Nano titanium dioxide and wastewater plants: insights into behaviour and analytical method.

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Introduction

- The release in sewage stream of Titanium Dioxide (TiO_2) is exponentially increasing due to their use in cosmetics, clothing, biomedical applications and industrial catalysts [1,2];
- Found in high concentration (181- 1233 μg/L) in wastewater treatment plants[3], meant to be the last barrier between sewage and environment;
- Activate sludge treatment; Dissolved Organic matter removed by a consortium of bacteria (flocs)

Objectives:

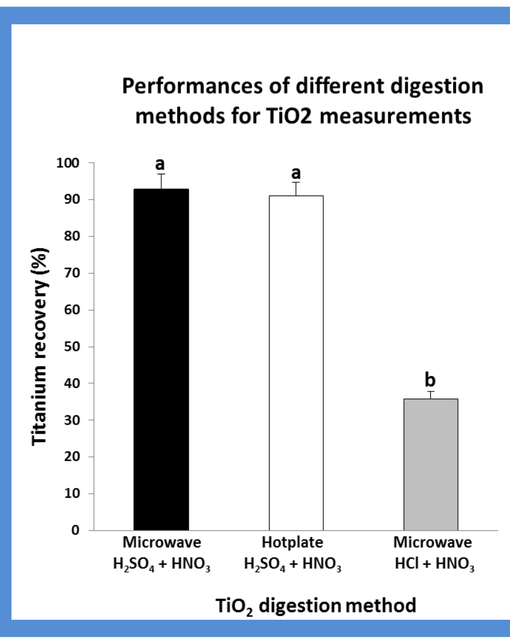
- Define if wastewater plants can cope with nanoparticles (TiO_2) loads (removal rate)
- Effects on wastewater treatment performances (effluent quality).

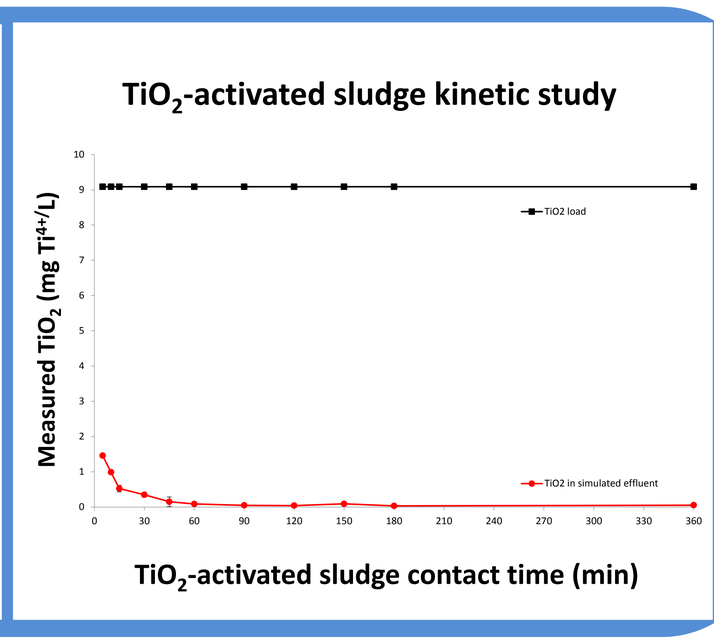
Methods

1. Development of a method to detect TiO_2 concentration, digested and measured as Ti^{4+} :
   - ❖ two acid mixtures: $H_2SO_4 + HNO_3$ *vs.* $HCl + HNO_3$
   - ❖ two instruments: Microwave *vs.* Hotplate
   - ❖ Reading of the samples with ICP-OES to calculate the percentage of Titanium recovery;
2. Detection Percentage of TiO_2 leaving the WWTP
   - ❖ Collection of the activated sludge from Shieldhall plant, Glasgow, Scotland;
   - ❖ Measurement of TiO_2 in the activated sludge and simulated effluent .

Results

- ✓ $H_2SO_4 + HNO_3$ gives high recovery with both microwave and hotplate;
- ✓ Removal of TiO_2 happens very quickly (>80 % after 5 min).
- ✓ >99% removal achieved after 60 min.
- ✓ High removal rate during activated sludge treatment (>99%).





Future

- ➢ Quantification of nanoparticles loads and discharge from Shieldhall;
- ➢ Lab scale activated sludge system;
- ➢ Nanoparticles-activated sludge kinetic studies;
- ➢ Toxicological assays;
- ➢ Mix it up: mixture of different nanoparticles classes.

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References:

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3- Westerhoff et al., (2011) 'Occurrence and removal of titanium at full scale wastewater treatment plants: implications for TiO2 nanomaterials', *Journal of environmental monitoring.*