

Which gloves should be used to protect against nanoparticles?

Nanotechnology is becoming more and more important in our daily lives. Commercial applications of nanomaterials are growing, and consequently the exposure in the workplace to such nanoparticles is exponentially increasing. Health and Safety organizations therefore have started to consider such exposures as a particular risk.

What are nanoparticles?

Nanoparticles are chemicals that are about 1 – 100 nanometers in size (a nanometer corresponds to 10^{-9} m). They are used mainly in the form of powder, or as a colloidal solution (most of the time in water). The most widely spread nanomaterial is TiO_2 (titanium dioxide) – some examples of its use are as a pigment in paints and varnishes, as pigment or sunscreen in cosmetics, and as a food colorant.

Although the main risk of exposure to nanoparticles is generally considered to be inhalation, there are growing concerns about the cutaneous route. This however has not been studied extensively.

Penetration of nanoparticles through materials

The study as described in the bibliography section* has led to believe that penetration of nanoparticles through protective glove materials cannot be simply assumed as non-existing. As a result of this study (even though the conclusions are preliminary) and the growing general belief, caution with regard to the choice and conditions of use of protective gloves has to be recommended.

It seems that nanoparticles in powder form would not penetrate through glove materials (nitrile, neoprene, latex or butyl) without the application of mechanical stress. However, some mechanical stress in the form of flexing and stretching is inherent to the barrier material when in use. When this stress is applied by a simulation (dynamic deformation), nanoparticle powder may be able to pass through the membrane after a period of time, and this is particularly the case for thin nitrile disposable gloves.

Butyl gloves have proven to be a very effective barrier against nanoparticle powders (butyl is also highly impermeable to gases, which have a similar behavior because the gas molecules are also extremely small in size). This is particularly interesting as butyl is commonly used in glove box applications.

In the case of nanopowder in colloidal solution in water, possible penetration was detected, particularly when dynamic deformation was applied. Also nitrile, latex and neoprene showed substantial swelling after short immersion times in the colloidal solutions.

Recommendations

In the specific case of glove box use, we recommend butyl gloves, as they form a very effective barrier, even against nanoparticle powders.

In the case of general laboratory work with the need for disposable gloves, we recommend the use of good quality nitrile disposables with a thickness of minimum 0.10 mm (TouchNTuff® 92-600, 92-605, 92-670, Microflex® Supreno EC 93-853, Microflex® Supreno SE 93-843) or neoprene disposables (NeoTouch® 25-101, 25-201) – or gloves in those materials from our pharma or cleanroom range. Double gloving is also worthwhile considering, if this is practically possible.

Which gloves should be used to protect against nanoparticles?

Given the impact of mechanical stress on the glove barrier performance, replacing the gloves regularly - and certainly as soon as they come in contact with nanoparticle in colloidal solution - is recommended.

Anyhow a safe working practice for disposable gloves in the laboratory environment implies to replace them as soon as get splashed, regardless of which chemical.

*Bibliography

Development of a method of measuring nanoparticle penetration through protective glove materials under conditions simulating workplace use, Report R-785, June 2013, IRSST, NanoQuébec

Recommendations made in this note are based on extrapolations from laboratory test results and information regarding the composition of chemicals and may not adequately represent specific conditions of end use. Synergistic effects of mixing chemicals have not been accounted for. For these reasons, and because Ansell has no detailed knowledge of or control over the conditions of end use, any recommendation must be advisory only and Ansell fully disclaims any liability including warranties related to any statement contained herein.