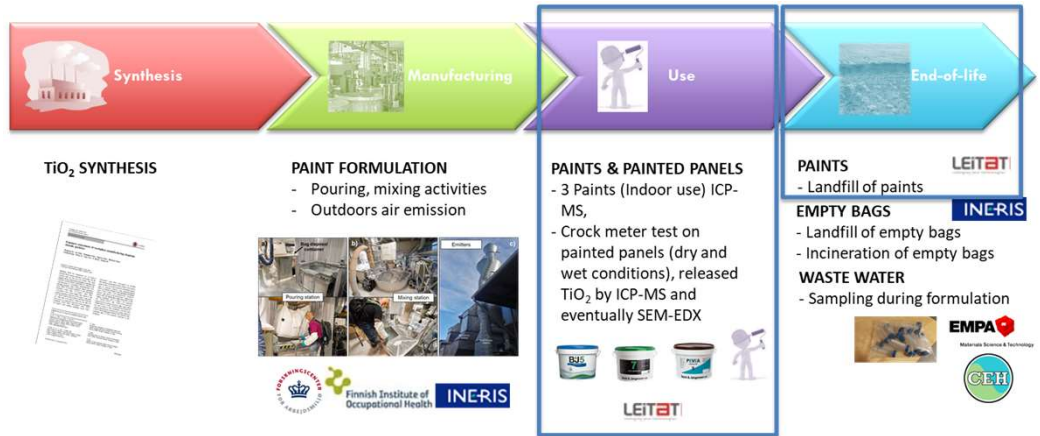


Data to support Risk Assessment along use-phase and end-of-life: the caLIBRAtE case study on paints containing TiO₂ and filler materials

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Data generated in different exposure scenarios, including paint formulation, use and end of life

For the demonstration of the caLIBRAtE framework, a state-of-the-art suite of value-chain case-studies (CS) are provided as standard examples and inspiration for using the risk assessment (RA) models/tools selected. The most comprehensive CS attempt to cover as many critical exposure scenarios (ES) along the life cycle stages as possible and focusses on a fully implemented industrial application of NMs: the use of TiO₂ NM as pigment in the paint industry (B&J Case Study). To investigate possible release of NM during the use-phase and end-of-life scenarios, three different paints containing TiO₂ NM were used in experiment aimed to simulate use-phase and end-of-life situation/activities.



Nano-enable product description

- TiO₂, size=173nm,
- BET=12.6 ± 1.3 m²/g,
- 95% TiO₂, coating of Al, Si and Zr,
- Dustiness TiO₂= 73,1 ± 42,2 mg/Kg,
- Rutile.

Paint 1 (BJS): Polyvinyl acetate TiO₂= 13,9 w.%
Eco-Label, house and office

Paint 2 (7): Acrylic paint TiO₂= 14,9 w.%
used for ceilings and walls

Paint 3 (PEVEA): Polyvinyl acetate TiO₂= 12,9 w.%
used for ceilings and walls

Methods: Use and end of life simulation

Use

Protocol (ISO 105-X12:2016)

- Force of 9 N
- Wet and dry crocking cotton
- 10 cycle: 0,031 m²
- 100 cycle: 0,31 m²
- 200 cycle: 0,62 m²
- Dry rubbing
- Wet rubbing

Simulate the release during paint use involving smooth rubbing

- Hand contact
- Paint cleaning

EoL

Paint were grinded at 2 mm

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 agitation

- Fraction up to 20 µm : not leached
- Below 20 µm: total leached fraction
- Below 0,45 µm

Results

End of life: landfill leaching

Paint	<20 µm Water	<0,45µm water	<20 µm TCLP	<0,45µm TCLP
Paint 1	~1.5%	~0.5%	~0.5%	~0.2%
Paint 2	~0.8%	~0.2%	~0.1%	~0.1%
Paint 3	~7.5%	~2.5%	~1.0%	~0.1%

- Use: release of paint thickness after 200 wet rubbing cycles is 2,3, 5,3 and 1.16 microns, for paint 1,2 and 3, respectively while dry rubbing between 8 and 19 nm,
- High variability of leaching depending of the paint matrix
- Paint solubility increase the release during leaching but reduce it during wet rubbing

Paint use: Hand contact

Paint	Dry (10 cycles)	Dry (100 cycles)	Dry (200 cycles)	Wet (MilliQ) (10 cycles)	Wet (MilliQ) (100 cycles)	Wet (MilliQ) (200 cycles)
Paint 1	~10	~22	~23	~1	~4	~6
Paint 2	~10	~12	~13	~5	~10	~15
Paint 3	~10	~24	~25	~1	~6	~10

Conclusion

- The use of normalized protocol allows generating comparable data with other NEP,
- Collaboration with industrials allows to investigating realistic manufacturing condition and relevant commercialized NEP,
- Lab-scale experiments provided data on the potential release of TiO₂ NM from paints in real-life exposure scenarios that can be used for model demonstration purposes.
- The incorporation of the data in exposure models is the next step to assess the exposure all along the NMs life cycle and define the critical LC stage, compartment involved