IOSR Journal of Engineering (IOSRJEN) **www.iosrjen.org**
ISSN (e): 2250-3021, ISSN (p): 2278-8719
Vol. 06, Issue 11 (*Nov*. 2016), ||V2|| PP 25-29

Comparative study of Removal of Cu and Pb from Aqueous Solution by using Rice Husk Ash as an Adsorbent

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Abstract:- The adsorption efficiency of Rice husk ash powder for the removal of Cu and Pb was studied as Rice husk ash consist of silica , alumina , mangnesium oxide , calcium oxide etc. The research is a batch scale experiment using different amount of adsorbent in solution with five different concentrations (5, 10, 15, 45,100 mg/L) of both metals and in mixed combination. About 92% to 100% Cu removal achieved by using 0.5 to 1.5 g adsorbent for solution having concentration of 5 and 10 mg/L of Cu. Two main things comes out by the above study, first, the adsorption efficiency depends on the amount of adsorbent as the adsorption efficiency of Pb was increased from 80% to 100% in the same solution (5mg/L). it was also found that adsorption efficiency decreased about 2.5 % and 5.8% of Cu and Pb to mixed metal solution, which clearly indicates that the presence of more metals in the solution will decrease the adsorption efficiency.

I. INTRODUCTION

The release of industrial effluents containing heavy metals to the river water causes several adverse effects. Water is essential to all forms of life and makes up 50-96 % of the weight of all plants and animals. It is also a vital resource for agriculture, manufacturing and other human activities. In urban areas, the careless disposal of industrial effluents and other wastes in rivers & lakes may contribute greatly to the poor quality of river water [1-4]. African countries and Asian countries experiencing rapid industrial growth and this are making environmental conservation a difficult task[5] . Heavy metals are dangerous environmental pollutants due to their toxicity and strong tendency to concentrate in environment and in food chains[6-7] . The source of environmental pollution with heavy metals is mainly industry, i.e. metallurgical, electroplating, metal finishing industries, tanneries, chemical manufacturing, mine drainage and battery manufacturing [8]. Considerable research been carried out over the last decade on the protection against plant and animal life degradation. Several big cities contribute to increase this problem, as they are sources of industrial effluents. In order to reduce the environmental pollution, a number of studies been considered to minimize the problems caused by the commonly employed treatment of metal bearing effluents [9-10]. Removal of metals from wastewater achieved principally by the application of several processes such as adsorption[6], sedimentation[11], electrochemical processes[12], ion exchange[13] ,cementation[14], coagulation/flocculation[15] , filtration and membrane processes[16] Chemical precipitation and solvent extraction[17-18] . Adsorption is the one of the important procedure for the removal of heavy metals from the environment because of strong affinity and high loading capacity. Moradabad also known as Brass City of India situated at a distance of 167 km from the national capital, New Delhi (NH 24), on the bank of river Ramganga and located at 28.830 N 780 E. It has an average elevation of 186 meters (610 feet) above sea level. The city has seen rapid industrialization during last few decades. The city is full of brass and steel industries. Most of these industries are in unorganized sector and thus have unplanned growth leaving to high degree of air, water and soil pollution[19-20] . The most of the industries are dumping their effluents in Ram Ganga River pass from the heart of the city. A large number of small-scale manufacturing units of brass been also situated in the heart of the city. As Copper, Zinc & Lead and its compounds used in brass industries, the continued intake of copper and lead by humans leads to severe diseases like mucosal irritation, depression and most dangerous lung cancer. Therefore, there is a considerable need to treat industrial effluents containing such heavy metals prior to discharge to protect public health. The metal needs to be removed from industrial effluents before discharge into the environment to minimize any impact on plant, animal and human beings. In the present study, adsorption potential of low cost adsorbent (Rice husk ash) towards Cu and Pb has been examined.

II. MATERIAL AND METHODS:

Adsorbents The RHA from Amrit Vanaspati Company Ltd Punjab, India. It was washed with distilled water until the pH was constant, dried in an oven at 105°C for 24 h. It was cooled in incubator and determined its size distribution by USA Standard Sieve (≤125, 125-250, 250-500 μm). The size distribution results are shown in Table 1. Thus, studied particle size was 250-500 μm. Preparation of Modified Rice Husk Ash

(MRHA): The modification of rice husk ash done by, the RHA was mixed with 0.1 M NaOH (1:20) for 30 min, after treatment with 0.1 M NaOH, the excess NaOH form the Modified Rice Husk Ash (MRHA) was washed with distilled water until the pH was constant and then it was dried in an oven at 105°C for 24 h.

III. ADSORBATE SOLUTION:

Analytical grades of $Pb(NO_3)_2$, HCl and NaOH were purchased from Merck, India. Lead ions were prepared by dissolving its corresponding Nitrate salt in distilled water. Stock solution of Cu(II) was prepared by using $CuSO_4.5H_2O$. All chemicals were used of analytical grade and distilled water was used to prepare solutions.

IV. ADSORPTION STUDIES:

Individual and mixed solutions of Pb and Cu with different concentrations of 5, 10, 15, 45, 100 mg/L were prepared, the experiment were performed using three different amount of adsorbent 0.5, 1, 1.5, in single solution. 0.5 gm adsorbent was placed in a conical flask in which 100 ml of solution with known concentration of Pb was added and the mixture was shaken in shaker. The mixture was than filtered after 12 hours contact time and final concentration of metal ion was determined in filtrate by atomic adsorption spectrophotometer (GBC 902). All the Experiments carried out in triplet and mean concentration calculated by averaging them. The procedure repeated by varying the adsorbent dose and concentration of Pb and Cu solution both individual and in mixed solution. Based on residual concentrations, the adsorption efficiency of Rice Husk Ash is calculated and summarized in Table 1-3. Results and Discussion The above analysis indicates that the adsorption efficiency of Rice Husk Ash is high for Cu (Table-1and 2). Table 1 shows the adsorption efficiency for various concentrations of Cu by 0.5 g Rice husk ash . It is clear that Rice Husk Ash is a good adsorbent for removal of Cu from wastewater. The adsorption rate is dependent on adsorbent amount and initial concentration of metal in synthetic solution. 92.8% removal of Cu from 5 mg/L solution was possible by applying 0.5 g Rice Husk Ash. where as the similar amount of adsorbent was not enough to treat 100mg/L Cu solution to above 72%. However, by increasing the amount of Rice husk ash powder to 1.5 g it was possible to increase the efficiency of adsorption to about 96.3% for the same solution (100mg/L Cu). It shows that we would have better treatment by using excess Rice Husk Ash. Table- 2 indicates that adsorption efficiency is dependent on the type of metal too, as for Pb we have 80% removal in same condition (0.5 gm adsorbent in solutions 5mg/L). Table-3 represent the results of adsorption experiments conducted on the mixture of metal solution as mentioned before, the maximum and minimum removal efficiency in the first stage experiments with 0.5g of adsorbent was 92.8% and 80% for Cu and Pb. However, for the mixture of these metals a decrease of 2.8% has observed for Cu whereas Pb adsorption has decreased about 5.8%. The efficiency of Cu and Pb adsorption by various amounts of Rice Husk Ash shown in fig.1 to 3 for individual solution and for mixed solution of Cu and Pb (fig.4).

Table 1Rice husk ash Adsorption Efficiency for Copper at various Concentrations (12 hour contact time)

s.no	Rice husk ash(gm)		Initial concentration of Cu (mg/l)				
			5	10	15	45	100
			Adsorption efficiency (%)				
1	.5		92.8	89	88	80	72
2	1		98	98	94.6	94	95.3
3	1.5		100	98	95	93	96.3

Table 2Rice husk ash Adsorption Efficiency for lead at various Concentrations (12 hour contact time)

s.no	Rice husk ash(gm)		Initial concentration of Cu (mg/l)				
			5	10	15	45	100
			Adsorption efficiency (%)				
1	.5		80	76	75	72	60
2	1		90	91	88	80	77
3	1.5		100	98	91	90.3	86.3

Table 3Rice husk ash Adsorption Efficiency for Copper and Lead in Mixed Metal solution using 0.5g Rice husk ash (12 hour contact time)

S.NO	Metal solution	Initial concentration of Cu (mg/l)				
		5	10	15	45	100
		Adsorption efficiency (%)				
1	Cu	90	88	88	84	82
2	Pb	74.2	72	72.6	67.5	61

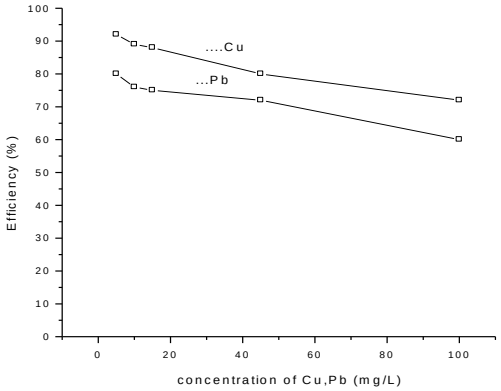

Figure 1 % Adsorption of Copper and Lead by .5g Rice husk Ash

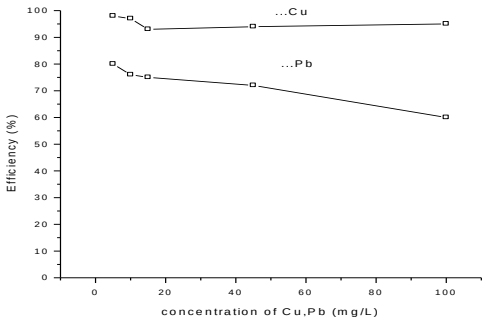

Figure 2 % Adsorption of Copper and Lead by 1g Rice husk Ash

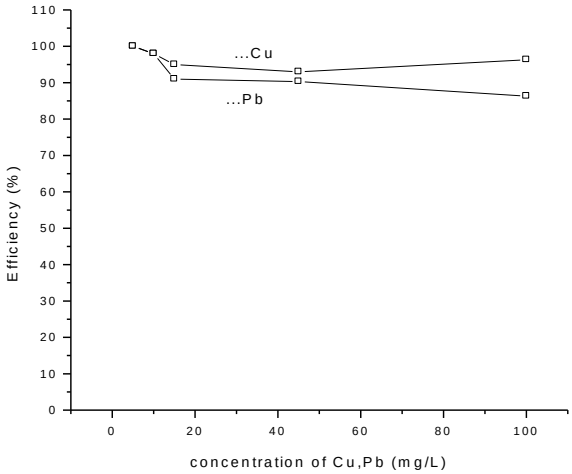

Figure 3 % Adsorption of Copper and Lead by 1.5g Rice husk Ash

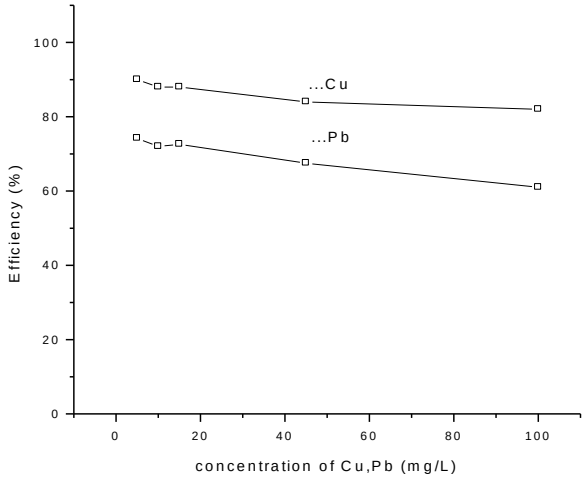

Figure 4 % Adsorption of Copper and Lead in mixed metal solution by using by .5g Rice husk Ash

V. CONCLUSION

The above analysis shows that Rice Husk Ash like the most other natural adsorbents can be used in the treatment process of heavy metals and the treatment efficiency may be as high as 100% by precise choosing of adsorbent amount. It was also observed that the concentration of heavy metals has an important effect on the result of this treatment. Rice husk ash is a waste material and conveniently used for the treatment of industrial wastewater containing Cu and Pb heavy metals. The most important finding of the study shows that in the mixture of metal ions the % adsorption is decreased. It clearly indicate that heavy metals need to be removed from the industrial waste before the discharge into the rivers as study shows that the presence of one more metal will decrease the adsorption efficiency of adsorbent.

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