PHOTOCATALYTIC DEGRADATION OF PESTICIDES IN AQUEOUS TiO_2 SUSPENSION

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Introduction. In Mexico and especially in regions of karst geology, in other words, deposits of highly permeable limestone, pollution of surface and ground water by pesticides used in agriculture, has caused seriously health problems, such as breast cancer, congenital malformations and even neonatal mortality [1].
Faced with this problem, it is intended to establish the optimal operating conditions at level pilot plant for degradation of Gesaprim® (atrazine) and Esteron* 47-M (2,4-D), the most widely used pesticides in Mexico, by solar heterogeneous photocatalysis, as a preliminary stage in the industrialization of solar photocatalytic processes.

Methods. Pesticides degradation was carried out in a Compound Parabolic Collector (CPC), with 30L of tap water at natural pH (6.8-7), under a cloudless sunny sky; 110 ppm of TiO_2, 90 ppm of atrazine and 56 ppm of 2,4-D were added and homogenized for 10 minutes. Then, H_2O_2 was added at 30% and the solar photo catalysis was carried out during 30 minutes. The mineralization degree of the mixture was evaluated on a Total Organic Carbon (TOC) analyzer according to the method of catalytic combustion-oxidation at 680 °C by Shimadzu (TOC-L CSN) [2]; monitoring and evaluation of the active ingredients degradation was fulfill by UV/Vis spectrophotometer (Jenway, 6715), at 222 nm and 280 nm for atrazine and 2,4-D, respectively, while for H_2O_2 consumption was determine at 410 nm, according to Eisenberg y Eisenhauer [3].

Results. TOC degradation is shown in Fig. 1 with a 52.14% of mineralization for herbicides mixture during 30 minutes of reaction. In the same way, a degradation of the active ingredient (atrazine) of 18.14% can be seen, while in 2,4-D, degradation increases to 71.81% during de first 10 min of reaction. The addition of H_2O_2 promotes the degradation of 2,4-D, however, atrazine degradation is not equally favoured [4]. Due to its complex structure, degradation takes places more slowly than 2,4-D, besides this, it also presents a stripping effect, as a result of its water solubility. The comparison between the graphics, suggests the formation of intermediaries compounds that may also compete in equal or greater intensity by hydroxyl radicals, decreasing speed of degradation of principals compounds [5].

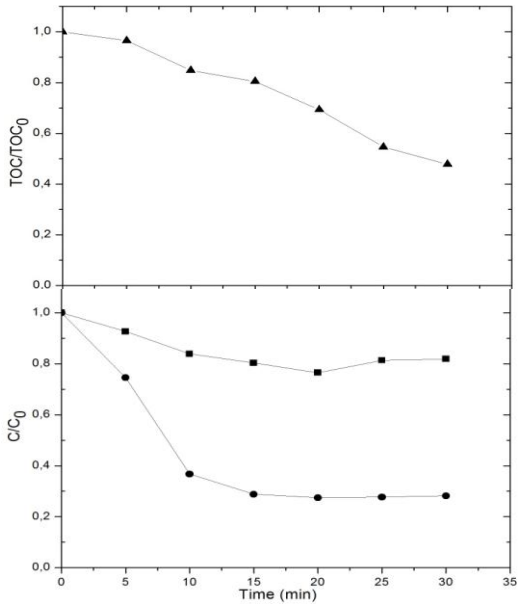

Fig. 1 Monitoring of TOC degradation (▲) of herbicide mixture, Gesaprim®-Esteron* 47-M and of the active ingredients (■) atrazine and (●) 2,4-D.

Conclusions. The Photocatalytic process can be a good substitute for treatments that consume too much energy, as it uses renewable solar energy and pollution-free. The degree of mineralization in 30 minutes is high, as well as the degradation of 2,4-D, from a commercial herbicide, while for atrazine can linger longer for its complete mineralization. The degradation of active ingredients using TiO_2 nanoparticles is posible, besides being a variable alternative for the disinfection of wastewater contaminated with pathogenic bacteria, due to it disrupts the plasma membrane causing cell death. Therefore, the TiO_2 can be used for chemical and biological decontamination processes at the same time.

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