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TREATMENT OF TEXTILE WASTEWATER BY USING ELECTROCOAGULATION PROCESS

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Abstract— Textile Industries are the most polluting industries as it uses large amount of water and various chemicals for finishing and dying processes. The Electrocoagulation (EC) process is an effective treatment for the textile wastewater with high removal efficiency. Electrocoagulation combines the functions of conventional coagulation, flotation and electrochemistry in wastewater. This study was performed in a bipolar arrangement of four aluminum electrodes connected in parallel. Several Parameters such as dye concentration, applied voltage, conductivity and reaction time were studied to achieve the high removal efficiency. The electro coagulation process showed the maximum dye removal efficiency with an applied voltage of 30V, reaction time of 45 min, conductivity 4560µS/cm and Ph 7 was equal to 97%.Our results indicated a high removal efficiency of COD (90%), BOD_5 (85%), TDS (95%).Color removal efficiency was increased in accordance to increase in applied voltage and simultaneously electrode and energy consumption was increased. Electro coagulation technique is found to be highly efficient and relatively fast method as compared to conventional techniques.

Keywords—Electro coagulation, textile wastewater, bipolar arrangement, aluminium electrode

I. INTRODUCTION

Clean, accessible water for all is vital need for human life. Wastewater is a byproduct of domestic, industrial, commercial or agricultural activities [1]. The characteristics of wastewater vary depending on the source. The textile industry is an intensive producer of wastewater. The wastewater produced during the production of yarns and fabrics contains a very diverse range of chemicals and dyes .A reliable wastewater treatment is most important for the production of textile. In the past, the process of Electrocoagulation has attracted much attention [2,3].This process is known for its simple equipment and process and for producing relatively low amounts of sludge [4].The Electrochemical system comprises the in-situ generation of coagulant with the dissolution of these sacrificial anode. The anode is commonly made of aluminum or iron [5].The electro coagulation is based on the electrolytic dissolution of anode with the anodic action and gas bubbles formation takes place at cathode surface, promoting electro flotation. Generally, Al, Fe, Stainless Steel(SS) are used as electrode materials as these materials are cheap, non-toxic and proven effectiveness than other metals such Mg[6]. Electrocoagulation is based on the stability of colloids, emulsions and a suspension is influenced by electric charges. It produces destabilizing agents that causes charge neutralization for the reduction of pollutants. The reduction of pollutants under the action of electric field induced between the electrodes and coagulating action of product generated by oxidation of anodes. After Destabilization of colloids floc formation of particle takes place by the process of floatation [7].
The reaction taking place at anode and cathode are as follows:

- At Anode:

$$Al_{(s)} \rightarrow Al^{3+}_{(aq)} + 3e^- \qquad (1)$$

- At Cathode:

$$3H_2O + 3e^- \rightarrow (3/2)H_{2(g)} + 3OH^-_{(aq)} \qquad (2)$$

- In the Solution:

$$Al^{3+}_{(aq)} + 3H_2O \rightarrow Al(OH)_3 + 3H^+_{(aq)}$$

II. EXPERIMENTAL SETUP

One Electrode material is used, namely aluminum of grade Alloy 6061 composed of zinc(0.25%),silicon(0.81%), iron(0.7%)and Aluminum(98.5%) manufactured by TATA steel. The effluent was brought from the textile industry named Basutkar Industries located in Solapur. The laboratory based reactor is designed of volume 5 litres with tank dimensions 20cm X 15cm X 15cm as shown in Figure 2. The setup consists of bipolar arrangement of aluminum electrodes connected to a continuous DC power supply MD302D manufactured by MD Electricals (India).The electrodes are rectangular plate arranges in parallel and separated from each other at a fixed distance of 4 cm with a 7.2 cm width and 20cm height of surface area 108 cm^2 as shown in Figure 1 and Figure 3.The optimize time for electrolysis is 45 min by preliminary investigation and runs of experiment.

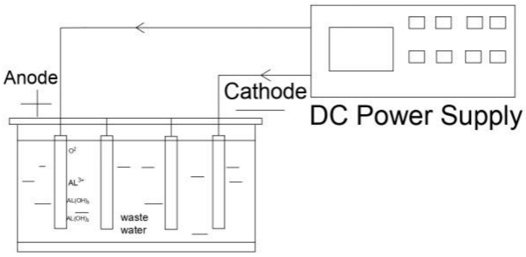

Figure 1 Schematic view of EC experimental setup

Figure 2 EC model

Figure 3 Electrodes before and after

III. RESULTS AND DISCUSSIONS

A. Effect of Operating Time

The effect of operating time was studied at current density 185 A/m^2.Figure 4 depicts the effect of operating time on the removal of different parameters like COD, BOD, TDS, Conductivity. By changing the operating time from 10 to 45 min the removal of all parameters increases from 18% to 97% respectively. In this process, it involves two stages: destabilization and aggregation. Metal ions, as destabilization agents are produced at the anode through electrochemical reactions. This leads to low charge loading when the operating time is shortened; there is insufficient destabilization of all colloids and finely suspended particles [8]. Results shows the maximum removal efficiency of all parameters at optimize time of 45 min.

B. Effect of Voltage on removal efficiency

In electrocoagulation process, the applied voltage is an important parameter for controlling the reaction rate within the electrochemical reactor. It is well-known that this variable determines the production rate of coagulant, adjusts also bubble production and affects the growth of formation of flocs [10].To determine the effect of applied voltage, electrocoagulation process was carried out using various applied voltage for 45 min operation. In fact, as the applied voltage was increased, the required time for the electrocoagulation process decreased. In the **Figure 4**, for a given time, the removal efficiency increases significantly with an increase in applied voltage.

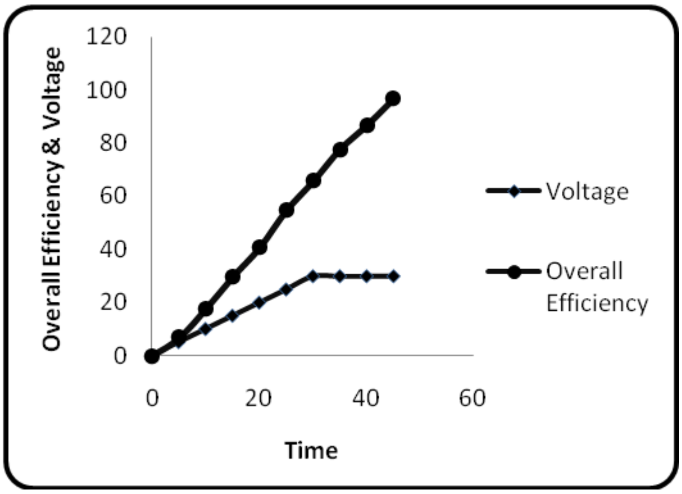

Figure 4 Effect of operating time on voltage and overall removal efficiency

B. Effect of operating time on pH

Generally, the pH of solution changes during operating process and this change depends upon type of electrode material and initial pH. The EC process exhibits buffering capacity in alkaline medium which prevents large changes in pH and decreases the pollutant removal efficiency [9].After the treatment of effluent we found that the pH changes from 5 to 7 as shown in Figure 5.

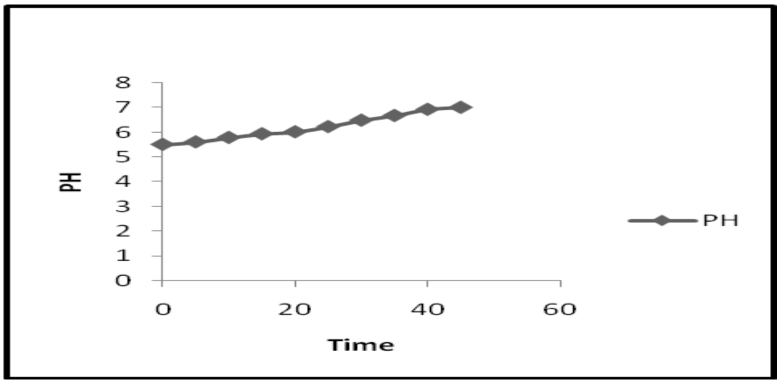

Figure 5 Effect of operating time on pH

Table 1 Characteristics of Textile Wastewater Before and After EC process

Parameters	**Standards**	**Results before EC**	**Results after EC**
pH	5.5-9.0	5.73	7
TDS(mg/*l*)	300-500	1839	91.95
BOD(mg/*l*)	30-500	156	23.4
COD(mg/*l*)	200-300	2437	252.7
Electrical conductivity(μS/cm)	1500-50000	15337	4560

III. CONCLUSIONS

The electro coagulation process with integrated electrical connections showed an efficient treatment for highly polluted textile wastewater. It is capable of being an effective treatment process as compared to conventional coagulation process. It has been noted that electrocoagulation is capable of having high removal efficiencies of color, chemical oxygen demand (COD), biological oxygen demand (BOD), and achieving a more efficient treatment process quicker than traditional coagulation and inexpensive than other methods of treatment such as ultraviolet (UV) and ozone.

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