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Lignolit Properties and Application

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In this paper the main assumptions are presented, concerning the production of new generation of wood-based products made from small size wood pieces, on the basis of solutions included in the patent concerning: The method of disintegrating plant stems, particulary of wood, in the process of producing ligno-celulose products and machines for this disintegration.

The test proved that small size pine wood pieces disintegrated with the method of cyclic splitting can produce wood-based material of high strength quality. The tested wood-based material due to its characteristic structure and high mechanical properties was given a transient name of lignolit (lignum-wood, lite-solid) – a wood-based materials with parameters resembling those of natural wood.

Keywords: wood; disintegration; gluing; pressing; wood-based material

INTRODUCTION

In 1993 in the Patent Office of Polish Republic an invention was registered concerning: The method of disintegrating plant stems, particularly of wood, in the process of producing ligno-cellulose products and machines for this disintegration, [3]. In the method a plant stem transported continuously in the approximately axial position is being splitted simultaneously on many parallel planes. The parts are moved out across the direction of transport and compressed perpendicularly to the grain. In the following work cycles each part from the previous cycle is split, compressed and moved to the next splitting unit. Hence the plant material is disintegrated into grain bands forming "a mat" of practically any small thickness and the length equal to that of the disintegrated stem pieces. The product, after drying and covering with glue, can be arranged and pressed into a beam or board of practically unlimited dimensions. The patent includes the equipment to carry out the disintegration of plant stems in this way.

The goal of this paper is to describe basic parameters of the new kind of wood-based material produced from small size ($\phi \leq 10$ cm) pine, larch and aspen wood pieces disintegrated in the method protected by the patent 288747.

EXPERIMENTAL

The first batch of the new product was made from pine, larch and aspen poles 70-80 mm in diameter which, after removing bark, were cut into pieces 450 mm long. The experimental bolts were disintegrated along the grain in prototype laboratory equipment into bands (bundles) of wood fibre. The bands were as long as bolds and had irregular cross-section shape with following dimensions: width from 2 to 8 mm, thickness from 2 to 4 mm. The disintegrated wood was, after drying, covered with phenol – formaldehyde glue (KP-74) which was dried at 70°C for 20 minutes. From so prepared material sets were arranged (parallely to the grain) to be pressed into boards.
The following technological parameters were observed during production of the experimental boards:

- moisture content of the disintegrated wood – 8%,
- gluing degree – 16%,
- expected board density – 750 kg/m^3,
- board thickness – 24 mm,
- unit pressure of pressing – 1.8, 2.0 and 2.2 MPa,
- pressing time – 16 minutes,
- pressing temperature – 145°C.

After six weeks of seasoning the board in laboratory conditions samples were taken for which the following parameters were determined: density, moisture content, static bending strength, elasticity coefficient at bending. For comparison the same parameters were determined for natural wood from twin bolts.

RESULTS

The results describing basic parameters of the produced boards and those of the wood used in their production are presented in Tables 1-3. The Table 1 given also the data on quality of the known wood-based materials produced from small size pine wood pieces.
Analysis of the data presented in the Tables facilitates conclusion that the investigated material is significantly better then the comparable wood-based products. It is worthwhile noticing that the value of strength coefficient of the new material is only by 40% lower then that for natural, faultless pine wood. Analysing results of the given in Table 3, it should be concluded that the magnitude of pressing pressure applied in the experiments significantly effects

density and mechanical parameters of lignolite. From the data results that with the increase in pressing pressure the density of wood-based material and numerical value of its strength rise as well. High quality of the experimental material is mainly decided by the length of disintegrated wood pieces and their parallel arrangement in the whole volume of the board (Fig. 1).

TABLE 1. Some parameters of wood based materials produced from small size pine wood pieces

Kind of materials	Density	Static bending strength	Coefficient of quality
–	kg/m^3	MPa (%)	km (%)
Pine wood[1] (*P. sylvestris* L.)	520 (100)	87 (100)	16.7 (100)
Testing board[1] (*P. sylvestris* L.)	740 (142)	75 (86)	10.1 (60)
Wood based material "Scrimber"[2] (*P. radiata* D. Don)	650 (125)	54 (62)	8.3 (49)
Single layer particle board[3] (*P. sylvestris* L.)	700 (134)	33 (38)	4.7 (28)

(1) – own investigation
(2) – Cowan R.M. [1]
(3) – Stefaniak J. [5]

TABLE 2. Parameters of produced boards of pine, larch and aspen woods (2.0 MPa)

Tested parameter	Unit	Pine		Larch		Aspen	
		Board	Wood	Board	Wood	Board	Wood
Density	kg/m^3	740	520	710	490	720	480
Moisture content	%	8.8	9.0	8.5	8.7	8.3	8.6
Static bending strength	MPa	75	87	79	85	80	89
Elasticity coefficient of bending	MPa	6700	9900	7100	8800	6900	7800

The tested wood-based material due to its characteristic structure and high mechanical properties was given a transient name of lignolite (lignum – wood, lite – solid) – a wood-based materials with parameters resembling those of natural wood.

TABLE 3. Parameters of produced boards of pine wood (unit pressure of pressing: 1.8, 2.0 and 2.2 MPa)

Tested parameter	Unit	Solid wood	Composite wood product		
			Unit pressure of pressing		
			1.8	2.0	2.2
			MPA		
Density	kg/m^3	490 (100)	670 (137)	740 (151)	810 (165)
Compression strength	MPa	49 (100)	50 (102)	56 (114)	66 (135)
Static bending strength	MPa	76 (100)	71 (93)	73 (96)	75 (99)
Elasticity coefficient of bending	MPa	8700 (100)	6900 (79)	7600 (87)	7900 (91)
Coefficient of quality	km	15.5 (100)	10.5 (68)	9.8 (63)	9.3 (60)

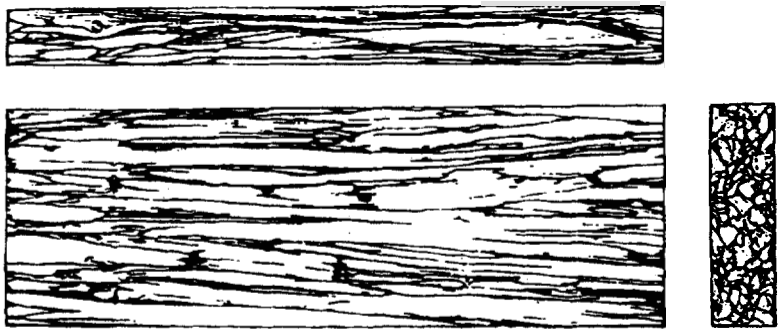

FIGURE 1. Macroscoping picture of a lignolite board

CONCLUSIONS

The tests proved that small size pine, larch and aspen wood pieces disintegrated with the method of cyclic splitting [2-4] can produce wood-based material of high strength quality.

On the basis of the results of the tests described in the work it can be stated that disintegrating small size pieces in non-conventional way will, in industrial practice, produce the following effects:

- considerable broadening of application range for small size wood pieces

- obtaining, from small size wood pieces, material for production of the elements like construction beam of any dimension and high strength value
- obtaining material for boards of any dimension and high mechanical parameters.

At the same time the experiments indicate usefulness of further work to improve the technique and technology for producing lignolite on semitechnological scale.

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