Effluents from wastewater treatment plants (WWTP) contain micropollutants which have endocrine disruption capabilities. Removal of these endocrine disruptive compounds (EDCs) necessitates tertiary or quaternary treatments. Reliable means are required for monitoring the performance of these processes in order to evaluate their impact and optimize their use. Bio-indicators are currently the tool of choice for this analysis as they provide a global readout of the WWTP effluent, empirically giving information on the net disruptive effect of the overall sample. In this context, SIAAP Veolia and Watchfrog have jointly investigated the effectiveness of a tertiary treatment process (Actiflo® Carb) coupled with in-line monitoring of the endocrine disruptive effect using bio-indicators (Watchfrog). We used fish fry and tadpoles that generate a fluorescent protein when their endocrine system is impacted by pollutants present in the sample. A specific instrument called the Frogbox, allows continuous, real-time monitoring of the fluorescence of these larvae. We studied the performance of the Actiflo® Carb process over several months using two Frogboxes (inlet and outlet of the process). We demonstrated that the EDC activity varies greatly between different days and weeks of measurement. Chemical analysis of various micropollutants has enabled us to demonstrate that the disruptive effect on the thyroid hormonal axis is well correlated with the concentration of pollutants. These results demonstrate the usefulness of such a tool not only to monitor the performance of the treatment process but also to provide a real-time indication of the activity impact on the environment. The efficiency of the Actiflo® Carb process has also been demonstrated along with possible strategies for optimising activated carbon consumption and their activity impact on wildlife.

**Bio-indicators monitoring of tertiary treatment performance for the removal of micro-pollutants from urban wastewater**

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**Veolia**

17 million m3 / day 6 million population equivalents

**Seine-Aval WWTP**

**Micro-pollutants content ?**

**Endocrine disrupting activity ?**

**Tertiary treatment Pilot (Actiflocarb)**

**Micro-pollutants content ?**

**Endocrine disrupting activity ?**

**Vertebrate Bio-indicators for endocrine disruption**

**In line endocrine disruption assessment**

**Dynamic profile of endocrine disruption activity in the WWTP effluent**

**The tertiary treatment reduces the endocrine disrupting activity**

**The blue and red bars indicate the percentage of measures showing an endocrine activity respectively in the tertiary treatment inlet or outlet.**

**The thyroid disrupting activity is linked to the micro-pollutant load in the WWTP outlet.**

**The thyroid disrupting activity correlate with the micro-pollutant load in the WWTP outlet.**

**Synthesis of the results obtained on the thyroid and estrogenic activity assessed in the tertiary treatment inlet and outlet.**

**Conclusions**

The assessment of the endocrine effect using the Frogbox for several consecutive months has highlighted:

- Variations in the endocrine activity in the treated wastewater over the course of days, weeks and months. The weakest endocrine effects early August when the population is reduced by the high water temperature in the French summer.
- The thyroid effect to be over correlated with the changes in concentrations of micropollutants targeted by the chemical analysis. Importantly, notable exceptions were observed when the micropollutants concentration was low but the thyroid activity stayed high showing that the global load in micropollutants could not always predict the thyroid activity.
- Discussions to be only approach integrating the action of all molecules to reveal the physiological effect of the water.

This study also shows the relevance of in-line biossays for endocrine activity assessment. This technology allowed the characterisation of the efficiency of the tertiary treatment and highlights the efficiency of the activated carbon based tertiary treatment for the removal of the endocrine disruptors.