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ADSORPTION OF LEAD ON RED SOIL OF KUMAUN REGION OF UTTARAKHAND

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ABSTRACT

The Red soil studied for adsorptive removal of lead. The present study has been done to optimize the conditions for the maximum removal of the lead. The variation of removal efficiency with adsorption parameters pH, contact time and adsorbent dose is performed. This is first study of this kind in this field and also be useful for developing the non-conventional utilization of soil as natural adsorbent.

KEYWORDS: Red Soil, Adsorption of Pb, Cation Exchange Capacity, Organic Matter, pH, Contact Time, Adsorbent Dose, Removal Efficiency

INTRODUCTION

The Anthropological activities are very much responsible for the increase in the heavy metal concentration above the limiting values. The atmosphere is heavily polluted with the hazardous heavy metals. The water bodies are also having these contaminants above the bearable limit. Lead is wide spread non-biodegradable metal contaminant usually received though city waste, sewage disposals to soil and water bodies. Soils have good adsorption affinity for lead influenced by the physico-chemical properties including soil texture, pH, CEC and organic matter content. The present investigation is carried out to optimize the conditions for the maximum adsorption with lead removal from synthetic waste water.

MATERIAL AND METHODS

The red soil was collected from Berinag tahsil of Pithoragarh district, Uttarakhand. The soil sample were air-dried and crushed with a wooden pestle and mixer grinder. There after soil was seived through a 2mm mesh sieve. The textural analysis, CEC, pH and organic matter was determined by standard methods at Regional Soil Testing Laboratory, Rudrapur, Uttarakhand.

Adsorption Studies

The batch experimental method is used for the adsorption studies of lead onto the red soil. The synthetic waste water is prepared with lead nitrate [$Pb(NO_3)_2$] in double distilled water. In all experiments the working solution of 10 mg/L metal ion concentration were used. The 1 gm soil adsorbent is treated with 100 ml of working solution for 20 minute interaction time at 200 rpm then the filtrate is analyzed for metal ion concentration by Atomic Absorption Spectophotometry. The pH is remained constant for all experiments at 4 except in which pH is variable parameter. The amount of lead adsorbed was calculated as the difference between initial and final lead concentration in solution.

The adsorption efficiency for metal ions was calculated by formula.

The adsorption efficiency = $C_0 - C_e/C_o * 100$

C_0 & C_e are initial & final concentrations of metal ions respectively.

RESULTS AND DISCUSSIONS

The physico chemical properties of the soil reported in table 1 revealed that the soil is sandy with a high percentage of sand 80%, containing % organic matter. The pH 5.3 makes it strongly acidic soil not suitable for agricultural purposes. The CEC of soil is 16.8 meq/100g.

Table 1: Physico-Chemical Properties of Red Soil

S.N.	Property	Value for Red Soil
1	Soil textute	
	(a) Sand	82 %
	(b) Slit	10 %
	(c) Clay	8 %
2	pH	5.3
3	CEC (meq/100 g)	16.8
4	Organic Matter	0.67%

Table 2: Effect of pH on Removal Efficiency of Soil for Lead

pH	Initial Concentration (mg/L)	Final Concentration (mg/L)	Removal Efficiency (%)
2	10.000	9.650	3.5
3	10.000	9.267	7.33
4	10.000	8,723	12.77
5	10.000	7.856	21.44
6	10.000	6.254	37.46

Table 3: Effect of Contact Time on Removal Efficiency of Soil for Lead

Contact Time (min.)	Initial Concentration (mg/L)	Final Concentration (mg/L)	Removal Efficiency (%)
20	10.000	8.723	12.77
40	10.000	8.416	15.84
60	10.000	8.125	18.75
80	10.000	7.862	21.38
100	10.000	7.557	24.43

Table 4: Effect of Adsorbent Dose on Removal Efficiency of Soil for Lead

Adsorbent dose (g)	Initial Concentration (mg/L)	Final Concentration (mg/L)	Removal Efficiency (%)
1	10.000	8.723	12.77
2	10.000	8.389	16.11
3	10.000	8.022	19.78
4	10.000	7.327	26.73
5	10.000	7.108	28.92

The effect of pH variation is illustrated in table 2, shows that removal efficiency 3.5 % and on high pH 6 the removal efficiency for lead increased to 37.46 %. As the contact time increased from 20 minutes to 100 minutes the efficiency gradually rises from 12.77 % to 24.43 % (table 3). The similar behavior is obtained with increasing adsorbent dose. With 1 gm adsorbent the removal efficiency is 12.77 % while 5 g adsorbent 28.92 % removal has been achieved (table 4).

CONCLUSIONS

Adsorption of lead increased simultaneously with the pH of the working solutions. Amount of lead adsorbed has been related to interaction time, as more interaction increased adsorption efficiency. Results revealed that amount of adsorbent have positive effect on adsorption. It concluded from study that the for highest adsorption efficiency the optimized conditions are high pH 6, more interaction time and more availability of adsorbent. These results also confirm that red soil is a sufficient adsorbent for lead.

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