MODIFICATION OF POLYMER MELT-BLOWN FILTER FIBERS BY AEROGELS TO INCREASE THE EFFICIENCY OF OIL MIST SEPARATION

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Oil mist is an aerosol composed of droplets from 0.1 nm to 10 μm, therefore it is dangerous for humans. Except skin irritation it can penetrate very deep into the respiratory track causing various diseases. Moreover, it can reach other organs and even cause cancer, e.g. urinary bladder cancer, gastrointestinal cancer. Oil mist is formed during various processes like machining and cutting, compressed gas cleaning, contaminated air recirculations through the building (e.g. for heating), in an engine closed crankcase ventilation. Due to the wide range of droplet diameters forming the oil mist, the medium separating them from the gas should be characterized by deep-bed structure, high efficiency and high oil sorptivity. Nonwoven filters are a suitable tool for this purpose. The current trend in research on these materials is to modify the surface of their fibers by various methods. This increases their filtration efficiency with a slight increase in pressure drop or/and gives them new properties, e.g. antibacterial.

Therefore, this work is in line with above trend and concerns the modification of polypropylene melt-blown fibers with aerogels. Aerogel is a high porosity silica-organic material with a high specific surface area which is effective oil adsorbent. Our intention was to combine the advantages of melt-blown fibrous filters (i.e. controlled deep-bed structure, high porosity) and aerogels based on MTMS (Methyltrimethoxysilane) (i.e. porous structure, high sorptive, hydrophobic and oleophilic properties) in order to obtain perfect tool for effective oil mist separation.

During this study the two-step sol-gel aerogel synthesis method was developed to modify the melt-blown fibrous filters. The proposed procedure was changed several times to obtain extensive gel structures, which not completely filling the free spaces in the filter volume. As it has already been mentioned, this is a very important issue in the context of modifying the fibers' surface of the depth filters due to the undesirable significant increase in pressure drop. It was proven that MTMS:methanol volume ratio affects sorptive properties of modified filters. The oil mist separation efficiency of new materials depend not only on amount of deposited aerogel but also on distribution of aerogel structures. In all analysed cases the aerogel-polymer composites better filtrate DEHS (diethylhexylsebacate) oil droplets compare to raw polypropylene deep-bed filters (see example results in the Fig. 1).

The presented method of modification is very interesting and promising from both scientific as well as industrial point of view. It leads to the formation of polymer-aerogel material characterized by higher fiber surface roughness, higher oil sorptivity and more efficient in the case of oil mist separation compared to raw polymer filter.

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