Photo-assisted Electrochemical Treatment of Pesticide residues

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Introdução

Almost every stage of pesticide use involves the formation of waste, which must be disposed of in a suitable manner. In recent years effort has been concentrated on the development of friendlier substances that are more readily degradable under environmental conditions. However, whilst this is the ideal solution, it is also true that, inevitably, large quantities of pesticide-containing waste are generated during agricultural processes, which can result in localised pollution. Pesticide disposal methods suggested by organisations such as the Food and Agricultural Organisation (FAO) of the UN include, amongst others, incineration, landfill disposal and long term storage, which are clearly not “green” solutions. Experts argue that there is a need for the development of cleaner treatment systems that can be employed by small-scale users and are sufficiently mobile to be shared between various locations [1]. Treatment systems using photoelectrochemical methods (a combination of photochemical and electrochemical techniques) are promising for use in such mobile systems as the equipment required tends to occupy a relatively small area (compared to biological systems) and the control parameters (current, potential) are relatively easy to monitor and control. In this light, the present paper describes the study of the photoelectrochemical degradation of two distinct pesticides: carbaryl (1-naphthalenylmethyl-carbamate) and atrazine (2-chloro-4-ethylamino-1,3,5-triazine). These substances represent two widely employed classes of pesticide and by employing them we hope to demonstrate the wide spectrum of application of the technique.

Studies were performed in a photoelectrochemical flow-cell using a dimensionally stable anode (area=14 cm^2) of nominal composition $Ti/Ru_{0.3}Ti_{0.7}O_2$. Experiments were performed by applying an electrochemical potential or current simultaneously with application of UV-vis radiation. Na_2SO_4 (0.033 mol/L) was used as supporting electrolyte and the pesticides were present at 20 mg/L in all cases.

Resultados e Discussão

The results obtained during fixed current photoelectrochemical treatment show the effectiveness of the degradation process used. Fig.1 shows the extent of atrazine removal as a function of photoelectrochemical treatment time at 10 mA/cm^2 and as a comparison the corresponding photo/electrochemical methods are presented. It is apparent that the combined method is far more effective than the isolated methods. The same phenomenon is also observed when carbaryl is treated under the same conditions. It is noted that the energy efficiency of pesticide degradation is improved at lower applied currents than at higher ones. An important observation is that the chemical oxygen demand (COD) is significantly reduced during the treatment, but barely changes when the isolated processes are used.

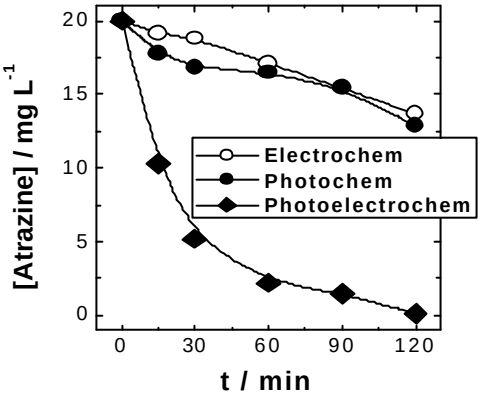

Fig1: Variation of **a**trazine concentration during photoelectrochemical (10 mA/cm^2) treatment of a 0.033 mol/L $NaSO_4$ solution containing 20 mg/L of atrazine

Conclusões

Overall the results demonstrate the effectiveness of the treatment process employed and its applicability for degradation of pesticides of different structural classes. The paper also presents results of the effect of varying reactor conditions and the results are discussed in terms of the energy per order (kW h / order), according to IUPAC guidelines [2].

Agradecimentos

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