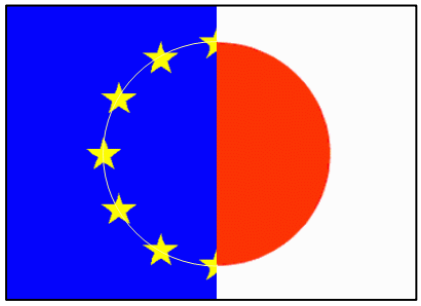
SAPP XV

15th Symposium on Applications of Plasma Processes



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Decomposition of Humic Acids Methylene Blue during the Electrical Discharge in Foam

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Abstract

Electrical discharge was obtained in the foaming apparatus. The high concentration of hydrogen peroxide, gaseous ozone, dissolved ozone and hydroxyl radicals were generated using pulse power supply at the average discharge voltage of 25 kV and at different repetition rates. The system was applied for the decomposition of methylene blue and humic acids.

Introduction

Numerous systems and processes were developed to control and reduce the quantity of pollutants by environmental engineers [1-2]. In this paper the foaming apparatus as a new alternative for simultaneous oxidants' generation and for the pollutants' treatment process in one reaction vessel was proposed.

Foam was formed without the addition of surface-active components in a strict gas flow regime and gas/liquid ratios in the reactor of a special construction [3].

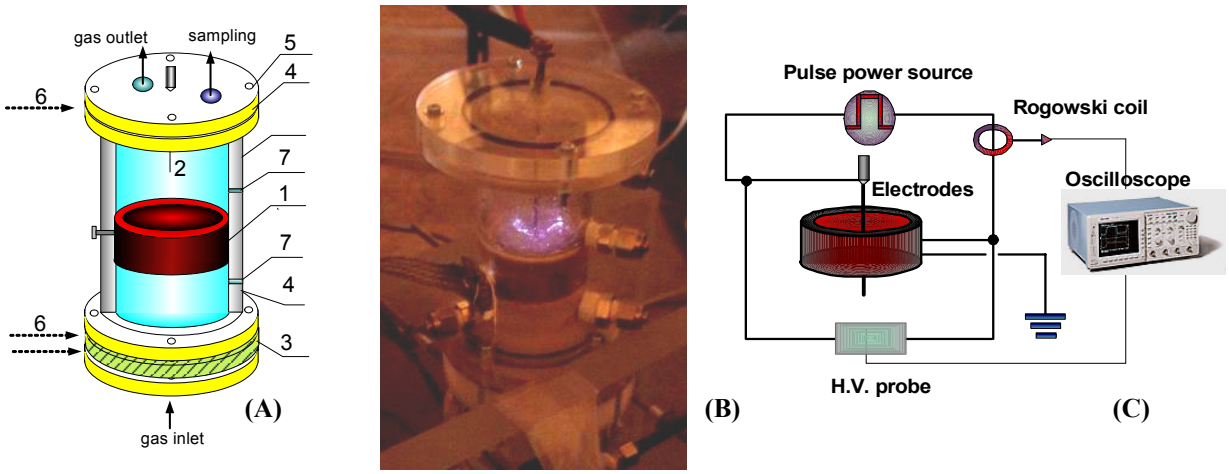

Figure 1. (A) Cylindrical foaming column. 1,2- electrodes, 3- ceramic diffuser, 4- housing, 5-bolts, 6-orings, 7- foam level control. (B) The photo of reactor. (C) The electrical pulse power supply.

Experimental Apparatus

The main reactor, (depicted in Fig. 1A, B) was a cylindrical, polyacrylate column with a ceramic diffuser. The stainless steel electrodes (the central one of d_{in}=40 mm, l= 30 mm and the inner one of d_{out}= 1.5 mm) were placed above the diffuser.

The samples of the gas and liquid substrates and the products were taken to the chemical analysis system. Analysis included the evaluation of the oxidants concentrations and the measurement of the pollutants removal rate, determined using Hydrogen Peroxide Test Kit (HACH, Model HYP-1), the HACH spectrometer, FTIR, and the GASTEC and KITAGAWA gas probes. The electrical circuit, presented in Fig. 1C, consisted of the pulse power source

(operated at variable frequencies), which was connected to voltage and current measurement system (high voltage probe and the Rogowski coil with an oscilloscope.

Results and Discussion

The quality and conditions of the foam obtained in the reactor, the electrical discharge properties and the detailed description of the generation of oxidants in the foam`ing column were described elsewhere [4]. During the experiment 0,25 mg/l of dissolved ozone and 40 mg/l of hydrogen peroxide were detected in the post-foaming liquid after 5 min. application of the electrical discharge. The concentrations of oxidants increased with the increasing of applied voltage and with increasing of the pulse repetition rate.

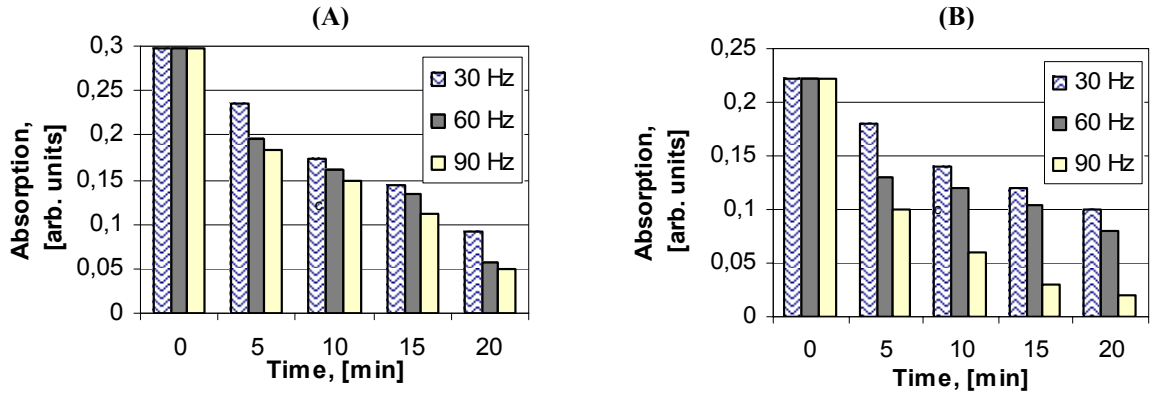

Figure 2. The decomposition of methylene blue (A) and humic acid (B) in dependence on frequency.

The process of decomposition of methylene blue was studied. 60 ml of 35 mg/l solution was used in the same flow regime conditions. Analyzed UV absorption (550-665 nm) decreased constantly with time as it is presented in Fig. 2A. Visually, the full discoloration was possible.

Formed oxidants took an important part in the decomposition of humic acid (Fig. 2B). 100mg/l was suspended in pure water. UV absorption (260 nm) and organoleptic measurements were performed after each 5 minutes of treatment by the discharge in foam. After 20 min of treatment the color of solution became much weaker and the amount of suspended matter after the sedimentation significantly decreased. However, the treatment time should be extended to obtain the full purification.

Conclusions

An apparatus based on the discharge in the foam was designed. Hydrogen peroxide and dissolved ozone were generated in the same reaction vessel using the electrical discharge within foam. Methylene blue and humic acid were relatively easily decomposed in the foaming environment. The higher amount of oxidants was formed and visually full removal of color was attained at the higher frequencies.

Acknowledgments

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