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Degradation behaviors and genetic toxicity variations of pyrazolone pharmaceuticals during chlorine dioxide disinfection process

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Abstract

Pyrazolone pharmaceuticals such as isopropylphenazone (PRP) and aminopyrine (AMP) were commonly used as antipyretic analgesics, and their frequently detection in aquatic environment has become a major concern in recent years. Chlorine dioxide (ClO_2) disinfection process has been proved to be a feasible way to degrade antipyrine (ANT), which is the first synthetic pyrazolone pharmaceutical. In this work, the reaction kinetics, degradation pathways and genetic toxicity of PRP and AMP during ClO_2 disinfection process were investigated. Experimental results demonstrated that the reaction of both PRP and AMP with ClO_2 followed second-order kinetics, the second-order rate constants were calculated to be k_{app}(PRP) = 11.0 $M^{-1}s^{-1}$ and k_{app}(AMP) = 1.30 × 10^5 $M^{-1}s^{-1}$ at neutral pH. Slightly alkaline environment (pH = 9) was in favor of the reaction. C=C double bond and C-N bond on pyrazolone ring were main active groups under ClO_2 electrophilic attack. The degradation pathways of pyrazolone pharmaceuticals could be concluded as C=C cleavage, ring-opening reaction and de-carbonyl reaction. Pyrazolone contaminated water exhibited

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