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Influence of filling mixtures on the properties of HDF surface

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Abstract: *Influence of filling mixtures on the properties of HDF surface.* During the production of MDF boards, the mats were coated with a different filling mixtures in aim to reduce the surface roughness and liquid absorption of produced panels. The mixture was composed of wood dust, a starch (barley or potato) and water. The use of the filling layer has reduced roughness of boards 25 - 60%, the absorption of water 12-24% and toluene more than 100%.

Key words: HDF boards, surface properties

INTRODUCTION

Surfaces of raw MDF boards, including HDF are subjected to finishing before their applications. For this purpose, the surfaces are covered either with laminates, veneers, films, paints or lacquers. The quality of the surface is examined by measurement their roughness and absorption of liquid (water and / or the toluene). If the surfaces are smoother and less absorb liquid, a smaller quantity of paint is needed for the treatment of boards.

The surface quality of the raw boards depends on a few factors: the size of the wood fibers, fiber moisture content, amount of adhesive resin, the degree of compression of mat (density of boards including density of the surface layers), sanding conditions, if such an operation is carried out.

In this research, the top surfaces of mat were coated with a filling mixture in the production of HDF boards. Some experience with the production of hardboards and paper products were used. In the production of hardboards the surface of mats overlaps the pulp about the high degree of freeness (DS. 80-120) (Oniśko 1978). In the paper industry, on the surface of paper, the coating mixtures are applied to impart the suitable properties of papers (increase resistance to fats, temperature, humidity, et al.) (Drzewińska and Stanisławska 2007, Sobczak 2003). The main components of these mixtures are pigments and binders.

In the previous works (Nicewicz and Monder 2013, 2014) it was found that the optimal amount of a filling mixture should be 20 g/m^2. The components of a filling mixture were: an organic filler - pine wood dust, obtained as waste during sanding, binding component - potato starch and water; water was added to obtain viscosity (200 - 400 mPa • s).

In this research, a barley starch has been investigated as a component of a mixture and, for comparison, a potato starch. A barley starch was tested because it is cheaper than a potato starch.

The aim of research was to reduce the roughness and liquid absorption of surfaces while maintaining strength and physical properties HDF boards contained in the standard PN-EN 622-5 / 2010.

MATERIALS AND METHODS

Pulp from pine wood, obtained in industrial conditions was applied in the production of HDF. Melamine-urea-formaldehyde resin was added as an adhesive in the amount

of 13.5% in relation: resin solid content to over dry fibers. The boards with a target density of 890 or 700 kg/m^3 and thickness of 3 or 4 mm respectively, were produced in laboratory conditions. Resin was sprayed onto fibers in a blender. The blended fibers were manually formed into mats using a wooden frame. Filling mixture (FM) was sprayed as a thin layer (20 g/m^2) to the top surface of formed mats. The mixture, which contained a potato starch – *hereinafter: p* and barley starch: *hereinafter: b*. The mats were pressed in hot-press at 180^{o}C, at a pressure 2.5 MPa, press factor 10 s/mm.

The produced panels were tested in case of bending strength - MOR (EN 310), internal bond strength - IB (EN 319), thickness swelling –TS (EN 317), surface absorption – water and toluene (EN 382-1 and EN 382-2 respectively) and surface roughness Mitutoyo SJ-201. The significance of differences between means was determined by the Student t-test at 0.05 significance level.

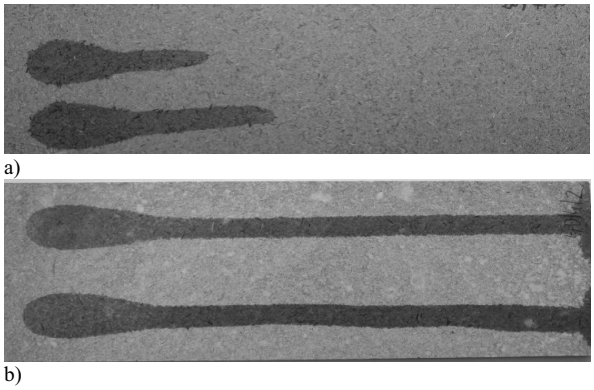
RESULTS AND DISCUSSION

The properties of surface of boards with the filling mixture and for comparison the properties of raw boards are shown in Table 1 and additionally in Figure 1.

Table 1. HDF surface properties

Density of boards (kg/m^3) /amount of FM (g/m^2) /kind of starch	R_a µm	WA g/m^2	TA mm
890/0	5.77	126	144
890/20/*p*	4.32	112	>283
890/20/*b*	3.48	126	>283
700/ 0	8.10	140	134
700/20/*p*	2.66	104	>283
700/20/*b*	3.10	134	>283

R_a - arithmetic average deviation from the mean line profile
WA - water absorption
TA - toluene absorption



a) raw surface of board
b) surface with filling mixture

Fig.1. Toluene absorption of HDF boards

The data presented in Table 1 and Figure 1 shows that the filling mixture improves the surface quality of HDF boards. The impact on the properties is varied and depends on the properties of the raw boards; in this research on the density of the boards. The surface roughness of boards with a density of 890 kg/m^3 decreased depending on the type of starch (25% for potato starch and 40% for barley) and boards with density 700 kg/m^3 - over 60% for both. The significantly decreased absorption of toluene can be observed - the length of toluene spots on the surfaces with the filling mixture "overstep" beyond the length of the all samples (Fig.1b). The surface water absorption decreased (by 12-24%) only for those boards, which had potato starch in the mixture. It appears that the fine grains of wood dust are a kind of filler space between the wood fibers in the mats. It causes a lower roughness boards and make difficult the absorption of liquid. Starch as a polysaccharide binds the fine dust grains themselves and with wood fibers. Considering all the properties it should be found that potato starch is a better binder than barley starch in the filling mixture.

Strength properties and thickness swelling of the tested boards are shown in Table 2.

Table 2. Strength properties and thickness swelling of HDF

Density of boards (kg/m^3) /amount of FM (g/m^2) /kind of starch	MOR N/mm^2	SD N/mm^2	IB N/mm^2	SD N/mm^2	TS %	SD %
890/ 0	37	13	0.7	0.2	14	2
890/20/p	41	8	0.6	0.1	19	6
890/20/b	37	6	0.6	0.2	17	3
700/0	29	6	0.4	0.1	12	2
700/20/p	30	7	0.4	0.1	10	3
700/20/b	30	6	0.4	0.2	14	2

The data in Table 2 shows that the filling mixture does not cause a statistically significant changes in strength properties of boards.

The thickness swelling of the boards with the filling mixture was higher than thickness swelling of the raw boards, in most cases. This increase may be due to the fact that wood dust is more hydrophilic than the wood fibers. However, it can be noticed that thickness swelling of all boards was significantly lower than the values prescribed in the standard (30%).

CONCLUSION

The studies have shown that barley starch can be used in the filling mixture. Some of the properties of the surface of the boards (water absorption) are lower using a potato starch. Using the mixture in an amount of 20 g/m^2 can be improved properties of surface of both kind of HDF - about density 890 kg/m^3 and about the lowered density to 700 kg/m^3: roughness 25 - 60%, the absorption of water 12-24% and toluene more than 100%.

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Streszczenie: *Wpływ mieszanin wypełniających na właściwości powierzchni HDF.* Podczas wytwarzania płyt HDF, na kobierce włókniste nanoszono mieszaninę wypełniającą w celu zmniejszenia chropowatości i absorpcji cieczy (wody i toluenu) powierzchni produkowanych płyt. Mieszanina składała się z mączki drzewnej uzyskanej podczas szlifowania drewna sosny, skrobi jęczmiennej lub ziemniaczanej i wody. Każdą z mieszanin nanoszono w ilości 20 g/m^2, co pozwoliło zmniejszyć chropowatość powierzchni płyt o 25 - 60%, absorpcję wody o12-24% i absorpcję toluenu o ponad 100%.

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