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## WOOD TECHNOLOGY CENTRE TESTING LABORATORY OF WOOD, WOOD-BASED MATERIALS, PACKAGING, FURNITURE AND CONSTRUCTIONS

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### SOLID BIOFUELS TESTING SECTION



AB 088

Poznań, 17<sup>th</sup> April 2023



# TEST REPORT No. BDB-23-A-1290

**Subject of the order** Quality testing of wood pellets (A1) – Mako Pellet Sp. z o.o.

**Order No.** A/DBD/BDB/1290/2023

**Name and address of the customer** Control Union Poland Sp. z o.o.  
al. Wojska Polskiego 45, 65-764 Zielona Góra

**Name and address of the producer** Mako Pellet Sp. z o.o.  
Makowiska 13, 86-050 Solec Kujawski

**ENplus® ID / Sample No.** PL050; 6mm/MakoPellet/A1/2023-1

**Performance date** 23.03 – 17.04.2023

**Operators** Jacek Pawłowski, M.Sc.  
Dariusz Radoński, B.Eng.  
Małgorzata Walkowiak, M.Sc. (Eng.)  
Magdalena Witczak, PhD. (Eng.)

Compiled by

Authorized by

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Małgorzata Walkowiak, M.Sc. (Eng.)

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*A qualified electronic signature has been affixed to this document, which according to the law is equivalent to written form.*

## 1. IDENTIFICATION (DESCRIPTION OF TEST SAMPLE)

The object of the assessment was a sample of pellets with the diameter of 6 mm, described by the customer as pellets made of chemically uncontaminated sawdust.

Sample number: 6mm/MakoPellet/A1/2023-1.

Identification number: A-1290/2023.

## 2. DELIVERY DATE OF TESTED SUBJECTS

The sample was taken by the customer and delivered to the laboratory on 23<sup>rd</sup> March 2023.

## 3. TEST METHODS

- EN ISO 14780:2017 Solid biofuels – Sample preparation (Method 16M)
- EN ISO 18134-2:2017 Solid biofuels – Determination of moisture content – Oven dry method – Part 2: Total moisture – Simplified method (Method 1M)
- EN ISO 18134-3:2015 Solid biofuels – Determination of moisture content – Oven dry method – Part 3: Moisture in general analysis sample (Method 1M)
- EN ISO 18122:2015 Solid biofuels – Determination of ash content (Method 2M)
- EN ISO 17828:2015 Solid biofuels – Determination of bulk density (Method 4M)
- EN ISO 18125:2017 Solid biofuels – Determination of calorific value (Method 6M)
- EN ISO 16948:2015 Solid biofuels – Determination of total content of carbon, hydrogen and nitrogen (Method 7M)
- EN ISO 16994:2016 Solid biofuels – Determination of total content of sulfur and chlorine (Method 8M)
- EN ISO 18846:2016 Solid biofuels – Determination of fines content in quantities of pellets (Method 9M)
- EN ISO 17831-1:2015 Solid biofuels – Determination of mechanical durability of pellets and briquettes – Part 1: Pellets (Method 10M)
- EN ISO 17829:2015 Solid biofuels – Determination of length and diameter of pellets (Method 11M)
- EN ISO 16968:2015 Solid biofuels – Determination of minor elements (Method 13M)
- EN ISO 21404:2020 Solid biofuels – Determination of ash melting behaviour (Method 14M)

## 4. EQUIPMENT OF THE TEST STANDS (elementary)

No.	Name	Type	Producer	Lab.No.
1.	Analytical balance	LE26P-0CE	SARTORIUS	M7/2
2.	Analytical balance	CPA225D-0CE	SARTORIUS	M8/57
3.	Laboratory drier	Redline RF115	BINDER	M1/47
4.	Calorimeter	C6000	IKA	M6/83
5.	Elemental analyzer	Flash EA 1112	THERMO ELECTRON CORPORATION	M7/8
6.	Furnace	FCF 7SM/pl	CZYLOK	M2/4
7.	Ionic chromatograph	ICS-1100	THERMO SCIENTIFIC	M8/54
8.	Laboratory balance	PS 6000/C/2	RADWAG	M3/50
9.	Laboratory balance	WLC 6/F1/R	RADWAG	M9/46
10.	Pellets durability tester	TUMBLER 3000	BIOENERGY ANLAGENPLANUNG	M10/42
11.	Sieve 3.15 mm	-	RETSCH	M9/34
12.	Caliper	SD-10	BAKER	M3/14
13.	Microwave oven	MARS 6	CEM CORPORATION	M13/80
14.	Atomic Absorption Spectrometer	280FS AA	AGILENT TECHNOLOGIES	M13/66
15.	Atomic Absorption Spectrometer	280Ze AA	AGILENT TECHNOLOGIES	M13/67
16.	Mercury analyzer	DMA80	Milestone	M13/117
17.	System for determination of characteristic temperatures of ash melting behaviour	PR-37/1600	Radio Research Institute	M14/88
18.	Sieve 0.075 mm	-	ATEST	M14/91

## 5. TESTS RESULTS

Tests results are presented in Record No. 1/1290/2023.

## 6. DECLARATION

Test results presented in this Report refer to the tested samples only.

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**Record No. 1/1290/2023**

**Sample name:** Wood pellets  
**Name of Producer:** Mako Pellet Sp. z o.o.  
 Makowiska 13, 86-050 Solec Kujawski  
**ENplus® ID / Sample No.** PL050; 6mm/MakoPellet/A1/2023-1

<b>Origin:</b>		1. Woody biomass				
<b>Traded form:</b>		Wood pellets				
<b>Classification of origin according to EN ISO 17225-1:2014</b>		1.2.1 Chemically untreated by-products and residues from the wood processing industry				
Parameter	Unit	Value	Uncertainty [±] <sup>1</sup>	Threshold value acc. to ENplus® Handbook, Part 3 version 3.0		
				A1	A2	B
Diameter	mm	6.1	0.2	6 ± 1 or 8 ± 1		
Length	mm	15.9	7.3	3.15 < L ≤ 40		
Moisture	w-% <sub>ar</sub>	7.2	0.3	≤ 10		
Ash	w-% <sub>d</sub>	0.38	0.025	≤ 0.7	≤ 1.2	≤ 2.0
Mechanical durability	w-% <sub>ar</sub>	99.1	0.2	≥ 98.0	≥ 97.5	
Fines (< 3.15 mm)	w-% <sub>ar</sub>	0.09	0.01	≤ 1.0 (< 0.5%) <sup>2</sup>		
Gross calorific value	MJ/kg <sub>d</sub>	20.83	0.05	-		
Net calorific value	MJ/kg <sub>ar</sub> kWh/kg <sub>ar</sub>	17.83	0.08	≥ 16.5		
		4.95	0.02	≥ 4.6		
Bulk density	kg/m <sup>3</sup> <sub>ar</sub>	670	11	600 ≤ BD ≤ 750		
Carbon	w-% <sub>d</sub>	50.45	0.33	-		
Hydrogen	w-% <sub>d</sub>	6.53	0.21	-		
Nitrogen	w-% <sub>d</sub>	< 0.08	0.01	≤ 0.3	≤ 0.5	≤ 1.0
Sulfur	w-% <sub>d</sub>	0.0060	0.0001	≤ 0.04	≤ 0.05	
Chlorine	w-% <sub>d</sub>	0.008	0.001	≤ 0.02		≤ 0.03

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Parameter	Unit	Value	Uncertainty [±] <sup>1</sup>	Threshold value acc. to ENplus® Handbook. Part 3 version 3.0		
				A1	A2	B
Ash shrinkage temperature SST <sup>3,4</sup>	°C	1260	29	Should be stated		
Ash deformation temperature DT <sup>3,4</sup>	°C	> 1500	-	≥ 1200	≥ 1100	
Ash hemisphere temperature HT <sup>3,4</sup>	°C	> 1500	-	Should be stated		
Ash flow temperature FT <sup>3,4</sup>	°C	> 1500	-	Should be stated		
Arsenic	mg/kg <sub>d</sub>	< 0.1	-	≤ 1		
Cadmium	mg/kg <sub>d</sub>	0.28	0.02	≤ 0.5		
Chromium	mg/kg <sub>d</sub>	< 0.5	-	≤ 10		
Copper	mg/kg <sub>d</sub>	0.52	0.04	≤ 10		
Lead	mg/kg <sub>d</sub>	< 0.5	-	≤ 10		
Mercury	mg/kg <sub>d</sub>	0.0023	0.0001	≤ 0.1		
Nickel	mg/kg <sub>d</sub>	< 0.5	-	≤ 10		
Zinc	mg/kg <sub>d</sub>	8.02	0.01	≤ 100		

<sub>d</sub> dry <sub>ar</sub> as received

1. the expanded uncertainty was determined for coverage factor k = 2 and 95% confidence level
2. at factory gate, at the end of production or when loading truck for deliveries to end-users (< 0.5% when filling pellet bags or sealed big bags)
3. characteristic ash melting temperature determined in an oxidizing atmosphere
4. ash received at 815°C

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End of report