

Nanomaterial release data: Are current data useful for material flow modeling?



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Context

- Limited capacity to measure directly concentrations of nanomaterials into the environment.
- Limited capacity to differentiate between engineered and natural nanomaterials.
- MFA Models have been used as an alternative to predict the flows of **engineered** nanomaterials into the environment.

Goal

- Does the release literature provide the data required to quantify the release parameters in MFA models?

Method

1. Review the available MFA models to understand the methods and strategies to quantify release parameters
 - 16 articles
2. Review the release literature to evaluate whether or not it provides the data required by MFA models
 - 106 articles

Results I – Strategies implemented by MFA modeling

Strategy	Description	# Art
Worst case assessment	Use of precautionary stance to predict maximum potential release	2
Qualitative assessment	Evaluation of non measurable aspects of release using rankings or scores.	1
Release scenarios	Definition of use and environmental physico-chemical settings that produce ENM release	6

Results I – Strategies implemented by MFA modeling

Strategy	Description	# Art
Product categorization	Use categories to group the different group types by release potential and simplify the assessment	11
Mechanistic assessment	Description of the mechanisms governing release	2
Dynamic assessment	Incorporation of the time dimension of release behavior	5

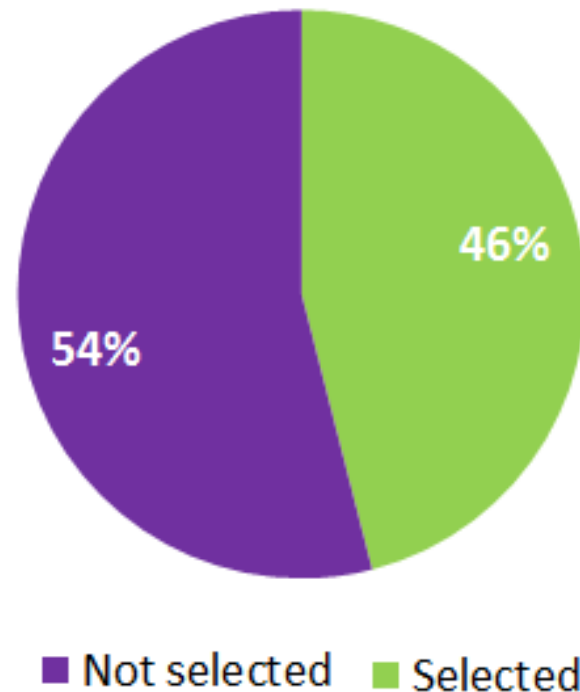
Main results of MFA modeling review

- No method provided for the estimation of the transfer coefficients.
- Input data rely to a considerable extent on extrapolations, author's assumptions, expert opinions and other informal sources of information.
- Systematic assessment of uncertainty usually not applied.
- Models ignore transformations of released nanomaterials.

Results II – Release literature assessment

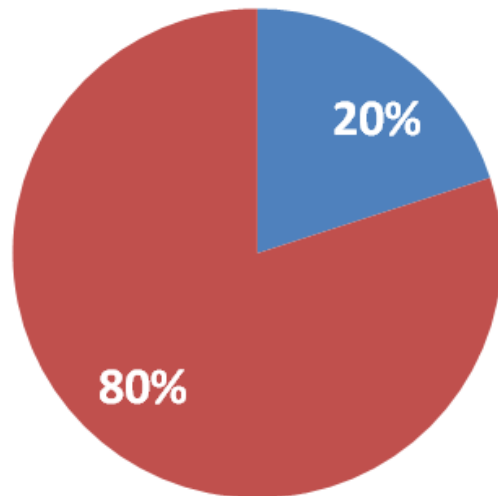
- **Applications available** in the market.
- Average **environmental conditions** assessment.
- Provide **nano mass** data released
- Provide data on the **characteristics of the nano mass** released

Literature selected for further assessment



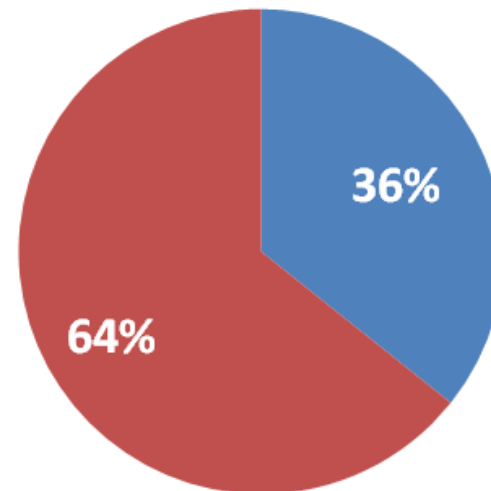
Results II – Release literature assessment

ENM in applications



■ Covered by the release literature

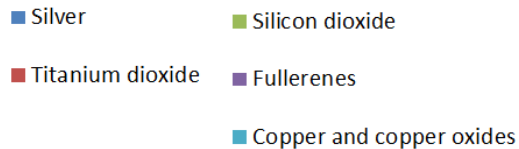
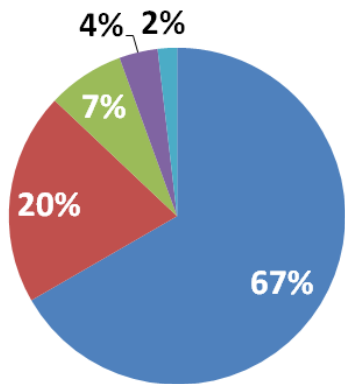
Product categories of nano-applications



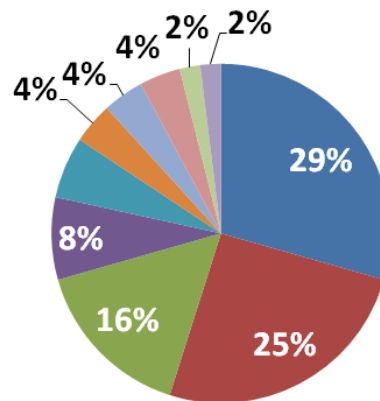
■ Not covered by the release literature

Results II – Release literature assessment

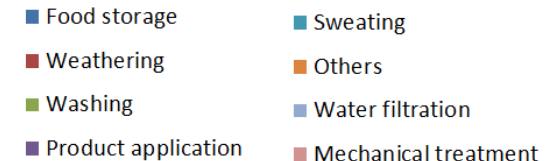
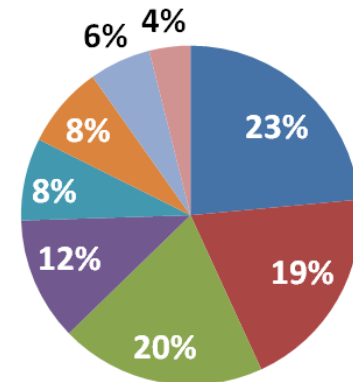
ENM coverage
(distribution)



Categories coverage
(distribution)

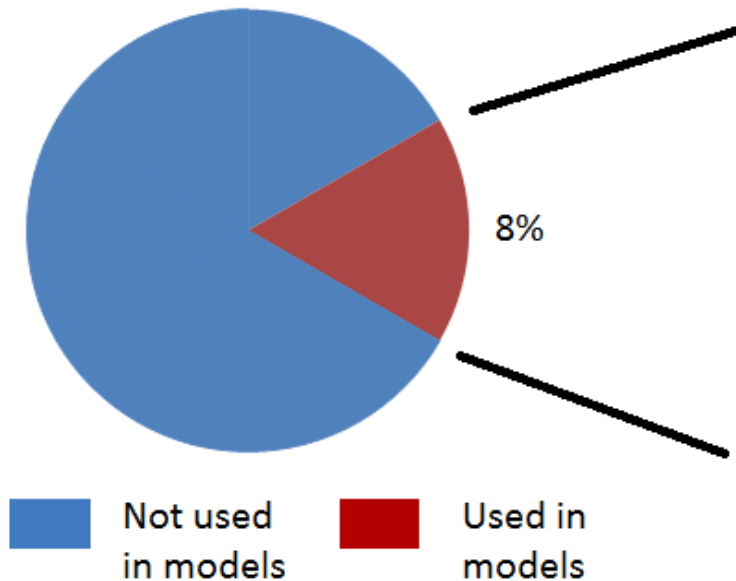


Release scenarios
considered (distribution)

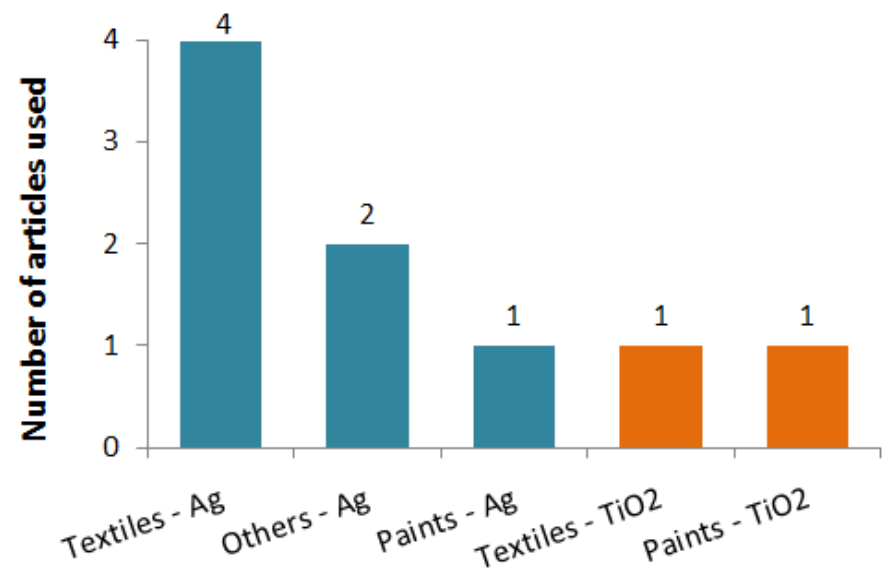


Results II – Release literature used in MFA models

Release articles used by MFA models



Characteristics of the release literature used by MFA models



Results II – Release literature assessment

Aspect	Comments
Initial characterization	<p>More details about the application and the initial state of the ENM required:</p> <ul style="list-style-type: none"> - ENM mass content and location - Application model and pictures - Size distribution - ...
Characterization of the mass released	<p>Going beyond shape, size and composition is required:</p> <ul style="list-style-type: none"> - Surface area - Surface chemistry - Particle number concentration - ...

Results II – Release literature assessment

Aspect	Comments
Transformations	Description of the mechanisms ruling transformation required to improve the predictions provided by models.
Determinants of release	Little attention was given to this aspect. In general, determinants assessment is basic and complexity is ignored .
Quantitative information	Should be nano-specific . Comprehensive data sets required <ul style="list-style-type: none"> - Mass released as % of the initial ENM content. - Observations as function of time.

Main conclusions

- MFA models have not fully exploited the data provided by the release literature (development of methods required).
- Release literature covers only a fraction of the whole universe of ENMs, applications and release scenarios
- The information presented by release experiments still has room for improvement in terms of applicability for MFA models.
- **THERE IS A LOT OF WORK PENDING!**

Main reference

Caballero-Guzman, A., Nowack, B., 2016. *A critical review of engineered nanomaterial release modeling: are current data useful for exposure modeling?* Environmental Pollution 213, 502-517. DOI: [10.1016/j.envpol.2016.02.028](https://doi.org/10.1016/j.envpol.2016.02.028)

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