**Vol. 7. No. 2. 2020.**


**Contents available at:**

**www.crdeepjournal.org**

**Global Journal of Current Research (ISSN: 2320-2920) SJIF: 3.269**


Full Length Research Article

# Decolorization of Dye Waste Water by Activated Carbon

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ARTICLE INFORMATION

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*Article history:*
Received: 23-04-2020
Revised: 27-04-2020
Accepted: 22-05-2020
Published: 25-05-2020

*Key words:*
waste water, dye industry, woodchips, activated carbon, pHmetre, nephlometric meter, total dissolved solvent tests.

ABSTRACT

*Waste water is any water that has been affected by human. Waste water is released from any combination of domestic, Industrial, commercial, (or) agricultural activities these may come from surface runoff (or) storm water and sewer inflow or sewer infiltration .Therefore water is by-product of domestic, industrial, commercial, agricultural activities. In Dharmavaram there are 138 dye industries from which 5000 liters of waste water is released from each industry every day. The waste water will be very harmful to the human beings and environment. The main objectives of our project are to collect waste water releasing from the dye industries, analyzing physical and chemical parameters of water like Pl-cobalt, total dissolved solids, turbidity, jar test, threshold, acidity, alkalinity and hardness of water and compare with standard values. The present experimental investigation focuses attention on the sampling analysis of waste water from dye industries with the standard values and appropriate chemicals. Removal of colored water was studied using absorbent prepared from activated carbon of natural wood. Batch adsorptions performed by varying absorbents dosage, pH effluent and contact time adsorption color is containing highly pH and the results obtained indicate that maximum removal 92.60% took place at 100mg/l pH range of 8 experiments reveal that transparency of color reached equilibrium with 120 min. activated carbon is a Good material for adsorption of color to treat waste water containing lower concentration of color.*

## Introduction

Waste water is any water that has been affected by human use. Wastewater is "used water from any combination of domestic, industrial, commercial or agricultural activities, surface runoff or storm water and any sewer inflow or sewer infiltration". Therefore, waste water is a by-product of domestic, industrial, commercial or agricultural activities. The characteristics of waste vary depending upon the source. Types of Waste water include: water waste from households, municipal waste from communities and industrial waste. Waste water can contain physical chemical biological pollutant The marginal materials used in our project are natural material. The natural materials that used for the Project is rice husk and wood chips. Rice husk is one such material which is being considered as potential substance fro wood and wood based products. Rice husks contain silica making them difficult for termites to consume. They are also a very abundant resource, often ending up being used as bedding for farm animals. (Wikipedia)

## Materials and methods

*Study area*

Located at a distance of 47 kms from Anantapur, Dharmavaram is well-connected both by rail and road. Dharmavaram is also known for its cotton and silk weaving-industry with it's silk sarees popular all over the world. This place is also known for its expertise in making leather puppets. In fact, it is one of the best places to shop for ethnic and stylish sarees in the country. Usually these sarees have broad borders, adorned by brocaded gold patterns. Not following any color contrast, Dharmavaram sarees comprise heavy 'pallus' with exclusive designs. Dharmavaram is located at 14$^{o}$ 26'N 77$^{o}$ 43'E / 14.43$^{o}$ N 77.72$^{o}$ E / 14.43; 77.72.[1] It has an average elevation of 345 metres (1131 feet). Demographic of 2006[update] India census, Dharmavaram had a population of 150,400. Males constitute 51% of the population and females 49%. Dharmavaram has an average literacy rate of 56%, lower than the national average of 59.5%: male literacy is 65% and, female literacy is 46%.

**Fig 1.** Preparation of silk with synthetic dyes


**Fig 2.** Entrance of dharmavaram

## Methodology

A major contribution to colour in textile wastewater is usually the dyeing and the washing operation after dyeing which as much as 50% of the dye might be released into the effluents (Joshi *et al.*, 2004). Textile dyes are mainly cationic, anionic and non-ionic dyes. The chromophores in anionic and non-ionic dyes are mostly azo group or anthraquinone types. The reactive cleavage of azo linkage is responsible for the formation of toxic amines in the effluents. Presence of colour in the waste water is one of the main problems in textile industry. Anthraquinone based dyes are most resistance to degradation due to their fused aromatic structure and therefore remain coloured for long time in the textile wastewater. These colours are easily visible to human eyes even at very low concentration. Hence, colour from textile wastes carries significant aesthetic importance. Most of the dyes are stable and has no effect of light or oxidizing agents.

## TDS and TSS

Total dissolved solids (TDS) is a measure of the combined content of all inorganic and organic substances contained in a liquid in molecular, ionized or micro-granula (colloidal sol) suspended form. TDS is used as an indication of aesthetic characteristics of drinking water and as an aggregate indicator of the presence of a broad array of chemical contaminants. TSS is solid materials, including organic and inorganic, that are suspended in the water. TDS are difficult to be treated with conventional treatment systems. Disposal of high TDS bearing effluents can lead to increase in TDS of ground water and surface water. TSS in effluent may also be harmful to vegetation and restrict its use for agricultural purpose.

## pH

pH is a measure of the concentration of hydrogen ions in the wastewater and gives an indication of how acid or alkaline the wastewater is. This parameter is important because aquatic life such as most fish can only survive in a narrow pH range between roughly pH 6-9.

## BOD and COD

Biochemical oxygen demand ( BOD) is defined as the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at certain temperature(20$^{o}$C)over a specific time period (5-day). BOD can be used as a gauge of the effectiveness of wastewater treatment plants. COD is a measure of the oxygen equivalent of the organic material chemically oxidised in the reaction and is determined by adding dichromate in an acid solution of the wastewater. So the textile wastewater effluent contains high amounts of agents causing damage to the environment and human health including suspended and dissolved solids, biological oxygen demand (BOD), chemical oxygen demand (COD),chemicals, odour and colour. Most of the BOD/COD ratios are found to be around 1:4, indicating the presence of non-biodegradable Substances . Typical characteristics of textile effluent are shown in Table

## Textile effluent treatment processes

Many pollutant removal technological processes have been developed in the past decades to treat the textile wastewater. The treatment processes is being chosen on the basis of composition characteristics and concentration of material present in the effluents. These processes are pre-treatment or preliminary, primary or physicochemical, secondary, tertiary treatment or combined treatment processes depending on type, sequence and method of removal of the harmful and unacceptable constituents. Most commonly used processes are being discussed below:

## Pre-treatment processes or preliminary treatment

Prior to textile Dyeing, the fabric must be clean & clear of all impurities. It should be free from dust particles and coloring materials. In order to obtain a white pure fabric, the fabric undergoes a series of cleaning steps covered in Pretreatment. The process of fabric treatment prior to dyeing or printing in order to achieve a clean fabric is known as pretreatment. The basic aim of the pretreatment is to prepare the fabric for dyeing and printing which gives the best result in respect to economy and quality. It is assumed that 70% dyeing & printing faults are coming from the pretreatment. Natural fibers and synthetic fibers contain primary impurities that are contained naturally, and secondary impurities that are added during spinning, knitting and weaving processes. The most conventional treatment processes in textile wastewater treatment is the removal of suspended solids, excessive quantities of oil and grease and gritty materials (Eswaramoorthi *et al.*, 2008). The coarse suspended materials such as yarns, lint, pieces of fabrics, fibres and rags is being removed from the effluent by using bar and fine screens (Das, 2000). The screened effluent then undergoes settling for the removal of the suspended particles. The floating particles are removed by mechanical scraping systems. Neutralization is done to reduce the acidic contents of the effluents. Sulphuric acid and boiler flue gas are the most commonly used chemicals to alter the pH. A pH value of 5-9 is considered ideal for the treatment process (Babu *et al.*, 2007; Das, 2000; Eswaramoorthi *et al.*, 2008). The common primary treatment processes are shown as follows.

**Adsorption**

The adsorption process is used to removes colour and other soluble organic pollutants from effluent. The process also removes toxic chemicals such as pesticides, phenols, cyanides and organic dyes that cannot be treated by conventional treatment methods. Dissolved organics are adsorbed on surface as waste water containing these is made to pass through adsorbent. Most commonly used adsorbent for treatment is activated carbon . It is manufactured from carbonaceous material such as wood, coal, petroleum products etc. A char is made by burning the material in the absence of air. The char is then oxidized at higher temperatures to create a porous solid mass which has large surface area per unit mass. The pores need to be large enough for soluble organic compounds to diffuse in order to reach the abundant surface area. This normally effects partial recovery of activity and necessitate frequent recharging of carbon. For thermal regeneration, the exhausted carbon is transported preferable in water slurry to regeneration unit where it is dewatered and fed to furnace and heated in a controlled conditions This results in almost complete restoration of its adsorption. There are some other materials such as activated clay, silica, flyash, etc are also known to be promising adsorbents.

**Secondary Treatment**

The Secondary treatment process is mainly carried out to reduce the BOD, phenol and oil contents in the wastewater and to control its colour. This can be biologically done with the help of microorganisms under aerobic or anaerobic conditions. Aerobic Bacteria use organic matter as a source of energy and nutrients. They oxidize dissolved organic matter to $CO_2$ and water and degrade nitrogenous organic matter into ammonia. Aerated lagoons, trickling filter and activated sludge systems are among the aerobic system used in the secondary treatment. Anaerobic treatment is mainly used to stabilize the generated sludge.

**Straining**

Pouring water rough through a clean piece of cotton cloth will remove a certain amount of the suspended silt and solids. It is important that the cloth used is clean, as dirty cloth may introduce additional pollutants. Specifically made monofilament filter cloths may be used in areas where guinea-worm disease is prevalent.

**Storage and settlement**

When water is stored for a day in safe conditions, more than 50% of most bacteria die. Furthermore, during storage, the suspended solids and some of the pathogens will settle to the bottom of the container. The container used for storage and settlement should have a lid to avoid recontamination, but should have a neck wide enough to facilitate periodic cleaning. For the example a bucket with a lid could be

Used for this purpose. Water should be drawn from the top of the container where it will be cleanest and contain less pathogen. Storage and settlement for at least 48 hours also eliminates organisms called the ova and cist, which act an intermediate host in the life cycle of bilharziasis (schistosomoasis), a water-based disease prevalent in some countries. Longer periods of storage will leader to better water quality.

**Color Removal**

Pulp wood is the timber with the principal use of making wood pulp for paper productions. Trees raised specifically for pulp production account of 16% of world pulp production, old growth forests 9% and third and more generation forests account for the balance. Reforestation is practiced in most areas, so trees are renewable resource.

**TESTING**

*Collection of samples*

Dye industry: K.R DYES

- The amount of water collected average at 5 litres.
- The samples are collected in sterilized bottle to avoid contamination.
- Samples are collected in the central part, discharge point, left part of the effluent tanks.
- Samples are collected from depth of 2mtrs from the eff;uent tank.
- The samples are stored in refrigerator after 2 hours from collection
- The adsorbent wood was collected from the natural areas.
- The wood was burnt and made into ash powder

**Fig.3** Collection of wood

**Fig.4 N**atural activated carbon

**Results**

*Dye removal study with activated carbon Violet*

Effect of Contact Time

**Table. 1** Details about amount of color removal waste water

| Activated carbon added for one litre(mg) | Contact time (min) | Percentage of color removal |
|---|---|---|
| 50 | 0 | 0 |
| 50 | 10 | 93.6 |
| 50 | 30 | 92.4 |
| 50 | 60 | 95.2 |
| 50 | 90 | 95.9 |
| 50 | 120 | 95.5 |
| 50 | 150 | 96.3 |
| 50 | 180 | 98.5 |
| 50 | 240 | 99.9 |

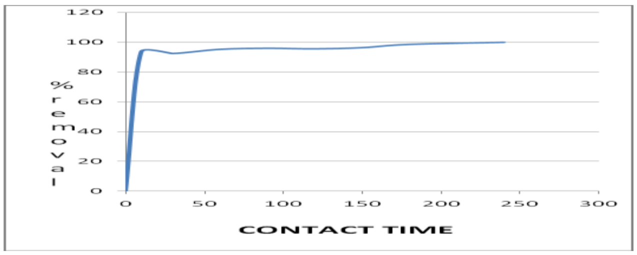


**Fig 5.** Percentage of color removal with in increasing in time with activated carbon

**Table 2** Amount of color removal waste water

| Activated carbon added for one litre(mg) | Contact time (min) | Percentage of color removal |
|---|---|---|
| 100 | 0 | 0 |
| 100 | 10 | 95.9 |
| 100 | 30 | 91.2 |
| 100 | 60 | 95.6 |
| 100 | 90 | 96.7 |
| 100 | 120 | 94 |
| 100 | 150 | 98.3 |
| 100 | 180 | 96.9 |
| 100 | 240 | 99.5 |

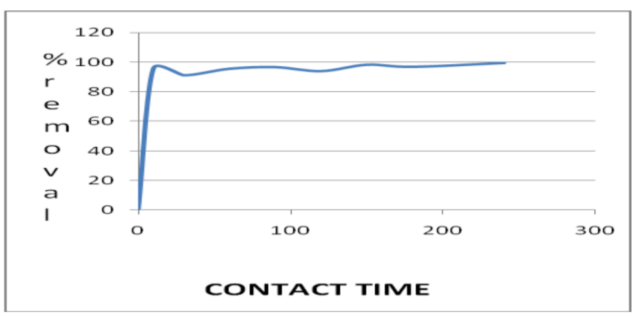


**Fig 6.** Percentage of color removal with in increasing in time with activated carbon

*Dye removal with activated carbon Blue*

Effect of contact time

**Table 3** Amount of color removed from waste water

| Activated carbon added for one litre 50 (mg) | Contact time(min) | Percentage of color removal |
|---|---|---|
| 50 | 0 | 0 |
| 50 | 10 | 72.3 |
| 50 | 30 | 66.4 |
| 50 | 60 | 84 |
| 50 | 90 | 83.5 |
| 50 | 120 | 8.4 |
| 50 | 150 | 77.5 |
| 50 | 180 | 84.9 |
| 50 | 240 | 84.2 |

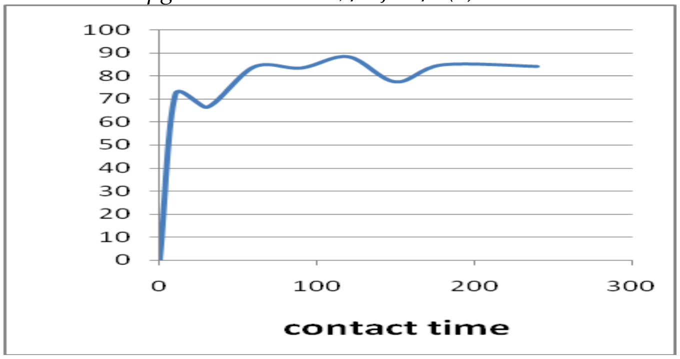


**Fig 7.** Percentage of color removal with in increasing in time with activated carbon

**Table 4** Amount of color removed waste water

| Activated carbon added for one litre (mg) | Contact time(min) | Percentage of color removal |
|---|---|---|
| 100 | 0 | 0 |
| 100 | 10 | 78.6 |
| 100 | 30 | 74.9 |
| 100 | 60 | 67.8 |
| 100 | 90 | 81.5 |
| 100 | 120 | 86.3 |
| 100 | 150 | 78.3 |
| 100 | 180 | 80.5 |
| 100 | 240 | 82.6 |

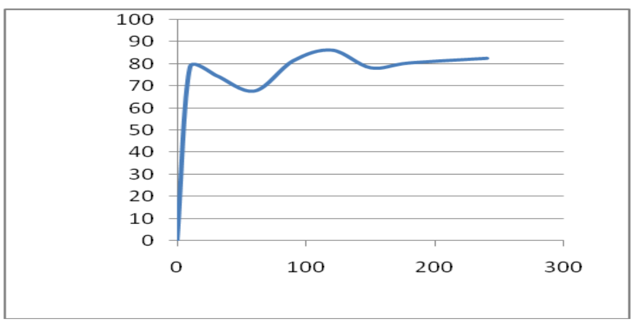


**Fig 8.** Percentage of color removal with in increasing in time with activated carbon.

The values of percentage obtained in the removal of different time intervals are given in the above tables 1, 2, 3 & 4 As increase in the contact time increases the removal percentage from the liquid solution and trend in the Constituent for all concentration of dosages.

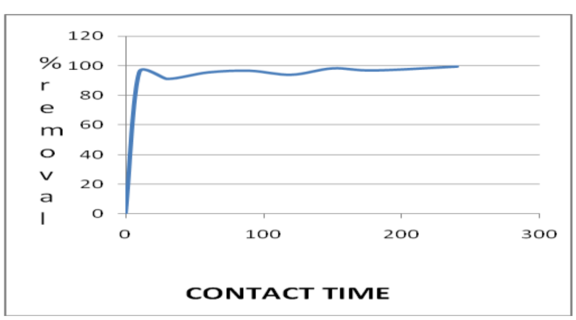


**Fig 9.** Effect of contact time for violet for 50 mg/l

As can be seen from the figure above that for 50 mg/l adsorption increases more rapidly at the initial time period and rate of adsorption decreases as we proceed to the saturation limit. The equilibrium can be assumed to have achieved after 100 minutes as, the final dye concentration does not seem to increase much after this limit. The reason might be the saturation of the active sites which do not allow further adsorption to take place. The values are expressed in the above table 1.

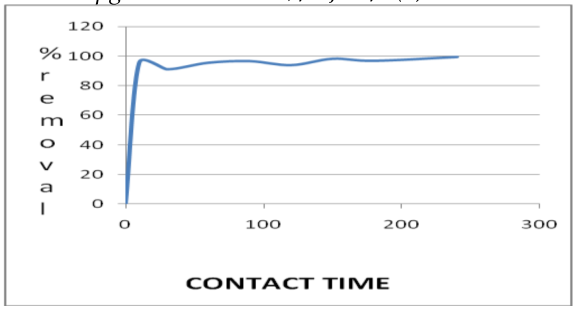


**Fig 10.** Effect of contact time for violet for 100mg/l

As can be seen from the figure above that for 100 mg/l adsorption increases more rapidly at the initial time period and rate of adsorption decreases as we proceed to the saturation limit. The equilibrium can be assumed to have achieved after 100 minutes as, the final dye concentration does not seem to increase much after this limit. The reason might be the saturation of the active sites which do not allow further adsorption to take place. The values are expressed in the above table 2

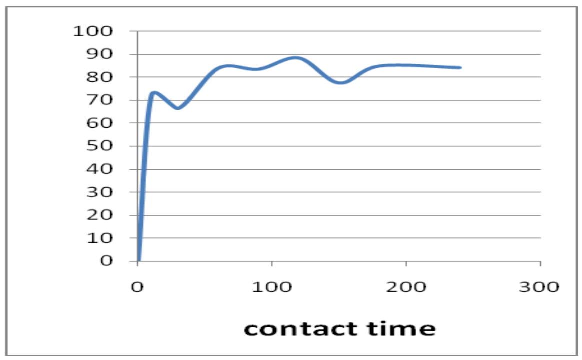


**Fig 11.** Effect of contact time for blue for 50mg/l

As can be seen from the figure above that for 50 mg/l adsorption increases more rapidly at the initial time. period and rate of adsorption decreases as we proceed to the saturation limit. The equilibrium can be assumed to have achieved after 100 minutes as, the final dye concentration does not seem to increase much after this limit. The reason might be the saturation of the active sites which do not allow further adsorption to take place. The values are expressed in the above table 3

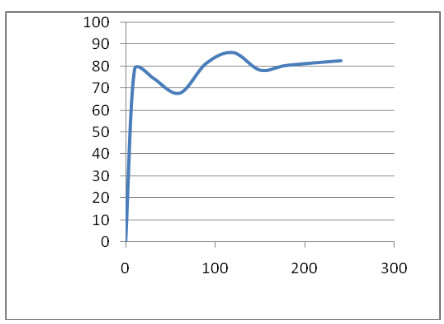


**Fig 12.** Effect of contact time for blue for 100mg/l

As can be seen from the figure above that for 100 mg/l adsorption increases more rapidly at the initial time. period and rate of adsorption decreases as we proceed to the saturation limit. The equilibrium can be assumed to have achieved after 100 minutes as, the final dye concentration does not seem to increase much after this limit. The reason might be the saturation of the active sites which do not allow further adsorption to take place. The values expressed in the above table 4.

**Conclusions**

Waste water was collected from dye industries in dharmavram. Quantity of waste water releasing from dye industries in dharmavram was studied. Waste water collected from dye industries was analyzed. Waste water collected from dye industry was treated and color removed. Treated water was analyzed. pH , turbidity, color, odour, are found to be in permissible level after retreating of water.

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