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SCREENING EXPERIMENTS ON FLUTAMIDE DEGRADATION VIA TiO₂ ASSISTED PHOTOCATALYSE

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Introduction

Flutamide, 2-methyl-N-[4-nitro-3-(trifluoromethyl)phenyl]-propanamide (FT) is nonsteroidal androgen drug used mainly for treatment of prostate cancer, but also for transgender hormone therapy and skin and hair conditions.

There is available very limited information on FT degradation using advanced oxidation processes (AOPs). In fact, to our knowledge only one study is available which used direct photolysis, UV/H₂O₂ and UV/S₂O₈²⁻ systems and concluded that FT degradation was not very effective pointed out the need to consider also other advanced oxidation processes and/or a combination of them. In this aim, a preliminary screening of FT degradation via TiO₂ assisted photocatalyse was performed. The main photocatalyse parameters that were investigated were the photo catalyst dose and irradiation time.

Materials and methods

The following reagents were used during the photocatalyse experiments: flutamide (Sigma), TiO₂ (Merck). Photocatalyse experiments were performed using a Heraeus UV reactor equipped with a TQ150-Z3 medium pressure mercury lamp. All experiments were made on synthetic solutions and prior to irradiation the samples were bubbled with air for 30 minutes in order to avoid holes-electrons recombination. FT concentration was monitored using HPLC technique.

Results and conclusions

In order to determine optimum TiO₂ dose, a synthetic solutions of FT with the concentration of 19.23 mg/L = 6.97×10^{-2} M was subject to degradation for 30 minutes of irradiation at TiO₂ doses between 100-400 mg/L. Experimental results presented in the following table revealed that the optimum dose for FT degradation is 100 mg/L TiO₂. The optimum photo catalyst dose assured a degradation efficiency of 22.83% and a residual FT concentration of 14.84 mg/L = 5.38×10^{-2} M after 30 minutes of irradiation. Larger TiO₂ doses led to a decrease of FT degradation efficiency that can be explained on the one hand by the UV radiation scattering effect and on the other hand by the tendency of the photo catalyst to agglomerate. Experimental results on TiO₂ dose influence upon FT degradation efficiency is presented within Table 1.

Table 1. Flutamide degradation efficiency vs. TiO₂ dose

TiO ₂ mg/L	[FT] mg/L	[FT] M	Efficiency %
100	14.84	5.38×10^{-2}	22.83%
200	15.48	5.61×10^{-2}	19.50%
300	15.77	5.71×10^{-2}	17.99%
400	15.95	5.78×10^{-2}	17.06%

In order to establish the optimum time degradation experiments in the same conditions were performed for an irradiation time up to 420 minutes (7h). Prolonging the irradiation time proved to have a positive effect upon FT degradation efficiency. The linearization of FT degradation reaction after a pseudo-first order kinetic allowed to calculate the process' rate constants for each photo catalyst dose, from the graphs slopes, as showed in Figure 1.

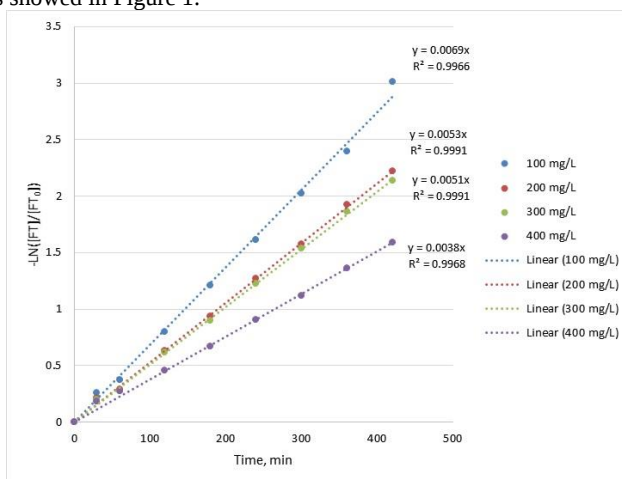


Figure 1. Pseudo-first order kinetic of FT degradation

Experimental results confirmed that optimum conditions for FT degradation via UV/TiO₂ system are: photo-catalyst dose of 100 mg/L and irradiation time of 420 minutes, which assured the substrate $[FT]_0 = 19.23 \text{ mg/L} = 6.97 \times 10^{-2} \text{ M}$ degradation with an efficiency of 95% and a residual FT concentration of $0.95 \text{ mg/L} = 3.44 \times 10^{-3} \text{ M}$. Our results are similar with those reported in the only study found in literature on FT degradation via AOPs and only a final conclusion can be drawn: there is need to combine various AOPs processes in order to improve generation of highly reactive radicals, which could be more efficient in FT degradation process.

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