

Toxicity of PPCPs on Adapted Sludge Community

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Abstract : Wastewater treatment plants (WWTPs) are supposed to hold an important place in the reduction of emerging contaminants, but provide an environment that has potential for the development and/or spread of adaptation, as bacteria are continuously mixed with contaminants at sub-inhibitory concentrations. Reviewing the literature, there are little data available regarding the use of adapted bacteria forming activated sludge community for toxicity assessment, and only individual validations have been performed. Therefore, the aim of this work was to study the toxicity of Triclosan (TCS) and Ibuprofen (IBU), individually and in binary combination, on adapted activated sludge (AS). For this purpose a battery of biomarkers were assessed, involving oxidative stress and cytotoxicity responses: glutathione-S-transferase (GST), catalase (CAT) and viable cells with FDA. In addition, we compared the toxic effects on adapted bacteria with unadapted bacteria, from a previous research. Adapted AS comes from three continuous-flow AS laboratory systems; two systems received IBU and TCS, individually; while the other received the binary combination, for 14 days. After adaptation, each bacterial culture condition was exposure to IBU, TCS and the combination, at 12 h. The concentration of IBU and TCS ranged 0.5-4mg/L and 0.012-0.1 mg/L, respectively. Batch toxicity experiments were performed using Oxygraph system (Hansatech), for determining the activity of CAT enzyme based on the quantification of oxygen production rate. Fluorimetric technique was applied as well, using a Fluoroskan Ascent Fl (Thermo) for determining the activity of GST enzyme, using monochlorobimane-GSH as substrate, and to the estimation of viable cell of the sludge, by fluorescence staining using Fluorescein Diacetate (FDA). For IBU adapted sludge, CAT activity it was increased at low concentration of IBU, TCS and mixture. However, increasing the concentration the behavior was different: while IBU tends to stabilize the CAT activity, TCS and the mixture decreased this one. GST activity was significantly increased by TCS and mixture. For IBU, no variations it was observed. For TCS adapted sludge, no significant variations on CAT activity it was observed. GST activity it was significant decreased for all contaminants. For mixture adapted sludge the behaviour of CAT activity it was similar to IBU adapted sludge. GST activity it was decreased at all concentration of IBU. While the presence of TCS and mixture, respectively, increased the GST activity. These findings were consistent with the viability cells evaluation, which clearly showed a variation of sludge viability. Our results suggest that, compared with unadapted bacteria, the adapted bacteria conditions plays a relevant role in the toxicity behaviour towards activated sludge communities.

Keywords : adapted sludge community, mixture, PPCPs, toxicity

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