DESIGN, DEVELOPMENT, AND CHARACTERIZATION OF ATMOSPHERIC PLASMA SYSTEM FOR WASTEWATER TREATMENT

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Abstract. In recent years, cold atmospheric plasmas (CAPs) are gaining attention in the field of water decontamination. CAP is a new and emerging chemical free advanced oxidation process (AOP) for the removal of various organic micropollutants (OMPs) from water. In this study, 1-needle and 3-needle electrode atmospheric pressure plasma jet was used as a plasma source. Plasma was governed by using high voltage RF power supply with sine signal at 350 kHz, whereas argon was used a working gas. Three different OMPs (acid blue 25 dye, diclofenac and para-chlorobenzoic acid) were selected as model pollutants and treated with plasma. Electrical circuit in the experiment enabled electrical characterization at the jet and in the grounded line. This provided information about power deposition at two points in the plasma system: at the jet, i.e. the input power, and power from the plasma delivered to the sample. Optical measurements were obtained by using optical emission spectroscopy (OES) and imaging - an iCCD camera coupled with band pass filters for spectrally resolved imaging. The emission spectra provided the evidence of reactive and excited species within the plasma discharge while imaging gave time integrated information on spatial profiles of certain reactive species in the plasma ($HO^{\cdot}$, $O^{\cdot}$, ...). After plasma treatment the samples were analysed by using a HPLC and showed that faster degradation of OMPs was observed in the following order: diclofenac> acid blue 25 dye> para-chlorobenzoic acid. The highest degradation efficiency was achieved with diclofenac while para chlorobenzoic acid demonstrated the lowest decomposition. Nevertheless, the CAP based AOPs can be used for the efficient elimination of various OMPs from water.

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References

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