Risk Assessment for Carbon Nanotubes

Albin, Maria; Bohgard, Mats; Hedmer, Maria; Gustavsson, Per; Kanje, Martin; Rissler, Jenny

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1) Risk assessment for carbon nanotubes.

M Albin, M Bohgard**, M Hedmer*, P Gustavsson***, M Kanje***, J Rissler***

Departments of Occupational and Environmental Medicine, Ergonomics and Aerosol Technology**, Cell and Organism Biology***, Lund University, Lund, Sweden.*

Background and methods: The use of carbon nanotubes (CNTs) has increased substantially in recent years, and a strong further increase is expected. We reviewed, based on a systematic search, exposure, toxicology and protective measures for the Swedish Work Environment Authority.

Results: Inhalation appears to be associated with the greatest potential risk, since CNTs, in bulk form, have a very low density and produce a lot of dust during handling. The measured levels have typically been 0.1 mg/m^3 or less, but higher concentrations have been reported.

CNTs may cause inflammation and fibrosis in the airways, lungs and pleura in laboratory animals. Some studies suggest that longer CNTs cause greater biological effects than shorter carbon ones. Several studies indicate a genotoxic effect, but data for assessing carcinogenicity are insufficient. The functionalization of carbon CNTs, i.e. attaching chemical groups to the tubes strongly affects the half-life period in the blood and may influence their biological effects.

Based on the effects on laboratory animals, the lowest dose observed to cause adverse effects on the respiratory airways (inflammation and slight granuloma) was 0.2 to 0.3 mg/kg bw, the lowest air concentration where this has been observed is 0.1 mg/m^3. At higher levels, more severe pulmonary reactions were observed as well as cardiac effects. After exposure to doses of 0.06 mg/kg bw via tube-feeding, DNA damage occurred.

Conclusions: There is a need to standardize the measurement methodology for the quantification of occupational exposure to CNTs, and there are major gaps in knowledge regarding the health effects of CNTs. It is particularly important that long-term animal inhalation studies are conducted (including studies of functionalized CNTs). Human data is lacking.

Today, there is not enough knowledge about either exposure levels or the health effects when handling CNTs. A precautionary principle should therefore prevail in the manufacture, handling and use of CNTs, as well as in the processing of materials containing CNTs. In practice this means that established safety and protection devices should be used, together with personal protective equipment.

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