Removal of Heavy Metals from Synthetic Waste Water using Natural Adsorbent

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Abstract— The aim of project is the selection of the best adsorbent material for removal of copper and cadmium exclusively and determination of optimum operating conditions. Hence an attempt has been made in the present work to use the low cost adsorbent i.e. Alluvial Soil which can be utilized for the removal of copper and cadmium from waste water by adsorption techniques using batch study.

Whenever toxic heavy metals are exposed to the natural ecosystem, accumulation of metals ions in human bodies will occur through either direct intake or food chains. Copper and cadmium are out of those which the excess intake proves to be harmful and fatal to human as well as aquatic life. Present study dealt with deriving the effectiveness of low cost absorbent such as alluvial soil .for removal of Lead and copper from synthetic water with batch method was employed to study the effects of various parameters like pH, stirring rates and contact time etc., on removal of copper and cadmium from metal solution.

Keywords—Adsorbent ,Copper Cadmium

I. INTRODUCTION

In recent past growth of population lead to increased industrialization. Which ultimately resulted in types of pollutions like water, noise, soil, air pollution etc. In spite of continuous improvements in manufacturing processes, newer several technological innovations in treatment of various wastes, still there is need to achieve improvements regarding cost-effectiveness, availability of materials etc. to remove the impurities from waste of any kind.

Heavy metals, as seen earlier are of prime importance in regard of their removal from water and waste-water. Since they directly or indirectly relate with human and aquatic animals' and plants' health, they need more attention regarding concentrations in water and waste-water.

Present study deals with study of new low cost materials and their efficiency to achieve removal of heavy metals from waste water. It is relatively high density, or of high relative atomic weight. Heavy metals are toxic. These metals find their way into the aquatic environment through waste water discharge because they are non-biodegradable; they tend to accumulate in aquatic organisms. Feeding aquatic organisms such as fish, crabs or using such contaminated water can lead to metal poisoning in man. Heavy metals pose health hazards, if their concentrations exist above the allowable limits. Even when the limits are not exceeded, there are still the potentials of a long term poisoning, since they are known to accumulate within biological systems.The increasing awareness of the environmental consequences arising from heavy metal accumulation of aquatic environment has lead to the demand for the treatment of industrial waste-water before discharge into aquatic environment.

Adsorption is a process that occurs when a gas or liquid solute accumulates on the surface of a solid or a liquid (adsorbent), forming a molecular or atomic film (the adsorbate). Adsorption is operative in most natural physical, biological, and chemical systems, and is widely used in industrial applications such as activated charcoal, synthetic resins and water purification. Among these methods, adsorption is currently considered to be very suitable for waste-water treatment because of its simplicity and cost Adsorption is commonly used technique for the removal of metal ions from various industrial effluents. Activated carbon is the most widely used adsorbent. It is a highly porous, amorphous solid consisting of micro crystallites with a graphite lattice, usually prepared in small pellets or a powder. It can remove a wide variety of toxic metals. Some widely used absorbent for adsorption of metal ions include activated carbon , clay minerals , materials, industrial solid wastes and zeolites. Natural material or certain waste from industrial or agricultural operation is one of the resources for low cost adsorbents.

II. MATERIALS AND METHODS:

It is decided to remove heavy metals by using natural absorbent as per reference natural alluvial soil is used as absorbent.

Materials**:** Alluvial soil

A. Preparation of standard solution of metal :

The sample were prepare from concentrated aqueous solutions of pb, Cd (1000 ppm each) in distilled water. They were diluted to give initial concentrations of 5.00 and 7.00ppm.

B. Collection and preparation of adsorbent:

Alluvial soil were collected from Godavari River which situated in Kopargaon , after collection of alluvial soil it dried in an oven at temperature of 105 OC for 1hour ,then specific gravity is checked using density bottle then after this other parameters like bulk density and particle density were checked and obtained results are shown in the below table,

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Sr. No.	Properties	Observed Values
1	pH	7.35 to 7.40
2	Specific Gravity	2.25
3	Particle density	2.525
4	Bulk Density	1.4 gm/cm3

TABLE 1 PROPERTIES **OF ALLUVIAL SOIL OBTAINED**

C. Specific gravity:

The specific gravity of the sample was determined using specific gravity bottle. The sample was dried at 105 ^{0}C until a constant weight was obtained. A pre-weight specific gravity bottle was taken (whose volume was known) and filled with the dried sample. Its weight was recorded. Another same pre-weighed specific gravity bottle was taken of same volume and filled with the dried sample. Its weight was recorded. Another same pre-weighed specific gravity bottle was taken of same volume and filled it with distilled water and its weight was recorded. The specific gravity was then calculated using the following formula:

Specific gravity =**Error! Reference source not found.**

Where,

A1 = weight of empty bottle with distilled water.

A2 = weight of bottle used for sample.

B = weight of the empty bottle used for distilled water.

D. Bulk density (g/cm3):

Specific gravity bottle of 50 ml. capacity without the stopper was weighed. Then it was filled with the sample upto the edge of the neck tapping the bottle upto 20 times and weighed . The bulk or apparent density was obtained by dividing the weight of the sample with volume of the sample.

$$\text{Bulk density} = \frac{W_2 - w_1}{V}$$

where, weight of the empty bottle =W1

weight of the bottle + sample =W2

volume of sample = V

E. Particle density (g/cm^3) :

A clean dry pycnometer was weighed out and filled it with oven dried sample upto half of its volume .The outside and neck of the pycnometer bottle was clean to remove any sample adhering .The stopper was inserted and weighed. The boiled and cooled distilled water was added into the pycnometer (partially filled with sample until the level of water reaches 3/4th of the volume of the pycnometer). Now the pycnometer was heated gently to remove the entrapped air. Now contents were agitated to remove the entrapped air. Now the contents were agitated gently to prevent of sample by foaming. After the contents was cooled and space in the pycnometer was filled with distilled water. Then the stopper was inserted. The outside of pycnometer was dried by wiping it dry with a cloth and weighed. After that, the soil water suspension from the pycnometer was removed weighed with tap water and rinsed it with distilled water. Then the pycnometer was filled with distilled water completely. Now the stopper was inserted spilling some water through the mouth.

F. PH:

The pH meter was calibrated using pH 7 buffer solution then meter was adjusted with known pH of buffer solution 4.0 and 9.2 , 20 gm of soil weigh and transferred into 100 ml beaker,40 ml distilled water was added and stirred well with a glass rod this was allowed to stand for a half an hour with intermittent stirring.

To the soil water suspension in the beaker the electrode was immerged and pH value was determined from the atomic display of pH meter.

G. Testing and Experimental study:

100 ml of either the 5.00 or 7.00 ppm solution of lead is mixed with a given amount of known adsorbent, with continuous stirring for specified time. Then the mixture is filtered through Whatman filter paper No. 42 and the metal concentration ofthe filtrate can measure. Metal ion concentrations were measured by Atomic Absorption Spectroscopy (Bulk Scientific Model 2001) using the standard methods of the Association of Official Analytical Chemists (AOAC).

III. RESULT *AND DISCUSSION:*

TABLE NO.2

Independent Variable	Range And Level				
	-α	-1	0	1	α
pH	4	5	6	7	8
Adsorbent Dose	1	2	3	4	5
Initial Concentration	1	2	3	4	5
Stirring Time	30	60	90	120	150

TABLE NO.3

Run No.	Independent Variable				% Removal	
	X1	X2	X3	X4	Cd	Cu
1	5	2	2	60	85.15	96.75

2	7	2	2	60	87.70	97.30
3	5	4	2	60	61.35	97.65
4	7	4	2	60	82.90	98.00
5	5	2	4	60	71.03	83.25
6	7	2	4	60	61.23	99.00
7	5	4	4	60	77.95	98.05
8	7	4	4	60	83.35	98.95
9	5	2	2	120	61.50	97.80
10	7	2	2	120	76.05	98.05
11	5	4	2	120	83.60	96.95
12	7	4	2	120	86.15	97.95
13	5	2	4	120	80.40	0.25
14	7	2	4	120	72.50	99.18
15	5	4	4	120	74.95	98.83
16	7	4	4	120	74.65	98.70
17	4	3	3	90	63.33	98.57
18	8	3	3	90	90.20	98.67
19	6	1	3	90	72.67	95.67
20	6	5	3	90	62.00	98.53
21	6	3	1	90	65.00	97.80
22	6	3	5	90	79.90	99.26
23	6	3	3	30	85.53	99.07
24	6	3	3	150	67.07	98.47
25	6	3	3	90	66.77	98.43
26	6	3	3	90	71.90	98.23
27	6	3	3	90	67.13	96.97
28	6	3	3	90	77.97	98.50
29	6	3	3	90	82.00	98.50
30	6	3	3	90	81.80	98.47

IV. CONCLUSION:

1]As the environmental impact of industrial activities increase, consequently the public awareness places greater pressure on business and governments for reducing the pollution. Hence, more stringent environmental regulations are being enacted and enforced the around world. More demand for effective remedial technology results in many opportunities for adsorption which leads to future success.

2]A wide range of low cost adsorbents have been studied worldwide for toxic or heavy metal and it is evident from this work, that inexpensive and locally available material could be used.

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