

Efficiency of pine wood separation from air with increased relative humidity

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Abstract: *Efficiency of pine wood separation from air with increased relative humidity.* The paper deals with fractional separation efficiency of pine wood dust using polyester needlefelt. Separation efficiency depends on the air relative humidity and the duration of filtering process.

Keywords: wood dust, pulse-jet filtration

INTRODUCTION

Pulse-jet fabric filtration is one of the most efficient ways to remove of fine particulate matter from the air. Fabric filters are the versatile separation devices and their capital and operating costs give them a considerable advantage over the other kinds of separators. As a result of this the fabric filters are in common usage in the woodworking industry. It is caused by the necessity of the efficient removal of wood dust particles from the recirculated air in production rooms. It especially relates to the inhalable dust particles. The particles from this range can be a cause of the health risk connected with the human respiratory system. Removal of these particles from the air in woodworking environment is then very important (Dolny 1999).

Separation efficiency of the pulse-jet bag filter depends on many factors. These factors are the size and shape characteristics of dust particles, technical properties of filtering fabrics, parameters of filtering process and properties of the gas stream. The gas motion stream for wood dust particles is the air from working positions in woodworking factories. It can be characterized by various relative humidity which influences on the efficiency of filtering process (Mukhopadhyay 2009).

The aim of present work was to determine the influence of increase of the air relative humidity on the separation efficiency of dust coming from the pine wood sanding.

MATERIAL AND METHODS

Comparative tests of processes filtering separation of the pine wood dust at the air relative humidity 20 % and 50 % were conducted. The tests were done using the lab stand for tests of filtering bags. Construction and principle of operation of this stand were described in previous works (Dolny 1998, Dolny 1987). The experimental filtering processes were conducted at the filtration velocity 0,04 m/s and the dust concentration at inlet 12 g/m³. They serve as a base of evaluation of the separation efficiency of the polyester needlefelt type PES with hydrophobic superficial finishing.

Concentration of the dust particles in the cleaned air in the range < 25 μm was measured by the laser particle counter HR 5250A. The inhalable dust particles are included in this measurement range.

Wood dust used in the test came from the sanding positions of furniture elements. These elements were sanded by paper with granulation signed 80. Particle-size distribution of the dust was determined by laser particle sizer Analysette 22 MicroTec Plus. Percentage content of the particles from the range < 25 μm was separated from the overall particle-size distribution obtained by this sizer. Comparison of rates of the particles from the investigated range in the overall mass of inlet dust and the rates of these particles in the dust remaining in

the cleaned air enabled to calculate the fractional separation efficiency. The fractional separation efficiency was determined for the both levels of the air relative humidity in the initial stage of the filtering process (after 50 cleaning cycles) and at the end of the process (after 50 cleaning cycles).

RESULTS

The particle-size distribution of dust used to creation of aerosol shows figure 1. Concentration of dust particles from investigated percentage ranges show fig. 2. The decreased concentration of dust particles in the cleaned air of higher relative humidity is an effect of the growth of their mass and size in touch with the humid air.

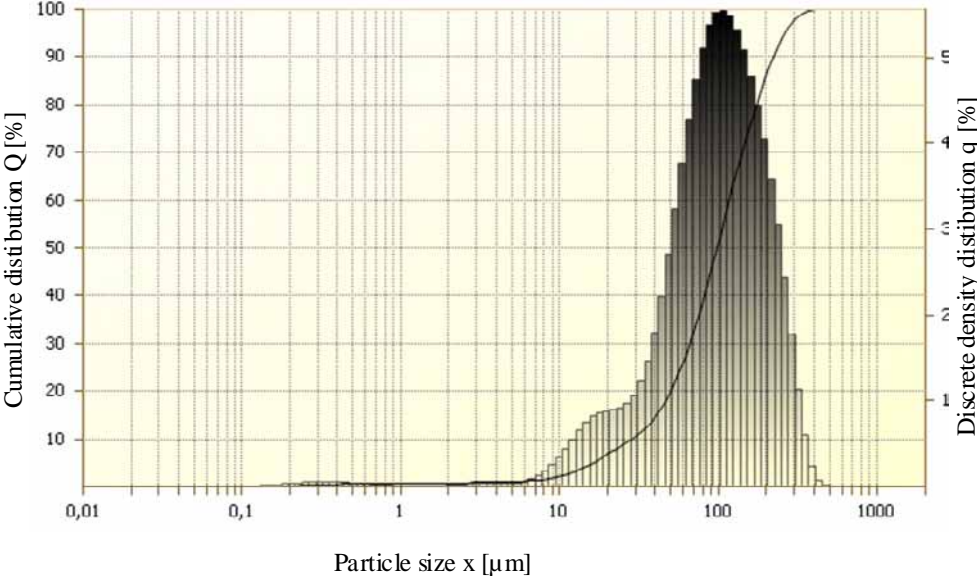
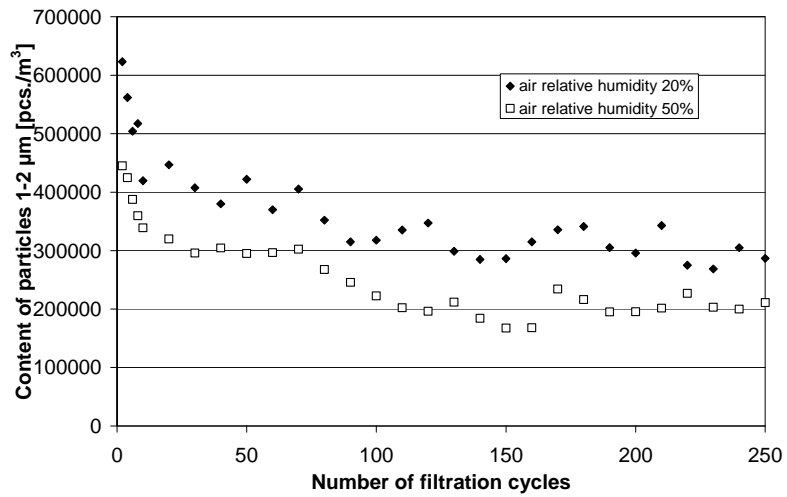
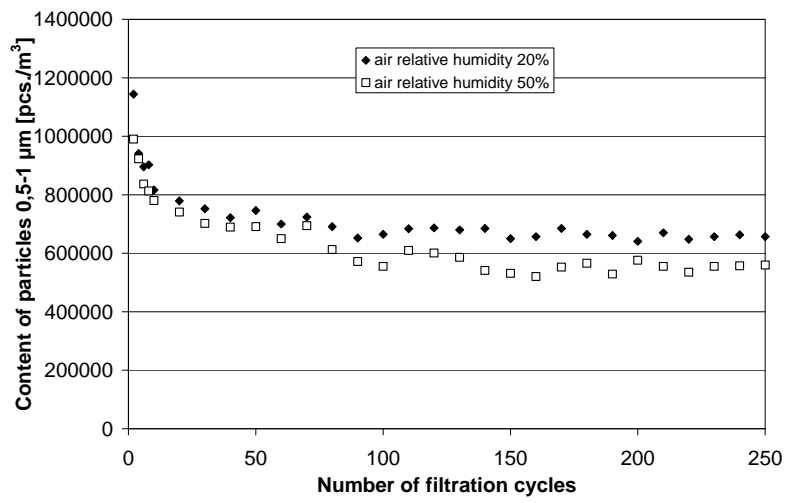
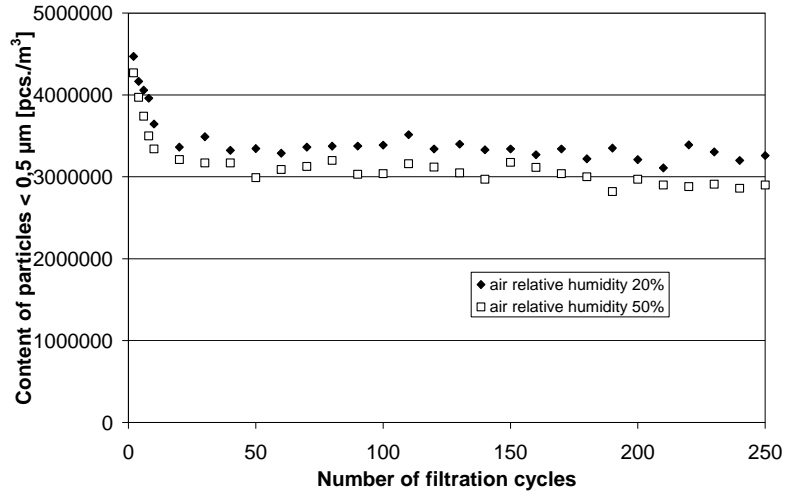
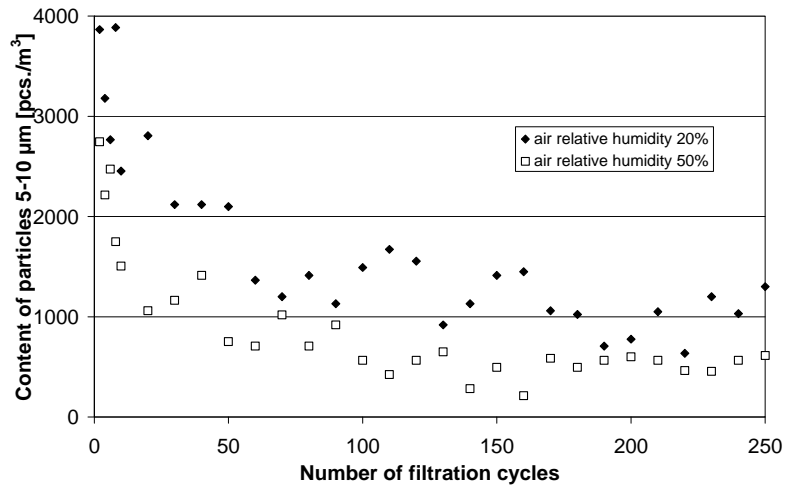
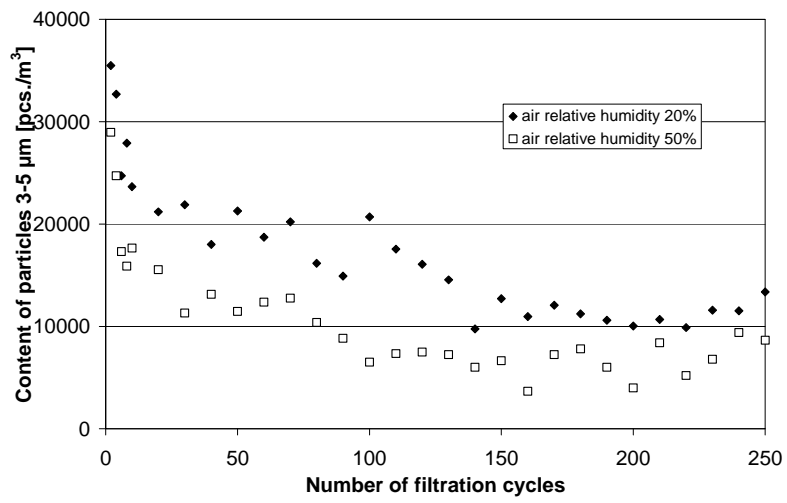
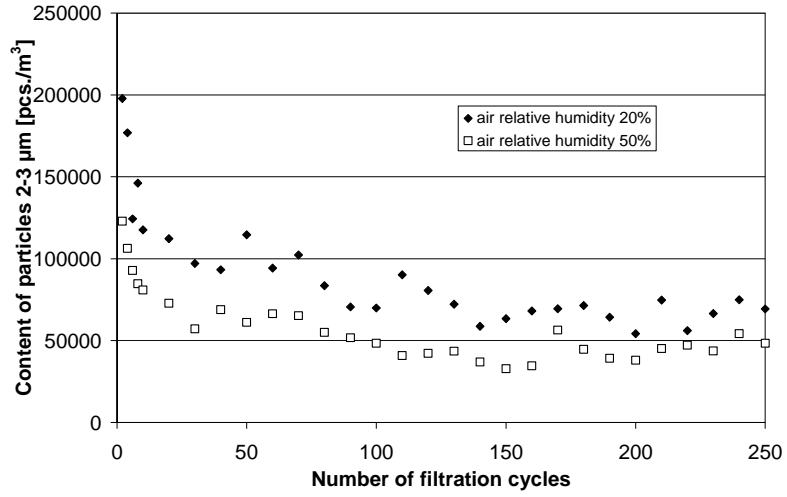


Fig. 1 Particle-size distribution of dust





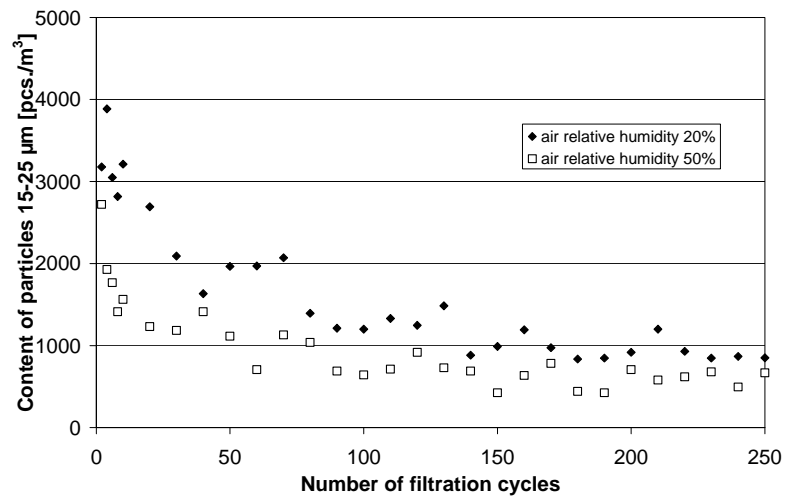
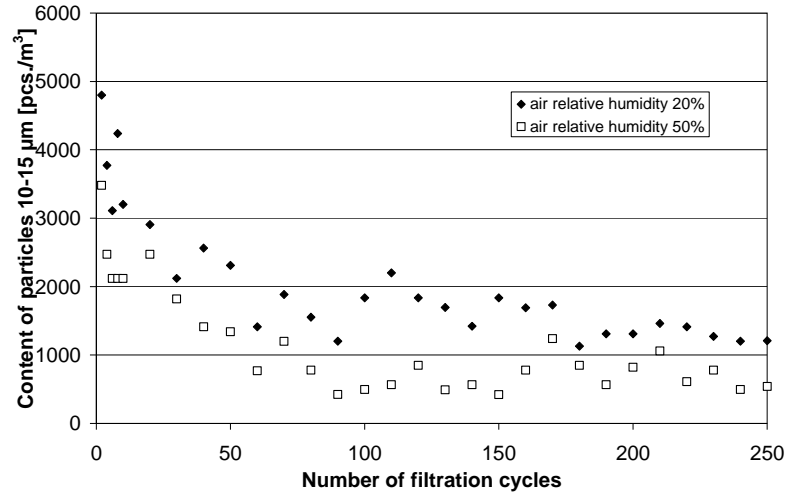


Fig. 2. Content of particles in cleaned air

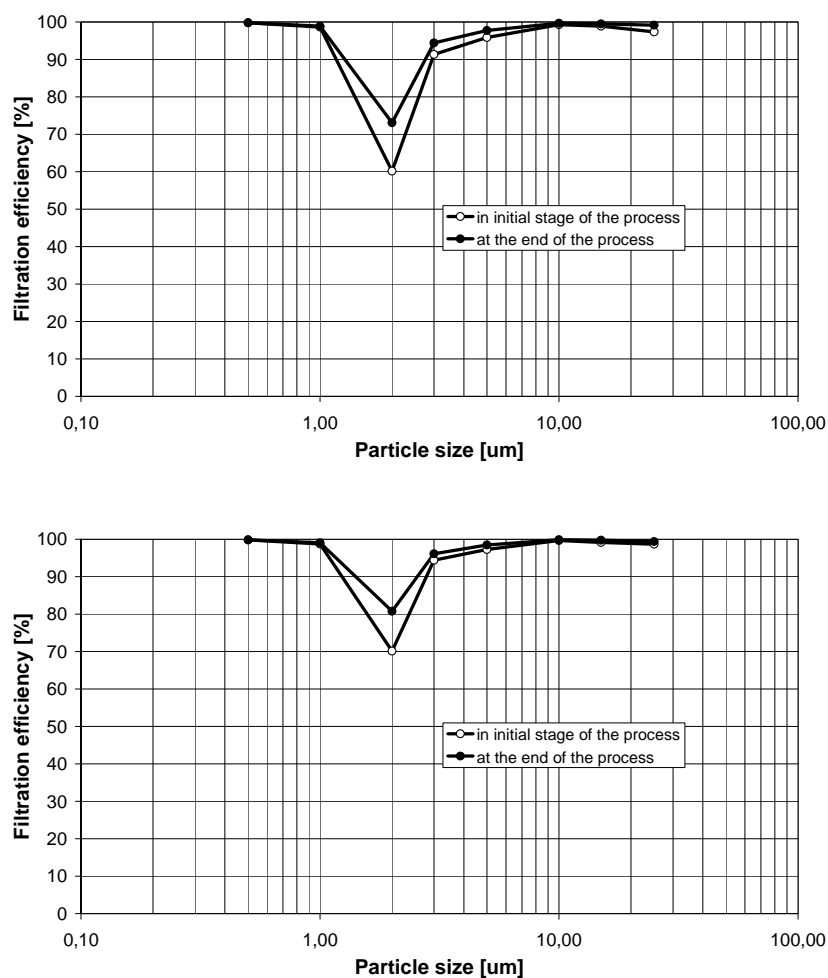


Fig. 3. Fractional separation efficiency (air relative humidity 20% - upper diagram, 50% - lower diagram)

The increase of the mass of particles is caused by sorption and moisture condensation on their surface. The growth in size results from swelling of wood under the influence of moisture content. These phenomena are the reason of higher separation efficiency of the pulse-jet bag filter in condition of heightened air relative humidity (fig. 3).

Tested needlefelt shows the lowest level of the separation efficiency in relation to the particles of size 2 µm. It is an effect of relative low filtration velocity. The most penetrating particles may have lower size after the increase of the filtration velocity.

CONCLUSION

The investigations the fractional separation efficiency of the pine wood dust showed that the most penetrating particles have the size about 2 µm. The separation efficiency of these particles was 10 % higher at the air relative humidity 50% than at the air relative humidity 20%. The improvement of the separation efficiency follows in such relation along the time of duration of the experimental filtering process.

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Streszczenie: *Sprawność filtracyjnego oczyszczania powietrza o podwyższonej wilgotności względnej z cząstek pyłu sosnowego. W pracy przedstawiono wyniki badań frakcyjnej skuteczności separacyjnej poliestrowej włókniny filtracyjnej względem pyłu sosnowego. Skuteczność separacji zależy od wilgotności względnej powietrza oraz czasu trwania procesu filtracyjnego.*

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