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Abstract

Pulsed Corona Discharge Plasma Combined with Photocatalytic Oxidation Technology for the Degradation of Volatile Organic Compounds in Air †

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Abstract: The anthropogenic impact on the environment has long been known to negatively affect the quality of air. Volatile organic compounds (VOCs) are widely used in domestic and industrial applications, generally as solvents. They are mobile in both gaseous and aqueous phases, and thus their spread in environment could have massive effect with dramatically negative consequences. Pulsed corona discharge (PCD) and photocatalytic oxidation (PCO) are considered as efficient and eco-friendly methods for the energy-efficient abatement of gaseous hazardous pollutants. One of the main problems of PCD application in air treatment, however, is residual ozone, a side product of air ionization considered as secondary air pollution. Photocatalytic processes are known to degrade ozone extending simultaneously the photocatalyst lifetime. Thus, combining PCD and PCO in a two-step treatment system could solve the problem of the presence of residual ozone and complement each other's strengths. In this study, experiments were conducted in separate systems, i.e. photocatalysis and plasma, making a prerequisite for the progress in the combined PCD/PCO applications. A prototype PCO reactor was built and tested with ozone and 2-methoxyethanol (2ME) in combinations. 2ME was chosen as a hazardous model VOC used in industry in solvents and paints. For the PCD experiments xylene was tested. Being refractory air pollutant, extensively studied for its removal, xylene provides a basis for the comparison of its abatement methods. The PCD treatment showed unequalled energy efficiencies in gaseous xylene oxidation. With respect to PCO experiments, the degradation of 2ME and ozone was 40% and 95%, respectively. High ozone degradation performed by PCO confirms the expediency of proposed air cleaning combination.

Keywords: volatile organic pollutant; heterogeneous photocatalysis; pulsed corona discharge

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