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METHYL PARABEN DEGRADATION USING TITANIUM DIOXIDE ASSISTED PHOTO CATALYSE

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Introduction

Parabens presence within the environment was confirmed by their identification in concentrations up to mg/L. Even if classical municipal wastewater treatment plants achieve their removal up to 98%, parabens were still identified within discharged effluents in concentrations of ng/L or in some cases up to µg/L. Therefore, there is a need for more performant treatment methods that allows parabens' advanced removal.

Materials and methods

UV/TiO_2 system was tested for the advanced degradation of MeP from mono component synthetic solutions. The influence of following parameters was investigated: photo catalyst dose, initial solution pH, irradiation time, using a UV-VIS Heraeus type reactor equipped with a TQ150-Z3 lamp which emits in the domain λ = 320 – 550 nm. MeP concentration was monitored using GC-FID technique using an Agilent 6890N. MeP from Sigma – Aldrich and TiO_2 from Merck were used.

Results and conclusions

Photo catalyst dose influence

Photocatalytic degradation experiments were performed in the following operating conditions: initial pH = 7, initial pollutant concentration $[MeP]_0$ = 8,85 mg/L, photocatalyst dose $[TiO_2]$ = 100 – 800 mg/L, irradiation time = 30 minutes. The experimental results are presented within Figure 1.

The results revealed the improvement of MeP degradation rate with the increase of TiO_2 dose within the interval 100-200 mg/L, due to the availability of more active sites for pollutant adsorption. The further increase of photo catalyst dose within the domain 300-800 mg/L led to a negative effect on MeP degradation rate due to the light scattering effect. The optimum TiO_2 dose was set at *200 mg/L*. It assures MeP degradation with an 83% efficiency and degradation rate of 3×10^{-5} M s^{-1} after 30 minutes of irradiation,

Initial pH and irradiation time influence

Photocatalytic experiments were performed at optimum TiO_2 dose at various initial pH: 5, 7, and 9 and irradiation time in the domain 30-90 minutes. Obtained experimental results are presented within Table 1.

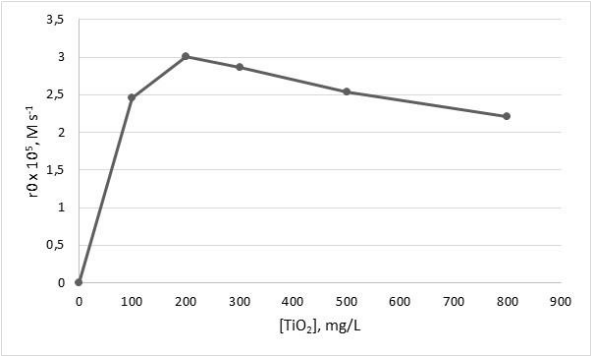

Figure 1. MeP degradation rate vs. photocatalyst dose

Table 1. Initial pH influence upon MeP degradation at various irradiation time

Time, min	[MeP], mg/L	Efficiency, %	k x 10^3 s^{-1}
	pH = 5		
20	1.49	83.14	*1.34*
30	0.81	90.86	
45	0.28	96.83	
60	0.07	99.20	
90	*0.005*	*99.93*	
	pH = 7		
20	3.75	57.62	0.76
30	1.48	83.28	
45	1.06	87.99	
60	0.63	92.88	
90	0.17	98.10	
	pH = 9		
20	4.17	52.86	0.52
30	3.52	60.26	
45	2.20	75.14	
60	1.55	82.48	
90	0.55	93.73	

Better degradation efficiencies are registered for acidic conditions (pH = 5). This behaviour is due to interactions between pollutant and catalyst surface charge that are more powerful with the pH increase, MeP has a pKa = 8.17 and TiO_2 is characterised by PZC = 7.

Summarising the optimum conditions for MeP degradation are initial pH = 5, TiO2 dose = 200 mg/L and irradiation time = 90 minutes.

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