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ADVANCED TREATMENT OF SAHEBGHARANIEH SECONDARY EFFLUENT BY OZONATION

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Key words: *Advanced wastewater treatment, secondary effluent, chemical oxidation, ozonation, Sahebgharanieh*

Abstract

Chemical oxidation is one of the most suitable treatment methods for reducing organic pollutants and the number of pathogens remaining in secondary effluents. Ozone is the most powerful oxidizing agent commonly used because of it's many advantages over chlorination. In this study the efficiency of ozonation in advanced wastewater treatment of Sahebgharanieh Plant has been determined. Ozone generation has been performed by irradiation of compressed air with 4 special UV lamps. The total output of these lamps was determined to be 0.74 mg ozone per minute at established conditions. Considering 3 periods of ozonation of effluent samples (30,60 and 120 min) and ozone transfer coefficient of 95%, the concentrations of applied ozone for wastewater treatment were specified to be 10.5, 21 and 42 mg/l, respectively. Ozonation of secondary effluents at these periods has resulted in 17,24 and 30 percent reduction in average COD and about 20,18 and 32 percent decrease in BOD5. It is believed that the 2 percent incerease observed in BOD after 30 minutes is caused by changing some amount of COD to BOD5 by applied ozone. According to the prescribed reduction values it could be concluded that the final effluent of a typical treatment plant would become better qualified for water reuse in irrigation. But it should be declared that the effluent may not be completely disinfected irrespective of about 99.0% decrease determined in MPN of total coliforms. Also it must be noted that this degree of disinfection was accomplished only for 62.5% of samples. Ozonation of effluent samples has caused an increase in pH value which was at least 0.4 of a pH unit.

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Introduction

Ozone is the strongest oxidant used for treating wastewater. It has been shown as a multi-purpose chemical in wastewater treatment and suitable candidate to replace chlorine due to more stringent requirements for discharge of effluent into the environment (9). Since the quality of secondary effluents may not always meet discharge requirements and reuse criteria, additional treatment is necessary in most cases. The additional treatment processes are also considered critical elements in water resurces planning (5). Many advanced wastewater treatment methods have been developed to help meet growing water needs.

Wastewater reclamation by ozone oxidation has several notable environmental advantages compared to other alternatives. Ozone rapidly degrades to oxygen so toxic residuals are not present and oxygen levels in the effluent are often at saturation (8). It can also be used in advanced treatment applications in order to remove the concentrations of residual organics, ammonia and the bacterial and viral content of wastewaters (5).

In this study, the efficiency of ozone has been determined in the process of advanced wastewater treatment of Sahebgharanieh Plant in Tehran. Ozone generation has been performed by special UV lamps. These lamps have high emission intensity at wavelengths lower than 200 nm which are needed to convert oxygen to ozone (4).

Materials and methods

Ozone generation : In this study the UV-photochemical generation of ozone with special mercury lamps have been used. The characteristics of this lamp is presented in Table 1. Four lamps have been used in series. Fig. 1 and Fig. 2 illustrate the shape of this lamp and the mode of connecting lamps together. Each lamp was located in a polyethylene case and joined to the next in series with glass tubes. It was proved by experiment that using lamps in series would be more efficient in generating ozone (1).

In order to produce required dry clean air, the discharge air for a compressor was passed through a column containing silicagel and activated carbon granules. This air was then directed to pass through the UV lamps.

Ozone Determination : The micro-amounts of ozone was determined in gaseous phase spectrophotometricall by a iodometric technique. This analysis was accomplished by measurig the absorption of an equivalent amounts of iodide ions liberated from an absorbing solution. This absorbing solution (1%KI in 0.1M phosphate buffer) was in a glass impinger which was placed in the line consisting of a rotameter and the compressor. The irradiated air was directed to this impinger (2).

Source of wastewater: The secondary effluents of Sahebgharanieh Plant in Tehran have been used as the source of wastewater in this study. Grab samples were collected from December to January 1997. This Plant uses activated sludge process in treating wastewaters with the average flow of 50 m3/day and peak flow of 100 m3/day. For contacting the effluent samples with ozone a 2-litter flask was used. This flask was equipped with a gas diffuser of stone-like type for introducting ozone saturated air into the liquid. Also a magnetic stirrer has been used for mixing ozone bubbles completely with the sample of wastewater in the flask. The shape of ozone contacting reactor is shown in Fig. 2.

Wastewater analysis: Characteristics of wastewater samples have been determined using the procedures outlined in reference No.3 Calculation of MPN/100 ml of all sampes has been done as outlined in reference No.6.

Results and discussion

The changes in concentration of produced oznone at different rates of air flows are shown in Fig.3 and Fig. 4. According to the data presented in these figures the amount of ozone generation of each UV lamp is inducated to be 0.185 mg per minute. According to the reauired power input, the generation of ozone was about 0.55 g/kWh.

Fig. 5 to 8 represent the amount of pollutant parameters in the effluent samples of Sahebgharnieh Treatment Plant before and after ozonation at 30,60 and 120 minutes. As shown , the concentrations of pollutants are often more than that are required for discharge and it should be added that even in the case of good operation of this conventional plant there would be still need to perform further treatment. Condisering the three periods for ozonation and ozone transfer coefficient of 95%, the concentration of applied ozone for treatment of 2 liter samples were specified to be about 0.5, 21 and 42 mg/l, respectively. In Fig. 6 to 9 the concentrations of SS,COD,BOD and MPN/100 ml for total coliforms in the effluent samples are compared with the similar figures after ozonation. As noted therein, the final pollutants concentration decreased as the period of ozonation was raised. The most substantial reduction occurred at 2 hours ozonation and were indicated to be about 31%, 32% and 99.8% for COD, BOD5 and MPN/100 ml respectively. It is believed that the initial concentration of organic materials in a typical secondary effluent rarely exceeds 100 mg/l and is mostly nonbiodegradable, so by only 30% reduction caused by oxidation or percipitation of organic matter by ozone, the effluent may become more qualified for discharge or reuse. Ozonation has also a considerable effect on reducing remained suspended solides of secondary effluents which was about 60% reduction only in one hour ozonation (by applying 21 mg/l ozone). Refereein to Fig. 9, it is noted that ozone has also influenced coagulation. Ozonation of effluent samples has caused an increase in pH value, and the maximum amount observed was about one pH unit.

Finally, it has been proposed that ozonation be utilized as an alternative to chlorination but it should be emphasized that the process developed by the authors for ozone production was not able to produce enough ozone in a desirable time interval, so the Ct values obtained in this study were certianly much more than the advisable amounts. If we would be able to produce enough ozone at the time and point of use it could serve as an invaluable material in oxidation, coagulation and disinfection of effluent. As a result of the decision to use ozone, the wastewater can be recycled and find some uses, including irrigation purposes. Disinfection by ozonation is expensive but may not have problems associated with chlorine.

Table 1- Characteristics of the UV Lamp used for Ozone Generation (7)

Starter	Socket (mm)	Length (12)mm	Length (11)mm	Tube Diameter (d) (mm)	Uv Radiation Power (W)	Radiation Intensity (μ W/cm2)	Lamp Power (W)	Current Intensity (mA)
Build-in	E27	142	221	10	7	80	20	500

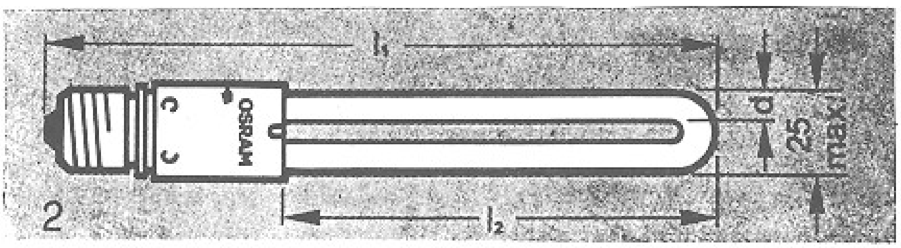


Fig. 1- The Shape of UV Lamp (7)

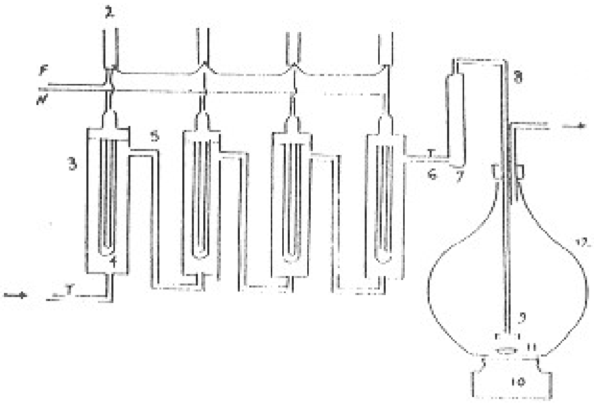
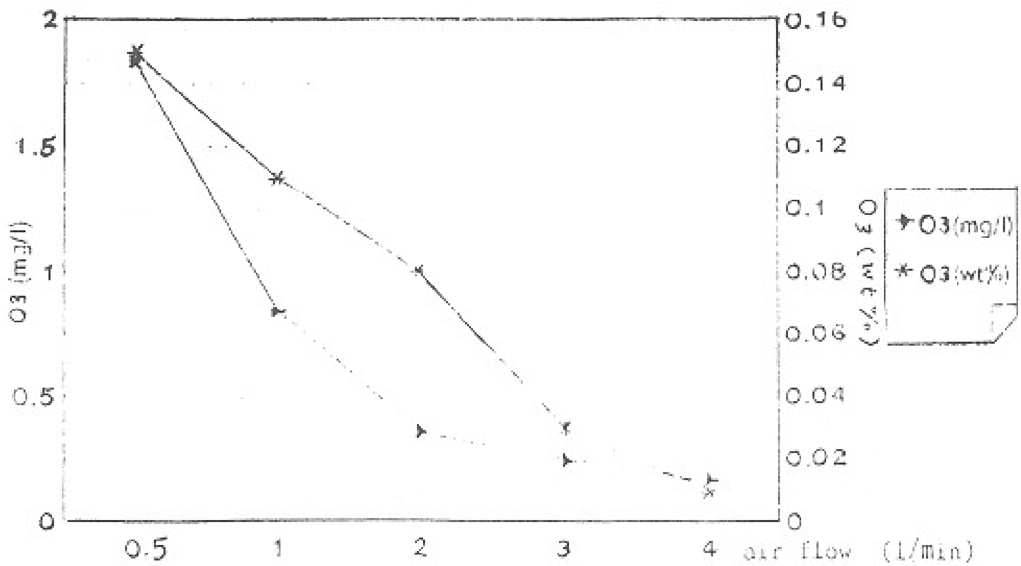


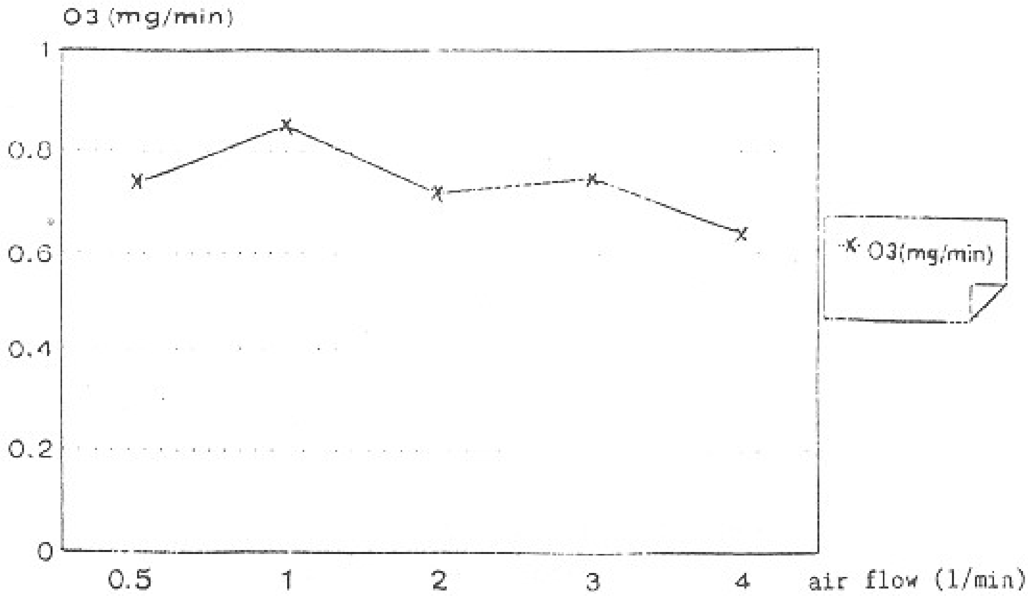
Fig. 2- Mode of connecting lamps and the shape of ozone contactor (1)

1- power supply, 2- choke coil , 3- lamp case, 4- UV lamp, 5- glass tube,
6- gas valve, 7- gas flowmeter, 8- glass tube, 9- gas diffuzer,
10- stirrer divice, 11- magnet, 12- 2-litre flask



O3(mg/l)	1.84	0.85	0.36	0.25	0.16
O3(wt%)	0.15	0.11	0.08	0.03	0.01

Fig.3- Changes in the amount of ozone produced (in mg/l) at different air flows exposed to 4 UV/OZ lamps (1)



O3(mg/min)	0.74	0.85	0.72	0.75	0.64

Fig. 4- Changes in the amount of ozone produced (in mg/min) at different air flows exposed to 4 UV/OZ lamps (1)

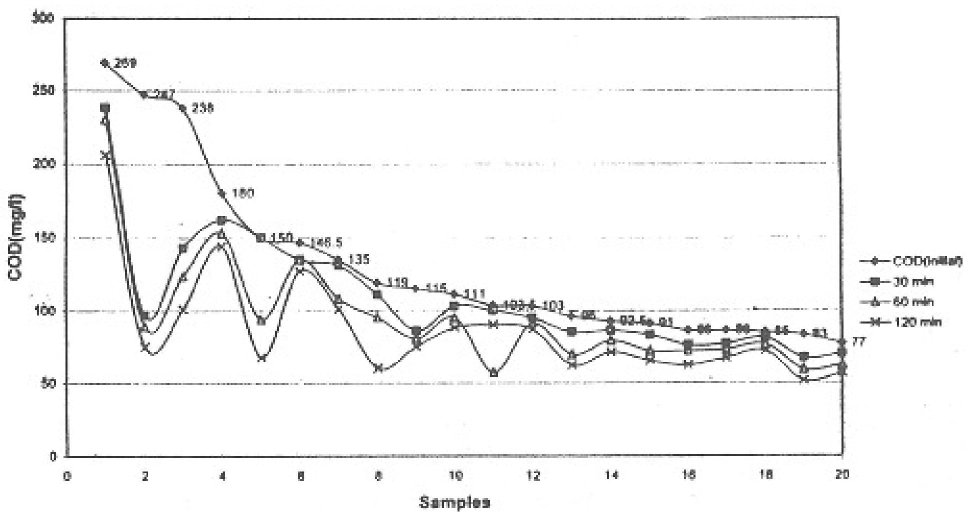


Fig. 5- COD reduction as a function of ozonation period

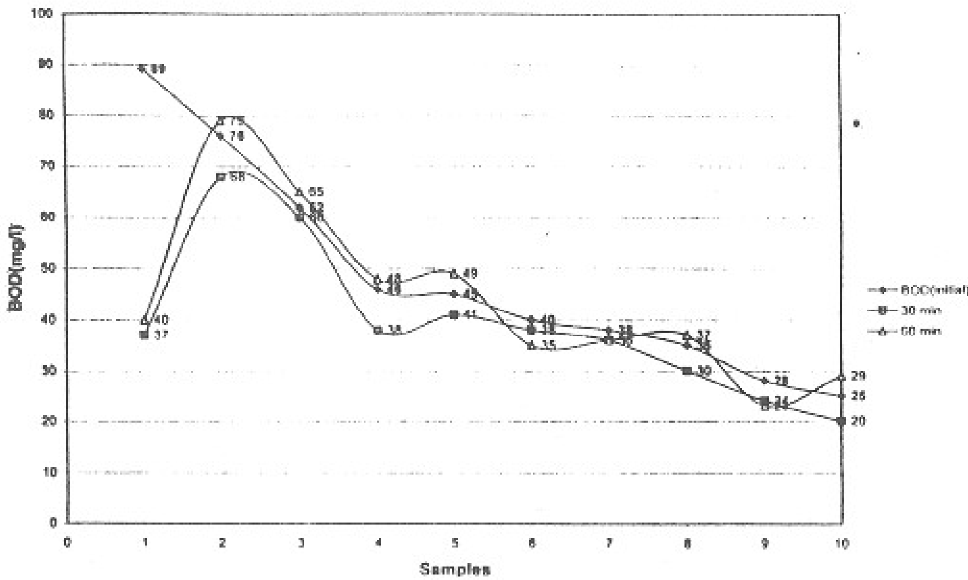


Fig. 6- BOD reduction as a function of ozonation period

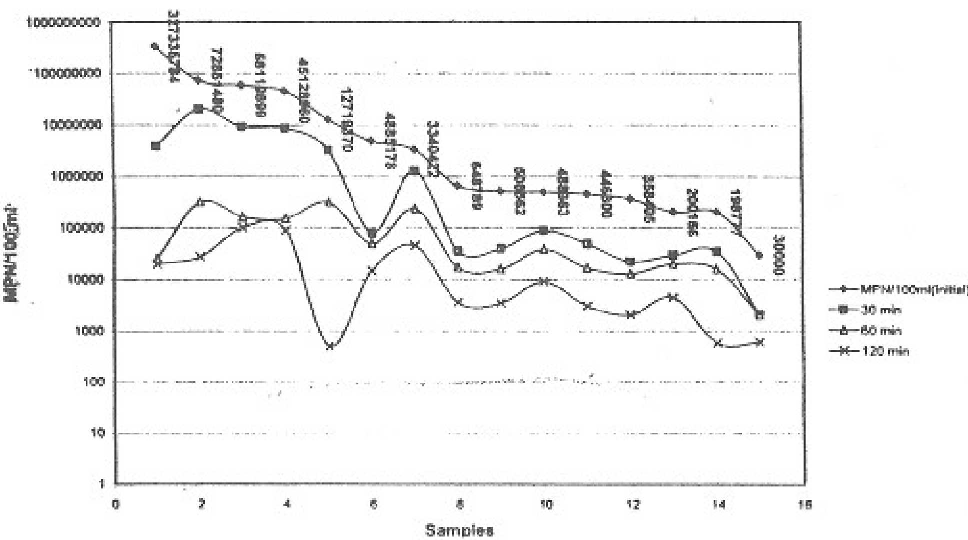


Fig. 7- MPN/100 ml remained in effluent samples as a function of ozonation period

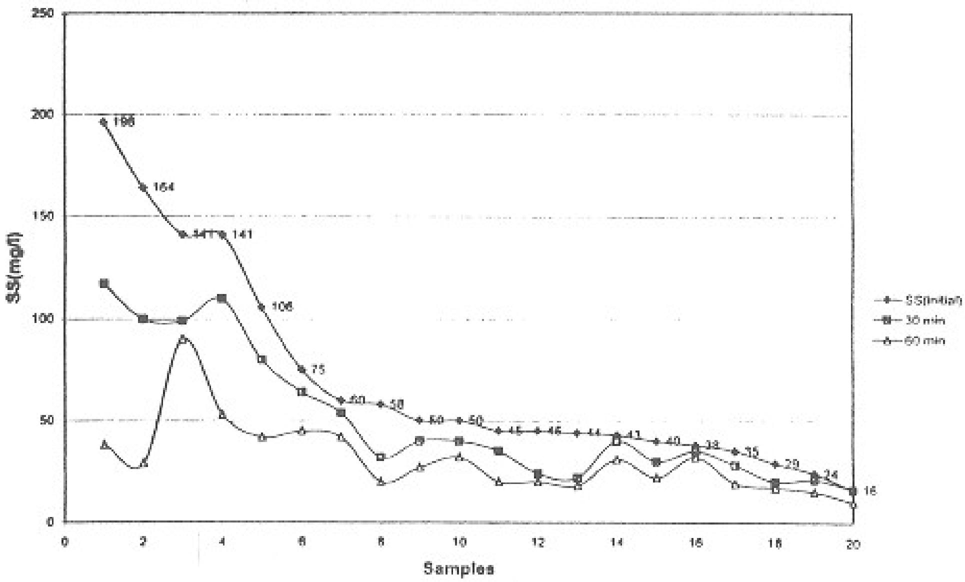


Fig. 8- SS reduction as a function of ozonation period

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