ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2015; 1(9): 411-413
www.allresearchjournal.com
Received: 14-06-2015
Accepted: 17-07-2015

Manish Singh Rajput
M. Tech., Department of Chemical Engg. Ujjain Engg. College, Ujjain (M.P.)-456010, India.

Dr. Ashok K. Sharma
Associate Professor, Department of Chemical Engg, Ujjain Engg. College, Ujjain (M.P.) - 456010, India.

Dr. Sarita Sharma
Associate Professor, Department of Chemical Engg, Ujjain Engg. College, Ujjain (M.P.) - 456010, India.

Dr. Sanjay Verma
Associate Professor, Department of Chemical Engg, Ujjain Engg. College, Ujjain (M.P.) - 456010, India.

Correspondence:
Manish Singh Rajput
M. Tech., Department of Chemical Engg. Ujjain Engg. College, Ujjain (M.P.)-456010, India.

Removal of Lead (II) from aqueous solutions by orange peel

Manish Singh Rajput, Ashok K. Sharma, Sarita Sharma, Sanjay Verma

Abstract
Lead can cause a variety of adverse health effects human and environment. Lead has the potential to cause cancer from a life time exposure at levels above the action level. The present study deals with the biosorption of Pb (II) from aqueous solution using orange peel. The experiment results showed that maximum removal of Pb (II) by orange peel is 78 % respectively at optimum condition.

Keywords: lead, aqueous solution, adsorbent, agricultural wastes, adsorption.

1. Introduction
Lead is one of the heavy metals that are often found in industrial wastewater and its discharge into the environment poses a serious threat due to its toxicity to aquatic and terrestrial lives [1]. It is a group IV element on the periodic table which is remarkably highly resistant to corrosion in most acid and naturally occur as element buried in the earth crust in insoluble and biologically inoffensive forms [2]. Enhanced industrialization such as manufacturing of storage batteries, television tube, printing, paints, pigments, photographic materials, gasoline additives, matches and explosives brought about lead bearing wastewater [3]. Exposure to Lead is widely recognized as a major risk factor for several human diseases once it goes beyond the World Health Organisation (WHO) maximum permissible limit (3-10$\mu g \cdot L^{-1}$) in drinking water [4]. It forms complexes with oxo-groups in enzymes to affect virtually all steps in the process of haemoglobin synthesis and porphyrin metabolism [5]. Other problems associated with toxic levels of lead exposure are encephalopathy, seizures and mental retardation, anemia and nephropathy [6]. Hence, lead must be removed as much as possible from industrial effluents to prevent environmental hazard from its discharge. Adsorption technology has been widely preferred to other traditional methods such as coagulation, flocculation, filtration, ozonation or sedimentation in the removal of pollutants from wastewater [7]. In this investigation experiment perform to evaluate the effectiveness of employing a orange peel for the adsorptive removal of Pb (II) from aqueous solution, using batch experiment and isotherm studies to determine the adsorption capacities.

2. Materials and Methods
Chemicals: All chemicals used in present work were either of analytical reagent (AR) or laboratory reagent (LR) grade. Pb $(NO_3)_2$ (99%), H_2SO_4 (98% w/w, 36N), HCl (98% w/w, 36N) supplied by s.d. fine-chem limited, Mumbai. Distilled water was used in all preparations. Lead nitrate [Pb $(NO_3)_2$] and deionized water was used to prepare synthetic lead Pb (II) ions containing wastewater.

Adsorbent: Orange peels were selected and washed with water several times to remove ash and other contaminants, followed by double distilled water (DDW) washing. The washed peels were left to dry at ambient temperature for 36 hrs, then crushed and sieved to small particles (3.35 mm sieve) [8].

Adsorbate: $Pb(NO_3)_2$ were obtained in analytical reagent (Sd fine chem.co.) and used without further purification synthetic 1000ppm stock solution prepared for lead metal.
Lead solution: 1.6 grams of Pb $(NO_3)_2$ was added in 100ml of distilled water in 1000ml volumetric flask. It was dissolved by shaking and the volume was made up to the mark. Lead solution concentration of this solution was 1000 mg/l.

2.1. Batch mode adsorption studies

The adsorption of heavy metals on adsorbent ware studied by batch technique. The general method used for this study is described as below:

A known weight of adsorbent (e.g. 0.5 g adsorbent) was equilibrated with 100 ml of the lead solution of known concentration (10, 20, 50 and 100ppm) in 12 stoppered borosil glass flask at a fixed temperature (30 ^{0}C) in a orbital shaker for a known period (30–150 Min.) of time. After equilibration, 10 ml sample collected from each flask, in time interval of 30, 60, 90, 120 and 150 minutes, the suspension of the adsorbent was separated from solution by filtration using Whatman No.1 filter paper. The concentration of heavy metal ions remaining in solution was measured by atomic absorption spectrophotometer. The effect of several parameters, such as pH, concentrations, contact time and adsorbent dose on the adsorption were studied. The pH of the adsorptive solutions was adjusted using sulfuric acid, sodium hydroxide and buffer solutions when required.

The results of these studies were used to obtain the optimum conditions for maximum heavy metals removal from aqueous solution. The percent heavy metal removal was calculated using Eq.

Metal ion removal (%) = $[(C_o - C_e) / C_o] \times 100$…………… (1)

Where C_o: initial metal ion concentration of test solution, mg/l; Ce: final equilibrium concentration of test solution mg/l.

3. Result and Discussions

3.1. Effect of contact time variation: Figure 1 shows the effect of contact time on Pb (II) removal efficiencies of orange peel adsorbent. Removal efficiency up to 90 min. at maximum 77 percentage after that is decreases slowly up to 120 and 150 min. for 10 ppm concentration.

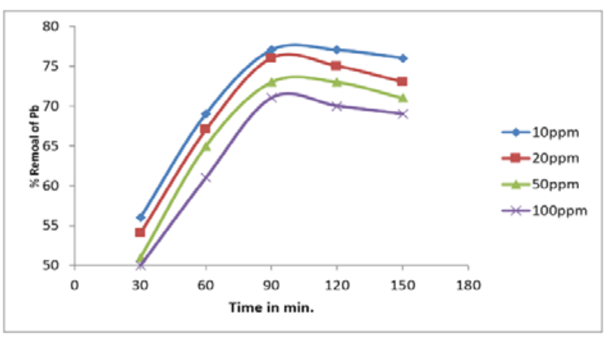

Fig 1: Effect of contact time on percentage removal of lead ion by orange peel at continuous parameter- 0.5g adsorbent dose, 6pH.

3.2. Effect of pH variation: pH variation is one of the most important parameters controlling uptake of heavy metals from wastewater and aqueous solutions. Fig. 2 shows the effect of pH on Pb (II) removal efficiencies of orange peel adsorbent. These studies were conducted at an initial metal ions concentration of 10, 20, and 50ppm in 100ml solution, and constant adsorbent dose 0.5g /100ml solution and agitation period are 90 min. for lead ions at varying the pH in each solution.

The percentage adsorption increases with pH to attain a maximum a 7 pH for Pb (II) and there after it decreases with further increase in pH. The maximum removals of Pb (II) at 7 pH were found to be nearly 78 percentage respectively. The maximum adsorption at 7 pH may be attributed to the partial hydrolysis of M^+, resulting in the formation of MOH^+ and M $(OH)^2$ would be adsorbed to a greater extend on the non-polar adsorbent surface compare to MOH^+. With increase of pH from 6 to 7, the metal exists as $M(OH)^2$ in the medium and surface protonation of adsorbent is minimum, leading to the enhancement of metal adsorption.

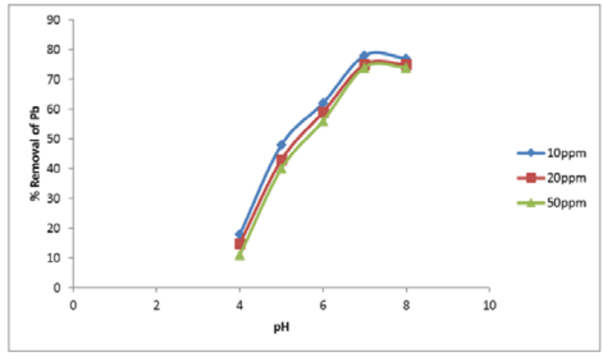

Fig 2: Effect of pH on percentage removal of lead ion by orange peel at continuous parameter- 0.5g adsorbent dose, 90 min. contact time.

3.3. Effect of adsorbent dose variation: The results for adsorptive removal of Pb (II) with respect to adsorbent dose are shown in Fig. 3 over the range 0.2 to 1gram/100ml, at pH 6 and 90 minutes contact time. The percentage removal of Pb (II) is seen to increase with adsorbent dose. It is observed that there is a sharp increase in percentage removal with adsorbent dose for Pb (II) ions. The maximum removal of Pb (II) 78 percentage respectively at 0.6 gram dose amount of orange peel adsorbent.

It is apparent that the percent removal of heavy metals increases rapidly with increase in the dose of the adsorbents due to the greater availability of the exchangeable sites or surface area. Moreover, the percentage of metal ion adsorption on adsorbent is determined by the adsorption capacity of the adsorbent for various metal ions.

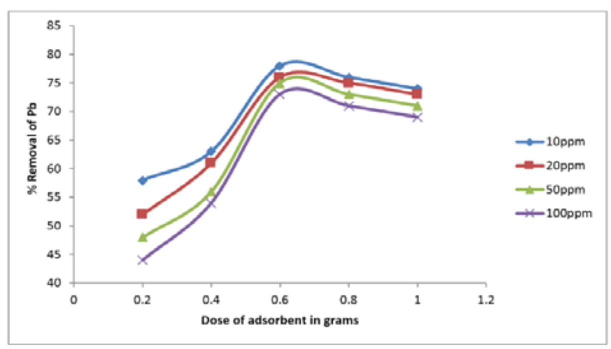

Fig 3: Effect of adsorbent (amount) dose on percentage removal of lead ion by orange peel at continuous parameter- 6pH, 90 min. contact time.

3.4. Effect of initial concentration variation: The effect of concentration on % removal of lead ion by orange peel at 0.5g/100ml adsorbent dose, 6pH and 90 contact time are shown in Fig. 4. It can be seen from the figure that the percentage removal decreases with the increase in initial lead concentration for Pb (II) the percentage removal is highly effective on the 10 ppm for initial concentration after which percentage removal decreases gradually to below 56 percentage. At lower initial metal ion concentrations, sufficient adsorption sites are available for adsorption of the heavy metals ions. Therefore, the fractional adsorption is independent of initial metal ion concentration. However, at higher concentrations the numbers of heavy metal ions are relatively higher compared to availability of adsorption sites. The maximum removal of Pb (II) ion are 78 percentage respectively at 10 ppm concentration.

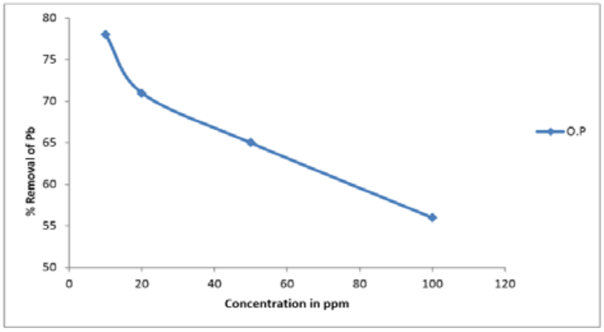

Fig 4: Effect of concentration on percentage removal of lead ions by orange peel (O.P) at continuous parameter- 0.5g adsorbent dose, 6pH, 90 min. contact time.

4. Conclusion

Orange peel is a cheap and effective adsorbent for the removal of Pb ions from aqueous solution.

Experimental results showed that maximum removal of Pb (II) by orange peel at optimum condition parameter 7Ph, 90 min. contact time, 0.6g/100ml adsorbent dose and 10 ppm concentration is 78%. These experimental studies on adsorbents would be quite useful in developing an appropriate technology for the removal of lead ions from contaminated industrial effluents.

5. References

1. DCK Ko, Porter JF, Mckay G. Optimized Correlation for the Fixed Bed Adsorption of Metal Ions on Bone Char. Chemical Engineering Science 2000; 55:5819-5829.
2. National Research Council Canada Effect of Lead in the Canadian Environment, Report NRCC 16745, Ottawa, 1978.
3. Patterson JW. Industrial Wastewater Treatment Technology. 2nd Edition, Butterworth Publishers, Stoneham, 1985.
4. Needleman HL. History of Lead Poisoning in the World. In: George, A.M., Ed., Lead Poisoning Prevention and Treatment: Implementing a National Program in Developing Countries, The George Foundation, Bangalore, 1999, 17-25.
5. Ademorati CMA. Environmental Chemistry and Toxicology. Foludex Press Ltd., Ibadan, 1996.
6. Schumann K. The Toxicological Estimation of the Heavy Metal Content (Cd, Hg, Pb) in Food for Infants and Small Children. Zeitschrift für Ernährungswissenschaft 1990; 29:54-73.
7. Hinchee RE, Alleman BC. Hydrocarbon Bioremediation. CRC Press, Boca Raton, 1991.
8. El-Said AG, Gamal AM. Potential Application of Orange Peel (OP) as an Eco-friendly Adsorbent for Textile Dyeing Effluents., Journal of Textile and Apparel, Technology and Management, Spring, 2012, 7(3).