

TITLE: ADVANCED OXIDATIVE TREATMENT FOR WASTE WATER CONTAMINATED BY PHARMACEUTICAL PRODUCTS

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ABSTRACT: Many pharmaceuticals products are introduced into the environment by domestic, industrial or hospital waste waters. It has been observed that many of them are not well removed by traditional biological waste water treatment plants (WWTP). Our collaborative research elaborated a physico-chemical process that has to be placed at the end of existing WWTP. Such processes already exist and are based on an ozone and UV radiation combination to oxidize organic compounds. Our study showed that better degradations could be reached using heterogeneous photocatalysis in addition to ozone and UV radiation.

At the laboratory scale, fifteen pharmaceuticals products in the range of 1µg/L to 10 µg/L have been chosen to model waste water: hormones (17-alpha-ethinyl-oestradiol, beta-oestradiol), antibiotics (azithromycin, clarithromycin, erythromycin, sulfamethoxazole, trimethoprim) anti-inflammatory drugs (diclofenac, ibuprofen), analgesics (tramadol), diuretics (furosemide), anticonvulsant (carbamazepine), benzodiazepines (alprazolam, lorazepam) and anti-diabetic drug (metformin). Their degradations were evaluated by UHPLC-MS.

Nine different photocatalysts have been synthesized by organic and aqueous sol-gel methods and deposited as thin films by dip-coating on alkaline-free glass substrate: zinc oxide (ZnO), titanium dioxide (TiO₂) and doped titanium dioxide (with Ag, Degussa P25, and MnO₂ - nanoparticles, with Zn²⁺ ions and with carbon nanotubes). Characterizations were made by profilometry for films' thickness and roughness, by GIXRD for photoactive crystalline phase presence, by diffuse reflectance from corresponding powders for Band-Gap determination and by ICP-AES for dopants percentages in films and in water (leaching concentration through delamination).

The best photocatalyst found was silver doped titanium dioxide. A film was then deposited inside a one-meter long alkaline-free tube for pilot trials. Experiments were carried out with 150 L of our model water and with 150 L of waste water at the exit of a WWTP. Both experiments have confirmed laboratory results for degradation of pharmaceutical products in water.

Degradation of 15 pharmaceutical products by an ozone - UVc - Ag doped TiO₂ combination: laboratory & pilot scales

