Effect of Ozonation on Anaerobic Organic Removal from Membrane Concentrate

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***Abstract*—This study was focused on anaerobic treatment of textile wastewater. In this research, treatability of concentrate from nanofiltration of textile wastewater. Results indicated that membrane concentrate could be effectively treated with bacterial treatment. Moreover it can be said that both fermantors were approximately the same in terms of removal efficiencies. According to the experiment of results chemical oxygen demand (COD) and and biochemical oxygen demand (BOD_5) removal efficiency were around 65% and 80%, respectively. Methane and cumulative biogas production almost the same both for ozonated and non ozonated concentrate.**

***Index Terms*—Anaerobic fermantor, membrane concentrate, ozone, textile wastewater**

I. Introduction

Textile sector is one of the important manufacturing industries in Turkey. Dying, bleaching, printing and finishing processes in textile industry consumes great amount of fresh water and produces highly polluted wastewater. Textile wastewater is characterized with strong color and high concentrations of suspended particles and chemical oxygen demand (COD) concentration [1]. Various treatment technologies have been proposed for the treatment of textile wastewaters. Among them, coagulation-flocculation and biological treatment using aerobic and anerobic microorganisms have been mostly used [2].

Membrane technology has been successfully applied for the treatment of various wastewater [3], [4]. Membrane treatment is also promising alternative for textile wastewater however, its main drawback is the generation of highly polluted concentrate during operation [5], [6] Increasing environmental awareness and strict regulations put pressure on the effective treatment of membrane concentrate. So far, a few reports have been released on the treatment of membrane concentrate from textile waste water[7].

In this study, anaerobic treatment was applied on the concentrate from nanofiltration (NF) of textile wastewater. Effect of pre-ozonation on the anaerobic organic removal from NF concentrate was investigated.

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II. Materials and Methods

A. Wastewater Sampling

Wastewater samples were taken from a textile factory in Istanbul. In this factory, manufacturing steps are divided into many processes and the most important one is cotton weaving with high impurity. In this study; sample was taken from bleaching and dying processes and wastewater which is used in experimental studies, was prepared with80%of bleaching and 20% dying water.

All samples were kept at 4^0C in a refrigerated room prior to analysis.

B. Membrane Filtration

Membrane treatment system includes cartridge filter, ultrafiltration (UF) membrane and nanofiltration (NF) membrane. In the first step, textile wastewater was pretreated by 5 μm cartridge filter after that ultrafiltration membrane (UP150) at 2.5 bar was applied. Finally textile wastewaters treated with nanofiltration membrane (NF270) at 5 bar operating pressure.

C. Experimental Set-up

Fermentor system was composed of bioreactor, control panel, and cooling system. Volume capacity was 6 liters and 5 liters of this volume was operated as bioreactors. Anaerobic granular sludge was obtained from a paper-cardboard factory sewage treatment plant in Corlu and was used as a seed for fermantor.

First anaerobic fermentor was fed with ozonated concentrate stream (F1) and second one (F2) was fed with membrane concentrate stream.

During operation, pH, temperature and ORP of the fermantorwas kept constant and were monitored continuously and automatically. pH value of fermantors was kept in 7, and in order to provide this condition, 3N NaOH and 5N $H_3PO_4$was added automatically when pH value had changed.

Fermantor temperature was kept constant at 37 °C with the electrical blanket surrounding the reactor. Impellers were used to provide homogenous mixingin bioreactors and its rotation speed could be adjusted automatically. This mentioned conditions are the most appropriate operating conditions for anaerobic reactors [6]-[8]. Moreover, during operation ORP value was range from -400 to -500 mV and it showed that anaerobic conditions were provided.

D. Analytical

COD analyses were carried out by closed reflux colorimetric method according to SM-5220-D. BOD_5 was analyzed in accordance with the procedure of 5210 B in

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standard methods of APHA-AWWA-WEF and as a seed forBOD_5 analysis, domestic wastewater was used. pH and conductivity was measured by WTW 3210. Total gas was measured by water displacement method and its content was measured by Gas Chromatography (GC)-Perkin Elmerduringthecharacterizationstudies.

As expected, BOD values of fermantor I were higher than fermantor II (Fig 2) and that can be explained as the ozonation increases biodegradability of the wastewater [9], [10]

III. Results and Discussion

A. Wastewater Characteristics

The characteristics of wastewater are given in Table I. Throughout the study, rawwater, membrane permeate and concentrate waste waters were characterized. pH were ranged between 7.9-10.3 and membrane concentrate has high level of COD. Furthermore, COD value decreased with ozonation while BOD_5 value increased.

TABLE I: Characterization of Textile Wastewater

Parameter	Unit	Raw Water	Permeate	Concentrate (nonozonated)	Concentrate (ozonated)
Conductivity	mS/cm	6.11	6.44	8.98	9.12
pH	-	10.3	7.9	8.5	9.3
COD	mg/L	2968	384	3425	2573
BOD_5	mg/L	112	56	300	850

B. Organic Matter Removal

According to Fig. 1 it can be seen that; COD removals for both reactors were nearly parallel to each other.

While COD removal efficiency was 30% in the first 20 days, it reached to 80% between day 75 and remained constant subsequent days.

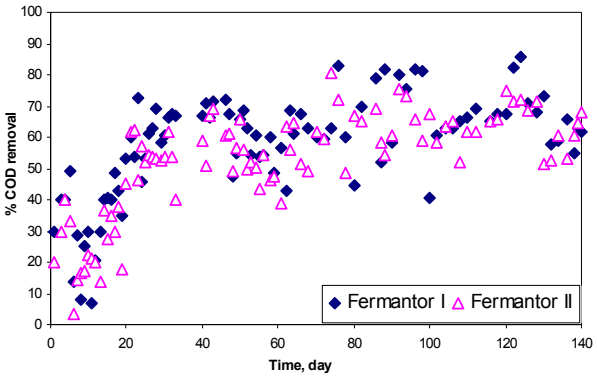

Fig. 1. COD removal efficiency

When BOD removal efficiencies were compared, it was found that; the removal in fermantor I was slightly higher than fermantor II.

As it can be seen in Fig. 2 thatBOD removal efficiency in fermantor I was approximately 80%.

C. Biogas Production

Biogas production amounts of each fermantor were approximately equal (Fig. 3). Moreover, from Table II it can be seen that the methane content of fermantor I was a bit higher than production in fermantor II.

Methane gas produced in Fermantor I was higher than fermantor II. It could be explained by ozonation. Fermantor I had been fed with ozonated concentrate, so that ozone assisted to increase biodegradability.

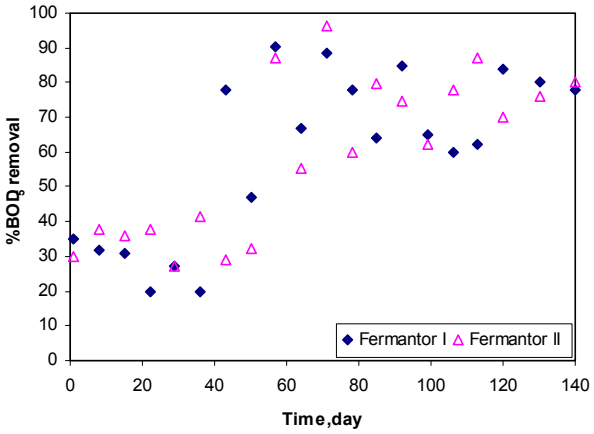

Fig. 2. BOD_5 removal efficiency

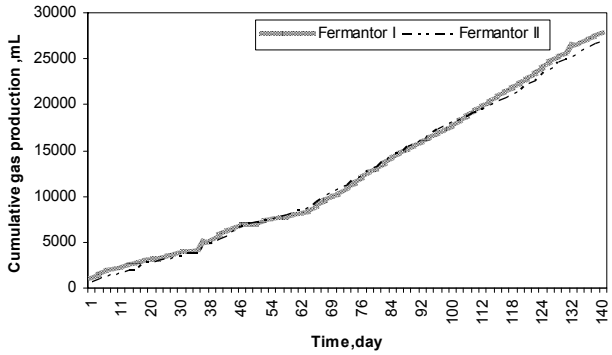

Fig. 3. Gas production

TABLE II: Biogas Content %

	F I	F II
CO_2	31.4	37.3
CH_4	68.57	62.5
H_2	0	0.16

IV. Conclusion

Experimental results indicated that membrane concentrate can be effectively treated by anaerobic technology. However, ozone pretreatment has no effect on anaerobic degradation of concentrate.

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