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ADSORPTION STUDIES FOR THE AMPUTATION OF LEAD FROM SQUANDER WATERS BY USING STRAWS OF ORYZA SATIVA (RICE)

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Abstract: Adsorption is potentially an attractive technology for the treatment of waste water for retaining the heavy metals from dilute solutions. And it is one of the most common phenomenons for the treatment of lead-polluted water. The study evaluated here presents the experiments to determine the suitable conditions of Temperature, Contact Time, pH, Agitation Speed, Adsorbent Dose, Mesh Size and Metal Ion Concentration, for the use of Oryza Sativa (Rice) Straw, as adsorbent for the exclusion of lead from aqueous solution. The results revealed that maximum adsorption was observed at 20 degrees Celsius and at a contact time of 1.5hr and an equilibrium time for keeping the ions adsorbed was observed between 0.5-1.5hrs at a pH range of 6.9-7.0 and at an agitation speed of 150rpm, with an adsorbent dose of 3.5grams and mesh size 50-80, for as dilute metal ion concentrations as 16 ppm.

Key words: Sorption, removal of lead, adsorption of lead.

Introduction

Environmental pollution is a product of urbanization and technology, and other attendant factors of population density, industrialization and mechanization that serve to provide the necessities of the population.[1] Heavy metals; the essential parts of necessary products are being accumulated in the environment. As the exhaust of most of the industries is the natural water bodies, so water; the main environmental part and essential dietary component is getting contaminated.

Lead is one of the toxic heavy metals and it needs not to enter the environment, because it is found in all parts of our environment from construction materials to the ceramics used on the dinning table. Much of it comes from human activities including burning fossil fuels, mining, and manufacturing.[2] If consumed or inhaled, it can affect nearly all systems in the body. Lead poisoning or plumbism is very serious health issue. Usually lead poisoning is of two types and both kinds are adverse for body systems. **Acute Poisoning** (caused by consuming large amount of easily and readily absorbable lead) causing Nausea, vomiting, encephalopathy (headache, seizures, ataxia, obtundation). And **Chronic Plumbism** (occurs when less absorbable forms of lead are consumed, inhaled or absorbed through skin) causing encephalopathy, anemia, abdominal pain, nephropathy, foot-drop/ wrist-drop.[3] In 1991, the Centre for Disease Control (CDC) lowered the safe blood lead level to less than 10μg/dL.[4]

The following study had been conducted to have a great deal with the amputation of lead from water; the central and essential constituent of diet. And the phenomenon used for the following studies was **adsorption;** capability of all solid substances to attract to their surfaces molecules of gases or solutions with which they are in contact.[5] The noticeable advantages of this technology includes the high metal removal efficiency, low investment and operational cost, minimization of

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chemical sludge and regeneration of the adsorbent. The mechanism of adsorption is complex; it mainly involves ion exchange, chelation and surface binding by physical and chemical linkages. There are several chemical groups that would attract and sequester the metal ions on the adsorbent, for example, −OH, −COOH, −NH2, −C═O, −NH−C═O, etc[6,7,8]

The agro wastes like husks, straws, roots and fibers of different cereals and plants are found to be inexpensive and showing better results for adsorption of metals from waste waters.[9] The interaction between the adsorbent and metal ions occurs due to the presence of polymeric groups like cellulose, pectin, lignin and proteins.[10]

The adsorption studies deal auspiciously with the removal of lead from contaminated waters by using cheap adsorbent; the straw of Oryza Sativa (Rice); waste product of the rice splitting mill, and this had been proved to be the best adsorbent for the removal of lead from water, as about 98% of the lead in water got adsorbed on it.

Experimental Work Preparation of Adsorbent (Oryza Sativa Powder)

Straws of Oryza Sativa (Rice) obtained from the rice splitting mill were washed exclusively with distilled water and dried in an oven at 105 degree Celsius overnight. Dried Rice Straws were ground by electrical grinder and sieved through 50-80 mesh steel sieves. This ground dried adsorbent was kept in air tight jars and was subjected to adsorption studies by pre heating of one hour in an oven at 105 degree Celsius.

Preparation of Solutions

The stock solution of Pb (II) ions was prepared by dissolving 1.596g of Pb(NO3)2 (Riedel-de-Haen) in distilled water (1000mL). Successive dilutions of the stock solution were carried out to set up standard solutions ranging 5-50 ppm. Solution of 50ppm was used as a sample for studying each of the intent factors for adsorption studies.

Effects of Mesh Size

For observing the effect of mesh size of adsorbent, various mesh sizes were ground ranging 10-80 mesh size and were added to the sample solutions (50ppm, 50mL) of Pb(II) in different beakers. Each of the beakers was subjected to mechanical stirring for one hour. The solutions were then filtered to remove the adsorbent and filtrates were then subjected to Atomic Absorption Spectrophotometer (AAnalyst 100) to measure the absorbance of Pb(II).

Effects of Metal Ion Concentration

To determine the best metal ion concentration range for the %age adsorption, solutions of different concentrations of Pb(II) ranging 10, 20-100ppm were taken in different beakers and to each beaker one gram of dried ground adsorbent was added and left for one hour, with successive mechanical stirring. The solutions were then filtered through Whatman filter paper and the filtrates were subjected to Atomic Absorption Spectrophotometer to measure the absorbance of Pb(II). Later on the concentration range was narrowed between 10 to 20ppm, with difference of 2ppm.

Effect of Adsorbent Dose

To study the effect of adsorbent dose, various quantities of adsorbent ranging from 0.5, 1.0, to 4.5 grams were added to the sample solutions (50ppm, 50mL) of Pb(II) in different beakers. The samples were subjected to mechanical stirring for one hour and then filtered and measured for absorbance of Pb(II).

Effect of Time of Contact

Sample solutions (50ppm, 50mL) of Pb(II) were taken in ten different beakers, to each beaker one gram of adsorbent was added and the time of contact between the solution and adsorbent was settled in the range 0 to 150 minutes with an interval difference of 15 minutes. Each of the solution was filtered on its turn. And then the filtrates were subjected to absorbance measurement by Atomic Absorption Spectrophotometer (AAnalyst 100).

Effect of Agitation Speed

To study agitation factor, sample solutions (50ppm, 50mL) of Pb(II) were taken in four different beakers, to each solution, one gram of adsorbent was added. And each beaker was subjected to different agitation speed ranging from 50 to 200 revolutions per minute (rpm), with agitation difference of 50 rpm. After an hour each of the solutions was filtered and filtrate was measured for absorbance of Pb(II)

Effect of Temperature

To study the temperature effect, the sample solutions (50ppm, 50mL) of Pb(II) ion were taken in four different beakers and to each of the beaker, one gram of adsorbent was added. Then each of the beakers was settled on the orbital shaker at 150 rpm. Each of the sample solution was kept in an electric oven to maintain the temperature parameter. And temperature was adjusted in the range of 20 to 50 degree Celsius, with equal difference of 10 degrees.

Effect of pH

Sample solutions (50ppm, 50mL) of Pb(II) were taken in three different beakers, to these solutions pH was adjusted as 2, 7 and 10 by using dilute hydrochloric acid and sodium hydroxide solutions. One gram of adsorbent was added to each of the beakers, and left for one hour with successive mechanical stirring. After an hour the solutions were filtered and observed through Atomic Absorption Spectrophotometer. Later on the pH range was narrowed between 2 to 10, with one pH unit difference.

Results and Discussions

The adsorbent's mesh size was taken under observations for checking the maximum adsorption, and the smallest mesh size (50-80) was come to know as best for adsorption, as particles with smallest size presents a larger surface area and the results are shown (Fig 1).

The factor of metal ion concentration showed an inverse relation with the %age adsorption, for this factor a full range for metal ion concentration (10, 20-100ppm) verses adsorption was studied and it was found that adsorption increased between concentration range of 10-20ppm and then declined. Later on to get the exact point for maximum adsorption, the concentration range was narrowed within a figure of 10-20ppm with a difference of 2ppm. And point of maximum adsorption was found as 16 ppm (Fig 2).

The experiments for examining the relation of adsorbent dose verses %age adsorption showed a direct relation (Fig 3), its so because greater amount of adsorbent presents greater number of active binding sites.

The time factor showed that the %age adsorption went on increasing up to 90 minutes and this contact remained for further 15 minutes i.e up to 105 minutes (Fig 4) and then the metal ions started to be desorbed from the adsorbent particles, and it is so because each metal ion has a particular time of contact with the active binding site of the adsorbent, and as this time reaches to an end the ion gets detached from the binding site.

The Agitation Speed factor showed the best results at 150 revolutions per minute (rpm), while the collisions exceeding 150rpm resulted in desorption (Fig 5).

For the following adsorption studies, the temperature factor showed an inverse relation with % adsorption. As at high temperatures the kinetic energy of metal ions, solvent molecules and adsorbent particles was increased and lead to an increased number of collisions between the mixture components and ultimately ended at desorption. Also elevated temperatures causes the active binding sites to be deactive. The best results for temperature factor were observed at minimum observed temperature 20 degree Celsius (Fig 6).

The pH factor gave an indication that the removal of lead from waste water could be better at neutral conditions (Fig 7).

Conclusions

The adsorption studies for the amputation of Lead {Pb(II)} here ended with the finest adsorption of lead from water up to about 98-99%. It comes up with comparatively higher benefits, composed as follows:

- It gives the appreciable results for the adsorption of lead metal ions from the solution in a reasonable time and at neutral pH.
- It presents the use of cheapest adsorbent which is almost a waste from the rice splitting mills.
- It is inexpensive as it uses least of chemicals.

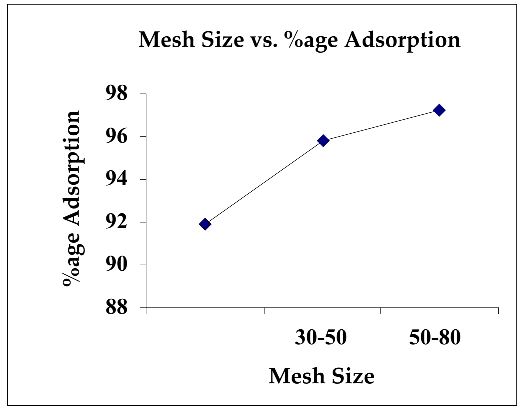

Fig 1; Mesh size vs. %age Adsorption

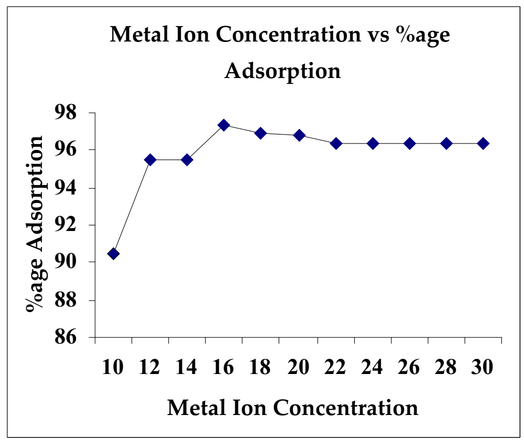

Fig 2; Metal Ion Conc. vs %age Adsorption

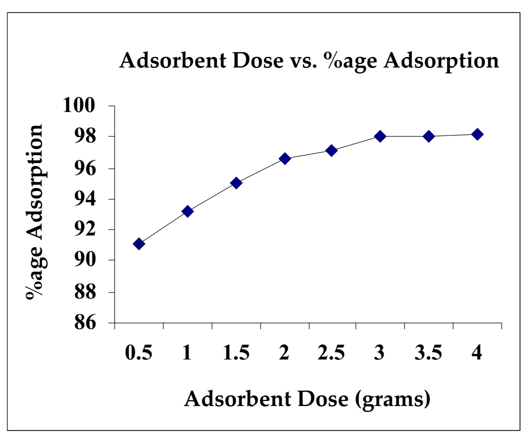

Fig 3; Adsorbent Dose vs. %age Adsorption

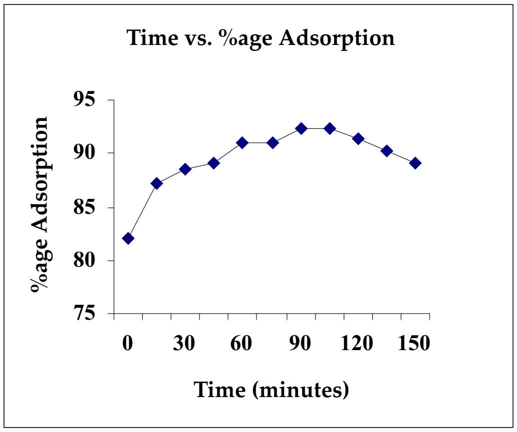

Fig 4; Time vs %age Adsorption

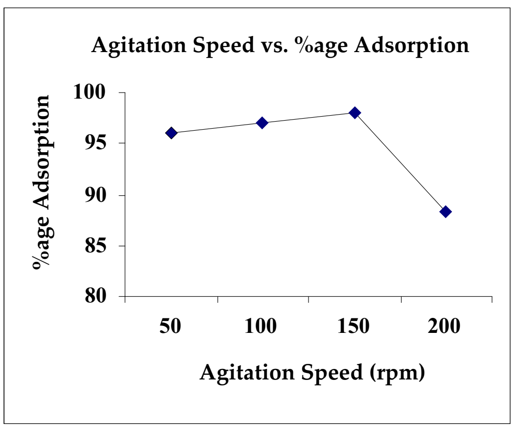

Fig 5; Agitation Speed vs. %age Adsorption

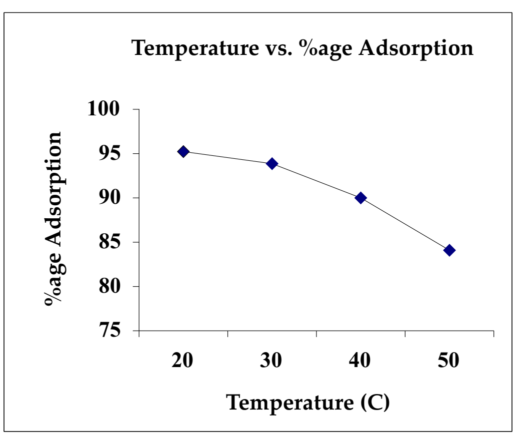

Fig 6; Temperature vs. %age Adsorption

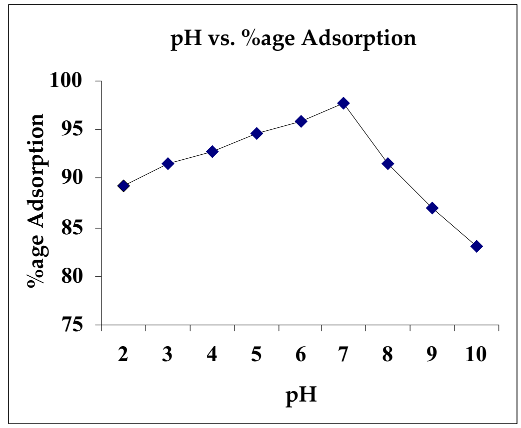

Fig 7; pH vs. %age Adsorption

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