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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 ( $\text{ClO}_2$ ) disinfection process has been proved to be a feasible way to degrade antipyrene (ANT), which is the first synthetic pyrazolone pharmaceutical. In this work, the reaction kinetics, degradation pathways and genetic toxicity of PRP and AMP during  $\text{ClO}_2$  disinfection process were investigated. Experimental results demonstrated that the reaction of both PRP and AMP with  $\text{ClO}_2$  followed second-order kinetics, the second-order rate constants were calculated to be  $k_{app}(\text{PRP}) = 11.0 \text{ M}^{-1}\text{s}^{-1}$  and  $k_{app}(\text{AMP}) = 1.30 \times 10^5 \text{ M}^{-1}\text{s}^{-1}$  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  $\text{ClO}_2$  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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