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Occupational Exposure to Nanocompounds
A Case Study in an Industrial Production Plant

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Abstract

While novel nanotechnological achievements are becoming increasingly important in everyday life, there is emerging evidence from nanotoxicology for human health hazards. This is particularly relevant in nanoparticle production facilities, where the enhanced presence of engineered nanoparticles may cause increased exposure levels. Research on occupational nanoparticle exposure is currently in its infancy. The purpose of this case study was the qualitative and quantitative characterisation of nanoparticle exposure in an industrial production facility, the evaluation of personal protective equipment, and the application of established indoor models for the reproduction of measured particle concentrations. In collaboration with HeiQ Materials Ltd., 25 days of field measurements were performed. Thereby, submicron mass and number concentrations as well as the corresponding particle size distributions were monitored using an Optical Dust Monitor, Condensation Particle Counters, and Scanning Mobility Particle Sizers. With respect to respiratory protection, mask filter performance was evaluated under production conditions. All measurements were complemented by the characterisation of ambient conditions (air velocity, temperature, and relative humidity) and thorough logging of the production outline, operator activities and surrounding influences. Elevated levels of nanoparticles from production and maintenance procedures could be found throughout the facility; the average number concentration during production steady-state conditions was approximately 60,000 p/cm^3, which was sevenfold the mean background level. However, the absolute number concentration, in comparison to literature values from other occupational settings, appeared to be rather moderate. The production unit and cleaning system were identified as the main emission sources. Independent of ambient conditions, *number* concentrations followed the daily production pattern and showed little spatial variation within the production area. Conversely, corresponding *mass* readings did not reflect particle emission patterns. Furthermore, commercially available respirator filters were found to reduce particle number concentration by more than 96.7%. Finally, the adaptation of a one-box model illustrated the feasibility of modelling the present concentration profiles. This study permits insight into important exposure aspects at the investigated production site and provides indications that may be applicable in other production facilities and cues for potential regulatory adaptations of currently mass-based exposure thresholds.