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Adsorption of Lead Using Pogamia Pinata Powder as A Low Cost Adsorbent

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ABSTRACT- The study on performance of low-cost adsorbent such as *pinata* leaves powder in the removal of Lead (II) ion from aqueous solution is performed. In present study *p. piñata* Leaves Powder adsorbent prepared. The adsorbent material adopted was found to be an efficient media for removal of Lead (II) ion with different parameter like Adsorbent dosages, Concentration and contact time etc. The different contact time and reduced concentration determines using Atomic Absorption Spectrophotometer (AAS). It was found that the metal uptake capacity (amount of removal) of and Lead (II) ion decreased but the adsorption capacity (percentage of removal) increased with the decrease in the concentration of and Lead (II) in the initial sample solution.

Keyword- Low cost, Piñata leave, AAS, Ion decrease, Lead

I. INTRODUCTION

The fruits and sprouts of *P. piñata* were used in folk remedies for abdominal tumors in India, the seeds for keloid tumors in Sri Lanka and a powder derived from the plant for tumors in Vietnam. In ancient India, seeds were used for skin aliments. Today, the oil is used as a liniment for rheumatism. Bark is used internally for bleeding piles. Juices from the plant as well as oil are antiseptic. In the traditional systems of medicines, such as Ayurveda and Unani, the *p. piñata* is used for anti-inflammatory, anti-plasmodial, anti-nonciceptive, anti hyperglycaemics, anti-lipidoxidative, anti-diarrhoeal, anti-ulcer, anti-hyperammonic and antioxidant. Its oil is a source of biodiesel. It has also alternative source of energy, which is renewable, safe and non-pollutant [1]

Scientific Classification

Kingdom:	Planate
Division:	Magnoliophyta
Class:	Magnoliopsida
Order:	Fabales
Family:	Fabaceae
Genus:	*Pongamia*
Species:	*Pongamiapinnata*

Evergreen trees, to 18 m high, bark 10-12mm thick, surface grey, smooth, speckled with brown; blaze-yellow; branch letslenticellate. Leaves imparipinnate, alternate; stipules lateral, small, oblong, cauducous; rachis 10-15 cm long, slender, pulvinate, pubescent; leaflet 4.5-12 × 2-7 cm. The leaves of tree are soft and lustrous burgundy while the color changes to green when it matures. Flower bisexual, pueplish-white, 15-18 mm long, in lax axillaries racemes. The flowers are white, pink or purple borne in clusters throughout the year on the branches.

COMMON NAMES:

- Hindi, Bengali, Marathi and Gujarati: Karanj, Karanja
- Sanskrit : Naktamala
- English : Indian beech
- Telgu : Pungu, Gaanuga
- Tamil : Ponga, Pongam
- Malayalam : Pungu, Punnu
- Oriya : Koranjo
- Punjab : Sukhehein, Karanj, Paphri
- Assam : Karchuw

Lead enters into the human system through a number of processes like breathing workplace air (lead smelting, refining and manufacturing industries), eating lead-based paint chips, drinking water that comes from lead pipes or lead-soldered fittings, breathing or ingesting contaminated soil, dust, air, or water near waste sites, breathing tobacco smoke, eating contaminated food grown on soil containing lead or food covered with lead-containing dust, breathing fumes or ingesting lead from hobbies that use lead (leaded-glass, ceramics).

The health hazards due to the presence of lead in water are of extreme concern to the public, government and industry. Lead has toxic effects on the neuronal system and on the function of brain cells. [7,8] The soil plays an important role in the productivity of crops as well as the improvement in environment [16]. This underlines the need for developing methods for effective removal of lead from water at least below the regulatory level. Heavy metals in aqueous solution are usually removed by adsorption, ion exchange, coagulation, floatation, hyper-filtration, chemical precipitation, reverse osmosis etc. Use of ion exchange resins requires considerable cost and adsorption on activated carbon is beset with problems related to regeneration of the adsorbent and recovery of the contaminants. These technologies, apart from being expensive, create secondary problems with metal-bearing sludge [9]. The mangroves help the ecosystem by contributing to the oxygen Budget and in Soil Conservation and various physico-chemical parameters were analyzed and study of marshy and sandy habitat in Kachchh region.[17] This has initiated research in new, low-cost materials for possible use as adsorbents. Such materials can be broadly classified into three categories: (i) Natural minerals and similar materials like coal, peat, clays (kaolinite, wollastonite, sepiolite, etc.), red mud, sand, hydrous ferric oxide, etc., (ii) Industrial wastes like fly ash, saw dust, biogas slurry, chrome sludge, electric furnace slag etc. and (iii) Biological materials like coconut shell, banana pith, beech leaves, orange peel, waste tea, water hyacinth, moss, algae, chitin, bagasse, tree fern, soya cake, olive cake, almond shells, cactus leaves, fly larva, cypress, chinchona and pine leaves and in many cases their carbonized products. The efficiency of various bacteria, yeast, fungi, algae and bio-adsorbents for heavy metal uptake has been observed over two decades. [10] The interesting features of the newly developed bio-adsorbents are their high versatility, metal selectivity, high uptake, no concentration dependence, high tolerance for organics and regeneration. [11]

II. RELETED WORK

Pharmacological studies on this herb have shown Juice of roots with coconut milk and lime water used for treatment of gonorrhea. [2] Used for cleaning gums, teeth and ulcers. Roots are bitter anti-helmintic and used in vaginal and skin diseases. Juice of the root is used for cleansing foul ulcers and closing fistulous sores. [3] Aqueous extracts of stem bark exhibit significant CNS sedative and antipyretic activity. [4] Juice of leaves is used for cold, cough, diarrhea, dyspepsia, flatulence, gonorrhea, leprosy. [5] Leaves are anti-helminthitic, digestive and laxative used for inflammations, piles and wounds. As an infusion is relieve rheumatism. As an extract is treat itches and herpes. Fruits used for abdominal tumors. Useful in ailments of female genital tract, leprosy, tumour and piles the ulcer and upward moving of the wind in the abdomen. [6]

III. METHODOLOGY

Preparation of piñata powder

The preparation of the adsorbent, *p. piñata* Leaf Powder (PLP), mature *p. pinata* leaves were collected from a number of tall *p. piñata* trees (Bhuj Kachchh, Gujarat, India) and were brought to the laboratory in plastic bags. The leaves were washed repeatedly with water to remove dust and soluble impurities and were allowed to dry at room temperature in a shade. The leaves were then further dried in an air oven at 333-343 K for 30 h when the leaves became crisp and brittle. The crisp leaves were ground in a mechanical grinder to obtain a fine powder.

Preparation of lead nitrate solution

All the chemicals used in the experiments were of analytical grade. Pb $(N0_3)_2$ was used as the source of Pb(II) without further purification. All the solutions were made in double-distilled water. The solutions of Pb(II) for the adsorption experiments were made from a stock solution containing 1000 mg of Pb(II) in 1 L. The pH of the aqueous solution was - 6.0, which did not change much with dilution.

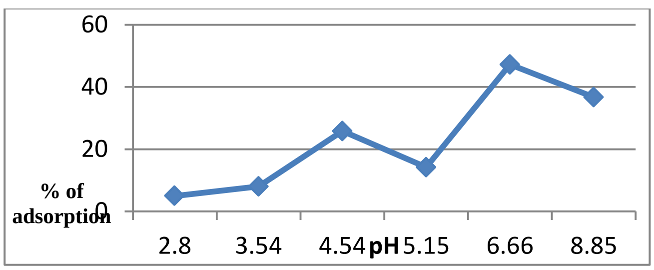
Initial Pb(II) concentration (mg/L)	50, 100, 150, 200, 250, 300
Amount of adsorbent (mg/L)	0.4, 0.8, 1.2, 1.6, 2.0, 2.4
pH	2-8
Agitation time (min)	30, 60, 90, 120, 150, 180, 210
Adsorption temperature, *T (K)*	295, 299, 304, 309

IV. RESULT AND DISCUSSION

Effect of pH

The pH is an important controlling parameter in all adsorption processes. In the present work, adsorption could not be carried out beyond pH 6.0 due to precipitation of $Pb(OH)_2$ and therefore, the experiments were done in the pH range of 2.0 to 8.0. For a typical experiment with Pb(II) solution of concentration 200 mg/L, adsorbent amount of 0.6 g/L, and agitation time of 1 h, the extent of adsorption at 298K increased from 1 to72.5 % in the pH range of 2.0 to 8.0. It is seen that adsorption increases continuously with decrease in acidity till it reaches an almost constant value between pH 4.5 and 6.5, after which the extent of removal of Pb (II) again shows an increase.

The increase might be due to the onset of precipitation. Low pH depresses adsorption of Pb(II) due to stiff competition with IP ions for appropriate sites on the adsorbent surface. However, with increasing pH, the competition weakens and Pb(II) ions replace H^+ ions bound to the adsorbent or forming part of the surface functional groups such as OH, COOH, etc. It is also possible that the adsorption of the metal ion may take place through binding of both Pb^{2+} and $Pb(OH)^+$ ions to the adsorbent surface. [12, 13]



Effect of pH on adsorption of Pb p.pinata at 298K (200 mg/L, adsorbent: 0.6g/L, agitation time: 1 h).

Effect of agitation time

The kinetics of Pb(II) adsorption on Neem leaf powder (NLP) was evaluated by batch experiments with a constant Pb(II) concentration of 200 mg/L at 298K with NLP amount 0.6g/L and when the agitation time was varied from 30 to 300 min in each case. A gradual increase in the extent of adsorption with time was observed. The Pb(II) adsorption increased from 22 to 61.2% in the time interval of 30 to 300 min for NLP amount of 0.6 g/L.

Such behavior is expected in a batch reactor with either constant adsorbent amount or varying initial adsorbent concentration or vice versa [15]. An increase in the adsorbent amount should result in a decrease in the agitation time to reach apparent equilibrium while the fraction of the metal removed from the aqueous phase should increase with an increase in the adsorbent amount the nature of the adsorbent and its compactness affected the time needed to reach equilibrium. In the present case, the adsorbed adsorbent interactions approached pseudo equilibrium at around 300 min.

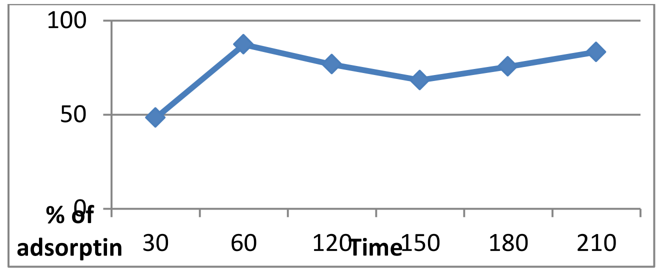


Figure 1 Effect of agitation time on adsorption of lead on p.pinata leaf powder at 298K concentration: 200 mg/L).

Effect of adsorbent dose

The kinetics of Pb(II) adsorption on p.pinata (PLP) was evaluated by batch experiments with a constant Pb(II) concentration of 200 mg/L at 298K with eight different NLP amounts of 0.4, 0.8, 1.2 1.6, 2.0, 2.4, 2.8, 3.2 gm/L. when the agitation time was varied from 60 min in each case. A gradual increase in the extent of adsorption with time was observed.

In the same interval of time, Pb(II) removal increased from 10.8to 49.2% for NLP amount of different NLP. Such behaviour is expected in a batch reactor with either constant adsorbent amount and varying initial adsorbate concentration or vice versa (Chu, 2002)[15]. An increase in the adsorbent amount should result in a decrease in the agitation time to reach apparent equilibrium while the fraction of the metal removed from the aqueous phase should increase with an increase in the adsorbent amount the nature of the adsorbent and its compactness affected the time needed to reach equilibrium. In the present case, the adsorbate-adsorbent interactions approached pseudo equilibrium at around 300 min. The amount of Pb(II) adsorbed per unit mass of the adsorbent steadily increased with an increase in the agitation time at a constant Pb(II) concentration, but the values decreased with increase in PLP amount.

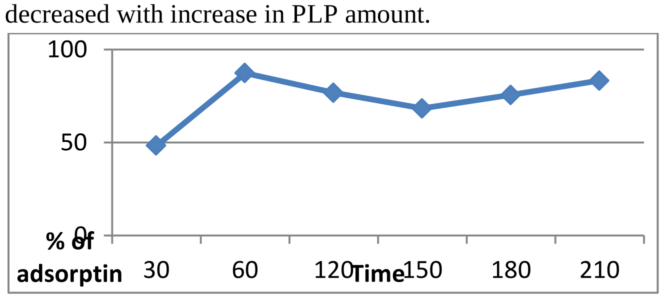


Figure 2 Effect of adsorbent dose on lead on *p.pinata* leaf powder lead conc. 200mg/L and time 1hr

Effect of Concentration

When Pb concentration has variation occur there were also increasing in extend of adsorption. There were constant agitation time 1hr, and adsorbent dose 0.6 g/l. so the concentration of lead was different. It was increase 22 to 45.8% extend of adsorption occur. When concentration increases there were dose same so it decreases so when adsorbent dose were increased so concentration also increased.

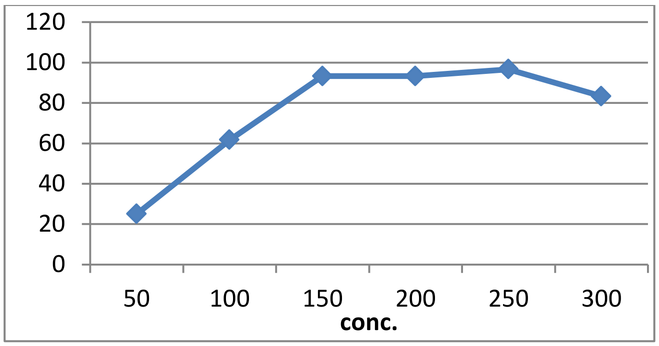


Figure 3 Effect of lead conc. on adsorption of lead on p.pinata leaf powder at 298K (adsorbent: 0.6g/l, agitation time: 1h).

Effect of Temperature

In present study, Adsorption of Pb(II) on PLP decreased when the interaction temperature was increased from 293 to 306K. In here, lead concentration was 50 to 400 mg/l, and for the optimum capacity to remove lead ion concentration the condition was adsorbent dose 0.8gm and contact time for maximum removal capacity at 150 min.

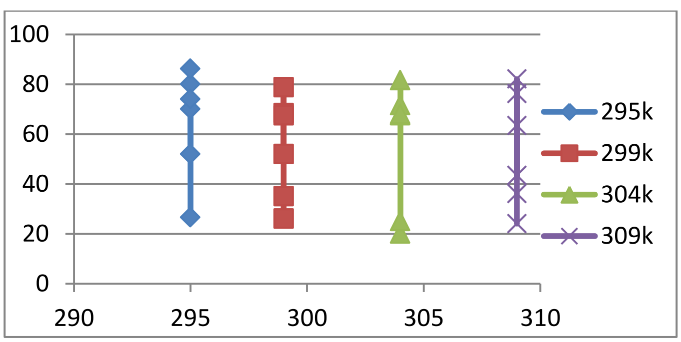


Figure 4 Effect of temperature has different temperature of lead time 2 hr dose 0.8 mg/L

V. CONCLUSION

By showing the data of graph the adsorption occurs at five different parameter, the maximum adsorption occurs at ph 6; dose 2g/L; concentration 250mg/L; at maximum time 60min at the showing maximum temperature at 295K the percentage of adsorption occurs 80%.

The pH is an important controlling parameter in all adsorption processes. In the present work, adsorption could not be carried out beyond pH 6.0 due to precipitation of $Pb(OH)_2$ and therefore, the experiments were done in the pH range of 2.0 to 8.0.

A gradual increase in the extent of adsorption with time was observed. The Pb(II) adsorption increased from 22 to 61.2% in the time interval of 30 to 300 min for NLP amount of 0.6 g/L.

p. piñata (PLP) evaluated with a constant Pb(II) concentration of 200 mg/L at 298K with eight different NLP amounts of 0.4, 0.8,1.2,1.6, 2.0, 2.4, 2.8, 3.2 gm/L. when the agitation time was varied from 60 min in each case.

Pb concentration has variation occur there were also increasing in extend of adsorption. agitation time 1hr, and adsorbent dose 0.6 g/l. so the concentration of lead was different. It was increase 22 to 45.8% extend of adsorption occur.

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