

THE EFFECT OF REACTOR TEMPERATURE ON OZONE CONCENTRATION PRODUCED BY DC CORONA DISCHARGES FED BY OXYGEN

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Abstract. The ozone generation in DC positive and negative corona discharges fed by oxygen has been investigated. Especially the effect of the discharge power on the reactor temperature and subsequent influence of reactor temperature on the ozone concentration were examined.

1. INTRODUCTION

The industrial production of ozone is more than 150 year old plasma-chemical process. Ozone is usually produced by electrical discharges at atmospheric pressure. Corona discharge is typical example of atmospheric pressure discharge. The production of ozone in the corona discharge gap is strongly affected by the electrical properties of the discharge. It must be noted, however, that there is efficient feedback of ozone concentration on electrical properties of the discharge [1, 2, 2, 3, 4].

The second important parameter influencing the ozone production is the temperature of gaseous medium. Held & Peyrous calculated theoretically ozone concentration produced by DC negative corona discharge fed by oxygen and compared their calculations with experimental results [5]. They have found out that the rate of ozone formation in their model was independent on the temperature. Contrary to this the rate of ozone destruction was increasing with increasing temperature. There is evident disagreement between theoretically calculated and experimentally measured dependencies of the ozone concentration on the so called Becker parameter.. Theoretically calculated dependences exhibited continuous exponential increase of concentration with increasing Becker parameter while the experimental data exhibited clear extreme character.

In present paper the results of the experimental study of the effect of the reactor temperature on the ozone concentration produced by DC corona of both polarities in flowing dry oxygen are discussed.

2. EXPERIMENTAL APPARATUS

The experimental apparatus is shown in figure 1. Discharge tube containing coaxial cylindrical electrode system (a stainless steel inner electrode of diameter 125 μm and a brass outer electrode of diameter 16 mm) was used in these experiments. The active part of the discharge tube was 6.5 cm long. The Pt100 detector was built into the outer wall of the discharge reactor. A DC corona discharge of both polarities was generated in this reactor. The industrial purity oxygen was flowing through the tube at gas flow rates 10cm³/min and 100cm³/min maintained by mass flow controller. The same gas was closed in the comparative cell of the Shimadzu UV spectrometer, which was used to measure the transmittance of light passing through the gas in the discharge tube. The transmittance was recorded simultaneously with discharge voltage, current and the resistance of the Pt100 detector. Ozone concentration was calculated from the transmittance data of light at wavelength within characteristic Hartley Band (centred at 254nm) and ozone concentration then calculated using the Lambert-Beer formula. Glassman high voltage power supply was used to provide power to the discharge electrodes. All experiments were carried out at atmospheric pressure.

The dependencies of the ozone concentration on the temperature of the wall of the reactor, which was practically identical with the temperature of the gas inside the reactor, were measured for both polarities of the discharge.

Moreover the dependencies of the ozone concentration on Becker parameter have been measured too.