Instrumentation for qualifying and quantifying nanoparticles' exposure into occupational environment

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Abstract
The work characteristics, technology and tools are constantly changing, especially in countries such as Latvia, where since the early nineties the occupational environment is developing.
Occupational environment air quality is an important public health factor what influence persons' health and well-being. Occupational air quality is characterized by physical (microclimate: air temperature, relative humidity, noise, lighting, etc.), chemical (dust, inorganic compounds: formaldehyde, carbon dioxide, organic compounds, etc.) and biological (dust mites, molds, etc.) pollutants. Much attention in the world is given to a very fine dust particles (PM_{10}, $PM_{2.5}$ and $PM_{0.1}$, where the PM - *Particular matter* - particulates with a diameter of 10 mm, 2.5 mm and 0.1 mm or 100 nm - nanoparticles) in ambient and during last 10 years also in the occupational environment. Dust particles, especially nanoparticles, are identified as one of the emerging risk factors of occupational environment. Because the particles are finer and there many of them in the air their active surface area is greater. It is important to note the importance of the chemical composition of dust particles [*1*]. However, dust particles are not enough investigated, including adverse effects of nanoparticles in occupational environment and the health of workers, quality of life, work capacity and productivity.
There are little research in the world on nanoparticle exposure in the occupational environment and the information is controversial about the nanoparticles health effects related with nanoparticles chemical composition, structure, and induced effects. Open is the question of the toxicity of nanoparticles and correlation with particle properties. The assessment of harmful effects caused by the nanoparticles are used markers of inflammation and allergies, but there is lack of comprehensive information about nanoparticle effects on different biological processes (oxidative stress, cancer aetiology, DNA damage) [*2;3;1*]. Therefore the studies of nanoparticle toxicity and nanoparticle exposure assessment methods and instrumentation are very topical with development of technology (especially nanotechnology) and the production of materials.
There is limited facifilities use the mobile and informative instrumentation for particle (also nanoparticle) quantifying and qualifying particles into occupational environment. However there are some instruments what were and are tested still into occupational environment of Latvia. According to data from the office environment (pilotproject data, see Figure 1), more useful and informative is "P-Trak ultrafine Particle Counter" Model 8525 (particle size: 20 - 1000 nm) for particle counting at occupational environment; other - "AeroTrak 9000" (nanoparticles size: 10 - 1000 nm; particle surface area are determined in two fractions: TB-traheobronhial (particle size <1000 nm) and A-alveolar (particle size <250 nm)) for particle surface area measurements (see Figure 2). For simultaneous particles size distribution, counting, surface area measurement, mass concentration measurements from experience very informative is ELPI+. Besides doing air measurements by ELPI+, it is possible collect dust samples also for dust gravimetric (sampling aluminium foils as collection substrate), chemical (on polycarbonate foils as collection substrate) and electron microscopy analyses (see Figure 1). Next step of testing this instrumentation will be welding and wood-working processes. All previously counted instrumentation for particles (also nanoparticles) exposure measurements gives possibilities to make air sampling as close as possible to workers breathing zone what is important for correct occupational exposure quantification and qualification. But personal sampling instrumentation for simultaneous nanoparticles' counting, surface area, mass, size distribution etc. parameters is still under development process and gives higher precision on workers' personal exposure calculations.

References

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Figures

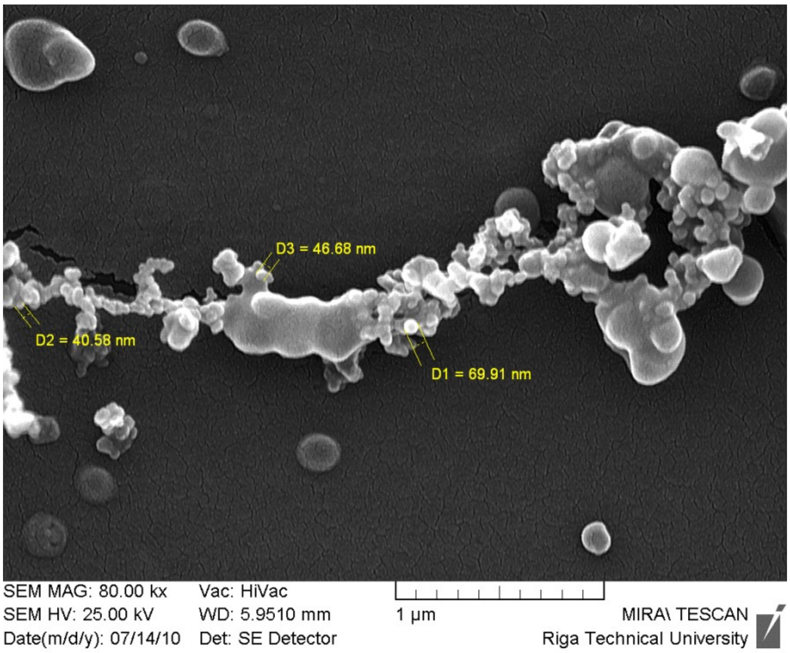

Figure 1. Laserprinters distributed dust particles (D1, D2, D3) sizes in nanometers (nm).

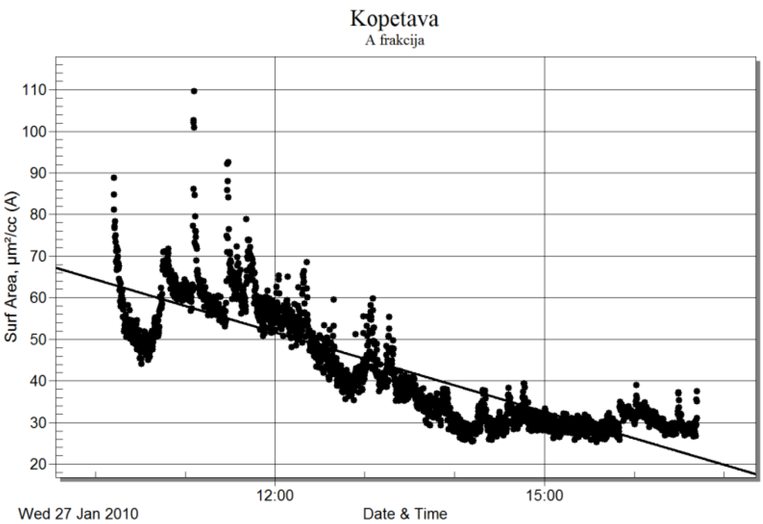

Figure 2. The alveolar fraction of dust particle surface area concentration in copy shop sampling by "AeroTrak 9000".