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Розроблення програмного забезпечення для моделювання міцності деревини з двовісним напруженим станом

Розроблено алгоритм та програмне забезпечення для моделювання міцності композитних матеріалів з двовісним напруженим станом.

Ключові слова: алгоритм, критерій міцності.

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PRODUCTION OF WOOD-BASED COMPOSITES MADE FROM RAPE STRAW WASTES

The article deals with the analysis of the component structure, the structure of plant material made from rape stems in terms of prospects of their use in the manufacture of particle board or other composite-based materials. It has been presented the basic technological aspects of production of wood-based composite materials using rape raw materials and some of their physical and mechanical property indicators.

Keywords: wood-based composites, particle boards, plant based raw materials, physical and mechanical properties, rape stem.

The current state of the issue. Wood is considered to be a traditional raw material for production of wood-based composites. The intensity of global deforestation and its impact on the environment has been forced manufacturers of these products to search for alternative sources of raw materials. This is mainly lignocellulosic raw materials of agricultural production, straw in particular. One of the main factors that hinder the use of straw as a raw material for the production of wood-based panels is the presence of wax with a rather complex chemical composition. The fact is that wax is not scattered throughout straw mass as it is in the case of wood but it is almost entirely spread on the surface of the stem. The formation of such a layer of adhesive coatings on the surface of the straw prevents wetting of the particle surface and impede bonding.

Research results. Equally with the use of straw as one of the most promising types of plant material for the production of wood-based composite materials (WCM) there is a stalk of rape. Rape raw is an extremely valuable oil crop but it can be also as one of the elements of resources in the manufacture of these materials.

The chemical composition of the stalks of rape is like wheat straw but they have a number of *peculiarities* (Table 1). It should be noted that stalks of rape are differ from the straw of different crops by their increased thickness and stiffness, and because of

that fact they are not applied for traditional agricultural purposes. In contrast to the hollow stalks of rye, rape stalk axial channel is filled with a porous white parenchyma tissue. The shape of the cells in cross section is close to the hexagonal one and transverse dimensions of the cells do not greatly exceed the longitudinal ones.

Cellular structure of the parenchymal tissue with its shape and size of cells is different from the stalk wall, so it is can be easily determined the boundaries between the components. In the rape stalk wall capillaries are narrower than in the straw, their diameter is less than 50 microns, with the difference size of 20 microns, that there is less than in the peripheral layer of rye stalks.

Table 1. Component Composition of Different Types of Wood and Plant Raw Materials

Material	Cellulose	Lignin	Pentosin	Resin, Fat, Wax	Ash
Wheat straw	44.3	16.5	26.7	5.22	6.65
Rye straw	45.2	19.3	26.2	5.86	4.63
Rape straw	39.3	18.5	20.2	3.12	10.9
Sawdust	46.1	28.5	10.7	2.93	0.18

Wheat-rye straw is characterized by greater uniformity along the length of the stalk. The most homogenous material is rye raw. The volume of its axial channel is the most part of the stalk volume, its diameter is almost the same along the all length.

As for rape, it depends on the part of the stalk (basal, central, top) axial channel capacity is 38.0-54.0% of the total volume of the stalk, density of parenchyma tissue that fills the axial channel is extremely small. The internal parenchyma structure of the rape stalk is characterized by extremely high porosity. The composition of pentosin in the rape parenchyma tissue is 15.3-17.3%. According to general indicators of porosity rape stalks are only slightly inferior to the straw.

Thus, it is presented the comparative analysis of rape and wheat stalks, wheat straw and some properties that allows arrive to the following conclusions:

- The ripe stalk tissue is characterized by denser and harder structure compared with straw.
- Based on type and quantitative composition components, rape stalks are close to the rye-wheat straw.
- In contrast to straw, rape stalks contain a small amount of wax substances.
- Inner parenchyma tissue of the rape stalk has very high porosity (is considered to be a natural foam plastic).
- Close to the composition and properties of rape stalks, wheat-rye straw and wood proves its use as a raw material for production wood-based composites
- It can be assumed that the low content of wax substances in rape stalks can have a positive impact on the degree of bonding of chipped particles with a binder, i.e. adhesion increases.

Because of the fact that rape stalks contain fewer amount of wax substances compared with straw and they are spread throughout the whole volume, the value of adhesion is much larger that positively affects the physical and mechanical properties of composites; that is expanded the raw resources for the production of and save valuable wood material. The manufacture of wood-based composites includes the following operations such as chipping, drying, mixing with glue, mat forming and composite pressing. Raw wood and ripe stalks are separately chipped to obtain wood and rape particles. The particles are fed to the drying operation. The mass ratio between the wood particles and the rape one is 70:30. Prepared mass of wood and rape particles mixed with the glue of urea and phenol formaldehyde resins. Content of resin in the composites is 14% of the absolutely dry particle mass. As for a hardener, ammonium chloride is used. It is in an aqueous solution of 20% concentration in the amount of 1%. After mixing with the

glue, a single layer chip mat is formed. The mat is pressed of 3 MPa and a normal air temperature within 1 min and then is fed to the operation of pressing composite. Pressing single layer boards of density 650 kg/m³ and a thickness of 16 mm is performed under the following schedule: pressure of 2.2 MPa, temperature of 170 °C, duration of 0.38 min / mm (6.14 min). Humidity of finished composites was 8%.

It is experimentally proved that WCM produced by traditional technology with adding layers up to 30% of rape particles have mechanical properties that meet the National Standard of Ukraine (DSSU EN 312-2:2003) (Table 2).

Table 2. Properties of WCM

Tensile strength in static bending, MPa	12,3
Tensile strength perpendicular to the plane of a surface, MPa	0,28
Water, %	85
Swelling, %	32

Wood-based materials produced manufactured with adding more than 30% of the filler material from rape raw of coarse fraction are characterized by a high aesthetic quality and low surface roughness and can be used as faced wall panels without additional mechanical conversion.

Conclusions. Thus, proving rape waste into the manufacture of wood composites allows to expand the raw resources and to reduce the cost of materials and consequently save valuable wood raw material, that is extremely important for rarely forestry regions of Ukraine.

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Виготовлення деревинних композитів з використанням відходів ріпаку

Проаналізовано компонентний склад, будову рослинної сировини виготовленої із стебел ріпаку з точки зору перспективності їх використання у виробництві стружкових плит та інших композиційних матеріалів. Наведено основні технологічні аспекти виготовлення деревинних композитів з використанням ріпакової сировини та деякі їх фізико-механічні показники.

Ключові слова: деревинні композиційні матеріали, стружкові плити, рослинна сировина, фізико-механічні властивості, стебла ріпаку.

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INFLUENCE OF THE STRUCTURAL ELEMENTS' PLACEMENT OF THE FURNITURE BOARDS ON THEIR SHAPE STABILITY

Furniture boards made from wooden wastes have a number of the significant economic and environmental benefits in relation to their use in furniture and woodworking industries in comparison to the usual furniture boards made from wooden timber which are connecting into furniture boards in size of length using finger ironings and in size to the width – using adhesive on the smooth puffer. One of the possible disadvantages of the furniture boards made from structural elements of small size is a deviation from flatness that sometimes exceeds the permissible value. Comparison of deviation from