Decolorization of Textile Wastewater with Activated Carbon made of Coconut Shell

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Abstract. This study focuses on the removal of textile dyeing effluent by analyzing the physio-chemical parameters such as color, turbidity, pH, Chemical Oxygen Demand (COD). Activated carbon is used for removing color from the wastewater collected from silkworm textile industry, Bishnupur, West Bengal. We have used activated carbon made with coconut shell which is eco-friendly and low in cost. The results of the analysis were compared with the water quality standards of BIS (Bureau of Indian Standard) for further application of the treated water in agricultural field. Also, this paper includes the case study on textile dyeing industry in Bankura district, West Bengal, India and its impacts of pollution load in the environment.

Keywords: Textile effluent, pH, turbidity, COD, color, activated carbon.

1. Introduction
Textile industry is one of the oldest and largest industries in India and it gives job to huge number of people in our country (Hussain et al., 2004). About 81 percent of all industries in India are situated in Tamil Nadu, Gujarat, Punjab, West Bengal, and Maharashtra (Husain et al., 2012), and this textile industry is diverse. According to the Ministry of Textiles, India now has 2,500 textile weaving facilities and 4,135 textile finishing industries (Elango et al., 2017), contributing 2.3 percent to the country's GDP, 13% to industrial output, and 12% to export profits in 2020. The textile sector is the world's third biggest user of water. In India, the usage of water for the textile industries increase with every year and was estimated to be about 63 Billion Cubic Meter (Kabilashasundari et al., 2019). In India textile industry uses about 42500000 Gallons of water in daily basis and it takes about 500 gallons of water to produce enough fabric to cover one sofa (Rita Kant, 2012). Textile industry produces multi-component wastewater and sludge in huge amount which can be difficult to treat (Paul &Dhas, 2008). The polluted water is affecting and damaging the environment very severely. In textile waste water, the pollutants like color, chemical, pH, TDS, TSS etc. have destructed the environment and this physio-chemical textile industrial effluent was analyzed by different methods (Panwar et al., 2019). Activated charcoal is also preferred as an adsorbent for treating wastewater containing different classes of dyes for so long period (Himanshu Patel, 2018). It has the property to absorb the color. Peoples are trying to use low-cost materials to make and activated carbon and treat wastewater, such as agricultural by products and natural fibers, namely; waste coir pith (Namaeivayam et al., 2001), corn cob and barley husk (Robinson et al., 2002), sawdust (Khatmode et al., 2015), coconut shell, palm shell, pistachio shell, tropical wood and almond shell (Adib et al., 2018). In this project aggregates are used as filter medium and activated carbon is used as absorbent of color.

The wastewater was collected from a small textile industry in Bankura district in West Bengal, India.
Bengal, were the silkworms are used for extracting the silk and used the various dyes to color the silk. Wastewater from dyeing units is rich in color, containing residues of reactive dyes and chemicals (Nasipude et al., 2015) and the water was get discharged in several water bodies like lakes and ponds without any treatment. Without proper treatment, disposal of wastewater can harm the aquatic species, ecosystem and environment as well (Adib et al., 2016). After the treatment, recycled water can be used for multi purposes like agriculture, car wash, gardening, etc. (Francics et al., 2015).

2. Materials Used

2.1 Coarse Aggregate

Coarse aggregate is often used as filtration medium to terminate the solids comes with wastewater and reduces the turbidity of water (Gnanaraj et al., 2019). In this project the two sizes of aggregate like, 6-8 mm and 12-16mm which is washed several times to remove all the dirt’s from the surface of aggregates.

2.2 Fine Aggregate

Fine aggregates were works as physical strainer and biological renovator to help the pathogens to die. It also helps to decrease the COD of wastewater. The size of 0.5-1.0mm sand was sieved and washed 2 to 3 times to remove small particles and dried of (Gnanaraj et al., 2019).

2.3 Activated Carbon

Activated carbon has been used to clean water as a water filtration media. Activated carbon's primary function is to absorb colour and odour. Due to its great adsorption capability, granular activated carbon was extensively utilised to remove pollutants from water.

2.4 Physical phenomena

Possesses an exceptional ability to capture water-dissolved contaminates because of its rare quality. These contaminant-carbon surface interactions happen for Van der Waal forces.

2.5 Granular activated carbon

millimeter sized granular activated carbon can remove pollutants to concentrations below analytical detection limit and it requires about 1/4th of powder activated carbon. But activated carbon never lasts long period, so periodically it’s needed to be changed for proper removal.

3. Filter Setup

Table 1. Description of Material layers from bottom to top

| Layer No. | Materials          | Depth | Size   |
|-----------|--------------------|-------|--------|
| 1st       | Fine aggregate     | 150 mm| 0.5-1 mm |
| 2nd       | Coarse aggregate   | 100 mm| 6-8 mm |
| 3rd       | Coarse aggregate   | 100 mm| 12-16 mm |
| 4th       | Activated carbon   | 30 mm | Granular |

Activated carbon is made of coconut shell which is heated and burnt up to 2/3rd part of volatiles out of shells, creating a carbonaceous mass full of pores. Then with help of pyrolysis
process activated carbon was prepared. In 20 litre waste water bottle the filtration medium was set. The layers are shown below:

![Filtration medium Setup](image)

**Figure 1. Filtration medium Setup**

### 4. Tests & Results

Wastewater was collected first and treated, the standard values as per IS codes after treatment (Rice et al., 2017) are given in table 2.

| No. | Parameter | Instrument | Methods |
|-----|-----------|------------|---------|
| 1.  | pH        | pH meter   | IS 3025 Part 11-1983 (Reaff:2012) |
| 2.  | COD       | Standard Method | IS 3025 Part 58-2006 (Reaff:2012) |
| 3.  | Turbidity | Turbidity meter | IS 3025 Part 10-1984(Reaff:2012) |
| 4.  | Color     | Spectro-photometer | IS 3025 Part 4-2006 (Reaff:2002) |

**Table 3: Results before treatment**

| No. | Parameter | Result |
|-----|-----------|--------|
| 1.  | pH        | 9.1    |
| 2.  | COD       | 1034 mg/l |
| 3.  | Turbidity | 62.1 NTU |
| 4.  | Color     | 3685 Pt-Co |

The wastewater now passes through the filter unit and collected in a glass jar for further treatment. Activated carbon is used as 2, 2.25, 2.5 g/l ratio for treating water.

**Table 4: Post-treatment results**
Both before and after treatment parameters were compared with BIS (Bureau of Indian Standards).

Table 5: Comparison of results with BIS

In Bishnupur, Dist. Bankura from where the water was collected has large number of small handloom industries where dyeing of silk materials happens. It generates huge amount of wastewater which is released in environment without treatment. So, the wastewater enters to the nearby lake and pollute those water bodies. Above method can be used for small scale
industry very effectively to treat the wastewater and released in environment without any harm. With increasing the amount of activated carbon /lit more effective results could be achieved.

(a)                                     (b)                                    (c)                               (d)

Fig. 3: Waste water sample (a) before treatment, (b) treated with 2g/l activated carbon, (c) treated with 2.25g/l activated carbon, (d) treated with 2.5g/l activated carbon

The use of activated carbon as 2g, 2.25g, 2.5g per lit helps to remove the COD, Color, Turbidity, pH in acceptable range of BIS standards. 2g/l activated carbon is able to remove the COD and Color about 49.12% and 86.67%, 2.25g/l activated carbon is able to remove the COD and Color about 64.31% and 94%, 2.5g/l activated carbon is able to remove the COD and Color about 77.6% and 98%.

But the problem with activated carbon is that, it’s never long lasts. So, the time frequency of changing the activated carbon could be done.

6. Conclusions

From the project we observed that waste water generated by textile industry has great impact in environment due to the presence of COD, color, turbidity and various high amount of chemicals. We can use activated carbon in 2.5g/l for the better results and it gives the results within the permissible limits of BIS standards. The discussed treatment can be helpful to decrease the waste water and manage the destruction of environment. Preparation of activated carbon with coconut shell will reduce the cost for treatment. Wastage of water needs to be prevented to overcome water scarcity. So, the treated water can be used for agricultural purposes, gardening and car washing etc.

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