Can Wastewater Treatment Plants (WWTPs) cope with future nanoparticles (ENPs) loading scenarios?

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Introduction

- **NP production, and thus release in sewage stream is exponentially increasing due to their use in cosmetics, clothing, biomedical applications and industrial catalysts[1]**
- **Problematically, some nanoparticles (AgNP, TiNP, AuNP) are toxic[2]**
- **Significant concern as to how they will impact wastewater treatment processes[1]**
- **NPs may be harmful to essential bacteria in activated sludge (AS) [3]**
- **Wastewater treatment process may not be able to effectively remove NPs allowing them into the environment**

Methods

NP-Flocs Sorption-Desorption-Transport

- Lab scale simulated activated sludge
- ICP-AES partitioning analysis to determine uptake of NPs by activated sludge
- Microscopy (TEM-SEM) and fluorescence microscopy to visualize NPs within flocs

NPs impact on sludge performance

- Impact of NPs on COD and N-removal
- Comparison with Shieldhall plant
- Sub-acute toxicity biomarkers

Changes in microbial community

- Next-gen genomic analysis
- Bioinformatics

Results

- ✓ **ENP interactions and movement in real WWTPs flocs**
- ✓ **Evaluation of WWTPs pollutants removal performances under ENP exposure**
- ✓ **Assessment WWTPs capacity to remove ENPs from sewage stream**
- ✓ **Monitoring actual and future ENP concentration in WWTPs and in natural water bodies**
- ✓ **Development a predictive tool encompassing ENP-WWT biofilm interactions**

Future

- ➢ **Establishment of standard method to asses ENP effects on WWTPs**
- ➢ **Improvement of structural innovation to allow WWTPs to cope with future ENP concentrations**
- ➢ **Modelling ENPs release rate, movement and environmental effects**
- ➢ **Legislative process**

Image

Fig a, Activated sludge treatment source Wastewater Study World press. **Fig b,** Colorized transmission electron micrograph of nanoparticles, source News Medical Life Science. **Fig c,** Microorganisms in activated sludge, source Wastewater Processing. **Fig d,** Daily products containing nanoparticles, source ©2006 David Hawxhurst, Woodrow Wilson International Center for Scholars.

References

1) Massarsky et al., 2014, predicting the environmental impact of nanosilver. Environmental toxicology and pharmacology, 38: 861-873

2) Moore, 2006. Do nanoparticles present ecotoxicological risks for the health of the aquatic environment? Environment International, 32: 967-976.

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