Pilot-scale assessment of tertiary treatment technologies for pharmaceuticals and personal care products removal from municipal wastewater

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In recent years, the occurrence, fate and effects of emerging contaminants have been increasingly investigated, indicating the growing need for effective technologies to control the spread of these pollutants into the environment. Several technological opportunities emerged for removing compounds refractory to biological processes. Among them, degradation by ozone and adsorption on activated carbon were identified as sustainable alternatives. Since the application of these technologies is consolidated for conventional contaminants, commercial solutions are already available. Nevertheless, more data about the removal of emerging contaminants under realistic conditions are required.

In the present work, ozonation and adsorption on powdered activated carbon (PAC) were studied separately as tertiary treatments in two municipal wastewater treatment plants (WWTPs) at the pilot-scale over a long-lasting experimental campaign for assessing the removal of 19 compounds, including pharmaceuticals, personal care products and some of their biodegradation products. Moreover, the influence of operating conditions and wastewater characteristics was assessed, in the view of defining robust guidelines for processes design and operation.

The ozone contactor consisted of two identical sequential columns (0.84 m^3 in total) providing ozone mass flowrate up to 8.5 gO_3/h for treating a wastewater flowrate from 1 to 2 m^3/h. The PAC was dosed in an Actiflo® Carb system, a patented Veolia technology combining coagulation, flocculation and sedimentation on lamella plates. Following operating conditions were studied on 2 PAC types: PAC dosage 5-20 mg/L, system PAC concentration 0.2-1 g/L, wastewater flowrate 6-9 m^3/h.

For both technologies experimental results evidenced excellent removal efficiencies (80-100%, >95% in most cases) for most of investigated compounds. However, lower removal efficiencies (between 20% and 80%) were observed for several pollutants (e.g. gabapentin-lactam, galaxolidone, irbesartan, lamotrigine and tonalide for ozone, diclofenac, gabapentin-lactam, irbesartan, propyphenazone and sulfamethoxazole for PAC) with significant worsening under sub-

optimal operating conditions. The influence of operating conditions was clearly identified for both technologies, being ozone and PAC dosages the most influential ones, and predictive models were proposed. The limited variability in wastewater characteristics resulted in weak indications about detrimental effect on processes.

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