Removal of Arsenic (V) in Water using Humic Acid-Modified Meetiyagoda Kaolinite

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Introduction

Kaolinite is one of the major clay types which can be used to remove ions from the water by using its adsorption capacity (Krishna and Gupta, 2006). Though several clay types are found in Sri Lanka, significant use of them for value addition purposes is not practiced.By considering that fact and the unique ability of kaolinite to remove ions from water is targeted throughout this research.Meetiyagoda kaolinite is used as clay type, because it is currently used only as a raw material for ceramic industry and none of the researches have been conducted to investigate its ability to remove ions from water. Therefore the ultimate goal of this study is to fill that gap and develop a value added product from Meetiyagodakaolonite. This research focuses on removing arsenic (V) from water while modifying kaolinite surface using Humic Acid in order to enhance its adsorption capacity and measuring the removal amount of arsenic (V) by changing amount of clay, concentration of arsenic (V) and pH.

Methodology

The purified Meetiyagoda kaolinite sample was taken from Meetiyagoda clay refinery and it was dried, ground and sieved to obtain 75µmparticle size.This particle size was preferred because, when particle size gets smallest it increases the surface area of kaolinite which results in more adsorption of arsenic on to kaolinite surface. Humic acid was prepared by mixing dried humus with 0.5M NaOH and the pH was adjusted 4.5 by adding HCl. Ca^{2+} homo-ionized clay was prepared using kaolinite and 1M $CaCl_2$.Previously prepared humic acid was readjusted to neutral pH (pH 7) using 1M NaOH. The Ca^{2+} homo-ionized clay was added to pH neutral humic acid and the humic acid-clay suspension was incubated in mechanical shaker, then the suspension was centrifuged. Finally the humic acid coated clay sample was dried and used. The effect of arsenic removal by humic acid modified Meetiyagoda kaolinite was analysed while changing amount of humic acid modified clay, initial arsenic concentration and pH of the solution using Varian 700ES ICP-OES Atomic Absorption Spcetrophotometer.

Results and Discussion

The results in Tables 1, 2 and 3 show that the percentage removal of As(V) by humic acid modified Meetiyagoda kaolinite gives the highest removal percentage over 99% with changing amount of clay, initial arsenic concentration and pH.

Table 1. Effect of amount of humic acid modified kaolinite.

Amount of clay/g	Initial As Concentration/ mol/L	Final As concentration/ mol/L	Removal amount of As/ mol/L	Percentage removal / %
0.1	50	0.000482	49.999517	99.9991
0.2	50	0.000491	49.999508	99.9990
0.3	50	0.000499	49.999500	99.9989
0.4	50	0.000588	49.999411	99.9988

Table 2. Effect of initial As(V) concentration

pH	Final As concentration/mol/L	Removal amount of As/ mol/L	Percentage removal / %
5	0.00067	49.99932	99.9986
6	0.00032	49.99967	99.9993
7	0.00056	49.99943	99.9988
8	0.00054	49.99945	99.9989
9	0.00049	49.99950	99.9990

Table 2. Effect of pH.

Concentration/ mol/L	Final As concentration/mol/L	Removal amount of As/ mol/L	Percentage removal / %
30	0.0005	29.9994	99.9982
50	0.0003	49.9996	99.9993
100	0.0018	99.9981	99.9981
150	0.0021	149.9978	99.9985
200	0.0011	199.9988	99.9994

According to Figure 1, when increasing amount of modified kaolinite in initial solution shows decreasing pattern of removing As(V). Removal amount of As (V) has increased when increasing the initial As (V) concentration in the solution (Figure 2). Figure 3 shows that the optimum pH for removing As(V) using modified kaolinite is 6.0.

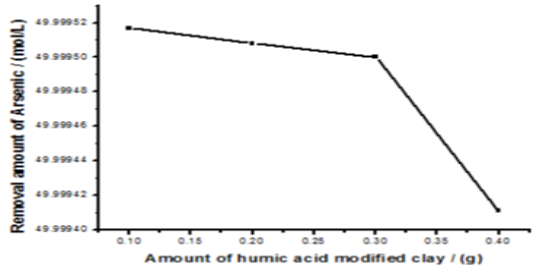

Figure 1.Influence of amount of adsorbent on adsorption of As(V) onto humic acid modified kaolinite.

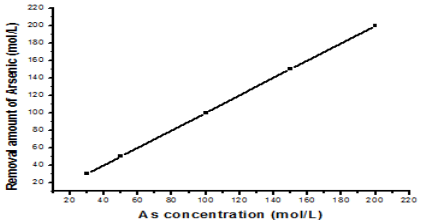

Figure 2. Influence of initial As(V) concentration on adsorption of As(V) onto humic acid modified kaolinite.

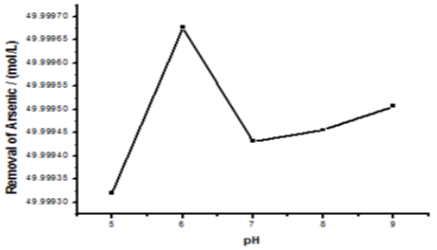

Figure 3. Effects of pH for adsorption of As (V) onto humic acid modified kaolinite.

Conclusions

This study shows that, the humic acid modified Meetiyagoda kaolinite is better for removing As(V) from water since it has obtained over 99% of removal percentage as well as the preparation cost of humic acid modified kaolinite is comparatively low when cost for other modifications are considered thus, this method is cost effective for removing As(V) from water.

References

Krishna, G.B., Gupta, S.S., 2006. Adsorption. 12, 185-204.