Treatment of wastewater in Algeria by a cold discharge

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***Abstract*— Different processes, both in addition or in substitution biological treatment, have been proposed and developed order to remove different pollutants. One of these processes, the oxidation, seems to be of most interest. An oxidation process can also be envisaged using electrical methods. Indeed, electrical discharges produced either directly in water or in humid air in contact with the liquid to be treated, generate highly reactive species such as ozone. This shows that the electric discharge must be able to effectively degrade different types of pollutants. The objective of this work is to realize a study of the mechanisms of cold plasma in water and evaluate their effectiveness to oxidize some pollutants in wastewater. In order to properly assess energy efficiency of this process, we realized an ozone generator cylindrical shape in an attempt to produce free electrons from the electrical energy supplied to generate cold plasma in water. This useful study is to demonstrate the efficiency of this energy conversion through analysis methods allowing the measurement of the pollutant concentration of wastewater.**

Key-Words— wastewater, treatment, cold plasma, ozone, high voltage

I. INTRODUCTION

In our days, the use of wastewater in urban agriculture is inevitable in African countries, considering the scarcity of the water resource. Climate context increases the tension on the water resources, increasing urbanization and irrigated agriculture booming have led to the implementation of effective treatment techniques to guarantee the reuse of treated wastewater. The Oxidation by electric methods upon which rest this work is one of the most possible alternatives. This method is very simple to apply and performance to the wastewater depollution, more over this is an electrical depollution method which occurs without the addition of chemical reagents.

The purpose of this study is to apply a process of domestic wastewater treatment of the Mascara region by ozone order to ensure physico-chemical and bacteriological quality the spills of these treated water in the Ghriss plain and El Kaouyer perimeters which serve for agricultural irrigation hence the necessity to evaluate the effectiveness of activated sludge treatment of this WWTP.

II. OZONE GENERATION BY DBD

The dielectric barrier discharges (DBD) have been known since over a century and the first experiments on these discharges were reported by Siemens in 1857 [5], [2]**.** One of the most important applications of this type of discharge is the generation of ozone for water treatment [6], [4]. It is well known that in an electric discharge ozone is produced in two steps [3]:

The oxygen atoms are produced by direct dissociation of molecular oxygen:

$e + O_2 \longrightarrow O + O + e$

Ozone is produced through a process with three bodies:

$e + O_2 + M \longrightarrow O_3 + M$

($M = O_3$ *or* $M = N_2$ *or* $M = O_2$ ...)

III. MATERIALS AND METHODS

A. Generator DBD

We achieved a DBD generator (ozone generator) of cylindrical configuration, consisting of a steel outer electrode and a glass tube. The second internal metal electrode, an aluminum adhesive tape, is covered inside the glass tube in contact with it. Two orifices are operated on the generator to enable air inlet and ozone outlet (Figure 1). Indeed, a non-uniform interval would pose a problem of uniformity of the electric discharge [1].

Fig.1. Cylindrical DBD generator

B. Experimental setup

The generator that we realized is used in a treatment system of the physico-chemical and bacteriological quality of wastewater by oxidation. The experiences of wastewater treatment with ozone are conducted in a reactor together with its annexes devices (Figure 2).

The capacity of the reactor is 1L. It is surrounded by an electrical circuit originating from an autotransformer and possible to impose a high working voltage. The injected ozone is produced by an ozonizer from air. An ozone analyzer is connected to the ozone generator that displays the produced ozone concentration. A syringe is used to collect samples for analysis.

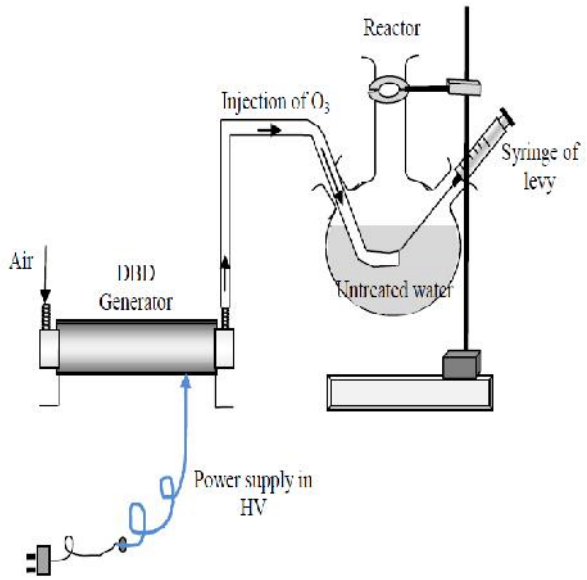

Fig.2. Experimental setup of the DBD treatment

IV. RESULTS AND DISCUSSION

The analytical methods used are described by Rodier [7] and catalogs of the equipment used. The physico-chemical (Chemical oxygen demand COD, biological oxygen demand BOD5, turbidity) and bacteriological (total coliforms TC, Fecal coliforms FC, Escherichia coli E. coli) analyzes allowed us to obtain the rate of degradation for waters treated by activated sludge and the water treated by ozonation. Our results show that the elimination yields of different parameters by ozonation exceed those obtained after biological treatment, which proves the efficiency of this process. In addition, the values of ozonated water are very conforming to the standards rejections.

The figures (3 and 4) allowed us to show that the potential degradation and inactivation by ozonation have been very significant as those obtained after biological treatment, particularly for the turbidity and E.coli.

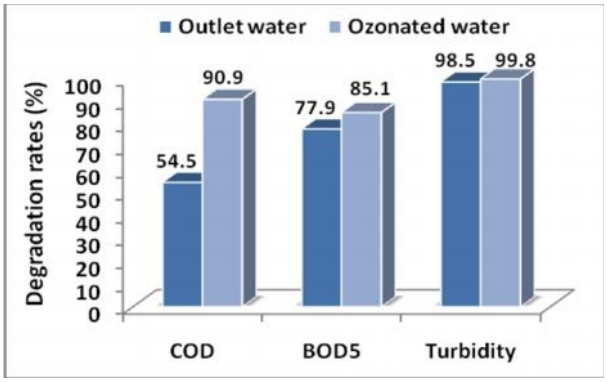

Fig.3. Elimination rate of physicochemical parameters

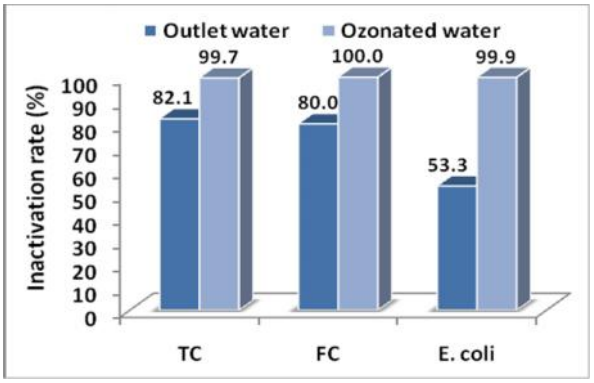

Fig.4. Inactivation rate of bacteria

V. CONCLUSION

In conclusion, the application of the process of ozonation in the treatment of wastewater allows showing effectiveness of depollution removal of organic and inorganic matter and disinfection to inactivate microorganisms. The current configuration of our process of ozonation allows according to the results of this work to guarantee treatment and to meet the standards.

ABBREVIATIONS

DBD Dielectric barrier discharge
COD Chemical oxygen demand
BOD_5 Biological oxygen demand
TC Total coliforms
FC Fecal coliforms
E. coli Escherichia coli

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