

## FUEL WOOD CHIPS FRACTIONS

Katarzyna Glazar

Agricultural University of Poznań

**Abstract.** The object of the performed investigations was to determine fractions of fuel wood chips. The fuel wood chips were harvested with chippers: Bandit 1400 and Vermeer BC1800A. The determination of chips fractions was based on 5 fraction classes. In all the samples, 11-35 mm fraction was the most numerously represented. In case of < 2 mm and 11-35 mm fractions the statistical substantial differences were found between average values participation of these fractions. The results of fractions of fuel wood chips dimensions in majority were up to Polish standards of fuel wood chips dimensions.

**Key words:** fuel wood chips, fuel wood chips fractions, fuel wood chips dimensions

### INTRODUCTION

Chips (or small parts of wood) emerge in result of wood crumbling with chippers (chipping). Dimensions of chips are included within borders from several millimeters to several centimeters. Depending on the sort of timber, dimension and ownership, wood chips can be assigned for production of particle and fibre boards, cellulose, for extraction of resin and tannins, for production of ferroalloys. In many countries, recently in Poland too, wood chips are utilised as fuel [Rzadkowski 1995].

The Polish Standard PN-91/D-95009 – Zrębki leśne determines the terms of chips harvesting in Polish forests. According to this standard, the fuel wood chips can be harvested from coniferous and leafy timber of all kind. The humidity of wood chips is not normalized. The border for 50 mm determines the fuel wood chips dimension, at that the fundamental fraction (not less than 90%) should not surpass 40 mm.

The object of performed investigations was to determine fractions of fuel wood chips. The chips were harvested with chippers Bandit 1400 and Vermeer BC1800A. The determination of chips fractions was based on 5 fraction classes.

## MATERIAL AND METHODS

The research was carried out in experimental pine stands (II and III age classes), situated in forest divisions of: Kliniska (1-2) and Wejherowo (3-4). Rolls and rods were harvested and chipped in all the experimental areas, within the confines of improvement cuttings. On surfaces 1-3 the chipping was carried out with a chipper Bandit 1400. On surface 4 the wood was chipped with a chipper Vermeer BC1800A. In total, approx. 125 m<sup>3</sup> fuel wood chips were harvested from the investigation surfaces (1-4). Three independent samples from each surface in the amount 5 kilograms each were collected for determination of fractional composition of wood chips. The collected material seeded by array of sieves about diameter of mesh: 2 mm, 10 mm, 35 mm, 50 mm. The obtained fractions were weighed with accuracy to 1 gram. The percentage participation of fractions with dimensions: < 2 mm, 3-10 mm, 11-35 mm, 36-50 mm and > 50 mm was defined.

The estimation of differences between average values participation of fuel wood chips fractions on experimental sites was performed on the basis of statistical analysis (Fischer F-test, Tukey T-test).

## RESULTS OF INVESTIGATIONS

The results of the investigations are shown in Table 1. In all the samples, fraction 11-35 mm was the most numerous, then fraction 3-10 mm was the second most numerous represented. The thickest fraction (> 50 mm) and slightest fraction (< 2 mm) were represented faintly. On surface 4 there was no fraction of over 35 mm.

Table 1. The participation of fuel wood chips fractions in analysed samples, which were harvested on experimental sites (1-4)

Tabela 1. Udział frakcji wymiarowych pozyskanych zrębków opałowych w analizowanych próbkach, na poszczególnych powierzchniach badawczych

Dimensions of fractions Wymiary frakcji	Area – Powierzchnia											
	1			2			3			4		
	The participation of fuel wood chips fractions in each sample, % Udział frakcji w poszczególnych próbkach, %											
	1	2	3	1	2	3	1	2	3	1	2	3
< 2 mm	1	1	1	1	1	1	4	3	2	3	2	1
3-10 mm	7	7	10	10	13	10	23	9	7	9	8	13
11-35 mm	91	90	89	88	85	88	73	85	76	88	90	86
36-50 mm	1	2	0	1	1	1	0	3	12	0	0	0
> 50 mm	0	0	0	0	0	0	0	0	3	0	0	0
Total Razem	100	100	100	100	100	100	100	100	100	100	100	100

In case of < 2 mm and 11-35 mm fractions statistical substantial differences were found between average values participation of these fractions.

The substantial differences were found with Tukey T-test application:

– < 2 mm fraction: between surfaces: 1 and 3, 2 and 3,

– 11-35 mm fraction: between surfaces: 1 and 3, 2 and 3, 3 and 4 (Tables 2-3).

In case of 3-10 mm fractions no statistical substantial differences were found.

Table 2. The comparison of average values participation of < 2 mm fuel wood chips fraction between experimental sites (1-4) with Tukey T-test application

Tabela 2. Porównanie średnich wartości udziału frakcji zrębków < 2 mm między poszczególnymi powierzchniami z zastosowaniem procedury Tukeya

Area Powierzchnia	1	2	3	4
Average participation of < 2 mm fraction, % Średni udział frakcji < 2 mm, %	1	1	3	2
Area – Powierzchnia	1	2	3	4
1		1	<b>0.035</b>	0.369
2	1		<b>0.035</b>	0.369
3	<b>0.035</b>	<b>0.035</b>		0.369
4	0.369	0.369	0.369	

Table 3. The comparison of average values participation of 11-35 mm fuel wood chips fraction between experimental sites (1-4) with Tukey T-test application

Tabela 3. Porównanie średnich wartości udziału frakcji zrębków 11-35 mm między poszczególnymi powierzchniami z zastosowaniem procedury Tukeya

Area Powierzchnia	1	2	3	4
Average participation of 11-35 mm fraction, % Średni udział frakcji 11-35 mm, %	90	87	78	88
Area – Powierzchnia	1	2	3	4
1		0.715	<b>0.012</b>	0.889
2	0.715		<b>0.049</b>	0.983
3	<b>0.012</b>	<b>0.049</b>		<b>0.030</b>
4	0.889	0.983	<b>0.030</b>	

## DISCUSSION

The investigated fuel wood chips dimensions in majority were up to Polish standards of fuel wood chips dimensions. In over 90% the dimension of chips of over 35 mm did not surpass. Only on surface 4 (chipping with chipper Bandit 1400) overhead border of dimension surpassed. The average amount of fuel chips over 50 mm presented 1%. This wood material was qualified for production of boards.

## CONCLUSIONS

1. In all the samples, fraction 11-35 mm was the most numerous.
2. In case of < 2 mm and 11-35 mm fractions statistical substantial differences were found between average values participation of these fractions.
3. The fuel wood chips dimensions in majority were up to Polish standards of fuel wood chips dimensions.

## REFERENCES

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## ANALIZA FRAKCYJNOŚCI ZRĘBKÓW OPAŁOWYCH

**Streszczenie.** Celem przeprowadzonych badań było określenie frakcyjności zrębków opałowych, uzyskanych z użyciem maszyn zrębkujących Bandit 1400 i Vermeer BC1800A, na podstawie 5 klas frakcyjności. We wszystkich próbkach poddanych analizie najliczniej była reprezentowana frakcja o wymiarach 11-35 mm. W wypadku frakcji < 2 mm oraz 11-35 mm zaobserwowano statystycznie istotne różnice między średnimi wartościami udziału tych frakcji uzyskanymi na poszczególnych powierzchniach. Otrzymane w badaniach wyniki frakcyjności w większości były zgodne z obowiązującą w naszym kraju normą, określającą wymiar pozyskiwanych zrębków opałowych.

**Słowa kluczowe:** zrębki opałowe, frakcyjność zrębków opałowych, wymiary zrębków opałowych

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