Assessment of efficiency of meltblown filtering materials used for respiratory protective devices against nanoparticles

Krzysztof Makowski, Agnieszka Brochocka

Central Institute for Labour Protection – National Research Institute, Lodz, Poland

The appearance of new dangerous harmful aerosols containing nanoparticles has necessitated work on ensuring effective protection of the respiratory system. So far, there is no uniform method for evaluating the efficiency of respiratory protective devices against nanoaerosols, which would make it possible to classify filtering devices. The basic aim of this research work was to establish efficiency of filtering materials widely used in filtering respiratory protective devices. The authors assessed the porosity and charge of filtering materials, nanoparticle size and changeable flow rate of aerosol. Tests were carried out using an electrostatic classifier and condensation particle counter. The measuring range of the system made it possible to conduct tests for particles sized between 7 to 270 nm. Tests were performed at 5 aerosol flow rates: 30 l/min, 45 l/min, 60 l/min, 75 l/min, 90 l/min. The experimental results were subjected to theoretical analysis based on filtration theory.

The experiments showed that filtration efficiency of nanoparticle aerosols by filtering materials commonly used for respiratory protection on the one hand depends greatly on the size range of nanoparticles and on the other hand on the characteristic geometry and electret features. It needs to be stressed that nonwovens with great porosity (relatively low value of air flow resistance) should not be used in constructions of respiratory protective devices against nanoaerosols as even inducing electrostatic effects in them does not improve their efficiency enough to become sufficiently safe for the users. It needs to be stressed that none of the types of filtering non-woven currently used in construction of respiratory protection equipment fully complies with expectations concerning efficient capture of nanoparticle aerosols. The tests carried out point out that in practice, in respiratory protective devices, systems of filtering materials that ought to be used should be those that ensure high efficiency for the whole spectrum of nanoaerosols. Materials used currently are characterized by high efficiency only for certain ranges of particle sizes.