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A Review on - "Phenol Reduction by Waste Derived Activated Carbon"

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ABSTRACT

Among the various pollutants present in wastewater there is a common pollutant known as "Phenol". There are various techniques for the reduction of Phenol which are Distillation, Adsorption, Pre Evaporation, Membrane Extraction, Oxidation etc. This paper presents review on phenol reduction by adsorption using various waste derived activated carbons. Studies carried out by using various waste derived activated carbon indicates that there is a wide scope for the reduction of phenol from wastewater by waste derived activated carbon. The effectiveness and efficiency of these waste derived activated carbon was observed by Langmuir and Freundlich isotherms equations.

KEYWORDS | Adsorption, Waste Derived Adsorbents, Adsorption Model

I. INTRODUCTION

Due to increase in industrial activities has led to the discharge of large amount of wastewater. Phenol and its compounds are the one that are present in the wastewater as discharge from coal conversion, petroleum, oil refineries, phenolic resin plants etc. 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 phenol from wastewater like distillation, adsorption, pre evaporation, membrane extraction, oxidation etc.

Adsorption is a simple and relatively economical method and is widely used technique in the removal of pollutants. The present review paper presents the scope of adsorption as a effective phenol removal technique using various waste derived activated carbon as an adsorbent and also focuses on the various parameters affecting adsorption, i.e. pH, Phenol Conc. In feed, Bed height or surface area of adsorbent, contact tome etc.

II. ADSORPTION

Adsorption has been found as a low cost physical process for the treatment of wastewater. It exploits the ability of certain solids to preferentially concentrate specific substance from solution onto their surfaces. Adsorption using commercially activated carbon is the most commonly used method due to its porous nature and high adsorption capacity resulting from high surface area of the activated carbon surface. Various waste derived activated carbon as an adsorbent like saw dust, coconut shell, rice husk, wood, fly ash, baggase, tea leaves etc. have been tried by the researchers.

III. PARAMETERS AFFECTING ADSORPTION

1. Effect of pH

The removal of phenol from wastewater by adsorption is highly dependent on pH. Results showed that the percent adsorption of phenol increases up to pH 6 and then decrease with further increase in pH **[1][5].**

2. Effect of adsorbent dose

The results showed that the percentage removal of phenol increases with increase in adsorbent dosage. Because adsorption is mainly a surface phenomenon, the amount of surface available for adsorption process consequently the mass of adsorbent can considerably affect adsorption efficiency **[3].**

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 **[1][3].**

4. Effect of phenol concentration

With increase in the initial phenol concentration, the removal percentage increases as excepted but after certain concentration, increase in the initial concentration has adverse effects on the removal percentage **[3][5].**

IV. VARIOUS ADSORBENTS FOR PHENOL REMOVAL

The removal of phenol by using following adsorbents by the researchers. The review presents the summary of this research work. Various adsorbents used for phenol removal includes saw dust, coconut shell, rice husk, wood, fly ash baggase, tea leaves etc.

The research on adsorption of phenol from industrial wastewater using the local sawdust indicates the significance of the individual factors and their interactions on both adsorption process.**[1]** Box-Wilson design of experiments was adopted to find a useful relationship between the four variables and the removal efficiency. The experimental data collected by this method is successively fitted to a second order polynomial mathematical model. The optimum conditions for the removal of phenol within the experiment range of variables studies were 130 mg/l of initial phenol concentration, 0.82 gm of adsorbent dose, natural pH value of 6.7 and 120 min of contact time. Under these conditions the maximum removal efficiency was 91.6%. Batch kinetic and isotherm studies were carried out to evaluate the effect of initial phenol concentration, adsorbent dose, pH and contact time. It was found that the equilibrium data agree very well with the Langmuir and Freundlich models.

Studies on the sorptive removal of phenol from aqueous solution by ammonium chloride- treated and carbonized moringa oleifera seed shells was investigated and various parameters such as initial phenolic solution, pH and adsorbent dosage on equilibrium sorption were studied. Adsorption isotherms and kinetic experiments performed at 25 – 40°C furnished some thermodynamic and kinetic parameters, respectively. Phenol uptake decreased with increase in solution pH for both adsorbents. Adsorption kinetics obeyed the pseudo second-order model **[2].**

The research on adsorption of phenol on saw dust, polymerized saw dust and saw dust carbon was studied using various factors such as initial concentration, agitation speed, amount of adsorbent, temperature and pH on the adsorption capacity.**[3]** The percentage removal of phenol is observed to increase, with the increase in initial concentration of phenol. With increase in temperature the adsorption of phenol decrease, indicating exothermic nature or the reaction. Adsorption isotherm data could

be interpreted by the Langmuir and Freundlich equation. The kinetics of adsorption of phenol on saw dust, polymerized saw dust and saw dust carbon can be explained satisfactorily using pseudo-second order model with regression coefficient greater than 0.98.

Studies have also been carried out on the potential of Rice Husk, Activated carbon in combination with Amberlite-XAD4 for phenol adsorption from Bisphenol-A manufacturing plant waste water.**[4]** The adsorption of phenol is maximum in the pH range of 7-8. Results showed that the equilibrium data for all the phenol-rice husk system fitted the Freundlich model best within the concentration range studied. However Langmuir model is fitted well for the phenol-activated carbon system for the concentration range 100-1000 ppm. The study showed that rice husk is very effective and low cost adsorbent for phenol removal. The studies showed that the rice husk could be used as a polishing/ pretreatment for removal of phenol from water and wastewater in combination with Amberlite-XAD4 and Activated Carbon.

Studies on the efficiency of groundnut shell for removal of phenol from wastewater had also been carried out.**[5]** Various parameters like initial concentration, adsorbent dose, pH, contact time have been studied. The phenol uptake process followed the Langmuir isotherm more closely than the Freundlich isotherm, indicating monolayer adsorption. The optimum values for contact time, adsorbent dose, pH and particle size were observed to be 120 minutes, 3 grams per 100 ml, 6 and –72 mesh respectively. The percentage removal upto 92-98 percent was obtained during the studies.

A review on removal of phenol from water environment by activated carbon (AC), bagasse ash (BA) and wood charcoal (WC) has been carried out in batch experiments. The study was performed with two initial phenol concentrations, viz. 30 and 50 mg/L, with an equal amount of adsorbent dose (50 g/L). The effects of solution pH, concentrations of EDTA, anions, and dosages of adsorbent on removal of phenol were examined. Experimental results showed that for phenol – AC, phenol – WC and phenol – BA adsorption systems, approximately 98%, 90% and 90% removal efficiencies were achieved at given adsorption conditions.**[6]**

The research on phenol removal by activated carbon produced from avocado kernel seeds was carried out by Liana Alvares Rodrigues et al (2011)**[7]**. Adsorption isotherm showed that the interaction of phenol with AAC surface was described by a localized mono layer adsorption. The results showed that the prepared activated carbon was an effective adsorbent for phenol removal from aqueous solution.

V. CONCLUSION

A review on waste derived activated carbon is presented here to show a great potential for the reduction of phenol from wastewater through adsorption process. Various waste derived activated carbon has been effectively used in the studies for the reduction of phenol from wastewater and found that most of the waste derived activated carbon have shown the phenol reduction efficiency above 90 percent. The effectiveness of adsorption for reduction of phenol is the effective method of regeneration of adsorbate. Adsorption in fixed bed by waste derived activated carbon is promising alternative for phenol reduction from wastewater.

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