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Influence of storage raw material in the form of wood chips on the properties of particleboard

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Abstract: *Influence of storage raw material in the form of wood chips on the properties of particleboard.* The storage method of wood raw material determines the changes its moisture content during storage process. Storage method of raw material in the form of wood chips influence on the properties of manufactured particleboard. It has been shown that the storage of raw materials at silo-building with forced air circulation allows a reduction in decline in the value MOR produced particleboard.

Keywords: wood chips, storage, particleboard

INTRODUCTION

Poland is a second largest producer of particleboard and MDF (Medium-density fibreboard) in Europe. Such a high position depends on the amount of the available wood raw material and the possibility of its storage.

In the wood-based panels industry the main raw material assortments used for manufacturing are: pulpwood – 43% and wood chips – 21%. The remaining 36% falls on brush (17%) and different types of waste: sawdust (15%), edgings logs (4%), postconsumer wood (1%) [Kozakiewicz i in. 2011]. Stacking wood raw material in form of wood chips allows to limit the surface needed for the storage by about 40% in regards to uncrushed material and also gives the possibility of using the waste produced by sawmills. Moreover, this way of stacking benefits the reduction of costs related with the manipulation of raw material in storage facility. [Modrzejewski et al. 1969, Mróz 1986].

The crucial disadvantages of stacking raw material in a form of wood chips in regards to stacking uncrushed material are: a greater loss of unit weight and mass of wood, greater susceptibility to decay, and unfavorable changes at chemical composition, which is all well visible within the first four months of storage, etc. [Modrzejewski et al. 1969, Mróz 1986].

Wood raw material can be divided due to its purpose to: industrial wood chips and fuel wood. Industrial wood chips mainly find its use in the paper-pulp and wood-based materials industries. While the fuel chips are used in the energy industry as a biofuel [Sztyber2008].

Sztyber [2008] propose a classification of wood storages for raw material in form of chips, due to its destiny to: base and buffer landfill. The base storage are designed to store large volumes of raw material and located some distance from the customer. While the buffer compositions should secure the continuity of production processes or the supply of fuel in a power chip case. Moreover, stockyards for wood raw material stacking in form of wood chips can be divided into open-air and covered. Open-air stockyards are generally used for long-term storage of wood chips in an amount corresponding configurations of the base. In regions with unfavorable climate, chips should be stored in covered stockyards (indoor or in special tanks). In covered stockyards adequate ventilation of stack must be ensured. For that reason, floor in such stockyards should meet the function of grate under which via appropriate channels air is blown. Designed this way room with forced air flow serves as a channel dryer [Sztyber 2008].

Wood raw material in form of chips is usually stored over several months (industrial wood chips) and year or two (chips fuel) [Sztyber 2005].

As a result of the study conducted for the pulp and paper industry Modrzejewski et al. [1969] recommend that the duration of wood chips storage to be as short as possible and in the summer should not exceed 2 months, and in the winter 4 months. However, Morze and Struk [1988] as a result of research made for the wood-based panels industry, recommend the storage time for wood chips stacked in piles should not be longer than 8-weeks in case of pain chips, 7 weeks for pine chips "green", and 10 weeks for birch chips. When mentioned terms end, the irreversible weakening of bonds in the wood begin to occur - this process can significantly reduce the strength properties of particle board.

The number of publications about industrial wood chip storage is limited. Research in this field have been made only in terms of raising pulp, paper industry, or the use of wood chips for energy purposes [Garstang et al. 2002]. It is necessary to investigate the relationship between method of storage raw material in form of wood chips and properties of particleboard manufactured from that material.

MATERIAL AND METHODS

This study includes three options for the storage raw material in form of wood chips:

- on the open square with concrete pavement (S1)
- under shade in the square with concrete pavement (S2)
- silo-building with forced air circulation (S3)

For the purpose of research the raw material in form of chips from pine wood (*Pinus silvestris* L.) was used. The raw material has been stored for four months. Every month during storage the measurement of moisture content in the material was taken. After four months wood chips from each variant of storage were processed to wood particles in the laboratory slicer.

For each storage variant were produced sufficient amount of particle boards with a density of 650 kg/m^3, 16mm thickness and UF glue content of 10% (core layer) and 8%. (surface layer). Produced particleboards were conditioned over 7 days under laboratory conditions (20 ±2°C, 60±5% humidity). Manufactured particleboard were tested: MOR and MOE according to EN 310:1994, IB according to EN 319:1999, thickness swelling after 2h and 24h soaking in water according to EN 317:1999.

RESULTS AND DISCUSSION

The results of moisture content of stored material shows table 1.

Tab. 1 Moisture content of stored material in the following months

	Moisture content of stored wood chips [%]				
	0	**1**	**2**	**3**	**4**
S1	120	118	111	114	108
S2	120	117	111	107	100
S3	120	90	58	35	20

Moisture content of material stored for four months in the silo-building with forced air circulation characterized decreasing value of moisture content from an initial 120% to 20%. However, in other variants of storage decrease in moisture content was slight.

Moisture content material is important in case of sourcing wood particle on slicer. In case of too dry material during cutting produced large proportion of dust fraction, while too high moisture content material causes clogging of the sieve in slicer, increasing the energy consumption of the process of obtaining the particle.

The results of properties of particleboard shows table 2.

Tab. 2 Properties of particleboard

	MOR		MOE		IB		Swelling after 2h		Swelling after 24h	
	[N/mm^2]	x**	[N/mm^2]	x**	[N/mm^2]	x**	[%]	x**	[%]	x**
S0*	13.5	9	2445	7	0.63	15	19.3	11	19.8	8
S1	11.8	7	2447	10	0.66	12	18.9	12	19.6	6
S2	12.5	9	2444	9	0.65	18	19.1	9	19.6	9
S3	12.9	8	2446	6	0.62	19	19.4	10	19.8	9

* particleboard made from fresh wood chips
x** variation coefficient [%]

In this study none of the differences of MOE, IB and swelling value were statistically important, and the differences were within experimental errors.

Particleboard made of material stored on the open square characterized the highest decrease in MOR value compared to particleboard made from fresh raw material - from 13.5 to 11.8 N/mm^2. For those particleboard manufactured from material stored on the open square the decrease of MOR value is statistical important in comparison with particleboard made from fresh wood chips. In case of comparing particleboard manufactured from material stored at silo-building with forced air circulation to particleboard made from fresh wood chips decrease of MOR value is statistically unimportant. However, in this case of differences of MOR values between particleboard made from materials stored on the open square and silo-buildings with forced air circulation are also statistically important. This mean that storing material at the silo-building with forced air circulation allows for reduction of decrease MOR value during storage process.

CONCLUSIONS

Storage wood chips at silo-building with forced air circulation for a period of four months can reduce the initial moisture content of the raw material from 120% to 20%.

Storing material at the silo-building with forced air circulation allows for reduction of decrease MOR value during storage process.

Particleboard made from wood chips stored on the open square characterized by greatest decline in MOR value comparing to particleboard manufactured from fresh wood chips, from 13.5 to 11.8 N/mm^2.

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Streszczenie: *Sposób składowania surowca drzewnego determinuje zmiany jego wilgotności podczas składowania.* Sposób składowania surowca drzewnego w postaci zrębków ma wpływ na właściwości wytworzonych płyt wiórowych. Wykazano, że składowanie surowca w obiekcie murowanym pozwala na zmniejszenie spadku wartości MOR wytwarzanych płyt wiórowych.

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