Removal of some types of polyphenols and aromatic amines in textile industry wastewaters by nanocerium-dioxide-doped titanium dioxide

Delia Teresa Sponza*, Rukiye Oztekin

Department of Environmental Engineering, Engineering Faculty, Dokuz Eylul University, Tuztepe Campus, 35160 Buca/Izmir, Turkey, Tel. +90 232 301 7119; Fax: +90 232 453 11 43; emails: delya.sponza@deu.edu.tr (D.T. Sponza), rukiyeoztekin@gmail.com (R. Oztekin)

Received 2 June 2016; Accepted 26 December 2016

**Abstract**

The interfacial and surface structures of CeO₂-doped TiO₂ prepared under laboratory conditions have been investigated in detail by means of X-ray diffraction (XRD), Brunauer–Emmett–Teller (BET) surface area measurement, a high-resolution transmission electron microscope, X-ray photoelectron spectroscopy (XPS) and energy-dispersive spectroscopy (EDS). TiO₂ and CeO₂ are in the anatase phase and the cubic-fluorite phase in CeO₂–TiO₂ mixed oxides, respectively. The mixed CeO₂–TiO₂ nanocomposite exhibits much higher surface areas than the individual oxides. Field-emission scanning electron microscopy analysis showed that TiO₂ exhibited aggregated spherical particles while a flake-like shape was observed for CeO₂. The peak locations and relative intensities in XRD showed cubic-fluorite crystalline structure for CeO₂. BET analysis results showed that the maximum surface area and pore volume were obtained at a CeO₂ ratio of 15 mg/L CeO₂-doped TiO₂ nanocomposite. The energy dispersive spectrum of the CeO₂-doped TiO₂ nanocomposite showed that only Ti, Ce and O elements are detected in the CeO₂-doped TiO₂ nanocomposite and Ce is mixed with TiO₂. Maximum color, polyphenols (quercetin, fisetin, ellagic acid, carminic acid, luteolin and curcumin) and polyaromatics (2,6-dimethylaniline, 2-aminoanisole, 2,4-toluenediamine, 4,4-thiobisbenzenamine and 3,3-dichlorobenzidine) removal efficiencies were observed between 97% and 99% in a textile industry wastewater (TI ww) treatment plant located in Izmir, Turkey, during photodegradation experiments, under 130 W UV light, at 15% CeO₂ containing 15 mg/L CeO₂-doped TiO₂ nanocomposite, at 21°C, after 30 min irradiation time. The results show that the CeO₂/TiO₂ nanocomposite produced has a high photocatalytic activity to remove pollutants from TI ww.

**Keywords:** Cerium-dioxide-doped titanium dioxide; Nanocomposite; Polyaromatics; Polyphenols; Textile industry wastewater

* Corresponding author.