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PROPERTIES OF CHIPS FROM MANUFACTURING OF WOODEN GARDEN ARCHITECTURE

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Abstract

Some problems with proper utilization of sawdust and wood chips created during woodworking in the sawmill producing elements of wooden garden architecture were presented in this paper. The possibilities and potential ways of utilization of very large amount of wood waste were discussed. Beneficial use of waste requires effective separation, dimensional and qualitative sorting and skillful handling. Detailed characteristic of chips is necessary for this purpose. The basic properties such as particle-size distribution, bulk density and angle of repose of chips created on different processing stations were determined. On the basis of this data proper technical solutions of wood waste utilization systems can be designed and implemented in sawmills.

Key words: *sawdust, wood chips, garden architecture, woodworking, wood dust*

INTRODUCTION

A large quantity of chips created during mechanical processing of wood poses a considerable problem when it comes to their removal from workstations, the maintenance of air quality in the work environment as well as handling of such waste. Utilization of wood waste involves mainly using it for energy purposes. Thermal energy obtained in this way meets the technological needs – supplies timber drying equipment and heating system of a plant. Moreover, chips with suitable properties can be used for the production of particleboards, elements of special purpose such as chip blocks of pallets. They may also be used as animal bedding.

Recovery of chips, which can be destined to be used for different purposes, requires their effective separation from the air. The quantitative and dimensional sorting of chips may be necessary during the separation. High level of separation efficiency is also required for recycling of the heated air into workstations. This is not possible when using only mechanical dust collectors – cyclones, commonly used for large chips created in sawmills. The separation of the finest dust particles is therefore essential. It is possible only with the use of filter dust collectors. Different ways of wood chips utilization are connected with the adaptation of the exhaust system in a sawmill to new requests. Modernization and development of technical solutions for effective separation and sorting of wood chips requires the gathering of data on their quantity and properties.

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The aim of this paper was the characterization of chips created in a sawmill specialized in manufacturing of wooden garden architecture. It was planned to determine the particle-size distribution, bulk density and angle parameters of chips created on some technological stations of the sawmill.

MATERIAL AND METHOD

Chips from the sawmill producing elements of garden architecture were examined in this paper. So far, cyclones have been used for separating wood chips in this sawmill. But a concept of implementing a two-stage extraction using pulse-jet bag filters was developed for the purpose of air recycling and better utilization of chips. Chips from 6 essential processing stations (2 frame sawing machines, 3 four side planers and 1 rounding machine) were collected for the evaluation of future dust load of the filters. Then their characteristics were determined. The characteristics consisted of the following properties:

- Moisture content,
- Particle-size distribution,
- Bulk density,
- Tapped bulk density,
- Angle of repose,
- Sliding angle of repose.

Moisture content was determined using moisture analyzer type AGS50 (Axis, Poland). The method of sieve analysis was used for determination of particle-size distribution. An automatic vibration sieving machine AS 200 (Retsch, Germany) with a set of sieves with sizes of meshes 4 mm, 2 mm, 1 mm, 0.5 mm, 0.25 mm, 0.125 mm a 0.063 mm was applied for this purpose. Bulk density, tapped bulk density, angle of repose and sliding angle of repose were determined according to methods described by McGlinchey (2005) and Dzurenda (2007) and in appropriate Polish standards.

RESULTS

Moisture content in chips collected on the processing positions is shown in Table 1. Mositure content in chips created in the sawmill is high and uneven. It can be a reason of serious problems in the use of filters (Dolny and Rogozinski, 2007; Dolny and Rogozinski, 2006; Dolny et al. 2006; Dolny and Rogoziński, 2010a; Mukhopadhyay, 2010).

Table 1. Moisture content

Processing position	Moisture content [%]
frame sawing machine no 1	50.21
frame sawing machine no 2	76.32
four side planer no 1	36.43
four side planer no 2	29.6
four side planer no 3	56.37
Rounding machine	114.96

Particle-size distributions of chips are shown on fig. 1-6. A large difference between the dimensions of sawdust generated when sawing logs and the dimensions of the chips coming from the planers can be noticed. Mechanical separators, usually cyclones, should effectively separate such chips. Although the sieve analysis of wet chips does not show any very fine particles, after drying to the moisture level of 12% the smallest dust particles can be detected (fig. 7). Adhesion between the particles decreases upon reduction of moisture content, so that the smallest particles do not adhere to the larger ones and can move separately in the exhaust system. The movement of air undoubtedly has an important influence on the moisture content of wood particles being transported in the pipes of the system. The use of filtration method for air purification to the extent required for recirculation of air can be necessary in the case of decrease in the moisture content in chips during transport.

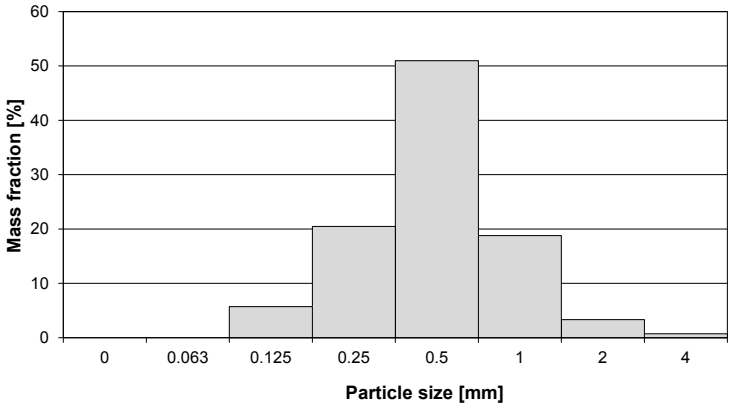

Fig. 1. Particle-size distribution of chips from frame sawing machine no 1

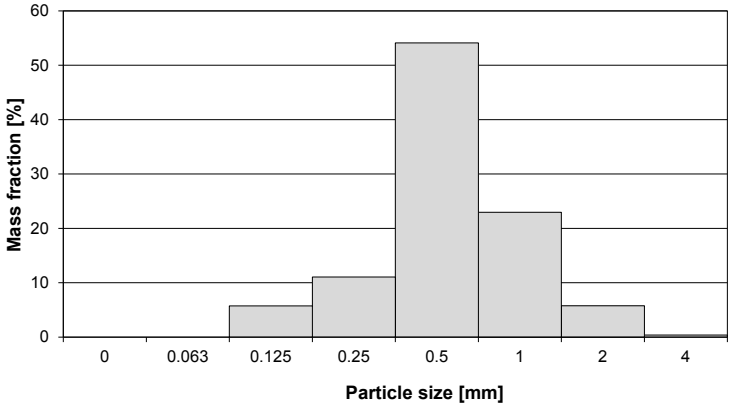

Fig. 2. Particle-size distribution of chips from frame sawing machine no 2

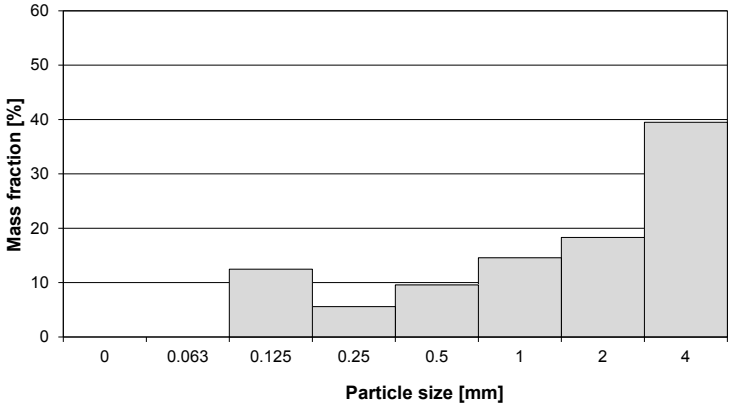

Fig. 3. Particle-size distribution of chips from four side planer no 1

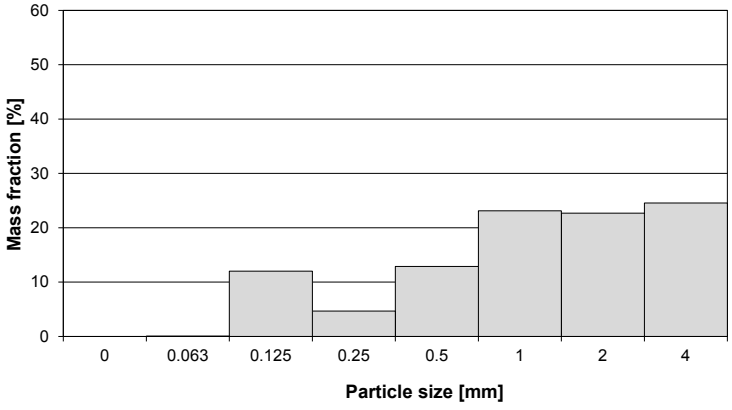

Fig. 4. Particle-size distribution of chips from four side planer no 2

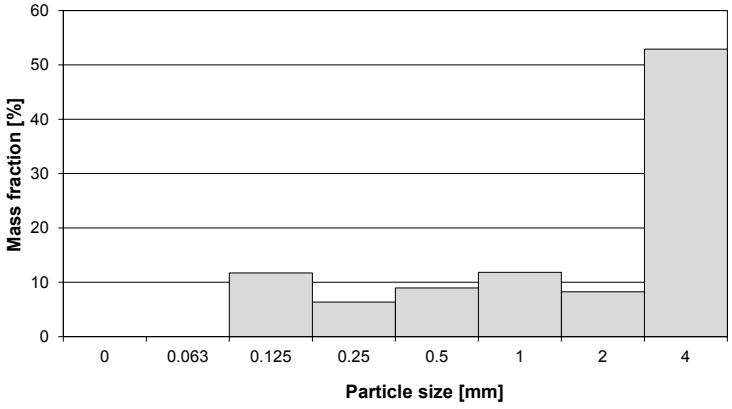

Fig. 5. Particle-size distribution of chips from four side planer no 3

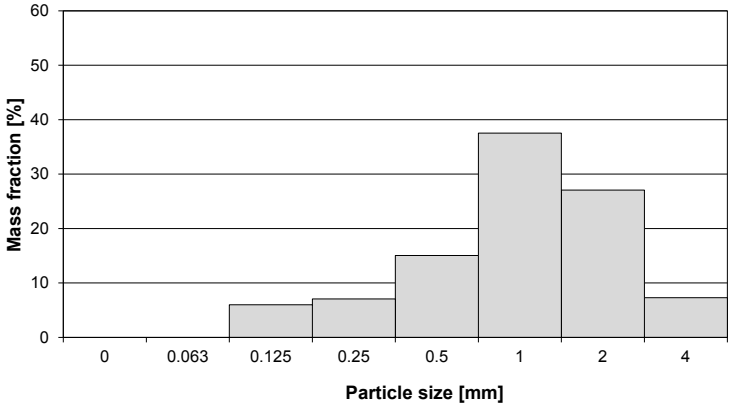

Fig. 6. Particle-size distribution of chips from rounding machine

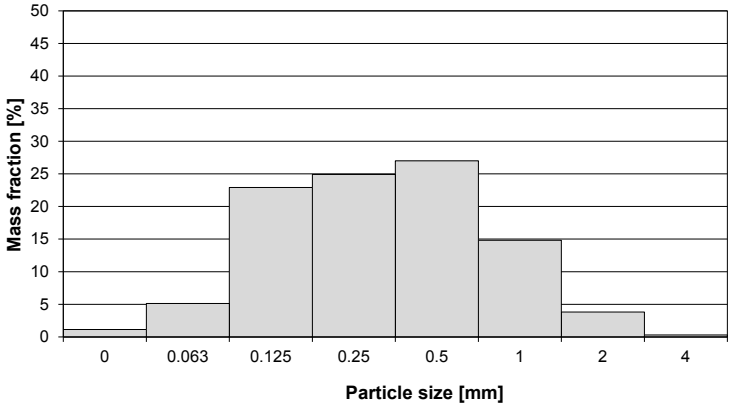

Fig. 7. Particle-size distribution of dried chips from frame sawing machine no 1

Table 2. Bulk densities and angle parameters of chips

Processing position	Bulk density	Tapped bulk density	Angle of repose	Sliding angle of repose
	[kg/m^3]		[°]	
frame sawing machine no 1	189	235	53.5	47
frame sawing machine no 2	139	163	53.5	48
four side planer no 1	51	60	57.2	38
four side planer no 2	58	85	56.9	38
four side planer no 3	42	48	58.6	43
Rounding machine	270	301	49.8	46

Bulk density of sawdust from frame sawing machines is a few times greater than the density of chips from planers (Tab. 2). It is connected with diffrent dimensions of these two groups of woodworking waste. Angle of repose and sliding angle of repose are of relatively high values due to high moisture content (Dolny and Rogoziński, 2010b, Rogoziński and

Dolny, 2004). Both the bulk densities and the angle parameters are also influenced by moisture content so it should be taken into consideration in design and selection of proper parameters of separators and hoppers.

CONCLUSION

Charakteristic of chips cerated during manufacturing of wooden garden architecture is different depending on the processing position. Processing on frame saws or rounding machines creates smaller waste particles than large chips from planig or moulding machines. Values of bulk denstity and angle of repose are an effect of moisture content and sizes of chips. All of these properties should be taken into account when designing extraction and utilization system intended for wood waste particles.

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