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Use of bovine catalase and manganese dioxide for elimination of hydrogen peroxide from partly oxidized aqueous solutions of aromatic molecules – unexpected complications

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Abstract

Being a toxic substance, hydrogen peroxide (H₂O₂) formed during application of advanced oxidation processes disturbs the biological assessment of the treated solutions. Therefore, its removal is necessary when the concentration exceeds the critical level relevant to the biological tests. In this study, H₂O₂ removal was tested using catalase enzyme or MnO₂ as catalysts and the concentration changes were measured by the Cu(II)/phenanthroline method. MnO₂ and Cu(II) ions were found to react not only with H₂O₂ but also with the partly oxidized intermediates formed in the hydroxyl radical induced degradation of aromatic antibiotic and pesticide compounds. Catalase proved to be a milder oxidant, it did not show significant effects on the composition of organic molecules. The Cu(II)/phenanthroline method gives the correct H₂O₂ concentration only in the absence of easily oxidizable compounds, e.g. certain phenol type molecules.

1. Introduction

In Advanced Oxidation Processes (AOP) used for elimination of toxic organic substances from water/wastewater, the oxidation of contaminants is usually induced by hydroxyl radical ([•]OH) reactions. During these reactions in aerated solutions hydrogen peroxide (H₂O₂) always forms in relatively high concentrations, e.g. in the reaction sequence: organic radical + O₂ → peroxy radical → O₂^{•-}/HO₂[•] elimination (von Sonntag, 2006). The termination reaction of the O₂^{•-}/HO₂[•] pair gives H₂O₂. When high energy ionizing radiation is used for water treatment

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