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프라즈마에 의한 질소산화물의 생성과 파괴에 관한 연구

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A STUDY ON PRODUCTION AND DESTRUCTION OF NITROGEN OXIDES IN PLASMA REACTORS

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1. INTRODUCTION

An overall objective of this research is to continue with this technique and expand on the earlier results obtained during the preliminary study, and to develop a better understanding of the parameters that influence the formation of nitrogen oxides in ACPR.

An ACPR uses electrical current to generate a high potential difference between two surfaces of concentric tubes. This high voltage drop causes an electrical breakdown of the gas entrapped in the annulus. The electrical breakdown of the gas is called a discharge. This discharge is initiated due to the presence of free electrons in the gas. These electrons are drawn to the positively charged surface at high speed. In the process they collide with the gas molecules which are moving at random in the annular space of the reactor to form radical ions and more electrons which recombine to form different kinds of neutral species. Thus the use of plasma reactors to obtain specific by-products is an easy and efficient technique.

2. EXPERIMENT

An ACPR is the primary tool for this research and it consists of two concentric quartz tubes which have been fused at both ends. The Reynolds number is calculated for two flow rates to determine the flow conditions. It is found that residence time close to 1.2 second the flow regime is laminar. The annular gap of the ACPR is calculated by trial and error from the breakdown voltage equation. The discharge reactor was fabricated using Pyrex glass which is chemical resistant borosilicate glass with a dielectric constant of 4.6 at 25 ℃.

The variables that need to be monitored for this particular research are primary voltage, residence time, humidity, and power input.

3. RESULTS AND DISCUSSION

3.1 Effect of Primary Voltage and Frequency on Power and Secondary Voltage

The optimum conditions were observed at certain values of frequencies for particular primary voltages. At a certain frequency for a particular primary voltage, reactor power goes through a maximum and then begins to decrease with increasing frequency. This peak is called the optimum condition. The reason for the optimum condition is bekieved to be a result of the secondary electrical circuit loading on the transformer.

3.2 Plasma Behavior with respect to Humidity

Optimizations were conducted with dry air and humidified air. Humiduty has negligible effects in the given humidity range on plasma behavior.

3.3. NO_x Production Potential

The primary objective of this experiment was to determine the effectiveness of NO_x production mecchanism and how the production is affected by primary voltage, frequency, flow rate, and humidity variations. The range of production obtained with respect to the target variables is quite large, from 3 to 1500ppm.

The directly proportional relationship between primary voltage and NO_x production stems from reactor power input. In previous destruction studies increased destruction efficiency was reported as optimized primary voltage increased. These results support why NO_x production increases with increased primary voltage.