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BISPHENOL A DEGRADATION VIA TIO_2 ASSISTED PHOTOCATALYSE

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Introduction

Endocrine system is playing an important role in short and long term functioning of metabolic processes. For example is responsible for digestive, cardio, hepatic functions. Endocrine disruptors are perturbing normal functioning of endocrine function, having an adverse effect on human health. Bisphenol A (BA) is an endocrine disruptor omnipresent within plastic materials based on polycarbonate and epoxy resins such as water plastic bottles, food boxes, water pipes, medical equipment a.s.o. More than half million tonnes of BA are released in the environment each year. Exposure to BA can lead also to high level of anxiety, depression, hyperactivity, behaviour issues for children. BA it was found in mother's milk, urine and placenta tissue.

Materials and methods

BA synthetic solutions were subject to photocatalytic experiments using a Heraeus type reactor. The following parameters were varied during the photocatalytic experiments: photocatalyst dose $[TiO_2]$ = 50 – 500 mg/L, pH = 4-10, irradiation time = 30-120 minutes, initial pollutant concentration $[BA]_0$=1.255 – 28.982 mg/L. BA concentration was monitored via GC-MS.

Results and conclusions

The photocatalytic experiments revealed that BA degradation efficiency is increasing with the increase of photocatalyst dose up to 200 mg/L. This behaviour is explained due to the increase of active sites on photocatalyst surface. At TiO_2 concentration higher than 200 mg/L degradation efficiencies are decreasing due to the light scattering phenomenon. This is also sustained by the evolution of BA initial degradation rate after 30 minutes of irradiation at various TiO_2 doses. From the obtained results was selected an optimum photocatalyst dose $[TiO_2]$ = 200 mg/L whicih assures degradation of substrate $[BA]_0 = 5{,}22 \times 10^{-5}$ M with the highest degradation rate $v_0 = 1{,}357 \times 10^{-6}$ M min^{-1}. In order to evaluate the pH effect photocatalytic experiments were performed for the same initial concentration of BA, the obtained results proving that optimum pH is 8. Prolonging of irradiation time it was found to have a positive effect on BA degradation efficiency an efficiency of 99.93% degradation being achieved after 120 minutes of irradiation.

It was also checked that BA degradation is respecting Langmuir Hinshelwood model using the linearized equation

$$\frac{1}{v_0} = \frac{1}{k_r K_{ad}[P]_0} + \frac{1}{k_r} \qquad (1)$$

where: v_0 = initial pollutant degradation rate (M min^{-1}); $[P]_0$ = initial pollutant concentration (M) ; kr = rate constant for pollutant photocatalytic degradation (min^{-1}) ; K_{ad} = pollutant's adsorption – desorption equilibrium constant on photocatalyst surface (M^{-1}).

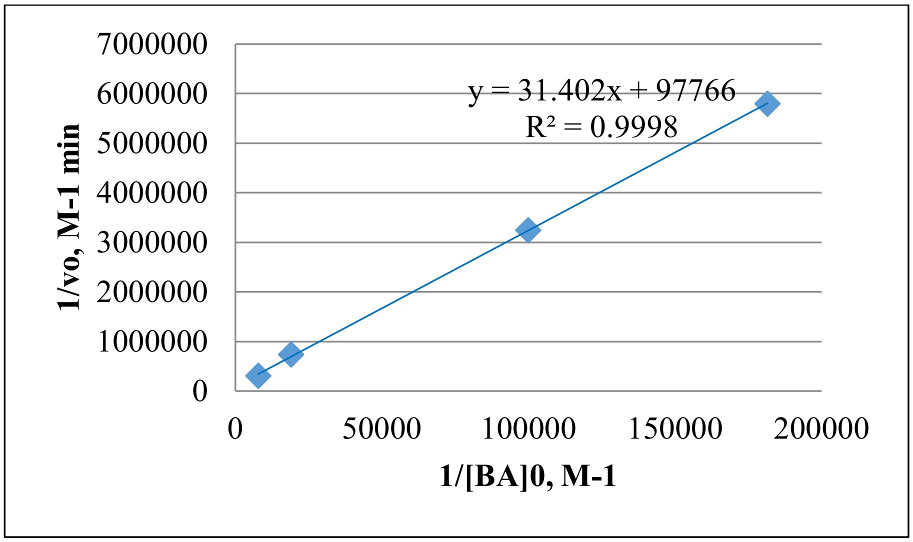

Figure 1. Linearized Langmuir – Hinshelwood equation

Adsorption – desorption equilibrium constant K_{ad} = 3114 M^{-1} was calculated from the slope , and a rate constant value of k_r = 1,03 x 10^{-5} M min^{-1} was obtained from the intercept.

Experimental results proved that BA photocatalytic degradation is obeying Langmuir Hinshelwood model and reaction rate constant and adsoprtion – desorption equilibrium constant were calculated. Optimum operational parameters: photocatalyst dose, pH, irradiation time were established.

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