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Decolourization Of Synthetic Wastewater Of 'Reactive Yellow 145 Dye' Using Tea Waste Powder

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Abstract : Dyeing wastewater from the textile industries produces highly polluted effluents and is a serious concern for the environment and human beings. Approximately ten thousand different dyes are currently used in the textile industries and the amount of wastewater is huge. Dye decolorization is of crucial concern for effectively treating dye wastewater. In this study, rapid and effective decolorization of Reactive Yellow 145 Dye was achieved by Tea Waste Powder. The findings from this study provided an economical and environmentally friendly technique for the effective decolorization of dye wastewater.

I. INTRODUCTION

Water is one of the prime substances, which support life on earth. It is vital for all known forms of life. Water covers 70% of the earth's surface and makes up over 60% of the human body. In ancient India, water was considered as an inexhaustible gift of God and water was pure because the effluents at that time were limited (Mehta et al, 2004). But rapid urbanization and industrialization has caused a great harm to the quality of water and made it polluted. Water pollution is a global concern and one of the major threats to the environment.

It has been suggested that water pollution is the leading worldwide cause of deaths and diseases. An estimated 14,000 people in worldwide and 580 people in India die of water pollution related illness every day (Wikipedia). Environmental water pollution control has been an issue of major concern in many countries. Increase in population has boosted the growth of different industries leading to discharge of pollutants into the water bodies.

Since fashion and design has achieved more attention of mankind, printing and dyeing became most necessary processes in textile sector and hence dye containing wastewater and textile industrial effluent became major serious problem from water pollution point of view. The incorporation of the wastewaters which come from textile, food, cosmetic, paper industries lead to discharge of dye to natural currents generates severe environmental issues like photosynthetic processes inhibition and problems due to their toxic content. A large amount of azo dyes or their degradation byproducts have toxic or carcinogenic effects as well (Ramírez- Montoya et al., 2014; Güzelet al.,2015). Approx 10 Lakhs tones and around 10000 different types of dyes and pigments are produced with 15% of dye-containing effluents are emitted into the environment worldwide yearly.

- **Problems which are caused in environment by dyes:**

Depending on exposure time and dye concentration, dyes can have acute or chronic effects on exposed organisms. The presence of very small quantities of dyes in water (less than1ppm) is highly visible due to their brilliance. The greatest environmental concern with dyes is their absorption and reflection of sunlight entering the water. Light absorption diminishes photosynthetic activity of algae and seriously influence on the food chain. Dyes can remain in the environment for an extended period of time, because of high thermal and photo stability.

II. AIM OF THE STUDY

Decolourization Of Synthetic Wastewater Of 'Reactive Yellow 145 Dye' Using Tea Waste Powder

III. SCOPE OF THE STUDY

The overall scope of the present work is to test the effectiveness of Tea waste powder for the decolorization of Reactive Yellow 145 Dye by adsorption technique.

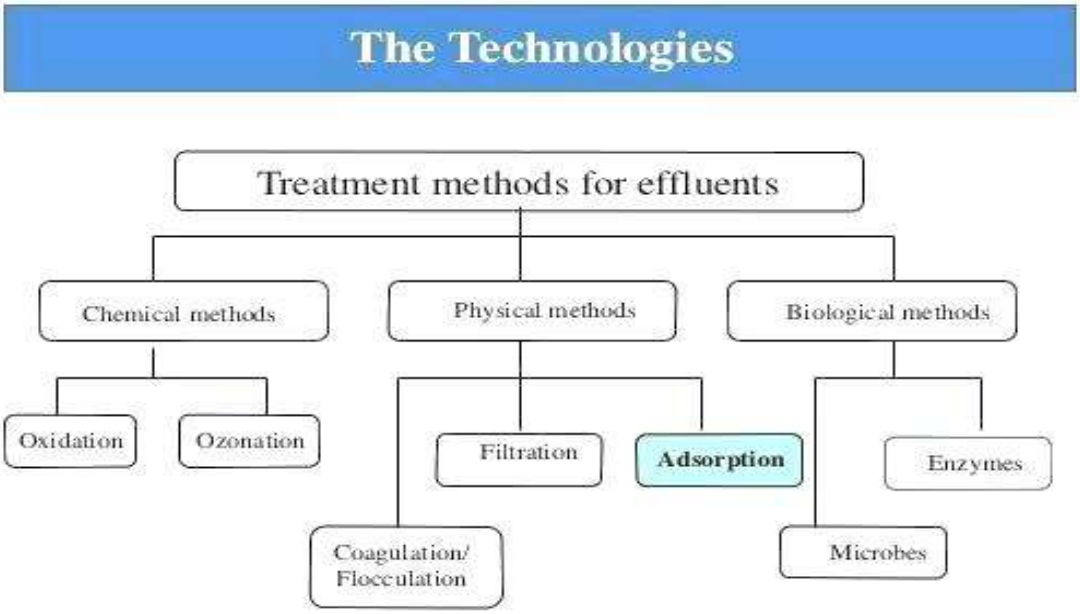
IV. OBJECTIVE OF THE STUDY

1. To study the decolourization of Reactive Yellow 145 Dye using Tea waste powder.
2. To study the effect of several parameters such as pH and adsorbent dosage with fix Dye Concentration (i.e., 100 ppm).
3. To study the removal efficiency of dye using tea powder.
4. To determine optimum condition for best removal

V. NEED OF THE STUDY

- **Environmental effect of Reactive Yellow 145 dye (why we use this dye?):**
  Reactive Yellow 145 was selected for the adsorption experiment due to its presence in wastewaters of several industrial such as textile, paper, soap, cosmetics, polishes, wax etc. It is anionic dye. Its toxic and carcinogenic nature has been reported. This dye can pollute waterways and change the biological cycles, affecting the photosynthesis process. In addition, it can also threaten human health during extended contact with these products, that can induce toxic reactions such as skin sensitization (dermatitis) and also affect respiratory functions.

- **Various Treatment Options for Dye Containing Wastewater:**
  Treatment technologies for dye wastewater can be divided into three categories: Biological, Chemical and Physical methods.



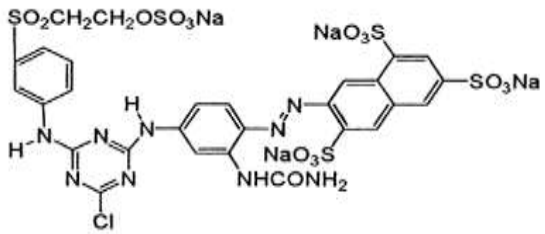
- **Some of the advantages of applying adsorption are as below:**
  1. less land area (half to quarter of what is required for a biological system);
  2. lower sensitivity to diurnal variation;
  3. not being affected by toxic chemicals;
  4. greater flexibility in design and operation, and
  5. Superior removal of organic contaminants (Alves & Pereira,2012).

- **Why we use Tea waste Powder:**
  1. Tea is the second most consumed drink in the world after water and its global production is about 5.8 million metric tons and its global consumption is about 273 billion liters and is forecasted to reach about 297 billion liters by 2021.
  2. India is the biggest consumer of tea thus produces huge amount of tea waste.
  3. Tea wastes were used because it contains cellulose, hemicelluloses, lignin and tannins and amino acids.
  4. It is cost effective, environment friendly; easily scaled up for large scale synthesis and in this method there is no need to use high pressure, energy, temperature and toxic chemicals.

VI. MATERIALS AND METHODS

- **Dye:**
  Reactive Yellow 145 having molecular weight of 1026.25 gm/mol and absorption range of 417 nm was supplied by M/s. Tausy Chem and was used in the study. Reactive Yellow 145 dye is Single azo class dye. It has the appearance of Yellow powder.

Chemical Structure Of Dye



Property Of Dye

Other names	Reactive Yellow MR Dye
Chemical formula	$C_{28}H_{20}ClN_9Na_4O_{16}S_5$
Molecular Weight	1026.25 g/mol
Reactive Group	Sulphatoethyl Sulphone
Maximum absorbance(λmax)nm	417 nm

- **Adsorbent:**
  The Tea Waste Powder was obtained from local Tea Stole.
  Preparation Of Tea Waste Adsorbent :
  Tea waste collected from the local tea stall. Proper washed out using tap water to remove unnecessary compound. After that this waste had been sun dried. To make fine particles of adsorbent, dried tea waste was grinded using home grinder.
- **Synthetic Wastewater:**
  Synthetic wastewater of Reactive dye 145 were made up in tap water. 100 ppm synthetic wastewater were prepared.

- **Instruments:**
  pH meter, Spectrophotometer and Magnetic stirrer were used.
- **Preparation Of Synthetic Wastewater :**
  200 mg dye were weighed using digital weighing balance. This quantity of dye were dissolved into 2 liters of tap water to prepare synthetic wastewater having concentration 100 ppm.
- **Batch Adsorption Studies**:
  Reactive Yellow 145 dye was not given any pre-treatment to give a practical significance to the study. To keep adsorbent into suspension sample were continuously mixed at 300 rpm with the help of magnetic stirrer. Decolourization experiments were performed in an open batch system at room temperature at different pH and different dose of tea waste with fix concentration of dye (100 ppm).

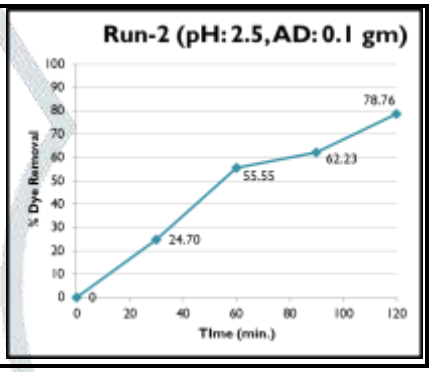
VII. RESULT & CONCLUSION

- **Preparation of Calibration graph:**
  - **Spectrum of dye:**
    Prepared synthetic wastewater having dye concentration 100 ppm, analyzed to know their characteristics peak with concern wavelength. Spectrum was taken from 200 to 800 nm wavelength. Spectrum was found as under, in which maximum absorbance (λmax) was found at 417 nm wavelength: Stock solutions with 10,20,30,40,50 and 100 ppm were prepared. Measured absorbance for each stock solution and plotted calibration graph. Calibration graph found linear, which shows dye was not saturated at 100 ppm concentration.
- **Experimental Results:**
  All experiments were done with following static conditions:

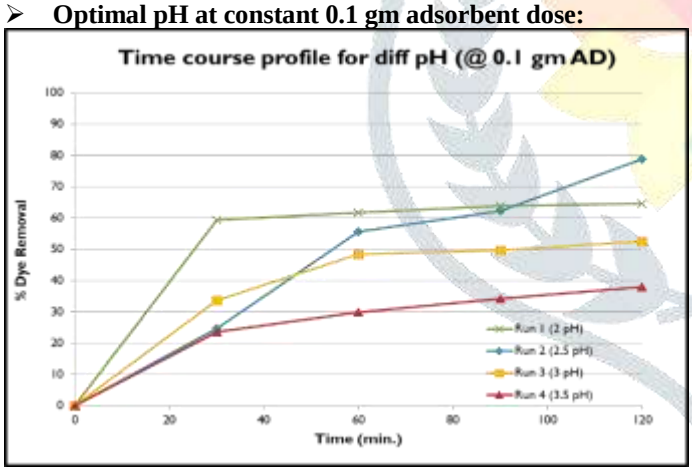
Sr. No.	Particular	Values
1	Dye Concentration	100 ppm
2	Initial pH	7
3	Volume of reactor (i.e., Synthetic WW)	100 mL
4	RPM	300
5	Time of experiment	2 hrs.

To find out optimal pH at constant 0.1 gm adsorbent dose:
Run-1 (adjusted pH = 2.0 (using 1N H2So4):

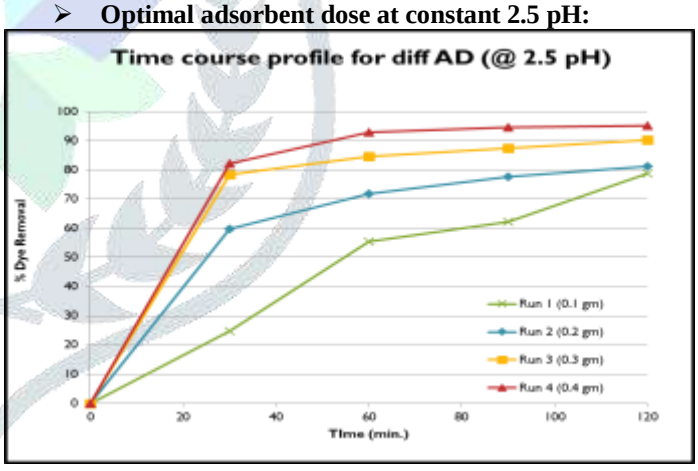
Time	Absorbance	Removal
0	2.542	0
30	1.032	59.40
60	0.973	61.72
90	0.92	63.81
120	0.898	64.67



- **Optimal pH at constant 0.1 gm adsorbent dose:**



- **Optimal adsorbent dose at constant 2.5 pH:**



- **Optimal adsorbent dose at constant 2.5 pH:**
  From the above graph optimal adsorbent dose 0.4 gm was found for dye removal. If we noted that at 0.4 gm adsorbent dosage and 2.5 pH, 82.14 % dye removal found at 30 min. and 95.24 % dye removal found at 120 min. If we optimize for reaction time dye removal at 30 min reaction time is excellent compared to 120 min. Because from 30 to 120 time period only 13.1 % additional removal found.

  In consideration of the results derived, following conclusion can be declared:
  Optimal experimental conditions was derived dye removal from 100 ppm aqueous dye solution of Reactive Yellow 145. 0.4 gm adsorbent dose, 2.5 pH and 30 min reaction time optimized from this experimental work.

In future this experimental data will be useful as supplementary data for comparison of:

(1) different dye removal by use of tea waste adsorbent and
(2) Removal of Reactive Yellow 145 dye with different adsorbents.

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