COMBINED COAGULATION AND ADSORPTION TREATMENT FOR COLOUR REDUCTION OF TEXTILE WASTEWATER

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Abstract:. Different methods are used to treat wastewaters from various origins. Each method is selected depending on the characteristics of the wastewater and the treatment objectives. Depending on its origin, wastewater contains a complex mixture of organic and inorganic pollutants. Discharged in the environment without treatment, wastewater leads to the breakdown of the ecosystem and creating potential health risks.
The textile dyeing industry consumes large quantities of water and produces large volumes of wastewater from different processes in dyeing and finishing processes. The low-cost, easily available naturally prepared coagulants like papaya seeds, and adsorbent like coconut shell powder as an alternative to recent expensive coagulant and adsorbent methods for dye removal has been investigated in this study, Various process parameters like, coagulant dose, adsorbent dosage, turbidity , color and also its optimization were exploited. The maximum percentage turbidity removal was found for the dosage of 2.5 ml of maize solution using jar test apparatus and maximum color removed for the dosage of 8gm of charcoal prepared from sugarcane leaves by orbital shaker apparatus. This work explores the feasibility of sugar cane leaves and maize powder for the removal of color and turbidity respectively

Index terms – coagulation ,papaya seed ,coconut shell , textile wastewater, colour Adsorption

1. INTRODUCTION

The textile dying industry consumes large quantities of water and produces large volumes of waste water from different processes in dyeing and finishing processes 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. In many developing countries, the wastewater is usually directly discharged to the river body without any treatment. This severe possesses a threat to flora and fauna in the river, and also to people that use the water for daily life. The unused materials from the processes are discharged as wastewater that is high in colour, biochemical oxygen demand (BOD), chemical oxygen demand (COD), pH, temperature, turbidity and toxic chemicals.

The discharge of coloured wastes into streams not only affects their aesthetic nature but also interferes with the transmission of sunlight into streams and therefore reduces photosynthetic action. Colour is one of the most important environmental parameters. The dye's structures are high molecular weight and complex structures, resulting in greater difficulty to degrade the dyeing wastewater. Further, coloured wastes may contain chemicals which exhibit toxic effects towards microbial populations and can be toxic and/or carcinogenic to mammals. Hence, it becomes necessary to remove dyes from textile effluents before discharge to avoid negative environmental impacts.
In general, dyes are poorly biodegradable. Conventional biological treatment processes are not very effective in dye removal. Textile industry involves wide range of raw materials, machineries and processes to trick the required shape and properties of the final product. 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. Dyes are used in large quantities in many industries including textile, leather, cosmetics, paper, printing, plastic, pharmaceuticals, food, etc. to colour their products, which generates wastewater, characteristically high in colour and organic content.
The waste water generated from textile industry is generally warm, Alkaline, Strong smelling and colored by chemicals used in dyeing processes. On an average 125-150L of water is required to produce 1kg of textile wastewater.

A typical textile waste water is known to have various pH solutions, high temperature, high chemical oxygen demand(COD),high biochemical oxygen demand(BOD), high suspended solids (SS) and also characterized by high level color imparted by residual dyes. These colored waste waters are equally hazardous to the human health and therefore needs to be treated. As industrialization develops and wastewater is not only the main maker of environmental imbalance but also furnish to the decrease of fresh water source of earth. Presently, there is a demand for new and environmental friendly wastewater treatment technology as the fresh water is polluting Naturally occurring coagulants and adsorbent are biodegradable and are safe for human health thus, in waste

water treatment, the use of natural coagulants and adsorbent could be an option with many advantages over chemical agents, particularly the biodegradability, low toxicity, low residual sludge production and safe to human.

Adsorption, ion exchange, membrane filtration, coagulation and biological processes are the various treatment technologies for textile wastewater. Coagulation and adsorption for textile wastewater has been used for many years as main treatment or pretreatment due to its efficiency and low capital cost. Natural coagulants and adsorbents possess a few crucial advantages compared to chemical coagulants, such as environmentally friendly (sustainable and biodegradable), toxic-free and safer for application

Coagulant such as maize and adsorbent like sugarcane leaves used as an alternative to recent expensive coagulant and adsorbent for reactive dye removal has been investigated in this study to extracts the highest performance in turbidity and color removal, As locally available natural coagulants in this study to reduce turbidity of synthetic water

2.MATERIALS AND METHODOLOGY

2.1 Preparation of coagulant

Papaya seeds are used as a coagulant in the study, it was collected from a nearby place. This seeds were collected and repeatedly washed to remove impurities, followed by oven drying at 110˚C for 10 hours. Dried seeds were then crushed and sieved to obtain papaya seed powder through 0.3 mm sieve. These dried papaya seed powder was used as coagulant.

Fig 2.1 (a) papaya seed

Fig 2.1(b) papaya Powder

2.2 Treatment of coagulation

The coagulation studies were conducted in a jar test apparatus with 6 beakers of 1litre capacity each. Each of the beakers contains 1litre of settled textile wastewater. The coagulant papaya seed powder is added into the beakers without pH adjustment. Rapid mixin g at 150rpm for 4 min followed by slow mixing at 40rpm for 20 min. The flocks was allowed to settle for 1h and the supernatant was carefully extracted by pipetting just below the surface of settled water. Afterward, the supernatant is examined for turbidity of the treated wastewater. After coagulation, supernatant was used for further process.

Fig 2.1 (c) Jar test apparatus

3.Adsorption trearment

Preperation of activated charcoal

Coconut shell is collected, crushed and submerged in H_3PO_4 solution for 24 hrs, then it is taken out and kept in oven at the temperature of 200^0C for 15 minutes latter is carried out in furnace at 450^0C for 45 minutes. This powder is washed with distilled water by maintaining PH and kept in oven at 105^0C for overnight.

Fig 2.3(a) activated charcoal from coconut shell

Fig 2.3(b) Orbital shaker

Adsorption experiments with the 3 adsorbents as a low-cost adsorbent is carried out in 500mL flasks. Each test consists of 400mL of supernatant with a desired initial concentration of adsorbent without pH adjustment and Different doses of wood apple powder, sugarcane leaves and coconut shell charcoal is added to the wastewater sample, and the obtained suspension is immediately stirred for 2 hrs by using orbital shaker(200 rpm shaking speed). After 1 day of contact time, the samples are withdrawn from mixture using a micropipette and are analyzed for the determination of the colour using spectrophotometer.

3. RESULT AND DISCUSSION

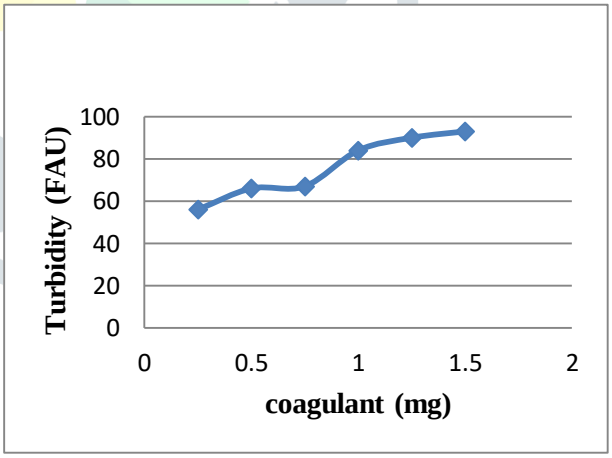
3.1 Raw wastewater characteristics

Sl. no	Characteristics	BIS standards	Results
1	Turbidity	10	59 FAU
2	Colour	25	824 PCU
3	pH	5.5 - 9	5.7

Fig 3.1(a) Raw Wastewater

3.2 Coagulation results of papaya seed powder

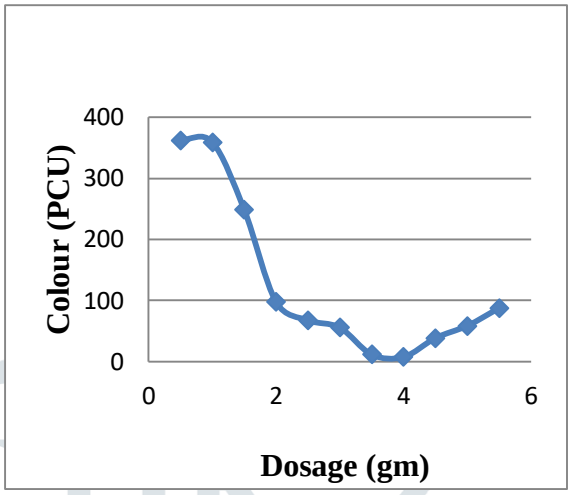
Jar no	Coagulant(mg)	Turbidity(FAU)
1	**0.25**	**56**
2	**0.5**	**66**
3	**0.75**	**67**
4	**1**	**84**
5	**1.25**	**90**
6	**1.5**	**93**



Graph no 3.1(a) Coagulant v/s turbidity

3.3 Adsorption results of coconut shell

sl.no	Dosage (gm/400ml)	Colour (PCU)
1	0.5	363
2	1	359
3	1.5	249
4	2	98
5	2.5	68
6	3	56
7	3.5	12
8	**4**	**8**
9	4.5	39
10	5	59
11	5.5	88



Graph 3.2(a) Colour v/s Dosage

Fig 3.2(a) Adsorption using coconut shell

Table 3.4 Results and % Removal of treated wastewater

characteristics	BIS Standards	Raw Wastewater	Treated Wastewater	%Removal
Colour	25	824 PCU	8	98
Ph	5.5 - 9	6.77	7.5	--

Fig 3.2 (b) raw wastewater **fig 3.2(c) treated water**

4. Conclusion

It is important to develop a bio-degradable and eco friendly organic coagulant without secondary pollution for wastewater treatment. Papaya seed , coconut shell powder contain characters that are effective as coagulant and adsorbent .

We have successfully utilized papaya seeds powder as a natural coagulant for the removal of real textile wastewater. Papaya seeds powder contains some functional groups that indicate the good possibility to be used as a natural coagulant. Optimum condition was obtained at 0.5m g/L coagulant dosage with turbidity removal efficiency of 93%. The present investigation shows that activated carbon prepared from coconut shell is a promising adsorbent for the removal of color from textile wastewater. Optimum condition was obtained at 10g/L adsorbent dosage with removal efficiency of 98%.

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