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TREATMENT OF CHEMICAL POLLUTANTS FROM EFFLUENTS OF TEXTILE INDUSTRIES

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Abstract

The problem of pollution from effluents of textile industry is of great concern to community because such water contains contaminants like dissolved solids, toxic compounds, color etc. The removal of these toxic constituents from textile effluents by conventional methods of wastewater treatment is quite difficult. Textile industry effluents are a major source of water pollution because dyes, detergents and other contaminants present in the wastewater undergo chemical as well as biological changes, consume dissolved oxygen, destroy aquatic life and pose a threat to human health as many of these contaminants are highly toxic in nature. Adsorption has been found to be an efficient and economical process for the removal of pollutants such as dyes, color etc. from wastewater. Several workers have studied the removal of dyes and color from wastewater using various adsorbents. Charcoal is a very effective adsorbent due to its porous nature and large surface area. It is effective in the removal of a wide variety of contaminants as well as taste, color and odor from water.

Keywords: *Chemical Pollutants, Effluents, COD, BOD.*

Objective:

The aim of the present study is to study the effect of different adsorbent dosages, contact duration and temperature on the removal of components contributing to COD and BOD by adsorption onto powdered charcoal, from the combined wastewater of a synthetic textile processing unit under investigation and to give appropriate mathematical models viz., Freundlich and Langmuir adsorption isotherm models and to evaluate, powdered charcoal as an adsorbent.

Experimental :

For treatment of the wastewater sample, powdered charcoal with a specific surface of 5401.69cm2/gm, dried at 100°C was added to wastewater samples and the mixture was stirred. Powdered charcoal was kept in contact until equilibrium state was attained. The important physicochemical characteristics i.e. pH, alkalinity, COD, and BOD were determined before and after treatment using standard methods.

Discussion and results:

A number of dyes that were in use some years ago were subsequently found to be human carcinogens. In other cases, intermediates used in dye synthesis and/or trace contaminants of dye preparations showed similar properties. With the growing movement for pollution control all over the world and the strict by-laws of the statutory authorities, the importance of proper effluent treatment is receiving increasing importance. It is likely that in the present climate of concern, many studies will be carried out on the chemicals in use and on the effluents in order to reduce the risks to the workers handling them and to the environment. Depending on the production (Kg/day), wastewater produced in a textile processing unit usually ranges from 900-6200 cubic meters per day.

Treatment of effluents from textile plants has been described by various research workers. These studies tend to concentrate on the effluents associated with the early stages of textile processing- dyewastes are only briefly mentioned. About 38% of the total water used in textile mill is consumed in this section. Scouring is generally carried out in kiers by treating the textiles with caustic soda, soda ash, wetting agents, surfactants etc., with water and steam. Significant characteristics of effluents discharged from this section are high COD, high temperature, high pH, high cations in the form of sodium and high total solids. The pollution load contributed by scouring process forms a major part of the composite mill wastes. It creates a number of problems during treatment processes, especially in biological ones because of its high temperature and alkalinity.

The ferrous ammonium sulphate solution was standardized daily against standard potassium dichromate solution. 10 ml standard K2Cr207 was diluted to 100 ml with distilled water and 30 ml concentrated sulphuric acid was added. The mixture was cooled and titrated against ferrous ammonium sulphate using ferroin indicator. A 25 ml sample or a suitable portion diluted to 25 ml was taken for titration. Samples with pH in the range 7 to 10 were titrated directly. The pH of samples not in this range was adjusted with H2S04 or NaOH. A few drops of K2Cr204 indicator was added and the sample was titrated against standard AgN03 solution to a pinkish yellow end point. A reagent blank was determined by the titration method outlined above, using a volume of distilled water equal to that of the sample. AgN03 titrant was standardized against NaCl solution.

The observed linearity suggests the applicability of Freundlich isotherm model in both cases and indicates a monolayer coverage of the adsorbate on the outer surface of the adsorbent. The value of 1/n, related to adsorption intensity is close to 1 (1.2195 in the case of COD and 1.4285 for BOD). This indicates high adsorptive intensity at high equilibrium concentrations that rapidly diminishes at lower equilibrium concentrations covered by the isotherm. The values of K, related to adsorption capacity were found to be 22.3872 in the case of COD and 1.8620 for BOD As the Freundlich equation indicates, the adsorptive capacity, x/m, is a function of the equilibrium concentration of the solute.

Therefore, higher capacities are obtained at higher equilibrium concentrations. The Langmuir constant related to adsorption capacity, 9, in mg/gm and the constant related to adsoiption energy, b x 10 L/mg of powdered charcoal for COD exerting components is found to be 2032.08 and 0.12 respectively and for BOD exerting components, the values are found to be 128.92 and 3.20 respectively. In both the cases equilibrium has not been attained even after 120 minutes of contact time. For a 7 gm/L dosage of powdered charcoal, an equilibrium concentration of 217.0 ppm of BOD is attained within 15 minutes of contact time. The pH and alkalinity have been observed to increase slightly within 30 minutes of contact time.

Percent removal of COD at constant temperature and powdered charcoal dosages of 2 gm/L, 4 gm/L and 7 gm/L respectively. Tables 5.10 to 5.12 show the same for BOD. The removal of COD per gram of powdered charcoal was seen to increase from 255.6 mg/gm at 15 minutes to 340.8 mg/gm at 120 minutes, from 298.2 mg/gm at 15minutes to 340.8 mg/gm at 120 minutes and from 183.9 mg/gm to 207.5 mg/gm at 120 minutes for 2 gm/L, 4 gm/L and 7 gm/L dosages of powdered charcoal respectively. The values of percent removal of COD are seen to increase and those of adsorption rate to decrease in accordance. The values of percent removal of BOD are seen to increase and those of rate of adsorption are seen to decrease in accordance. In the case of 7 gm/L dosage of powdered charcoal, the removal of BOD reaches equilibrium condition within 15 minutes of contact time, the removal being 70.8 mg/gm. the process of adsorption of components contributing to COD and BOD from the wastewater of textile industry under examination is a first order reaction from the kinetics viewpoint. For the determination of rate constant, the mathematical expression used is as follows:

$K^* = 2.303/t - a/(a-x)$

Where; a is the initial concentration of COD or BOD

x is the amount of COD or BOD removed at time t

K* is the rate constant

Using the relation, slope = -K*/2.303, the K* values obtained for COD are 5.263 x 10"3, 1.944 x 10"2 and 1.919 x 10-2 for 2 gm/L, 4 gm/L and 7 gm/L of powdered charcoal respectively. K* values for removal of BOD are 6.823 x 10"4 and 2.388 x 10"3 for 2 gm/L and 4 gm/L respectively.

Powdered charcoal was found to be very effective in the removal of contaminants contributing to the COD and BOD of the wastewater at all doses studied. Higher efficiency (adsorption per gram of adsorbent) of adsorption is obtained at lower doses of powdered charcoal. Freunlich and Langmuir adsorption isotherms are found to be applicable for the removal of components contributing to COD and BOD from the wastewater by adsorption onto powdered charcoal. Equilibrium is attained for the removal of components contributing to COD within 45 minutes of contact time whereas that for components contributing to BOD takes more than 120 minutes. Maximum removal of components contributing to COD was found to occur at a temperature of 303 K and that of components contributing to BOD at 298 K.

Bentonite is a natural clay composed of montmorillonite (Al4Si802o(OH)4-nH20), together with beidellite (Al4Si802o(OH)4). Table 6.1 shows the effect of different doses of bentonite on various physico-chemical characteristics of combined wastewater of a synthetic textile processing mill. It can be seen that there is a reduction in the COD content from an initial value of 839.0 ppm to 519.3 at a dose of 100 gm/L of bentonite. BOD had an initial value of 31.0 ppm, which was unaffected by 10 gm/L and 20 gm/L doses of bentonite and was reduced to 15.5 ppm by 40 gm/L and higher doses. There is an increase in hardness, chloride content and conductivity at all doses. This may be due to the presence of some soluble salts in bentonite. Alkalinity and pH remain unaffected. The polyelectrolytes studied were found to be effective in reducing the COD and BOD content of the wastewater to a certain extent. Out of the four polyelectrolytes studied, Maxfloc-506 was found to give best results.

The polyelectrolytes are effective at very low dosages and the optimum dosage must be strictly maintained to obtain best results.

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