2011 2nd International Conference on Chemical Engineering and Applications
IPCBEE vol. 23 (2011) © (2011) IACSIT Press, Singapore

Treatment of Textile Wastewaters by Electrocoagulation Method

Umran TEZCAN UN [1+] and Ersin AYTAC [2]

[1]Department of Environmental Engineering, Anadolu University, 26555 İki Eylul Campus, Eskişehir, Turkey, Tel: +90 222 335 05 80, ext: 6400, Fax: +90 222 323 95 01

[2] Department of Environmental Engineering, Zonguldak Karaelmas University, 67100 Incivez, Zonguldak, Turkey, Tel: +90 372 257 40 10, ext: 1552, Fax: +90 372 257 21 40

Abstract: This study was designed to treatment of textile wastewater using iron electrodes with the process of electrocoagulation. Two types of flow regimes: semi-continuous and continuous flow regimes have been altered to investigate the effects on COD and dyestuff removal efficiencies. In semi-continuous flow regime different feed flow rates have been investigated. With increasing feed flow rates from 240 to 930 mL/min at semi-continuous flow regime , the final COD concentrations were also increased from 97 to 226 mg/L with a removal efficiencies of 95- 88% respectively. The absorbance of the dye was reduced by over 93% at all experiments. As a result of this study it is concluded that treatment of the textile wastewater by our designed electrocoagulator can be successfully achieved.

Keywords: Electrocoagulation, textile wastewaters, decolorization.

1. Introduction

Textile industry is one of the largest water consumers in the world [1]. Textile industries are characterized by high water and chemical consumption due to dyeing, finishing, sizing processes and multiple washing and rinsing cycles [2]. Considering both the volume generated and the effluent composition, the textile industry wastewater is rated as the most polluting among all industrial sectors [3]. The textile wastewater is notoriously known to have strong color, large amount of suspended solids, broadly fluctuating pH, high temperature, and high chemical oxygen demand concentration [4]. Various treatment methods including, physical, physico-chemical and chemical processes have been investigated for treating textile wastewaters.

The electrocoagulation (EC) technique is considered to be potentially an effective tool for treatment of textile wastewaters with high removal efficiency [5]. Electrocoagulation is an electrochemical technique whereby anodes (aluminum 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 [6].

This study was designed to investigate the treatability of textile wastewaters by electrocoagulation using iron electrodes. In semi continuous flow regime experiments were conducted to examine the effect of the feed flow rate on dye and COD removal in the electrocoagulation process. An experiment with continuous flow regime has also been done.

2. Materials and Methods

The wastewater was obtained from a local textile factory in Eskisehir. The influent COD concentration of wastewater and absorbance at 553nm was 1953 mg/L and 0.337 respectively.

The cylindrical reactor used as cathode with a height of 50 cm and diameter of 4.3 cm was made of iron and iron hexagonal wire netting anode with a height of 50 cm placed on the centre of the reactor. When the

[+] Corresponding author. Tel.: +90 222 3350580 ext: 6418; Fax: +90 222 3239501.
E-mail address: utezcan@anadolu.edu.tr

reactor was operated in semi continuous flow regime, wastewater was continuously recycled from storage tank to reactor by peristaltic pump during 90 min. The experimental setup can be seen in Fig. 1.

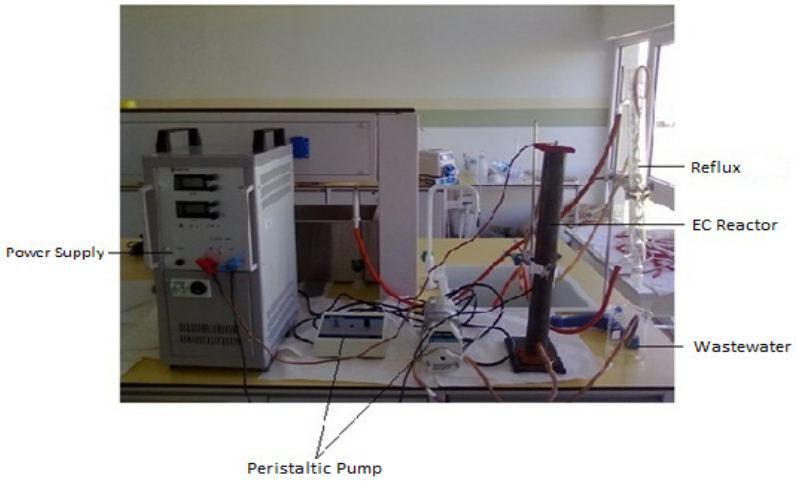

Fig. 1: Experimental setup

After each assay, the mixture was centrifuged and the residual dye concentration in the supernatant was determined with a spectrophotometer. The COD values were determined by a titrimetric method after digestion of the sample by a Hach COD Digestion Reagent.

3. Results

In the semi-continuous flow regime, as the wastewater continuously recycled to the reactor during 90 min, the effect of feed flow rate to the reactor was examined at 240, 540 and 930 mL/min at current density of 20 mA/cm^2 and 0.05M Na_2SO_4 concentration. Fig. 2 shows the change of COD during each experiment. For 240, 540 and 930 mL/min feed flow rates, the final COD concentrations obtained after 90 minutes of electrocoagulation were 97, 179 and 226 mg/L corresponding to removal efficiencies of 95, 91 and 88% respectively. Dye absorbance was reduced to 0.015, 0.017 and 0.021 abs. at 240, 540 and 930 mL/min respectively as shown in Fig.3.

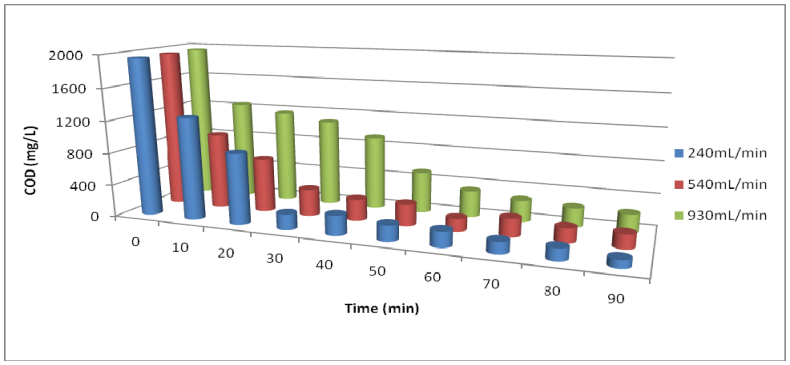

Fig.2: Effect of feed flow rate on COD in semi-continious flow regime

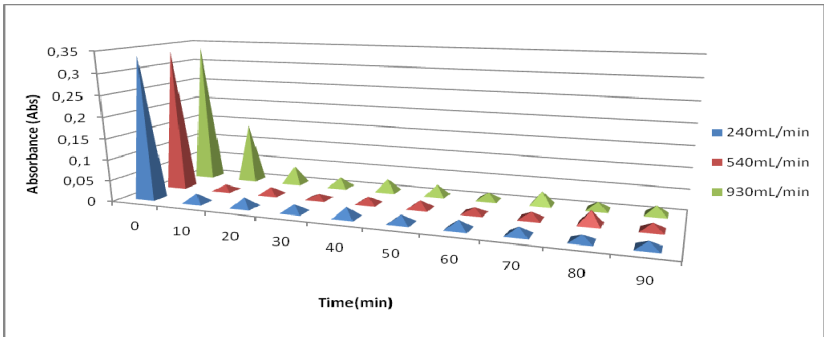

Fig. 3: Effect of inlet flow rate on absorbance in semi-continious flow regime

For determine the effect of flow regime an additional experiment has been done with continuous flow regime with a retention time in the reactor of 60 minutes at 20 mA/cm^2 and 0.05 M Na_2SO_4. Fig. 4. shows the COD abatement. The effluent COD concentration was reduced from 1953 to 30 mg/L with the removal efficiency of 98.5 %. The absorbance was reduced from 0.337 to 0.021 abs. in a removal efficiency of 94 % as seen in Fig.5.

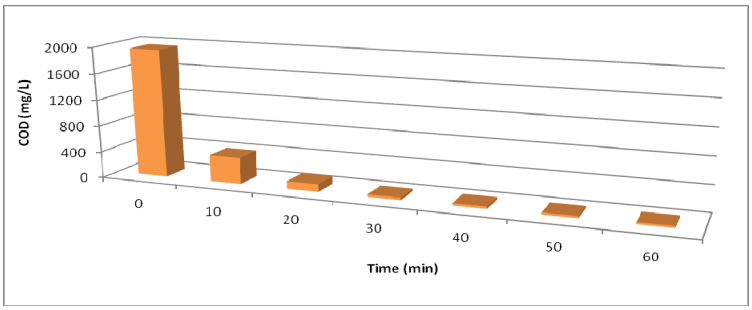

Fig. 4: COD abatement during continuous flow regime

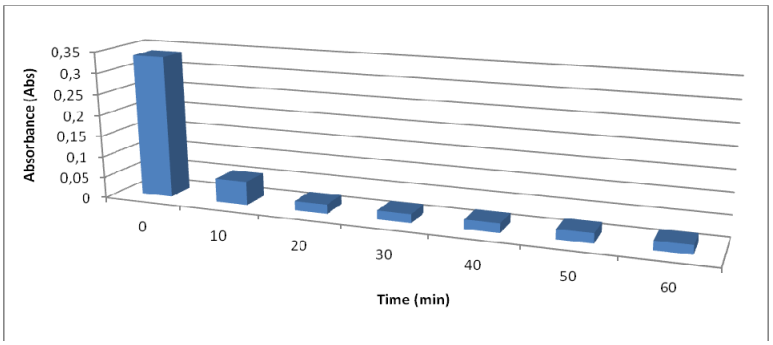

Fig.5: Absorbance abatement during continuous flow regime

4. Conclusions

In this study high COD removal efficiencies and dye removal efficiencies were achieved using unique designed electrocoagulation reactor for the treatment of textile wastewater. The inlet COD concentration of 1953 mg/L was reduced to 30 mg/L at current density of 20 mA/cm^2 and retention time of 60min. High dye removal efficiencies over 93% were also obtained. Experimental results clearly points out that, electrocoagulation process has the potential to treat the textile wastewater and thus to reduce the contamination to the environment.

5. References

[1] Z.Fu, , Y.Yugao Zhang, , X.Wang, , Textiles wastewater treatment using anoxic filter bed and biological wriggle bed-ozone biological aerated fitler, *Bioresource Technology*, 2010, DOİ:10.1016/j.biortech.2010.12.002.

[2] E.Sahinkaya, N. Uzal, U.Yetis, F. B.Dilek, Biological treatment and nanofiltration of denim textile wastewater for reuse, *Journal of Hazardous Materials,* 2008, **153**: 1142–1148.

[3] S.Sena, and G. N.Demirer, Anaerobic treatment of real textile wastewater with a fluidized Bedreactor, *Water Research*, 2003, **37**: 1868–1878.

[4] T.Hyun Kima, C.Parka, J.Leec, E.Bai Shinb, S.Kima, Pilot scale treatment of textile wastewater by combined process (fluidized biofilm process–chemical coagulation– electrochemical oxidation), *Water Research*, 2002, **36**: 3979–3988.

[5] W.Balla, A.H.Essadkia, B.Gouricha, A.Dassaab, H.Chenika, M. Azzib, Electrocoagulation/electroflotation of reactive, disperse and mixture dyes in an external-loop airlift reactor, *Journal of Hazardous Materials*, 2010, **184**: 710–716.

[6] C.Phalakornkule, P. Sukkasem, C.Mutchimsattha, Hydrogen recovery from the electrocoagulation treatment of dye-containing wastewater, *International Journal of Hydrogen Energy*, 2010, **35**: 10934-10943.