TiO_2 photocatalyst thin film by emulsions and their activity in the degradation of phenol

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Introduction

The TiO_2 emulsions correctly prepared generate an alternative for the synthesis of catalytic films in appropriate supports [1], and being the phenol one of the pollutants most difficult to eliminate in the exhausts and its frequent presence in the chemical and petroleum industries [2], it was compare, in this paper, the efficiency of the photocatalyst destruction of phenol using kaolin pellets coatings with TiO_2 impregnated by different emulsions.

Materials and Methods

The extruded was prepared using industrial kaolin and 2 % of magnesium silicate as the binder. There were prepared three different emulsions of TiO_2 for obtaining the coatings on the supports, a TiO_2 suspension, a standard emulsion and an emulsion with acrylic resin.

The catalysts were prepared by dip-coating and they were dried and calcined as was described before [3]. The water treating had 100 ppm of phenol and the reaction was realized in a tubular reactor of ½ inch of diameter and 88.4 ml of capacity, using an external mercury lamp of black light, 15W, in a continuous flow mode, 30 grams of catalyst were used in every test, the water samples were analyzed using a GC-HP at different time intervals. Samples of catalysts before use in the reaction were studied with X-ray diffraction (XRD) in a Siemens 5000 powder diffractometer in the 20-90° region using CuKα lamp radiation, inductively coupled plasma (ICP) optical emission spectroscopy Perkin Elmer 2380, UV-Vis diffuse reflectance spectra, Raman spectroscopy using charge coupled detector to 5145 angstroms and a FTIR Perkin Elmer System 2000x.

Results and Discussion

The ICP results showed in the table 1, show similar results in the content of TiO_2, but in agreement to the area used they indicate more than 60 % in the surface of the catalyst. The XRD results, appears clearly the presence of anatase and in minor proportion rutile, being major its presence in the catalyst prepared by suspension, and major the presence of anatase in the catalyst with the employment of the resin.

For the spectra Raman observes a strong interaction between the support of kaolin and the titanium which modifies its curves showing the typical peaks of the kaolin and diminishing the presence of the titanium, for what it does not appreciate any sign of the presence of rutile. During the reaction the catalysts showed a low resistance to the wear, losing small quantities of catalyst during the tests of 5 hours, in major proportion the catalyst prepared by suspension. The conversions showed very similar results, between 65 and 70 % from its first step along the reactor, conversion that they increase with the time, up to 100 % after 4 hours of reaction.

Table 1. Inductively coupled plasma results

Catalyst	TiO_2 (wt %)
TiO_2 suspension	2.3
TiO_2 emulsion	2.2
TiO_2 emulsion with resin	2.38

Significance

The obtained results show that catalysts of titanium of easy preparation allow getting commercial conversions, with which there is opened the possibility of being applied in processes of control of pollution, especially in systems in which the conventional equipments do not work

References

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