ANALYSIS OF THREE-STATE REACTOR IN THE INDUSTRIAL WASTEWATER TREATMENT SYSTEM BASED ON PULSED DISCHARGE PLASMA

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INTRODUCTION

The development of the industry may bring much wastewater. For instance, in some textile mills or chemical plants, some organic wastewater is generated in the manufacture activities. This wastewater is a great threat to the environment. If it is discharged without treatment, it may cause serious pollution. Thus, according to the requirement of the government and the environment ministry, all industries with wastewater should take measures to dispose it before it is discharged. At present, there are many methods as to the treatment of the wastewater, such as adsorption method with activated carbon, biological treatment with micro organism, and etc. However, the treatment efficiency still needs improvement. In order to improve the disposal efficiency, a new kind of reactor, that is a solid-liquid-gas (SLG) three-state reactor for the high voltage pulse discharge plasma system, is put forward and analyzed in this paper.

WORKING PRINCIPLE OF THE WASTEWATER TREATMENT SYSTEM

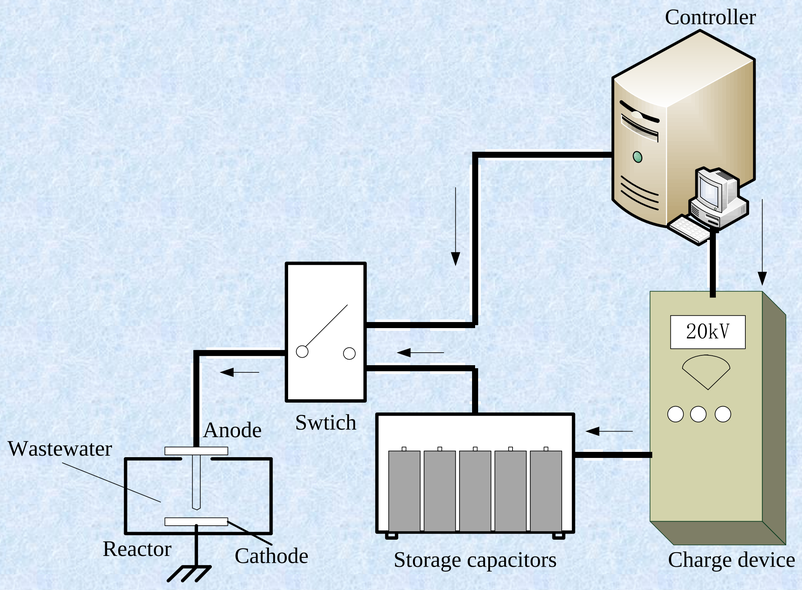

Figure 1. Typical structure of the wastewater treatment system based on high voltage pulsed discharge plasma

The basic working principle of the wastewater treatment system is as follows: Firstly, the wastewater is pumped in to the wastewater reactor, and then the storage capacitors are charged to high voltage by the charging device. The controller sends a trigger signal to the trigger switch, and then the switch is turned on. The storage capacitors with high voltage begin to discharge through the water and the electrodes in the reactor. Then the high electric field is generated between the electrodes. If the electric field is large enough, the medium such as the water between the anode and the cathode may be broken down and generate plasma. Accompany with the reaction, the water molecule is decomposed into different ions, such as -OH, O_3, and etc, which have strong oxidizing property.

DESIGN OF THE SLG REACTOR

A. Structure of Barrel Type Electrode

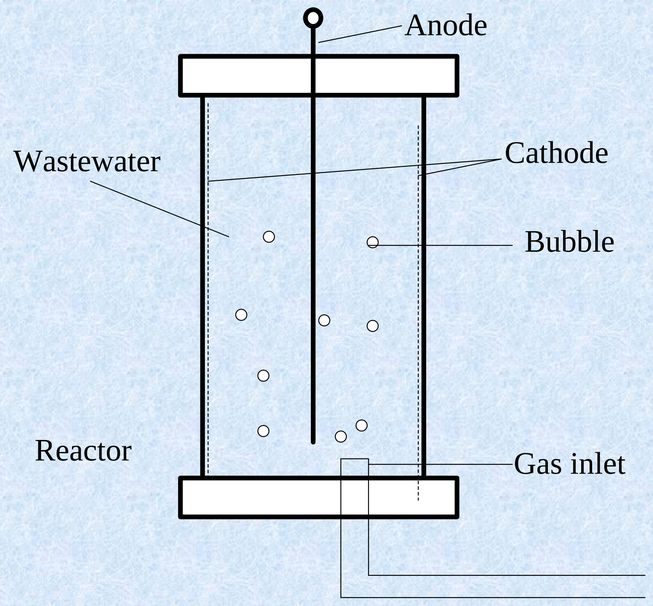

Figure 2. Principle diagram of reactor with barrel type electrode

It can be seen from the Fig.2 that the reactor is a barrel type with cathode and anode. Generally, the anode of the reactor is a metal stick made of copper, and the cathode of the reactor is a copper net which is distributed all the inner surface of the reactor. Furthermore, the container of the reactor is usually made of synthesis glass.

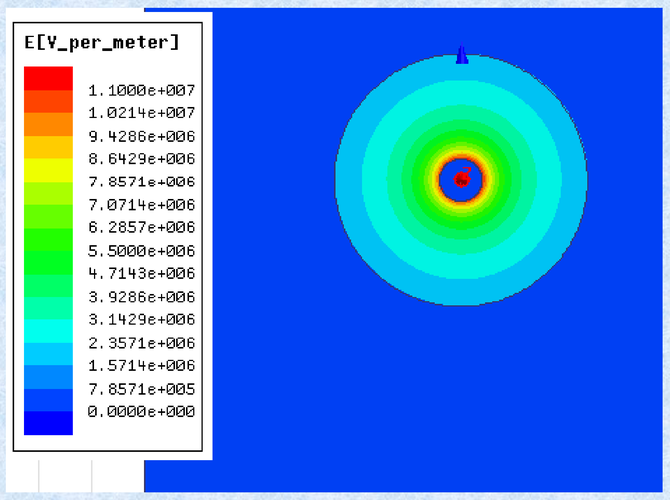

Figure 3. Distribution of electric field for the barrel type reactor

B. Electric Field Distribution of SLG Three State Reactor

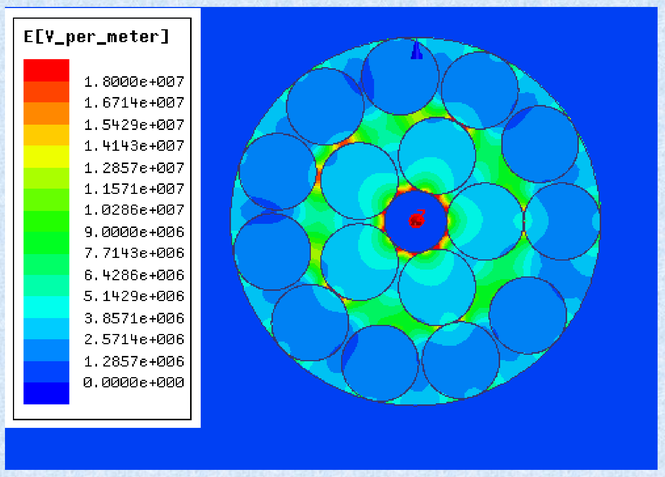

Figure 4. Distribution of electric field for the SLG reactor

ANALYSIS OF THE SLG REACTOR AT DIFFERENT PARAMETERS

A. Characteristics of the Electric Field at Different Voltage

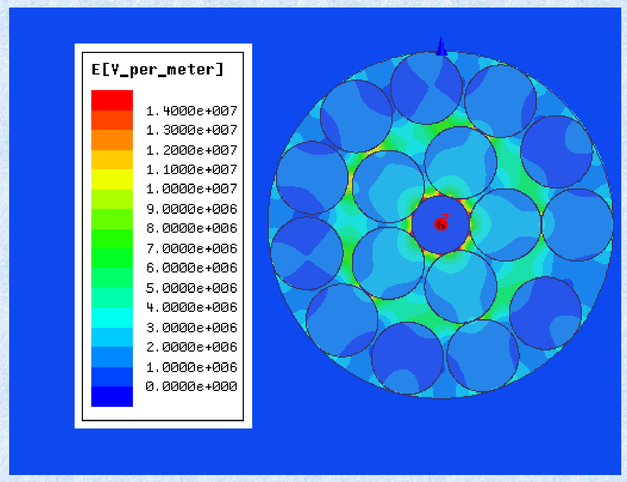

Figure 5. Distribution of electric field for the SLG reactor when the voltage is 25 kV

B. Characteristics of the Electric Field with Different Radius of the Glass Balls

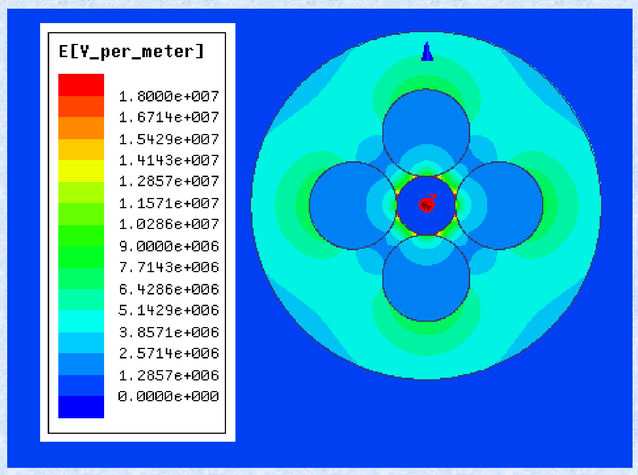

Figure 6. Distribution of electric field for the SLG reactor when the voltage is 40 kV and the radius of glass ball is 3mm

SUMMARY

Reactor is very important to the degradation rate and the disposal efficiency of the wastewater treatment system based on high voltage pulsed discharge plasma. Aiming to the deficiency of the needle-plate type reactor and the traditional barrel type reactor, it put forward a new kind of SLG three-state reactor. From the analysis above, it can draw the conclusion that the solid packing in the reactor can change the distribution of the electric field and improve the strength of the electric field at different areas of the reactor. Thus, it can improve the treatment efficiency and the degradation rate of the wastewater. Furthermore, the requirement of the voltage is brought down by the SLG three-state reactor. Meanwhile, the design and the application of the treatment system based on high voltage pulsed discharge plasma is easier. Besides, the radius of the glass balls can affect the distribution of the electric field. Generally, the small radius of glass ball is more beneficial to the distribution of the electric field.