

Study of Synergetic Effect by Combining Dielectric Barrier Discharge (DBD) Plasma and Photocatalysis for Abatement of Pollutants in Air Mixture System: Influence of Some Operating Conditions and Identification of Byproducts

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Abstract : Volatile organic compounds (VOCs) constitute one of the most important families of chemicals involved in atmospheric pollution, causing damage to the environment and human health, and need, consequently, to be eliminated. Among the promising technologies, dielectric barrier discharge (DBD) plasma - photocatalysis coupling reveals very interesting prospects in terms of process synergy of compounds mineralization's, with low energy consumption. In this study, the removal of organic compounds such butyraldehyde (BUTY) and dimethyl disulfide (DMDS) (exhaust gasses from animal quartering centers.) in air mixture using DBD plasma coupled with photocatalysis was tested, in order to determine whether or not synergy effect was present. The removal efficiency of these pollutants, a selectivity of CO₂ and CO, and byproducts formation such as ozone formation were investigated in order to evaluate the performance of the combined process. For this purpose, a series of experiments were carried out in a continuous reactor. Many operating parameters were also investigated such as the specific energy of discharge, the inlet concentration of pollutant and the flowrate. It appears from this study that, the performance of the process has enhanced and a synergetic effect is observed. In fact, we note an enhancement of 10 % on removal efficiency. It is interesting to note that the combined system leads to better CO₂ selectivity than for plasma. Consequently, intermediates by-products have been reduced due to various other species (O•, N, OH•, O₂•-, O₃, NO₂, NO_x, etc.). Additionally, the behavior of combining DBD plasma and photocatalysis has shown that the ozone can be easily also decomposed in presence of photocatalyst.

Keywords : combined process, DBD plasma, photocatalysis, pilot scale, synergetic effect, VOCs

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