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COMPOSITE PLATES FROM WOOD-FLOUR

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Abstract: *In this paper we present the possibility to recycle the wood – flour from industrial processes and blend with resin. The aim is to found the sources and to use these wastes in order to obtain new composite materials. The effects of different types of fiber treatments on the mechanical properties of composites materials made from wood-flour were also presented. The new plates are characterized and compared with classic wood plates.*
Keywords: *wood flour composites, composite plates, waste recycling, mechanical properties*

1. INTRODUCTION

Concern for the environment, both in terms of limiting the use of finite resources and the need to manage waste disposal, has led to increasing pressure to recycle materials at the end of their useful life [1].
This century has been named the Age of Materials. By improving and reuse the materials of all types, technology will advance very much, said the researchers. The interest in replacing inorganic filler and reinforcement materials with renewable organic materials such as natural fibers and wood-flour in composites materials is increased for environmental reasons [2].
For example, one of the most used materials is wood, which has many applications in new composite materials. In many case-studies, the authors confirm that wood is the most efficient material – known with his stability, load-bearing capacity, toughness, etc. These properties do not derive from the constituent materials, but rather from their arrangement. Wood is composed of parallel columns of long hollow cells (fibers) which confer strength. Each layer is a composite of cellulose crystalline fibers in a resinous matrix of organic polymers – lignin, hemicelluloses and non-crystalline cellulose [3].
The main disadvantage of natural fiber is their hydrophilic nature that lowers the compatibility with resin matrices in the process. For using these materials in outdoor applications, for example, makes it necessary to analyze their mechanical behavior under the influence of the weathering action [4, 5].
The properties of composite materials will depend on the technique used and the processing parameters [6] which can modify the properties of the melt state and its crystalline structure.
Reducing quantities of waste is a great interest in all countries. It is a challenge to obtain new composite materials from waste, knowing the problems facing our country in terms of recycling and reusing waste.
We can obtain composite materials with high qualities and properties, using the wood waste. These mean a reunion between two or more materials with different properties which finally confer a material with superior performance.

2. MATERIALS AND METHODS

2.1. Sources of wood waste.

According to the National Institute for Research and Development Environmental Protection, ICIM Bucharest, there are several sources of waste wood: forests, wood processing residues behind, wood waste from construction and demolition, etc.
The result of processed wood is an industrial waste in the form of sawdust; chips and wood flour (approximate 15% of wood cut).

The form of used materials was determinate. In Figure 1 are presented the form of wood waste from S.C. Kronospan S.A Sebeş which they use to obtain PAL and MDF plates.

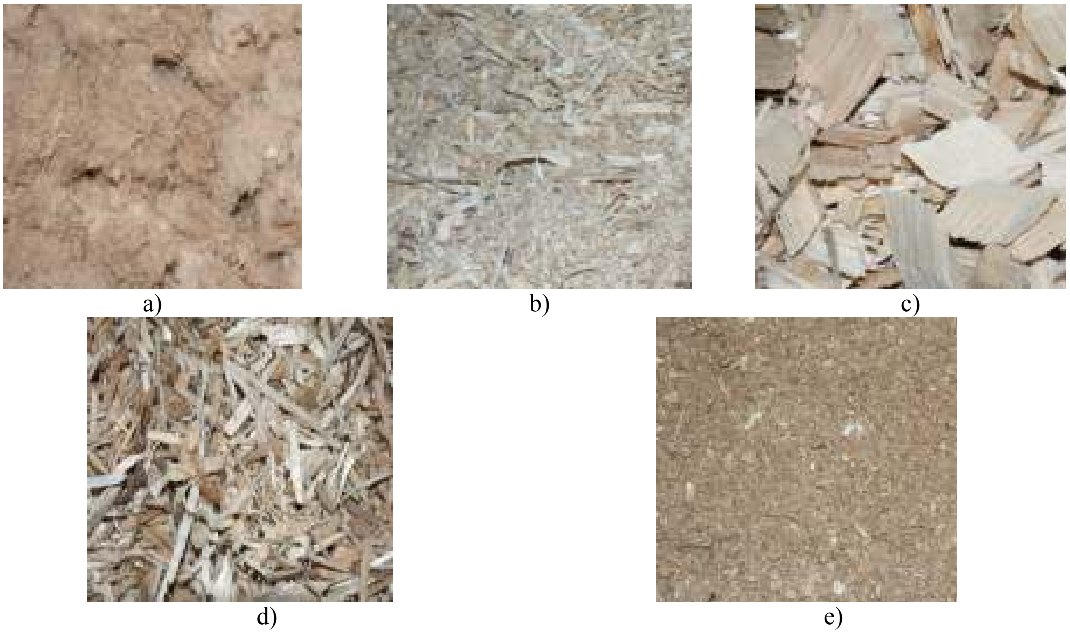


Figure 1: Wood waste: a) fiber for MDF; b) pine sawdust + 90% pine; c) mince shelled initial stage – coniferous; d) sawdust final size for PAL; e) mixed pine and hardwood sawdust.

2.2. Materials

In this study we used a mixture of hardwood sawdust from S.C. Kronospan S.A Sebeş. One aspect to be taken into account in the characterization of wood fibers is their size. Fiber dimensions affect the quality of the interfaces that appear in the composite material and its default properties.

Following the quantities selection of hardwood sawdust mixture we made a size separation. For this we use a grading system. The materials were sorted in different intervals: 1.6 ÷ 0.44 mm, 0.32 mm, 0.20 mm, 0.16 ÷ 0.040 mm. The sawdust dimensions used in this work was between 0,8 ÷ 0,44 µm.

The new composite plates were obtained using an epoxy resin (Adhesive STE Chimiver, UN 1133) and an unsaturated polyester resin (Ortophtalic Polyester Resin LERPOL TIX 3603) like matrix. Table 1 present the main characterizations of these resins.

Table 1: Resin characteristics

Resin type	Resins properties	Value	Measurement unit
Unsaturated Polyester Resin	Brookfield viscosity	400 ± 50	cps
	Density	1110 – 1120	kg/m^3
	Monomer content	38 ± 1	%
	Gel time at 25 °C	10'00'' ± 2'00''	minutes
	Exothermic peak	190 ± 2	°C
	Heat distortion temperature (HDT)	90 – 95	°C
Epoxy Resin	Brookfield viscosity	95-120	mPa
	Density	1310	kg/m^3
	Non-volatile content	100	%
	Epoxy-equivalent	0.240-0.275	E/100g
	Softening temperature	50-58	°C
	Wet glass transition temperature	163	°C

3. EXPERIMENTAL

3.1 Fiber treatments

According to literature, an important step in the process of obtaining composite materials containing fiber sawdust is the treating these fibers. The chemical treatments are designed to modify the fiber surface. This operation removes impurities, increase the roughness and ensure a high mechanical adhesion to the matrix.
The most effective chemical treatments for natural fibers are the alkaline treatments. A solution of potassium hydroxide (KOH, 5%) was used.
The treatment was done by immersing the fibers of sawdust in 5% KOH solution for 3 hours at room temperature, being achieved degreasing fiber surface. There followed a fiber washing with distilled water for 30 minutes. To neutralize the contact surfaces of the fibers, they were immersed in a solution of acetic acid (CH_3COOH) for 30 minutes and washed again with distilled water. Following this operations, sawdust was placed in the oven for 24 hours at a temperature of 105 °C.

3.2. Composite plates processing.

Several attempts were made of particle board from sawdust and resin without taking into account parameters like temperature, pressure or time. In figure 2 are presented these plates initially obtained in experiments. Plate processing was done in a fiber-resin ratio of 1:2.

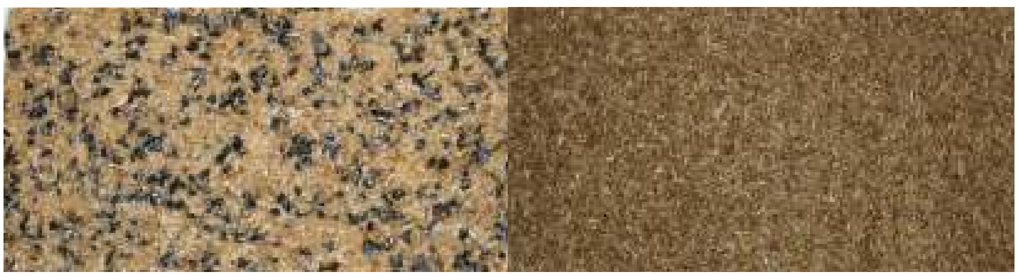
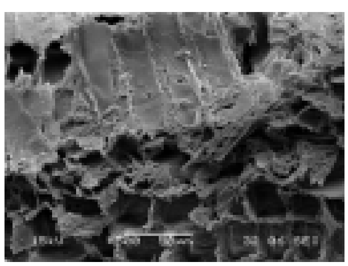


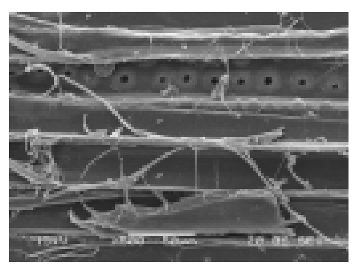
Figure 2: Particle board from sawdust and resin

4. RESULTS AND DISCUSSIONS

The used wood fibers are examined in order to characterize the surface morphology.



a)



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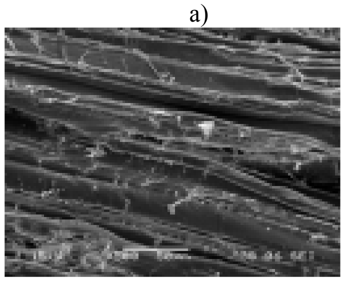

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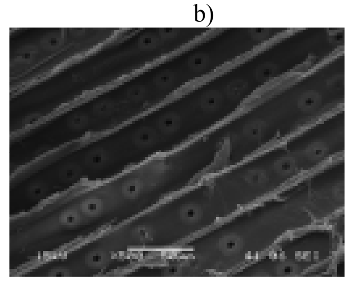

d)

Figure 3: SEM images of wood fiber: a) - b) untreated; c) - d) treated with KOH 5%.

In untreated sawdust we can see the normal cellular structure of wood fiber unchanged, a regular form of fibers, arranged longitudinally and cellular communication channels of fiber (trachea) which transport water, minerals and elaborated sap from root to leaf area. A JOEL JSM5510 LV Scanning Electron Microscope was used to observe the surface morphology of sawdust before and after chemical treatments. All samples were coated with gold before examination. The SEM images show the difference between treated and untreated wood fibers. Untreated fiber surface has many large impurities (Figure 3b) and in the section can be seen a much clogged honeycomb structure. Wood fibers treated (c), d)) with KOH solution are not affected, there is no fracture and provide a clean surface with few traces of impurities.

Table 2: Water absorption in time

Sample	Plate type		Initial form	3 hours	48 hours	144 hours
1	Sawdust + epoxi resin	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	13	14	14	14
		Weight [g]	3.90	5.05	5.24	5.91
2	Sawdust + epoxi resin	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	14	15	15	15
		Weight [g]	4.15	5.20	5.62	5.83
3	Sawdust + polyester resin	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	9	10	10	10
		Weight [g]	3.80	4	4.29	4.52
4	Sawdust + polyester resin	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	8	9	9	9
		Weight [g]	3.42	3.73	4.08	4.31
5	Melamine chipboard	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	19	-	22	-
		Weight [g]	6.02	-	9.75	-
6	Melamine chipboard	Dimensions [mm]	20/20	20/20	20/20	20/20
		Thickness [mm]	19	-	22	-
		Weight [g]	5.86	-	9.82	-

5. CONCLUSIONS

Using renewable resources such as wood fiber or saw dust in composite materials has recently been considered attractive both from economical and environmental point of view. Wood fibers have been treated with 5 % KOH. The morphological changes were examined using scanning electron microscopy. The chemical treatments can increase the interface adhesion between the fiber and matrix resin. Therefore, chemical treatments can be considered in modifying the properties of natural fibers. Because the chemical treatments clean the fibers we can observe a less water absorption of the finite composite board and a better comportment in humid environment.

6. ACKNOWLEDGEMENTS

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