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EXPERIMENTAL STUDY CONCERNING THE BEHAVIOUR OF BLACK LOCUST WOOD TO WEAR TEST

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Abstract: *The paper presents the experimental values obtained for the wear test of black locust wood, determined along the grain direction on the radial and tangential sections, respectively. The wear degree is estimated through the mass loss or the sample thickness reduction, produced by mechanical stresses of friction and shock type. The tests were performed on samples made of black locust wood harvested from two different geographical areas from Romania, North – Carei area and South – Arges area, respectively. As a result of the experimental study already achieved, the black locust wood presented higher wear resistance on the tangential section compared to that one on radial section, regardless of its exploitation area.*
Key words: *robinia, wear, resistance, mass, thickness*

1. INTRODUCTION

The wood resistance to different stresses is influenced by factors, such as: wood species, density, moisture content, fibres direction, wood defects etc.

The black locust wood (*Robinia pseudacacia* L.) presents high density (650…870kg/m³), good dimensional stability and low coefficient of anisotropy, high hardness and an excellent natural durability and due to these qualities, this wood species was introduced within the protected exploitations of high forestry interest (Pescarus & Marinescu, 1977).

The wear test is the effect of crushing, detachment and grinding the wood surface, due to its friction with taugh pieces that present hard abrasive properties. The capacity of wood to oppose to this action is called wear resistance. Under its common utilizations wood is subjected to wear when is used as floorings and parquet especially, but also the carriageable parts of wooden bridges, sills and stairs (Filipovici, 1965; Pescarus & Cismaru, 1979).

The speciality literature comprises very little data concerning the wear resistance of wood species (Comsa, 2001), the study purpose being focused on the determination of this parameter for black locust wood harvested from two different geographical areas from Romania.

2. MATERIAL AND METHODS

The experimental tests were performed on samples made of black locust wood harvested from two geographical areas, North – Carei area and South – Arges area, respectively. From each area, four mature black locust trees were selected (SR ISO 4471-1993), being cut in samples for wear testing (SR ISO 3129-1993). Ten samples for each section (radial and tangential) and area (North and South) were obtained by cutting along the grain the solid wood without defects, achieving plane and parallel surfaces.

The method is regulated by SR 9160-93. Its principle refers to the determination of thickness and mass loss for a sample (50 x 50 x 22 mm), by using a wear device of Kollmann type as in Fig. 1, consisting of: the trolley box (1) in which the sample (2) is set, the drummer (3) with abrasive belt of 24 grit size, the electric motor (4), the electronic counter operated with electric impulses taken from a limit stop (5).

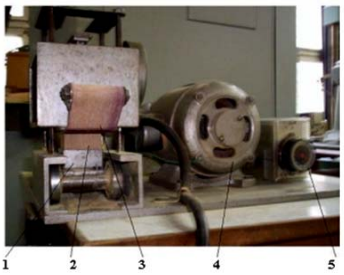

Fig. 1. Experimental trial stand – (after Kollmann, 1968)

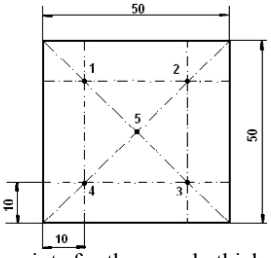

Fig. 2. Measuring points for the sample thickness

There are positioned five points (Fig. 2) on the back of the conditioned sample (U=8-12%), for measuring the thickness with the help of a micrometer, having an accuracy of about 0.01 mm. The sample thickness represents the average of five measurements; the sample mass is established with the help of an analythical balance, having an accuracy of about 0.001 g.

The sample is set at the begining with its grain direction parallel to the trolley movement. 2500 cycles are performed and then its mass and thickness in five points are measured; the test is repeated respecting the grain direction perpendicular to the trolley direction; the cycle is carried out up to 20000 rotations; for each cycle all data are recorded and the abrasive belt and sample position are changed. The electronic counter stops automatically the wear device when reaching 2500 cycles.

The solid wood wear is determined through the mass (U_m) and thickness (U_g) loss, according to the following relations:

$$U_m = \frac{m_i - m_f}{s}, \text{[g/cm}^2\text{]} \quad (1)$$

where: m_i – the sample initial mass, in g;
m_f – the sample final mass, in g;
s – the friction surface, in cm^2.

$$U_g = g_i - g_f, \text{[mm]} \quad (2)$$

where: g_i - the sample initial thickness, in mm;
g_f - the sample final thickness, in mm.

3. RESULTS AND DISCUSSIONS

The experimental results obtained for the wear test applied to black locust wood, expressed by the mass and thickness losses, are presented as average values in Tab. 1 and Tab. 2.

Samples	Radial section		Tangential section	
	Density, g/cm^3			
	728		730	
	U_m, g/cm^2	U_g, mm	U_m, g/cm^2	U_g, mm
1	0.076	1.24	0.076	1.17
2	0.081	1.26	0.071	1.15
3	0.062	1.25	0.058	0.82
4	0.073	1.22	0.060	1.16
5	0.070	1.20	0.059	1.05
6	0.076	1.17	0.064	1.14
7	0.085	1.27	0.066	1.14
8	0.067	1.24	0.062	1.12
9	0.075	1.27	0.057	1.06
10	0.077	1.22	0.063	1.17
Avg	**0.074**	**1.23**	**0.064**	**1.10**

Tab. 1. Wear resistance of black locust wood from North

samples	Radial section		Tangential section	
	Density, g/cm^3			
	704		709	
	U_m, g/cm^2	U_g, mm	U_m, g/cm^2	U_g, mm
1	0.110	1.37	0.075	1.11
2	0.101	1.34	0.105	1.27
3	0.102	1.35	0.098	1.25
4	0.099	1.31	0.082	1.22
5	0.095	1.42	0.095	1.25
6	0.091	1.36	0.090	1.30
7	0.092	1.27	0.102	1.30
8	0.102	1.28	0.094	1.31
9	0.108	1.25	0.070	1.04
10	0.101	1.27	0.082	1.18
Avg	**0.100**	**1.32**	**0.089**	**1.22**

Tab. 2. Wear resistance of black locust wood from South

Fig. 3 presents the mass variation of samples depending on the number of cycles recorded by the electronic counter during testing. The curves show a progressive downward trend of the samples mass when increasing the number of cycles, as normally as expected; during each cycle a certain amount of chips is detached, the loss being extremely pronounced for the wood from South. The mass loss depending on the number of cycles respects the same behaviour, regardless of its section, but being higher on the radial one.

Fig. 4 presents the thickness variation of samples depending on the number of cycles recorded by the electronic counter during testing. The curves highlight a gradual decrease of the samples thickness when increasing the number of cycles; each cycle is finished with a certain amount of chips already detached. The thickness loss of samples is higher on the radial section.

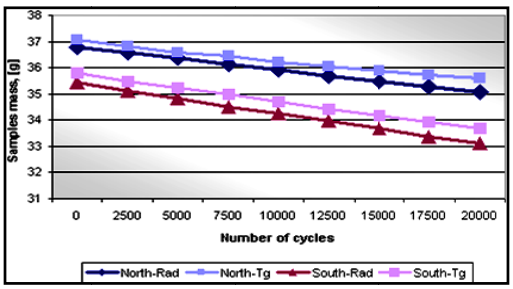

Fig. 3. Wear variation expressed through the mass loss

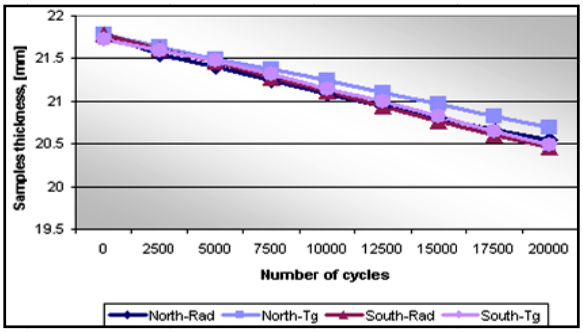

Fig. 4. Wear variation expressed through the thickness loss

4. CONCLUSION

- Regardless of exploitation area, the smallest wear value expressed through the mass loss was recorded for the tangential section of samples; black locust wood from South presented 34% higher mass losses than that one from North;
- Regardless of exploitation area, the smallest wear value expressed through the thickness loss was recorded for the tangential section of samples; black locust wood from South presented 11.4% higher thickness losses than that one from North;
- Regardless of exploitation area, the wear expressed through the thickness loss presented higher values than that ones expressed through the mass loss; there is no direct correlation between the amount of detached chips, mass and thickness;
- For all the samples under study the wear increased with the orientation angle of annual rings, a minimal wear value being recorded for tangential section ($\alpha=0^0$) while for the radial one ($\alpha=90^0$) the wear value was maximal;
- Wear decreased with the increase of wood density.

The values obtained for the wear tests applied to black locust wood (Porojan, 2007) are comparable to that ones from the speciality literature (Comsa, 2001), reccommending this wood species for applications, such as: floorings, parquet, carriageable parts of wooden bridges, stairs, sills. The wear test is representative and significant besides the wood hardness one when selecting wood species for applications in which the friction of wood with taugh pieces that present abrasive properties occurred.

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