NANOPARTICLES

Handle with care … even with gloves!

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››› “Nanoparticles are found in all industrial settings,” explains Ludwig Vinches, postdoctoral researcher at École de technologie supérieure working under the direction of Professor Stéphane Hallé. “It is important to understand that they are not all bad, however, as they are very useful to us. Nonetheless, as long as nanotoxicologists are unable to tell us at what concentrations nanoparticles become toxic, workers must be protected by applying the precautionary principle.”

This is why Ludwig Vinches took part in an innovative research project funded by the IRSST to develop a method for measuring nanoparticle penetration into materials used to make protective gloves under conditions representative of the workplace setting. The report on the project is available at www.irsst.qc.ca. Examined were certain models of disposable gloves made of nitrile, latex and neoprene. A test rig was designed to deform the gloves and simulate opening and closing of the hand in the way that workers do. In addition, a physiological solution mimicking sweat was put inside the gloves while the outside of the glove was placed in contact with a solution containing nanoparticles.

Though the gloves were handled far less in the laboratory than they would be in a work setting, the researcher found, by observing them under a scanning electron microscope, that the integrity of the materials composing them was compromised to the point of allowing nanoparticles to pass through. “Considerable abrasion was noted,” says Ludwig Vinches. “Though the gloves did not tear, the worn surface no longer stopped penetration of nanoparticles.” In addition, with sweat on one side and nanoparticles on the other, the material began to swell, the elastomers spreading apart and the gloves allowing nanoparticles to pass through. Last, the mechanical deformation caused by opening and closing of the hand creates crystalline areas that harden the gloves imperceptibly, breaking the elastomer chains and once again promoting passage of nanoparticles. Latex, neoprene and one type of nitrile proved effective for designing gloves that protect against nanoparticles.

Some leads for manufacturers to explore

Ludwig Vinches explains that the gloves are fragile: “If a worker who handles nanoparticles notices a scratch or tear, he or she should throw out the glove immediately.” And even if there are no apparent tears or scratches, the gloves should not be worn for more than two hours at a time and should never be used again once removed. “I have demonstrated, during my doctoral studies,” says Ludwig, “that after two hours of use, there is a risk that a significant quantity of nanoparticles will pass through the glove material. In fact, a number of articles about this have been published.”

Ludwig Vinches

When he left his native France to settle in Québec, Ludwig Vinches planned to continue conducting research along the same lines as he did at the Université de Bordeaux, where he obtained a Master’s in physical chemistry. His research on nanoparticles didn’t necessarily mean he would work in occupational health and safety, but he is delighted to do so. Since arriving in Québec, he has completed a Ph.D. in mechanical engineering at École de technologie supérieure (ÉTS) and a postdoc in chemical engineering at McGill University, for which he received a grant from the IRSST. He is currently completing a postdoc in mechanical engineering at ÉTS, on thermal stress in extreme environments.

Ludwig believes that additional research should be conducted, preferably in collaboration with glove manufacturers. “We don’t have the material design competencies required, but we can tell them where the problems lie, indicate the physical phenomena observed in the laboratory and suggest promising avenues to explore to improve the materials and reduce the risks that nanoparticles well penetrate the gloves.” ‹‹

Suzanne Blanchet