



Degradation of organic dye by pulsed discharge non-thermal plasma technology assisted with modified activated carbon fibers

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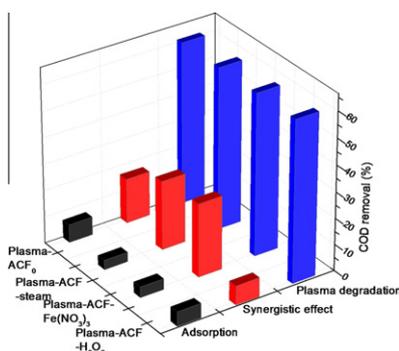
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HIGHLIGHTS

- ▶ Combined systems of plasma and modified ACF samples were utilized for MO removal.
- ▶ The adsorption–catalytic effects of ACFs with various modification methods were studied.
- ▶ The property changes of MO solution were estimated in various degradation processes.
- ▶ Plasma degradation, adsorption and synergistic effect for organic removal were extensively evaluated.

GRAPHICAL ABSTRACT

Plasma degradation, adsorption and synergistic effect for organic removal were extensively studied and synergistic effect played an important role for organic removal in combined degradation processes.



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ABSTRACT

Methyl orange (MO) was employed to evaluate degradation efficiency of the synergistic effect of activated carbon fibers (ACFs) and pulsed discharge non-thermal plasma in aqueous solution. In order to study the roles of the ACFs during the degradation activities, adsorption–catalytic effects of ACF samples modified with H₂O₂, Fe(NO₃)₃ and steam were assessed. The chemical and physical properties of these ACFs were characterized by XRD, SEM, BET and chemical titration methods. For comparative purposes, experiments of adsorption on ACF samples, plasma degradation, and plasma degradation in the presence of ACF samples were carried out. Plasma alone can obtain the decoloration of 77.3% for 100 mg/L MO solution and generate H₂O₂ (0.88 mM) and O₃ (0.025 mM) after 30 min treatment. Results also showed that the presence of either ACF₀ or modified ACFs considerably improved MO decoloration and COD removal in the plasma reactor. Compared with ACF₀ and ACF–H₂O₂, a total decoloration of MO and above 90% COD removal were obtained in approximately 30 min for ACF–steam and ACF–Fe(NO₃)₃ due to their larger adsorption capacities and better catalytic effects. In combined degradation processes, the yields of H₂O₂ and O₃ all decreased in presence of ACF samples as compared with plasma alone process. It was also observed that ACF samples can be well regenerated in combined processes and their adsorption behaviors contributed little for final organic removal.

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1. Introduction

Dyes and pigments are widely used in various industries to color the final products and 10–15% of the world's total output of dye