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EXPLOITATION PARAMETERS OF PHENOL PHOTOCATALYTIC DEGRADATION FOR A PILOT-PLANT

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Abstract.

The oxidation of low concentrations of phenol (25-200 ppm) by heterogeneous photocatalysis (TiO_2; 7% ActiveCarbon-Titanium dioxide) has been studied in order to establish general exploitation parameters for a pilot-plant using solar radiation. Several experiments have shown no critical influence of tap water in degradation rate not even some ions activities below 200 ppm. The cumulative values were controlled by an ion chromatograph (DIONEX with electrochemical detector ED50; chloride, sulphate).

Special attention has been paid to photocatalysts recycling after degradation processes, showing no critical influence after system losses replacement without treatment. The use of the pilot-plant demands optimization of reagents and catalysts addition, valuing not only efficiency but the amount of used catalyst, the loads of polluting agent and the times of degradation as well. The purpose of optimizing costs in the operation of the system at industrial level should not take into account the little difference in the efficiencies in the case of an increase of the 100% in the presence of the catalyst from a given concentration (0.5 g/l), at least in the degradation of phenol under 100 ppm. No critical differences have been observed between the use of TiO_2 and TiO_2 with an addition of 7% Active Carbon in plant for concentrations under 50 ppm. System losses in both components have shown not to be proportional after active carbon removal from recycled catalysts so especial attention has to be paid in catalysts losses replacement.

Solar radiation effective minima have been established for different initial concentrations of phenol and catalysts. A schedule of minimum efficiency leaves dairy optima from 8:45 for 20:30 in spring-summer and from 10:00 for 17:15 in December. Reaction presents critical rates under 11 W/m^2 (cal. 200-400 nm) so no reaction has been conducted regularly under these conditions. The cumulative radiation for different degradation comparisons has been established directly from pilot-plant radiometer measurements (HAMMAMATSU G5842; 10,4 mm^2 x 2; cal. 200-400 nm) previously calibrated by a Grasby photodiode whose answer we considered adjusts to its theoretical spectral response (UDT 222UV; 1 cm2; lime. 200-400 nm). Laboratory irradiation from Philips CLEO (15W x 4; solar spectrum simulator) was calibrated trough Grasby photodiode.

Influence of intermediates (cathecol, hydroquinone) and pH deviations control over degradation process have shown optimisation potential to improve daily degradation rates. The relations and evolution found *in labo* and the later experiments under solar irradiation display similar relative magnitudes and behaviours. Degradation rates after two hours show no critical differences with recycled catalysts but the proportional total organic carbon from intermediates increases. Nevertheless the time at which phenol, cathecol and hydroquinone

become under detection limit after two hours control present no significant differences. After TOC (< 0.48 ppm) falls under detection limit no organic compounds have been found over catalysts surface. After phenol and main intermediates fall under detection limit (< 1,6 ppm) TOC remains around 5 ppm and formiates have been mainly detected over catalysts surface by FTIR (Mattson-UNICAM Research Series I).

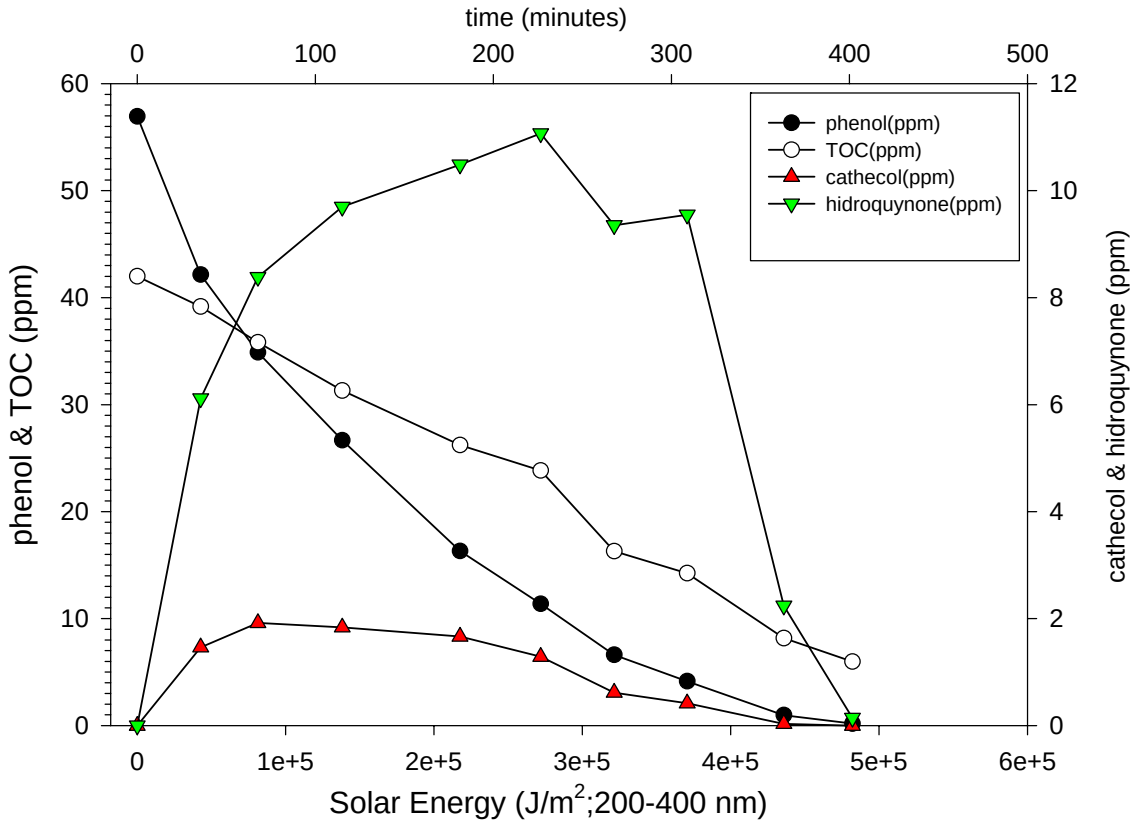

Figure 1. Phenol (•), two reaction intermediates (cathecol (▲), hydroquinone (▽)) and TOC (○) evolution in pilot-plant with recycled catalysts (TiO_2).