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Original Research Article

Packed Bed Studies for Iron and Chromium Removal by Low Cost Adsorbents

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ABSTRACT

Removal of heavy metals by low cost adsorbents is effective way of heavy metal treatment. Batch experiments are generally carried out for determining kinetics, isotherms and affecting parameters. Practical application of adsorbents calls for studies on different contacting equipments. Packed and fluidized beds can be used for removal of heavy metals from wastewater. In the current investigation, packed bed, 45 mm in diameter is used for adsorption of iron and chromium from synthetic effluent. The break through time was observed to be 40 to 45 minutes for removal of these heavy metals. Ideal adsorption time was 88 to 90 minutes.

Key words: Heavy metals, adsorbent, breakthrough time, ideal adsorption time, concentration.

INTRODUCTION

Heavy metal removal by adsorption is efficient treatment method for metal ion removal from industrial effluent. Batch experimentation for heavy metals has been carried out by various investigators with different adsorbents. [1-3] The main objective of these studies was to study affecting parameters, kinetics and isotherms. [4-7] These studies help in understanding the mechanism of adsorption and estimating possible extent of removal. The column data can be used for designing equipments for adsorption. Investigations on packed bed for removal of phenol and heavy metals have been carried out by researchers to study break through curve and estimate breakthrough time. [8-12] In the present investigation packed column studies have been carried out with bagasse adsorbent [BA] and groundnut shell adsorbent [GSA].

MATERIALS AND METHODS

Preparation of Adsorbents

The adsorbent was prepared from the low cost raw materials (bagasse and groundnut shells). The material was sun dried and then kept in oven at 150^{O}C. Then it was treated with strong acid. It was then carbonized in the furnace at 300^{o}C and washed. The washed product was then filtered out and dried at 120^{o}C.

Preparation of Stock Solution

An aqueous stock solution of Iron (Fe) (III) ions (1000ml/l) was prepared by using ferrous ammonium salt. Chromium (Cr) stock solution was prepared by dissolving appropriate quantity of $K_2Cr_2O_7$ in water.

Column Experimentation

A column with height of 45 cm was made with the bagasse and ground nut shells and small stones as a packing medium. The

iron and chromium adsorption was performed for individual adsorbent.

RESULTS AND DISCUSSION

Bagasse Adsorbent (BA)

The results of column experiments for iron and chromium removal by bagasse adsorbent (BA) are shown in Table 1 and 2 respectively. For iron adsorption the break through time, considered as time required for reaching 10 percent of initial concentration was observed to be 40 minutes. The ideal adsorption time (time to reach 50 percent initial concentration) was observed to be 90 minutes. The values of break through time and ideal adsorption time for chromium removal by bagasse adsorbent were observed to be 40 minutes and 88 minutes respectively. The saturation time was 130 minutes for both metals

Table1: Iron removal by BA

Time (min)	% Adsorbed
10	0
20	0
30	0
40	6.42
50	17.81
60	19.03
70	24.11
80	35.79
90	50.91
100	69.22
110	78.13
120	83.63
130	88.21
140	88.42
150	88.37

Table 2: Chromium removal by BA

Time (min)	% Adsorbed
10	0
20	0
30	0
40	9.21
50	15.82
60	19.82
70	26.32
80	37.07
90	55.21
100	69.92
110	78.33
120	81.12
130	86.27
140	86.62
150	86.79

Groundnut Shell Adsorbent (GSA)

Table 3 and 4 depicts the results of column studies for iron and chromium removal respectively with GSA. As shown in table 3, for iron removal, breakthrough time and ideal adsorption time were observed to be 45 minutes and 90 minutes respectively. For chromium removal, as shown in table 4, these values were 57 minutes and 90 minutes respectively. Saturation time was 130 and 120 minutes respectively for iron and chromium.

Table 3: Iron removal by GSA

Time (min)	% Adsorbed
10	0
20	0
30	0
40	4.82
50	15.41
60	19.03
70	23.12
80	31.79
90	50.81
100	71.45
110	79.21
120	84.99
140	85.57
150	85.81

Table 4: Chromium removal by GSA

Time (min)	% Adsorbed
10	0
20	0
30	0
40	2.11
50	3.42
60	14.87
70	21.33
80	30.19
90	49.79
100	69.82
110	76.69
120	82.31
130	82.57
140	82.66
150	82.89

CONCLUSION

Packed column removal of heavy metals is practical and efficient method of treatment. The breakthrough time obtained was 40 to 50 minutes for heavy metals. The ideal adsorption time was observed to be 88 to 90 minutes. The time required for saturation of bed varied from 130 to 150 minutes. The maximum percentage removal obtained in the experiments was 88.42 percentage for iron and 86.79 percent for chromium, both for bagasse adsorbent.

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