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Studies on Treatment of Textile Effluent Using Activated Charcoal

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Abstract: *Water being an essential component of life and symbol of purity, is becoming extinct and contaminated with extensive use by industries. The sources of occurrence of water pollution are majorly from textile industries. Waste minimization is of great importance in decreasing pollution load and production costs. So, in order to minimize the waste from the textile industries, the effluent from the industry are treated and reused. The treatment process is carried out with the help of activated charcoals prepared from the waste natural materials. The activated charcoal acts as an adsorbent for the adsorption of the dye and impurities. The treatment process comprises of separation of dyes from the textile effluent and treating the wastewater extracted from the effluent for reuse. The charcoal used for the treatment process are regenerated and reused again for adsorption process. This treatment facilitates the textile industries to reuse the water, which can reduce the demand of the water. The materials used in the treatment process are regenerated and reused hence the amount of waste liberate from the industries can be reduced. Since natural waste materials are used for the treatment and the used materials are reused, it makes the treatment process economical.*

Keywords: *Activated Charcoal, Economical, Natural Waste Materials, Regeneration And Reuse.*

I. Introduction

Water is, literally, the source of life on earth. Water is the biggest crisis facing the world today. In India the crisis in terms spread and severity affects one in three people. The worldwide rise in population and the industrialization during the last few decades have resulted in ecological unbalance and degradation of the natural resources.[4] One of the most essential natural resources, which have been the worst victim of population explosion and growing industrialization, is water. Huge quantity of wastewater generated from human settlement and industrial sectors accompany the disposal system either as municipal wastewater or industrial wastewater. The sources of occurrence of water pollution are majorly from textile industries. Waste minimizationis of great importance in decreasing pollution load and production costs. So, in order to minimize the waste from the textile industries, the effluent from the industry are treated and reused. The treatment process is carried out with the help of activated charcoals prepared from the waste natural materials.[2]

Charcoal is a highly porous and brittle material which properties are determined by the condition of the carbonization process and used raw materials. Charcoal is mostly pure carbon, made by cooking wood with low oxygen.[5] The process can take days and burns off volatile compounds such as water, methane, hydrogen, and tar, and leaves about 25% of black lumps and powder of the original weight. Charcoal fresh from the kiln contains usually less than 1% of moisture, but the moisture content could reach 5-10%, as absorption of moisture from the humidity of the air itself is rapid. Moreover, when the hygroscopitity of charcoal is increased, the moisture content of charcoal can rise to 15% or even more. High quality charcoal has the moisture content of around 5-15% of the gross weight of charcoal. The charcoal's ash content varies from 0.5% to more than 5% depending on raw materials.[7]

II. Materials And Methodology

2.1 Materials used

The primary materials required for the study was charcoal. It is prepared using immature coconut nuts, male inflorescence of palm tree (kookan), Seeds of pine tree (savukku) and logs of *Prosopisjuliflora* (karuvelam). Coconut nuts and seeds of pine tree (savukku) were collected from the areas around Abishegapakkam, Cuddalore district, male inflorescence of palm tree (kookan) was collected from the location around Kalapet, Puducherry. Logs of *Prosopisjuliflora* (karuvelam) were collected in the area around Madagadipet, Puducherry.

The effluent textile waste water sample was collected from the dying industry in the area of Siruvanthadu, Villupuram, Tamilnadu.

2.2Preparation of Charcoal

The raw materials of immature coconut nuts and seeds of pine tree (savukku), male inflorescence of palm tree (kookan) and logs of *Prosopisjuliflora* (karuvelam) were dried under the sunlight for 10 days to make it free from moisture and they are preserved. Traditional methods were employed to prepare charcoal from the collected samples. [5]

A pit of adequate size was made. The dried samples of immature coconut nuts were placed in the pit and burnt until they form a correct consistency. This process is followed for other samples also after burnt, the pit was closed and the charcoals are let to cool (auto cool) for about 3-4 hrs. Later the charcoals are collected and preserved. [7]

2.3 Activation of Charcoal

The prepared charcoals were powdered and activated in order to increase the pore size. The activation process was done with the help of calcium chloride. By adding calcium chloride to the charcoal and kept for 24 hours in room temperature. Later it was placed in an oven at 110^{o}C for 8 hours. On activation the pore size of the charcoal is enlarged.[7]

III. Treatment Of Effluent

3.1 Characteristics of Textile effluent

The chemical properties includes pH, alkalinity, total solids, conductivity, dissolved oxygen, residual chlorine and manganese were analyses as IS code. [7]

The characteristics of textile effluent as given in Table 3.1

Table 3.1: characteristics of textile effluent

Tests	Values
pH	8.62
Alkalinity	3.8 mg/ lit
Total solids	0.020mg/lit
COD	32.000 mg/l
Conductivity	2.5/cm^2
Dissolved oxygen	5.053 mg/l
Residual chlorine	3.545 mg/l
Manganese	0.03 ppm

3.2 Treatment of textile effluent

After determining the characteristics of the textile effluent, the mix proportion of the activated charcoal was determined. The activated charcoal was introduced to the effluent in the ratio 1:10 (1 part of charcoal: 10 part of effluent). The effluent was stirred well and kept for 24 hours. The activated charcoals acts as an absorbent and absorbs the impurities of the effluent (absorbs dye). The absorbed charcoal and the wastewater was separated.[2]

3.3 Regeneration of charcoal

The absorbed charcoal was separated by filtering with a filter paper. The filtered charcoal was diluted with NaOH solution prepared in various ratio. The charcoal was regenerated by centrifugal process. Prepared solution (charcoal + NaOH) was kept in centrifugal tube and placed in the centrifugal apparatus. The centrifugal rotates at an rpm of 3500 for about 10 min.The charcoal floats and the dye is separated in the form of aqueous solution. The charcoal are removed from the aqueous solution and reused.[3]

3.4 Treatment of dye

The dye from the aqueous solution was removed by re-adsorption process.Charcoal is added to the aquous solution and stirred for about an hour.The stirred solution is filtered using filter paper.The charcoal thus obtained was grinded and can be used as a fertilizer for plants. Since these charcoals contain nitrogen and carbon, which are helpful in the growth of plants.[6]

IV. Results and Discussions

4.1 Properties of treated effluent

The effluent is treated with activated charcoal. The treated effluent is collected and the properties are determined by carrying on the following tests. The treated test results are compared with the Indian standards of portable water (IS 10500: 2012).The test results are tabulated in the table 4.1.

Table 4.1: Properties of the Treated Effluent

Test carried out	Values
pH test	7.02
Alkalinity test	0.2 mg/lit
Total solids	0.020 mg/lit
COD	11.999 mg/lit
Conductivity	0.21mu/cm2
Dissolved oxygen	7.548 mg/l
Residual chlorine	3.545 mg/l
Manganese	0.08 ppm

4.2 Particle size of charcoal

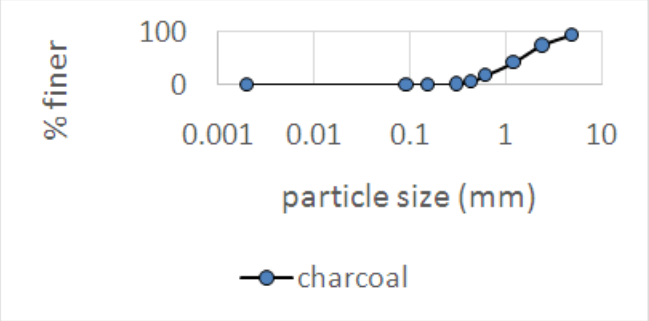

Figure 4.1 Particle size characteristics of Charcoal

Particle size of charcoal is determined by sieve analysis. The particle size of charcoal is poorly graded. The sieve analysis is carried as per IS 2720 (Part-IV).

4.3 Properties of regenerated charcoal

The charcoal from the treated effluent was separated and was regenerated. The results of the regenerated charcoal are tabulated in the table 4.4

Table 4.2: Properties of regenerated charcoal

Ratio	pH value	Manganese
2g NaOH + 100ml water	8.50	0.11
4g NaOH + 100ml water	8.31	0.12
6g NaOH + 100ml water	8.40	0.13
8gNaOH + 100ml water	8.33	0.10

4.4 Properties of re-adsorbed aqueous solution

The re-adsorption process is carried out to the regenerated charcoal. The properties of the aqueous solution are tabulated in table 4.3

Table 4.3: properties of adsorbed aqueous solution

Ratio	pH	Manganese
8g NaOH + 100ml distilled water	7.45	0.16
6g NaOH + 100ml distilled water	7.62	0.18
4g NaOH + 100ml distilled water	7.81	0.17
2g NaOH + 100ml distilled water	7.88	0.15

V. Conclusion

The present study showed that the activated carbon prepared from the natural waste material, adding with Calcium chloride can be used as an adsorbent for removal of dye from the textile effluent. The treatment process comprises of separation of dyes from the textile effluent and treating the wastewater extracted from the effluent for reuse. The amount of dye adsorbed varied with initial concentration, adsorbent dosage, pH and temperature. Activated carbon can be conveniently and economically prepared from the natural waste materials such as immature coconut nuts, Male inflorescence of palm tree (kookan), Seeds of pine tree (savukku), Logs of *Prosopisjuliflora*(karuvelam).

The activated carbon adsorbs the dye from the effluent and the charcoal are separated from the effluent. The effluent water is treated to reach the standards of portable water as per IS 10500. As per the Indian standards IS 10500 (Part 11), the pH value of the portable water should be in the range of 6.5 to 8.5. The pH

obtained from the treated effluent is 7.02. The COD of the effluent is reduced from 32 mg/lit to 11.999 mg/lit. The water treated from the effluent are reused in the same textile industry. The charcoal used for the treatment are regenerated and neutralized for reuse. Since majority of the waste liberated from the effluent are treated and reused, the waste liberated from the industry are minimized. As the waste is minimized and the raw materials used for the treatment process are regenerated and reused this process becomes more economical.

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