

A Parametric Evaluation of the Removal As(III) and As(V) from Aqueous Water by Red Mud

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Abstract— In the present study, removal of arsenide (As(III)) and arsenate As(V) ions from water/wastewater by adsorption on red mud is investigated. Laboratory experiments were carried out to analyze removal capacity of the adsorbents, to achieve adsorption isotherms and kinetic parameters. Optimum doses of adsorbents, pH dependence of solutions, and contact time have been discussed. This study proposes the potential adsorbent material for water/wastewater which is contaminated with As species.

Keywords: Adsorption, Red mud, pH, Adsorption isotherms

Introduction

Arsenic contamination in water results in severe health problems throughout the world. Due to its toxic and carcinogenic effects on human beings, the contamination level of arsenic in water has taken serious consideration by environmental authorities. According to World Health Organization (WHO), 10 µg/L has been adopted new contamination level of arsenic in drinking water [1].

In natural water, arsenic occurs both in organic and inorganic forms. Although organic arsenic is detoxified by methylation process, inorganic arsenic is needed a well-established treatment. Inorganic arsenic exists in -3, 0, +3 and +5 oxidation states in aquatic systems. The elemental state 0 and -3 are quite rare as compared to +3 and +5 oxidation states. Especially, As(III) has greater toxicity and mobility than As(V) [2].

Experimental

In this study, a series of batch adsorption tests were conducted to evaluate red mud efficiency correlated with pH ranges. The adsorption studies were carried out by adding 2-40 g/L adsorbent to 50 mL of As(III) and As(V) working solution at concentration 5 mg/L and pH (ranging from 3.0 to 8.0).

Results and Discussion

Arsenic concentrations of the solutions were measured with a Varian, Vista-Pro CCD simultaneous inductively coupled plasma ICP-OES spectrophotometer.

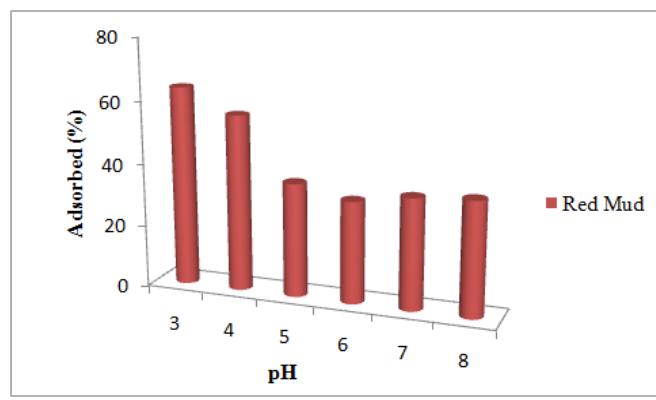


Figure 1. Effect of pH on adsorption of As (III) with red mud, initial arsenic concentration is 5 mg/L and 0.1 g red mud

Adsorption of As(III) as a function of pH for red mud at 25°C with concentration of 2 g/L and an initial arsenic concentration of about 5 ppm and adsorption time of 24 hours is presented in Fig.1. Decreased adsorption values were observed at higher pH values. The maximum As(III) adsorption percentage occurred in pH 3 that it reached 64.18%.

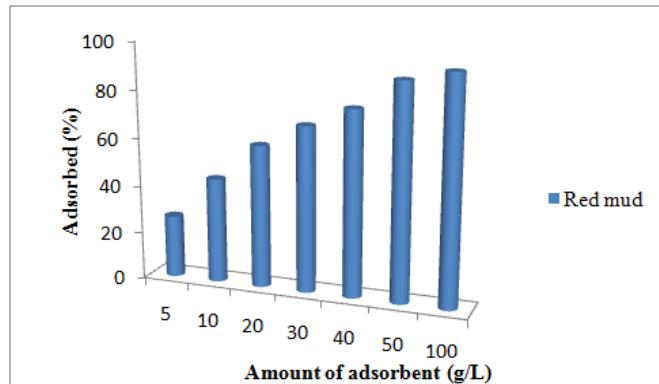


Figure 2. Effect of adsorbent amount on adsorption of As (III)

The effect of adsorbent dose on As(III) uptake was depicted in Fig. 2, which showed that adsorption efficiency of As(III) increased very rapidly with an increase in dosage of red mud from 5 g/L to 100 g/L; a marginal increased was observed on further increase in the adsorbent dose. The increase in the efficiency of removal may be ascribed to the fact that with an increase in the adsorbent dose, more adsorbent surface, or more adsorption spots were available for the solute to be adsorbed.

Conclusions

In summary, for the purpose of an economical water treatment process, removal of arsenic from water/wastewater by adsorption using red mud was investigated. This study demonstrated that red mud showed higher As(III) adsorption efficiency at lower pH values.

Since the optimum pH value and adsorbent amount for red mud were determined, forthcoming studies will be based on improving the As(III) adsorption capacities of red mud by impregnation with different metals.

References

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- [2] M.E. Pena et al, (2005), *Water Research*, vol. 39, pp. 2327-2337.