

New trends in advanced oxidation processes: Electrochemical and Sonochemical oxidation systems for tartrazine removal

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1. Introduction

Tartrazine degradation was investigated by electro-oxidation and sono-chemical processes. Anodic oxidation was carried out using boron-doped diamond electrodes (BDD) to establish the influence of the variables and to determine an optimum. Total removal of tartrazine was obtained when an energy dose of 3.5 A.h.dm⁻³ was applied, removals of 94.4% and 72.8% of COD and TOC, respectively were obtained. The removal of dye, the kinetic constant, and total organic carbon (TOC) removal were chosen as target variables. In optimal conditions Sonochemical oxidation experiments at high frequency range (MHz) were executed in order to establish the influence of the different operation variables; ultrasound frequency (0.5-1.1 MHz), ultrasound amplitude (0-100%) and pulse-stop ratio (1-5). In optimal conditions, a tartrazine removal of 30% was obtained at 30 min of cavitation.

2. Experimental

For the oxidation process by electro-oxidation, the experimental installation consists of Single-compartment electrochemical cell, where boron-doped diamond (DDB) is used as an anode and stainless steel (AISI 304) as cathode. The experimental installation for sonochemical oxidation consists of a transducer E/805/T/M (Meinhardt Ultrasonic) with flat transducers of V4A Titan and 75mm diameter, a centrifugal pump working at 280 cm³/min, and a multi-frequency generating source.

3. Results and Discussion

❖ Electrochemical oxidation processes:

Eqs. (1), (2) show the adjustment coefficients for each of the factors, where C represents the concentration of compound and j represents the current density.

$$\begin{aligned} \% \text{ Tartrazine removal} &= 99,7175 + 8,70709 \cdot j - \\ &- 1,08477 \cdot C - 8,39627 \cdot j^2 + 2,1725 \cdot j \cdot C + 1,92628 \cdot C^2 \quad \text{Eq. 1} \end{aligned}$$

$$\begin{aligned} \% \text{ TOC removal} &= 72,8838 + 14,6048 \cdot j + 5,9532 \cdot C - \\ &- 8,10878 \cdot j^2 - 1,88 \cdot j \cdot C + 0,188757 \cdot C^2 \quad \text{Eq. 2} \end{aligned}$$

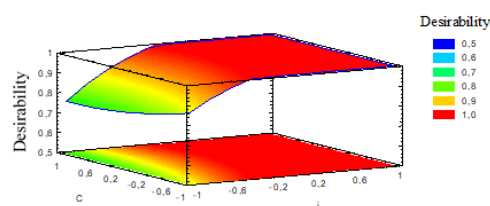


Figure 1. Desirability curve of compound removal and kinetic constant reaction rate. Electro-oxidation treatment.

❖ Sonochemical oxidation Processes

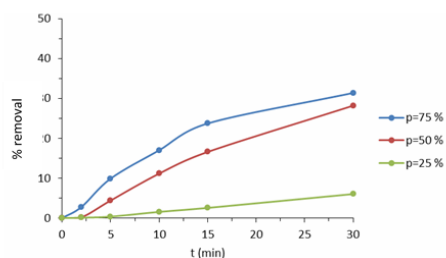


Figure 2. Influence of power/amplitude on Tartrazine removal. f=578kHz P-p=250-50 ms..