Elimination of Rhodamine B Dye Color from Aqueous Solution via Electrocoagulation Process

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Abstract:
The main aim of this research is to find out the Effect of Direct Current (DC) on removal of Rhodamine B (RhB) dye from aqueous solutionby Electrocoagulation Process.Different operating parameter like Initial pH, Current Density (A/m^2),Processing time (min) were investigated for removal of RhB from aqueous solution.The result shows that 98%colour removal of RhB was achieved with 10.53 Electrical Energy Consumption (KWh/m^3) at 7 pH,150 A/m^2 and 30 min using Fe Electrode with 1 gm/L NaCl Conc. at 50 ppm RhB Dye concentration.
Keywords:Electrocoagulation, Direct Current.

1. INTRODUCTION:

Our environment is having serious ecological problem, due to water pollutants mainly due to industrial waste disposed in water bodies without treatment [1]. Dye Industries generating Wastewater which is themajor threat to our environment [2].Rhodamine B (RhB), which known as a tracer fluorescent, isone of the most commonly used colorant in textiles and food stuffs [3]. Electrocoagulation Process is used for treatment of colour removal of Rhodamine B dye solution.Electrocoagulation is an electrochemical process in which flock of metallic hydroxides are generated within the effluent, which to be treated, by electro dissolution of anodes.The electrocoagulation (EC) technique is considered to be potentially an effective tool for treatment of textile wastewaters with high removal efficiency [4]. Electrocoagulation is an electrochemical technique whereby anodes (aluminium or iron electrodes) corrode to release active coagulants into solution. These hydroxides / polyhydroxides / polyhydroxy-metallic compounds have a strong affinity with dispersed/dissolved molecules as well as any dissolved ions to cause coagulation/adsorption [5].

2. EXPERIMENTAL (SETUP):

An electrochemical reactor shown in figure, having 500 ml with a speed of agitation of 200 rpm with Fe electrodes in series arrangement connected to a DC power supply. The total 2 no of electrodes are used at a distance of 2 cm. Initial Dye conc. & NaCl conc. are 50 ppm and 1 gm/L. Experimental work is carried out by changing Different operating parameter like Initial pH (5,7,9,), Current Density (50,100,150 A/m^2), Processing time (0 to 30 min). The % removals of colorswere calculated by changing different parameters: pH, electrode gap and operation time.

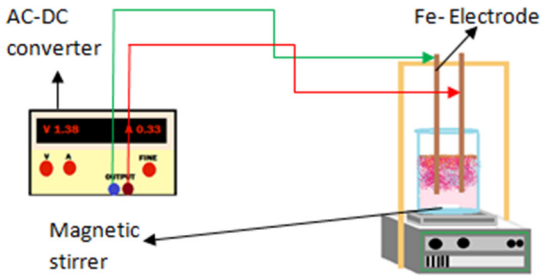

Figure 1: Experimental Set up

Run	1	2	3	4	5	6	7	8	9
Initial Dye Conc. (ppm)	50	50	50	50	50	50	50	50	50
Initial PH	5	7	9	5	7	9	5	7	9
Initial NaCl conc. (gm/l)	1	1	1	1	1	1	1	1	1
Current Density (A/m^2)	50	50	50	100	100	100	150	150	150

Table 1: Operating parameters and their levels.

Analysis and Calculation:

The color removal was chosen as a key parameter for evaluating the effect of electrochemical treatment process. Color removal efficiency was determined according to Eq. (1):

$$\textbf{\% Colour Reduction=} \left(\frac{A_0 - A}{A_0}\right) \times 100$$

Where, A_0 and A are the light absorbance of dye before and after electrochemical treatment, respectively.

EEC= electrical energy consumption [kWh/m3]
= UIt/60V
Where U is the applied voltage [V],I is applied current [A], t = treatment time [min], and V is the volume of the treated water [dm3]

3. REULTS & DICUSSION:

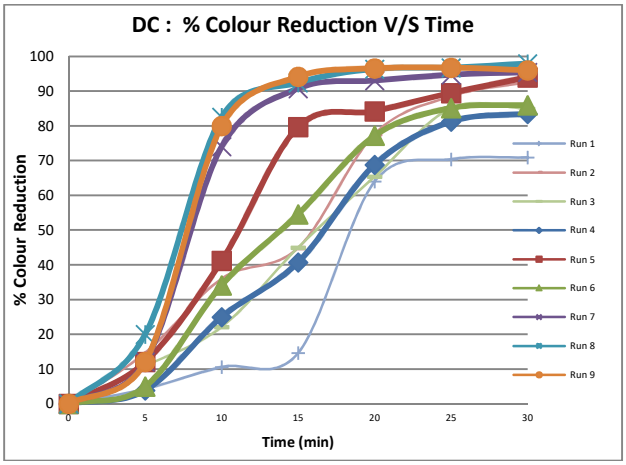

Figure 2: % Colour Reduction v/s time at all runs

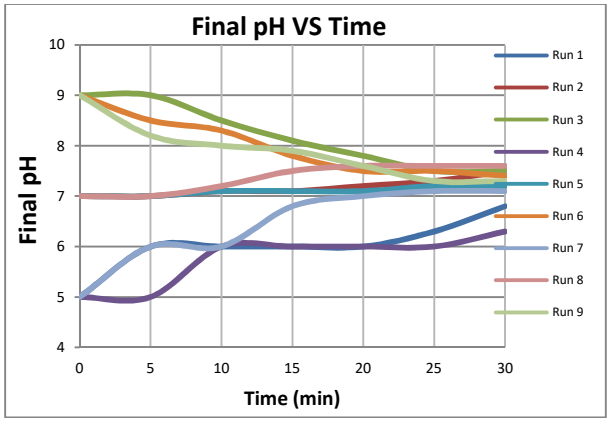

Figure 3: Final pH v/s time.

Effect of Initial pH and Current Density on % Colour Removal:
The effect of initial pH on the percentage RhB dye removal by electrocoagulation process is shown in Fig. 2. The results in the figure show that the percentage dye removal increase from 70.93 % to 95.93 % at 5 pH when current density increase from 50 to 150 A/m2. Similar results obtain for 7 and 9 pH also. Maximum % colure removal obtain at 7 pH. Current density is one of the significant operating parameters influencing the percentage removal of colour and power consumption. According to Faraday's Law, the amount of anode material that dissolves in the solution is directly proportional to current density. The collisions between particles, flocculants growth, and the potential for material removal and coagulant-are determined by the current density. The increase is ascribed to the fact that an increase in current density leads to an increase in the quantity of oxidized irons generated from the electrode, resulting in the growth of flocks and hydroxyl radicals due to which % colour removal increases.
Electrical Energy Consumption (KWh/m3):
As Current density increases EEC also increases. Maximum EEC 10.53 KWh/m3 obtain at 7 ph and 150 A/m2 Current density.

4. CONCLUSIONS:

The maximum result found as 98.00 % colour removal of RhB was achieved with 10.53Electrical Energy Consumption (KWh/m^3) at 7 pH,150 A/m^2 for 30 min using Fe Electrode with 1 gm/l NaCl Conc. as a electrolyte.

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