Stochastic fate analysis of engineered nanoparticles during release processes, e.g. in an incineration plant

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Hotspots of nanoparticle emissions

Raw materials → Synthesis → Application → Use

Waste management
Nanowaste

Products containing engineered nanoparticles at the end of the use phase

Persistence of engineered nanoparticles in a municipal solid-waste incineration plant

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Experiment on the fate of nano-CeO$_2$ in incineration

10 kg nano-CeO$_2$
No alteration of nano-CeO$_2$

High removal rate of nano-CeO$_2$

Aim of the study

- Structure of a dynamic stochastic flow model
- Associated uncertainties with their propagation
- Evidence for consistency of measurement results
- Benefits for future experiments

Model

Walser & Gottschalk (2014)
Output interpretation

Walser & Gottschalk (2014)
Input data and uncertainty ranges

Walser & Gottschalk (2014)
Model geometry

Waste bunker

Incinerator

Fly ash

Electrostatic filter

Boiler

Slag pool

Wet scrubber

Slag

Air

Waste water

1. Not detected
2. Not yet transported further
3. Dwell time (flow rate)
4. Deposited/transformed
Some results

- Ending up in Slag
- Waster water contents: Not detected after waste incineration
- Air release
- Not detected in Waste bunker

Graphs showing mass in g over time in h for different scenarios.
Overall recovery

Walser & Gottschalk (2014)
Conclusion

• Dynamic probabilistic flow model, based on real, time dependent measurements
• Model adds an additional flow in comparison to the measurements
• Consistency of measurement results
• Underlying mass flows are decisive for uncertainty range
• The model can be easily adapted to various types and conditions of MSWI plants
Outlook

• non-rhythmic material transfer, e.g. pulse releases
• inclusion of reactivity and bonding, and other chemical processes
• Added new engineered nanoparticles
... this helps improving fully probabilistic risk evaluation for engineered nanomaterial (ENM)


Thank you for your attention!

https://www.etss.ch/

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