Separation of Nano-Particles from cutting fluids by using nonwoven materials

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Modern industrial cutting technologies (e.g. drilling, sawing, milling) are using cutting fluids. The cutting fluids are including oils, oil-water emulsions or mists. The properties of the cutting fluid are the ability to keep the workpiece at a stable temperature and to maximize the life of the cutting tool by lubricating the working edge. Based on the high temperature during the cutting process fractions of the cutting fluid are vaporizing and forming particles. Measurements of cutting fluid concentrations in the air at the workplace have shown that a description confined to the general conditions in the working area concerned is insufficient for deriving action to ensure compliance with the German air limit value of 10mg/m³ (Stockmann *et al.*, 2004).

This paper gives an overview about measurements of the removal efficiency of nanoparticles of cutting fluids by using specially manufactured nonwovens. Measurements took place in the test laboratory of ILK in Dresden. Particle size distributions were measured by an SMPS (Model 3936, TSI, USA, Particle-Range: 0.02–0.8 µm) and APS (Model 3321, TSI, USA, Particle-Range: 0.5–5 µm).

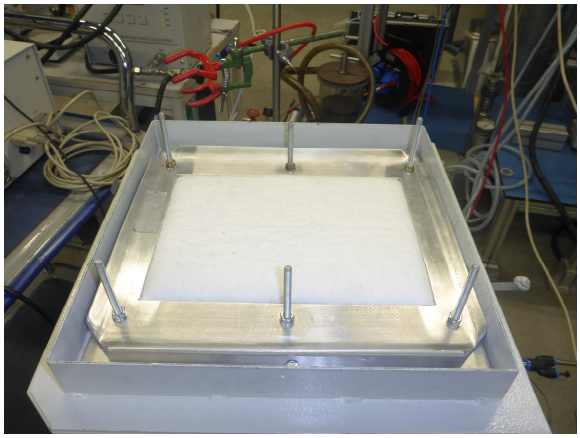

Figure 1. framework for holding nonwovens

Figure 1 shows the experimental setup for the measurements with the framework holding the filter materials. The investigations were carried out on different filter nonwoven materials with dosage of a common-used oil aerosol.

In initial studies the influence of the materials on the separation of nanoparticles were investigated. It was shown that only one material was able to separate nanoparticles lower than 500 nm effectively by nearly 25 % (figure 2). A particle mode in the range of 300 nm was achieved.

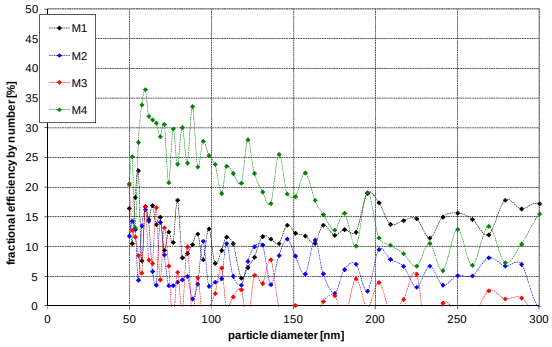

Figure 2. separation efficiency particles 0.05-0.3 µm

The separation efficiency of particles between 0.5 to 3 µm has been further investigated (figure 3). It was shown that now two materials were able to separate particles lower than 4 µm very effectively by nearly 90 % (figure 2). A particle mode in the range of 2µm was achieved.

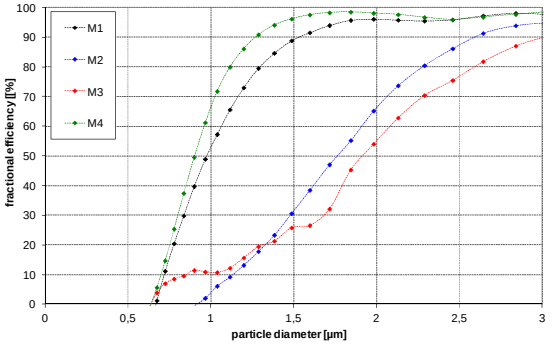

Figure 3. separation efficiency particles 0.5-3 µm

As a result of the measurements the nonwovens materials will be further developed to reach a separation efficiency greater than 50% for nanoparticles lower than 1 µm.

Stockmann, R., Böckler, M., Tiegler, A., Wüstefeld, B., Kleine, H. (2004), Substitution of cooling lubricants in the machining of metal., St. Augustin, Germany, BIA-Report 4/2004