Life cycle thinking in nanoform release assessment using GRACIOUS case studies

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Nanomaterials release during their life cycle

- Release of nanomaterials occur during their complete life cycle and have been assessed for a number application.

- Since 20 years, release library is growing, and release database are created with models build on top of it to predict exposure.

- Parameters driving the release which can be link to release process, the NFs property or the product property

- We can start to establish hypotheses and provisional criteria for grouping and guiding principles for read-across

Release **rate**   Release **Form**   Exposure **route** and **population**

NFs release: Criteria for grouping

Parameters driving the NFs release

Process

- Energy
- Time
- Aging factor

Nano-Enable Product (NEP)

- Product matrix degradability toward aging factor (Dissolution, UV resistant, permeability, mechanical property,..)
- NFs localization: coating, embdedded in the product
- NFs and NEP matrix binding type

NFs property

- Shape
- Chemistry
- Dustiness
- Size
- Solubility
- State (powder, liquid aerosol)
- ....

Parameters driving the NFs release

| Synthesis | Manufacturing | Use | End-of-life |

Processes

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Paint Case study

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Paint Case study

Weathering

Gracious case study

NMs/NFs

NEP

NEP produced by an industrial partner
- Relevant product
- Information's available on the product, the NF function, the NFs incorporated, the NFs content,..

Simulating the NEP life cycle stage

Use   **End-of-life**

Food contact

Abrasion

Landfilling

Smooth rubbing: Dermal contact

Weathering

Incineration

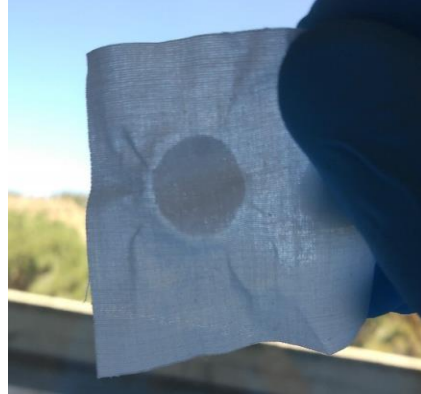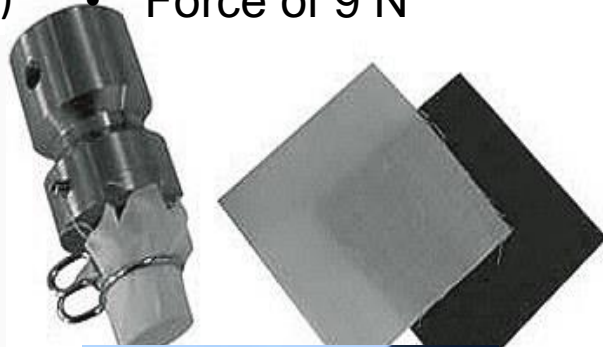Release **rate**   Release **Form**   Exposure **route** and **population**

Simulating product life cycle: simulating hand contact

Protocol (ISO 105-X12:2016)

- Force of 9 N

Crockmeter have been validated by the US consumer product safety comision (CPSC) for wood playground impregnated with antifungial copper materials
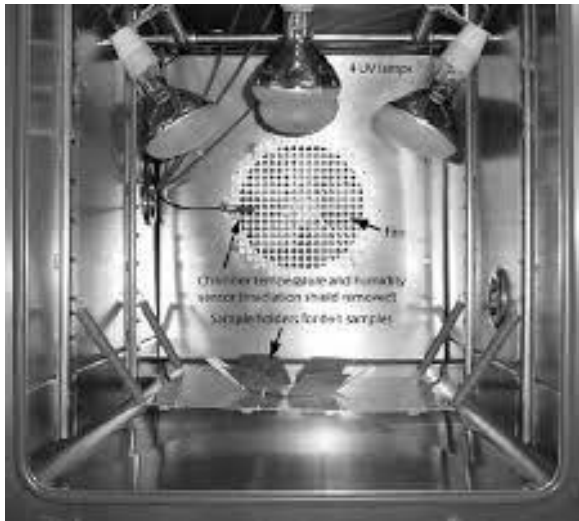
VALIDATED

Simulate the release during paint use involving smooth rubbing

- **Hand contact**
- **Paint cleaning**

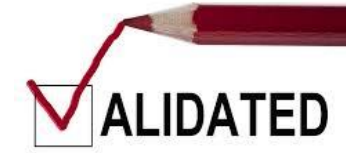# Simulating product life cycle: weathering

Climatic chamber

Cycle of UV and rain

The UV energy is used as a way of comparison between experiment and to extrapolate to real life climat

Runoff is collected and analyzed (ICP-MS, Microscopy, size fractionation)

Unaged

TPU-Cu   **PA6-Cu**   **PLA-Cu**

Aged

Simulating product life cycle: Landfilling

Toxicity characteristic leaching **procedure**
TCLP method: EPA standard Method 1311
- Batch test
- LS of 20
- Leaching solution:
• Acid acetic and NaOH (pH: 4,8)
• MilliQ
- 18H rotative aggitation

Extrapolation ???

Image credit: istockphoto.com/xe#josantec

Environment

The need for worst case (accelerated) scenario

Thank you for your attention!

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