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The kinetics of the removal of organic pollutants from drinking water by a novel plasma-based advanced oxidation technology

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ABSTRACT

The main goal of this study was to examine the oxidation kinetics of four common organic pollutants, Chicago Sky Blue 6B (CSB), Rhodamine B (RhB), phenol, and 4-chlorophenol (4-CP), in drinking water using an advanced oxidation processes (AOP) corona technology. This was achieved by determining the rate constants and by tracking $OH^{\cdot}$ kinetics. In most experiments, a pseudo-first-order kinetics was found. Due to its molecular structure, the constant rate of color removal ($K_{CSB} = 2.3E{-}3\,min^{-1}$) was higher than that of the aromatic groups ($K_{CSB} = 3.0E{-}4\,min^{-1}$). Hydroxyl radical kinetics was investigated by means of p-chlorobenzoic acid (pCBA) degradation. When 10 mg/l of phenol was added to the water, pCBA degradation decreased ($K_{pCBA} = 3.70E{-}04\,min^{-1}$). An experiment carried out under similar conditions, but with an inactive ozone injection system, caused the pCBA rate constant to decrease even more ($K_{pCBA} = 1.60E{-}04\,min^{-1}$). The rate constants significantly increased, when the injector operated, since polluted water entered the static mixer at high pressure, where a second encounter occurred with oxidative agents that originated in air enriched with ozone that was drawn from the reactor. The high pressure separates the water into droplets, which allows for a better exposure of pollutants to oxidative agents.

Keywords: Corona; AOP; Hydroxyl radical; CSB; RhB; Phenol; 4-CP

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