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A continuous-flow device for photocatalytic degradation and full mineralization of priority pollutants in water

Giora Rytwo[a,b,*], Tomer Klein[a,b], Sivan Margalit[a,b], Omer Mor[a], Aviv Naftali[a,b], Gonen Daskal[a]

[a]*Environmental Physical Chemistry Laboratory, MIGAL, Galilee Research Institute, Upper Galilee, Israel, Tel. +972 4 6953553; Fax: +972 4 6944980; emails: rytwo@telhai.ac.il (G. Rytwo), tomerklein15@gmail.com (T. Klein), margalit.sivan@gmail.com (S. Margalit), omi.mor@gmail.com (O. Mor), aviv.naftaly@gmail.com (A. Naftali), gonen.d@equashield.com (G. Daskal)*
[b]*Department of Environmental Sciences, Tel Hai College, Upper Galilee, Israel*

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ABSTRACT

The removal of hazardous pollutants which are harmful, even at very low concentrations, to human health and the environment is a challenging task. Standard techniques used to remove such pollutants from water often produce a polluted sludge that needs to be disposed of as hazardous waste. Photocatalytic degradation is an advanced oxidation process that might allow full mineralization of the pollutant with zero discharge of hazardous waste. However, most current devices performing photocatalytic degradation processes usually suffer from low efficiency due to technical problems that hinder efficient contact between the pollutant, the light and the catalyst. The system presented in this study aims to optimize this contact and allows photodegradation of polluted effluent flowing continuously through it. The system was used to study photodegradation of acetaminophen and picric acid. Under UVC radiation (254 nm), both pollutants underwent non-catalyzed photodegradation that followed zero-order kinetics. However, the addition of TiO_2 accelerated the process, reducing half lives to 25% of their respective non-catalyzed values, and completely changing the reaction mechanism: the catalyzed processes obeyed second-order kinetics law. When a relatively low concentration (2 ppm) of pollutant was treated with the device, it was completely removed within about 1 h of irradiation time.

Keywords: Acetaminophen; Paracetamol; Picric acid; Photodegradation; Titanium dioxide; Catalysis; Advanced oxidation process

*Corresponding author.