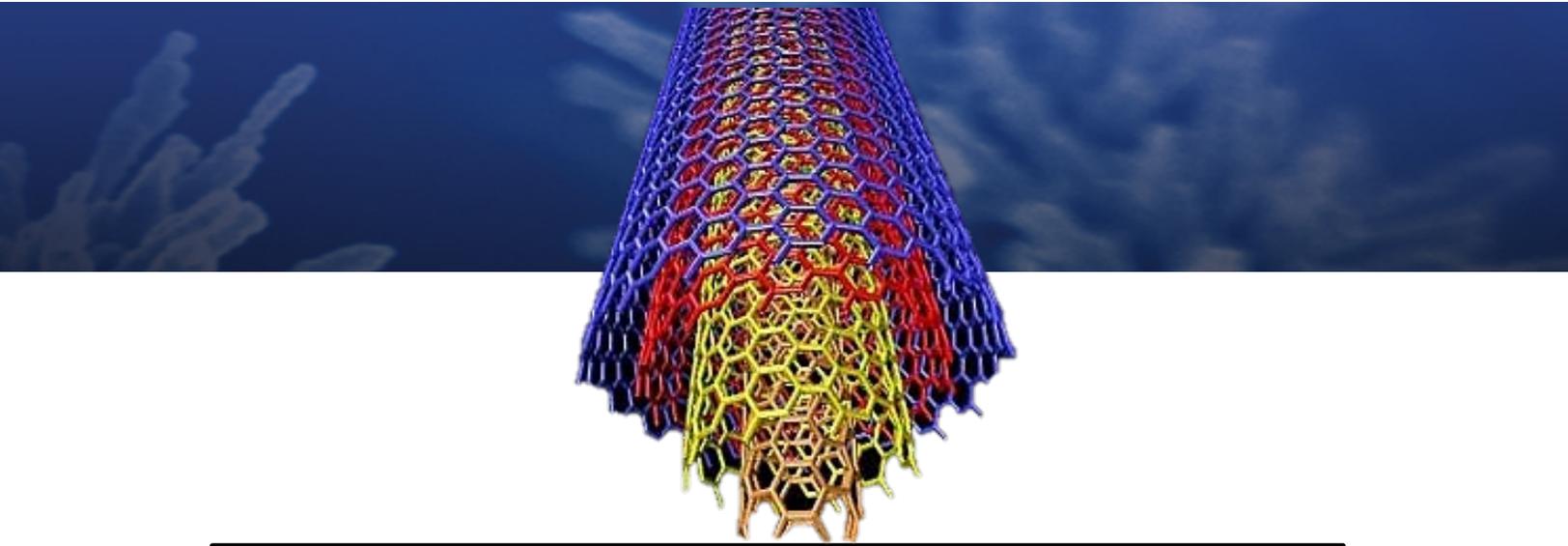


17. Toxicities Associated with the Occupational Life Cycle of MWCNT

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Companies synthesize or purchase as-produced multi-walled carbon nanotubes (AP-MW), apply a commercial or proprietary polymer coating (PC-MW), then embed the PC-MW into a composite matrix. Since workers are potentially exposed at each production stage, we evaluated the toxicity profile of these materials. Initially, male C57BL/6J mice aspirated 4 or 40 µg AP-MW or PC-MW using preparations to emulate personal breathing zone collections. Bronchoalveolar lavage and tissues were collected at 4 h, 1, 7, 28 and 84 d post-exposure. While the AP-MW induced dose- and time-dependent measures of pulmonary cytotoxicity and inflammation, applied polymer coatings did not enhance those effects. Histopathologic changes included small granulomas at terminal bronchioles at 84 d but no significant alveolar fibrosis at the 40 µg dose. The material was significantly aggregated and unlike larger diameter multi-walled carbon nanotubes (MW), no translocation to systemic organs was detected. Lastly, composites with 0.15% and 3% PC-MW by weight were subjected to an industrial sanding process. Assessment of generated aerosols show primarily micrometer-sized particles with some MW protrusions. No evidence of free MW was observed. Interestingly, the characteristics of the base composite material itself and the addition of PC-MW affect the particle number, and subsequently, the respirable fraction of the generated aerosol. These findings provide insight on the toxicity at different stages of the MW production and suggest that while the number of people potentially exposed increases along the product value chain during this kind of production process, the potential for MW exposure greatly decreases.

Keywords: Carbon-based nanomaterials, Life cycle analysis, Nanomaterial release, Occupational safety



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