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ANTI-INFLAMMATORY DRUGS REMOVAL THROUGH WASTEWATER DISINFECTION

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Abstract

Wastewater treatment plants are one of the major routes of transporting pharmaceuticals to the water bodies. Among pharmaceuticals anti-inflammatory drugs ibuprofen (IBF), naproxen (NPX), diclofenac (DCF) and ketoprofen (KFN) are of significant interest due to their persistent detection in raw and treated wastewater. It is well known that these compounds are only partially removed through conventional biological wastewater treatment thus being detected in secondary effluents. Disinfection of biologically treated wastewater is the minimum additional treatment stage required in order to provide for safe wastewater reuse. As the primary goal of disinfection is to reduce wastewater microbiological content, the effectiveness of such methods to reduce pharmaceuticals is unclear.

In view of the above the aim of this study was to examine whether typical disinfection methods, employed to provide for safe wastewater reuse, can lead to effective removal of IBF, NPX, DCF, KFN from wastewater and to assess the effect of critical parameters such as chlorine and UV dose and contact time in disinfection performance. Furthermore the effect of the target compounds and their metabolites generated during disinfection on the aquatic environment was assessed by the use of *Vibrio fischeri* as the indicative organism.

According to the results for Ct values between 40-300 mgCl₂·min/l, removal efficiencies were equal to 78-96%, 92-100%, 31-52% and 19-39% for NPX, DCF, IBF and KFN respectively. Removal efficiencies of NPX and DCF are practically independent of contact time whereas for both IBF and KFN removal efficiencies exhibited a polynomial dependence on the Ct dose. Therefore it can be postulated that in order to achieve a satisfactory removal of IBF and KFN significantly high chlorination Ct doses should be applied, with values higher than those required to guarantee proper disinfection for unrestricted agricultural and urban wastewater reuse. Furthermore UV disinfection at UV doses in the order of 40-150 mWs/cm² is not effective to remove anti-inflammatory drugs. From the target compounds tested, KFN and DCF exhibited appreciable removal only at higher UV doses whereas practically no NPX and IBF removal was recorded. Based on toxicity experiments, it is anticipated that following chlorination of the target chemicals, production of more toxic metabolites is taking place. More specifically the inhibition of luminescent activity of *Vibrio fischeri* was significantly increased with the increase of chlorine dose. Therefore the effectiveness of both chlorination and UV to remove anti-inflammatory drugs is questionable and more research is needed to guarantee for safe wastewater reuse.
