IOP Conf. Series: Materials Science and Engineering **254** (2017) 082010 doi:10.1088/1757-899X/254/8/082010

Decolorisation of disperse dark blue 148 with ozone

S Eren[1], I Yetisir[1,2] and H A Eren[1]
[1] University of Uludag, Department of Textile Engineering, 16059 Bursa Turkey
[2] Istanbul Kavram Vocational School, Department of Design, Bosna Bulvarı No 140, Cengelkoy-Istanbul, Turkey

E-mail: semihaeren@uludag.edu.tr

Abstract
The aim of this study is decolorisation of CI Disperse Dark Blue 148 dye by ozone treatment which is one of the most attractive alternatives for solving the problem of color in textile dyeing effluents. A venturi injection system added dyeing chamber for getting ozone from the ozone generator. And additive (acetic acid and dispersing agent) put in the dyeing. After the coloration, the experimental color, chemical oxygen demand (COD), pH, temperature (°C) and conductivity (µS/cm) were measured. The results encourage the use of the system for decolorisation trials as well as dyebath effluent recycling.

1. Introduction

Dyes and pigments have been used for coloring in the textile industry for many years [1,2]. Disperse dyes are the most important dyes also used in dyeing PET fibers.[3] The wastewater from textile dyeing typically contains high concentrations of colorants, effective decolorization methods are urgently required [2]. Wastewater discharge is extremely variable in composition, exhibiting strong colour, fluctuating pH, and significant COD loads [4]. Many techniques able to remove colour are listed in the literature, such as coagulation-flocculation, adsorption and membrane filtration, have been used to decolorize textile effluents, these techniques suffer disadvantages of sludge generation, adsorbent regeneration and membrane fouling. Oxidation is one of the potential alternatives to decolorize and to reduce recalcitrant wastewater loads from textile dyeing and finishing effluents[3-5] Because of O_3 is an unstable molecule and rapidly decomposes to O_2 that is capable of participating in many chemical reaction with inorganic and organic substances [3-7]

2. Materials and Method

In this study, CI Disperse Dark Blue 148 disperse dye was used at 0,1 g/l. The molecular structure of dye as shown Figure 1. The dye solutions were prepared either by using dye alone or by using dye and additives together. The dyeing additives were 1 ml/ l acetic acid and 1 ml/l dispersing agent.

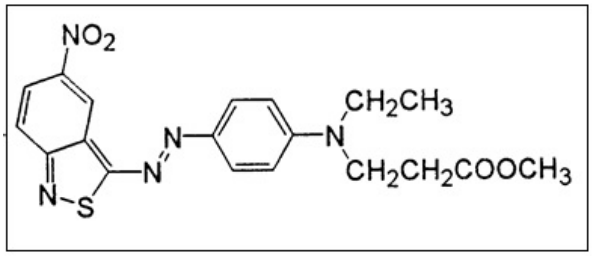


Figure 1. Dye structure of CI Disperse Dark Blue 148
(http://www.worlddyevariety.com/disperse-dyes/disperse-blue-148.html)

A Prodozon PRO DO25 model ozone generator (Ankara, Turkey) with a maximum ozone generation capacity of 25 g/h was used during the experiments. Ozone gas flow rate was adjusted to 5 g/h ozone was fed through a venture injector placed on the liquor circulation pipe of a Atac BB01F sample dyeing machine (Atac Co., Istanbul, Turkey). All connections were made by teflon tubing lines. The total amount of the treated liquor was 10 liters. The treatment time was extended to 20 min by 2,5 min steps. The ozone integrated system is given on Figure 2.

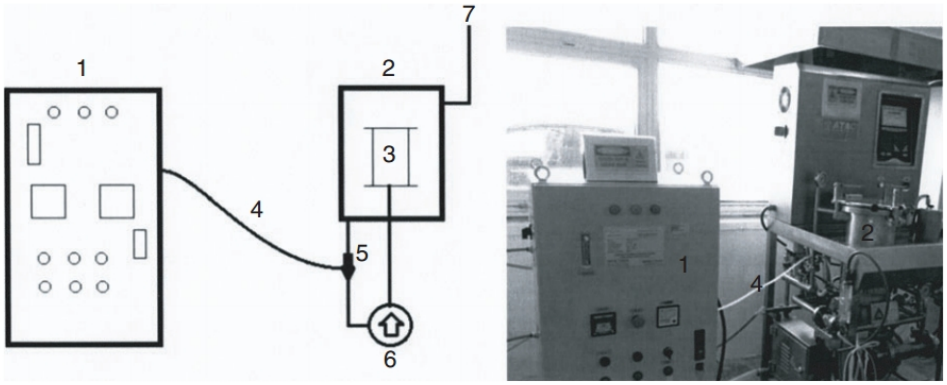


Figure 2. The Ozone integrated system dyeing machine: 1-ozone generator; 2-dyeing chamber; 3-beam; 4- ozone flow line; 5-venturi injection; 6-circulation pump; 7-exhaust ozone line [7].

Color, chemical oxygen demand (COD), pH, temperature (℃) and conductivity (µS/cm) were measured. Color and COD measurements were made on a Merck Pharo 300 UV-visible spectrophotometer. Conductivity, pH and temperature were measured on WTW Cond 3210 Set1, pH 3210 Set 2. Color difference value was measured at level of Absorbance 622 nm.

COD evaluation were made according to the standard titrimetric method (Standard Methods 5220 C: Closed Reflux, Titrimetric Method, APHA, 19th edn, American Public Health Association, 1995).

3. Results and Discussion

The measurement value of the reference (untreated dyestuff solution) and the samples (different ozonation time and dyeing process with additives) were summarized in Table 1 and Table 2.

The effect of ozonation time and dyeing additives on the temperature, pH, conductivity, color absorbance and COD of the dyeing water were investigated. As it was expected, when the ozonation time was increased; the measurement value of the temperature and conductivity were increased, pH value was decreased. This results were seen dyeing process with additives at the same time. Figure 3 shows the photo of the color change during ozone treatment. The colored water rapidly becomes clear after ozone treatment.

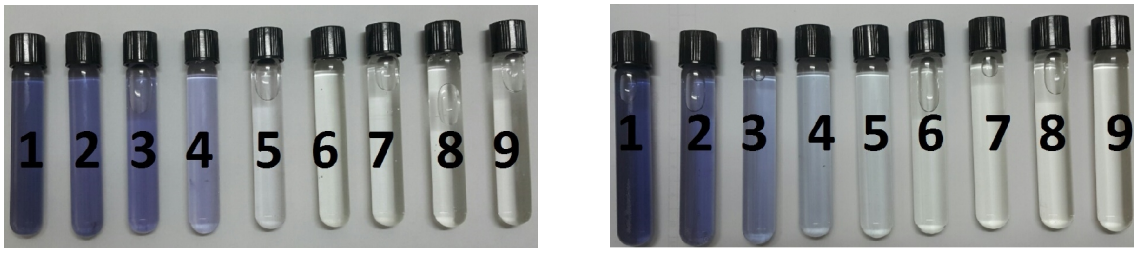
Table 1. pH and Temperature (ºC)and conductivity(µS/cm) Color (Absorbance at 622 nm) and COD (mg/l) values of ozone applied samples for 0,1 g/l dyestuff solution.

	Temperature (ºC)	**pH**	**Conductivity (µS/cm)**	**Absorbance (622 nm)**	**COD (mg/l)**
Untreated dyestuff solution	11.2	7.4	106.1	0.770	126
2.5 min. ozone	13.1	6.6	149.6	0.575	147
5 min. ozone	13.7	6.1	150.7	0.461	101
7.5 min. ozone	14.5	5.6	153.2	0.280	89
10 min. ozone	15.2	5.3	156.9	0.079	94
12.5min.ozone	16.1	4.8	159	0.027	77

15 min. ozone	16.6	4.8	163.6	0.025	80
17.5min.ozone	17.7	4.6	163.7	0.027	77
20 min. ozone	18.4	4.4	166.6	0.021	79

Table 2. pH and Temperature (°C)and conductivity(µS/cm) Color (Absorbance at 622 nm) and COD (mg/l) values of ozone applied samples for dyestuff solution with additives

	Temperature (°C)	**pH**	**Conductivity (µS/cm)**	**Absorbance (622 nm)**	**COD (mg/l)**
Untreated dyestuff solution	12.7	3.8	207	0.633	1510
2.5 min. ozone	13.6	3.7	214	0.465	1360
5 min. ozone	14.1	3.7	218	0.316	1400
7.5 min. ozone	14.8	3.6	220	0.216	1370
10 min. ozone	15.4	3.6	222	0.123	1270
12.5min.ozone	15.8	3.6	230	0.054	1390
15 min. ozone	16.3	3.6	230	0.034	1350
17.5min.ozone	16.8	3.6	230	0.021	1420
20 min. ozone	17.1	3.6	230	0.010	1320



a. **b.**

Figure 3. Color change during ozone treatment for **a.** *0.1 g/l dye solution* **b.** dye and additives together *(1- Control(Untreated dyestuff solution). 2- 2.5 min. ozone . 3- 5 min. ozone . 4- 7.5 min. ozone. 5-10 min. ozone . 6- 12.5 min. ozone. 7- 15 min. ozone. 8- 17.5 min. ozone 20s ozone 9- 20 min. ozone)*

Figure 4 shows the absorbance values. Both solutions of 0.1 g/l disperse dye with and without additives (acetic acid and dispersing agent) yielded similar decolorisation rates after 15 min treatment. However. decolorisation rate was a little higher for the dye solution without additives.

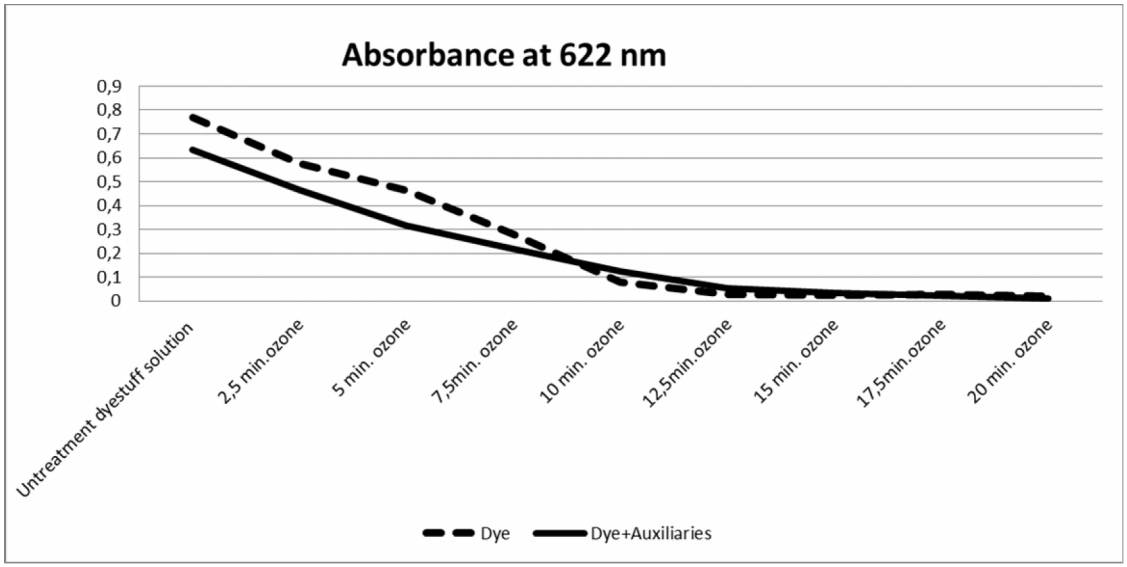


Figure 4. Color change during ozone treatment for *0.1 g/l dye solution with and without* additives *(1- Control(Untreated dyestuff solution). 2- 2.5 min. ozone . 3- 5 min. ozone . 4- 7.5 min. ozone. 5-10 min. ozone . 6- 12.5 min. ozone. 7- 15 min. ozone. 8- 17.5 min. ozone 20s ozone 9- 20 min. ozone)*

Figure 5 shows the COD values. The solutions of 0.1 g/l disperse dye with and without additives (acetic acid and dispersing agent) made a quite difference COD value all the ozone treatment time. It is originated from the using additives (acetic acid and dispersing agent) with dyeing. As it is known. using chemical makes the solution worse about the COD values.

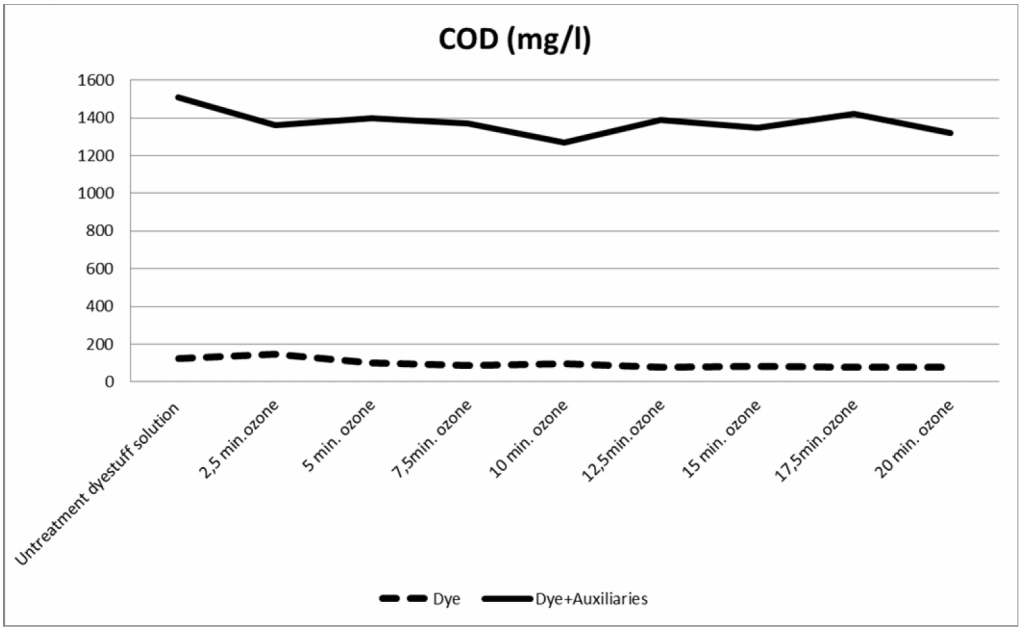


Figure 5. COD(mg/l) during ozone treatment for *0.1 g/l dye solution with and without* additives *(1- Control(Untreated dyestuff solution). 2- 2.5 min. ozone . 3- 5 min. ozone . 4- 7.5 min. ozone. 5-10 min. ozone . 6- 12.5 min. ozone. 7- 15 min. ozone. 8- 17.5 min. ozone 20s ozone 9- 20 min. ozone)*

4. Conclusion

This pilot-scale study investigated a venturi injection system added the dyeing chamber for getting ozone from the ozone generator. This system to the decolorisation of disperse dark blue 148 was achieved successfully either in presence of dyeing additives or not. The rapid decolorisation effect of

ozone is reported before in the literature mostly by using a diffuser to feed ozone into the reaction chamber [8-10]. However. in this study. trials were performed on ozone feeding integrated sample dyeing machine. Hence a venturi injection system was equipped rather than diffusers. The results encourage the use of the system for decolorisation trials as well as dyebath effluent recycling.

References

[1] Turhan K. Durukan I. Ozturkcan S.A. & Turgut Z 2012 Decolorization of textile basic dye in aqueous solution by ozone. *Dyes and Pigments*. **92**(3). 897-901.
[2] Güneş Y. Atav R. Namırtı O 2012. Effectiveness of ozone in decolorization of reactive dye effluents depending on the dye chromophore. *Textile Research Journal*. **82**(10). 994-1000.
[3] Eren HA 2006. Afterclearing by ozonation: a novel approach for disperse dyeing of polyester. *Coloration Technology*. **122**(6). 329-333.
[4] Shaikh IA. Ahmed.F. Sahito AR. Pathan AA 2014 In-situ Decolorization of Residual Dye Effluent in Textile Jet Dyeing Machine by Ozone. *Pakistan Journal of Analytical & Environmental Chemistry*. **15**(2). 6.
[5] Buyukada M 2016 Modeling of decolorization of synthetic reactive dyestuff solutions with response surface methodology by a rapid and efficient process of ultrasound-assisted ozone oxidation. *Desalination and Water Treatment*. **57**(32). 14973-14985.
[6] Benli.H. Bahtiyari MI 2015 Combination of ozone and ultrasound in pretreatment of cotton fabrics prior to natural dyeing. *Journal of Cleaner Production*. **89**. 116-124.
[7] Eren S. Gümüs B & Eren H A 2016 Colour stripping of reactive-dyed cotton by ozone treatment. *Coloration Technology*. **132**(6). 466-471.
[8**]** Eren HA. Avinc O. Erismis B 2007 Comparison of different ultrasound support methods during colour and chemical oxygen demand removal of disperse and reactive dyebath solutions by ozonation. *Coloration Technol*ogy **128** pp 446-453
[9] Eren HA 2007 Simultaneous afterclearing and decolorisation by ozonation after disperse dyeing of polyester. *Coloration Technol*ogy **123** pp 224-230
[10] Eren HA . Kurcan P. Aniş P 2007 Investigation of the Effects of Dye Hydrolysis on Decolor. of Reactive Dyeing Eff. By Ozonation. *Tekstil ve Konfeksiyon.* **2** pp 119-125