more than 90%) indicated that adsorption is considered as useful tool for the remediation process.

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