Nano and micro-TiO_2 for the photodegradation of ethanol: experimental data and kinetic modelling.

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The pollution abatement is very important nowadays, but the worldwide research needs to develop new "green" technologies [1]. The TiO_2-photodegradation of pollutants is an effective alternative to the much more expensive advanced oxidation processes (AOPs), as the VOC's degradation is a crucial point in order to improve both air and human health quality [2]. In this study, two different commercial TiO_2 samples were tested in the photodegradation of ethanol, chosen as model molecule, but also considering it as an important atmospheric pollutant: ethanol emissions accounted for about 4% of the total VOCs anthropogenic emissions in the UK in 1993 [3].
From a kinetic point of view, the whole process can be simplified considering a two consecutive first order reactions mechanism on the catalyst surface, in which the adsorbed ethanol is converted to acetaldehyde, which is mineralized to carbon dioxide and water (Langmuir-Hinshelwood mechanism). The experimental data were used for the regression of the characteristics kinetic parameters. Photocatalytic degradations were conducted in a cylindrical glass reactor with an ethanol concentration of 400 ppmv; the photon sources were provided by a 500 W UV lamp (Jelosil model HG 500) and the VOC's molecules were monitored by a gas chromatography (Agilent 3000 A microGC). The regression of the adsorption and the kinetic constants were made using MATLAB software; the simulated results exhibit a good fit for the test performed using both the micro- and nano-samples. The analysis of the kinetic elaboration gives us important information about the rate of reaction: it is in general increased if catalysed by nanometric sample. Nevertheless, the catalytic properties of micro-samples are confirmed. In particular, considering the degradation of ethanol, the rate of its conversion is not so different for either nanometric or micrometric samples. The micrometric TiO_2, less dangerous and less expensive with respect to the nanometric P25, is active as photocatalysts, being able to degrade VOCs into CO_2, also if with rate of reaction, and then kinetic constants, lower respect the P25. The good fitting between experimental and simulated results confirms the assumption of a consecutive first order reaction mechanism degradation pathway that is not influenced by the TiO_2 crystallites dimension.

Keywords: *Ethanol photodegradation, kinetic modelling, micrometric TiO_2, VOC.*
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