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Research Technology In Electrochemical For Wastewater Treatment

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Abstract

The industries are responsible for producing harmful chemicals which leads to the polluted water. This paper presents the output of an efficient electrochemical removal of toxicity of effluents from water. The electrochemical technique is studied and verified in terms of removal of toxic substances from water, decrease in chemical oxidation and total dissolved chemicals and decrease in harmful chemicals or toxic materials from water electrochemically.

Keywords: Electrolysis, cyclic voltammetry, effluents, wastewater, chemical oxidation, electrochemical treatment, industrial effluents, chemicals.

Introduction

The industries and factories have attracted the eyes of many geologists and environmentalists all over the world because of its high consumption of harmful toxic substances and effluents in production which leads to major water pollution. The ongoing wastewater treatment cannot show any results of the cleanliness of water which leads to major problems to the aquatic organisms as well as the whole world revolving around it. For removal of toxic and harmful inorganics by direct reduction or oxidation the electrochemical methods have been found useful in today's scenario. Electrochemical methods are getting promoted nowadays because of their excellent results in decrement of harmful effluents and decreasing toxicity from water leads to pure water. They are moreover very effective in removal because of its low cost and effective results.

Here the electrochemical techniques had experimentally studied and verified and the samples were collected and studied in labs to find the optimum solution of wastewater through electrochemical methods. The electrochemical behavior is analyzed in terms of decrease in reduction of effluents and toxicity from wastewater.

Experimental Procedure

Cyclic voltammetric experiments were done on EG and G Potentiostat of Princeton Applied Research integrated with Applied Electrochemistry software (Echem). Voltammograms were recorded by cycling the working electrode potential between -1.20V to +1.20V at different scan rates (10mV/s to 250mV/s). The electrochemical cells consist of a three-electrode system, placed 1.0cm apart from each other and dipped directly into the solution to be electrolyzed. A DC regulated power supply was allowed to flow between electrodes of the carbon as working electrode, saturated calomel electrode as reference and platinum wire as counter electrode. The PH metric measurements were made on Hach EC-40 Bench top PH/ ISE meter.

Controlled potential electrolysis was carried on Cyclic Voltammograph in connection with a digital electronic Omnigraph X-Y/ t recorder. A three-electrode cell was used for the purpose. The cell consists of a glass container with a cap having holes for introducing electrodes and tubing for nitrogen gas. Oxygen was removed from the solution by passing nitrogen gas through the solution for about 10 minutes and then a blanket of nitrogen was maintained throughout the experiment. In the present study, platinum foil (surface area 3*3cm sq) band steel foil (surface area 4.5*3.5cm sq) were used as the working electrodes, Ag/AgCl as the reference electrode and platinum wire as an auxiliary electrode. The platinum working and counter electrodes were activated by acid cleaning with conc.HN03. After this both working and counter electrodes were shorted. The UV-visible absorption spectra of samples were recorded on Elico SL-159 UV-vis spectrophotometer.

For measuring pollutional load of initial and electrolyzed solution, chemical oxygen demand (COD) was recorded. COD digestion apparatus was used for carrying out the experiment.

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Results and Verifications

The cyclic voltammograms of amine (1*0.01M) were recorded in distilled water and at different B.R buffers of pH range 2.5 – 12.0 at various scan rates ranging from 10 -250 mV/s. Glassy carbon was employed as working electrode. Amine gives a 2-electron diffusion controlled anodic peak in the pH range 2.5 to 12.0 and in distilled water. Voltammograms at pH2.5 at various scan rates. The electrochemical characteristics have been compliedin (Table 1). A positive shift was observed in the anodic peak with increase in pH from 2.5 to 12.0.

SCAN RATE	$V^{(1/2)}$	*ip,a* *μA*	*Ep, a* *(V)*
10	3.16	2.331	0.36
20	4.47	3.270	0.38
50	7.07	5.881	0.42
100	10.0	9.209	0.46

Table 1 Electrochemical characteristics of amine at Ph 2.5 at various scan rates at glassy carbon electrode, conc= 1*0.001 M

Cyclic voltammetric behaviorof effluent samples was studied at platinum working electrode of all effluent samples. Cyclic voltammograms of all the effluentsshowed cathodic peaks in the forward scan and an anodic peak in reverse scan. However, the changes due to electrochemical treatment are clearly visible in the figure below.

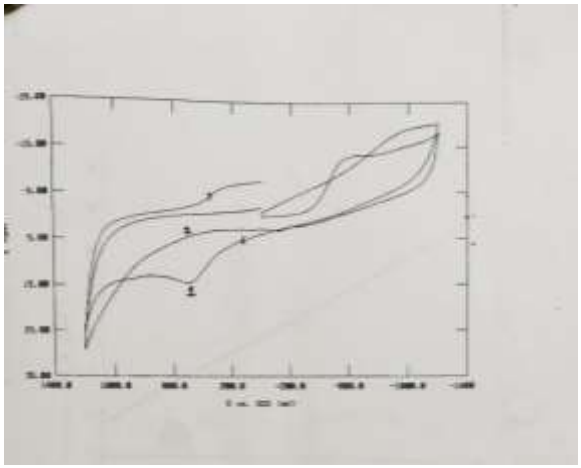

Fig. Cyclic Voltammograms of Amine at glassy carbon electrode

1. Before Electrochemical Treatment

2.After Electrochemical Treatment

The effluents were finally submitted to controlled potential electrolysis. The potential was controlled at -1.20 V, which is slightly higher than reduction peak potential in all the cases. All the effluent samples got decolorized within 20 min to 5 h of electrolysis. The progress of electrolysis was also monitored by recording decrease in current at different time intervals.

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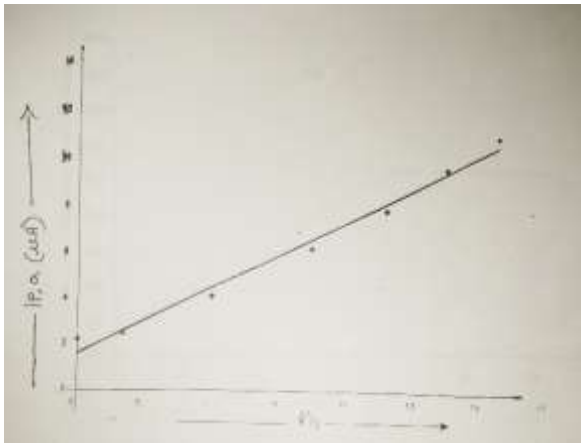

Fig 2. Plot of ip, a Vs v*v/2 of amine at 7.9 Ph at glassy carbon electrode, conc=1.0*0.001M

Conclusion

The sample obtained in the present experimental procedure states that high decrement is achieved in removal of waste water with considerable lowering of toxicity. The selected effluents could successfully be electrolyzed for 80-85 per cent effluents removal 58-59 per cent COD removal, and 55-65 per cent TDS removal in an experiment. Further the effluent did not require any additional additives like reducing agents, chemicals toxins or catalytic agents to reduce the harmful effluents present in water.

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