NEW RESEARCH
National Research Centre for the Working Environment, Denmark
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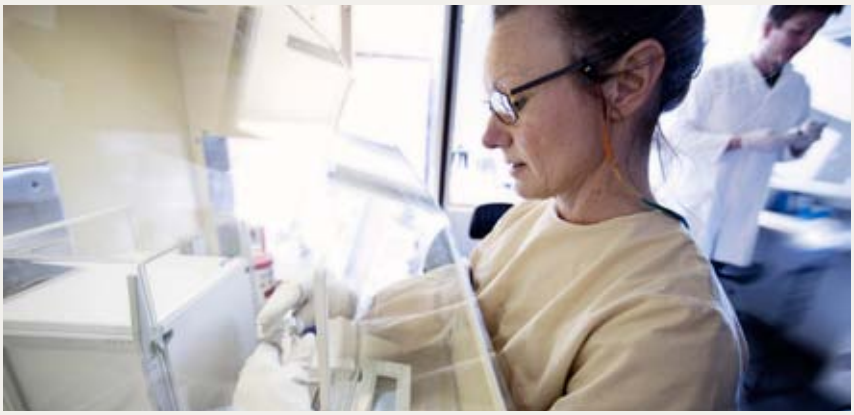
Inclusion of nanoparticles in paints, lacquer and plaster does not affect the health effects of sanding dust

Sanding dust from nanoparticle-containing paints, lacquer and plaster, give similar responses in terms of inflammation and DNA damage as sanding dust from similar products without nanoparticles after pulmonary exposure. This is the results from a study of the health effects of nanoparticles in paints, lacquer and plaster.



Nanoparticles are added to paints, lacquer and plaster because of improved properties such as self-cleaning properties or increased scratch resistance. We now know that inhalation of some pure nanoparticles cause adverse effects such as inflammation and DNA damage in rodent models. But will these adverse effects of nanoparticles change when the nanoparticles are included in complex matrices such as paints, lacquer or plaster? Danish researchers investigated this in a study that included eight different nanoparticles. Seven of these are potentially industrially relevant in the Paint and Lacquer industry.

Several of the nanoparticles caused inflammation and DNA damage in rodent models

The adverse effects of the nanoparticles were examined by depositing a single dose of the various nanoparticles into the lungs of mice. The dose was equal to five days of exposure at the Danish occupational exposure limit value for titanium dioxide (TiO_2) and 3 days at the Danish occupational exposure limit value for carbon black. The results show that

- mice had inflammation in the lungs 24 hours after deposition of Printex 90 (carbon black), TiO_2 W2730X (PhotocatalyticTiO_2), UV-titan L181 (NanoTiO_2), ASP-G90 (Kaolin) or Axilat LS5000 (Axilat) (silicon dioxide) into the lungs. Thus five of the eight tested nanoparticles caused inflammation when instilled into the lungs of mice. The degree of inflammation correlated with the total surface area of the deposited particles, i.e. the smaller particles having the largest total surface area in relation to their mass, resulted in the greatest inflammatory response.
- mice had DNA damage in the lung cells 24 hours after instillation of FineTiO_2 or NanoTiO_2 (both surface-treated titanium dioxide) into the lungs. Thus, two of the eight tested nanoparticles resulted in DNA damage when deposited into the lungs of mice which shows that these nanoparticles are potential carcinogens.

Nanoparticles included in paints, lacquer and plaster do not increase the adverse effects

The researchers also studied the health effects of sanding dust from three different paints, one lacquer and one plaster. For each product, the effects were investigated in at least one version with and one version without nanoparticles. This was tested at the same dose as used for the pure nanoparticles. The results show that

- none of the sanding dusts from paints, lacquer and plaster with or without nanoparticles caused lung inflammation or oxidative stress 24 hours after pulmonary deposition in mice
- the level of DNA damage was increased in mice 24 hours after exposure to sanding dust from one lacquer with and without nanoparticles or from an >

> outdoor acrylic paint without nanoparticles into the lungs.

The results show that the addition of nanoparticles does not increase the adverse effects of dust from paint, lacquer and plaster. The results indicate that the matrix itself (paint, lacquer and plaster) has a greater impact on the adverse effects than the addition of nanoparticles.

Facts about the study

The purpose was to investigate if the effect on exposure and health effects is affected when bulk chemicals are replaced by the corresponding nanoparticles in paint, lacquer and plaster.

First, the researchers examined the adverse health effects of eight industrially relevant nanoparticles. Seven of them were selected in cooperation with the Danish Paint and Adhesives Industry and are relevant to use in paints, lacquer and plaster. The last nanoparticle (Printex 90) is well-characterised and was included as a reference particle. The adverse effects of particles were studied by depositing the nanoparticles into the lungs of mice.

Secondly, the researchers investigated the adverse effects of five different types of products delivered by the Danish Paint and Adhesives Industry – a PVA paint, an acrylic paint for indoor use, an acrylic paint for exterior surfaces, a lacquer and a plaster. The products were delivered in a version without nanoparticles and at least one version with a relevant nanoparticle added to the product. E.g. the PVA paint was delivered in a version without nanoparticles and three different versions with different nanoparticles added. A total of thirteen different products were tested.

The different products were applied on wood panels. After drying and curing, the panels were sanded and dust was collected from each product. Then the potential adverse health effects of the dust samples were studied in mice.

Photocatalytic TiO_2 promotes allergic sensitization in mice

Researchers from the NRCWE investigated whether a nanosized photocatalytic TiO_2 has an allergic effect on mice. The results show that the tested photocatalytic TiO_2 results in inflammation and increases the allergic reaction in mice.

Source: Larsen ST, Roursgaard M, Jensen, KA, et al. nano titanium dioxide particles promote allergic sensitization and lung inflammation in mice. Basic & Clinical Pharmacology & Toxicology 2010,106 (2) :114-7.

NanoTiO_2 results in moderate atherosclerosis in mice

Researchers from the University of Copenhagen and the NRCWE investigated if NanoTiO_2 promotes the development of atherosclerosis in mice. The results show that pulmonary exposure to NanoTiO_2 results in slightly increased atherosclerosis in mice.

Source: Mikkelsen L, Sheykhzade M, Jensen KA, Saber AT, Jacobsen NO, Vogel U, Wallin H, Loft S, Moller P. Modest effect on plaque progression and vasodilatory function in atherosclerosis-prone mice exposed to nano-sized TiO_2. Part Fibre Toxicol. 2011 Nov 10; 8 (1): 32 [Epub ahead of print]

NanoTiO_2 affects both mice and their progeny

Researchers from the NRCWE tested whether inhalation of the nanoparticle NanoTiO_2 affects the health of mice and their offspring. The results show that inhalation of NanoTiO_2 results in long-lasting inflammation in the lungs of mice. Furthermore, more than 20 percent of the deposited NanoTiO_2 remain in the lungs 4 weeks after inhalation. NanoTiO_2 also affects the offspring of mice. The progeny of mice pulmonary exposed to NanoTiO_2 changed behaviour. This indicates that their nervous system is influenced before birth.

Source: Hougaard KS, Jackson P, Jensen KA, et al. Effects of prenatal exposure to surface-coated nanosized titanium dioxide (UV-Titan). A study in mice. Particle and Fibre Toxicology, 2010, 7 (16): http://dx.doi.org/10.1186/1743-8977-7-16

The research project behind the results

- The results originate from the research project 'Nanoparticles in the paint industry. Exposure and toxic properties – NANOKEM'.
- The study was conducted by researchers from the National Research Centre for the Working Environment, University of Copenhagen, Aalborg University and DHI.
- The project was financially supported by the Working Environment Research Fund.

Scientific articles

- Saber AT, Jensen KA, Jacobsen NR, Birkedal R, Mikkelsen L, Møller P, Loft S, Wallin H & Vogel U. Inflammatory and genotoxic effects of nanoparticles designed for inclusion in paints and lacquers. Nanotoxicology. 2012 Aug;6(5):453-71.
- Saber AT, Koponen IK, Jensen KA, Jacobsen NR, Mikkelsen L, Møller P, Loft S, Vogel U & Wallin H. Inflammatory and genotoxic effects of sanding dust generated from nanoparticle-containing paint and lacquers. Nanotoxicology 2012;6(7):776-788. [DOI: 10.3109/17435390.2011.620745].

Further information

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