

The influence of the kind of glue resins on the properties of MDF

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Abstract: The influence of the type of resins on the properties of MDF were investigated. Four kinds of synthetic resins: UF, MUF1, MUF2 and UMPF were used to gluing fibers. MDF were produced in laboratory conditions. Properties of obtained boards were tested.

Keywords: UF, MUF and MUPF resins, MDF

INTRODUCTION

In the production MDF, wood fibers are bonded by glue resins. At the present time commonly synthetic resins: urea- formaldehyde (UF), melamine- formaldehyde (MF) and phenol- formaldehyde (PF) or isocyanines are used. Singly melamine resins are not practical to use for the joining of wood fibers. These resins are added to urea or urea -phenol resins to improve the properties of board, mostly hydrophobic properties (Maylor 1995, Danky 1998, Pizzi A. 1994, Pizzi A. *et al* 2003).

The choice of the resin depends on conditions, in which the boards will be used. These conditions can be dry, humid or external. In our country almost all MDF are used in dry and humid conditions. Therefore, in this work, the influence of the amino resins on the properties of MDF was examined.

MATERIALS AND METHODS

Two series MDF were made in laboratory conditions: the first series -- MDF density 620 kg/m^3 , the second series -MDF density $700 \text{ kg/m}^3 (\pm 5\%)$. Target boards thickness of 12mm ($\pm 0,1\text{mm}$).

The standard pulp from pine wood, obtained in industrial conditions was applied. The pulp was the same for all boards. Four kinds of synthetic resins: UF, MUF1, MUF2 and UMPF were used for gluing fibers. Resins: MUF1 and MUF 2 differed with the content of melamine (6 and 18%). The appropriate resin was spread on the fibers in the quantity of 10% (in relation to absolute dry pulp) and the boards were produced.

Technological parameters during production: temperature of press platens 170°C , pressure 2.5 MPa, time 3 minutes. Properties of obtained boards were tested according to the obligatory standards PN -EN 622-5. The significance of the results was examined by means of the Student's criterion.

RESULTS AND DISCUSSION

Properties of boards are presented: in table 1 and 2 .

In table 1 properties of MDF of density 620 kg/m^3 are presented.

Table 1. Properties of MDF boards produced with the different kind of resins

Kind of resin	MOR (N/mm ²)	SD* (N/mm ²)	IB (N/mm ²)	SD (N/mm ²)	MOE (N/mm ²)	SD (N/mm ²)	TS after 24h (%)	SD (%)
UF	24	3.0	0,20	0.1	2350	130	27	1
MUF1	31	3,8	0,5	0,1	2900	190	2,4	0,5
MUF2	31	2,8	0,5	0,1	2670	280	6,6	0,5
MUPF	35	2,5	0,4	00	3097	110	5,5	0,6

*Standard deviation

As the visible, strength and hydrophilic properties of the boards were relative to the kind of resin used in their production. The boards with the lowest strength properties had fibers, that were glued by UF resin. Melamine contained in MUF resins had influence on the strength properties of the boards. The boards made with melamine had higher: a bending strength (about 30%), internal bond (about 250%) and the module of the elasticity (13 to 23%) as compared with the properties of boards manufactured with UF resin. The share of melamine in the resin (6 or 18%) had no significant influence on the value of these properties of boards.

The boards with the lowest thickness swelling were those made with the MUF 1 resin (6% melamine). Thickness swelling of these boards was only 2, 4% and was significantly lower compared to the thickness swelling of boards made with UF resin. Decreasing of the thickness swelling of the boards under melamine is easy to understand (Wirpsza, Brzeziński 1970). However it is difficult to explain, why the thickness swelling of boards made with MUF2 was higher than the thickness swelling of boards manufactured with MUF1.

The boards with the highest strength properties (the bending strength and the module of the elasticity) produced with the MUPF resin. This resin did not have influence on the internal bond of the boards. The thickness swelling of the boards manufactured with MUPF resin was significantly lower than the boards made with UF resin and from requirements in the standards PN-EN 622-5 .

In table 2 properties of MDF of density 700 kg/m^3 are presented .

Table 2. Properties of MDF boards of density 700 kg/m^3 produced with the different kind of resins

Kind of resin	MOR (N/mm ²)	SD* (N/mm ²)	IB (N/mm ²)	SD (N/mm ²)	MOE (N/mm ²)	SD (N/mm ²)	TS after 24h (%)	SD (%)
UF	36	3.0	0.75	0.1	2400	120	15	1
MUF1	39	4,0	0,5	0,1	3770	220	2,4	0,5
MUF2	39	3,0	0,6	0,1	3710	250	5,8	1,1
MUPF	44	2,0	0,5	0,1	3944	160	4,5	0,5

MDF with the density of 700 kg/m^3 , had higher strength properties, but similar hydrophilic properties in relation to boards of density 620 kg/m^3 . The influence of the kind of resin on the properties of the boards was similar to the first series of boards. Boards which were produced with both MUF resins had a higher bending strength (about 8%) and a module

of the elasticity (more than 50%) and also a lower thickness swelling (2,5 to 6 times) compared to the boards which had UF. The quantity of melamine in resins (MUF 1 and MUF2) did not have influence on the strength properties. As previously, the greater (18%) participation of melamine in the resin did not decrease the thickness swelling of boards, and outright inversely caused increasing of this propriety (from 2,4 to 5,8%).

The boards with the highest strength properties were whose fibers were glued by MUPF resin. This resin is not practical in the production of MDF. However, in the present work this resin was used for research .

CONCLUSIONS

1. The significant improvement of the mechanical propriety of MDF can be obtained by the increase of the density of boards and/or by the use of a suitable resin.
2. The boards with the highest strength properties were produced with MUPF resin.
3. The addition of melamine to the resin UF decrease the thickness swelling of MDF even about 2, 5 to 6 times.

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Streszczenie: *Wpływ rodzaju żywicy klejowej na właściwości MDF.* Wykonano dwie serie MDF o gęstości 620 i 700 kg/m³. W produkcji płyt zastosowano cztery rodzaje żywic klejowych: mocznikowo- formaldehydową (UF), melaminowo- mocznikowo- formaldehydową z udziałem melaminy 6% (MUF 1), melaminowo- mocznikowo- formaldehydową z udziałem melaminy 18% (MUF 2) i żywicę melaminowo- mocznikowo- fenolowo- formaldehydową (MUPF). Stopień zaklejenia włókien każdą z żywic wynosił 10%. Stwierdzono, że najwyższe właściwości wytrzymałościowe miały płyty wykonane z dodatkiem żywicy MUPF. Melamina obniżała w istotny sposób (2,5 do 6 razy) spęcznienie płyt, jednak nie zaobserwowano zależności proporcjonalnych pomiędzy zawartością melaminy a spęcznieniem płyt.

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