Decolorization Of Textile Dye In Aqueous Solution Using Corn Leaf

By

SIVAKAMI. A

(17PBX008)

A Thesis Submitted To The

Avinashilingam Institute For Home Science And Higher Education For Women,

Coimbatore-641043

In Partial Fulfillment Of The Requirements For

The Degree Master Of Science

In

Bio-Textiles

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Certifed As Bonafide Research Work

Signature Of The Head Of The Department

Signature Of the Supervisor

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1.INTRODUCTION

Dyes are widely used in industries such as textiles, rubber, plastics, printing, leather, cosmetics, etc. to color their products .As a result, they generate a considerable amount of colored wastewater. There are more than 10,000 commercially available dyes with over 7×5tonnes of dye stuff produced annually. It is estimated that 2% of dyes produced annually is discharged in effluents from associated industries. Among various industries, textile industry ranks first in usage of dyes for coloration of fiber. Removal of dyes from industrial waste water is an important problem due to the characteristics of these dyes, as they are non-degradable and therefore persistent . Moreover, most of the pollutants are toxic to living organisms and they have a large influence on the photosynthetic activity in aquatic biota. To respect the environmental, norms, the toxic materials should be removed from wastewater before its disposal.

Many treatment processes have been applied for the removal of dye from wastewater such as Fenton process (Behnajady et al.2007).electrochemical degradation (Fanet al .2008) ,adsorption process(Tan et al.2007),chemical coagulation/flocculation, ozonation, cloud point extraction, oxidation, nano-filtration, chemical precipitation, ion-exchange, reverse osmosis and ultra-filtration (Lorenc -grabowsk and grygelewic et al 2007).Among treatment technologies, Adsorption is rapidly gaining prominence as a method of treating aqueous effluent. Some of the advantages of adsorption process are possible regeneration at low cost, availability of known process equipment, sludge-free operation and recovery of the sorbate (kapdan and kargi 2002).

Agricultural waste material have little or no economic value and often pose a disposal. The utilization of agricultural waste is of great significance(Geopaul, 1980). A number of agricultural waste materials are being studied for the removal of different dyes from aqueous solutions at different operating conditions. Agricultural waste includes coir pith.

OBJECTIVES

Hence the present study decolonization of textile dye in aqueous solution using corn leaf was designed with the following objectives,

- To screen various agro-wastes as adsorbent for decolourization of selected methylene blue
- To optimize various parameters such as adsorbent dosage, microscopy dye concentration,
- time, temperature and pH for efficient removal of dye from aqueoussolution
- To assess phytotoxicity of decolourized dyesolution
- To reuse the decolourized dye solution for dyeing the selectedfabric
- To compare the properties of the fabrics dyed with fresh water and decolourizedwater.

REVIEW OFLITERATURE

The review of literature pertaining to the study "**Decolonization of textile dye in aqueous solution corn leaf agro waste"**discussed under the following headings.

2.1 Textile industries and environmental pollution

Environmental pollution caused by the rapid industrialization is one of the major and mostimportant problems of the modern world . The huge grow in the textile industries has been resultedin an immense increase in the complexity and thevolume of the dye containing waste water.

Several textile dyes are reported to be carcinogenic and mutagenic in nature (Eichlerova*et al.*, 2006).Waste water dischargedfrom different industries such as the textiles, leather, paper, food, hair coloring, etc.are usually polluted by dyes for example, malachite green is most commonly used for the dyeingof cotton, silk, paper, leather and also in manufacturing of paint and printing inks. Mostof the dye, including malachite green, are toxic and must be removed before discharge intoreceiving streams (Hasan *et al.*, 20 The word "environment" is most commonly used for describing"natural" environment and means the sum of all living and non-living things that surround anorganism, or group of organism. Environment includes all element, factors and conditions that havesome impact on growth and development of certain organism. Environment includes both bioticand abiotic factors that have influence on observed organism. Biotic factors are all living thingsand abiotic factors are light, temperature, water and atmospheric gases. Environment oftenchanges after some time and therefore many organisms have ability to adapt to those changes.

The textile industries are the greatest generators of liquid effluent, due to the high quantityof water used in the dyeing process. Fifteen percent of the total world productionof dyes is lost during the dyeing process and is released in textile effluent. Asclean fresh water is increasingly more difficult to obtain in parts of the world, recycling of Wateris seen as a means to increase water supply. However, some waste water contains high concentrationof metals, which will pose a risk to all forms of life along food chain. For example consumptionof the rice irrigated with river water containing cadmium (Rocha *et al.*, 2009).

2.2Textile waste water treatment

The textile production makes use of several thousand different substances, ranging from solvents toresins and from caustic soda to bleach. The applied processes can differ significantly from factory to factory.But all fabs have one thing in common: During rinsing, which is necessary after many of the process steps,it is impossible to completely avoid some measure of the substances used ending up in the wastewater.

The textile industry is very water intensive. Water is used for cleaning the raw materialand for many flushing steps during the whole production. Produced waste water has to be Cleaned from, fat, oil, color and other chemicals, which are used during the several production steps.

The cleaning process is depending on the kind of waste water (not every plant use theSame way of production) and also on the amount of used water. Also not all plants uses the Samechemicals, especially companies with a special standard (environmental) try to keep watercleanedin all steps of production. So the concepts, to treat the water can differ from each other.

Water treatment with different kind of pollutants, is large-scale, because of many cleaning andremoving steps involved.

2.3Dyes

A **dye** is a colored substance that chemically bond to the substrate to which it is being applied, this distinguishes dyes from pigments which do not chemically bind to the material they colour. The dye is generally applied in an aqueous solution, and may require a mordantto improve the fastness of the dye on the fiber.Both dyes and pigments are colored, because they absorb only some wavelengths of visible light.Dyes are usually soluble in water whereas pigments are insoluble. Some dyes can berendered insolublewith the addition of salt to produce a lake pigment.

2.3.1 Classification of Dyes

In terms of compatibility, reactive dyes are used for printing on fabrics made of cellulosic fibers including cotton, linen and rayon. It is also possible to print silk with reactive dyes, although acid dyes are more typically thought of for this application. In addition to silk, acid dyes are compatible with nylon and nylon lycra blends. As a result, they have application for products including swimwear and performance or technical apparel made with nylon. To offer greater substrate flexibility, Huntsman Textile Effects recently introduced a universal ink.

The primary inks included in this set will behave as reactive or acid dyes depending on fabric selectionand preparation. Thus, the printer can devote a single printing mechanism to a broader selectionof fiber types without the need for ink changeover.

2.3.2 Toxicity effects of dyes

Basic dyes have high intensity of color and are greatly visible even in very little concern (Viraraghavan, 2002). The complex dyes are generally chromium based, which is carcinogenic (Gupta, 1990). Dyes may affect the photosynthetic activity in aquatic life due to decreased light penetration and may also be toxic to some aquatic life due to the presence of metals, aromatics, etc. (Lazar, 2005).in the dye bath is another area which has received lot of attention from researchers as it will not only improve shade reproducibility and problem of repeat shade but also reduce to a matter of controlling and handling spills and clean up (Bradbur and Kent, 1994).

2.4.Dyestuff and Colour Removal from Textile effluent

Colour removal is a pertinent problem for all categories of textile effluents due to thevariety of Chemicals used in dyeing and printing of fibre, yam or fabric. Colour pollutioncan be most Efficiently Controlled by good source reduction practices, administrative andengineering controls,process and Product design and work practices. The search for dynamicResponseand improved. productivity has served to focus the attention of the colouration industryon right first time.

2.4.1 Advantage of Dye Removal Method

Physical treatment such as adsorption by activated carbon results in good removal of wide variety of dyes. Most membrane filtration removes all dye types. From exchange or regeneration no adsorbate will loss. Biological treatment of decolorization by white – rot fungi and other microbial cultures in 24-30 hours adsorption by live and dead microbial systems of dyes have a particular affinity for binding with microbial species. In photochemical (NaCl) sodium hypochloride no sludge is produced and foul odours are greatly reduced. In chemical treatments ozone can be applied in its gaseous state and does not increase the volume of wastewater and sludge (Salleh *et al.*, 2011).

2.4.2 Disadvantage of Dye Removable Method

Physical treatments are very expensive and the adsorption by activated carbon are not effective for all dyes. Membrane filtration requires a lot of dissolved water. And electrokinetic coagulation results in high sludge production. Biological treatmentfor enzyme production has also been shown to be unreliable under aerobic conditions.

Adsorption by living microbial biomass are not effective for all dyes. Photochemical formationof by–products will release of aromatic amines and electrochemical destruction are relativelyhigh flow rates cause a direct decrease in dye removal. Chemical treatment agent needs tobe activated by some means sludge generation for short half- life (Salleh *et al.,* 2011).

2.4.3 Adsorption of dyes

The term adsorption refers to the accumulation of substance at the interface betweentwo phases (liquid – solid interface or gas – solid interface). The substance that accumulatesat the interface is called adsorbate and the solid on which adsorption occurs is adsorbent (Dabrowsbi, 2001). Chemical adsorption or chemisorptions is illustrated the formation of strong chemical associations between molecules or ions of adsorbate to adsorbent surface, which is generally due to the exchange of electrons (Allen *et al*., 2005) and thus chemical sorption generally is irrepressible. Adsorption on most of the adsorbate including agriculture by-product is controlled by physical forces with some exception of chemisorptions. The main physical forces controlling adsorption are van dervaals forces, hydrogen bonds, polarity, dipole interactions (Ali *et al*., 2010). This processes provides an attractive for the treatmentof polluted water, especially if the sorbent is inexpensive and does not regain an additional pretreatment steps before its application. Adsorption has been found to be superior to other techniques in terms of flexibility and simplicity of design, initial cost, insensitivity to toxic pollutants and ease of operation. Adsorption also does not produce harmful substances (Gini, 2006).

2.5 Factors affecting adsorption of dye

There are many factors affecting dye adsorption such as solution pH, temperature and initial dye concentration. Thus the effects of these parameters are to be taken into dye removal treatment processes.

2.5.1Effect of solution pH

pH is a measure of acidity of an aqueous solution. The pH factor is very important in the adsorption process especially for dye adsorption. The pH of a medium will control the magnitude of electrostatic charges which are imparted by the ionized dye molecules. As a result, the rate of adsorption will vary with the pH of an aqueous medium (Onal et al., 2006).

The pH of initial dye solution can be adjusted by the addition of dilute 0.1 N HCl or 0.1 N NaOH. Generally, at low pH solution, the percentage of dye removal will decrease for cationic dye adsorption, while for anionic dyes the percentage of dye removal will increase. In contrast, at a high pH solution the percentage of dye removal will increase for cationic dye adsorption and decrease for anionic dye adsorption.

2.5.2 Effect of initial Dye concentration

The percentage adsorption for dye removal is highly dependent on the initial dye concentration. The effect of initial dye concentration depend on the immediate relation between the concentration of dye and the available sites on an adsorbent surface. The percentage of dye removal decrease with an increase in the initial dye concentration, which may be due to the saturation of adsorption sites on the adsorbent surface. On the other hand the increase in the capacity of the adsorbent and this may be due to the high driving force for mass transfer at a high initial dye concentration (Bulut*et al.*, 2006).

2.5.3Effect oftemperature

The temperature dependence of adsorption reactions gives valuable knowledge about the enthalpy and entropy changes during adsorption (Alkan et al 2003). Temperature is an indicator for the adsorption nature whether it is an exothermic or endothermic process (Salleh et al., 2011). If the adsorption capacity increases with increasing temperature then the adsorption is an endothermic process. This may be due to increasing mobility of the dye molecules and an increase in the number of active sites for the adsorption with increasing temperature (Senthil kumar et al, 2006).

The adsorbed water molecules, which are displaced by the adsorbate species, gain more translational entropy than it is lost by the adsorbate molecules, thus allowing the prevalence of randomness in the system. Increasing temperature may decrease the adsorptive forces between the dye species and the active sites on the adsorbent surface as a result of decreasing adsorption capacity (Ofomaja and Ho.,2007).

Table 3

The effect of temperature on the adsorption of dyes using various adsorbents

Adsorbents	Dye name
Pine leaves	Methlene blue
Treated rice husks	Methylne blue

2.5.4 Effect of Amount of adsorbent

Adsorbent dosage is an important process parameter to determine the capacity of an adsorbent for a given amount of dye adsorbed at the operation conditions.The percentage of dye removal increase with increasing adsorbent dosage, the surface of adsorbent willincreasing by increase the amount of the adsorbent. (Viraraghavan, 2006).

EXPERIMENTAL PROCEDURE

The experimental procedure adopted for the present study" "is discussed under the following headings

3.1 Collection of dyes

3.2 Collection of different agrowastes

3.3 Screening of different agrowastes for decolorizing methylene blue

3.4 Optimization of various parameter for the decolorization of methylene blue dye.

3.4.1 Optimization of agro- waste concentration

3.4.2 Optimization of contact time

3.4.3 Optimization of pH

3.4.4 Optimization of temperature

3.5 Decolorization of methylene blue dye solution using selected agro-waste under optimized conditions

3.6 Reuse of Decolourized solution for fabric

3.7Dyeing of selected fabric with reactive dye using fresh and decolorized water

3.8 Dyeing procedure

3. 9 Evaluation of dyed fabric

4.0 Objective Evaluation

4.0.1 Fabric weight

4.0.2Fabric thickness

4.0.3Fabric Strength and Elongation

4.0.4 Fabric Stiffness

4.1Colour Fastness Tests

4.1.1Fastness to sunlight

4.1.2Fastness to Wet and dry crocking

4.1.3Fastness to washing

4.1.4Fastness to Wet and dry pressing

3.1 Collection of dyes

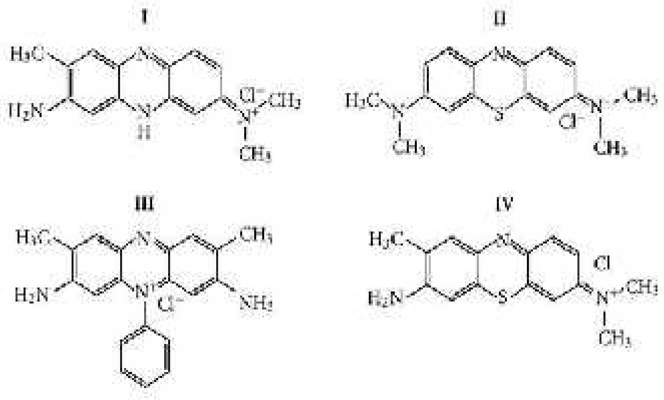
Adsorbents such as corn leaf,were collected from local markets.The collected adsorbentsWere cleaned to remove soil and dust particles from it.to remove the misture from adsorbents were claned to remove soil and dust particles from it.To remove the moisture from adsorbents,it is kept under the sun and grounded to power.

3.2Preparation of dye solution

Methylene were procured from shiv sagar estate"A", Dr.annie beasant road,worli,Mumbai. The dye solution were prepared at a concentration of room temperature.

Chemical structure:

Methylene blue



3.3Screening of different adsorbents for decolourization of methylene blue aqueoussolution

About five gram of each adsorbent was added separately into a series of beakers containing 0.01% of methylene blue. The solution was kept at room temperature for 24 hours.

$$\% \text{ Decolourization} = \frac{\text{Methylene blue absorbance} - \text{Final absorbance}}{\text{Methylene blue absorbance}} \times 100$$

Plate I

Selected adsorbents for the decolourization of selected dyes.

The decolourization efficiency of different adsorbents such as, corn leaf, and the result are present.

3.0Optimization of various parameters for decolourization of selecteddyes

Effect of adsorbentdosage

To determine the optimum quantity of adsorbent to decolourization the selected dye solutions,1g, 2g, 3g, 4g and 5gm of powder corn husk was added separately to beakers containing 0.01% of methylene blue. The dye solution was kept at room temperature for 24 hrs. The same procedure was followed for methylene blue. The absorbance of dye solution was measured in UV-visible spectrophotometer and the percent decolourization wascalculated.

3.3.1Effect of methylene blue concentration of thedye

To determine the effect of microscopy dye concentration of methylene blue dye 0.01, 0.02, 0.03, 0.04, and 0.05 percent of the dye was added individually to beakers containing optimum adsorbent dosage. The UV-Visible spectrophotometer was used to measure the absorbance of dye solution.

3.3.2Effect oftemperature

To determine the optimum temperature for decolourization of methylene blue, beakers containing 0.01% of dye with optimum concentration of corn leaf was incubated at different temperatures such as 30^0C, 40^0C, 50^0C, 60^0 C and 70^0C. The percent decolourization wasdetermined.

3.3.3Effect oftime

To determine the optimum time for decolourization of methylene blue, the dye solutions at 0.01% concentration and optimum adsorbent dosage were kept at room temperature at different time intervals such as 6 hrs, 12 hrs, 18hrs, 24 hrs, 30hrs, 36hrs,42hrs. Percent decolourization was determined.

Control and decolourized solution of methylene blue

Plate II

Dye Solutions Using Selected Adsorbent Under Optimized Conditions

3.3.4Effect ofpH

To evaluate the optimum pH for decolourization, the methylene blue pH of dye solution was adjusted to 5,6,7,8 and 9 using Na^2co^3 and Nacl and Percent decolourization was determined.

3.3.5Decolorization of selected dye solutions under optimizedconditions

Methylene blue dye solution was decolorized using corn leaf (1%) at optimum dye concentration of 0.01% and pH 6for 24 hours at 90°C. methylene blue dye solution was decolorized using optimum concentration of corn leaf (1%) at pH 6 for 24 hours at 60°C.

The decolorized solution was reused for dyeing and analysed for and UV- Vis spectral analysis.

3.3.6Reuse of decolourized dyesolutions

Reuse of wastewater involves environmental benefits, because it decreases discharge of pollutants and collection of high quality water from ground and surface aquifers. Recycled water can satisfy most water demands, as long as it is adequately treated to ensure water quality appropriate for the use (Mansour et al.,2012).Hence in the present study, an attempt was made to reuse the decolourized dye solution. The decolourizd dye solution was used to methylene blue.

3..5.1. Selection of fabric

Cotton is the oldest and the most important of the textile fibers. cotton is called king of fibers, because of its versatility of its use and its properties (Asaduzzaman et al.,2016).Hence, cotton fabric was chosen for the present study.

3.5.1Desizing of the fabric

Desizing is the process in which the size applied to the warp yarn before weaving is removed to facilitate the penetration of chemicals in the subsequent wet processing operation. Desizing of cotton fabric was carried out with following procedure:

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Table 1

Desizing of cottonfabric

Cotton material	1 meter
Material liquor ratio	1:20
detergent	1%
Wetting agent	0.5%
temperature	90^{o}c
Time	1 hour

The desized fabric was rinsed with water and air dried.

3.5.2Dyeing

Dyes are chemicals which on binding with a material will give colour to the material (Allen.,2005). Dyeing is the application of colourant to the substrate in order to enhance the appearance by the attraction of hue. The selected cotton fabric was desized and then dyed with the reactive red and methylene blue dyes using decolourized and soft water. The dyeing of cotton fabric with selected dyes was carried out with the followingprocedure:

Table 2

Procedure for dyeing with methylene blue

Percentage of shade	**1%**
NaCl	**0.5%**
Na_2CO_3	**10%**
M:L ratio	**1:20**
Temperature	**90^0 C**
Time	**1 hour**

The dyeing was done using fresh water and decolourized water**.** The dyed fabrics were rinsed with cold water and dried in shade. The dyed fabrics wear analysed for physical and color fastness properties.

3.6Assessment of physicalproperties

3.6.1FabricWeight

Fabric weight is the mass per unit area of a length of material that also plays an important role in determining the density of a material. The fiber content, yarn size, and fabric count depend upon the weight of the material (Bubonia,2014).Weight measurement of a fabric is often prerequisite for subsequent tests of other fabric properties.

Scope: To cut rapidity and accurately a circular specimen of 100 square centimeter. Capability upto 400 GSM.

Place the test specimen on the rubber pad preferably without wrinkles. Now keep the GSM cutter on the test specimen and rotate the knob of the cutter on. The blades are provided on the cutter which will cut the fabric. Remove the GSM cutter and collect the circular specimen of 100 cm^2.And weight the same on a electronic balance to obtain the grams per square meter for safety clock knot is provided on the cuttes.

3.6.2FabricThickness

A fabric thickness is determined according to ASTM.01777-20002.This thickness test has 2 parts the anvit and pressure feet which works under a lever spring action as on a top anvit indicatesthe thickness of the sample in 1000 of an inch. Each dimensions on the dial is ,mm. The sample placed in anvit plate and the lever of the pressure foot is released very slowly and the pressure slightly no the sample. The dial indication or the thickness of the sample of such reading coerl taken when mean value is calculated and recorded.

3.6.3FabricStrength

The equipment used for analysis the machine is normally arranged to have one load reading.The standard readings are suitable for tests up to 5×5 lb or metric readings. The standard machineare designed to test the fabrics up to 3.5 or 900mm wide and 7inch to 9 inches long between grips with allowances for stretch. Other sizes are also made to specific requirements. In modelsprovisions is made to change the gauge length of sample in steps of oneinch elongation scale isprovided to indicates the movements of lower grip representing the elongation of the sample atthe breaking point.

The cloth strength readings are shown on clearly marked dial in pounds andkilograms by a finger points. The pointer machanism is engaged by means of a quadrant wheel withAdial pendulum arm roller. For the lead screw a direct coupled motor through a worm redirectionenclosed type gearbox for silent running obtains deive. The bottom grip can be easily beisengaged (or)engaged by operating a cluth lever provided on the cluth. Box of the lower grip.

The operating lever positioned by two limit pins. The top grip is attached to pendulum lever rollerby a strip of tempered spring steel. The shaft to which the weight lever grip. The operating lever positioned by two limit pins. The top grip is attached to pendulum lever roller by a strip oftempered spring steel. The shaft to which the weight lever an roller are attached resets on ballbearings, out of dust and the top grip is provided with a locking deirce with two CAM leveron either side to lock and when the load applied to the specimem respectively.

3.6.4Fabric Elongation

Elongation is defined as the change in length of a material due to stretching. When a fabric of original length is stressed along its axis, it extends an amount. Strain is a dimensionless quantity, often reported as a percentage. Elongation at load is the amount, that a fabric stretches in length after a fixed load is applied. This is commonly used to define the level of stretch within the fabric. The elongation is noted as the increase in inches (Chen et al.,2013).Elongation measures the extent of deformation along the axis of a material under a tensile stress, and expressed in units of length of the fabric when loaded. Elongation reading was noted from the elongation scale when the strength of the fabric is tested. The specimen was removed and the machine positioned back to original and the five specimens of both directions from each samples were tested and readings were noted.

3.6.5Fabricstiffness

The stiffness tester is a simple fixed angle flex meter. It essentially consist of two side pieces of transparent acrylic sheets fixed with the base of the instrument. On the acrylic sheets two slighting

lines are engraved in back colour and the reflection of these two lines are seen in the mirror kept at a fixed angle. Both these lines are tying at an angle of 41.5 below the horizontal of a plat form.

The instrument is provided with a calibrated bending length scale. The scale is graduated in centrimeter and when the front edge of the scale is coincides with a datum line of red mark on the instrument. The scale is provided with a rubber sheet underneath so that when it lies on a cloth, specimen resting on the platform. The frictional contact of the rubber sheet carries the specimen with it.

Absorbencytests

3.6.5.1Fabric sinking

Sinking test is a sample test that helps to measure the wetability of the fabric about to sample were cut into a small square specimen about 1×1 is at a cheap. The surface is absorbed the starts the time greater the Wetability.

3.6.5.2Fabric wicking

The wicking test was conducted as per the procedure a strip of fabric (30 cm×2cm).was suspended vertically with an edge in reservoir of distilled water was then moisturized. To detect the position of water line a dye was added to the water ability to absorb water.

3.6.5.3Colour fastnesstest

This test is based on condition o0f the fabric of the fabric of the purposed to sunlight for several hours. A sample 16cm/5 cm was taken from the coloured material. The entire sample 16cm/5cm was taken from the coloured material. The entire sample was divided into 8 equal parts marking a distance of 2cms.The sought was covered with the black paper to prevent from direct sunlight for 8 hours. The changes in the colour of the sample was compared with the original was roted with a gray scale.

Class0-fabric that will stand to hours or less.
Class1&2-fabric that passes through 10-20 hrs exposure.
Class3-fabric that passes through 40 hours exposure.
Class 4-fabric that passes through are retain the colour even after 7 days.Fastness tosunlight

To test the fastness to sunlight the specimens of 7 cm x 10 cm were cut from each sample of dyed fabrics and divided into 6 equal parts measured as 10m each, the specimens were covered with black chart. For the successive 7 days the specimens were exposed to direct sunlight. First day first portion of the specimens were exposed and accordingly seven portions are exposed to Sunlight. The first portion was exposed from 7 days and the 7th portion was exposed for a day. The last portion was not exposed to sunlight and considered as standard. Comparisons were done using grey scale and the specimens wererated.

3.6.5.4Wet and drycrocking

Crocking is the rubbing fastness of dyes. Crocking is the transfer of colourant from the surface of the coloured fabric to an adjacent area of sample fabric or to another surface, principally by rubbing action. Fastness to crocking is important in both apparel as well as upholstery. Crocking test determine the extent to which colour may be transferred from the surface of the dyes fabric to another by rubbing.

Sasmira Crock meter was used to determine the fastness to crocking. Each of dyed samples was cut in the measurement of 20 cm x 25 cm and mounted on flat base. The desized white cotton fabric was mounted in a ring on rubbing finger. Each sample was given 10 rubs based on standardization. The colour transfer from the dyed sample to the white material was used for wet crocking. The procedure adopted is same as that of dry crocking. The color transfer from the dyed sample to the white material was assessed using grey scale.

3.6.5.5Fastness towashing

Major loss of colour from the fabric is due to washing and results in staining over the adjacent fabric. Test sample of the dyed fabric measuring 10*5cm size were cut. Each of them was sandwiched between the undyed white cloth which was desized well. Specimen were completely soaked in the soap solution about 4g/l for 20 minutes at 500C, after that the samples were removed, rinsed in cold water thoroughly, squeezed well and dried. Evaluations of staining on the white adjacent fabrics were found using a grey scale. The same procedure was carried out for other dyed samples.

3.6.5.6Wet and drypressing

Two specimens measuring 5 cm x 5 cm from each dyed samples were cut and one set of specimens covered at either side with 10 cm x 10 cm of desized white fabric. The prepared specimens were pressed for 5 seconds to assess its color fastness to dry pressing, while the others were covered with wet white cloth and pressed for 4 seconds to assess its color fastness to wet pressing. The same procedure was repeated for 4 specimens. The colour change in the dyed fabrics was graded using grey scale and the specimens were rated.

RESULTS AND DISCUSSION

The Results of the present study “Decolorization of textile dye in aqueous solution using corn leaf is discussed under the following Heading.

4.1Screening of different agrowastes for decolorizing methylene blue dye .

4.2Optimization of various parameter for the decolorization of methylene blue.

4.2.1Optimization of agro-waste concentration.

4.2.2.Optimization of contact time

4.2.3.Optimization of pH

4.2.4.Optimization of Temperature.

4.3Decolorization of methylene blue dye solution using selected agro-waste under optimized conditions

4.4Evaluation of dyed fabric

4.5.1Objectives evaluation

4.5.1 Fabric weight

4.5.2Fabric thickness

4.5.3. Fabric strength and elongation

4.5.4.Fabric stiffness

4.5.5Aborbency tests.

- Drop test.
- Sinking test.
- Capillary rise test

4.6.2Colour fastness tests

4.6.1Fastness to sunlight

4.6.2Fastness to wet and dry crocking

4.6.3Fastness to washing

4.6.4Fastness to wet and dry pressing

4.1Screening of different adsorbents for decolourization of selected methylene blue dyes

The decolourization efficiency of different adsorbents such as Rice bran, muskmelon,orange peel, corn peel, rice husk, pomegranate peel, corn leaf, sugarcane bagasse, ground net, garlic peel, were screened and the result s are presented.

Adsorbents	Percent decolourization
	Methylene blue (320)
Corn leaf	80

4.1Screening of different adsorbents for decolourization of selected methylene blue dyes

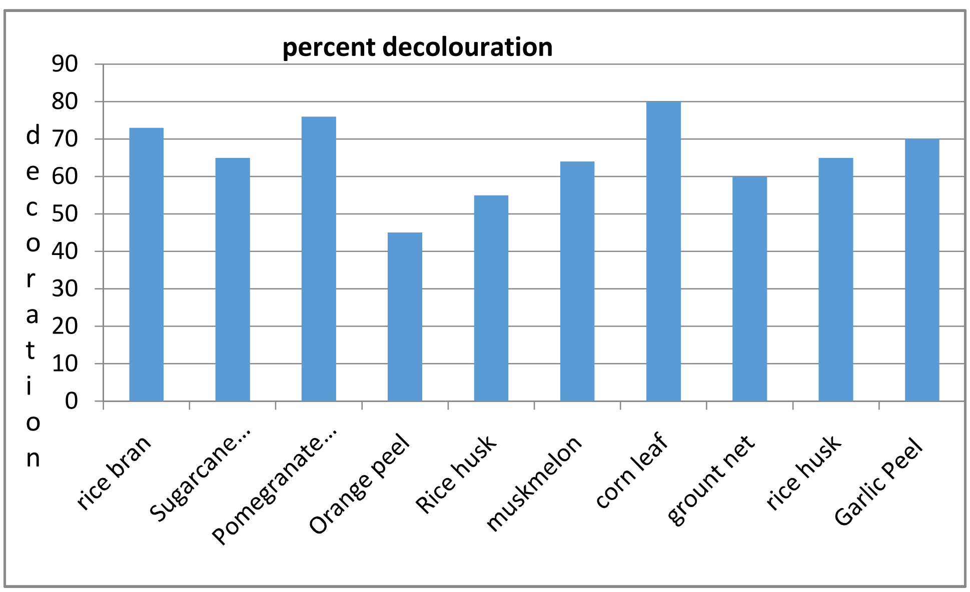

Figure 2

Among the selected adsorbents Corn leaf powder showed maximum decolourization percentage for methylene blue. The percent decolourization observed for methylene blue is respectively. Hence corn leaf was selected as potent adsorbent for the decolourization of selected dye.

4.2Optimization of various parameters for the decolourization of selecteddye

Adsorbentdosage

The 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. The effect of adsorbent concentration for the decolourization of selected dyes was studied and the results are presented in Table 5 and Figure 3

Agrowaste Concentration (%)	**Percent decolourization**
	Methylene blue
1	40
2	50
3	**70**
4	65
5	64

Table 5 Optimization of Adsorbentdosage

Adsorbent concentration (%)	Percent decolourization
	Methylene blue (320)
1	40
2	50
3	**70**
4	65

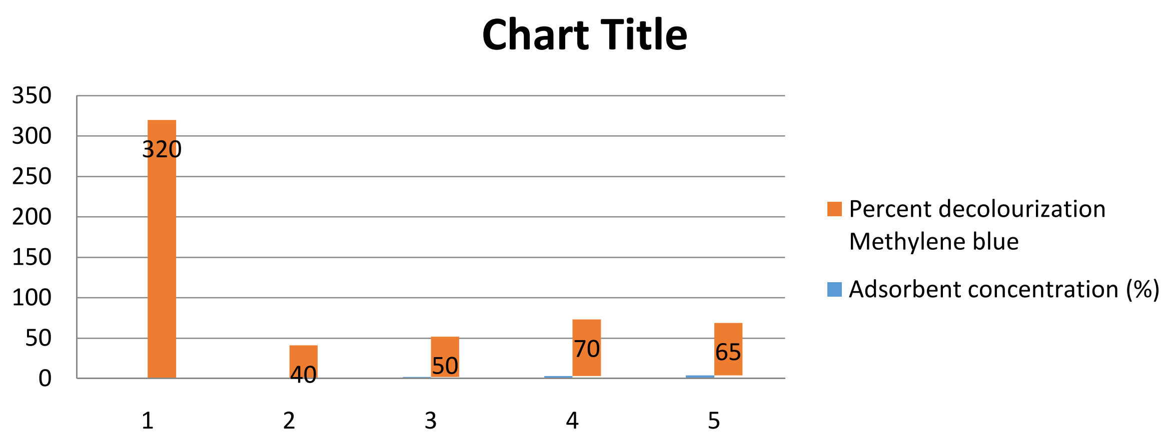

Figure 3

Optimization of Adsorbent dosage

Table 5 and Figure 3 clearly showed that the percent dye decolourization, increases with increase in adsorbent concentration . Maximum percent decolourization (70%) was observed at 3% for methylene blue. Hence adsorbent concentration of 3% was selected as optimum adsorbent dosage for decolourization of methylene blue and fixed for further experiments.

The percentage of dye removal increased by increasing adsorbent dosage. Initially the rate of increase in the percent dye 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 dose, the adsorbate (dye) is more easily accessible and because of this, removal per unit weight of adsorbent is higher. With rise in adsorbent dose, there is less commensurate increase in adsorption, The remaining sites results from unsaturated during the adsorption (Jain et al.,2003).

4.2Optimization of Initial Dye Concentration

The dye removal efficiency is highly dependent on the initial dye concentration. The effect of initial dye concentration on the decolourization of selected dyes was studied and the results are presented in Table 6 and Figure 4.

Table 6

Optimization of Initial Dye Concentration

Dye Concentration (%)	**Percent decolourization**
	Methylene blue (320)
0.01	**90**
0.02	80
0.03	61
0.04	35
0.05	24

4.3.1Optimization of aqro-wastes Dye Concentration

From Table 6 and Figure 4 it is clear that increase in methylene blue dye concentration lowers the dye decolourization percentage. Maximum dye removal was observed at an initial dye concentration of 0.01% for methylene blue (90%) respectively. Hence an methylene blue dye concentration of 0.01% was fixed as optimum and used for further experiments.

The Methylene blue dye concentration of an effluent is important since a given mass of sorbent material can only adsorb a fixed amount of dye (Benaissa,2005). The effect of methylene blue dye concentration can be carried out by preparing adsorbent–adsorbate solution with fixed adsorbent dose and different methylene blue dye concentration for different time intervals and shaken until equilibrium (Salleh et al., 2011). On the other hand, the increase in methylene blue dye concentration will cause an increase in the loading capacity of the adsorbent and this may be due to the high driving force for mass transfer at a high methylene blue dye concentration (Bulut and Aydin, 2006)

The capacity of the adsorbent material gets exhausted sharply with increase in methylene blue dye concentration. This may be probably a result of the fact that for a fixed adsorbent dose, the total available adsorption sites remain invariable for all the concentrations checked. With increasing concentration the available adsorption sites become fewer and hence the percent removal of dye is dependent upon the methylene blue concentration (Bharathi and Ramesh,2013).

4.3.2 Optimization of contact Time

The and clearly indicates that maximum percent dye removal was achieved when incubated for 24hrs for methylene blue . When the contact time was increased above 24 hrs, the percent decolourization was found to be reduced .In Hence, an optimum time of 24hrs was selected for decolourization studies.

4.3.3 Optimization of pH

pH is an important parameter in the adsorption process, particularly for dye adsorption. Effect of pH on decolourization of selected dyes was examined at various pH such as 5, 6, 7, 8 and 9 and the results are presented.

pH	**Percent decolourization**
	Methylene blue (320)
5	**91**
6	64
7	45
8	32
9	21

4.3.4Optimaztion of Temperature

The effect of temperature on decolourization of selected dye was examined at various temperatures such as 30^0C, 40^0C,50^0C ,60^0 C and 70^0C and the results are presented in Table 7 and Figure 5.

Table 7 Optimization of Temperature

Temperature(°c)	Percent decolourization
	Methylene blue (320)
30	**80**
40	65
50	60
60	50
70	55

4.3.4Optimization of Temperature

Table 7 and Figure 5 clearly indicates that percent dye removal was maximum at 30°C . methylene blue showed exothermic process with maximum dye removal at 30°C, and the percentage of removal was found to be 80%. Hence, an optimum temperature of 30°C,was selected for decolourizationstudies.

4.3.3 Optimization of Time

In adsorption studies, contact time plays a vit al role. Effect of contact time on decolourization of selected dyes was examined at various time intervals such as 6,12,18,24,30,and 36 hrs and theeresults are presented.

Time (hrs)	Percent decolourization

Table8

	Methylene blue (320)
6	45
12	63
18	71
24	**89**
30	85
36	80

4.3.2 Optimization of contact Time

The and clearly indicates that maximum percent dye removal was achieved when incubated for 24hrs for methylene blue . When the contact time was increased above 24 hrs, the percent decolourization was found to be reduced .In Hence, an optimum time of 24hrs was selected for decolourization studies.

4.3.3pH

pH is an important parameter in the adsorption process, particularly for dye adsorption. Effect of pH on decolourization of selected dyes was examined at various pH such as 5, 6, 7, 8 and 9 and the results are presented.

pH	**Percent decolourization**
	Methylene blue (320)
5	**91**
6	64
7	45
8	32
9	21

4.3.4Optimization of pH

From Table 9 and it is clear that, percent decolourization was maximum at pH 5 for methylene blue (91%). This might be due to the anionic dye adsorption which increases at low pH because the adsorbent is acting as a positively charged surface. Hence, pH of 5 was selected as optimum pH for decolourization of methylene blue

Evaluation of dyed fabric

4.0.1Fabricweight

The fabric weight and analysis of variance of the desized fabrics (DF), fabric dyed with Methylene blue(MDF) and fresh water are given in Table 10

.

Table 10

Fabric weight

S.No	Samples	Mean (GSM)
1	DF	0.7
2	MDF	0.8
3	MDD	0.9

From Table 10, it is clear that the weight of all the dyed samples increased after dyeing when compared to their desized fabric. The fabrics dyed using decolourized water exhibited higher fabric weight when compared to fabric dyed using fresh water. Statistical analysis proved that there was a significant difference at 1%level when compared between the dye samples. The observed results support that the treated water can be effectively used for dyeing cotton fabric.

4.0.2FabricThickness

Thickness and analysis of variance of the samples DF,MDF,MDD are presented in Table 11 and Figure11.

Table 11

Fabric Thickness

S.No	Samples	Mean(mm)
1	DF	0.32
2	MDF	0.39
3	MDD	0.42

From Table 11, it is clear that the thickness of the dyed samples increased when compared to the original fabric. The percent increase in thickness was found to be maximum in fabrics dyed using decolourized water. The increase in thickness may be attributed to increased uptake of dye. Statistical analysis proved that there was a significant.difference at 1% level when compared between the dyedsamples.

4.0.3Fabricstrength

Strength and analysis of variance of the samples DF, MDF, MDF, presented in Table 12

Table 12

Fabricstrength

S.No	Samples	Mean(kg)
1	DF	43
2	MDF	30
3	MDD	35

From Table 12 , it is clear that the strength of all the dyed samples decreased when compared to the desized fabric. Maximum decrease was found to be in sample MDD followed by MDF.

Statistical analysis proved that there was a significant difference at 1% level between the dyed samples. The obtained results showed that treated water could be effectively utilized for dyeing.

4.0.4FabricElongation

From Table 13 and Figure 13, it is clear that the elongation of the dyed samples increased when compared to their original fabric. The percent increase in elongation for fabric dyed using fresh water was (18.20%) in MDF (28.33%) where as in fabrics dyed using decolourized water the percent increase is (26.84%) in MDD samples.

Statistical analysis showed that there was a significant difference at 1% level between the dyed samples.

4.0.5FabricStiffnees

Fabric stiffness and analysis of variance of the samples DF, MDF, MDD, are presented in Table 14 and Figure 14**.**

Table 14

Fabric Stiffness

S.No	Samples	Mean (cm)
1	DF	35
2	MDF	26

3	MDD	27

From Table 14 and Figure 14, it is clear that the stiffness decreased in all the dyed samples when compared to their original fabric. Maximum decrease was found to be in sample MDD (20.40%) followed by MDF (25.10%). There was a significant difference at 1% lavel when compared between thesamples.

4.5.6AbsorbencyTest

4.5.6.1FabricWicking

Wicking and analysis of variance of the samples DF, MDF, MDF, are presented in Table 15 and Figure 15.

Table 15

FabricWicking

S.No	Samples	Mean (cm/min)
1	DF	1.30
2	MDF	1.65
3	MDD	1.92

From Table 15 and Figure 15, it is clear that the wicking of the dyed samples increased when compared to their desized fabric. Fabrics dyed using treated water exhibited higher absorbancy (wicking) of (40.82%) in MDD and (25.33%) in MDF when compared to fabrics dyed using fresh water.

4.5.6.2FabricSinking

Sinking and analysis of variance of the samples DF, MDF, MDF, are presented in Table 16 and Figure 16.

Table 16

Fabric Sinking

S.No	Samples	Mean (sec)
1	DF	0.52
2	MDF	0.40
3	MDD	0.40

From Table 16and Figure 16, it is clear that the time taken for sinking of the dyed samples decreased when compared to their original fabric. Maximum decrease was found to be in sample MDF (24.63%) followed by MDD(24%).

Statistical analysis proved that there was a significant difference at 1% level between dyed samples. From wicking and sinking tests, it could be concluded that the absorbance of the fabrics dyed using treated water is on par with fabrics dyed using fresh water. Hence the decolourized water can be reused fordyeing.

4.7.7 colour fastness test

The results of colour fastness tests to washing, sunlight, pressing and rubbing of dyed fabric are presented in Table 17.

Table 17

Colour Fastness Test

Samples	washing	sunlight	Rubbing		pressing	
			Dry	wet	Dry	Wet
MDF	5	4	5	4	5	4
MDD	4	5	4	5	4	5

5- Excellent 4- Good 3- Fair 2- Poor 1- Very poor.

From Table 17, it is evident that all the dyed samples showed good fastness to washing and sunlight. With regard to pressing all the samples recorded excellent to dry and good fastness to wet pressing. All the samples were found to exhibit good fastness to rubbing

SUMMARY AND CONCLUSION

5.0SUMMARY AND CONCLUSION

The textile industry is the largest and complicated industrial chains in manufacturing industry. The production of a textile requires different stages of mechanical processing such as spinning, knitting, weaving, and garment production, which seem to be insulated from the wet treatment processes like sizing, desizing, scouring, bleaching, mercerizing, dyeing, printing and finishing operations, but it has a strong interrelation between dry processes and consecutive wet treatments.

The wastewater discharged from industries such as textile, leather and dye manufacturing units have been of a major environmental concern for many years, due to its refractory nature, colour, toxicity and high levels of chemical oxygen demand (COD) and biological oxygen demand (BOD). colour in the effluent is one of the most obvious indicators of water pollution. The discharge of highly coloured synthetic dye effluents is aesthetically displeasing and can damage the receiving water body by impending penetration of light. Methylene blue dyes are more efficient but have been reported to be hazardous to human health. The environmental issues surrounding the presence of colour in effluent is a continuous problem for dye stuff manufacturers, dyers, finishers, and water companies. various conventional methods, such as physical, chemical, and biological processes have been tried for the removal ofdyes.

The adsorption process is one of the effective methods for removal dyes of from the textile effluent. The process of adsorption has an edge over the other methods due to its sludge free clean operation. It completely remove dyes ,even from the diluted solution. Adsorption methods employing solid sorbent are widely used to remove certain classes of chemical pollutants from waste water. Agricultural waste material have little or no economic value and often pose a disposal problem. A number of agricultural waste material are being studied for the removal of different dyes from aqueous solution at different operatingconditions.

Many researchers are inventing the new technologies to make a life to live easy and that makes a life easy but result in environmental hazards and polluting the lands with chemicals.

Hence the present study “Decolourization of textile dye in aqueous solution using cornleaf was designed with the followingobjectives,

To screen various agro-wastes as adsorbents for decolourizing methylene blue dye

- To optimize various parameters such as adsorbent dosage, methylene blue dye concentration, time, temperature and pH for efficient removal of dye from aqueoussolution
- To reuse the decolourized dye solution for dyeing the selectedfabric
- To compare the properties of the fabrics dyed with fresh water and decolourizedwater

Experimental procedure

- Different adsorbents such as rice bran, muskmelon, orange peel, corn peel, rice husk, pomegranate peel, corn husk, sugarcane bagasse, groundnut shell, garlic peel, were screened for their decolourization capacity for selected dye methylene blue
- Various experimental conditions like adsorbent concentration, contact time, pH, temperature and dye concentration were optimized for effective decolourization of selected dyes using selectedadsorbent.
- Uv –vis spectral analysis was done for selected dye solution and decolourized solutions.
- In order to assess the reusability of decolourized water, it was used for textile dyeing the selectedfabric.

Findings

- Among the different adsorbents screened,corn leaf was found to be more effective in the decolourization of selected dyes methylene blue
- An adsorbent concentration of 2% and 4% was found to be optimum for the decolourization of both the dyes methylene blue respectively
- An methylene blue dye concentration of 0.01% was found to be optimum for both the selected dyes.
- The optimum pH for decolourization of methylene blue was found to be6.
- Maximum percent decolourization was noticed at a temperature of 90^0C for both the dyes
- A contact time of 24 hours for both methylene blue dyes resulted in maximumdecolourization
- Fourier Transform Infrared showed the presence of functional groups in theadsorbent
- Samples dyed using decolourized water was rated as good, bright and evenly dyed when compared with fresh water dye sample.
- Fabric weight of the samples, dyed using fresh and decolourized water increased when compared over original. It may be due to the result of dye uptake by thesamples.
- Increased thickness was observed in decolourized water dyed samples than when compared to fresh water dyedsamples.
- The strength of all the dyed samples decreased when compared to their original fabric. Maximum decrease was found to be in sample methylene blue.
- Elongation of the dyed samples increased when compared to their desized fabric. The percentincreaseinelongationforfreshwaterdyedfabricwasfoundtobe(20.38%)in methylene blue(28.30%). The fabric dyed using decolourized water showed (28.82%) increase in MDD methylne blue samplerespectively.
- Dyeing has decreased the stiffness in both fresh water dyed and decolourized water dyed samples when compared over originalsample.
- Absorbance nature of the decolourized water dyed sample was found to be on par with fresh water dyedsample.
- Samples subjected to colour fastness test exhibited excellent colour fastness properties. Fastness to sunlight, pressing and rubbing was rated as excellent for both thesamples.

Conclusion

The present study proved that corn leaf could be effectively utilized for decolourization of selected dyes and the decolourized water could be effectively reused. Decolourization of dyes is essential to create ecofriendly environment. Hence corn husk powder, a low cost adsorbent could be effectively utilized for decolourization of textile dyeeffluent.

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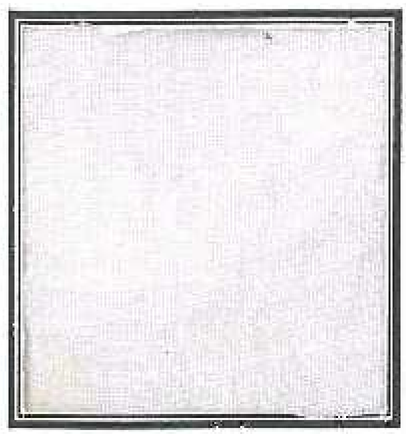
APPENDIX

ORIGINAL AND DED FABRIC SAMPLES



Desized Fabric

Fabric dyed with methylene blue180 using fresh water

Fabric dyed with methylene blue 180 using decolourized water.