**Assessment of Advanced Photocatalytic Oxidation process for Micropollutant Elimination in Municipal and Industrial Waste Water Treatment Plants.**

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**Highlights**

* Organic synthesis pathways by sol-gel process for photocatalysts.
* Ag and/or P25 nanoparticles-doped TiO2 photocatalysts.
* Ozonation and Photodegradation of micropollutants in aqueous media.
* Very high degradation efficiency for all micropollutants in a pilot reactor.

**1. Introduction**

Pharmaceuticals, personal care products, pesticides and other chemicals used for domestic purpose or industrial or agro-food production are continuously discharged into wastewater and lead to global contamination of the aquatic environment all over Europe [1]. Removal during conventional wastewater treatment is unsatisfactory knowing that only 20 to 50% of micropollutants are removed in current waste water treatment plants [2].

The objective of the AOPTi project is to develop and validate an innovative technology to ensure efficient elimination of different types of micropollutants and toxic effects in waste water. The process is a tertiary treatment process, which can be easily integrated into municipal and industrial WWTPs. It is an economical physico-chemical treatment step after the conventional biological treatment [3]. The process is based on oxidation by ozone and a subsequent photocatalytic treatment. The technology is developed for companies involved in the water purification sector and for companies with toxic effluents loaded with micropollutants. Process parameters have to be determined depending on the type of waste water in order to lead to almost total degradation of all micropollutants and to ensure absence of toxicity of the resulting water. Treated water will be characterized in term of chemical transformation products (TPs) and toxicity.

**2. Methods**

At the pilot scale (flow rate = 150 L/h), 24 major micropollutants have been chosen to model waste water like pesticides (simazine, diuron, isoproturon, DTT, atrazine, lindane), plasticizers (DEHP, tributyl phosphate), brominated compounds (PBDE), pharmaceuticals (metoprolol, diclofenac, carbamazepine…), industrial chemicals (PFOS), contrast agent (iohexol, iopromide). Their degradations are quantified by GC-MS/MS and UHPLC-MS.

Photocatalysts have been synthesized by organic sol-gel methods [4] and deposited as thin transparent films by spray-coating inside the long alkaline-free tube for a pilot test: pure TiO2 and doped titanium dioxide (with Ag and/or commercial Evonik P25 nanoparticles). Samples were characterized by profilometry, GIRXD, UV-Vis transmission. The absence of leaching was characterized by ICP-AES and MS.

**3. Results and discussion**

The best photocatalyst for the degradation of the 22 micropollutants is TiO2 doped with 2 wt.% of Ag and 10 wt.% P25. The results are presented in Figure 1, in which the percentage of each micropollutant present in water is shown after different treatments (ozonation, adsorption and photocatalysis). In Figure 1 (on the left):

(i) Chlortoluron and isoproturon are totally degraded by ozonation for 30 min; (ii) atrazine, DDT and BDE are totally disrupted thanks to photocatalysis; (iii) for the other micropollutants, their percentage of degradation evolves from 10% to 90% after a photocatalytic treatment for 6 h.

In Figure 1 (on the right):

(i) Carmabazepine, diclofenac, sulfamethoxazole, clarithromicyn and terburtyn are totally degradated by ozonation for 30 min; (ii) metoprolol is partially degraded after a photocatalytic treatment of 6 h (about 12% remains); (iii) the other pollutants are totally disrupted thanks to the photocatalytic treatment and sol-gel coating.



**Figure 1.** Evolution of 22 micropollutants concentrations during the ozonation and photocatalytic tests.

**4. Conclusions**

It is concluded that the use of an ozonation treatment followed by a photocatalytic treatment allow disrupting different micropollutants present in waste waters. And the toxicity of waters very strongly decrease during the AOP treatments.

**References**

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