REMOVAL OF CONTAMINANTS FROM TEXTILE EFFULENT BY USING SOYABEAN HULLS –REVIEW

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ABSTRACT

Human health and the environment may be endangered if industrial wastewater effluents are not properly treated before consumption. The textile industry uses a lot of water and generates a lot of effluent, all of which contain a wide variety of pathogens, inorganic and organic compounds that can be hazardous to human health and environment. Numerous physiochemical reactions occur in the hazardous wastewater generated by textile mills. When chemically polluted textile effluent is mixed with these natural resources and their dependent habitats and surroundings, it damages the quality of the soil and water. Textile industries are experiencing significant environmental difficulties as a result of the current problem of solid and liquid waste. The purpose of this study is to determine the most effective approach for removing contaminants from textile waste water. Based on performance and control technology, a number of protection authorities throughout the world have implemented effluent rules and laws for wastewater treatment plants. It is possible to divide treatment for TWW into three distinct stages: the primary, secondary, and tertiary stages. Adsorption, flotation, ozone, ion exchange and crystallization have all been used to remove TWW from the water supply in the past. The use of these procedures is no longer prevalent. It is possible to collect water from textile effluents using advanced wastewater treatment methods, and maybe reuse it in the production process manufacturing. This article conducts a review of the currently available literature on the typical and real characteristics of textile effluents, as well as constituents, such as chemicals used to prepare simulated textile wastewater containing dye, and the treatment methods used to treat the prepared effluents. The most cost-effective absorbent approach for removing pollutants from textile waste water (TWW) is discussed in this review study. Thus it is found that soya bean hulls are an excellent absorbent material.

Keyword : *Textile waste water(TWW), Soya bean hulls, pollutants, absorbent , and floatation*

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1. INTRODUCTION

Soybean hulls are a by-product of soybean processing and are mostly used in the animal feed industry. However, soybean hulls were used as a supply of peroxide (soybean peroxidase, SBP), an enzyme that has been used in a broad variety of applications, including bioremediation and wastewater treatment, biocatalysis, diagnostic tests, medicines, and biosensors [1]. Another option to repurpose soybean hulls is to use them as adsorbents for metal ions or organic compounds (including those listed as Emerging Concerns Contaminants) in polluted waters. The presence of these species in bodies of water is a major environmental problem due to the harmful effects they have on aquatic organisms, plants, human health, and climate change [2].

Additionally, the utilisation of residual biomass resources is critical for a recycle-and-reuse perspective. Compounds composed of carbon, such as activated carbons, graphene, and graphene oxides[3] The dyeing procedures in the textile industry use tremendous amounts of water, making it difficult to treat the massive amounts of this toxic wastewater. As a result, when released into the environment (air, soil, plants, and water), they can cause a variety of diseases in humans due to their detrimental effects when untreated or partially treated [4] Figure1 indicated that the classification of dyes used in textile manufacturing industry. Figure 2 depicts the methods for removal of dye from textile waste water.

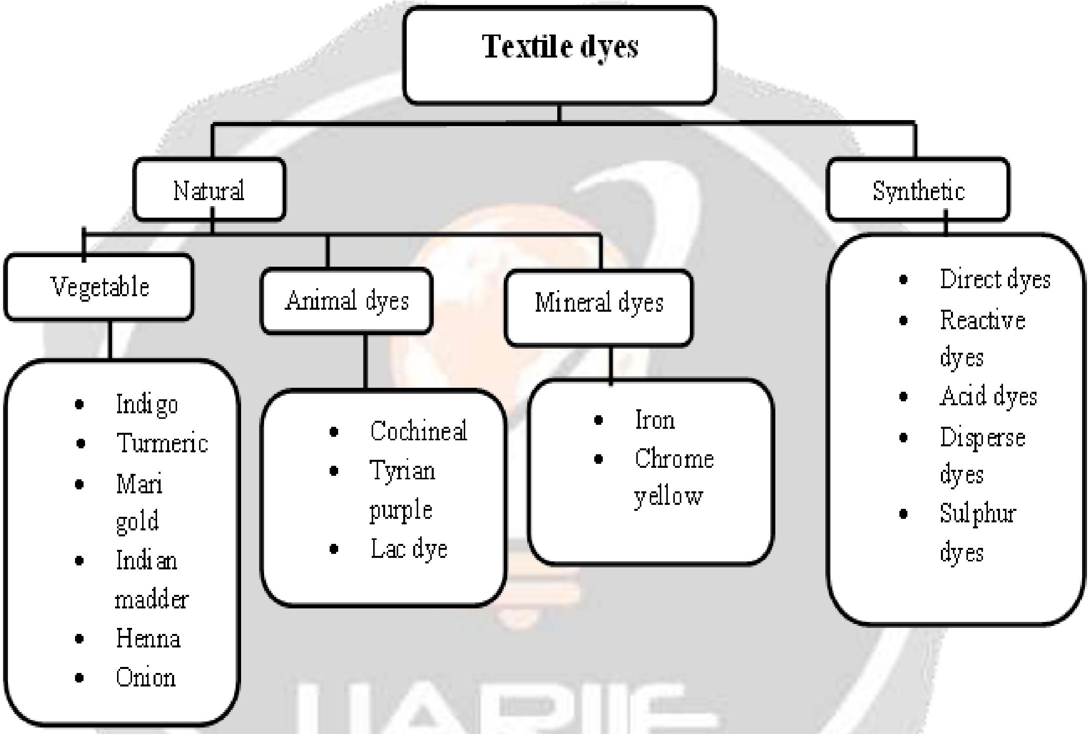


Figure 1 Classification of dyes

The dyeing process is critical in the textile manufacturing process. This stage involves the addition of colour to the fibres, and various chemicals may be employed to enhance the adsorption process between the colour and the fibres. Once the finished product is complete, some of these dyes and chemicals form part of the textile industry's effluents [28]. Apart from their objectionable look and hazardous effect upon breakdown, these dyes and chemicals may pollute neighbouring soil, sediment, and surface water, posing a significant global environmental pollution concern. Textile wastewater treatment is required to safeguard the ecosystem and to enable subsequent recycling of the treated effluent for irrigation or reuse in textile industrial processes. However, due to the lack of a permanent source of genuine wastewater, evaluating various pilot-scale treatment technologies remains challenging. As a result, more emphasis should be directed to the preparation of synthetic wastewater that mimics the effluents produced by textile factories.

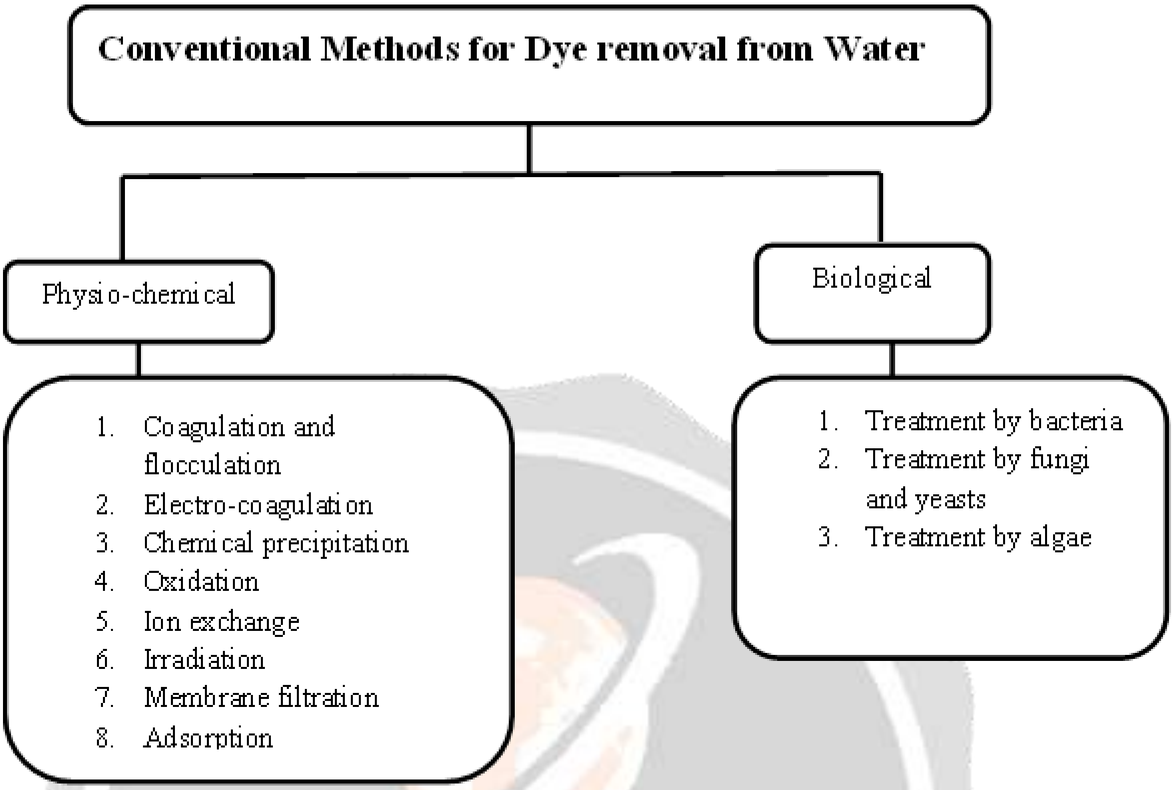


Figure 2 Methods for dye removal from textile waste water

1.1 Chemical precipitation method

This is a cost-effective method of heavy metal removal from wastewater. The chemical additive used in this procedure is chosen in such a way that it renders the metal to be removed insoluble in the effluent.[5]. Once the metal precipitates in the solution, it is easily removed from the water via filtration or settling. By increasing the pH to a neutral or alkaline level, the majority of metals precipitate as metal hydroxides. This approach, however, is insufficiently effective to meet effluent discharge regulations. An additional disadvantage of this approach is that chelated metal ions do not precipitate at all. Thus, sophisticated treatments such as reaction with organic or inorganic sulphides are used to dissolve metal hydroxides. Chemical precipitation employs reagents such as lime and soda that include hydroxide, carbonate, or sulphide.

1.2 Flocculation and coagulation

Flocculation is a common method for removing suspended solids from wastewater. It is a procedure that separates the metal to be extracted from the solution into floes or flakes that can be easily removed. Flocculation is frequently preceded by coagulation, in which chemicals are aggregated into microscopic particles and subsequently flocculate into bigger floes following the addition of a coagulant. Lin & Lin [29] used titration method, sedimentation, and the activated sludge technique to treat genuine textile effluent obtained from several dyeing and finishing companies in northern Taiwan. The results indicated that combining these techniques was effective at removing dye and COD. This procedure mixes the destabilised suspension very slowly to allow the particles to collide and produce floes. Aluminum sulphate, calcium oxide, iron (III) chloride, iron (II) sulphate, and sodium silicate are the most often used coagulant-flocculant in wastewater treatment . These are frequently employed in conjunction with a variety of coagulant aids, including synthetic polyelectrolytes (anionic, cationic, or non-ionic polymers), fly ash, and clay [6].

1.3 Adsorption method of textile waste water

1.3.1 Activated carbon

The use of powdered activated carbon is one of the most widely used ways by textile companies for dye removal from effluent. Raphael von Ostrejki is credited with inventing and patenting commercial activated carbon in 1900 and 1901. When used in the filtration process, it possesses a reasonable dye-eliminating capacity. The majority of activated carbon is porous and has a massive surface area ranging from 500 to 2000m2 /g. It can be any substance that contains a significant amount of carbon[7].

Due to its capacity to absorb a variety of hazardous pollutants including metal ions, phenols, chlorinated hydrocarbons, dyes, detergents, organic compounds, chemicals, and organisms, activated carbon is commonly used in wastewater treatment.[8]. Because of its high adsorption capacity for a wide range of compounds, activated carbons are still widely employed. Coal is the natural source of activated carbon, but coal-created activated carbon is a non-renewable resource that may be depleted in the near future, making it an expensive and non-renewable resource.[9]

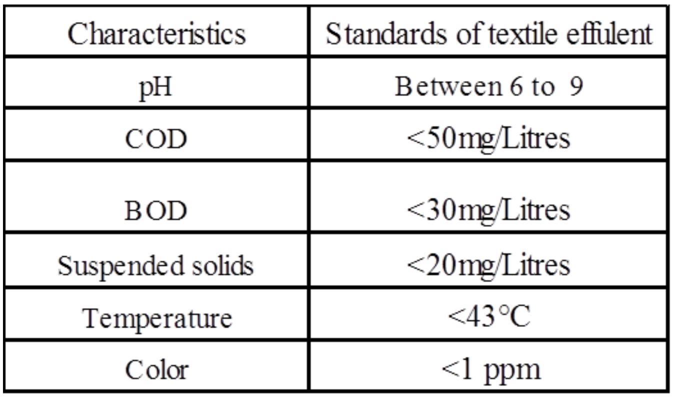
1.4 Some of The Adsorbents Used In Textile Waste Water Treatments

The textile industry is concentrating its efforts on dye effluent adsorption utilising low-cost adsorbents, as cost is the key factor in wastewater treatment. Certain agricultural and natural waste products may be used as cost-effective and alternative adsorbents. Linseed cakes, sunflower stalks, banana piths, orange peels, lemon peels, sugarcane bagasse, wood, maizecobs, wheatstraw, ricehulls, and soya bean hulls have all been utilised in their natural state to absorb colour effluent and heavy metals from textile wastewater.

Numerous them have been investigated and employed as adsorbents for dye removal. These inexpensive adsorbents are abundant in nature, cost-effective, need little processing time, and are particularly effective at treating textile effluent. Adsorption methods enable the dye to interact with the solid agricultural residue substrate. The agricultural waste is milled to increase its surface area and then dried to increase its adsorption capability. The adsorbent is added to the dye-containing wastewater and allowed to stand for 48 hours, enabling the decolorized water to be reclaimed and reused. Once the colour has been adsorbed on the agricultural residue, it is more treatable. This dye-adsorbed agricultural waste residue can subsequently be solid-state fermented with fungi. This fermentation process reduces the colour of the adsorbed agricultural waste while enhancing its nutritional and protein content. [10–12] Adsorption technique has been well reported for eliminating toxic waste from industrially treated water [25 - 26]

Table 1 shows the Characteristics of textile effluent and standard limits of TF.

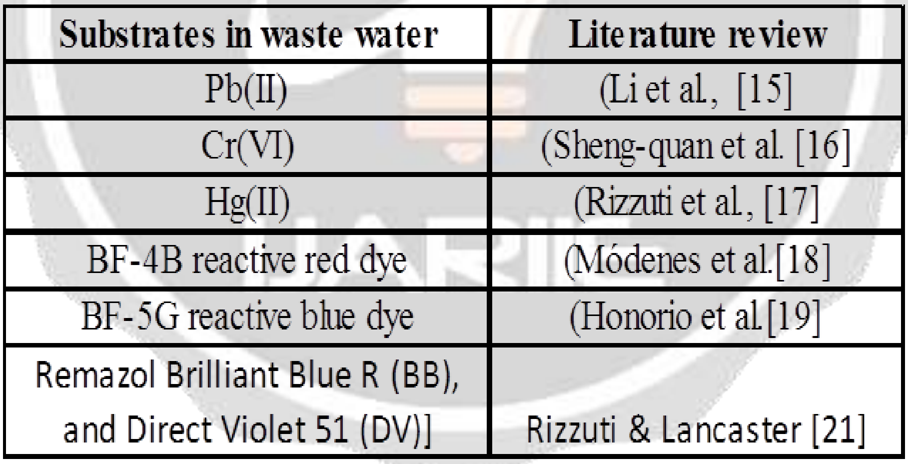
Table 1 Characteristics and Standards of textile effluent



Characteristics	Standards of textile effulent
pH	Between 6 to 9
COD	<50mg/Litres
BOD	<30mg/Litres
Suspended solids	<20mg/Litres
Temperature	<43°C
Color	<1 ppm

Cusioli, Luís[13] to determine the capacity of methylene blue to adhere to soybean hulls as a potential alternative use for this agro industrial residue. The material was examined morphologically and chemically, revealing its porous structure, heterogeneity, and functional groups that facilitate adsorption. Due to the surface's predominantly negative charge, pH had no effect on cationic dye uptake, allowing for a broad pH range. Following the adsorption experiments, the optimal experimental conditions were 298 K, 0.025 g, and 180 min contact time, resulting in a maximum adsorption capacity of 169.90 mg g1. When compared to other low-cost bio sorbents and activated carbons, it is possible to see soybean hulls being used in place of other bio sorbents and activated carbons in wastewater treatment. Additionally, Marshall and Wartelle [14] modified hulls to behave as dual-functional ion exchange resins and to improve their adsorption characteristics by imbuing them with a specific surface charge via a reaction with citric acid (negatively charged) or choline chloride.
Houda ,et.al(2021. Laccase from Trametes tro0gii and the absence of laccase mediators were used to decolorize and detoxify textile waste water by Khlifi et al. [23] They found that even at somewhat higher enzyme concentrations, laccase was unable to decolorize effluent. For textile effluent from laboratory waste water that contained two distinct reactive dyes, Khouni et al. [24] conducted another study and found that coagulation/flocculation removed 93% of the colour whereas commercial laccase catalysis eliminated 99% of the colour. Table 2 indicates that the Substrates in textile waste water based on literature studies

Table 2 Substrates in textile waste water from literature studies



Substrates in waste water	Literature review
Pb(II)	(Li et al., [15]
Cr(VI)	(Sheng-quan et al. [16]
Hg(II)	(Rizzuti et al., [17]
BF-4B reactive red dye	(Módenes et al.[18]
BF-5G reactive blue dye	(Honorio et al.[19]
Remazol Brilliant Blue R (BB), and Direct Violet 51 (DV)]	Rizzuti & Lancaster [21]

1.5 Application of soya bean hulls

Because the chemical composition of soybean hulls is dependent on the performance of the dehulling process, they may contain varying levels of cellulose (29–51%), hemicelluloses (10–25%), lignin (1–4%), pectins (4–8%), proteins (11–15%), and minor extractives. Soybean hulls are currently used in livestock feed, wastewater treatment, dietary fibre, and herbal medicine. Soybean husk conversion is concerned with the synthesis of ethanol, bio-oil, polysaccharides, microfibrils, peroxidase, and oligopeptides. We suggest using soybean hulls as a significant source of energy, materials, chemicals, medicine, and food based on the relevant data [10]

1.6 Soya Bean Hulls as a adsorbents for treatment of textile waste water

Soybean hulls are a common agro waste, however they have no practical application in any industrial activity. Bean grains are a major source of food and biofuel because of their high oil content, which may be utilised for both purposes.[27] BF-4B reactive red dye removal was the goal of Aparecido, et al [18] who used RSH as an adsorbent. Preliminary studies yielded the best conditions for conducting kinetic and equilibrium investigations. The pseudo-second order model better matched the kinetic data, revealing three distinct zones of mass transfer. Maximum absorption capacity was calculated to be 19 mg g1 in this study using soybean hulls as an adsorbent in the treatment of textile effluents without the need for pre-treatment has been proven to be a viable option.

2 CONCLUSIONS

Environmental pollution caused by dye wastewater discharge has become a significant issue in recent years. Without treatment, the majority of companies discharge dye wastewater into the environment. The wastewater is primarily composed of dye and other potentially hazardous chemicals. Colour has a significant influence on how the public perceives the quality of water, and hence the textile industry' primary objective becomes the removal of colour from effluent.

The primary issue is that the colour removal procedure is extremely inefficient, but effluent treatment has become essential in all textile industries due to stringent environmental regulations.

The discharge of coloured textile effluent into the environment is prohibited under this rule. Prior to disposal into aquatic bodies, effluent must be treated in accordance with international standards. As a result, a method for treating dye effluent must be developed that is both effective and inexpensive. Due to the efficacy of adsorption via adsorbents, it has received considerable attention in recent years. It is often dependent on a number of characteristics, including adsorption rate, time effect, pH effect, contact time, dye concentration, adsorbent dosage, and temperature. We have covered and highlighted the adsorption method and adsorbents used to remove dyes in this chapter. Commercially available activated carbon provides the most effective adsorption and decolourization of dye.

However, because activated carbons are costly, they can be substituted with less expensive adsorbents. Husks of soybeans In addition to agricultural residue, inorganic materials such as natural clays and metal oxides are employed for adsorption. The adsorbent should be chosen based on its availability, cost, and ability to be renewed. These adsorbents should be used on a large scale in industry. Finally, used adsorbent disposal should be addressed, as dumping these adsorbents into the environment could have a detrimental influence on Earth's life.

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