THE INFLUENCE OF MATERIAL DENSITY ON ITS GRANULARITY

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Abstract

This paper gives the results of experimental measurements of granularity of sand dust from sanding process of native wood (spruce, beech) and agglomerated wood materials (fibreboards, particleboards). The aim of the experimental measurements was to judge the influence of density of sanded material on airborne dust where aerodynamic particle size is 100 μm or less. The amount of airborne dust particles are for spruce 79, 92 % and for other three samples the value is at average 90 %. For native wood with wood density increasing the amount of airborne dust increases too, but for wood materials – MDF and particleboards density (in our followed interval) does not play so important role.

Key words: *native wood, agglomerated wood material, density, granularity, airborne dust*

INDRODUCTION

The well being at work – it is the main principle of holistic approach to the questions of health and safety at work. This approach is not only related to work injury and prevention of occupational diseases but it includes working environment, working conditions, employment relationship, social protection of workers, stress, mobbing, harassment and other factors influencing the well being at work. For wood industry there are typical hard working conditions with regard to hazardous influence of high noise, dustiness, vibrations, (Očkajová, 2004, Beljo Lučič et al., 2005).

In woodworking processes a large variety of particle sizes of chips and dusts is produced. The determination of the effect of the working parameters on dust level is based on the measurement of airborne dust emission. The unit of airborne dust emission is grams of airborne dust per second (g/s). Airborne dust is determined as a fraction of dust where aerodynamic particle size is 100 μm or less (Hemmilä, Gottlöber and Welling, 2003).

The aim of all experimental measurements leading to the decreasing of dust emission is to search optimal kinematical parameters of cutting processes and other conditions. The amount of dust is influenced by density of material, average chip thickness, cutting speed, cutting direction, but biggest possible chip thickness leads to a low dust but high noise level. Solution must be a compromise between both, that means not the biggest or lowest value (Gottlöber and Hemmilä, 2003; Varga et al., 2004).

Palmquist and Gustafsson (1999) found that cutting of MDF generates more dust than milling pine. This thesis was confirmed by Hammilä and Usenius (1999). Smaller density

of wood effects a smaller amount of dust when cutting native wood. When sanding native wood the results are the same, the difference is between the amount of dust particles on sieves 0,1 mm and 0,05 mm (Očkajová, A., Banski, A. and Rončka, 2006). The average chip thickness seems to be most important magnitude to influence the dust behaviour of wood cutting process. It is valid that all actions which leading to an increase of average chip thickness decreasing the amount of specific dust, (Očkajova et al., 2006; Gottlöber and Hemmilä, 2003). Cutting speed is playing an important role in terms of dust emission. With increasing of cutting speed an increasing of dust emissions was observed in the past. Reason could be that the higher speeds caused breakings of the chips and their destruction to dust partly. The influence of cutting direction to dust formation process is also discussed in the literature very controversial, but in sanding process we can confirm the increasing of dust particles for sanding perpendicular to the grains in comparison with sanding along the grains (Očkajová, A., Banski, A. and Rončka, 2006).

MATERIAL AND METHOD

Experimental equipment

The experiments were realized using equipment for observing the contact phenomena (Siklienka et al. 1999) whose base was the GBS 100 AE hand belt sander from the Bosch company.

Experimental conditions

- cutting speed – 7,8 $m.s^{-1}$
- power input – 1200 W
- specific pressure between the sample and sanding belt of 1,04 $N.cm^{-2}$

Sanding mean

- sanding belt LS 309 XH Klingspor
- dimensions 100*610 mm
- grit size 80.

Sanded samples

Samples were chosen from typical wood species and wood materials used in furniture industry, joinery manufacture, etc.

Spruce *(Picea abies L.)* - typical coniferous wood species, light and soft with density of 450 $kg.m^{-3}$.

Beech (*Fagus silvatica*) – diffuse porous leaf wood species, its wood is hard and medium-heavy with density of 620 $kg.m^{-3}$.

Fibre board (MDF) with density of 680 $kg.m^{-3}$.

Particle board with density of 715 $kg.m^{-3}$.

For this experiment were prepared samples with dimensions of sanded area 50*50 mm and moisture content of 12 %. Samples for granulometric analyse of sand wood dust were isokinetic taking from exhaust pipe of hand belt sander by standard STN ISO 9096 (83 4610).

Experimental measurement

For judging of dust behaviour from different viewpoints it is very important to know its granulated structure, it is a frequency or its mass frequency of particles in a definite range of their sizes and bulk properties of wood.

For determination of granulated structure after put more precisely method of granulometric analyse of sand wood dust we used set of sieves with mesh dimensions 2000 µm, 1000 µm, 500 µm, 250 µm, 125 µm, 80 µm, 63 µm, 32 µm and bottom. The experiments were carried out on the lab sieve machine Retsch as 200 – c. The weight of the sample was 40 g, the time of sieving - 25 minutes, disrupting interval of sieving - 20 seconds, amplitude 2 mm/ (g). The results were recorded and evaluated. The above mentioned procedure was repeated 3 times for every measured sample.

RESULTS AND DISCISSION

The results are given by granularity of sand wood dust, Table 1 and by curves of sieve residues, Figure 1. From our results we can see that sanding process is generated a big amount of airborne dust particles, where aerodynamic particle size is 100 µm or less, when we sanding native wood and agglomerated material too. For three samples the level of airborne dust particles is about 90 % , from 89,21 to 94, 28 %. Only for spruce is this value below 80 %.

Table 1 Granularity of sand wood dust from sanding of spruce, beech, particleboards and fibreboards

Dimension of sieve mesh [µm]	**Percentage share of fractions in [%]**			
	Spruce	**Beeech**	**Fibreboard (MDF)**	**Particleboard**
2000	0,37	0,46	0,42	0,35
1000	0,40	0,67	0,44	0,47
0,5	0,59	0,83	0,55	0,58
0,25	3,12	0,62	3,05	1,83
0,125	15,60	5,14	3,29	7,56
0,08	23,51	17,43	16,80	12,83
0,063	14,35	14,58	37,68	15,83
0,032	26,86	30,50	38,76	51,07
bottom	15,20	29,78	1,04	9,48
Particle < 100 µm	79,92	92,29	94, 28	89,21

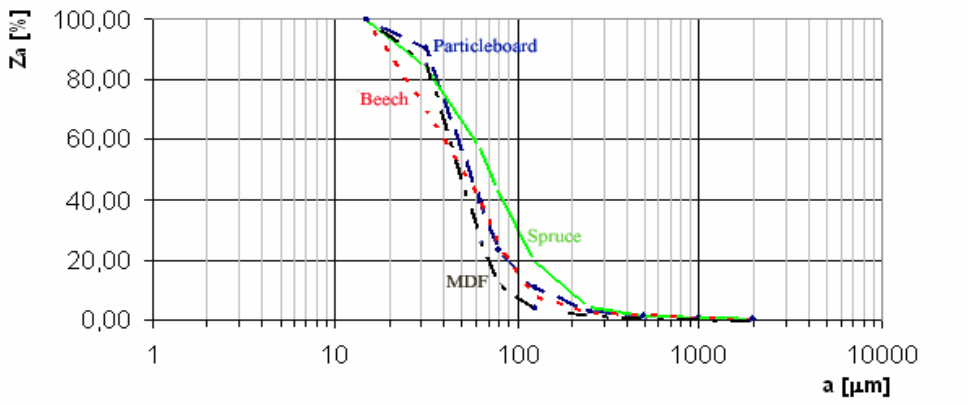

Figure 1: The curves of sieve residues of sand wood dust from spruce, beech, particleboards and fibreboards (MDF)

The results are different for sand wood dust obtained from native wood when with increasing of material density the amount of airborne dust increases too. It is about 10 %. The situation for particleboard and fibreboard (MDF) is different. We do not have so wide range of density for this type of agglomerated material, but with increasing of density the amount of airborne dust particles decreases. We supposed that by sanding of this type of material that is created from small particles will be processing higher amount of airborne dust particles, but our meaning does not be confirmed. But when we compare the residues on sieves 0,032 and bottom (the smallest particles) for these four samples, the highest value is for particleboard and beech at about 60 % and for spruce and MDF this value is only 40 %, what is influenced by density and by internal structure of wood and wood material (particle or fibre) too.

CONCLUSION

Sanding process is generated a big amount of airborne dust particles with particle size 100 μm or less at sanding of native wood and agglomerated material too. For three dust samples (beech, particleboard, fibreboard) the level of airborne dust particles is about 90 %, only for spruce is this value below 80 %.

For sand wood dust obtained from native wood with increasing of material density the amount of airborne dust increases too. It is about 10 %.

For sand dust of agglomerated material with increasing of material density the amount of airborne dust particles decreases in our followed interval and we supposed that besides density here plays a very important role an internal structure of these materials too.

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