NANOHOUSE

2. Nanoparticles release from nano-based paints

NanoHouse Dissemination report N° 2013-02

HOUSE COATING NANOPRODUCTS

Grant agreement N° 247810
Activities towards the development of appropriate solutions for the use, recycling and / or final treatment of nanotechnology-based products.
An European Integrated Project Supported by through the Seventh Framework

Dissemination reports from NanoHouse project are designed to highlight and present in a simplified way the main results obtained in the studies carried out during this project. These reports mainly deal with one question which is of general concern for whom is interested by the ***Cycle of Nanoparticle-based Products used in House Coating****. The full results are summarized in the corresponding Technical reports.*
All the Dissemination reports and Technical reports are publicly available from NanoHouse project website*:* ***http://www-nanohouse.cea.fr***

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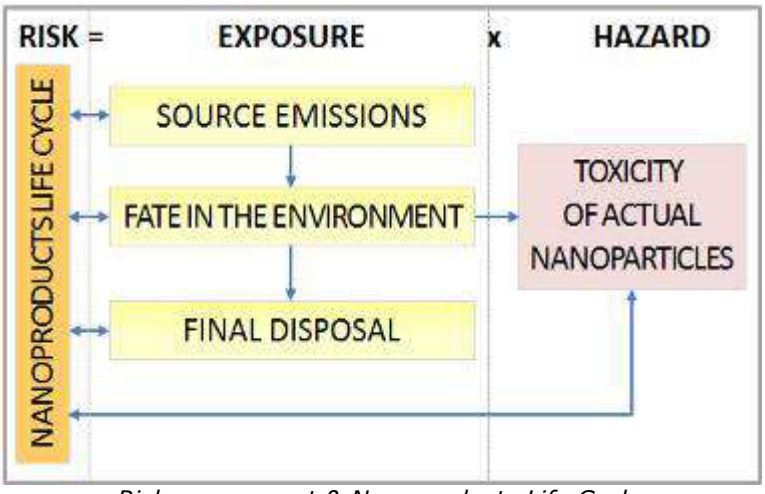
Why to identify the nano source emissions?



Risk assessment & Nanoproducts Life Cycle

In order to evaluate the potential risk of nanoproducts during all Life Cycle, we need to understand how Engineered NanoParticles (ENP) might be release from paint coatings in normal use but also during critical operations.
For each considered realistic scenarios the quantity and size of released ENPs has to be determined.
Then, taking into account the theorical and experimental results, the mechanisms able to induce ENPs release can be identified.

Titanium dioxyde nanoproducts in paints and glasses

In the absence of data concerning toxicity, ENP release understanding could be a great challenge for paints and coatings producers.
Safe by design could reduce as low as possible the ENP release and consequently the exposure level as well as the potential risk.
The main safe by design indicators are:

- Dispersion degree of ENPs within the matrix
- Quantity and type of binder for better embedding of ENPs
- ENP hooking in the matrix

The ENP source emission understanding is a key point for making safer painting products.

What are the experimental tests implemented?

Non-commercialised ''model'' façade paints with and without TiO_2, SiO_2 and Ag ENPs, were formulated and applied on suitable panels. Coated panels were submitted to accelerated weathering tests as UV light, heat and humidity cycles, and weathering tests accordingly to available ISO standard. Released results from paint products containing different types of ENPs were investigated under a combination of mechanical solicitations and suitable leaching tests.

Ultraclean box abrasion test equipment

Protocol used for ENPs release into the air

Taber test (EN ISO 7784-2) widely used to simulate wear of the coatings was adapted with the appropriate methodology to assess the potential ENPs release induced by abrasion in air.

Other mechanical stresses representative of critical operations like scratching were applied as well.
An ultraclean air box is used in order to isolate the ENP release from the nanoparticle background noise.

Protocol used for ENPs release into the water

Leaching test EN ISO 2812-2:2007 was selected and adapted to assess the ENPs release from facade paints in outdoor applications into water in normal conditions. Depending on the intended uses and application fields, different tests were identified. Accelerated weathering (UNI 10686 or UNI EN ISO 11507) tests to simulate degradability were applied.

QUV accelerated artificial weathering machine

Coated panels were exposed to UV light in a QUV accelerated weathering machine for 500 hours according to ISO 11507.

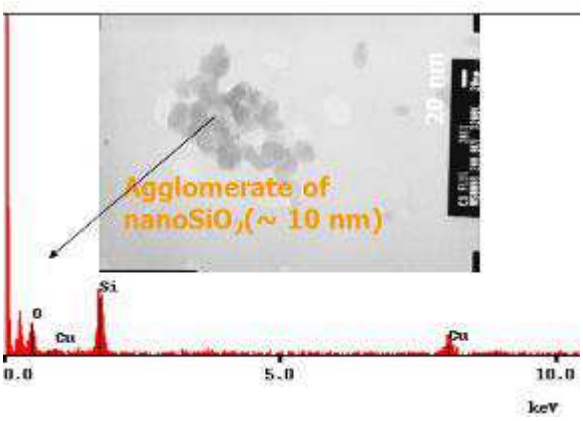
The QUV accelerated weathering machine reproduces the aging induced by sunlight, rain and dew on outdoor paints and coatings. It simulates in a few weeks, the aging that occurs over months or years outdoor.

The ageing conditions (the applied irradiance cycles) were chosen to simulate natural weathering.

Realistic and critical scenarios are implemented in order to test ENP release from painting products.

What are the obtained results on ENP released?

For normal use, release of free or agglomerated ENPs is negligible.

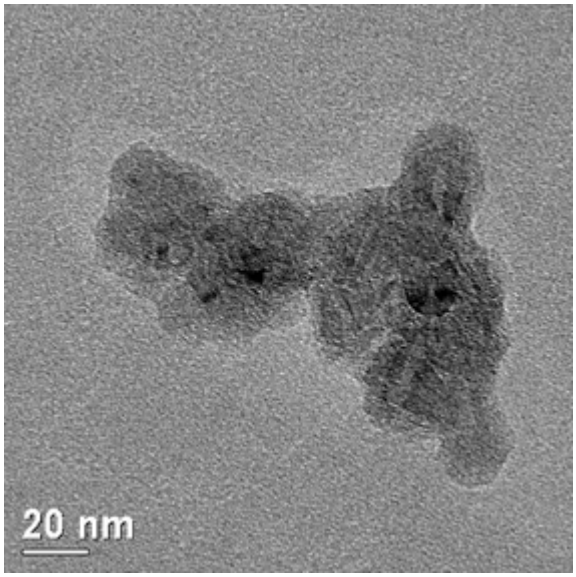


~ 10 nm SiO_2 released by hard abrasion from paint - TEM

For critical conditions the amount of released ENPs **in air** depends on:

- The intensity of the mechanical stress
- The paint formulation: pigment volume concentration and binder amount
- The aging treatment

Under hard abrasion, pieces of paints containing ENP embedded into the matrix are more likely to be removed. No free or agglomerated ENP were observed for the paints containing Ag or TiO_2. Paint containing nanoSiO_2 released very few free and agglomerated ENP. While same paint formulated without ENP release high amount of nanoparticles (pieces of matrix paint).
QUV ageing increase x2 the number of nanoparticles (not necessary engineered) released by comparison with an untreated paint.
Increase of the binder amount and the quantity of the TiO_2 pigment allow decrease ENP release toward zero.



~ 10 nm SiO_2 embedded in the organic binder and detected in leaching liquids - SEM

Considering the **water**, TiO_2 and Ag ENPs were not released from paints, while only a small release of SiO_2 was measured in leachates after 120h of immersion. Microscopy investigation highlighted that SiO_2 ENPs are mainly released in form of agglomerates, and that only very few single SiO_2 ENPs were present.

ENPs release from paints to water depends on:

- Paint formulation: type and amount of ENPs, binder, pigments, etc..
- Immersion cycles (wetting and drying cycles) of coated panels.
- While QUV aging and abrasion did not influence leaching of ENPs from coated panels.

Under hard abrasion and leaching: ENPs are mainly released embedded into the matrix paint or in agglomerate form. Very few single ENP are released from paints.

What are the economic and societal impacts?

In terms of economic impact, ENP source emissions understanding from nano products in general should be one of the success conditions for a 'Nano Responsible Label' definition.

This Label could guarantee a Safe by Design process in order to respect Human Health and Environment during all Life cycle of the product.

In terms of environmental impact, it is essential to identify the emission sources, and then in case of release, to evaluate the fate of released nanomaterials in environmental compartments (air, aquatic systems, and soils), possible chemical transformations and transfer and impact to living organisms.

In terms of social impact, ENP source emissions pragmatic identification is necessary in order to:

- Relativise the fashionable doom-watch imagining nanoparticles invading massively our environment.
- Make industrials aware of their products in terms of potential Health and Environmental impacts.

Source emission is a key point of the ENPs release issue for the market and the social acceptance of nanoproducts.

NanoHouse brings together twelve partners from eight different countries. The project is supported through the 7th Framework Programme for Research and technological Development. The project has started in January 2010 and will end in June 2013.
NanoHouse considers the ***whole product life cycle*** *in regard to EHS and to study the environmental behaviour and the toxicological effects of the* ***actually released Engineered NanoParticles ("aged" ENPs)****, and to compare them with the pristine ENPs.*

Partners

Commissariat à l'énergie atomique et aux énergies alternatives – CEA **Fr**
www.cea.fr

Eidgenössische Materialprüfungs- und Forschungsanstalt – EMPA **CH**
www.empa.ch

Consorzio Venezia Ricerche **I**
www.veneziaricerche.it

Katholieke Universiteit Leuven – KUL **B**
www.kuleuven.be

Université Joseph Fourier **Fr**
Institut des Sciences de la Terre
www.isterre.fr

MATERIS PAINTS ITALIA **I**
www.materispaints.it

GFC CHIMICA **I**
www.gfcchimica.com

AKZO NOBEL COATINGS S.A. **Fr**
http://www.akzonobel.com/

PPG Industries **NL**
www.ppg.com

http://www-nanohouse.cea.fr

NANOHOUSE

Dissemination report

Nanoparticles release from nano based paints

The ENP source emission understanding is a key point for making safer painting products.

Realistic and critical scenarios are implemented in order to test ENP release from painting products.

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Source emission is a key point of the ENP release issue for the market and the social acceptance of nano products.

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