mgr inż. Agnieszka Fiszka Borzyszkowska
Katedra Technologii Środowiska
Wydział Chemii
Uniwersytet Gdański

Summary of doctoral dissertation

"Removal of cytostatic drugs from aqueous solutions by photocatalysis and electrolysis"

The main sources in the environment of cytostatic drugs commonly used in chemotherapy are insufficiently treated hospital, municipal and industrial sewage. Due to their carcinogenic, teratogenic and mutagenic properties, their discharged into the aquatic environment poses a threat to aquatic organisms and humans. Cytostatics are compounds with good solubility in water, they do not undergo photolysis, they are poor in biodegradability, which result in low efficiency of their removal in conventional wastewater treatment plants and consequently the presence in the water body.

Advanced Oxidation Processes - AOP are an alternative to conventional water treatment. The present studies are focused on photocatalysis and electrolysis belonged to AOP, which were applied to remove cytostatic drugs from aqueous solutions. The first stage of study included the synthesis and characteristic of a series of xBi-B-TiO_2 photocatalysts with the B content of 2 mole % and the Bi content in the range from x = 0 to x = 5 mole %. Then, the photocatalyst with the highest photocatalytic activity was selected for detailed studies of kinetics and mechanism of degradation cytostatic drugs such as ifosfamide (IF), cyclophosphamide (CF), 5-fluorouracil (5-FU) and imatinib (IMA) In the electrochemical process, a commercial BDD electrode (boron doped diamond) was used to remove above mentioned cytostatics from water solutions. In both processes the effect of pH and drug concentration on efficiency and drug removal rate was determined. Furthermore, depending on the method used, the process conditions were investigated. For the photocatalytic process the dose of the photocatalyst was optimized, while for the electrochemical processes, the current density, the flow rate of the solution and the type of electrolyser were selected. Additionally, the effect of ions (Cl^-, $H_2PO_4^-/HPO_4^{2-}$, HCO_3^-, NH_4^+, NO_3^-) naturally occurring in waters on the electrochemical decomposition rate of IF was determined.

The mechanism of drug degradation was studied by: reaction with scavengers of species fotogenerated during the process (h^+, $OH^{\bullet}$, $O_2^{\bullet-}$) or examination $^{\bullet}OH$ radicals generation by reaction with N-dimethyl-p-nitrosoaniline (RNO) during electrolysis. The quality investigations of organic products by a technique LC-(ESI) MS/MS and quantity of inorganic products using a commercially available test cuvette was examined. In addition, the eco-toxicity tests towards *L. minor* for drugs and mixtures of their products after the decomposition process was investigated.

The research has indicated that the proposed oxidation can successfully be applied for the removal of cytostatic drugs from the aqueous body.

Keywords: electrocatalysis, photocatalysis, cytostatic drugs, Advanced Oxidation Processes (AOP)