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Dyes Pollution and Their Prediction: A Review

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***Abstract**: In that review paper, we predict the utility of water. What kinds of industrial activities which turns fresh water to polluted water. Identifying those major pollutants and treatments are studied on them. Review about the essential factors/conditions required to treat those kinds of wastewater in well manner. Basically, dyes containing wastewater required huge kinds of treatments for fit that water.*
Keywords : Pollutants, Prediction, Treatments, B.O.D., Wastewater.

Introduction

In 21^{st} century water scarcity becomes a global issue arise infront of the world. Many fresh water resources replenished rapidly and remains are polluted due many kinds of anthropogenic activities, conducted in Industries [1]. Industries were discharged high toxic or hazardous dyes containing wastewater either treated or partially treated or sometimes untreated [2]. These discharged wastewater responsible for major water pollution for flora and fauna in received water body [3]. These water would consumed by humans, cattles etc. which creates carcinogenic, mutagenic impact on their body and those wastewater decomposed by using huge quantities of oxygen from water [4]. If sudden reduction oxygen is occurred and it takes long time for it to be restored, there may be serious pollution [5].

Dyes and Their Characteristics

Dyes are coloured chemicals having ionising, aromatic organic compounds and as such, these are based fundamentally on the structure of benzene. Like all chemicals, they are similar in their reactions to some other chemicals and distinctly different from others and the same rules that apply to sodium chloride, acetic acid, Benzidine and a host of others also apply to dyes so far their chemical interactions are concerned [6]. Dyes may be toxic, carcinogenic, mutagenic, tetarogenic or harmful to health in some other way [7]. Dyes are broadly classified as natural or synthetic. In ancient time, all the dyes used were natural, as synthetic dyes were not produced until after the middle-ages. The dyestuffs came from a variety of natural sources. Some were commonly available, while others were quite rare or difficult to produce.
Some of the common dyes included logwood or quercitron, fustic and indigo. An example of the rare dyes would be cochineal and tyrian purple. Collectively, these substances are called dyestuffs were occasionally extracts from plants, mollusks, insects, wood and certain naturally occurring minerals. There are many plants which produce dyes, suitable for the dyeing process, and many of these have been cultivated at large. Madder and woad were grown in Europe specifically for their dyeing properties. Saffron was also extensively grown in Anatolia for its yellow dye. Probably one of the most famous dyes was tyrian purple, from a Mediterranean shellfish. The Phoenicians of tyre (in Lebanon) produced this very expensive dye long before the age of written history started.

Literature Review

The presence of undesirable compounds has always been unacceptable in water for any use. It is, therefore, not at all surprising to note that the undesirable compounds in wastewater have now been considered as a pollutant that needs to be treated before discharge [8]. Thus, pollutants removal is one of the most critical tasks to be faced by various industries [9]. Industries are required greater amounts of water and are, therefore, a broad source of pollution. In order to implement an appropriate treatment process, it is of significant to minimise pollution, and to do that, it is compusary to know its exact phenomena [10].
Removal of pollutants such as heavy metals and dyes from wastewater, so, needed treatments like adsorption, coagulation/flocculation and biological methods [11-13].

Adsorption

Among all treatments the adsorption technique has become successful in recent years for wastewater treatment owing to its efficiency in the removal of pollutants. Adsorption is influenced by such factors as adsorbate/adsorbent interaction, adsorbent's surface area, particle size, temperature, pH and contact time. The main benefit of adsorption recently became the use of low-cost materials, which reduces the cost of treatments.

Baccar et. al, [11] have analysed on modeling of adsorption isotherms and kinetics of a tannery dye onto an activated carbon prepared from an agricultural by-product. According to them the equilibrium data were perfectly represented using a Langmuir isotherm. The maximum monolayer adsorption capacity was found to be 146.31 mg g^{-1} at 25°C. The kinetic studies indicated that the adsorption process followed a pseudo-second-order model. The application of an intra-particle diffusion model revealed that the adsorption mechanism of the concerned dye is a rather complex process and that diffusion is involved in the overall rate of the adsorption process, but it is not the only rate-controlling step. The calculated thermodynamics parameters revealed the spontaneous and endothermic nature of the adsorption process. The activation energy, Ea = 9.50 kJ mol^{-1}, could indicate a physical adsorption process. Despite the presence of other components in the real effluent, the adsorbent was able to remove the target dye. The present study indicates that activated carbon prepared from olive-waste cakes is a promising candidate as a low cost adsorbent for the removal of a tannery dye from industrial wastewater.

Uddin, Sujari and Nawi [14] have examined the effectiveness of peat coagulant for the removal of textile dyes from synthetic aqueous solution and textile wastewater. Tropical peat soil after chemical modificaio was found to be an effective coagulant for clarification of some of the textile dyes from their aqueous solution. Results showed that the coagulant could remove reactive, vat and disperse dyes from their aqueous solution upto 50 mg/l concentration. It was observed that the removal of Reactive Blue (RB) 19 and Cibacron Brilliant Red (CR) was 99% and 97% respectively, while in case of Vat Blue (VB) 14 and Disperse Red (DR) 72, it was 98% and 97% respectively. Even though study with 10% alum and PAC (Poly Aluminium Chloride) solution showed a 100% removal of disperse and vat dyes, both of these materials showed a relatively poor removal of the two reactive dyes.

Lakshmi et. al, [15] rice husk ash as an effective adsorbent and evaluation of the adsorptive characteristics of Indigo Carmine dye. According to them the optimum conditions were found to be: $pH_0 = 5.4$, t = 8 h and m = 10.0 g/l. The pseudo-second-order kinetic model represented the adsorption kinetics of IC on to RHA. Equilibrium isotherms were analyzed by Freundlich, Langmuir, Temkin and Redlich-Peterson models using a non-linear regression technique. Adsorption of IC on RHA was favorably influenced by an increase in the temperature of the operation. The positive values of the change in entropy ($\Delta S°$) and heat of adsorption ($\Delta H°$); and the negative value of change in Gibbs free energy ($\Delta G°$) indicate feasible and spontaneous adsorption of IC on to RHA.

Soni et. al, [16] have worked for adsorptive removal of Methylene Blue Dye from an aqueous solution using Water Hyacinth Root Powder As A Low Cost Adsorbent according to them, adsorbent prepared from roots of water hyacinth; an aquatic weed was used to remove the Methylene blue from an aqueous solution. The batch adsorption study was carried out by varying the parameters such as pH adsorbent dose, initial concentration of dye, and contact time to obtained removal kinetic data. At optimum experimental condition maximum 95% removal of dye was achieved. Equilibrium data were best represented by both Langmuir and Freundlich isotherms. The maximum dye uptake was found to be 8.04 mg/g.The adsorption kinetic data are adequately fitted to the pseudo second order kinetic model. On the basis of experimental results WHRP was found to be an excellent adsorbent for the MB removal from wastewater.

Coagulation/Flocculation

In coagulation process flocs formation were occurred when added in wastewater, it creates gelatinous liquid which adhered surrounding of particle due that suspended particles are combined each other and with the influence of gravity, it would settle down.

Joo et. al, [17] have studied the process decolourisation of reactive dyes using inorganic coagulants and synthetic polymer. A polymeric flocculants were synthesized using cyanoguanidine and formaldehyde. This synthetic polymer was tested for the (synthetic reactive dye) wastewater and real wastewater from a local dyeing industry using jar test. Flocculation and subsequent, reactive dyes cannot be easily removed by conventional coagulation, sedimentation processes and aerobic biological wastewater treatment systems have limitations in full scale application on account of poor biodegradability of the reactive dyes. Unless the reactive dyes are sufficiently removed in the pretreatment process, subsequent activated sludge processes could not achieve the regulatory standards due to their low biodegradability. Purpose of their study was to determine the applicability of synthetic polymer as decolourzation agent in combination with inorganic coagulants for the removal of reactive dye from dyeing wastewater. Optimum conditions required for coagulation and flocculation such as pH, inorganic coagulant and polymer dosages were also investigated.

Basibuyuk et al. [18] have studied the use of sludge obtained from water treatment plant for treatment of dye wastes. Potential for using this sludge for the treatment of reactive, direct, disperse, acidic, and basic dyestuffs by coagulation and sorption has been investigated in detail. The sludge acted as a coagulant and removed colour with excellent efficiencies in case of basic, disperse and direct dyes. The optimum conditions were: pH value of 5 and a sludge dosage of 2000 mg/l. Mediocre results were obtained for acidic and reactive dyes. Efficiency of the sludge was also c o mpared with alum and ferric chloride for the same group of dyes. The sludge was also used as a coagulant to treat the wastewater from a textile industry. At dosage varying from 2000-4000 mg/l, the sludge was as effective as ferric chloride and alum removing COD. Sorption tests have revealed that disperse and reactive dyes could ***not*** get adsorbed onto the sludge. Langmuir and Freundlich constants were determined for the other three types of dyes. Rate constants for adsorption have been determined using the Lagergren equation.

Chu [19] has investigated that dye removal from textile dye wastewater using recycled alum sludge according to them One hydrophobic and one hydrophilic dye were
Used as probes to examine the performance of this process. It was found that RAS is a good way of removing hydrophobic dye in wastewater, while simultaneously reducing the fresh alum dosage, of which. One third of the fresh alum can be saved. The back-diffusion of residued dye from the recycling sludge is detected but is easily controlled as long as a small amount of fresh alum is added to the system.

Moghaddam et al. [20] have analysed decolorization of an acidic dye from synthetic wastewater by sludge of water treatment plant according to them effect of initial pH, coagulant dose and initial dye concentration on dye removal efficiency were investigated. Results showed that the dye removal rates were largely dependent on pH. When the solution pH was increased from 3 to 8, the dye removal rates decreased from 96.3% to 2.3%. The removal efficiencies of the dye using 130-350 mg dried sludge/L were more than 90% at initial pH =3. With the increase of initial dye concentration in the range of 10-200 mg/L, the removal efficiency increased at first (from 10-40 mg/L) and then declined.

Biological Methods

Application of anaerobic technologies for treatment of textile wastewater is being tried for some time now. Generally, wastewater of textile industries is difficult to be treated in aerobic plants, due to the high organic load and presence of different types of dyes. Anaerobic treatment can be a solution for both these problems. It has the capacity to decolourize the wastewater and it can handle high organic loads also. However, industrial (textile) wastewater presents the additional complexity of dealing with unknown quantities and varieties of kinds of dyes, as well as low BOD/COD ratios, which may affect the efficiency of the biological dacolourization [21]. Many anaerobic microorganisms are capable of reducing azo dyes and as a consequence, produce anaerobically recalcitrant aromatic amines [22]. Afterwards, many of these amines obtained as intermediate products, can be readilly mineralized aerobically. Therefore, an anaerobic system followed by aerobic treatmant has been proposed as afeasible treatment strategy [23].

Hamedaani, Sakuri and Sakakibara [13] have done experiments for decolourisation of 12 different azo, diazo and anthraquinone dyes. The study was carried out using a new isolated white rot fungus, strain L-25. A decolourisation efficiency of 84.9-99.6% could be achieved by application of this microorganism for 14 days on an initial dye concentration of 40 mg/l.

Chander and Arora [24] have studied the role of some less commonly studied white-rot fungi in bidecolourisation of industrial wastewaters having dyes. Dichomitus squalens, Daedalea flavida, Irpex flavus and Polyporus sanguineus were tested for their potential to decolourize various chromophoric groups of eight dyes, employed in different industries.

Conclusion:

Organic and inorganic pollutants which were discharged into the environment as a result of agricultural, domestic and industrial water activities lead to pollution. The normal treatment operations of these wastewaters were a growing number of treatment plants, in way to reduce those pollutants and to oxidise the organic material available in wastewater. The pollution is a result of discharge of many organic and inorganic materials into the environment. The sources of pollution include agricultural, domestic and industrial water. Treatments such as chemical precipitation, carbon adsorption, ion exchange, evaporations and membrane processes are found to be effective in treatment of waste and sewage water.

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