EUROMAT 2011

FEMS

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European Congress
on Advanced Materials and Processes

12-15 September 2011

Montpellier, France

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Main Topics

Functional Materials: Properties & Applications
Magnetic Materials; Materials for Nanostructures; Functional Polymeric Materials; MEMS, NEMS and Devices

Structural Materials: Properties & Applications
Advanced Metals; Advanced Ceramics; Hybrid and Composite Materials; Advanced Concepts in Structural Materials

Materials Processing
Solidification and Solid State Transformations; Joining; Powder Routes: from Synthesis to Materials; Coatings and Surface Engineering; New concepts in Materials Processing

Characterisation and Modeling
Microstructural Characterisation Techniques; Mechanical Characterisation Techniques ; Materials Modeling on all Length Scales

Energy and related Applications
Energy Production, Transportation and Management; Materials for Energy in a Sustainable Society; Materials for Transportation

Health Care Applications
Materials for Health Care Applications

Education

Topic Area E Energy and related Applications
Topic E2 - Materials for Energy in a Sustainable Society
Symposium E21 - Materials for Photovoltaics
Session Postersession

E21-P-1-25
1211

Importance of the colloidal state on the TiO2-based photocatalysis

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Abstract

Several studies have demonstrated the use of semiconductors in the photodegradation of organic compounds.1,2 However, there are no systematic studies reporting the influence of photocatalyst and organic molecule concentration in these processes, which may have influence on the colloidal state of the semiconductor nanoparticles.3 The present study evaluates the process of Rhodamine B (RhB) dye photodegradation with TiO2 semiconductor as photocatalyst using factorial planning with four levels of [TiO2] (75, 150, 300 and 500 mg/L) and [RhB]0 (1.0, 2.5, 5.0 and 7.5 mg/L). Observations showed a first order reaction with respect to RhB for the majority of the tests performed. However, a pseudo zero order kinetic was observed for tests with higher contaminant/photocatalyst ratios. The most important point in this study, the results showed that the concentration of RhB is determinant in the process due to its ionization, through an acid-base equilibrium, which causes pH variations of the solution and hence variations in surface charge and also in colloidal stability of TiO2. These changes are known to influence the interaction between RhB and TiO2 and thus, the process effectiveness. Because of that, to the system studied, only some relations between dye and photocatalyst concentration could have attractive interactions necessary to the process effectiveness.

A specific RhB concentration has the same pH where occurs the isoelectric point (IEP) of TiO2 used in this work. In that condition, we had great influence of the TiO2 concentration in k*, the rate constant of the reaction per unit of catalyst surface area. It was because of the colloidal state, where we had a lot of sedimented nanoparticles. In another conditions studied, the rate constant depended only on the surface area, being, as said before, constant per catalyst surface area. In [RhB]0=7.5mg/L, is noted a little decay in k* too, but in this case other effects are acting, like radiation scattering.

Keywords: Photocatalysis; Kinetic; Factorial planning; Concentration; Acid-base equilibrium.

1- U. I. Gaya, A. H. Abdullah, J. Photochem. Photobiol. C, 2008, 9, 1.
2- H. A. J. L. Mourão, V. R. Mendonça, A. R. Malagutti, C. Ribeiro, Quim. Nova, 2009, 32, 2181.
3- N. Barka, S. Qourzal, S. Assabbane, A. Nounah, Y. Ait-Ichou, J. Phochem. Photobiol. A, 2008, 195, 346.

$$v = -\frac{d[RhB]}{dt} = k[RhB][A.S.]$$

[A.S.] = actives sites concentration, which is directly proportional to specific surface area.

$$k' = [A.S.]k$$

$$-\ln\left(\frac{[RhB]}{[RhB]_0}\right) = k' t$$

$k' = k$ S.A.; Where S.A. is the specific surface area