

## Characteristic of post-consumer wood chips and particles used in particleboard production. Part I.

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**Abstract:** *Characteristic of post-consumer wood chips and particles used in particleboard production. Part I.* The presented studies include characteristic of post-consumer wood chips and obtained particles. Both chips and particles were studied in terms of quantity and quality. Measurement analysis and determination of fraction composition of chips and particles obtained from post-consumer wood was carried out. The share of particular assortments within post-consumer wood was also determined. The studies were carried out in comparison to pine wood.

*Keywords:* post-consumer wood, chips, particles, fraction composition, measurement and material analyses

### INTRODUCTION

One of the basic criteria determining the possibilities of post-consumer wood use is the content of harmful substances, wood protection agents, paints, varnishes and other contaminants [Danecki 2003, 2007]. Therefore, especially valuable types of post-consumer wood are products, which contain wood in its pure unmodified form, such as pallets and other wooden packaging.

It is estimated that in Poland 5.7 M m<sup>3</sup> of raw wood material is used for pallet and packaging production, and 1.9-2.2 M m<sup>3</sup> annually is recovered [Nicewicz, Danecki 2009]. In the authors' opinion this amount could satisfy 20% of the wood-based panel producers' demand for raw wood material.

The aim of the study presented in this article was to characterise the chips and particles obtained from post-consumer wood offered on the domestic market including determination of the share of particular assortments, fraction composition and measurement analysis.

### MATERIALS AND METHODS

Tests were carried out using post-consumer wood chips obtained in industrial conditions. Samples of the size of approximately 1 mp were taken randomly every five months from one of the domestic plants using this raw material for particleboard production. Materials were worn-out and damaged furniture and pallets, crates, baskets, dunnage, and cable reels. Chips were tested for their quality and quantity. Next this raw material was subjected to the process of cutting by a Pallmann type flaker with the knife position set at 0.95 mm. The obtained particles were sorted using an Allgaier vibration screening machine with a set of screens of the mesh diameter of 8, 2, 1, and 0.5 mm.

#### *Fraction composition of chips and particles*

Determination of the fraction composition of chips was carried out using a screening machine. To this end a set of screens with the following mesh diameters was used: 60 mm, 51 mm, 39.6 mm, 31 mm, and 5.8 mm. Next approx. 1 kg of raw material was sampled using the quartering method from randomly sampled portion of the post-consumer chips. Determination of the fraction composition of particles was carried out, after the sorting process, on the particle fraction 8/1, dried to a moisture content of approximately 8-10%. The test was carried out using a Fritsch screening machine. Approximately 200 g of raw

material was taken from a given particle portion using the quartering method. The screening time was 15 minutes.

#### *Measurement analysis of chips*

Due to the material diversity of raw material (solid wood, wood composites, the other materials) and a high content of tiny fraction (immeasurable), the measurement analysis covered solely the chips from ground solid wood.

#### *Material analysis of chips*

A sample of post-consumer material for testing was taken by the quartering method. Post-consumer wood was divided into particular assortments contained within it, i.e. solid wood, particleboards, laminated particleboards, fibreboards, lacquered fibreboards, plywood, bark, and plastics, metal and paper. The content of each assortment was weighted, and next the percentage of particular post-consumer wood components within tested portions was calculated.

All tests were performed in comparison to pine sawmill chips from wood in bark and particles obtained from them. Determinations were carried out three times, and the results were averaged.

## RESULTS AND DISCUSSION

The results of the studies on the post-consumer wood chips in comparison to pine chips are shown in Table 1.

**Table 1.** The analysis of post-consumer wood chips in comparison to pine chips

Parameter		Post-consumer wood chips		Pine chips
		Portion I	Portion II	
Chip average dimensions [mm]	Length	38,60	68,13	35,00
	Width	7,11	10,0	19,54
	Thickness	4,29	5,76	5,50
Content of tiny fraction below 5.8 mm [%]		8,7	10,0	0,8
Fraction exceeding 60 mm [%]		2,2	2,5	none
Rot		none	none	none
Stains		none	none	none
Bark [%]		1,08	0,71	12
Moisture content [%]		10,9	10,2	87,11

The studies proved little content of bark in both samples of post-consumer wood compared to pine chips. Moreover, post-consumer wood chips were characterised by a low moisture content at a level of 10%. Moisture content of pine chips was many-fold higher and equalled over 87%. The results of the measurement analysis indicated significant differences, especially in the average length of chips, between particular portions. The average length of chips in portion II was 68.13 mm and exceeded almost two-fold the measurements of chips sampled from portion I. A dispersion of particular chip measurements within each of the

portions was observed as well. Tested post-consume wood was characterised by a relatively high content of tiny fraction (approx. 9-10%), below 5.8 mm, which due its dimensions was not subjected to measurement analysis (Fig.1). Chips from both portions of post-consumer wood fulfilled PN-91/D-95009 standard – *Wooden Raw Materials - Forest chips* as regards the share of the fraction that goes through a screen with the mesh diameter of 31 mm and is retained on a screen with the mesh diameter of 5.8 mm, and these fractions were put into a flaker to obtain particles.

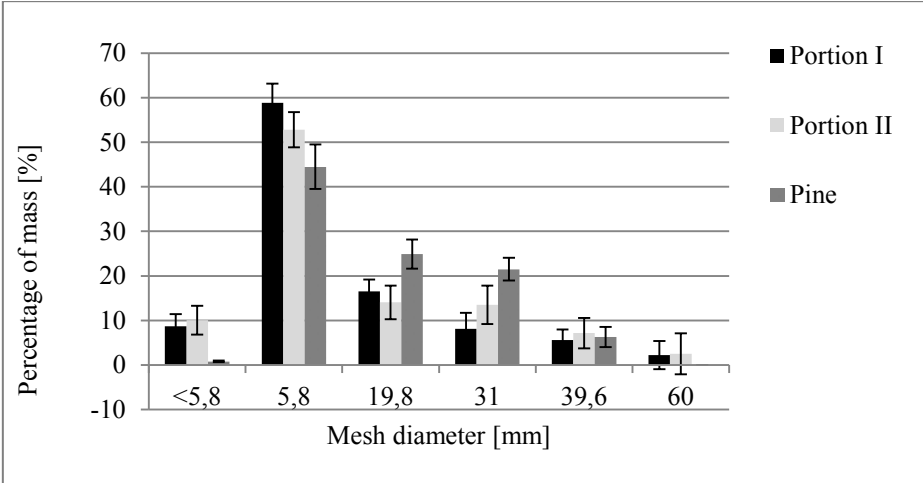


Fig. 1 Fraction composition of chips

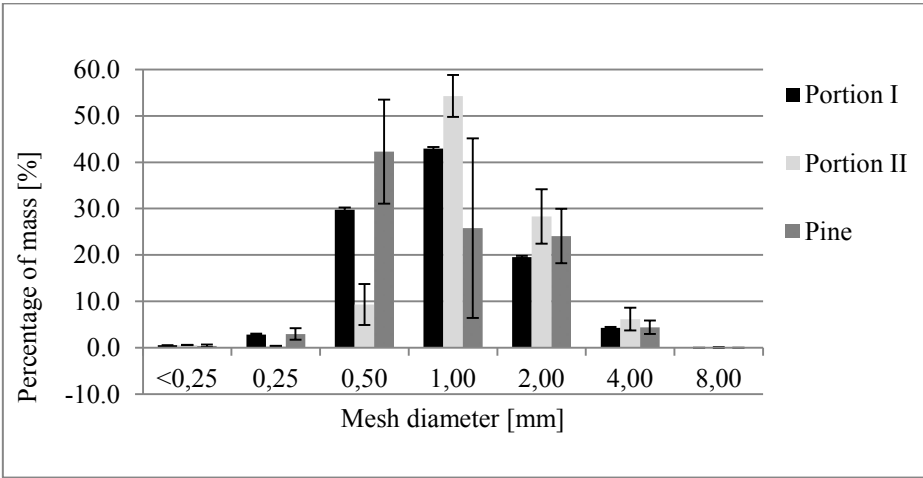
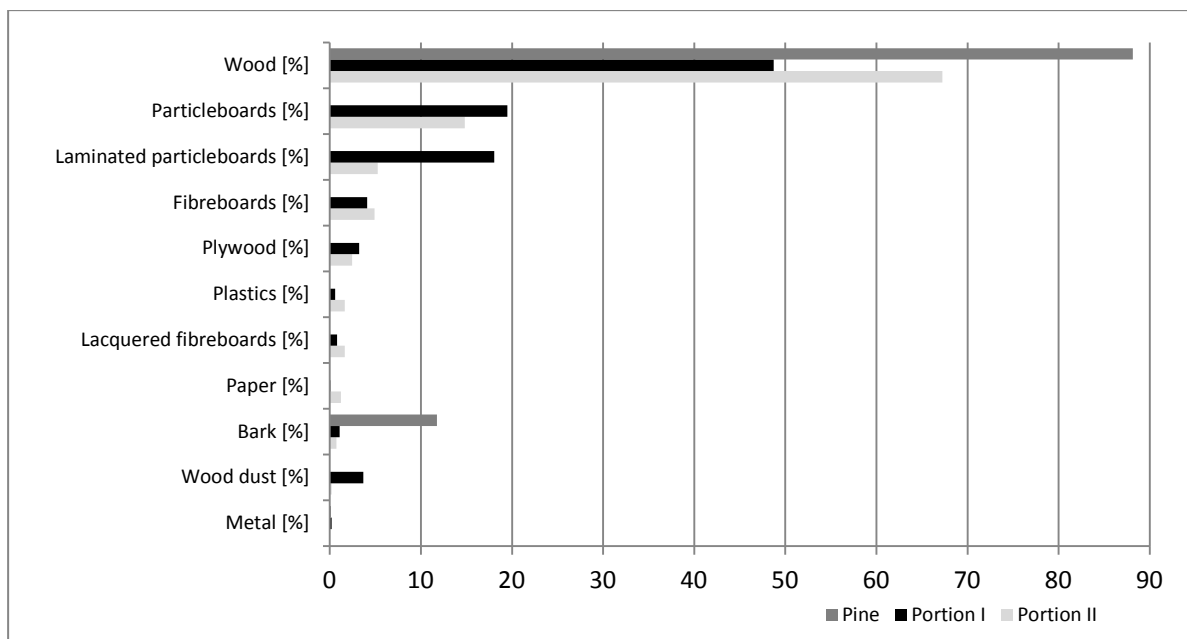


Fig. 2 Fraction composition of particles

The screen analysis of particles indicated differences between the individual portions of post-consumer wood. Particles from both portions differed in terms of the share of particular fractions (Fig.2); however, in the case of both studied portions the most raw material was obtained using screens with the mesh diameter of 1 mm. Pine particles contained the greatest amount of tiny fraction below 1 mm.



**Fig. 3** The material analysis of post-consumer wood chips compared to pine chips

The material analysis of studied post-consumer wood chips (Fig.3) proved that in the case of both tested samples of raw material the general composition of post-consumer wood was dominated by the solid wood share. Worn-out wooden packaging is the main source of this wood. It is the best assortment in terms of its use in the production of particleboards, for it contains the least processed lignocellulosic fibres. Particleboards were the second assortment in terms of their percentage share within studied portions of post-consumer wood. In the case of the first tested portion of raw material their share was 19.5%, and in the case of the second portion 14.8%. As regards laminated particleboards, their share differed depending on the portion and for the first tested portion it exceeded 18%, and for the second it was at a level of approx. 5%. After the process of cutting both raw and laminated particleboards contained in tested samples of post-consumer wood were tiny fraction, which was an addition to the particles intended for the outer layer of particleboards. Tested portions of post-consumer wood also contained other wood assortments, such as raw fibreboards (approx. 4%) and lacquered fibreboards (approx. 1-1.5%). The share of non-wood substances (paper, plastics, and metal) within tested raw material was relatively low and equalled 0.8% and 2.8% for portion I and II, respectively. Pine chips were characterised by much higher content of bark compared to tested post-consumer wood chips.

## CONCLUSIONS

The results of described studies proved differences within the individual portions of tested raw material in the case of both post-consumer wood chips and particles obtained from them. A dispersion of particular chip measurements was observed, especially the differences in the average length of chips in particular portions and in the percentage share of particular assortments within post-consumer wood chips. Nonetheless, the total share of assortments, which are the most valuable in terms of particleboard technology, such as solid wood, plywood, and particleboards was in the range of 80-90% for both tested portions. The share of non-wood substances (paper, plastics, and metal) within tested raw material was insignificant. Post-consumer wood chips and particles differed significantly from pine chips and particles in terms of particle measurements, moisture content, and bark content.

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**Streszczenie:** *Charakterystyka zrębków z drewna użytkowego wykorzystywanego w produkcji płyt wiórowych oraz pozyskanych z nich wiórów. Część I.* Celem pracy było scharakteryzowanie zrębków z drewna użytkowego, pozyskanego w warunkach przemysłowych oraz otrzymanych z nich wiórów pod względem ilościowym i jakościowym. Przeprowadzono analizę wymiarową, oznaczono skład frakcyjny zrębków i wiórów z drewna użytkowego. Określono również udział poszczególnych sortymentów w drewnie użytkowym. Badania przeprowadzono w odniesieniu do sosnowych zrębków tartacznych z drewna niekorowanego oraz pozyskanych z nich wiórów.

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