TRIESKOVÉ A BEZTRIESKOVÉ OBRÁBANIE DREVA, 8(1): 67–72, 2012
Zvolen, Technická univerzita vo Zvolene, ISBN 978-80-228-2385-2

AIR CLEANING FROM PINE WOOD SANDING DUST USING POLYESTER FILTRATION NEEDLE FELTS

Stanisław Dolny – Zbigniew Potok – Tomasz Rogoziński

Abstract

This study analyzes air flow resistance for three kinds of polyester filtration needle felts with different surface finishing. The effect of the surface finishing treatments on shaping flow resistance was investigated. Both flow resistance of clean filtration materials and shaping of this parameter value during filtration process were given full consideration. The study revealed that the lowest flow resistance in both stage of research shows needle felts type signed PES 450 g BS 11. For the other two kinds of materials value of this parameter was similar. The results signify that any finishing of working surface of needle felts reduces their permeability. The findings can be used by designers of filtration installations to develop detailed directions to choose operating parameters for this type of installations in factories which process large amounts of pine wood.

Key words: *filtration, polyester needle felts, flow resistance, pine dust*

INTRODUCTION

While working with wood or wood based materials there is a lot of waste. With respect to shape and dimension it can be very diverse. Formation of this waste has led to development of different kind of devices that minimise nuisance and danger caused by it. Filtration dedusters occupy the leading position among them.(Dolny 1999, Dzurenda 2007)

Air cleaning using filtration method is based on separating pollutant‘s particles from the air using partition made from porous material – usually fibrous one. The basic factors which determine effectiveness of filtration dedusters are: filtration velocity, size of dust particles and their number in an air unit, structural characteristics and type of material used to make filtration material and the properties of the air stream – dust carrier. The complexity of relations between each filtration parametres complicate exact cognition of influence these parametres have on air cleaning effectiveness. Because of that, accurate studies to determine influance of each fator on this process are needed. (Dolny 1998, Dolny 1999)

Filtration materials, from which partition was made, should meet several demands. At the same time fulfilment of all requirements is very difficult when using the currently known filter materials.(Hermann 1960, Wierzbowska 1992)

With the start of needle felts production, that are characterized by high strength paremetres, intensive introduction of their use in dedusters can be observed. Filtration

Poznan University of Life Sciences, ul. Wojska Polskiego 38/42, 60-627 Poznań, Poland
e-mail: zpotok@up.poznan.pl

needle felts could also be subjected to additional treatments for the change of their performance in the very wide range of uses. (Dobak 1997, Dobak 2002).

Both commonness and the price of pine wood causes that its processing is one of the largest among all type of woods. Because of that showing and describing the process of air cleaning from the dust waste genereted in the process of grinding pine wood is a very important task.

MATERIAL AND METHODS

General remarks

In this study three kinds of polyester filtration needle felts with different surface finishing were used.

Dust from grinding pine wood was downloaded directly from bilateral grinder to profile elements of UNICA 1. These materials were screened before using in the study on a sieve with a mesh size 0,3 mm, which corresponds to border size of dust partitions.

The main methodological assumptions

Filtration material in the form of bags delivered by producer with a diameter 150 mm and length 1,48 m was placed in a chamber to which dusty air constantly flown to. These bags were subjected to a cyclic regeneration treatment at minute interval during entire test cycle. Duration of the regenerative pulse was 15 ms, while the air pressure feeding regenerative system was set at 0,5 MPa. In the study two different filtration velocities were used: w_1 = 0,042 m*s^{-1} and w_2 = 0,056 m*s^{-1}, while keeping constant level of dusty air intake at a degree of about 10 g*m^{-3}. The method of functional interaction of experimental machine elements is shown on diagram in Figure 1.

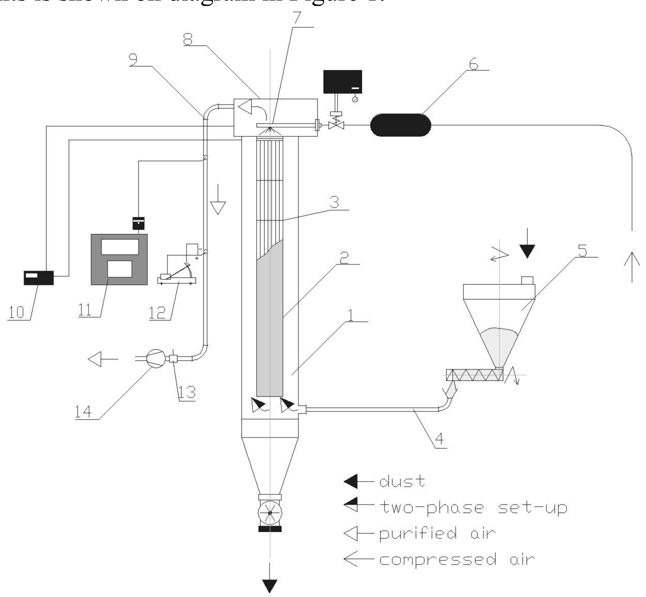

Fig. 1. Schema of position to research a filtration process in large scale:
1 – filtration chamber, 2 – filtration bag, 3 – tension basket, 4 – dust channel, 5 – dosing device, 6 – compressed air tank, 7 – channel with blod nozzle, 8 – regenerative chamber, 9 – outlet channel, 10 – digital differential micromanometer, 11 – laser particle counter, 12 – differential micromanometer, 13 – regulating bolt, 14 – filter circuit fan

Flow resistance of clean filter material

Clean filter bags were placed in the filtration chamber, and tightly fixed to the fixing connector. Then with the dosing device turned off, the filter circuit fan was activated. The air flow resistance readings were performed gradually from zero speed until the regulating bolt in front of fan was completely open. After reaching the highest level of filtration velocity it was gradually reduced. To measure resistance values digital differential micromanometer CMR - 10A was used.

Flow resistance during the test cycle

The second stage of the study was to define shaping values of flow resistance as a function of increasing thickness of dust layer deposited on the filtration material. Variability of air flow resistance across dust covered material was always fixed at a constant, one of two established filtration velocities.

The values of flow resistance was read just before and just after the regenerative pulse. The duration of whole experiment included 240 regenerative pulses following 60 second interval.

The study of clean air pollution degree

The degree of air pollution was determined using laser particle counter Hiac/Royco 5250A. With this device during each experiment the number of particles in the air that was filtered was monitored. Counter had a range of measured from 0,5 to 25 µm. It recognized a number of particles of sizes 0,5; 1,0; 2,0; 3,0; 5,0; 10,0; 15,0; 25,0 µm.

RESULTS

Flow resistance of clean filter material

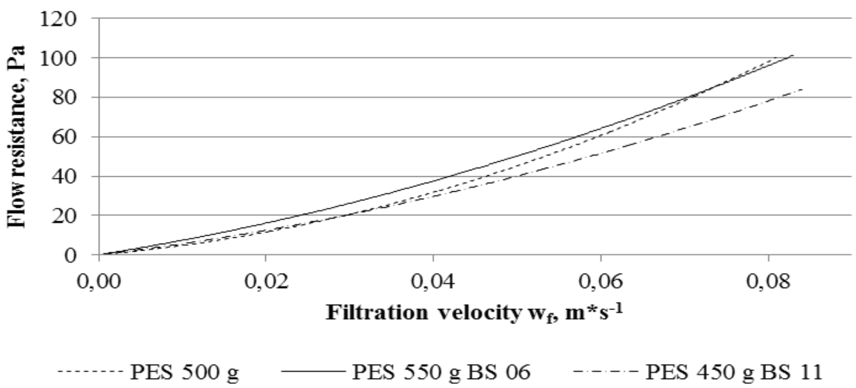

Fig. 2. The average flow resistance through clean materials

Among the tested needle felts the lowest flow resistance through clean materials shows PES 450 g BS 11 – material whith antistatic treatment. For the other two types of materials values of examined parameter are similar in all ranges of filtration velocity changes.

Flow resistance during the test cycle

Variability of flow resistance during the entire study was presented on the graphs. For each type of filter bags, resistances were presented on a single graph for a two filtration speeds. The diagrams show the resistance just before the regenerative pulse and immediately after it.

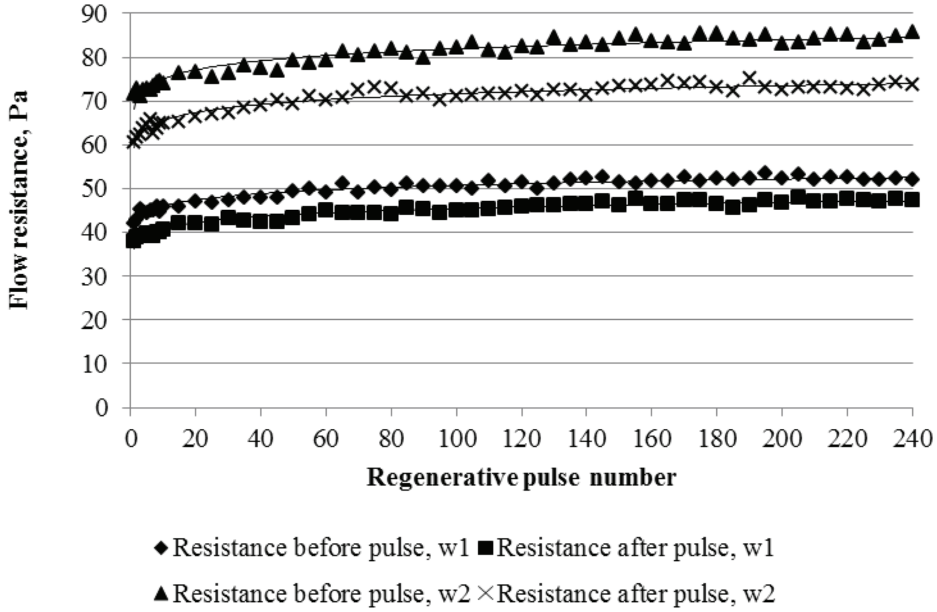

Fig. 3. Flow resistance during filtration on needle felt PES 500 g

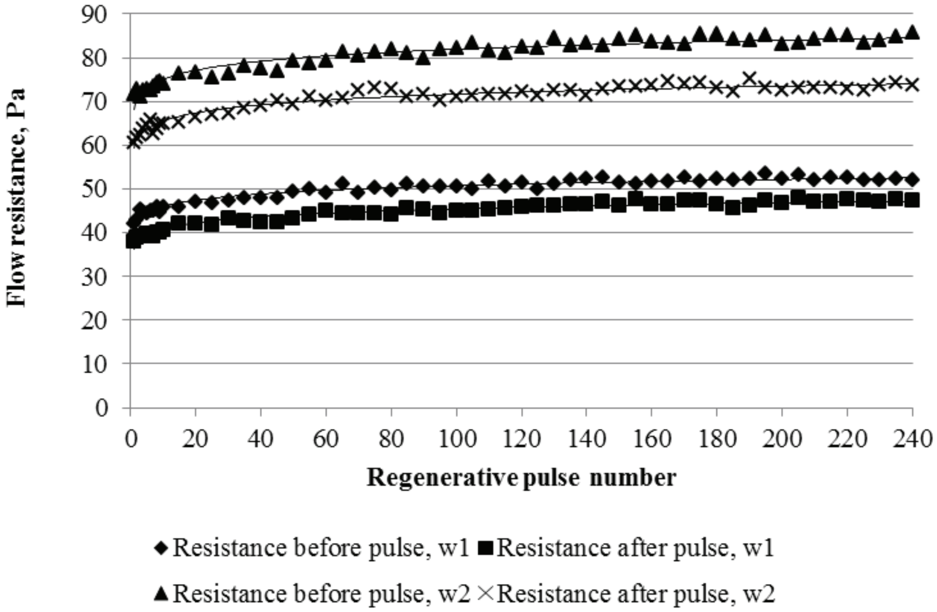

Fig. 4. Flow resistance during filtration on needle felt PES 550 g BS 06

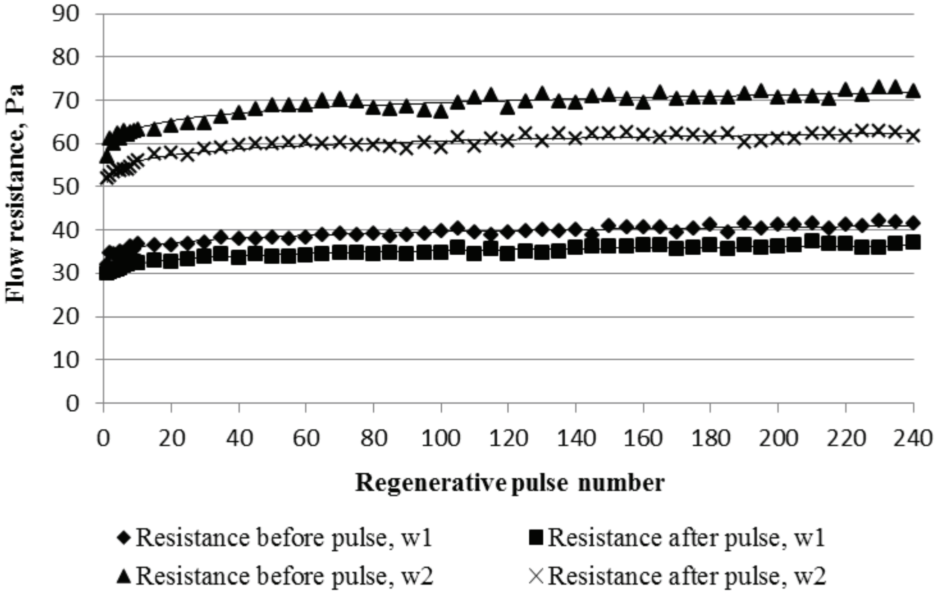

Fig. 5. Flow resistance during filtration on needle felt, PES 450 g BS 11

While increasing filtration velocity, the flow resistance before and after regenerative pulse also increased by about 20 – 30 Pa. In the first phase of experiment increase of resistance was very intense and with the time pass the differences between succeeding readings became much smaller with a tendency to stabilize. There are, of course, differneces in resistance values for different filtration materials. The smallest values shows material PES 450 g BS 11.

Clean air pollution degree

The content of dust particles in the air after filtration, was presented only for one selected kind of filter material at one filtration velocity

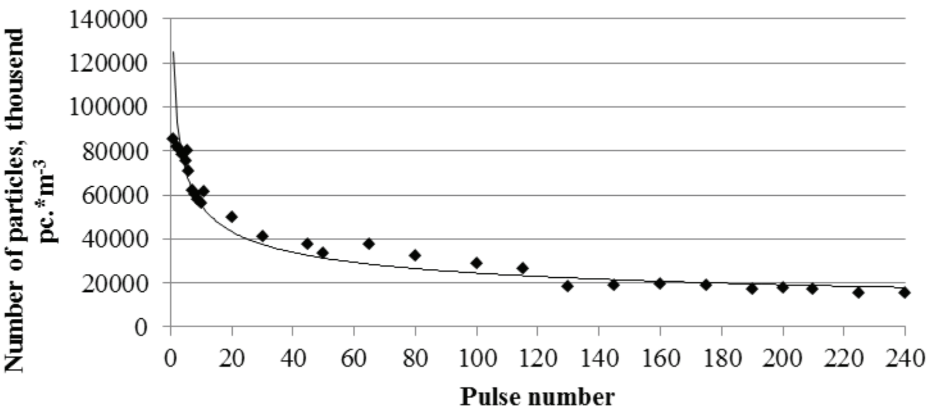

Fig. 6. The effectiveness of air purification with the PES 450 g BS 11

As time passes, number of particles in cleaned air was decreasing. From about 120th regenerative pulse number of particles in cleaned air starts to stabilize.

CONCLUSIONS

Based on the tests and results obtained from determinations the following conclusion could be made.

Flow resistance through clean filter materials is the lowest for the needle felt PES 450 g BS 11 which is material with antistatic treatment. For other two materials flow resistance through clean materials is higher by about 20 Pa.

The lowest flow resistance during a filtration, both for first and the second filtration velocity, shows needle felt PES 450 g BS 11. However the highest values of this resistance was recorded for PES 550 g BS 06. From about 160th regenerative pulse, stabilization of flow resistance is definitively noticeable. For the higher filtration velocity used in researches – 0,056 $m*s^{-1}$ flow resistance is higher by about 20 – 30 Pa for each of testet materials than for velocity 0,042 $m*s^{-1}$. That indicates increase in intensity of removing dust from filtration bag surface with an increasing velocity of inflow dusty air.

The number of particles contained in cleaned air decreased throughout the filtration process. The biggest drop was in initial phase of the experiment. From about 120th pulse the number of particles in cleaned air stays at the constant level.

REFERENCES

1. Dobak S. (1997): Tekstylne media filtracyjne – dobór i jakość. W: Problemy techniki pyłowej w drzewnictwie. Materiały konferencyjne. Kiekrz 22 – 23 kwietnia.
2. Dobak S. (2002): Nowe możliwości w dziedzinie filtracji pyłów drzewnych. Zastosowanie Ergonomii 1 – 4.
3. Dolny S. (1998): Badania oporów przepływu podczas filtracyjnej separacji pyłów powstałych w procesach przerobu materiałów drzewnych. Roczniki Akademii Rolniczej w Poznaniu. Rozprawy naukowe. Zeszyt 292.
4. Dolny S.(1999): Transport pneumatyczny i odpylanie w przemyśle drzewnym.
5. Dzurenda L. 2007: Sypká drevná hmota, vzduchotechnická doprava a odlučovanie. TU vo Zvolene. ISBN 978-80-228-1765-3.
6. Herrmann M. (1960): Entwicklungsstand der Gewebeentstuber für die Zementindustrie. Zament – Kalk – Gips 2.
7. Wierzbowska T. (1992): Nietkane materiały filtracyjne. Sympozjum: „Ochrona powietrza w przemyśle" 27 – 29 maja.