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CONCEPTUAL MODELS OF TEXTILE REINFORCED BIODEGRADABLE COMPOSITES USED IN AMBIENTAL PRODUCTS

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Abstract

Development of new textile reinforced composites by changing matrix and reinforcement has led to the production of composites which fall into different conceptual models.

(Bio)degradable composites with fibrous insertions are obtained by introducing textile fibers (flax, jute, hemp, etc.) in a polymer matrix alone or in conjunction with thin wood chips, dust or sawdust.

Laminated (bio)degradable composites are made by consolidating two or more layers of wood veneer and textile insertions through a polymeric matrix.

Boards of (bio)degradable composites are obtained by pressing the fibrous material and woody chips that are oriented perpendicular to the reciprocal surfaces (boards made of wood chips and textiles, or textile and wood fibers, extruded sheets, etc.).

Molded (bio)degradable composites have complex forms, which are obtained by stratification, agglomeration, extrusion etc.

Conceptual models of composites presented in this paper are only a part of the types of biodegradable composites which can be designed as ambient products.

Keywords: composites, textile, biodegradable, conceptual model.

INTRODUCTION

Introduction text. Biodegradable composites proposed in the present research are classified depending on the shape and nature of constituents in the following categories:

- (bio)degradable composites with fibrous reinforcement layers - are obtained by introducing lignocelluloses textile (flax, jute, hemp, etc.) in an oriented or un-oriented polymer matrix alone or in conjunction with thin chips, dust or sawdust, redistributing the internal tensions of the composite, creating a new, strong material, more elastic and hardness increased;
- (bio)degradable laminate composites - are obtained through consolidation of two or more layers of wood and textile reinforced through a polymer matrix. The obtained structure is characterized by the symmetry of the layers of constituent materials which are also perpendicular to each other. The laminated composites can be auxiliary protected on the surface layers by sheets, veneers, lacquers and other protective films, etc.
- (bio)degradable agglomerated composites - are obtained by mixing and pressing the fibrous material and wood chips that are oriented perpendicular to the reciprocal surfaces (wood chips and fabrics, textile fibers and wood veneers, extruded sheets, etc. .)
- molded (bio)degradable composites - have complex shapes which are obtained by stratification, agglomeration, extrusion methods etc.

Depending on the orientation of fibers, matrix or ingredients, composites can be targeted or untargeted, homogeneous or heterogeneous, depending on destination. Oriented composites have high mechanical strength in a certain direction, and the untargeted-homogeneous properties similar to (equivalent) in all directions since these composites are controlled isotropy,

which depends on destination and hence the manufacturing technology.

EXPOSITION

Existing conceptual models of classical composites used for furniture and building purposes can be classified in four distinct groups:

- cell composite panels - are used to obtain interior doors, some furniture components (art furniture) and furnishings;
- chipboard composite panels - are used in the structure of the furniture and housing,
- agglomerated panels with different destinations: furniture, civil and industrial buildings
- thermal-insulating composite panels - with application in building thermal insulation (polystyrene);
- molded composite panels - are used to obtain molded components of furniture (items with 3D shapes as chairs, tables, armchairs etc.); they are also used for house building purpose.

1. Thermal-insulating composites

The actual main conceptual models which have been designed for the thermal-insulating composites are the following:

- the expandable polystyrene - which is used in construction as panels with thickness from 1 cm to 10 cm; polystyrene density is comprised between 15kg/m^3 and 30kg/m^3;
- the extruded polystyrene - is used in high humidity environments: foundations, pedestals and terraces, floors.

2. Stratified composites

The main actual conceptual models which have been designed for stratified composites are:

- plywood is a wood composite made of three or more layers (an odd number) of veneer, arranged at 90 ° between them (depending on the grain direction), glued together and pressed. Plywood has superior strength compared to solid wood and its high quality indicator (ratio of strength and density) leads to the fact that plywood is superior to steel and aluminum alloys for some applications. Density of plywood is higher than that of the solid wood from which the veneer was obtained; the plywood hygroscopic capacity is lower than that of the solid wood; heat-absorption capacity and thermal conductivity are similar to those of solid wood; some acoustic properties (sound insulation and absorption) are superior to solid wood.
- laminated wood is a composite material consisting of layers of wood lamellas glued with phenol adhesives. They have the following advantages over solid wood: dimensional stability, high mechanical strength, degree of compactness higher than that of wood and plywood.

The main operations of obtaining plywood are presented in figure 1.

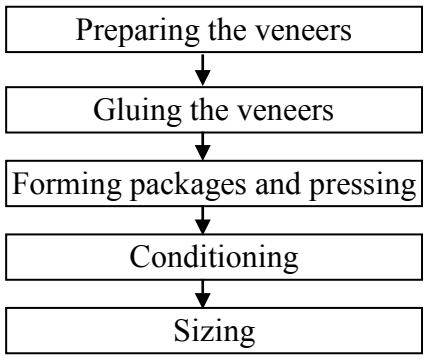


Fig. 1. *Technological flow to obtain plywood boards*

- *Blockboards* is a board consisting of pine wood lamellas for the core and two thick veneers for faces, with grains of the faces arranged perpendicular to the grains of the core, as shown in figure 2.

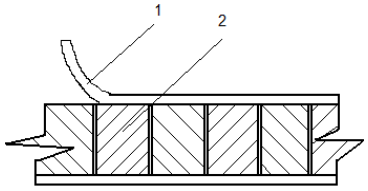


Fig. 2. *Blockboards – constitutive elements (1-veneer, 2-core)*

- *molded composites* are modern products made by gluing and pressing technical veneers into 3D devices. The shapes of the obtained products are spatial and complex ones.

The technological flow for molded composites is presented in figure 3.

The proposed conceptual models of present research for thermal-insulating panels in order to replace polystyrene are presented in table 1.

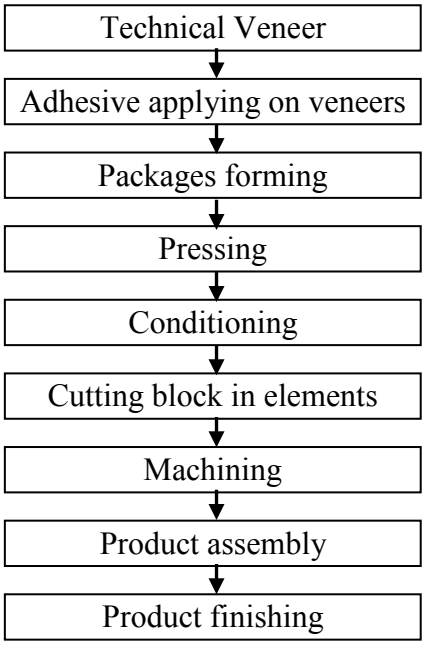
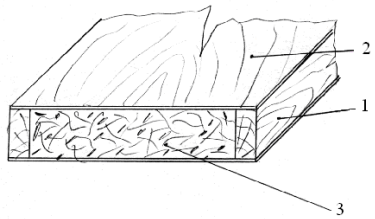
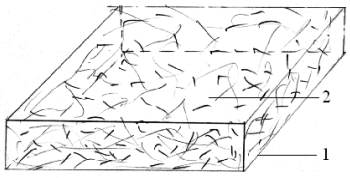


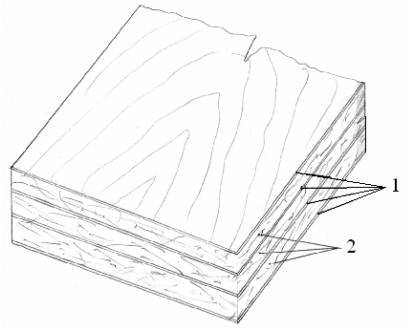
Figure 3. *Technological flow for molded composites*

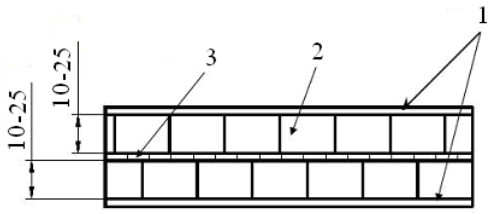
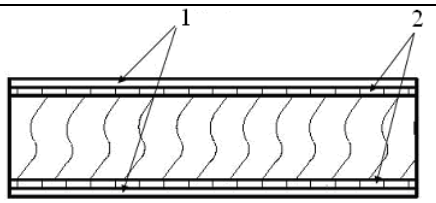
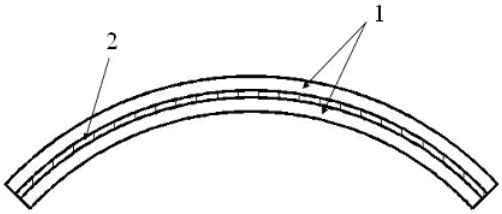
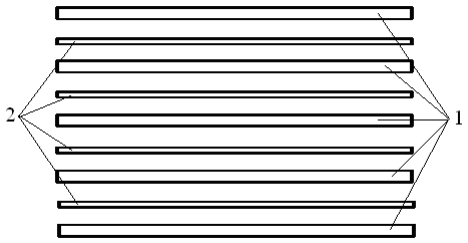
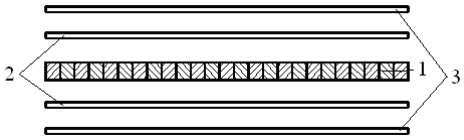
Table 1 Proposed conceptual models for thermal and sound insulating panels

Components of composites	Variant
Prefabricated and thermal-insulating composite panels 1 - timber frame 2 - thick veneer or thin plywood for faces 3 - composite insertion from textile waste mixed with wood fibers or wood chips and adhesives or other types of binders	
Thermal and sound insulating composites 1 – textile waste from wool, flax, hemp, wood particles (fibers, chips) 2 – natural binders: clay, wheat flour, ecological lacquer (water based)	

The present research theme is also focused on conceptual models for stratified composites as textile reinforced composites (see Table 2.)

Table 2 Proposed conceptual models for stratified composites

Components of laminated composites	Variants
Thick layer of veneer composite and mixtures of textile fibers, wood particles (fibers or chips) glued by natural polymers 1 – beech or poplar veneers; 2 – glued textile and wood inserts; Textile insertions of woven fabrics and mixtures of textile fibers, wood particles (fibers or chips) in solidarity with natural polymers 1 – Flat layers of fabric (woven or non-woven material) 2 – Glued textile and wood inserts Note: this structure is also valid for thermal-insulating panels	

Stratified composites with blockboards core, and textile reinforcement, glued with natural polymers 1 - veneer; 2 - core panel; 3 - textile reinforcement, etc.	
Core of chipboard panel, covered by natural fabric (as a sub-veneer) and wood veneer, glued with natural polymers 1 - veneer; 2 - textile reinforcement.	
Stratified composites made of rotary cut veneers and textile insert (fabric) glued with natural polymers 1 – rotary-cut veneer; 2 - textile reinforcement, etc. Note: This may be used for items of spatial components of furniture, obtained by molding.	
Stratified composites made of veneer (3-5 layers of veneer) and textile reinforcement (2 or 4 layers) glued by natural polymers: 1 - beech veneer; 2 - textile reinforcement	
Stratified composite made of wood for the core and reinforced with fabrics, glued by natural polymers 1 - poplar (or spruce) wood core; 2 - textile reinforcement; 3 - beech, oak veneer	

Conceptual models of composite proposed in this phase of the project do not cover all the variants and combinations to be achieved during the project.

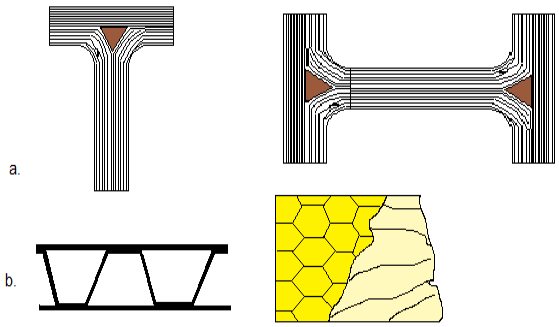


Fig 4. *Cellular beams and molded composites a-laminated beams; b-cell laminated boards*

Elements made of molded veneers are used for furniture, and also for curved shapes of beams of high strength, as seen in figure 4.

Wood-textile stratified composites might open new fields of application, as interior arrangements with curved shapes are. The textile reinforcement into wood stratified materials could increase their elastic properties and their flexibility, so to allow curving on smaller radius than the plywood is able today, creating thus new shapes in interior arrangement design.

CONCLUSION

Obtaining a biodegradable composite implies that at least one of the following conditions to be achieved:

- to use a biodegradable matrix;
- to use fillers and reinforcing materials also subjected to degradation;
- to introduce auxiliary constituents that maintain and stimulate biodegradation of stable components.

Methods used to induce or to accentuate biodegradable features should be selected in such a manner that the material can compete in terms of physical and mechanical properties with conventional composites.

Why biodegradability? Ecological and biodegradable are terms very often used today in order to protect the environment. Researchers are concerned about replacing all the materials that affect people's live and health with ecological and biodegradable ones. This is the case of polystyrene, used at present for buildings thermal insulating, which is not biodegradable and has a high grade of flammability. Materials as chipboard and plywood, very often used in furniture manufacturing are materials containing formaldehyde, a cancer providing chemical substance. That's why the present research work is focused on finding composites that can replace the noxious ones. The start point, presented in this paper is represented by types of conceptual model that need to be studied from physical, mechanical and technological points of view, tested and compared with classical materials, economically analyzed and proposed as substitutes. Small steps in this research have been done so far, with hopeful results for the proposed conceptual models, thing that encourage us to think that the future belongs to such kind of products.

ACKNOWLEDGEMENTS

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