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INVESTIGATION OF SOME PERFORMANCE OF WOOD FIBER BASE COMPOSITE MATERIALS

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Abstract. *In this paper the wood fiber base composite materials processing by isostatic compression is investigated. Two series of composite materials with different polymer matrices are obtained: phenolformaldechide - wood fibers base particles and bitumen- wood fibers base particles. The influence of process parameters on some of their properties (hardness and moisture absorption) are investigated and compared with the properties of commonly available wood-based products. The increase of pressure, time and fiber contents leads to higher hardness and moisture absorption of wood composites.*

Key Words: *Wood Fiber Base Composite, Isostatic Compression*

INTRODUCTION

The use of wood composites in construction has been on the rise for many years. The addition of woodfiber to plastic increases thermal and dimensional stability. The moldability of plastic allows for complex product designs. In addition, these composites are attractive in the environmental sense because both waste wood and recycled thermoplastics can be used to make the given products.

The aim of this paper is to explore the possibility of making a composite material on the base of wood fiber for isolation purpose. The raw material on the base of wood particles is filtration cake obtained by waste water treatment in hardboard factory ″Kopaonik″, Kuršumlija, Serbia and Montenegro. So, the aim of this paper is not only to investigate the new composite material, but it is attractive in the environmental sense, too. Also, it is a part of project supported by the Ministry for Science and Environmental Protection.

The properties of a composite material are strongly influenced by the properties of its constituents, their distribution and the quality of their interactions. The most important of all the composite properties are usually the mechanical ones since whatever may be the

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reason for the choice of a particular composite for some application, it must have certain characteristics of shape, rigidity and strength.

The plastic matrix in the composite is phenolformaldechide as thermosettings in one case and the bitumen as the thermoplastic resin in the second case.

EXPERIMENT

The filtration cake is composed not only on the wood fibers base but it also comprises residual components from hardboard processing and wastewater treatment (phormaldechide, paraffin, aluminum- sulfate, calcium-hydroxide). The inorganic content is 21 %. Because of that, the wet filtration cake gets solidified during drying on the air.

The particles on the wood fiber base of the dimension up to 2.6 mm are obtained from wet filtration cake by grating. After that the particles are dried to the constant mass, selected by dimension and then mixed with bonding polymer.

In the Series I of the experiments phenolformaldechide is used as a bonding polymer matrix in the composite, unlike bitumen in the Series II. The samples with different plastic portion are made by isostatic compression. Investigation of hardness by Janka test and moisture absorption is performed. Process parameters of isostatic compression process (time, temperature and pressure and the composition) and results of tests of hardness and moisture absorption are presented in Tables 1 and 2.

Table 1. Process Parameters for Series I (phenolformaldechide - wood fibers base particles)

%Phenol form.	Temperature (°C)	Pressure (MPa)	Time (min)	Hardness (MPa)	Moisture abs. (%)
4.2	140	5.1	20	4.30	44
16.6	130	5.1	20	5.20	26
4.2	130	9.6	20	9.52	30
16.6	140	9.6	20	8.50	33
4.2	130	5.1	30	6.25	32
4.2	130	9.6	30	12.13	35
4.2	140	9.6	20	12.43	40
4.2	140	9.6	30	14.14	39

Table 2 Process Parameters for Series II (bitumen- wood fibers base particles)

% Bitumen	Temperature (°C)	Pressure (MPa)	Time (min)	Hardness (MPa)	Moisture abs. (%)
12	70	2.9	3	2.75	-
12	60	2.9	3	3.53	-
13	70	9.6	1	-	9
13	70	19.2	1	-	24.9
13	70	28.8	1	-	26.2

RESULTS AND DISCUSSION

The hardness test and moisture absorption test of specimens are performed [1]. From the results in Table 1 for the Series I (phenolformaldechide - wood fibers base particles) it is obvious that any increase of pressure, time and fiber contents leads to higher hardness. In the case of the Series II (bitumen- wood fibers base particles) it is only a preliminary investigation and data are not completed. In the moisture absorption investigation better results are obtained for the Series II with bitumen. In Series I a higher content of wood particles leads to higher moisture absorption. The temperature influence is difficult to investigate because the experimental values of temperature are very close. These properties are compared with commonly available wood-based products and some wood fiber-plastic panel materials [2-4]. The referential literature does not comprise a lot of information on the specifically properties of wood-based and wood fiber-plastic panel materials. So, there is a range of values displayed for each material. Figure 1 presents hardness of these materials. Hardness values were higher for samples of Series I then for other composite products. Samples of Series II have lower hardness. Because particleboard is often used in flooring underlayment applications, this indicates that wood fiber plastic composite might work well in this application.

In the case of moisture absorption (Fig. 2) the samples of both series shows comparable values to the other materials.

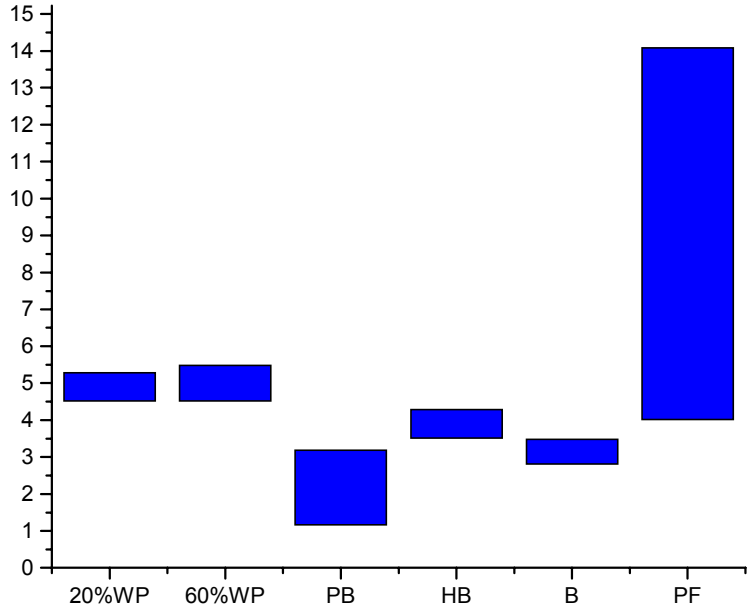

Fig. 1. Results of hardness tests 20% WP – mix of low-density polyethylene and polypropylene (50%-50%) with 20 percent wood floor by weight; 60% WP - mix of low-density polyethylene and polypropylene with 60 percent wood floor by weight; PB- particleboard, HB- hardboard, MDF- medium density fiberboard; B- bitumen with wood fiber particles; PF- phenolformaldechide with wood fiber particles.

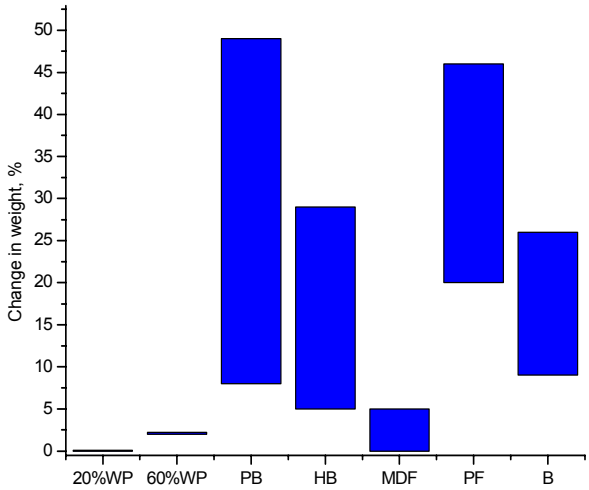

Fig. 2. Percentage change in weight after 24-hour moisture exposure 20% WP – mix of low-density polyethylene and polypropylene (50%-50%) with 20 percent wood floor by weight; 60% WP - mix of low-density polyethylene and polypropylene with 60 percent wood floor by weight; PB- particleboard, HB- hardboard, MDF- medium density fiberboard; B- bitumen with wood fiber particles; PF- phenolformaldechide with wood fiber particles.

This experimental result confirms that mechanical and water resistance properties of second-generation composites [5] made from recycled materials are essentially equivalent and better than properties of first-generation composites (made from virgin materials).

CONCLUSION

In this paper the results of investigation of processing of wood based composite materials are presented. These materials are obtained from waste wood fiber and bonding phenolformaldechide in Series I and bitumen in Series II.

The hardness test and moisture absorption investigation of the obtained samples are performed. Better hardness results are for Series I (phenolformaldechide - wood fibers base particles) and better resisting on the moisture absorption is for Series II (bithumen-wood fibers base particles). So, the first composite material could be used as a flooring underlayment application, and second as an isolation material.

The performances of these composites are compared to some commonly available wood based panel products and wood-plastic composite panels. The values of the hardness and the change in weight are comparable with those given in the Ref. for other conventional wood based products.

The results indicate that the production of these materials is attractive because both waste wood and recycled plastics can be used, and the investigation in this direction should be continued.

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ISPITIVANJE NEKIH OSOBINA KOMPOZITNIH MATERIJALA NA BAZI DRVENIH ČESTICA

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U okviru ovog rada ispitivano je procesiranje kompozitnog materijala na bazi drvenih čestica izostatskim presovanjem. Izvedeno je procesiranje dve serije kompozitnih materijala sa različitom polimernom matricom (fenol-formaldehid-drvene čestice i bitumen-drvene čestice) i ispitivan je uticaj procesnih parametara na tvrdoću i apsorpciju vlage. Dobijeni podaci za tvrdoću i apsorpciju vlage upoređeni su sa literaturnim podacima drugih komercijalnih materijala na bazi drveta. Na osnovu eksperimentalnih rezultata uočeno je da povećanje pritiska, vremena presovanja i sadržaja drvenih čestica vodi ka višim vrednostima za tvrdoću i apsorpciju vlage.

Ključne reči: *kompozitni materijal na bazi drvenih čestica, izostatsko presovanje*