

DECOLOURIZATION OF SYNTHETIC DYES BY USING ELECTROCHEMICAL METHOD

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Abstract: Water is a unique substance, because it can naturally renew and cleanse itself, by allowing pollutants to settle out (through the process of sedimentation) or break down, or by diluting the pollutants to a point where they are not in harmful concentrations. However, this natural process takes time, and is difficult when excessive quantities of harmful contaminants are added to the water and humans are using more and more materials that are polluting the water sources that we drink from Various dye solution namely Acid Yellow, Methyl violet, Rose Bengal have been decolorized by the reactive chlorine generated during electrolysis of Sodium Chloride solution, using graphite cathode and an anode (platinized Titanium/ Aluminum/Copper/ Mild Steel/ Stainless Steel). Maximum decolourization efficiency (DE) was obtained when 3.75g & 7.5g NaCl solutions were electrolyzed using Platinized Titanium as anode. The decolourization process has been followed by UV-Visible absorption spectroscopy.

IndexTerms – UV-Ultra violet, DE-Decolourization adsorption

I. INTRODUCTION

In nine of the last ten years, large blue-green algae blooms have appeared on the northern part of Lake Winnipeg. These are caused by excess phosphorus in the water. Fertilizer use is 15 times higher today than it was in 1945. Beach closures are becoming increasingly common. The list of pollutants is long and the signs of water pollution surround us, but the point is this: we are dumping contaminants into the small portion of water on the planet that is fit for drinking. There are two main sources of water pollution; point sources and non-point sources. Point sources include factories, wastewater treatment facilities, septic systems, and other sources that are clearly discharging pollutants into water sources. Non-point sources are more difficult to identify, because they cannot be traced back to a particular location. Non-point sources include runoff including sediment, fertilizer, chemicals and animal wastes from farms, fields, construction sites and mines. Landfills can also be a non-point source of pollution, if substances leach from the landfill into water supplies.

Effluents from textile industries contain large quantities of organic compounds, inorganic salts and reactive dyes. The release of colored waste water in the environment is a considerable source of non-aesthetic pollution and eutrophication. Therefore proper treatment this wastewater has been drawn increasing attention.

Commonly employed methods for colour removal are adsorption, coagulation, chemical oxidation, ozone, or Fenton's reagent, and advanced oxidation processes. However these processes are quite expensive and involve several operational problems. For these reasons, there has been increasing interest in the use of new methods such as electro-chemical oxidation.

II. MATERIALS AND METHODS

The dyestuff solutions were prepared dissolving Acid yellow (0.05 g in 100 ml distilled water), Methyl violet (0.05 g in 100 ml distilled water), and Rose Bengal (0.05 g in 100 ml distilled water). Electrolysis was carried out in an undivided cell with stirring bar. Temperature of the cell was maintained constant by circulation of water.

During electrolysis Graphite was used as cathode. One of the materials Platinized Titanium/Copper Steel /Mild Steel/Stainless Steel/ Aluminum Steel was used as anode. The optical density of the dye solution before and after decolourization was measured in photoelectric colourimeter-112.

UV-Visible absorption spectra of dye solution before and after decolourization were recorded in UV-Visible spectrophotometer Lambda 35 model.

III. RESULTS

The dye solutions **Acid Yellow**, **Methyl violet**, and **Rose Bengal** was taken. Graphite was used as a cathode. One of the metal Platinized Titanium/Copper Steel /Mild Steel/Stainless Steel/ Aluminum Steel was used as anode. 3.75 g/7.5 g of sodium chloride was added. Current was passed for 5 mins (2V;0.0025A/cm²/4V;0.005A/cm²). The optical density was measured before Decolourization process was carried out in an undivided cell, provided with stirring bar. 100 ml of and after decolourisation. The decolourisation efficiency DE was calculated using the relation.

$$\text{Percentage decolourization} = \frac{\text{Initial O.D.} - \text{Final O.D.}}{\text{Initial O.D.}} \times 100$$

$$\text{DE} = \frac{\text{OD}_1 - \text{OD}_2}{\text{OD}_1} \times 100$$

Where

OD₁ = Optical Density before decolourisation

OD₂ = Optical Density after decolourisation

DE = Decolourization efficiency

The results are summarized in the table 1, 2 & 3

The above DE data for **Acid Yellow** indicates that when the current density increases the DE also increases. This data also reveals that the increasing of concentration of NaCl

Influences the DE in the increasing order. It is observed that when 3.75g of NaCl is used the decreasing order of DE offered by various materials is as follows;

Pt/Ti>Cu>MS>Al>SS (2 volt)

Pt/Ti>>Cu >MS>SS>Al (4 volt)

The above DE order of various materials indicates that Pt/Ti offers the highest DE range at both current densities of 2V/4V, it is observed that when 7.5g of NaCl is used the decreasing order of DE offered by various materials as follows:

Pt/Ti>Cu>Al> MS >SS (2 volt)

Pt/Ti>Cu>MS>Al>SS (4 volt)

The above data shows that variation of concentration of NaCl influences the DE of Pt/Ti, Cu, MS,Al in the increasing order simultaneously. On the other hand the concentration of NaCl influences the DE of SS decreasing order.

From the above experimental results we conclude that Pt/Ti offers the highest DE range at both current densities 2V/4V and concentration conditions (3.75g & 7.5g NaCl).

The above policy DE data for **Methyl violet** indicates that when the current density increases the DE also increases. This data also reveals that the increasing of concentration of NaCl influences the DE in the increasing order. It is observed that when 3.75g of NaCl is used the decreasing order of DE offered by various materials is as follows;

Pt/Ti>Cu>MS> SS >Al (2 volt)

Pt/Ti>Cu>SS> MS>Al (4 volt)

The above De order of various materials indicates that Pt/Ti offers the highest DE range at both current densities of 2V/4V, it is observed that when 7.5g of NaCl is used the decreasing order of DE offered by various materials as follows:

Pt/Ti>Cu>MS> SS >Al(2 volt)

Pt/Ti>Cu> MS > Al>SS (4 volt)

The above data shows that variation of concentration of NaCl influences the DE of Pt/Ti, Cu, MS &SS in the increasing order simultaneously. On the other hand the concentration influences the DE of Al decreasing order.

From the above experimental results we conclude that Pt/Ti offers the highest DE range at both current densities 2V/4V and concentration conditions (3.75g & 7.5g NaCl).

Rose Bengal indicates that when the current density increases the DE also increases. This data also reveals that the increasing of concentration of NaCl influences the DE in the increasing order. It is observed that when 3.75g of NaCl is used the decreasing order of DE offered by various materials is as follows;

Pt/Ti>Cu>MS> Al>SS (2 volt)
Pt/Ti>Cu>MS> Al >SS (4 volt)

The above De order of various materials indicates that Pt/Ti offers the highest DE range at both current densities of 2V/4V, it is observed that when 7.5g of NaCl is used the decreasing order of DE offered by various materials as follows:

Pt/Ti>Cu>Al> SS >MS (2 volt)
Pt/Ti>Cu>MS> Al >SS (4 volt)

The above data shows that variation of concentration influences the DE of Pt/Ti, Cu, MS &SS in the increasing order simultaneously. On the other hand the concentration influences the DE of SS decreasing order.

From the above experimental results we conclude that Pt/Ti offers the highest DE range at both current densities 2V/4V and concentration conditions (3.75g & 7.5g NaCl).

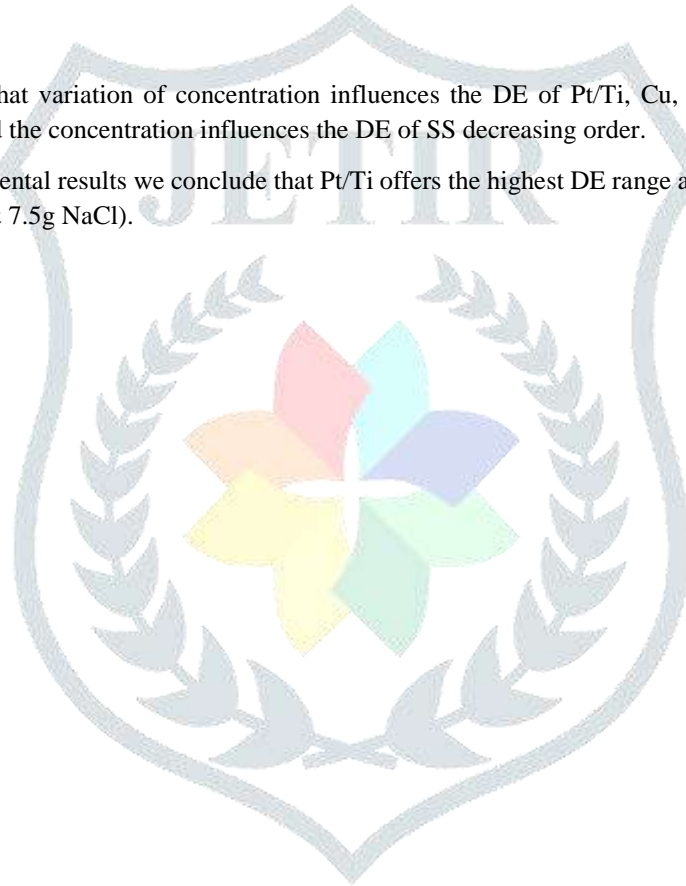


Table-1 :NaCl Is Increased 50% (7.5g Nacl) and Nacl (3.75g) is Used the Decreasing Order of DE Offered by Various Materials in Different Dyes.

S.N O	Anode	NaCl 3.75 g											NaCl 7.5g												
		2 volt						4 volt					2 volt					4 volt							
		OD AY	OD MV	OD RB	DE	DE MV	DE RB	OD AY	OD MV	OD RB	DE AY	DE MV	D E R B	OD AY	O D M V	O D R B	D E A Y	D E M V	D E R B	OD AY	O D M V	OD RB	D E A Y	DE MV	D E R B
1	Pt/Ti	0.08	0.105	0.05	82%	90%	93%	0.06	0.08	0.04	87%	92%	94%	0.05	0.09	0.03	89%	92%	96%	0.03	0.09	0.01	93%	91%	98%
2	Cu	0.09	0.14	0.07	80%	86%	90%	0.08	0.12	0.05	83%	88%	93%	0.08	0.13	0.09	83%	88%	87%	0.07	0.13	0.05	84%	87%	93%
3	Mild Steel	0.10	0.17	0.10	78%	83%	86%	0.09	0.16	0.09	80%	84%	87%	0.12	0.14	0.12	74%	84%	83%	0.09	0.14	0.10	80%	86%	86%
4	Stainless Steel	0.12	0.18	0.16	74%	82%	77%	0.13	0.14	0.14	72%	86%	80%	0.14	0.16	0.11	70%	86%	84%	0.11	0.16	0.12	76%	84%	83%
5	Aluminium Steel	0.11	0.2	0.12	76%	78%	83%	0.14	0.19	0.10	70%	81%	86%	0.11	0.19	0.10	76%	81%	86%	0.10	0.19	0.11	78%	81%	84%

OD =

Optical Density (after electrolysis)
 AY = Acid Yellows
 MV = Methyl Violet
 RB = Rose Bengal

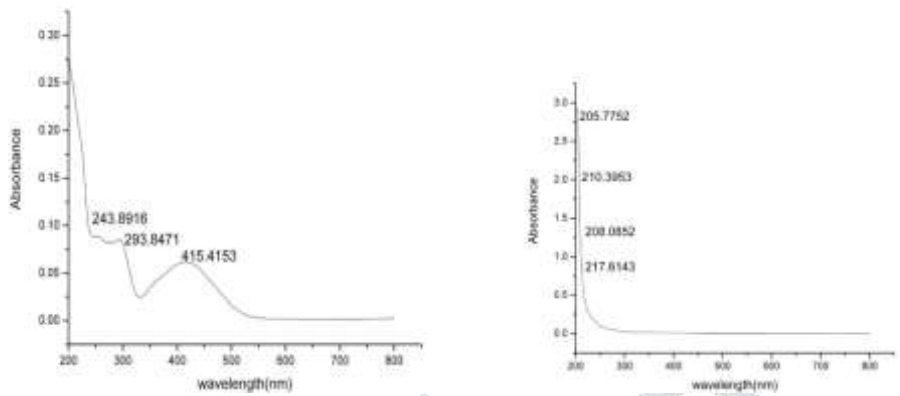


Fig.1 UV-Visible spectrum of Acid yellow Dye (Before Decolorization), Acid Yellow Dye (After Decolorization)

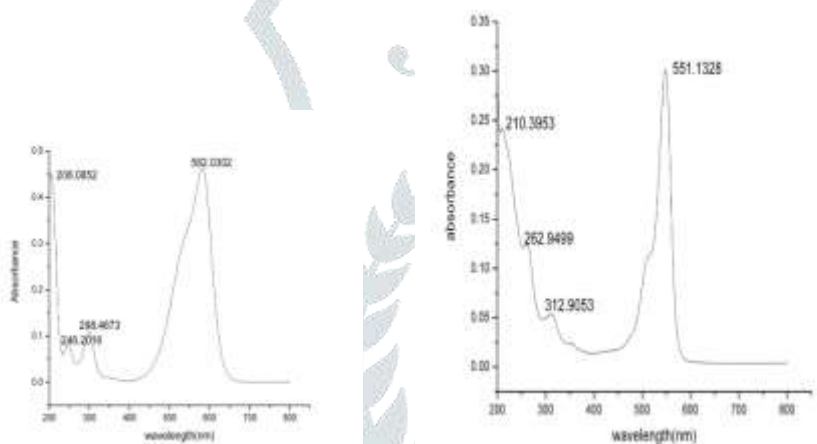


Fig. 2 UV-Visible spectrum of Methyl violet Dye (Before decolorization and After Decolorization, Pt/Ti Electrode: 7.5g NaCl, 4 volt; DE=94%)

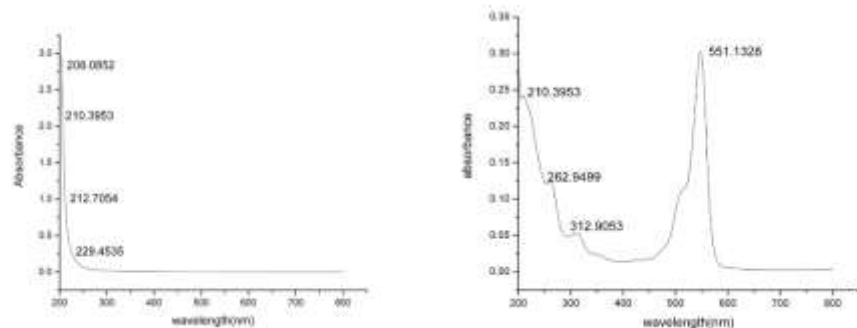


Fig.3 UV – Visible spectrum of Rose Bengal Dye (Before Decolorization and after Decolorization)

IV. CONCLUSION

Various dye solution namely Acid Yellow, Methyl violet, Rose Bengal have been decolorized by the reactive chlorine generated during electrolysis of Sodium Chloride solution, using graphite cathode and an anode (platinized Titanium/ Aluminum/Copper/ Mild Steel/ Stainless Steel). Maximum decolourization efficiency (DE) was obtained when 3.75g & 7.5g NaCl

solutions were electrolyzed using Platinized Titanium as anode. The decolorization process has been followed by UV-Visible absorption spectroscopy.

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