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# ANALYSING THE PHYSICO CHEMICAL CHARACTERISTICS OF TEXTILE EFFLUENT USING VARIOUS AGRO ADSORBENTS

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## ABSTRACT

In this present paper, low cost Environmental friendly agro adsorbents are used for the treatment of textile effluent. Current methods involve the application of various chemicals thus escalating the cost of treatment. Utilization of agricultural waste as low cost adsorbent has great significance in India where more than 200 million tons of agricultural residues are generated annually. Adsorption is the process which is inexpensive. A number of non-conventional low cost agro adsorbents such as neem leaves, banana peel, orange peel, garlic peel, jack fruit peel, prosopisjuliflora, calotropis gigantea latex, coconut coir, root of water hyacinth and banana pith juice are used in our project. Properly treated agricultural residues are used as adsorbents in our Project. Our Project main objective is to identify the low cost and adsorbent used for treating the textile effluent. By varying the adsorbent dosage and its contact time the optimal usage of the corresponding adsorbent were identified. The influent and the effluent were tested to identify the variation and changes in their physical as well as chemical properties. This paper will help the textile industry to treat their effluent more economical by using the low cost available adsorbents.

Keywords—neem leaves, banana peel, orange peel, garlic peel, jack fruit peel, prosopisjuliflora, calotropisgigantea latex, banana pith juice, coconut coir, root of water hyacinth.

## **INTRODUCTION**

Most of the developing countries face severe water scarcity due to ground water pollution. This pollution mainly caused by the discharge of untreated effluent. The Indian textile industry is one the largest sectors in the country. The textile industry consumes large quantities of water and produces large volumes of wastewater through various steps in dyeing and finishing processes. The discharge of toxic effluents from various industries adversely affects water resources, soil fertility, aquatic organisms and ecosystem integrity. Wastewater from dyeing and printing units is often rich in color, residues containing of chemicals and reactive dyes. The characteristics of textile industrial

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wastewater are high biological oxygen need, high chemical oxygen need, high pH, and high temperature. The textile waste water is rated as the most polluting among all in the industrial sectors. The textile waste water is a complex and variable mixture of polluting substances. The pollutants released from these processes are very dangerous and it is very necessary to treat the textile effluent. The waste water treatment is mostly by primary and secondary processes. The textile wastewater containing dye substances is not only toxic to the biological world, its dark color blocks sunlight that leads to severe problems to the ecosystem. However, these conventionalmethods of treatment are not very efficient in removal of pollutants such as dissolved solids, color, trace metals etc. The advance treatment methods, while reducing these pollutants also give scope for recovery and recycling. The usual treatment processes like physical and chemicalmethods such as coagulation, flocculation, adsorption, membrane filtration and irradiation. (Robinson et al., 2001) achieve gooddecolorizing efficiency but they have two main constraints high cost and the production of the significant amount of sludge material that requires final disposal again. Among all the methods adsorption is one of the most effective methods of removing dyes from waste sewage (Deans and Dixon, 1992; Nigam et al., 2000). The process of adsorption has an advantage over the other methods due to its sludge free operation and complete removal of dyes even from dilute solutions. Activated carbons have been extensively utilized in various industrial adsorption and separation processes because of its efficient adsorption of the organic compound. However there are a number of drawbacks in utilization for decolourisationlike higher cost and operational losses such as combustion athigh temperature, pore blocking and hygroscopicity. Recently, a considerable amount of research has been undertaken to findcheapersubstitutions to activated carbon.

Developmentsof new strategies of making use of low cost, easily availablebiological and agricultural waste materials for theadsorption process is gaining much importance to replace activated carbon. Due to high energy consumption or application of variety of chemicals, this would decrease the efficiency and increase cost of process. The adsorption is the process which seems to be the better alternative to other processes. A wide range of adsorbent are used to treat large quantity of textile effluent as a cost effective technique. It has potential advantages over the conventional methods as adsorption technique is low cost, high efficiency on heavy metal removal and discoloration, less use of chemicals, regeneration characteristics, minimum waste and recycling of water. In our studies we designed to exploit the abundantly available agricultural wastes for the treatment of textile effluents to remove color, pH, turbidity, suspended solids, TDS, COD, BOD, sulphide, phosphate.

#### MATERIALS AND METHODS

#### **TEXTILE WASTEWATER**

Our raw textile wastewater sample was collected from Tirupur industry. Samples were collected in sampling bottles and preserved at 4°C for analysis. The physicochemical parameters such as pH, turbidity, chemical oxygen demand (COD), biological oxygen demand (BOD) and Total suspended solids (TSS) were estimated before and after the treatment of water samples.

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### PREPARATION OF ADSORBENTS

Different agro adsorbents (neem leaves, banana peel, orange peel, garlic peel, prosopisjuliflora, calotropisgigantea latex, root of water hyacinth, jack fruit peel, banana pith juice and coconut coir) werecollected andrinsed several times with distilled water. The cleaned adsorbents were dried under sun and then it was oven dried. The dried adsorbents were ground to powder and then sieved to get fine particles. Each particle were sieved accordingly to their particle sizes using sieve set and stored in air tight container.

### **BATCH STUDIES**

Batch studies were carried out at room temperature to study the effects of important parameters such as effect of adsorbent dosage, shaking speed and contact time. A fixed amount of prepared adsorbent was placed in 250ml conical flask with known adsorbent dosage. Then the flask was agitated using orbital shaker and jar test apparatus. The supernatant solution thus obtained was filtered using filter paper and the physical and chemical parameters were examined. All the experiments were performed in triplicate and reported values are mean $\pm$ SD. The concentration of dye solution is determined by using UV Spectrometer.

The %age of dye removal was calculated by using the following relationship:  $\% \text{Removal} = \frac{Initial \ Abs - FInal \ Abs}{Initial \ Abs} \ge 100$ 

#### EFFECT OF ADSORBENT DOSAGE

Adsorbent dosage is an important parameter in order to determine the adsorbent's capacity for a given amount of the adsorbate at the operating conditions. Effect of adsorbent dosage was investigated by using different adsorbent doses (0.05, 0.1, 0.15 and 0.2g) 50mL<sup>-1</sup>. The effect of adsorbent dosage on the adsorption process can be carried out by preparing adsorbent–adsorbate solution with different amount of adsorbents and shaken together until equilibrium time. Generally, the percentage of removal increases with increasing adsorbent dosage. Initially the rate of increase in the percent removal has been found to be rapid which slowed down as the dose increased. This phenomenon can be explained based on the fact that, at lower adsorbent dosage the adsorbate is more easily accessible.

With rise in adsorbent dose, there is less commensurate increase in adsorption, resulting from many sites remaining unsaturated during the adsorption. But after a certain dosage the removal efficiency is insignificant with respect to increase in dose. This is due to the fact that, at higher adsorbent dosage there is a very fast superficial adsorption onto the adsorbent surface that produces a minimum solute concentration in the solution than when adsorbent dosage is lower.

### EFFECT OF CONTACT TIME

The effect of contact time on adsorption can be carried out by preparing adsorbent–adsorbate solution with fixed adsorbent dose for different time intervals and shaken until equilibrium. Generally the rate of removal increases with an increase in contact time to a certain limit. Further increase in contact time does not increase the uptake due to deposition of effluent on the available

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adsorption site on adsorbent material. The time required to attain this state of equilibrium is termed the equilibrium time and it reflects the maximum adsorption capacity of the adsorbent under those operating conditions.

Influent Characteristics								
PARAMETER	UNITS	BIS VALUE	TESTED EFFLUENT VALUE					
рН	-	6.5 – 8.5	9.5					
Turbidity	NTU	10	81.5					
Suspended Solids	mg/L	100	1800					
BOD <sub>5</sub>	mg/l	30	502					
COD	mg/l	250	990					
Sulphide	mg/l	2.0	.46					
Total Dissolved Solids (TDS)	ppm	2100	6780					
Iron	mg/l	3.0	0.16					
Phosphate	mg/l	5.0	19					

Table 1
Influent Characteristics

## **RESULT AND DISCUSSION**

## PHYSICO CHEMICAL CHARACTERIZATION OF TEXTILE EFFLUENT

The Influent characteristics of the samples were identified and the values are given in Table 1.After using the adsorbents there was a change noticed in the Effluent characteristic before and after adsorption trials for pH, Turbidity, COD, BOD, TDS and TSS and the values of these parameters are given in Table 2.Using the natural agro adsorbents plays a vital role in the removal of the organic pollutants present in the wastewater samples i.e the textile effluent.

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PARAMETER	pH	Turbidity	TSS	BOD 5	COD
NEEM LEAF	7.5	20.5	400	120	300
ORANGE PEEL	8.1	25.6	406	135	240
BANANA PEEL	8.5	30.3	500	420	200
GARLIC PEEL	7.9	40.5	1000	450	193.5
WATER HYACINTH	9.2	25.3	155	99.8	922.8
BANANA PITH JUICE	7.6	78.3	200	455.6	901.1
JACKFRUIT PEEL	8.9	80.1	1490	500	450
PROSOPIS JULIFLORA	8.8	79.8	1500	355.8	560.3
CALOTROPIS GIGANTEA	9.5	77.3	300	502	921.6
COCONUT COIR DUST	7.2	17.6	1700	467.8	777.8

**Table 2: Effluent Characteristics** 

#### **EFFECT OF pH**

pH is an important physical parameter to measure the quality of water. A general recommendation is that the water having pH below 6.5 and above 8.5 is not reasonable for public consumption. TDS refers to any minerals, salts, metals cation, or anion dissolved in water. The result indicate a decrease in COD, TDS, TSS and other physico-chemical parameters after the treatment of textile effluents through adsorption(using agro adsorbents) which shows that adsorption process is effective for the treatment of textile effluents. The response of each adsorbents with the variation of pH is shown in Fig 1 to Fig 10.





Fig 2:Dosage Vs pH value using Orange peel

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Fig 3:Dosage Vs pH value using Water Hyacinth RootFig 4: Dosage Vs pH value using Prosopis juliflora



Fig 5: Dosage Vs pH value using Garlic peel



Fig 6: Dosage Vs pH value using Banana peel



Fig 7 :Dosage Vs pH value using Banana pith juice





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Fig 10 :Dosage Vs pH value using Coconut Coir

From the above graph, we know that by varying the dosage as 1gm, 2gm, 3 gm....the removal deficiency of the adsorbent varies correspondingly. An increase in the dose due to the increase in removal efficiency. Among the ten adsorbents coconut coir has a good efficient to remove pH by the optimum dosage of 5gm.

#### **EFFECT OF TURBIDITY**

Turbidity is the major pollutant parameter found in the textile effluent due to the presence of suspended solids. The variation of Turbidity with the adsorbent dosage is given in the below graph.









Fig 14 :Dosage Vs Turbidity value using Waterhyacinth root

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![](_page_7_Figure_6.jpeg)

From the result obtained we have plotted the graph. Coconut coir has the good ability to remove turbidity form the textile effluent with the optimum dosage of 6gm for the 50 ml effluent.

#### EFFECT OF SUSPENDED SOLIDS

Suspended solids are those solids which remain floating in textile effluent. It is calculated by varying the adsorbent dosage and its contact time with the effluent.

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![](_page_8_Figure_4.jpeg)

Fig 27 :Dosage Vs TSS value using Banana pith juiceFig 28 :Dosage Vs TSS value using Jackfruit peel

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![](_page_9_Figure_3.jpeg)

![](_page_9_Figure_4.jpeg)

Fig 29 :Dosage Vs TSS value using Calotropis gigantean Fig 30:Dosage Vs TSS value using CoconutCoir

From the experimental study, we know that the suspended solids are removed efficiently by neem leaf powder.

![](_page_9_Figure_7.jpeg)

Fig 31 :Dosage Vs BOD value using NeemFig 32 :Dosage Vs BOD value using Orange peel

![](_page_9_Figure_9.jpeg)

![](_page_9_Figure_10.jpeg)

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![](_page_10_Figure_3.jpeg)

![](_page_10_Figure_4.jpeg)

Fig 35 :Dosage Vs BOD value using Prosopis Juliflora Fig 36:Dosage Vs BOD value using Bananapith juice

![](_page_10_Figure_6.jpeg)

Fig 37 :Dosage Vs BOD value using Garlic peelFig 38 :Dosage Vs BOD value using Jackfruit

![](_page_10_Figure_8.jpeg)

Fig 39 :Dosage Vs BOD value using Calotropis giganteanFig 40 :Dosage Vs BOD value usingCoconutCoir

If sufficient oxygen is available in textile effluent, the useful aerobic bacteria will flourish and cause the aerobic biological decomposition of textile effluent. Which will continue until oxidation is completed. The amount of oxygen consumed in this process is the BOD. By varying the adsorbent dosage the results obtained in plotted in the above graph. From the result we know that neem leaf powder is the best adsorbent to remove BOD.

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## **EFFECT OF COD**

Organic matter is most often assessed in terms of oxygen required to completely oxidise the organic matter to  $CO_2$ , $H_2O$  and other oxidized species. The COD of textile effluent is computed and plotted below in Fig :41 toFig: 50. From the graph we can use jack fruit peel for the removal of COD.

![](_page_11_Figure_6.jpeg)

Fig 41 :Dosage Vs COD value using Neem leaf Fig 42 :Dosage Vs COD value using Orange peel

![](_page_11_Figure_8.jpeg)

Fig 43 :Dosage Vs COD value using Banana peelFig 44 :Dosage Vs COD value using Water hyacinth

![](_page_11_Figure_10.jpeg)

Fig 45 :Dosage Vs COD value using Prosopis julifloraFig 46 :Dosage Vs COD value using Garlic peel

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![](_page_12_Figure_4.jpeg)

Fig 49 :Dosage Vs COD value using CalotropisGiganteaFig 50 :Dosage Vs COD value using Coconut Coir

## **REMOVAL EFICIENCY**

In order to identify which is the apt adsorbent for the treatment of textile effluent. All the parameters are compared with the removal efficiency of the adsorbents. The comparsion chart is plotted below.

![](_page_12_Figure_8.jpeg)

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![](_page_13_Figure_3.jpeg)

![](_page_13_Figure_4.jpeg)

#### Fig 52 :% of COD removal Vs adsorbents

![](_page_13_Figure_6.jpeg)

![](_page_13_Figure_7.jpeg)

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![](_page_14_Figure_3.jpeg)

![](_page_14_Figure_4.jpeg)

Fig 55 :% of BOD<sub>5</sub> removal Vs adsorbents

![](_page_14_Figure_6.jpeg)

![](_page_14_Figure_7.jpeg)

Fig 56: Overall Efficiency comparison of adsorbents

From this graph we have compared the removal efficiences with all adsorbents.Neem leaf can be efficiently used for the removal of BOD and TSS.Coconut coir is used for the removal of pH and turbidity. Jack fruit peel is used for the remval of COD in a effective manner.

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## CONCLUSION

The use of these low cost eco-friendly adsorbents is recommended since they are relatively cheap or of no cost, easily available, renewable and show highly affinity for dyes. The process of adsorption requires further investigation in the direction of modeling, regeneration of adsorbent and immobilization of the waste material for enhanced efficiency and recovery. Neem, orange peel, banana peel, garlic peel, juliflora and water hyacinth showed maximum efficiency for treatment of textile wastewater. Different parameters were optimized during the study and best removal was obtained with several adsorbent. Hence our project focuses to identify the adsorbents suitable for the maximum parameter removal and thus by making a membrane with all the apt adsorbent. Hence this project will give a way to choose the adsorbent that will give maximum removal efficiency of various parameters in the textile effluent.

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