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Removal of Zinc from Synthetic Waste Water By Saw Dust As An Adsorbent

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ABSTRACT

The industrial waste water contains highly toxic metal. The heavy metal such as Zn^+ are highly toxic and harmful for the living organism .different salt of zinc like zinc chloride is responsible for the many hazardous disease .There are so many different technique used for the purification of these waste water and removal of these heavy metal like ion exchange, solvent extraction, precipitation. But all these method are highly expensive and required proper setup to be used. The adsorption is the one of the most inexpensive mass transfer operation which is also used to remove these impurities the commonly used adsorbent used in the industries are activate charcoal or activate carbon which gives good result but highly expensive .There are so many alternative present in our environment which can easily replace this activate carbon with better efficiency .sawdust is one of them as it contain lignin and cellulose which easily traps all the impurities present in the waste water in the form of heavy metal like Zn^+. The present paper is about the experiment performed and the result showed the maximum removal of Zn^+ ion by sawdust is 90%.

Keywords:-sawdust, heavy metal, waste water, Zn^+, adsorption process.

1. INTRODUCTION

Zinc is the one of the important toxic heavy metal found in the waste water. Zinc is a chemical element with the symbol (Zn^+) and atomic number 30 .Zn^+ found in industries such as electroplating, battery manufacturing , painting , paper , pigments , explosive etc[1,2] .large amount of Zn^+ exposures causes depression, lethargy , neurological sign and increased thirst [3][4]

There are so many method which is easily available for reducing the concentration of the heavy metal in the waste water .The heavy metal can be treated via precipitation with hydroxide, ion exchange, reverse osmosis, electro dialysis, oxidation, reduction and adsorption [5][6].the removal of heavy metal by adsorption onto low cost waste material which is easily found in environment has recently become the important subject of considerable interest. Natural material that are found in large quantities, or certain waste product from industries and agricultural operation they have potential as a inexpensive adsorbent .due to their low cost, easily available ,easily found anywhere after these material can be expended ,they can easily disposed of without

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expensive regeneration[7].The wide variety of material such as fly ash[8, 9],peat[10] ,phenolic resin[11] ,wood[12] , maize cob[13], natural clays[14] ,activated sludge[15] , wood chips[16] ,jift[17] , palm fruit bunch particles[18], nanosize modified silica[19] , sugar beet pulp[20],activated carbon from fertilizer waste[21] ,olive mill products[22], activated slay[21 ,23] , bassage fly ash[24] , are widely used as a low cost adsorbent which is alternative to the activated carbon and charcoal[6].

Sawdust is one of the important possible material as it is produce in large quantities at sawmill as a waste material. Sawdust is made up of primarily lignin, cellulose and hemicellulose which easily traps the impurities present in the waste water as a heavy metal ion. The main interest in the use of sawdust as an adsorbent has been simulated by the good result that have been obtained [25][26] .

Adsorption is the mass transfer operation and it is a fundamental process in physicochemical treatment of waste water. The two phase interface involves accumulation of substance like liquid-liquid, liquid-gas, liquid-solid is called process of adsorption .the substance which adsorbed in the adsorbate and the adsorbing material is termed adsorbent. The driving force for adsorption process is surface affinity, chemical reactivity, pH, surface area for adsorption per unit volume and reduction in surface [27]

Table 1:-Varying tolerance limit of heavy metal in waste water

S.no	Heavy metal	Maximum tolerance limit in (mg/l)
1.	Chromium	0.05
2.	Mercury	0.1
3.	Copper	0.25
4.	Iron	0.1
5.	Cadmium	0.01
6.	Zinc	0.8
7.	Cobalt	0.5

2. MATERIAL AND METHOD

2.1 Preparation of sawdust

The ground sawdust was sieved and particle size of 100µm is taken. After that the sawdust were soaked in distilled water for 30 min and washed it with distilled water, the process is repeated until the clear distilled water will be obtained after washing.

The sawdust is dried in room temperature for 5 days then dried at60^{o}c in oven for 30 -40 min.

2.2 Preparation of synthetic waste water

Product number 28985, (Qualigens fine chemicals) of $ZnSO_4.7H_2O$ was taken for purification synthetic 1000ppm stock solution was prepared.

Zinc solution: - 4.40gm of $ZnSO_4.7H_2O$ added in 100ml of distilled water and mixed in 1000ml of volumetric flask and dissolved by shaking the solution .the concentration of the zinc solution is 1000mg/l.

2.3 Analysis

The concentration of zinc was determining using spectrophotometer at 310nm.

Fig 1:-UV –visible spectrophotometer

S. no	Instrument	Grade
1.	pH meter	µpH.System 361 Systronics
2.	Weight balance	KEA 210 K.Roy Instrument Pvt. Ltd.
3.	Watman No.1 filter paper	11µm
4.	Uv-visible spectrophotometer	Model UV 1700 Shimadzu corporation

Table 2:- list of equipment used during experiment

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3. RESULT AND DISCUSSION

3.1 Adsorption process

Heavy metal Zn^+ ion on sawdust adsorption was studied by batch process. The method used for the experiment is described below.

A known quantity of sawdust adsorbent (e.g. 0.5gm adsorbent) was treated with 100 ml of the heavy metal solution (Zn^+) of the concentration (10, 20, 30 ppm) in glass flask at a temp (30^0 C) and contact time (30-150 min). After treating collect the sample from the glass flask .The suspension solution can be separated from the adsorbent by using whatman No. 1 filter paper.

The concentration of heavy metal ion remaining in solution was measure by UV-visible spectrophotometer (Systronic 361).The parameter such as pH, contact time and adsorbent dose having various effects on adsorption process that was studied. The pH of the solution was adjusted using sulfuric acid, sodium hydroxide and buffer solution.

3.2 Formula used

The percentage removal efficiency of zinc can be determined by

$$\text{Metal ion removal (\%)} = \frac{C_o - C_e}{C_o} \times 100$$

where, C_o (mg/l):- is the initial metal ion concentration in the solution.

C_e(mg/l):- is the final metal ion concentration in the solution.

3.3 Factor effecting adsorbent

1. Effect of dose (adsorbent)

The experiment is carried out by varying the amount of adsorbent dose from 0.1 to 0.5gm and the adsorption efficiency of Zn^+ is studied by keeping the pH, contact time constant .The efficiency of zinc increased on increasing adsorbent dose. By reviewing some research paper lead to the conclusion that the greater availability of exchangeable sites for the ion is provides with the higher dose of adsorbent. From figure 2 the maximum % removal of Zn^+ was about 90% at the dose of 0.5 gm

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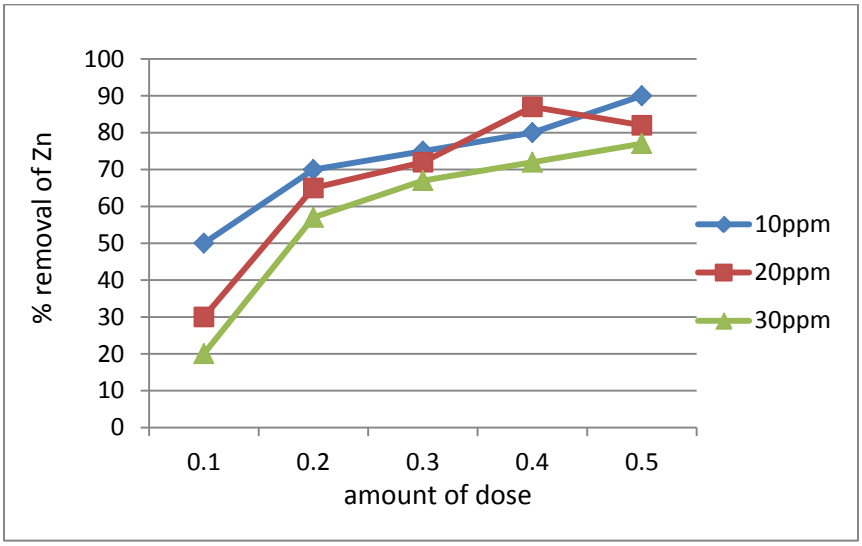

Fig 2. Effect of adsorbent dose on % removal of Zn by sawdust

2. Effect of pH

The pH influenced the removal efficiency of the Zn^{+} ion in the solution .The result indicates that Zn^{+} removal increased to maximum and then decrease with the variation of pH from 5 to 7 and temp 30^{o} C. From figure 3 the maximum % removal of Zn was about 90% at pH 5.

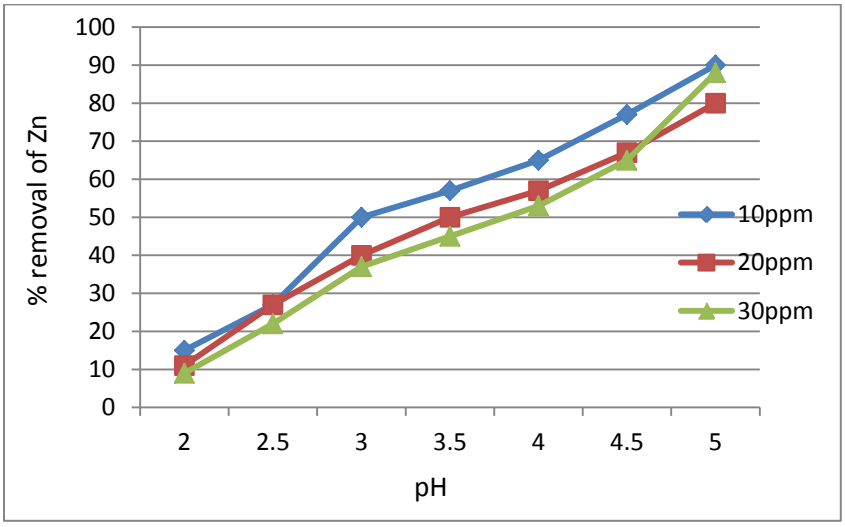

Fig 3. Effect of pH on % removal of Zn by sawdust

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3. Effect of contact time

The contact time effect the adsorption process of Zn was determined by conducting the experiment of adsorption at different contact time (30-150 min) .The amount of adsorbent was 0.5 gm .From figure 4 the plot show that the percentage removal of zinc was higher after 60 min of the beginning due to the large surface area of the adsorbent available for the adsorption. Equilibrium adsorption was reached a t 120 min

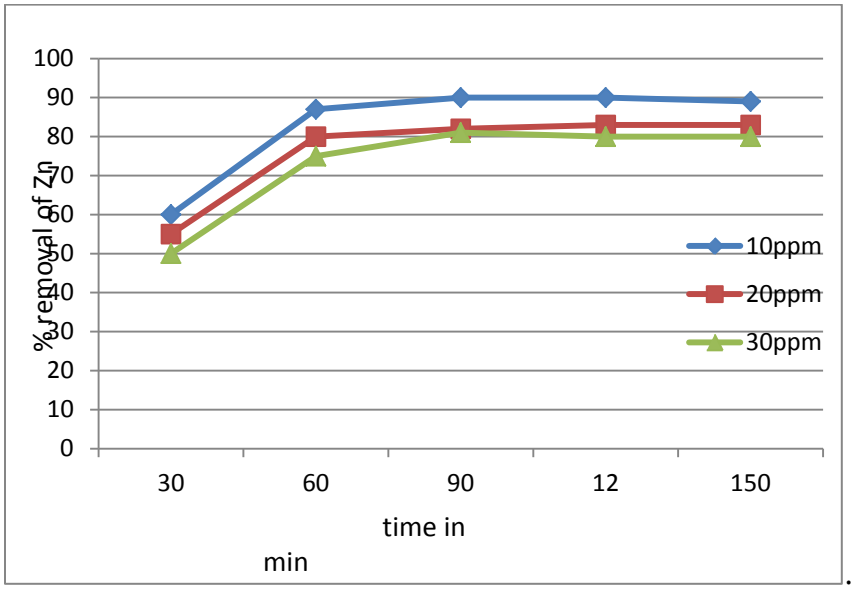

Fig 4. Effect of contact time on % removal of Zn by sawdust

4. CONCLUSION

Sawdust is a cheap and effective adsorbent for the removal of zinc ion from waste water. Experiment is carried out and showed that maximum removal of Zn^{+} by sawdust at optimum condition (5 pH, 120 min contact time, 0.5gm/100 ml adsorbent dose) is 90%. For the development of advanced technology, the removal of heavy metal ion from waste water is very useful.

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