



HAL
open science

The role of pesticides in aggregation of TiO₂ nanoparticles in aquatic environments

Svetlana Ilina, Nicole Baran, Danielle Slomberg, Nicole Sani-Kast, Jérôme Labille, Martin Scheringer, Patrick Ollivier

► **To cite this version:**

Svetlana Ilina, Nicole Baran, Danielle Slomberg, Nicole Sani-Kast, Jérôme Labille, et al.. The role of pesticides in aggregation of TiO₂ nanoparticles in aquatic environments. SETAC Europe 25th Annual Meeting, May 2015, Barcelone, Spain. hal-01140608

HAL Id: hal-01140608

<https://brgm.hal.science/hal-01140608>

Submitted on 9 Apr 2015

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

The role of pesticides in aggregation of TiO₂ nanoparticles in aquatic environments

Svetlana M. Ilina^{a,*}, Nicole Baran^b, Danielle Slomberg^{c,d}, Nicole Sani-Kast^e,
Jérôme Labille^{c,d}, Martin Scheringer^{e,f}, Patrick Ollivier^a,

^aBRGM (French Geological Survey), Water, Environment & Ecotechnology Division (D3E), 3 av. C. Guillemin, BP 6009, 45060 Orleans Cedex 2, France

^bBRGM (French Geological Survey), Laboratory Division, 3 av. C. Guillemin, BP 6009, 45060 Orleans Cedex 2, France

^cCNRS, Aix-Marseille University, CEREGE UM34, UMR 7330, 13545 Aix en Provence, France

^dInternational Consortium for the Environmental Implications of Nanotechnology iCEINT, Aix en Provence, France

^eInstitute for Chemical and Bioengineering, ETH Zürich, CH-8093 Zürich, Switzerland

^fInstitute for Sustainable and Environmental Chemistry, Leuphana University Lüneburg, D-21335 Lüneburg, Germany

Keywords: TiO₂ nanoparticles, natural colloids, pesticides, anthropogenic organic molecules, aggregation

ABSTRACT

The fate and behavior of engineered nanoparticles (NPs) released in aquatic environments will be influenced by the water chemistry, as well as the pesticide load due to the potential for NP interaction with anthropogenic organic molecules (AOMs). As such, surface charge and aggregation of pure hydrophilic 100 % rutile and pure hydrophilic 100 % anatase titanium dioxide nanoparticles (TiO₂ NPs, 5–30 nm) were evaluated in a modeled water solution in the presence of three common AOMs, glyphosate, aminomethylphosphonic acid (AMPA), and 2,4-D. The surface charge and size distribution were assessed over time as a function of various factors including surface chemistry of the NPs and AOMs, presence of mono- and bi-valent cations, pH, and ionic strength of the aqueous solution. The presence of AOMs (5 µg/L) affected TiO₂ NP (5 mg/L) homoaggregation in solutions (IS = 10⁻³ M - 10⁻² M)

with pH values below the NP point of zero charge (PZC) for the anatase NPs (pH=6.5) and with pH values above the NP PZC for the rutile NPs (pH=4.5). No changes in NP aggregation were observed in very low (IS=10⁻⁴M) or very high (IS= 10⁻¹M) ionic strength solutions. Passing through the PZC resulted in irreversible aggregation of the NPs, even in the presence of AOMs. The presence of the pesticides also caused a significant modification of the NP surface charge (zeta potential) over a large range of salt concentrations (IS=10⁻⁴M - 10⁻¹M). Compared to mono-valent cations, bi-valent cations (Ca²⁺) favored NP aggregation and an increase in zeta potential. Finally, these results demonstrated that, among the studied AOMs, glyphosate (with 4 pKa-s from 0.8 to 11) affects NP aggregation/stabilization in a wide range of physicochemical conditions. Overall, these results will aid in the evaluation of potential environmental risks posed by engineered NPs in the aquatic environments exposed to pesticide load.