

WG2

Pulmonary Injury Associated With Spray of a Water-Based Nano-Sized Waterproofing Product: A Case Study

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Case description

Ten workers suffered from respiratory symptoms following a spray impregnation application using a waterproofing product consisting of an aqueous suspension of fluorinated acrylate copolymer (MMAD 70 nm) in water with organic solvent additives. 1 L was sprayed in 4 min in a workshop of 2,600 m³. The spray applicant did not report any health complaints. A bystander, who entered the wood workshop 3 h later was hospitalized with severe chemical pneumonitis. On the following morning (15 h later) 9 persons working in an adjacent mail sorting center in the same building, experienced dry cough and substernal chest pain upon physical exercise. No other sources of causative exposure could be identified.

Aim

Attempt to explain the health effects resulting from the initial and secondary exposure.

Methods

The spray application was simulated in a measurement chamber and aerosols and vapors were measured over time. Chemical characterization was performed using GC-MS. A two-compartment model was used to calculate the concentration time pattern.

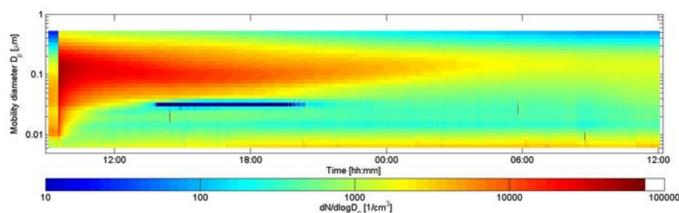


Fig. 1: Particle number size distribution and concentration as the function of time measured with a fast mobility particle sizer (FMPS).

Results

Trimethyl silanol, glycol ethers and fluoroalkenes were identified as the major volatile organic compounds (VOC). The fluoroalkenes reached a maximum 1-2 h after application and persisted in the gas phase along with trimethyl silanol and glycol ethers. After the spray application aerosols were observed in a concentration up to 6.3 x 10⁴ cm⁻³, corresponding to mass concentrations of 10 and 95 mg/m³ in the size ranges 5.6 to 560 nm and 0.22 to 30 µm, respectively (Fig. 1).

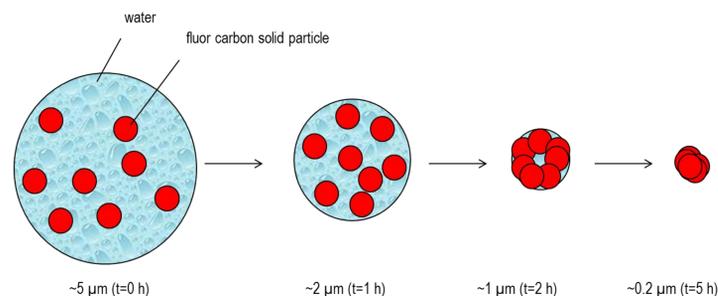


Fig. 2: Hypothesis concerning the aging of the aerosols.

After 15 h the mass concentrations of aerosols had decreased to values lower than 10 µg/m³ in both size ranges (Fig. 2). VOC concentrations were calculated to be 46 mg/m³ at the time and location of application and decreased to 5.5, 5.6 x 10⁻⁶ and 9.5 x 10⁻¹⁶ mg/m³, in the adjacent workplace after 15 h, corresponding to an assumed air exchange rate of 0.08, 1.0 and 2.5 h⁻¹, respectively (Fig. 3).

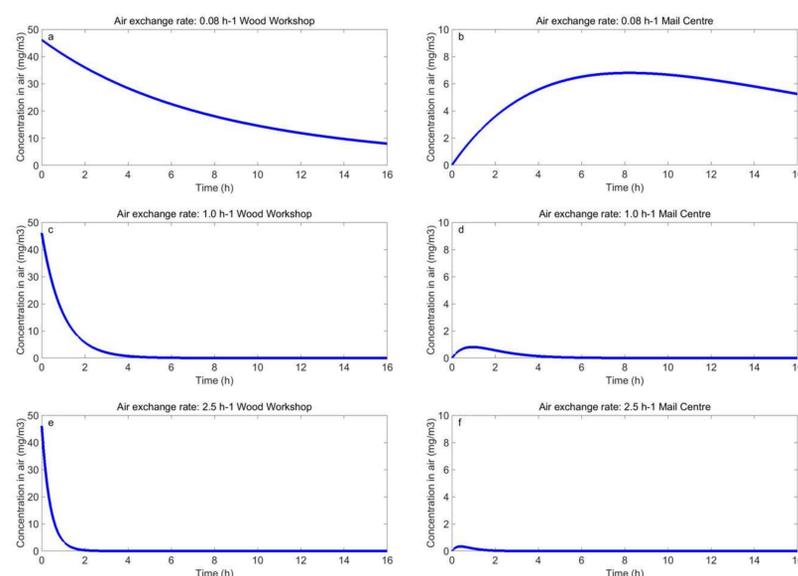


Fig. 3: Concentration of vapor in the wood workshop (left) and the adjacent mail center (right) for three different assumed air exchange rates of ventilation: 0.08 (airtight), 1.0 (moderate), and 2.5 (high).

Discussion and conclusions

- The worker who developed chemical pneumonitis was a smoker. Rolling and smoking cigarettes contaminated with fluorinated acrylate polymer is the most probable cause.
- Respiratory symptoms in the nine workers exposed 15 h after the spray event were most likely due to inhalation of re-suspended fluorocopolymer particles. VOC could only be involved if the building is assumed to be completely airtight, which is not realistic.