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Removal Efficiency of Lead, Chromium and COD by Plant materials

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ABSTRACT

The present investigation was carried out to study the removal of lead, chromium and COD using *Prosopis chilensis* and *Phyllanthus emblica* carbon. The characteristic of these carbons are compared with Commercial Activated Carbon (CAC). The process parameters studied include the agitation time and initial dose. It is found that bark of *Prosopis chilensis* is a good adsorbent for the removal of Chromium and COD whereas the of bark of *Phyllanthus emblica* carbon is suitable for the removal of Lead.

Keywords: Lead, Chromium, COD, *Prosopis chilensis* and *Phyllanthus emblica* carbon.

1. INTRODUCTION

Adsorption is a unique process useful for the removal of both organic and inorganic pollutants from water. It is a process by which the concentration of solute is enriched at the surface or interface between two phases. Several treatment methods for industrial effluent and aqueous solutions were carried out by many authors, using low cost adsorbents. The use of activated carbon for the adsorption of pollutants was first proposed by Deo Namita and Alimanzoor (1992) [1], Kannan and Jeya Ganesh (2001) [2] and singh et al., (2001) [3] employed adsorbents like paddy straw, fly ash- commercially activated carbon (CAC) and activated carbon from tea leaves respectively for the removal of chromium, colour (dye) and metals (Cr and Fe) respectively from aqueous solutions. In recent years several investigators have concentrated their work on low cost non-conventional materials to achieve the economically feasible and effective treatments of wastewater containing heavy metals and other pollutants. Various industrial solid wastes and agricultural byproducts have adsorbent affinity for pollutants, such as petroleum acid sludge, distillery waste, pulp mill waste, leather waste, rubber waste, fly ash, bagasse, molasses, saw dust, coffee beans, palm tree cobs, corn cobs, coconut coir, nut shells, rice hulls, jute stick, cotton seed hulls, seaweed, beet-sugar sludge, wheat straw, almond shells, rice husk, coir pith, tea dust etc. (Namasivayam, 1998) [4]. The low cost materials are used for the preparation of adsorbents for the removal of pollutants from aqueous solution (Selvi et al., 2001) [5].

Among the various methods adsorption is generally preferred for the treatment of polluted water due to its high efficiency, easy handling, availability of different adsorbents and cost-effectiveness. The main objective of this work is to evaluate the adsorption capacity of *Prosopis chilensis*, bark of *Phyllanthus emblica* and Commercial activated carbons for the effective removal of heavy metals and COD from known concentration of water samples with contact time. The following procedure was carried for the present work.

2. MATERIALS AND METHODS

The bark of *Prosopis chilensis* and *Phyllanthus emblica* were collected and soaked in distilled water for 24 hours and washed with distilled water several times. After completely drying under solar light, the adsorbents were finely ground and sieved into uniform particles of size 60µ mesh. The low moisture content, high ash content and larger surface area increase the efficiency of adsorption.

2.1. Preparation of activated carbon

The bark of *Prosopis chilensis* and *Phyllanthus emblica* carbon adsorbents were activated separately by keeping them in an oven maintained at a temperature of 140-160^{0}C.The carbonized material was washed well with water and dried at 105-110^{0}C. The dried material was

subjected to thermal activation in an atmosphere of carbon dioxide at 800-850^0 C for a period of 30 minutes. The materials were then ground to produce particles for different size for each adsorbent. The characteristics of activated carbon of the various adsorbents are summarized in table 1.

Table - 1: Characteristics of adsorbents after activation

Characteristics	CAC	*Prosopis chilenses*	*Phyllanthus emblica*
Bulk density g/ml	0.68	0.69	0.44
Moisture Content %	12.57	8.71	7.1
Ash Content %	2.91	0.51	3.16
Matter Soluble in Water %	1.55	0.48	0.51
Matter Soluble on Acid %	4.58	0.76	1.05
PH	9.2	6.24	3.5
Decolorizing Power (mg/g) (Mthylene Blue)	73.5	36.4	31.1
Phenol Number mg	5.15	8.5	6.30
Ion Exchange Capacity (mg/g)	Nil	0.035	0.011
Surface Area	296	412	176

2.2. Batch mode adsorption studies

Accurately 250 ml of known concentrations water samples were taken in five sets of stopper glass bottles separately. Weighed 1.0 g of activated carbon of *Prosopis chilensis*, *Phyllanthus emblica* and commercial activated carbon. Then the samples were agitated in a mechanical stirrer. 20 ml of the sample was withdrawn for every 30, 60, 90, 120,150 and 180 minutes form each bottle. Each sample was filtered separately through whatmann 42 filter paper. Then the filtered solutions were taken out for Analysis. The trace metals such as Pb, Cr were analyzed and COD was determined using standard procedure.

3. RESULTS AND DISCUSSION

All the results are presented in table 2, 3 and the figures 1 – 3 depicting the variation of percentage removal of heavy metals and COD with time. These results are discussed below.

3.1. Lead

The percentage reduction of lead is 30-49, 35-51 for the raw adsorbents of *Prosopis chilensis* and *Phyllanthus emblica* respectively. The percentage reduction of lead is 36-50, 39-59 for the activated adsorbents of *Prosopis chilensis* and *Phyllanthus emblica* respectively. When compared to raw adsorbents, the activated adsorbents have good removal efficiency of lead. Raw adsorbents of bark of *Phyllanthus emblica* has the removal efficiency up to 51%, but when it is activated, the percentage of reduction is increased by 59%. This may be due to high adequate availability of active sites and adsorptive forces (Nigam and Rma 2002) [6]. The present study infers that the activated bark of *Phyllanthus emblica* have good removal efficiency of lead compared to *Prosopis chilensis*.

3.2. Chromium

The percentage reduction of chromium is found in the range of 40-52, 35-55 for *Prosopis chilensis* , *Phyllanthus emblica* respectively. The percentage removal efficiency for chromium is 46-66, 39-60 for the activated adsorbents of *Prosopis chilensis* and *Phyllanthus emblica* respectively. The present study predicts that activated adsorbents have a good removal efficiency of chromium than raw adsorbents. *Prosopis chilensis* has more removal efficiency of 66% chromium compared *Phyllanthus emblica*. When the adsorbents are activated, the efficiency is increased. This increase may be due to the utilization of active sites availing the larger surface area. (Vivek babu et al., 2002) [7]. The percentage adsorption is found to increase continuously with time till the equilibrium is attained with saturation at two hours (Suguna Devi et al., 2002) [8].

3.3. COD

The percentage removal efficency of COD is found in the range of 40-57 and 40-60 by the raw adsorbents of *Prosopis chilensis* and *Phyllanthus emblica* respectively. The percentage removal efficiency of COD is found in the range of 42-61, 42-60 for the activated adsorbents of *Prosopis chilensis* and *Phyllanthus emblica* respectively.

The present study predicts that the maximum removal efficiency of COD is 61% for the activated *Prosopis chilensis*. The activated adsorbents have more removal efficiency those raw adsorbents. The maximum percentage removal efficiency is nearly 60% for both the adsorbents of Prosopis *chilensis* and *Phyllanthus emblica*. This may be due to the availability of active sites on the adsorbents. It is found that the percentage removal efficiency increase continuously with time for both the adsorbents. It is concluded that

Table - 2: Removal of heavy metals and COD with raw adsorbents

Raw adsorbent	Time (minutes)	% reduction of Pb	% reduction of Cr	% reduction of COD
Prosopis chilenses	30	30	40	40
	60	39	44	48
	90	41	48	52
	120	45	50	54
	150	48	51	56
	180	49	52	57
Phyllanthus emblica	30	35	35	40
	60	44	46	52
	90	48	50	56
	120	50	52	58
	150	51	54	59
	180	51	55	60

Table - 3: Removal of heavy metals and COD with activated adsorbents

Raw adsorbent	Time (minutes)	% reduction of Pb	% reduction of Cr	% reduction of COD
Prosopis chilenses	30	36	46	42
	60	40	54	48
	90	42	60	53
	120	46	63	56
	150	49	65	59
	180	50	66	61
Phyllanthus emblica	30	39	39	42
	60	48	48	49
	90	52	52	54
	120	56	56	58
	150	58	59	59
	180	59	60	60

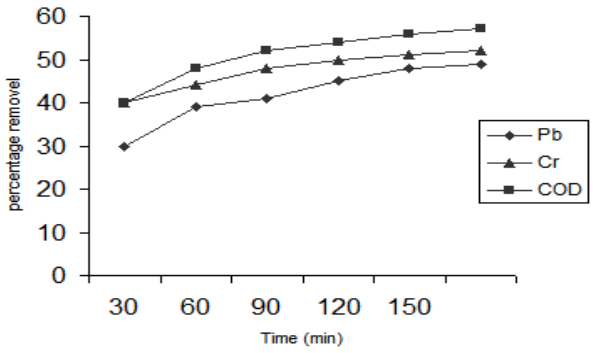

Figure - 1: Effect of Contact time and percentage removal on the adsorption of raw *Prosopis chilensis.*

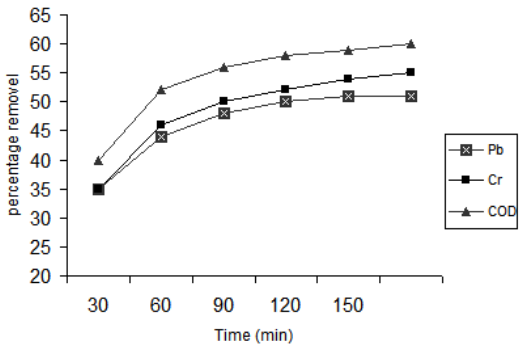

Figure - 2: Effect of Contact time and percentage removal on the adsorption of raw *Phyllanthus emblica*.

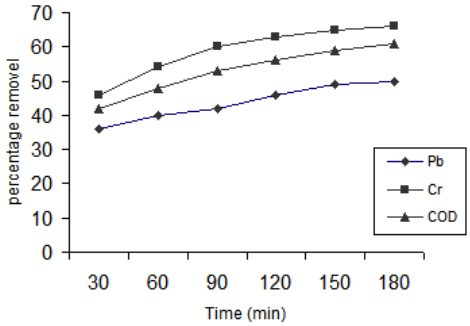

Figure - 3: Effect of contact time and percentage removal on the adsorption of raw activated *Prosopis chilensis*

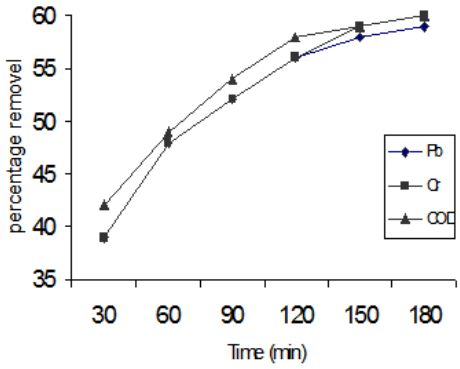

Figure - 4: Effect of Contact time and percentage removal on the adsorption of raw activated *Phyllanthus emblica*.

the activated *Prosopis chilensis* is suitable adsorbent for the removal of Cr and COD compared to *Phyllanthus emblica*. Whereas in the case of Pb the bark of *Phyllanthus emblica* is the suitable adsorbent compared to *Prosopis cheilensis*. Hence heavy metal pollution may be controlled considerably by the treatment methods using adsorbents in large scale and the water may be used for the potable.

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