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Tunnel workers exposed to excessive ultrafine particles

Tuesday 31 May 2016 3:23pm

A study of tunnel construction work has identified the types of workers exposed to high concentrations of hazardous ultrafine particles, which are associated with respiratory and cardiovascular disease.

Workers who performed PVC welding in a vertical position were exposed to the highest average concentration of 3.34x10^6 particles per cubic centimetre, with a maximum exposure of 6.4x10^6 particles per cubic centimetre, it found.

The next most at-risk workers in the studied subsea tunnel project in Norway were horizontal PVC welders, followed by slipforming machine operators and verge-finishing operators, the researchers from the Norwegian University of Science and Technology and Trondheim University Hospital found.

"The difference seen between horizontal and vertical PVC welding is probably due to differences in the techniques used," the researchers say.

"The vertical welding was more or less continuous, while during horizontal welding tasks such as gluing and moving the rack were performed as well," they say.

Slipforming machine operators experienced a higher exposure than verge workers due to the "lack of a closed cabin and the position of the exhaust pipe close to the operator of the slipforming machine's head".

According to the researchers, tunnel construction workers are exposed to particulate and gaseous air contaminants such as quartz, oil mist, oil vapours, organic carbon, elemental carbon, nitrogen dioxide, ammonia and thoracic, total and respirable dust.

Respiratory diseases are common in these workers, they say.

Similar types of exposures have been documented for other occupations, including metal welding, rubber manufacturing, asphalt and paving-related work, and work with industrial plants, as well as from cooking and surgical smoke.

"It has been suggested that exposure to ultrafine particles can explain some of the adverse health effects of exposure to particulate matter. However, exposure to ultrafine particles is not evaluated in the tunnel construction industry," the researchers say.

Previous research suggests that plastic welding is associated with one of the highest maximum concentrations of ultrafine particles among industries handling ultrafine powders, they say.

The researchers say ultrafine particles barely contribute to the mass of particles in the air, but their concentration can be very high and their reactivity and small size facilitate uptake into cells in the body.

"Epidemiological studies have shown a strong association between ultrafine particles in air pollution and adverse pulmonary and cardiovascular health effects," they say.

"Short-term exposure to ultrafine particles at average levels of 1.2-1.5x10^5 particles/cm3 induced a variety of changes in cardiovascular parameters for health volunteers in recent clinical studies."

Other research on the links between occupational exposure to particulate air pollution and an increase in risk of ischaemic heart disease (IHD) suggest ultrafine particles may "represent a potential risk for IHD" in construction workers.

Personal exposure to ultrafine particles from PVC welding and concrete work during tunnel rehabilitation.

Rikke Bramming Jørgensen, et al, Norway, *Occupational and Environmental Medicine*, online first 25 March 2016.