Potential for worker exposure to nano-size titanium dioxide above the recommended limit when spraying paint

Exposure to airborne nano-titanium dioxide during airless spray painting and sanding

Gavin H. West, Michael R. Cooper, Leonard G. Burrelli, Daniel Dresser, and Bruce E. Lippy. Journal of Occupational and Environmental Hygiene, 2019.

Overview

This study estimated exposures to nano-size titanium dioxide (TiO_2) while spraying and sanding a commercially available paint. The National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (REL) is eight times lower for ultrafine TiO_2 (0.3 mg/m3) compared to fine TiO_2 (2.4 mg/m3), as time-weighted average concentrations for up to 10 hours per day during a 40 hour workweek. Ultrafine includes nanoparticles. Air samples were collected while a tradesperson performed the tasks in an environmentally controlled chamber. Dust capture during sanding was provided by a dust collection bag or local exhaust ventilation attached to a high efficiency vacuum. Personal and bystander exposures were characterized using particle counts, airborne mass concentrations, and electron microscopy.

Key Findings

- Characterization of the paint before testing indicated that most of the TiO_2 primary particles in the paint were nano-size and bound together to form larger structures, called agglomerates.
- Sonication in acetone caused the nanoparticles to separate, raising the question of whether paint thinners and mechanical mixing could mimic this effect observed in the lab.
- Individual nanoparticles were detected by particle counters during spraying and sanding but could not be confirmed by electron microscopy.
- Exposures during sanding were below the NIOSH REL. Dust levels were relatively low, and local exhaust ventilation significantly reduced the number of airborne nanoparticles.
- The researchers concluded that workers could potentially be exposed to levels above the NIOSH REL for ultrafine TiO_2 when applying the paint with an airless sprayer.
- They recommended that employers and industrial hygienists should characterize exposures and use the hierarchy of controls to protect the health of employees.
- Future research should consider whether chemicals commonly used in construction, including those found in paint thinners, could impact occupational exposure to nanomaterials in paints.

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See abstract:
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