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TREATMENT OF TEXTILE EFFLUENT BY USING NATURAL COAGULANTS

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ABSTRACT

Textile industry is one of the major industries in the world that provide employment with no required special skills and play a major role in the economy of many countries. There are three different types of fibres used in the manufacture of various textile products: cellulose fibres, protein fibres and synthetic fibres. Each type of fibre is dyed with different types of dyes. The textile industry utilizes various chemicals and large amount of water during the production process. The water is mainly used for application of chemicals onto the fibres and rinsing of the final products. The waste water produced during this process contains large amount of dyes and chemicals containing trace metals such as Cr, As, Cu and Zn which are capable of harming the environment and human health. Wastewater of textile industry was found to contains a high degree of pollutants with high TDS and suspended solids. The wastewater is highly colored and viscous due to dyestuff and suspended solids respectively. Chloride is major anion found in the wastewater but concentration of bicarbonate, sulphate and nitrate are also high (>100 mg/L). Sodium salts of these anions are most commonly used in the processt. The wastewater also have high BOD and COD indication its polluting nature. In this study we have used natural coagulants such as moringa , lablab, Tamarind for the treatment of wastewater produced by the textile industries.The method used for the teatment of textile industrial wastewater was the conventional Jar Test method.From the result It was found that natural coagulant worked better with turbid water. Highest turbidity reduction efficiency of about 78% was noticed. The study clearly indicates that at optimum pH system conditions, there is significant reduction in coagulant dose required and in some cases a further increase in turbidity removal. Therefore in practical situations a judicious selection of system pH would result in either reduced coagulant dose requirements or an increased turbidity removal or even both. Utilisation of locally available natural coagulant was found to be suitable, easier, cost effective and environment friendly for water treatment.

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Keywords: Textile industries , Natural coagulants , Turbidity , PH

I. INTRODUCTION

India is the world's second major manufacturer of textiles and garments after china. The textile industry in India is one of the oldest manufacturing sectors in the country[1]. Textile industry involves wide range of raw materials, machineries and processes to trick the required shape and properties of the final product. The main

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cause of generation of harmful effluents is the use of huge volume of water either in the actual chemical processing or during re-processing in preparatory, dyeing, printing and finishing[1]. The fundamental strength of this industry flows from its strong production base of a wide range of fibers/yarns from natural fibers like cotton, jute, silk, and wool to synthetic/man-made fibers like polyester, viscose, nylon, and acrylic. With escalating demand for textile products, textile mills and their wastewater have been increasing proportionally, causing a major problem of pollution in the world.Among the many chemicals in textile wastewater, dyes are considered important pollutants. Worldwide environmental problems associated with the textile industry are typically those associated with water pollution caused by the discharge of untreated effluent and those because of use of toxic chemicals especially during processing.

The discharge of textile wastewater to the environment may cause serious and very harmful to the environment if released without proper treatment. Hence, it becomes necessary to remove dyes from textile effluents before discharge to avoid negative environmental impacts. Adsorption, ion exchange, membrane filtration, coagulation and biological processes are the various treatment technologies for textile wastewater Coagulation of dye containing wastewater has been used for many years as main treatment or pretreatment due to its efficiency and low capital cost[2] .Many coagulants are widely used in conventional water treatment processes, based on their chemical characteristics. These coagulants are classified into inorganic, synthetic organic polymers, and natural coagulants. Aluminium sulfate (alum)[2] is the most widely used coagulant in water treatment because of its proven performance, cost effectiveness, relative easy handling, and availability.

Naturally occurring coagulants are biodegradable and are presumed safe for human health. Thus, in water treatment, the use of natural coagulants could be an option with many advantages over chemical agents, particularly the biodegradability, low toxicity, low residual sludge production and safe to human. Cactus and Hyacinth bean, Tamarindus indica , Acacia (Babul)[3] were used as locally available natural coagulants in this study to reduce turbidity of synthetic water. Natural coagulants worked better with high, turbid, water compare to medium, or low, turbid, water. Highest turbidity reduction efficiency (95.89%) was found with Cactus and Hyacinth bean. About 89 to 96%[3] total coliform reduction were also found with natural coagulant treatment of turbid water. Using locally available natural coagulants, suitable, easier, and environment friendly options for water treatment were observed.

The ability of three plant materials, seeds such as Cactus and Hyacinth bean, Tamarindus indica , Acacia (Babul), to act as natural coagulants was tested using synthetic turbid water formulated to resemble the drinking water. An improved and alternative method for the extraction of the active coagulant Cactus and Hyacinth bean, Tamarindus indica , Acacia (Babul) was developed and compared with the conventional water extraction method.

Coagulant such as Cactus and Hyacinth bean, Tamarindus indica , Acacia (Babul) extracts is the highest performance in turbidity removal. The optimum coagulant dosage showed the coagulation with blended coagulant Cactus and Hyacinth bean, Tamarindus indica , Acacia (Babul).

The study was carried out for initial turbidity of the sample such as 100 NTU (low), 250 NTU (medium) and 500 NTU (high). For the natural coagulant dosage was found to be 250–1000 mg/L respectively[4]. It was found that the percentage of removal is highest in Cactus and Hyacinth bean.

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Use of natural coagulants can be very much beneficial as compared to chemical or synthetic coagulants for removing turbidity in effluents from textile industries.

II. INTRODUCTION TO SOME NATURAL COAGULANTS 2.1 TAMARINDUS INDICA

Tamarind (Tamarindus indica) is a leguminous tree in the family Fabaceae indigenous to tropical Africa. The genus tamarindus is a monotypic taxon, having only a single species. The tamarind tree produces edible, pod-like fruit which is used extensively in cuisines around the world. Other uses include traditional medicine and metal polish. The wood can be used in carpentry. Because of the tamarind's many uses, cultivation has spread around the world in tropical and subtropical zones. The tamarind is a long-lived, medium-growth shrub, which attains a maximum crown height of 12 to 18 metres (39 to 59 ft). The crown has an irregular, vase-shaped outline of dense foliage. The tree grows well in full sun in clay, loam, sandy, and acidic soil types, with a high resistance to drought and aerosol salt (wind-borne salt as found in coastal areas). it is cultivated all over India, especially in the Indian states of Maharashtra, Chhattisgarh, Karnataka, Andhra Pradesh and Tamil Nadu. Extensive tamarind orchards in India produce 275,500 tons annually.

Tamarind tree

Tamarind seeds

2.1 Acacia (Babul)

Acacia nilotica, or the common names gum arabic tree, Babul/Kikar is commonly found is india subcontinent, arab and australia. Babul tree is usually 5–20 m high with a dense spheric crown, stems and branches usually dark to black coloured, fissured bark, grey-pinkish slash, exuding a reddish low quality gum. The tree has thin, straight, light, grey spines in axillary pairs, usually in 3 to 12 pairs, 5 to 7.5 cm (3 in) long in young trees, mature trees commonly without thorns .babul tree has many uses its is a Mjor source of gum for making paints and dyes. The tender twig of this plant is used as a toothbrush in south-east Africa and India. The tree's wood is "very durable if water-seasoned" and its uses include tool handles and lumber for boats. The wood has a density of about 1170 kg/m.

Babul Tree

Babul seeds

2.2 Hyacinth Beans (Lablab)

Lablab purpureus is a species of bean in the family Fabaceae. It is native to Africa and it is cultivated throughout the tropics for food. English language common names include hyacinth bean, lablab-bean and bonavist bean/pea. The plant is variable due to extensive breeding in cultivation, but in general, they are annual or short-lived perennial vines. The wild species is perennial. The thick stems can reach six meters in length. The leaves

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are made up of three pointed leaflets each up to 15 centimeters long. They may be hairy on the undersides. There are many uses of lablab. The leaves are eaten raw or cooked like spinach. The flowers can be eaten raw or steamed. The root can be boiled or baked for food. The seeds are used to make tofu and tempeh. In Maharashtra, a special spicy curry, known as vaala che birde is often used during fasting festivals during Shravan month.

Bean tree

Hyacinth Beans

III. LITERATURE REVIEW

Natural coagulant is a natural based coagulant that can be used in coagulation process of wastewater treatment for reducing turbidity .efficiency of natural coagulant is up to 99.1% in removing turbidity in synthetic wastewater is comparable to the synthetic coagulant [1]

The quality of the wastewater treated by using natural coagulant is comparable to the quality of the wastewater treated by commercial coagulant and hence can be used to replace aluminium sulphate as commercial coagulant. The highest removal efficiency of roselle seeds was within 81.2 to 93.13% for synthetic wastewater at pH 4. However, the highest removal efficiency for industrial wastewater was within 76.8 to 87.18% at pH 10[1]

Talking about the dairy industry it is generally considered to be largest source of food processing. These industries wastewater is characterized by high COD, BOD, nutrients etc. Such wastewater is to be treated natural coagulants and then tests are to be carried to check the water characteristics like BOD, COD, pH and turbidity, etc. The initial pH, Turbidity, COD are 7.41. 289.5 NTU, 10000 mg/l respectively[2]

Efficiency of powder extracted from mature-dried Tamarindus indica and Litchi chinensis seeds for the turbidity reduction of polluted river water is excellent,Efficiency of Tamarindus indica and Litchi chinensis in removal of turbidity was compared with a synthetic coagulant Polyaluminiumchloride (PACs) Tamarindus indica achieved maximum 91.16% turbidity reduction aided with 0.5% PAM. Likewise, Litchi chinensis showed 91.82% turbidity reduction aided with 0.2% PAM[3]

Samples of municipal and industrial wastewaters were treated by coagulation-flocculation and sedimentation, using a crude water extract of dry Moringa oleifera seeds as a primary coagulant. The quality of the treated wastewater was analyzed and compared to that of the wastewater treated with alum. Results showed that Moringa oleifera seeds were efficient as a primary coagulant in wastewater treatment for removal of suspended solids and microorganisms, and also removal of some metals[4]

natural coagulants were used for the treatment of textile waste water in Erode district of Tamil Nadu (India).Different natural coagulants like Moringa oleifera, Tamarina indica, Strychonomous potatorum were used to spot the suitable one as primary coagulant. Floc formation in coagulation process had been studied in the laboratory scale to determine the optimum dosage of natural coagulants. Pre and post treated textile wastewaters with natural coagulants were considered to evaluate the percentage removal efficiency on the major pollutants of concern in textile effluent such as pH, turbidity, TSS, TDS, COD and BOD. From the observed results, the

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natural coagulant Moringa oleifera gives better removal efficiencies with respect to turbidity, TSS, TDS, COD and BOD and appears to be suitable for textile effluent treatment in Erode district, when compared with Tamarina indica and Strychonomous potatorum.[5]

IV. METHODOLOGY

4.1 Collection of Natural Coagulants used

1. Acacia (Babul)

Acacia catechu belongs to leguminosae family, commonly known as black catechu or cutch. It is deciduous, thorny tree which grows up to 50 ft height, widely distributed in central and northern part of India. It is well known as khair. Ayurveda recognizes the use of Acacia catechu heartwood (known as Khadira) invaluable for its powerful astringent and anti –oxidant properties. Acacia catechu extract is derived from heartwood of the tree and is known to contain catechins, which have wide range of therapeutic actions.The seeds we are using as a coagulants can be easily & directly obtained from the tree itself & are also easily available in market at low cost.

2. Tamarindus Indica

Tamarind is cultivated all over India, especially in the Indian states of Maharashtra, Chhattisgarh, Karnataka, Andhra Pradesh and Tamil Nadu .Tamarind is easily available naturally and in markets a low cost. The tamarind seed can be easily obtained from the Tamarind tree or from market.

3. Hyacinth Beans (Lablab)

Lablab is available naturally throughout the country. Due to its various uses such as as food it is cultivated all over india at a large scale . it is available in market at low costs and can be easily obtained from there , moreover it can be directly obtained from the lablab plant in the region where it grows.

4.2 Preparation of coagulant Extracts

1. Tamarindus Indica

Preparation of Seed Powder

Locally available dry Tamarindus indica seeds were obtained from the local market of during summer season. The seeds were dried in sunlight and kept in room temperature. Then the seeds were oven dried and grounded to fine powder using a mortar and then kitchen blender to make it of approximate size of 0.005mm to make soluble in water of active ingredients ofthe seeds (Figure1). Then the powder was stored in the laboratory for use in the experiment.

Preparation of the Seed Extract

Dried seed powder from Tamarindus indica used to prepare the seed extract. 1.0g of powder was added to 100ml of de-ionized water and then stirred for 15min using a magnetic stirrer. Then the solution was allowed to

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stand without disturbance for 15min for settling. After that seed extract was separated into another beaker. Fresh solutions were prepared daily to avoid aging effect

2. Acacia (Babul)

Procedure of extraction

Plant origin material bark of Acacia catechu were taken and air dried, grinded in a mortar and pestle into powder-form and sieved to remove large particles. 1 g of powder was mixed with 100 ml distilled water to form 100 ml of suspension (approximately 0.01 g/ml concentration). The suspension was then thoroughly mixed using a clean magnetic stirrer for 5 min to extract the active component, followed by filtration of the solution through a piece of clean white cloth so as to remove solid materials. The filtrate was then centrifuged at 30 rpm for 5 min, followed by filtrati on using what man filter paper. The obtained stock solutions from each of these methods were preserved at -4°C until analyzed

Bark of Acacia

Powder Form

3. Cactus and Peels Of Hyacinth Beans

Preparation of extract:

Dry Opuntia powder was prepared by cutting fresh opuntia species into strips of 1cm width and followed by drying at 60oC for 24 hours. Dry Opuntia species was ground in a grinder and sieved to get particles of the size 300 µm. Peels of Hyacinth bean was sun dried for 1 week and dried in Hot Air Oven at 60oC for an hour, then ground in a grinder and sieved to get the particles of size 300 µm. The powder of cactus and peels of hyacinth bean are shown in the figure.

Cactus

Hyacinth bean

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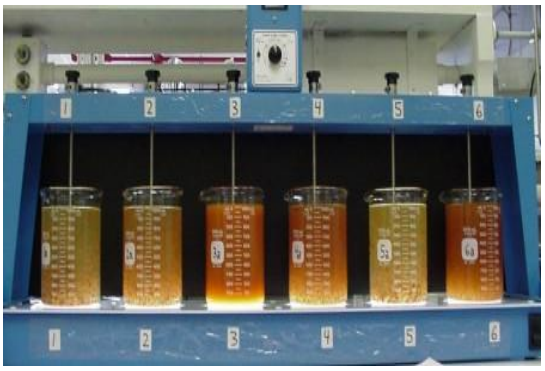
V. STANDARDS OF EFFLUENT FROM TEXTILE INDUSTRY AS PER CPCB.

PARAMETER	CONCENTRATION(MG/L)
PH	5.5 -9.0
TSS	100
BOD	30
COD	250
RESIDUAL CHLORINE	1
OIL & GREASE	10
TOTAL SULPHIDE	2
TOTAL CHROMIUM	2
PHENOLIC COMPOUNDS	1

VI.. COLLECTION OF TEXTILE WASTEWATER (SAMPLE)

Ess EII Handloon Corporation Textile Manufacturers and Textile Mills ,Vashi Mumbai.

VII. TEST PROCEDURE



JAR TEST INSTRUMENT

Jar Test Procedure

Fill the beaker to the 1,000 ml mark with the waste water sample to be tested, begin stirring the water at 100 rpm or maximum speed on the gang stirrer. Add natural coagulant (tamarind,acacia extracts or both) dosages to the beakers example, 20, 40, 60, and 80 ppm dosages.Allow the coagulant to mix at the rapid speed of 100 rpm for approximately 2 to 3 minutes.During this fast mix procedure, observe the jars very closely to determine which dosage yields the first floc or formation of particles. Make note which dosage showed this

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characteristic.As the 2-minute rapid mix time comes to an end, observe which dosage yields the largest floc size and clarity of water.After the 2-minute rapid mix time, reduce the speed to a slower mix of approximately 30-40 rpm. Allow the jars to mix at this lower speed for approximately 3 minutes or the times correlating to the plant system. During this period, continue to evaluate the floc size and clarity of water.At the end of the slow mix, turn the stirrers off completely and allow the floc to settle to the bottom of the jar, or possibly float, depending on the treatment application. Make note of which dosage yields the most rapid settling or floating rate, largest floc particles, and the clarity of water. After the jars have set for approximately 2 to 5 minutes, you can extract some water from the jars and run a turbidity analysis to determine more accurately which jar yields the best clarity water.Check the effectiveness of the natural coagulant used for the treatment of wastewater sample.

IX. CONCLUSION

From the study, it can be concluded that, the use of natural coagulants like Cactus and Hyacinth bean, Tamarindus indica Acacia (Babul) are receiving attention for their effectiveness in water treatment. Access to clean and safe water is difficult in rural areas because water is generally available in rainy season which is muddy and full of sediments, due to lack of purifying agents communities drink the water contaminated with sediment and human feces. Therefore, the use of natural coagulants that are locally available, abundant and inexhaustible provides a solution to the need for clean and safe drinking water in the rural communities. The technologies involved are economical, traditional, easy to implement and decreases morbidity and mortality from water borne diseases and thus, improve public health in rural areas. Among many engineering disciplines, Textile Engineering has direct connection with Environmental aspects to be explicitly and abundantly considered. The main reason is that the textile industry plays an important role in a country like India which accounts for one third of its total export. Out of various activities in textile industry, chemical processing contributes to about 70% of pollution. In this study the suitability and effectiveness of the Cactus and bean , Tamarind seeds and Acacia in the treatment of textile waste water were determined and the effect of the coagulant on the removal of color, turbidity, alkalinity and COD was also studied. When compared to the commercial resin, the natural coagulant obtained from Cactus and bean , Tamarind seeds and Acacia is cheaper and easily available source.

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