ADSORPTION OF HEAVYMETAL FE BY BIRDBONE PARTICLES FROM THE INDUSTRY EFFLUENT

Abstract

Birdbone particles help to remove heavymetal iron from the titanium industry effluent.

The binding of Fe by birdbone was found to be mainly influenced by pH, birdbone absorbed the highest quantity of iron at pH 7 and when 5g of adsorbent was leaving only 278.27±0.93 ppm of Fe in the raw untreated effluent. The metal uptake by birdbone particles was maximum at room temperature and 254.71±0.84 ppm of Fe was left in the effluent after adsorption Temperature when increased absorption increased hence directly proportional.

Keywords: Adsorption, Fe uptake, birdbone powder, titanium industry effluent.

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I. INTRODUCTION

Heavy metals released into the environment by industrial activities, become a serious threat to the environment (Kuppusamy *et al.,* 2004).

Bonechar is an adsorbent, mainly produced by the carbonization of bone (Choy and Mckay, 2005; Smiciklas *et al.,* 2008). It is used in the sugar refining industry to remove the color from sugar solutions (Gary *et al.,* 2007; Ofomaja and Ho, 2007).

Bonechar, a mixed adsorbent containing around10 percent carbon and 90 percent calcium phosphate, is mainly produed by the carbonization of bone (Choy and Mckay,2005; Smiciklas et al., 2008)

II. MATERIALS AND METHODS

1. **Preparation of Bone Char:** Bird bones collected from common fowls and the boneswere crushed into small fragments in a mechanical crusher and dried at 60°C in a hot air oven for 24h, then powdered in an electric blender and sifted inan 80 mesh sieve (<180 μm).

   Powdered adsorbents were mixed with the two different types of effluents raw as such and other treated effluent in 5 different concentrations(1, 2, 3, 4, and 5 mg/*l)*. Medium was separately maintained at six different pH levels (0.5, 2, 4, 7, 8, and 9). Thoroughly mixed with the toxicant solution and the mixture was agitated once in 2 h. The treatment was run for a period of more than 60 days. The Fe content of the effluents was estimated after 60 days of interaction with the bird bone powder.The difference between the initial and final levels indicated the quantity adsorbed.

   A 250ml Erhlen – Meyer flask was used to assess the effect of temperature. These flasks were incubated and maintained at temperatures 42, 32, and 28°C respectively. The experiments were continued for more than 60 days the quantities of Fe were estimated in the raw and untreated effluent.

2. **Estimation of Heavy Metal (Fe):** An Atomic Absorption Spectrophotometer (ELICO) model with Air-C2H2 flame type, was used for sample analysis.. The samples were finally injected into an AAS flame and the reading was directly measured.

III. RESULT AND DISCUSSION

Bird bone powder adsorbed the highest quantity of iron at pH 7 and when 5g of the absorbent was used leaving behind only 278.27$\pm$ 0.93ppm of Fe in the raw treated effluent. At pH 0.5, adsorption of Fe was minimum, and at 5g bird bone powder concentration, the Fe concentration of the raw treated effluent was 291.15 $\pm$ 0.84 ppm was left in the medium (Table 1).

The chromium adsorbed at 5g of bird bone at 28°C was highest at 245.30 $\pm$ 0.92 and the lowest adsorptionat 1g at 42°C was 275.94 $\pm$ 0.98 of iron left behind in the raw untreated effluent (Table 2).

The pH influenced the adsorption of Fe by bird bone powder. At acidic pH levels, the quantity of Fe absorbed is much less compared to neutral and alkaline pH levels. Thus pH plays a vital role in determining the quantity of Fe adsorbed from the medium by bird bone powder. The pH seemed to modify the adsorption potential of bird bone powder and the pH should be maintained at 7.0 to achieve maximum adsorption of Fe.

The temperature was another significant factor determining the adsorption of heavy metals. At higher temperatures (42^{o}C) adsorption was much less compared to lower temperatures (28^{o}C).

Namasivayam and Senthilkumar (1998) reported thata certain amount of adsorbents does not increase in the adsorption reaching equilibrium.Chojnacka (2005) and Chen*et al.* (2006) pointed out that cow bone charcoal(when the size of the ion becomes small),as a microporous adsorbent, metals penetratethese pores.

Ibrahim *et al.* (2012) studied the capacity of chromium and lead and used cow bone charcoal at 30^{o}C. Olaniyi *et al.* (2012)studied that, cow bone has the effect of temperature for the removal of metals.

Differentfunctional groups such as carboxyl, hydroxyl, and amide are responsible for the biosorption of metal ions andpotential sites for adsorption and the uptake of metal and their accessibility and affinity between the adsorption site and metal(Han *et al.* (2007) and Jain *et al.* (2009).

Moreno *et al.* (2010) stated that iron removal increasedfrom 0.01 g to 0.02 g cow bone charcoal dosages. At 30^{o}C, cow bone reported the effect of temperature on the removal of metals using an immobilized sorbent obtained from poultry waste(Olaniyi *et al.* (2012)).

Table 1: Fe Adsorption from Titanium industry effluent(treated) at different pH

S. No	Amount (in g)of bird bone powder	Fe in the effluent (ppm) control	Fe (ppm) in effluent					
			pH					
			0.5	2	4	7	8	9
1	1	452.25 ± 1.02	317.00 ± 0.85	312.39 ± 0.54	309.55 ± 0.51	297.69 ±0.60 (-34.00)	298.49 ±0.60	302.00 ±0.72
2	2		314.62 ± 0.65	307.20 ± 0.84	303.37 ± 0.47	291.16 ±0.93 (-35.44)	296.17 ±0.76	298.15 ±0.99
3	3		311.65 ± 0.85	302.23 ± 0.65	296.85 ± 0.76	285.88± 0.73 (-36.60)	291.41 ±0.98	293.68 ±0.92
4	4		311.10 ± 0.78	308.49 ± 0.71	306.98 ± 0.65	284.23± 0.85 (-36.96)	286.27 ±0.81	289.52 ±0.93

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5	5			291.15 ± 0.84	290.31 ± 0.79	286.27 + 0.81	278.27± 0.93 (-38.28)	281.23 ±0.80	283.18 + 0.86

Note: Percent decrease in Fe concentration in parentheses

Deviations significant at $P \leq 0.05$ (t-test)

Table 2: FeAbsorption from Titanium industry effluent(raw untreated) at pH 7 at different temperatures

S.No	Amount (in g) of bird bone powder	Fe in effluent (ppm)control	Fe (ppm) in effluent		
			Temperature (° C)		
			28	**32**	**42**
1	1		263.45 ± 0.96 (-41.54)	274.26 + 0.73	275.94 + 0.98
2	2		258.91 +0.70 (-42.53)	269.31 ± 0.87	271.55 ±0.85
3	3	452.25 ± 1.02	253.82 +0.65 (-43.65)	265.17 + 0.80	267.53 ± 0.89
4	4		246.39 + 0.57 (-45.29)	259.91 + 0.72	261.63 ±0.92
5	5		245.30 + 0.92 (-45.53)	254.71 +0.84	257.77 ±0.75

Note: Percent decrease in Fe concentration in parentheses

Deviations significant at $P \leq 0.05$ (t-test)

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