World Academy of Science, Engineering and Technology
International Journal of Environmental and Ecological Engineering
Vol:11, No:01, 2017

Synthesis of Visible-Light-Driven Magnetically Recoverable N-TiO2@SiO2@Fe3O4 Nanophotocatalyst for Enhanced Degradation of Ibuprofen

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Abstract : Ever since the discovery of TiO2 for decomposition of cyanide in water, it has been investigated extensively for the photocatalytic degradation of environmental pollutants, and became the most practical and prevalent photocatalyst. The superiority of TiO2 is due to its chemical and biological inertness, nontoxicity, strong oxidizing power and cost-effectiveness. However, during degradation of pollutants in wastewater, it suffers from problems, such as (a) separation after use, and (b) its poor photocatalytic performance under visible light irradiation (~45% of the solar spectrum). In order to bridge the research gaps, N-TiO2@SiO2@Fe3O4 nanophotocatalysts of average size 19 nm and effective surface area 47 m2 gm-1 were synthesized using sol-gel method. The characterization was performed using BET, TEM-EDX, VSM and XRD. The performance was improved by considering different factors involved during the synthesis, such as calcination temperature, amount of Fe3O4 nanoparticles used and amount of urea used for N-doping. The final nanophotocatalyst was calcined at 500 °C which was able to degrade 94% of the ibuprofen within 5 h of irradiation time. Under the influence of ~200 mT electromagnetic field, 95% nanophotocatalysts separation efficiency was achieved within 20-25 min. Moreover, the effect of different visible light source of similar irradiance, such as compact fluorescent lamp (CFL) and light emitting diode (LED), is also investigated in this research. The performance of nanophotocatalysts was found to be comparatively higher under ~310 µW cm-2 irradiance with peak emissive wavelengths of 543 nm emitted by CFL. Therefore, a promising visible-light-driven magnetically separable TiO2-based nanophotocatalysts was synthesized for the efficient degradation of ibuprofen.

Keywords : ibuprofen, magnetic N-TiO2, photocatalysis, visible light sources
Conference Title : ICCEEST 2017 : International Conference on Chemical, Ecological, Environmental Science and Technology
Conference Location : Singapore, Singapore
Conference Dates : January 08-09, 2017