

THE WAY OF USING LOGGING WASTE IN WOOD-BASED PANELS PRODUCTION

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In Ukraine in 2018 the amount of harvesting residues amounted to about 9 million m³ mainly accumulated in logging areas (tree tops, branches, decayed parts of trees, etc.) and subsequently incinerated

Among the harvesting residues, a considerable part is occupied by branches that are not used in the manufacture of wood-based panels and fuel briquettes due to its high bark content

It is suggested to use branches for production of wood-composite material. For this purpose, the wood component is not grinded as in the manufacture of known wood-composition material - chipboard, OSB, and are flattened. This separates the bark, while wood fibers retain their natural strength.

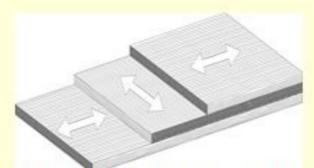
To obtain the wood component by the method of crushing, an experimental laboratory unit with four horizontal drums was used. Two of drums are adjustable for feeding raw materials to others which having grooves cut on both sides to prevent stretching of the crushed wood in different directions

Samples of poplar wood (Populus) branches were used to perform crushing cycles. Their length was around 1 m, diameter - 15 to 30 mm, and moisture content - 95 %. The branches were crushed until the weaving of fibers 1-10 mm thick was obtained.

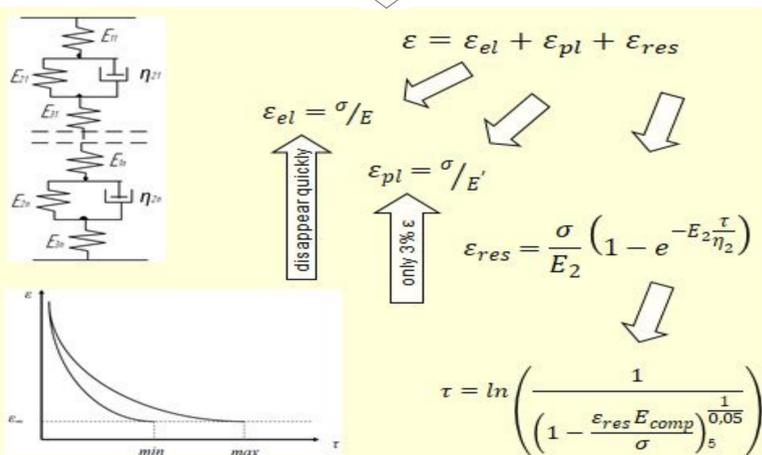


An important factor in pressed wood-composite panels is their form stability, which is achieved by minimal residual deformations and technological seasoning. To maximize productivity, the time of seasoning should be minimal. Its duration is affected by the pressing schedule, whose rational parameters help to reduce residual deformation. To determine the amount of deformation and relaxation time of the material after pressing in various schedules, a rheological model of a three-layer composite material of crushed branches consisting of elastic and viscous bodies of each layer has been developed.

Experimental studies of the physical and mechanical properties of panels of different construction from obtained fibers of poplar branches and two types of binder - urea-formaldehyde resin and phenol-formaldehyde resin allowed us to determine a rational construction of the wood-based panel material.



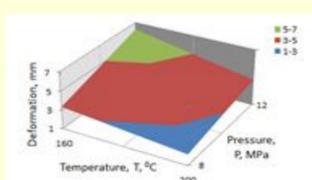
The best properties are shown by three-layer panels with mutually perpendicular arrangement of fibers made of weavings with thickness of individual wood elements ranging from 6 to 10 mm treated with phenol-formaldehyde resin.



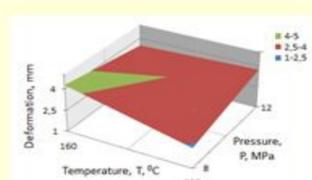
As a result of the experimental studies by the full factorial plan of experiment 2³ we obtained adequate regression equations ($F_{crit} = 1,34; F_{tab} = 4,07$) in the normalized values of residual deformations of the wood composite material from the pressing schedules, which allowed to determine the priority schedule parameters - temperature and pressure - $t = 200$ °C and $p = 8$ MPa. The results of calculating the time of form stabilization of the samples after pressing has shown that the smaller relaxation time $\tau = 7$ min had the samples pressed by the above schedule. This confirmed the rationality of obtained parameters of the pressing schedule.

Parameters		-1	0	+1
$t, ^\circ\text{C}$	x_1	160	180	200
p, MPa	x_2	8	10	12
τ, min	x_3	6	7	8

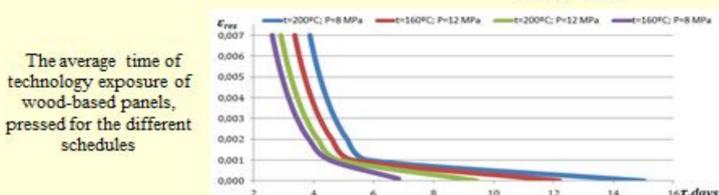
$$\varepsilon = 3,67 - 0,66x_1 + 0,62x_2 + 0,49x_2x_3 - 0,43x_1x_2x_3$$



The dependence of composite material deformation from temperature and pressure shutter 7 min.



The dependence of composite material deformation from temperature and pressure shutter 8 min.



The average time of technology exposure of wood-based panels, pressed for the different schedules



The values of strength limit and modulus of elasticity in static bending of the obtained material (with density 665 kg / m³) determined experimentally are 25 and 77 % higher, respectively, for the OSB panels of increased strength (650 kg / m³ density). The efficiency of using wood composite panels of crushed branches, which can be an alternative to OSB panels in both cost component and simplified technological process, is to improve the ecological state of logging areas and to make fuller use of wood raw materials.

The technological regulation for the production of wood composite material has been developed, which includes instructions for the process of flattening of wood raw materials (branches), drying of the obtained weavings of wood fiber, sizing, molding and pressing of composite material packages, as well as design concepts of the corresponding equipment.