



Fate of TiO₂ nanoparticles in the aquatic environment in the presence of anthropogenic compounds

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

► To cite this version:

Svetlana Ilina, Nicole Baran, Nicolas Devau, Danielle Slomberg, Nicole Sani-Kast, et al.. Fate of TiO₂ nanoparticles in the aquatic environment in the presence of anthropogenic compounds. SETAC Europe 26th Annual Meeting, May 2016, Nantes, France. hal-01283926

HAL Id: hal-01283926

<https://brgm.hal.science/hal-01283926>

Submitted on 7 Mar 2016

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.

Fate of TiO₂ nanoparticles in the aquatic environment in the presence of anthropogenic compounds

Svetlana M. Ilina^{a,*}, Nicole Baran^b, Nicolas Devau^a, 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 increasing production and use of nanoparticles (NP) in consumer products inevitably lead to ENP emissions into the environment. The physicochemical properties of NP depend on various parameters (e.g. pH, cations, IS). In natural waters, the stability of NP can vary as a function of a sum of these parameters and occurs by one of the numerous scenarios. In particular, the presence of anthropogenic organic molecules (AOM) can change the NP fate. Also, the presence of NP may affect the organic pollutants (fate and toxicity). The main objective of the work was to study the aggregation of TiO₂ NP (pure hydrophilic 100 % rutile and pure hydrophilic 100 % anatase, 5–30 nm) in the presence of the most frequently occur and representative pesticides (glyphosate, AMPA, 2.4D) in natural waters considering lab experiments under relevant aqueous conditions (pH, ionic strength, presence and

concentrations of mono- and bivalent cations). The presence of pesticides affected TiO_2 NP homoaggregation in solutions ($\text{IS} = 10^{-3}\text{M} - 10^{-2}\text{M}$) with pH values below the NP point of zero charge (PZC) for the anatase NPs ($\text{pH} = 6.5$) and with pH values above the NP PZC for the rutile NP ($\text{pH} = 4.5$). No changes in NP aggregation were observed in very low ($\text{IS} = 10^{-4}\text{M}$) or very high ($\text{IS} = 10^{-1}\text{M}$) ionic strength solutions. The presence of the pesticides caused a significant modification of the NP surface charge (zeta potential) over a large range of salt concentrations ($\text{IS} = 10^{-4}\text{M} - 10^{-1}\text{M}$). Compared to mono-valent cations (Na^+), bi-valent cations (Ca^{2+}) favor an increase in zeta potential of NP (anatase and rutile) at pH 8. There is no significant difference between at pH 5. 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 NP in the aquatic environments exposed to pesticide load.