REMOVAL OF CHROMIUM (VI) AS CHROMIUM DIPHENYL CARBAZIDE (CDC) COMPLEX FROM AQUEOUS SOLUTION BY ACTIVATED CARBON

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Abstract. Adsorption of Cr (VI) as CDC-complex from aqueous solution by activated C has been investigated. Factors like pH and presence of Cr (III) which affect the adsorption of CDC-complex were studied. The increase in particle size and surface area of activated C does not enhance the removal of CDC-complex. For different concentrations of Cr, the optimum quantity of Diphenyl Carbazide has been determined. The reduced Cr e.g. Cr (III) decreases the CDC-complex removal. The Langmuir and Freundlich isotherms constant as calculated are $I_m = 1.8932$ and $b = 0.2305$ and $n = 0.036$, log $K = 0.0266$, respectively.

1. Introduction

Presence of Cr in the environment has led to an increasing awareness and concern of its detrimental effect to nature and human beings (Browning, 1969). Chromium is of particular concern due to its widespread industrial use and its chemical complexity. Electroplaters, khaki dyeing and Cr plating are major sources of dispersion of Cr into the environment (Kothandaron et al., 1976; Chattarpadhaya et al., 1973, Arumogam, 1976). The toxicity of Cr is well documented and it poses a health hazard to man and animals. Hexavalent Cr in high concentration has been implicated as the cause of digestive tract cancer in man (Kaufman, 1970). There is an increased risk of lung cancer of workers exposed to high levels of Cr (Towill, 1978). Cr (VI) is corrosive to flesh and also is carcinogenic (Udy, 1956).

Usual method of treating Cr containing wastewater is by precipitation (Patterson, 1975). The current methods of treatment such as ion exchange process are either expensive or inconsistent in operation (Thomas and Theis, 1976). Removal of Cr from water and wastewater by activated C has been reported by many investigators (Huang and WU, 1977, 1975; Huang and Bowers, 1978). It shows that removal of Cr by activated C from highly concentrated solution is not effective. In such case, the adsorption of Cr by activated C can be obtained by complexing the Cr with organic ligands prior to its use. Sai et al. (1982) studied the adsorption behavior of Cr (III, VI) on activated C and oxine impregnated activated C. Yomamoto and Ohashi (1970) explained the formation of Cr (III) EDTA complex and its removal by reduction of Cr (VI) with a reducing agent in the presence of EDTA. Diphenyl carbazide (DC) is a standard compound prepared to determine Cr quantitatively. Since, adsorption of Cr (VI) diphenyl carbazide complex (CDC-complex) has not
been reported so far. A study has been undertaken for the first time to convert Cr to CDC-complex and remove Cr by activated C adsorption and findings are reported in this paper.

2. Materials and Methods

2.1. Active Carbon

Activated C used in this investigation is commercial grade, supplied by Hyderabad C and Chemicals, prepared by reaction of coconut char with steam at high temperature. Properties of two grades of activated C used are as under (Ramchandra Reddy et al., 1985).

<table>
<thead>
<tr>
<th>Active Carbon</th>
<th>Particle size (mesh BSS)</th>
<th>Surface area (m²g⁻¹)</th>
<th>Acidity due to CCl₄ adsorption meq⁻¹</th>
<th>CCl₄ adsorption (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>C A</td>
<td>3/6 &amp; 6/12</td>
<td>928.2</td>
<td>1.19</td>
<td>30</td>
</tr>
<tr>
<td>C B</td>
<td>3/6 &amp; 6/12</td>
<td>1293.0</td>
<td>1.59</td>
<td>70</td>
</tr>
</tbody>
</table>

According to classification of Steenburg (1944), activated C prepared above 700 °C by steam treatment is an H-type which on contact with water raises the pH of solution through hydrolytical reaction and adsorbs only acid.

2.2. Chemicals

Potassium dichromate, acetone, H₂SO₄ and diphenyl carbazide (DC) used are A.R. grade supplied by BDH.

2.3. Adsorption Studies

Adsorption studies have been carried out in 250 mL conical glass flask by taking 100 mL Cr solution (700 to 2600 μg g⁻¹). The initial pH was adjusted to acidic using H₂SO₄ acid followed by treatment with DC. The activated C was added to the solution and placed in electric shaker for desired period. The contents of conical flask were filtered through Whatman paper No. 42 to separate C prior to Cr determination. Filtrate was used to measure the residual Cr. Hexavalent Cr is analyzed by the pink color complex developed between DC and Cr ions in an acidified solution (A.P.H.A., 1985). Absorbance was then measured at 540 nm using spectronic 21 Bausch and Lomb Spectrophotometer. Total Cr was determined by oxidizing the trivalent Cr with potassium permanganate followed by analysis of hexavalent Cr.