



## **Heavy Metal Removal By Using Green Adsorbent**

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**Abstract –** The metal working industries discharge large amounts of heavy metals in their effluents which possess extreme threats to human and aquatic life. Several processing techniques are available to reduce the concentration of heavy metal ions which are Chemical precipitation, ion exchange, Activated carbon adsorption, membrane processing, electrolytic methods, cementation on iron etc. This paper presents review on heavy metal removal by using neem leaf powder as green adsorbent. Studies carried out by using green adsorbent indicates that there is a wide scope for the removal of heavy metals from aqueous solution. The effectiveness and efficiency of these green adsorbent was observed by Langmuir and Freundlich isotherms equations.

**Keywords-** Heavy metal Adsorption, Neem leaf powder, Batch process.

### **I. INTRODUCTION**

Due to rapid urbanization and industrial activities has led to the disposal of large amount of heavy metals in waste water. Heavy metals pollution occurs in much industrial wastewater such as that produced by metal plating facilities, mining operations, battery manufacturing process, the production of paints and pigments and metal plating industries. Due to its toxic nature it effects human beings as well as aquatic life even at very small concentration. There are various methods for removal of heavy metals from wastewater like Chemical precipitation, ion exchange, Activated carbon adsorption, membrane processing, electrolytic methods, cementation on iron etc.

Adsorption is a simple and relatively techno-feasible method and is widely used technique in the removal of pollutants. The present review paper presents the scope of adsorption as a effective removal of concentration heavy metal ion by using various types of green adsorbent such as powder of neem leaf, corn cob, peanut husk and coconut shell and also focuses on the various parameters affecting adsorption, i.e. pH, heavy metal Conc., adsorbent dosage, adsorbent particle size, contact time etc.

### **II. ADSORPTION**

Adsorption has been found as a low cost physical process for the removal of concentration of heavy metal ions of wastewater. Heavy metals are toxic and have the tendency to bio-accumulate. Adsorption by using neem leaf powder as green adsorbent is the most effective due to its number of sites available, their accessibility, affinity between sites and metal resulting in a higher rate of adsorption. Various green adsorbent like coconut shell, rice husk, corn cob, peanut husk, tea leaves etc. have been tried by the researchers.

### **III. PARAMETERS AFFECTING ADSORPTION**

#### **1. Effect of pH**

The pH value of solution strongly influences not only the site of dissociation of the biomass surface but also the solution chemistry of the heavy metals. The removal of Cu and Zn from wastewater by adsorption is highly dependent on pH. Results showed that the percent maximum removal of heavy metals at pH 6 and then decrease with further increase in pH [1] [2].

#### **2. Effect of adsorbent dose**

The results showed that the percentage removal of heavy metal ion concentrations increases with increase in adsorbent dosage. Because adsorbent dosage interferes between the binding sites and caused electrostatic interaction between cells. The percentage removal increases with increase in adsorbent dosage due to greater availability of the exchangeable sites or surface area [5].

#### **3. Effect of contact time**

The contact time between the adsorbate and adsorbent is one of the most important parameter that effects the performance of the adsorption. The results showed that the adsorption of adsorbate species is faster in the initial stage of contact period and become slow near equilibrium [3] [4].

#### 4. Effect of initial concentration of metal

With increase in the initial heavy metal ion concentrations, the removal percentage increases as expected but after certain concentration, increase in the initial concentration has adverse effects on the removal percentage [7] [6].

### IV. VARIOUS ADSORBENTS FOR HEAVY METAL REMOVAL

The removal of heavy metal ion concentrations by using following green adsorbents by the researchers. The review presents the summary of this research work. Various green adsorbents used for heavy metal ions removal includes, coconut shell, rice husk, wood, peanut husk, fly ash bagasse, tea leaves, neem leaf, corn cob, etc.

The research on adsorption of heavy metal ion concentrations from industrial wastewater by using the green adsorbent indicates the significance of the individual factors and their interactions on both adsorption process. The research on adsorption neem leaf powder to sequester copper from aqueous solution. Neem leaf serves as a potential alternative adsorbent to remove copper ions from copper containing solution. The adsorption experiments were conducted in batch and dynamic modes at optimum pH of 5. Adsorption equilibria data were also fitted by the well-known adsorption models, Freundlich and Langmuir. Langmuir equation represents the adsorption equilibria better than Freundlich. Thermodynamics data indicated that the adsorption of copper ion onto neem leaf is endothermic. Chemisorption can be pointed out as the controlling mechanism. Carboxylic groups, alcohols and phenols were involved in the binding process. Lastly, the dynamic data was also provided in the form of breakthrough curve along with Thomas model representation. Based on the results, the following conclusions can be drawn. The ground Neem leaves was very effective in removal of Cu and Zn ions from the synthetic waste water. Neem leaves are efficient biomaterial for removal of some heavy metals from industrial wastewater. This process can be effectively used in the heavy metals removal in industrial wastewater [1].

Studies have also been carried out to improved quality of treated effluent for removing toxic and hazards materials like Copper, Nickel Zinc and other metal ion to protection of environment, human health and aquatic life. Although many techniques can be employed for the treatment of wastewater laden with heavy metals, it is important noted that the selection of the most suitable treatment for metal contaminated wastewater depends on some basic parameters such as pH, initial metal concentration, contact time, amount of adsorbent, the overall treatment performance compared to other technologies, environmental impact as well as economics parameter such as the capital investment and operational costs. Finally, technical applicability, plant simplicity, and cost-effectiveness are the key factors that play major roles in the selection of the most suitable treatment system for waste water effluent. All the factors mentioned above should be taken into consideration in selecting the most cost effective treatment techniques in order to protect the environment and human health from toxic and hazardous contaminated wastewater. Adsorption is the most cost effective treatment method for removal of heavy metals from waste water by low cost adsorbent like tea waste, rice husk, coconut husk, drum stick, seeds powder, neem leaves etc. [2].

Studies have also been carried out for Coconut shell and the effect of initial concentration of  $Pb^{2+}$ ,  $Cu^{2+}$ ,  $Cd^{2+}$  and  $As^{2+}$  adsorbed at  $30^{\circ}C$ . It was found that the concentration of metal ions adsorbed increased with increase in initial metal ion concentration. The adsorption of heavy metals was studied and observed that the concentration of metal ions adsorbed on the coconut shell increased with time due to the migration of higher fraction of the metal ions from bulk solution through the adsorbent boundary layer onto the active sites of the adsorbent as time increases. The initial faster rate may be due to the availability of the uncovered surface area of the adsorbents, since the adsorption kinetics depends on the surface area of the adsorbents. Temperature can affect the adsorption behavior of metallic ions in solutions. The effect of temperature on the adsorption of heavy metal ions from solutions containing coconut shell was studied at a concentration of 0.5 mg/L for 30 minutes. Increase in temperature from  $30^{\circ}$ – $60^{\circ}C$  was found to result in a steady increase in the removal efficiency of the adsorbent for the metal ions. This is due to the effect of temperature on the interaction between the shell surface and the metal ions in solution. When the pH of the adsorbing medium was increased from pH 2 to pH 10, there was a corresponding increase in the deprotonation of the adsorbent surface, leading to a decrease in  $H^{+}$  ion on the adsorbent surface. This creates more negative charges on the adsorbent surface, which favors adsorption of positively charge species and the positive sites on the adsorbent surface [3] [7].

The research on Low-cost adsorbents like peanut husk charcoal, fly ash and natural zeolite are effective for the removal of  $Cu^{2+}$  and  $Zn^{2+}$  ions from aqueous solutions. The batch method was employed; parameters such as pH, contact time, adsorbent dose and metal concentration were studied at an ambient temperature  $27 \pm 2^{\circ}C$ . The optimum pH corresponding to the maximum adsorption of copper and zinc removal was 6–8. Copper and zinc ions were adsorbed onto the adsorbents very rapidly within the first 30 min, while equilibrium was attained

within 2–3 hour for copper and zinc ions using different adsorbents. The Langmuir isotherm better fitted the experimental data since the correlation coefficient for the Langmuir isotherm was higher than that of the Freundlich isotherm for both metals [4].

Studies on the efficiency of Activated neem leaves has a good adsorption capacity for the adsorption of Cr (VI). The equilibrium time for the adsorption of Cr (VI) on activated neem leaves from aqueous is estimated as required. The adsorption process of Cr (VI) can be described by Langmuir isotherms and Freundlich isotherms model. Removal of Cr (VI) increases with increase of adsorbent dosage. The maximum adsorption Cr (VI) took place in pH range 1-3. This study clear show that neem leaves powder which is cheap and abundantly available may be used as an effective adsorbent from removal of Cr (VI) from effluent [5] [6].

#### **IV. CONCLUSION**

This study shows that the heavy metal removal by using green adsorbent presented here to show a great potential for the removal of heavy metal from synthetic wastewater through adsorption process. Various green adsorbent has been effectively used in the studies for the removal of metal ion concentrations and found that most of the green adsorbent have shown the effective removal efficiency above 90 percent. The adsorption by using green adsorbent for removal of heavy metal ion concentration is the effective method to remove metal ion concentrations. Adsorption by using green adsorbent which is low cost adsorbent is an alternative for removal of heavy metal ions from synthetic wastewater.

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