NanoFASE

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POLICY AND EXPLOITATION FACTSHEETS

FACTSHEET 7

NANOMATERIAL BEHAVIOUR IN SURFACE WATERS – A RATIONAL VIEWPOINT

Manufactured Nanomaterials (NMs) are, and will continue to be, emitted into surface waters through wastewater treatment plants (WWTP), surface run-off, wet and dry deposition, and direct use. Within surface waters, NMs will undergo transformation reactions, such as dissolution, physical and chemical transformation and homo- and heteroagglomeration. In their various transformed forms, they will be transported downstream or into sediment and taken-up by various biota. The further transformation will occur in sediments and their pore waters, as well as in flocs of the suspended particulate matter and biota. Surface water acts as a highly complex reactor and conveyor for NMs.

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RECOMMENDATIONS

To assess exposure to NM in surface water systems, the results of the NanoFASE project support making informed simplifications, setting well-underpinned system boundaries and accepting and dealing with uncertainties, i.e. if further assessment is technologically unfeasible or if the cost-benefit analysis of implementing it deems it ineffecient. NanoFASE results also support implementing the Dahmköhler principle in which reaction rates are put into context with hydrological residence times (e.g. it is not needed to consider hetero-agglomeration if the NM dissolves in hours).

To evaluate existing experimental data addressing these processes, recommendations and considerations for dealing with related uncertainties are as follows:

- Bulk chemistry should be used to inform about the likelihood of dissolution, transformation or persistence.
- When looking at residence times (water: hours to days, sediment: years), it is safe to use dissolution rates, which can be calculated through bulk solubility and the application of existing models, such as Noyes-Whitney.
- Reactions of NM observed in WWTP are similarly observed in surface waters, with the exception that in surface waters the NM to flocculants ratio is larger.
- Persistent particles, or particles transformed to persistence, will homo- or heteroagglomerate.
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- Homo- and heteroagglomeration play equal roles depending on suspended particulate matter and NM size and concentration.
- For transport assessment, the order of magnitude of alpha values in heteroagglomeration will be sufficient to assess the mode of transport
- NM from WWTP enters surface water associated with sludge flocculants.
- Free NM or transformed NM have short lifetimes and eventually settle into sediment.
- NM or transformed NM attached to sediment might re-suspend as suspended particulate matter but will not detach to individual nanoparticles.

RELATED NANOFASE DELIVERABLE REPORTS

D8.2: Report on driving forces of NM behaviour in natural waters for agglomeration and transformation.

D8.3: Transformation and behaviour of NMs in surface waters in support of modelling since it deals with the same issues only under different water chemistries.

D8.4: Description of model framework for agglomeration and removal of NMs

D8.5: NMs behaviour and transformation in sediment pore waters and pore water gradients.

All NanoFASE deliverable reports are available at: **http://www.nanofase.eu/documents/reports**