

Biological tools to Optimize Treatment Technologies to remove micro Pollutants and Endocrine disruptors (BIOTTOPE)



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I. Introduction

Over the last twenty years, water suppliers have become increasingly interested in endocrine disruptors (ED) and others micro pollutants called emerging pollutants (pharmaceuticals, personal care products and industrial chemicals). Urban wastewaters contain a high number of emerging trace organics chemicals and a large number of studies have investigated the fate and removal of individual or specific groups of micro pollutants by various treatment processes, but little is known how these treatment processes change the composition and biological activity of the micro pollutants and whether these treatment processes could be monitored and controlled by using biological tools.

III. Methodology

A) Micropollutants removal

The project will implement, test and validate a new prototype water treatment technology (Actiflo® Carb, figure 2) at the semi-industrial scale to remove organic micro-pollutants. Treatment efficiency will be monitored using untargeted chemical analysis approach and by the endocrine disruption assessment. The strategy to analyze both no polar and polar compounds requires two high technological instrumentation : comprehensive two-dimensional gas chromatography coupled to mass spectrometry (GCxGC TOF MS) and liquid chromatography coupled to high resolution mass spectrometer (LC-HRMS). Organic pollutants will be identified thanks to homemade databases containing more than 1000 compounds for GCxGC TOF MS and 1500 compounds for LC-HRMS.

B) Endocrine disruption assessment

Endocrine disruption assessment of raw and treated wastewater, will be carried out with the reading flow system developed by WatchFrog (Figure 1). Small models organisms derived from amphibian and fish, fluorescent *Xenopus laevis* tadpoles and *Oryzias latipes* fry, are genetically modified to respond to the presence of endocrine disruptors in water. Organisms bear a genetic code that integrates hormonal response. When an endocrine disruptor is present, the response element of hormones can be activated for the thyroid (TH/bZIP model) or the estrogen (Choriogenin) hormone, triggering the synthesis of fluorescent proteins. The fluorescence is measured through the transparency of the organism (figure 1).

IV. Results & Perspectives

Results show that the WWTP effluents can have or not endocrine disrupting effects. This effect may depend on fluctuations in human activities and/or in the operation of the WWTP. Tertiary treatment technologies as adsorption on activated carbon can remove micropollutants that impact the endocrine system in living organism. Some of chemical compounds identified in raw wastewater are not included in French or European prioritisation lists. The next step will consist in the toxicity evaluation of some recurrent compounds to evaluate their relevance.

In vivo assays are today adapted to the evaluation of raw WWTP effluents. The interest of this test is to evaluate an impact on the physiology of organisms (biological effect) and not to identify a mechanism of action. The assays are very easy to put in place because the protocol is simple and enables a global evaluation of the stream. It is not necessary to preprocess (extraction, purification, concentration) the samples in contrast to other *in vitro* tests. However, we need to perform on site tests to establish and validate specifications of the on-line readout system.

II. Objectives

The BIOTTOPE project is designed to improve the quality of WWTP effluents, to reach a “good status” for coastal and inland waters, based on biological effects. The project will test a water treatment technology, based on activated carbon adsorption and on an accelerated settling step to remove micro-pollutants such as ED. Treatment efficiency will be monitored using an on-line read-out system with small biological aquatic organisms and by untargeted chemical analysis.

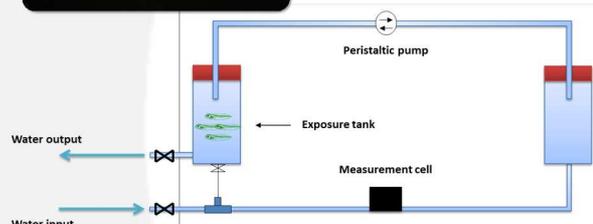


Figure 1. Scheme of the on-line readout system to the endocrine disruption assessment.

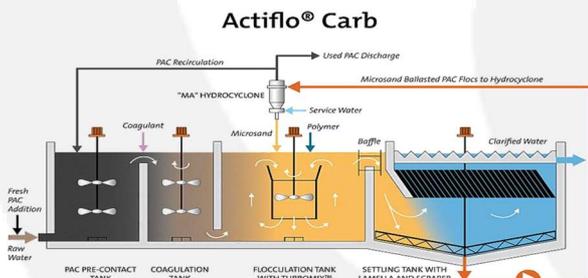


Figure 2. Scheme of the Actiflo® Carb technology to remove micropollutants from wastewater.



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