Nanosized TiO_2 compared according to chemometric analysis with other titanium dioxides for photodegradation application

Giovanni Visco, Francesco Bellanti and Luigi Campanella
Department of Chemistry, Rome University, La Sapienza, Pl. Aldo Moro 5, 00158 Rome, Italy, (visco@uniroma1.it)

For more than thirty years the so called oxidation advanced processes (AOPs) have been continuously studied. They are based on photochemical reactions catalysed by suitable metal oxides with semiconductor properties.

A particular attention was always paid to the reaction mechanisms and to the interaction with the energy source.

One of most critical parameters ruling the efficiency of the photocatalytic process is constituted by the interface between the liquid solution and the solid catalyst, generally coming to the conclusion that the surface area of the catalyst is a determining parameter as directly related to the process efficiency.

In this trend nanotechnologies play a very important role basing on the possibility of producing very thin powders (particle size less than 50 nm), corresponding to a surface area of 1000mq per gram.

In this paper we deal with the possibility of designing and building a system able to promote high efficiency photodegradative processes by the above catalysts.

This instrumental assembly is constituted by two cells bound by a tube system fed by a peristaltic pump. On each one of the cells two different light sources characterised by different spectra are inciding. As targets we focused on high environmental impact and large diffusion pollutants from textile industry easy to be found, as it is the case of four industrial dyes. Then we compared the efficiency of the nanosized catalyst with that of the same catalyst but used at greater particle size.

For each one of the catalysts the trend of the photodegradation yield on varying the amount of catalyst was studied to evaluate the least one needed to get significant photodegradation degrees.

The other parameter is the time of the treatment as its prolongment produces an increase of the operative costs and a decrease of the litres per hour yield.

Therefore we looked for a minimum time analogously to the minimum catalyst amount.

In fig. 1 we present these minimum values obtained with only one lamp, using UV/Vis spectrophotometry as monitoring very rapid and sensitive technique, in reason of the nature of the monitored molecules (dyes).

Experimental data are chemometrically handled due to the high number of variables used during the experiment.

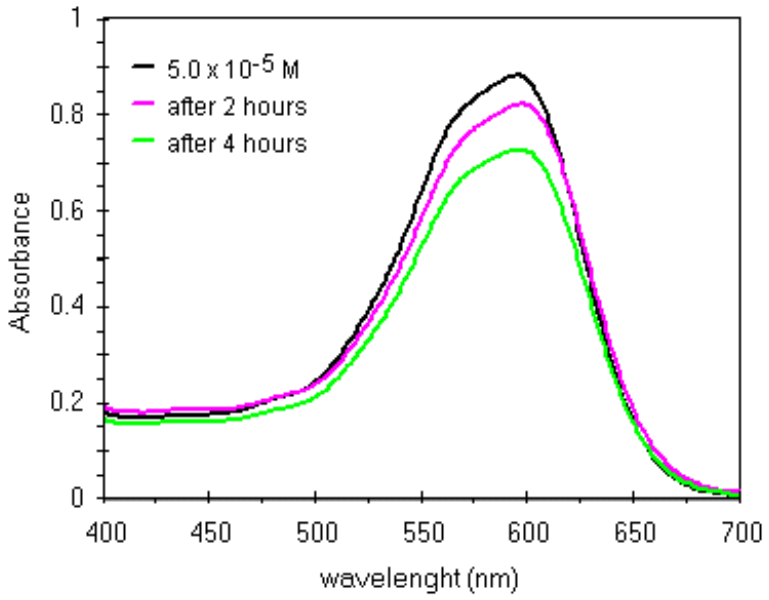

Fig. 1
Photodegradation of Acid Blue 29 dye with simulated solar spectrum; 20W dicroic lamp only with 0.5 g/L TiO_2 nanosize Degussa catalyst

To conclude, efficiency of nanosized TiO2 is largely better than that one of other types of catalyst so pointing out the relief of the nanotechnological approach even in this field.