

IMPACT OF CERIUM DIOXIDE NANOPARTICLES FROM DIESEL ADDITIVES ON WASTEWATER TREATMENT AND BIOSOLID VALORIZATION

Abdoul Karim KABORÉ^{1*}, Anaïs CUNY^{1,3}, Mélanie AUFFAN², Catherine SANTAELLA³, Nicolas ROCHE¹

- 1- Laboratoire de Mécanique, Modélisation & Procédés Propres, UMR7340, CNRS, Aix-Marseille Université, Aix-en-Provence Cedex, France
- 2- Centre Européen de Recherche et Enseignement des Géosciences de l'Environnement, UMR 7330, CNRS, IRD, Aix-Marseille Université, Aix-en-Provence Cedex, France
- 3- Laboratoire d'écologie microbienne de la rhizosphère et d'environnements extrêmes, UMR 7265, CEA, CNRS, Aix-Marseille Université, Saint Paul lez Durance, France

*Corresponding author: abdoul.kabore@univ-amu.fr

Keywords: CeO₂, aerobic wastewater treatment, Sludge anaerobic digestion,

Abstract

Several studies on the fate of released nanoparticles showed that wastewater treatment plants (WWTP) are primary sink (Eduok 2013; Eduok et al. 2015; Kim et al. 2010) for engineered nanomaterials, with sorption on activated sludge as the main process for their removal (Cháuque et al. 2016; M. A. Kiser et al. 2009; Mehlika A. Kiser et al. 2010). Previous work at the lab-scale, using aerobic sludge spiked with CeO₂ nanoparticles (nCeO₂) and synthetic wastewater as feeding, resulted in removal of 90% of CeO₂ from effluent and 44% of Ce reduction to Ce (III), after 5 weeks exposure (Barton et al. 2014). Our work is focused on (i) the effects of environmental concentrations of aged CeO₂ NPs on wastewater treatment and microbial communities and (ii) subsequent consequences on anaerobic digestion of sludge. We used nCeO₂ incorporated in a diesel additive (Envirox™) combusted at 850 °C in order to mimic the release by a diesel engine. We set-up a 5-L aerobic bioreactor spiked with sequential addition of nCeO₂ for 40 d until a final concentration of 2.8 mg/L, a realistic concentration in WWTP. The results showed that organic substances removal and sludge production were not affected by nCeO₂, with 3.7 and 3.5 g/L of total suspended solids for the control culture and culture spiked with nCeO₂, respectively. Nitrogen removal efficiencies of 94.1 and 94.5 % were similar between the two bioreactors. Unlike pub, exposure to 2.8 mg/L of nCeO₂ did not increase the production of loosely or tightly bound exopolysaccharides, which were seen as a matrix embedding nanoparticles and reducing their effects on sludge flocs. More insights into nCeO₂ fate from WWTP entrance to sludge digestion, and on consequences on system efficacy will be presented.

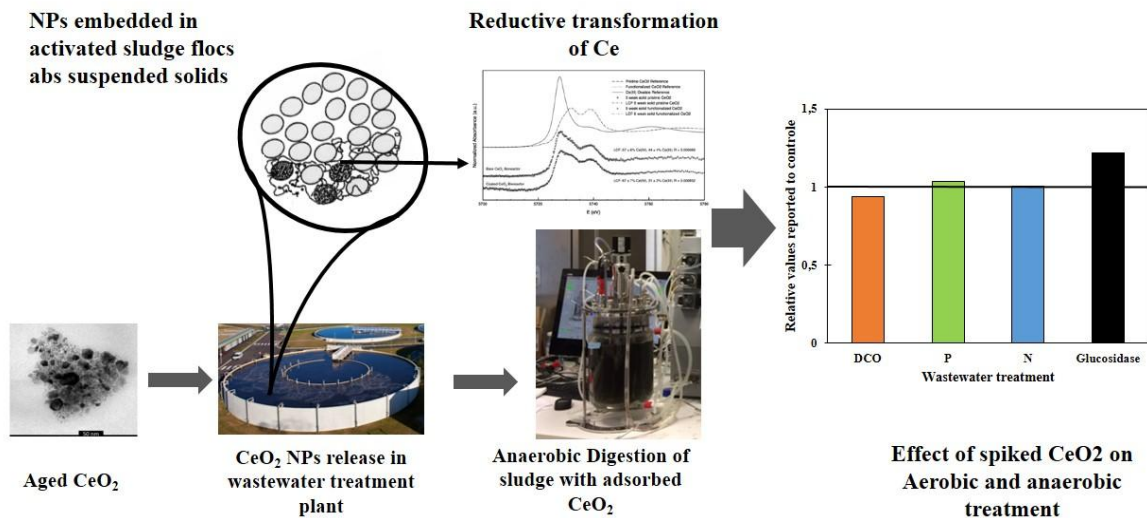


Figure 1: From CeO₂ NPs Release to their interaction with wastewater organic and inorganic components

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