

***PROJECT TITLE: DEVELOPMENT OF ENERGY EFFICIENT CENTRAL HEATING
COOKERS/STOVES FOR SENKO***

BENEFICIARY ENTERPRISE: SENKO

CONSULTANT: CENTER OF TECHNOLOGY TRANSFER

Annex to Report 4

ISPITNO IZVJEŠĆE Br. 19/22

TEST REPORT No.

Objekt mjerenja: Štednjak na kruto gorivo
Object o measurements: Residential cooker fired by solid fuel

Oznaka tipa: C
Type designation:

Verzije: 20, 30
Versions:

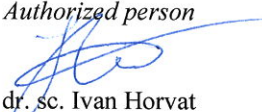

Naručitelj: Centar za transfer tehnologije d.o.o.
Customer: Ivana Lučića 5
 10000 Zagreb

Proizvođač: Senko d.o.o.
Manufacturer: Vladimira Nazora 22, Štefanec
 40000 Čakovec

Ispitano prema: HRN EN 16510-1:2018 u vezi s dijelom 2-3
Tested according to: (EN 16510-1:2018 in conjunction with Part 2-3)

Rezultati ispitivanja odnose se na navedeni objekt ispitivanja, vrijeme ispitivanja i uvjete okoliša.
The test results refer to the measured object, date of measurements and ambient conditions.

Dozvoljeno je umnožavanje Ispitnog izvješća u cijelosti. Za umnožavanje pojedinih dijelova potrebno je imati pisano odobrenje
 Laboratorija, osim za sažetak. Ispitno izvješće bez potpisa i žiga nije valjano.
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M.P.	Datum izdavanja <i>Issue date</i>	Odgovorna osoba <i>Authorized person</i>	Voditelj laboratorija <i>Head of the laboratory</i>
	10.11.2022.	 dr. sc. Ivan Horvat	 prof. dr. sc. Damir Dović

1. Summary

Customer	Senko d.o.o., Vladimira Nazora 22, Štefanec, 40000 Čakovec
Subject of test	Residential cooker fired by solid fuel according to HRN EN 16510-1:2018 (EN 16510-1:2018) in conjunction with Part 2-3
Appliance	Residential cooker fired by solid fuel
Type	C-20
Manufacturer	Senko d.o.o., Vladimira Nazora 22, Štefanec, 40000 Čakovec
Intended use	Cooking and Space heating
Fuel	Wood briquettes

	Unit	Value	Limit according to				
			HRN EN ¹	HRN EN ²	DIN plus	2. Stufe der 1.BImSchV	2015/1185 (EU)
Total nominal heat output	kW	15,0		-	-	-	-
Water heat output	kW	5,9					
Efficiency	%	82,17	> 70-80	> 60	-	> 75	-
CO – at O ₂ = 13%	mg/Nm ³	1.083	1.500	12.500	-	1.500	1.500
OGC – at O ₂ = 13%	mg/Nm ³	16	120	-	120	-	120
NO _X – at O ₂ = 13%	mg/Nm ³	96	200	-	200	-	200
Dust – at O ₂ = 13%	mg/Nm ³	24	40	-	-	40	40
Distance to combustible materials	Minimum distances at mm: - rear = 100 - sides = 100 - above = 1000 - front = 800						

¹ HRN EN 16510-1:2018 (EN 16510-1:2018) Annex H (informative)

² HRN EN 12815:2014/A1:2008/Ispr.2:2008 (EN 12815:2001/A1:2004/AC:2007)

	Unit	Value	Limit according to
Seasonal space heating efficiency	%	72,17	2015/1185 (EU) > 65

	Unit	Value	Energy efficiency class
Energy efficiency index (EEI)	%	109,15	2015/1186 (EU) A+

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 FAKULTET STROJARSTVA I BRODOGRADNJE
 Zagreb, Ivana Lučića 5
 Voditelj laboratorija
 Head of the laboratory

prof. dr. sc. Damir Dović

2. Product specifications

Residential cookers fired by solid fuel **C-20/30** manufactured by Senko d.o.o. are residential cookers fired by wood briquettes with grate and ash pan. Cookers are made of stainless-steel sheets and castings of quality gray cast iron. The combustion chamber is lined with chamotte bricks. Cookers are intended for cooking and household space heating. Cookers are fitted with a boiler. At the rear side, there is a Ø80 mm connection for secondary air. Additional four DN20 are also located at the rear side, supplying air directly to the combustion chamber (no control provided). Primary air inlet is located at the lower part of the front door. Chimney connection is located at the rear side.

Cookers are declared as being equipped with thermal discharge control: yes no

Detailed description is provided in the instructions for installation and operation which forms integral part of the source materials.

Type	Main dimensions (mm)			Nominal heat output (kW)*	Fuel consumption (kg/hour)*	Flue gas connector diameter (mm)	Operating draught (Pa)
	Height	Width	Depth				
C-20	850	600	620	15/6	3,96	140	12
C-30	850	600	780	20/12	5,28	140	12

* Declared by the manufacturer

Note: Design of variants C-20 and C-30 have different outer main dimensions, while the furnace is the same.

3. Sample tested

The product sample indicated in the following table was used for inspection, testing and evaluation:

Type	Date	Sample Reg. No.
C-20	06.10.2022. 21.10.2022. 25.10.2022.	prototype at the producer

Place of testing:	at the FSB-LTTU Laboratory <input type="checkbox"/>	at the manufacturer <input checked="" type="checkbox"/>	at the customer <input type="checkbox"/>	other:
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4. List of employed technical documentation

Employed documentation:
1. Instructions for installation and operation
2. Assembly engineering drawings and 3D model

5. Detailed test results

5.1 Measuring and testing equipment

No.	Name	Manufacturer/Type	Serial number	* Calibration certificate
1.	Thermocouple*	T/K type	-	Calibration certificate C-4225 / 21-07
2.	Multichannel test set up for temperature measurement*	Agilent/3491A	MY44008250	Calibration certificate C-4225 / 21-07
3.	Industrial scale**	Ohaus/CH30R11	-	2013-219-01
4.	Combustion analyzer	MRU/NOVA 2000	010277	Calibration certificate No. E36/2020
5.	Differential pressure sensor	Ahlborn FD A602-S2K	08080490	2-0061/14-05
6.	Contact temperature sensor	Ahlborn ZA 9020-FS	FPA32PH	Calibration certificate C-4225 / 21-07
7.	Stick meter	-	-	-
8.	Ultrasonic meter**	Siemens UH50-A36C-HR06-F	65 760 067	-

* Calibration done according to DKD-R 5-1:2018

** Calibration done according to the internal procedure

5.2 Thermal output, energy efficiency and emission of combustion products test

Testing method: HRN EN 16510-1:2018 in conjunction with Part 2-3

Sample tested: C-20

Measuring equipment used: 1, 2, 3, 4, 5, 7, 8

Test results – Nominal heat output

Date of testing:	21.10.2022.	$t_{ok} = 23\text{ °C}$	RH = 52%
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Variables measured and calculated:	Unit	Tests			Limit according to			
		1	2	Avg	HRN EN ¹	HRN EN ²	DIN plus	2. Stufe der 1.BImSchV
Fuel consumption	kg/hour	3,964	4,020	3,992				
Achieved input	kW	18,11	18,37	18,24				
Combustion air temperature	°C	23,3	23,1	23,2				
Chimney draught	Pa	12	12	12				
Average combustion product temperature	°C	171,3	174,2	172,7				
CO ₂	%	6,28	6,55	6,41				
CO – measured	%	0,0773	0,0744	0,0759				
CO – at O ₂ = 13%	%	0,0900	0,0833	0,0866		1,0		
CO – at O ₂ = 13%	mg/Nm ³	1.126	1.041	1.083	1.500	12.500		1.500
CO – at O ₂ = 0%	mg/MJ	723	687	715				
OGC – at O ₂ = 13%	mg/Nm ³	19,8	12,5	16,2	120		120	
OGC – at O ₂ = 0%	mg/MJ	13,1	8,2	10,7				
NO _x – measured	ppm	40,0	42,2	41,1				
NO _x – at O ₂ = 13%	mg/Nm ³	95	97	96	200		200	
NO _x – at O ₂ = 0%	mg/MJ	63	64	63				
Dust – at O ₂ = 13%	mg/Nm ³	20,6	28,2	24,4	40			40
Dust – at O ₂ = 0%	mg/MJ	13,6	18,6	16,1				
Flue gas sensible heat loss	%	17,07	16,79	16,93				
Flue gas chemical heat loss	%	0,80	0,74	0,77				
Heat loss of combustible constituents in the residue	%	0,13	0,13	0,13				
Efficiency	%	81,99	82,34	82,17	>70-80	>60		>75
Uncertainty (Efficiency)	%	1,0						
Total heat output	kW	14,9	15,1	15,0				
Water heat output	kW	5,5	6,3	5,9				
Rated total heat output	kW	15,0						

¹ HRN EN 16510-1:2018 (EN 16510-1:2018) Annex H (informative)

² HRN EN 12815:2014/A1:2008/Ispr.2:2008 (EN 12815:2001/A1:2004/AC:2007)

Note: The OGC and dust results are obtained from Laboratory Međimurje ZAING d.o.o., Emission measurement report of pollutants in the air from the prototype heating device, Report number: IV-01-150-22-1850-A

CO emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

OGC emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

NO_x emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Dust emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Efficiency → Compliance – The measurement result is above the specification limit when the measurement uncertainty is taken into account

Evaluation:

Measurement uncertainty: Specified with the measurement results

“The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, k=2, corresponding to the coverage certainty of 95% for standard classification. The standard uncertainty was determined in accordance with Document EA 4/02 M.”

Variables measured and calculated:		Value	Limit 2015/1185 (EU)
Seasonal space heating efficiency	%	72,17	> 65
CO	[mg/m ³]	1.083	1.500
OGC	[mg/m ³]	16,2	120
NO _x	[mg/m ³]	96	200
Dust	[mg/m ³]	24,4	40

Seasonal space heating efficiency → Compliance – The measurement result is above the specification limit when the measurement uncertainty is taken into account

CO emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

OGC emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

NO_x emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Dust emissions → Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Evaluation:

Variables calculated:		Value	Energy efficiency class 2015/1186 (EU)
Energy efficiency index (EEI)	%	109,15	A+

Fuel analysis

Wood briquettes			
Analytical indicator	Symbol	Unit	Value
Calorific value	Q_i	MJ/kg	16,45
All water in original condition	W_t	% by weight	9,3
Ash	A	% by weight	0,5
Carbon	C	% by weight	45,9
Hydrogen	H	% by weight	5,2
Nitrogen	N	% by weight	0,14
Sulphur	S	% by weight	0,011

Note: The results are obtained from Laboratory HEP - Proizvodnja d.o.o., Centralni kemijsko-tehnološki laboratorij, LABORATORIJSKI IZVJEŠTAJ br. 456/22

Residue analysis

Residue			
Analytical indicator	Symbol	Unit	Value
Carbon	C	% by weight	9,22

Note: The results are obtained from Laboratory HEP - Proizvodnja d.o.o., Centralni kemijsko-tehnološki laboratorij, LABORATORIJSKI IZVJEŠTAJ br. 457/22

Tested by: dr. sc. Ivan Horvat

Date: 09.11.2022.

Signed: _____

Reviewed by: prof. dr. sc. Damir Dović

Date: 10.11.2022.

Signed: _____

5.3 Temperature rise of the operating components

Testing method: HRN EN 16510-1:2018 in conjunction with Part 2-3 *

Sample tested: C-20

Measuring equipment used: 1, 2, 3, 6

Test results – Nominal heat output

Date of testing:	25.10.2022.	$t_{ok} = 23 \text{ }^\circ\text{C}$	RH = 55 %
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Measured point	Material	Temperature rise, K	Note
Front door handle	metal	19	$\leq 35 \text{ K}$
Operating knob (primary air)	metal	10	$\leq 35 \text{ K}$
Operating knob (secondary air)*	metal	64	$> 35 \text{ K}$

Note: The highest value is indicated in the table.
 *The use of protecting gloves is prescribed.

Test evaluation: Compliance

Measurement uncertainty: 0,5 K

“The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% for standard classification. The standard uncertainty was determined in accordance with Document EA 4/02 M.”

Tested by: dr. sc. Ivan Horvat

Date: 09.11.2022.

Signed: _____

Reviewed by: prof. dr. sc. Damir Dović

Date: 10.11.2022.

Signed: _____

5.4 Temperature safety test

Testing method: HRN EN 16510-1:2018 in conjunction with Part 2-3

Sample tested: C-20

Measuring equipment used: 1, 2, 3, 5, 7

Test results – Nominal heat output

Date of testing:	25.10.2022.	$t_{ok} = 23 \text{ }^\circ\text{C}$	RH = 55%
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Test No.	Ambient temperature	Draught in the chimney	Maximum temperature rise of adjacent combustible materials			Fuel quantity	Note
			Test corner	Floor	Ceiling		
-	$^\circ\text{C}$	Pa	K			kg/hour	
1.	23	16	27	2	5	7,39	$\leq 65 \text{ K}$

Note: During the test parameters were set for achieving maximum heat output declared by the manufacturer.

The appliance shows no permanent deformation or damage after the temperature safety test. The highest values are indicated in the table.

Test evaluation: Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Measurement uncertainty: 0,2 K

“The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% for standard classification. The standard uncertainty was determined in accordance with Document EA 4/02 M.”

Tested by: dr. sc. Ivan Horvat

Date: 09.11.2022.

Signed: 

Reviewed by: prof. dr. sc. Damir Dović

Date: 10.11.2022.

Signed: 

5.5 Hot plate boiling test

Testing method: HRN EN 16510-1:2018 in conjunction with Part 2-3
Sample tested: C-20
Measuring equipment used: 1, 2, 3

Test results – Nominal heat output

Date of testing:	06.10.2022.	$t_{ok} = 22 \text{ } ^\circ\text{C}$	RH = 48 %
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Variables measured	Unit	Test 1	Test 2	Avg	Note
Mass of the water	g	2000	2000	2000	
Water temperature at the start of the boiling test	$^\circ\text{C}$	19,0	19,2	19,4	
Time when the temperature is increased by 75 K	min	12,5	12,5	12,5	<15

Test evaluation: Compliance – The measurement result is below the specification limit when the measurement uncertainty is taken into account

Measurement uncertainty: 10 g / 0,2 K / 0,5 min

“The above-specified extended measurement uncertainties are calculated as a factor of the measurement uncertainty and the extension coefficient, $k=2$, corresponding to the coverage certainty of 95% for standard classification. The standard uncertainty was determined in accordance with Document EA 4/02 M.”

Tested by: dr. sc. Ivan Horvat

Date: 09.11.2022.

Signed: 

Reviewed by: prof. dr. sc. Damir Dović

Date: 10.11.2022.

Signed: 

List of referenced documents

- HRN EN 16510-1:2018 (EN 16510-1:2018)
- Emission measurement report of pollutants in the air from the prototype heating device, Report number: IV-01-150-22-1850-A, Međimurje ZAING d.o.o.
- LABORATORIJSKI IZVJEŠTAJ br. 456/22, Centralni kemijsko-tehnološku laboratorij, HEP Proizvodnja
- LABORATORIJSKI IZVJEŠTAJ br. 457/22, Centralni kemijsko-tehnološku laboratorij, HEP Proizvodnja

End of test report

Report number: **IV-01-150-22-1850-A**

Date: **October 24th, 2022**

EMISSION MEASUREMENT REPORT OF POLLUTANTS IN THE AIR FROM THE PROTOTYPE HEATING DEVICE

Name and address of the owner/user of emission source:

"SENKO" d.o.o. Štefanec, Vladimira Nazora 22

Measurement location/source:

Test station for the prototype solid fuel burning appliance
Heating device "C20" nominal heat output 15 kW

Međimurje ZAING d.o.o. Čakovec is authorized to perform the activities of monitoring the emissions of contaminated substances in the air from stationary sources by order of the Ministry of Environmental Protection and Energy

class: UP/I-351-05/22-04/16, register number: 517-04-2-1-22-2

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1. GENERAL INFORMATION

1.1 Name of the accredited laboratory:

MEĐIMURJE ZAING d.o.o.
Environmental and occupational safety
Zagrebačka 77, HR-40000 Čakovec

1.2 Report number: IV-01-150-22-1850-A

1.3 Name and address of the owner/user of emission source:

"SENKO" d.o.o. Štefanec, Vladimira Nazora 22

1.4 Measurement location:

Test station for the prototype solid fuel burning appliance
Solid fuel stove "C20" heat output 15 kW

1.5 Type of measurement:

Prototype measurement of pollutant emissions in the air from a stationary source

1.6 Order/offer number: 2022-00007/PON-22-0487

1.7 Serial number of the record: 1850-2022

1.8 Measurement date: October 21th, 2022

1.9 Report date: October 24th, 2022

1.10 Total number of pages: 8

1.11 The purpose of measurement:

The purpose of measurement is to determine the mass concentrations of certain pollutants from a stationary source according to customer requirements and to determine the combustion parameters of the prototype solid fuel burning appliance following HRN EN 16510-1:2018 Residential solid fuel burning appliances.

1.12 Measurement performed by:

Laboratory Manager:	Emil Novak, dipl.ing.stroj.
Examiners/Testers:	Emil Novak, dipl.ing.stroj. Goran Kovačić, bacc.ing.evol.sust.

1.13 Present during measurement:

Saša Senčar, CEO "SENKO" d.o.o. Štefanec
dr. sc. Damir Dovič, dipl.ing. – Faculty of Mechanical Engineering and Naval Architecture, Zagreb

2. EMISSION PARAMETERS

1. Oxygen level (O₂) – oxygen content in the waste flue gases (vol%)
2. Total organic gaseous carbon (OGC) – mass concentration (mg/m³_N)
3. Solid particles – mass concentration (mg/m³_N)
4. Waste gas humidity – the amount of water vapor in waste flue gases (%)

3. DESCRIPTION OF HEATING DEVICES AND FUEL USED

3.1 Solid fuel burning appliance data

The device on which the measurements are performed is a solid-fuel stove with an individual firing of briquettes. Wood briquettes are inserted into the stove at certain intervals. "Forest briketi" Petrol wood briquettes are used as fuel.

The information about solid fuel burning appliances is shown in the table 3.1.

Table 3.1 Technical characteristics of solid fuel burning appliance

	Technical characteristics	Solid-fuel stove
1.	Manufacturer	"Senko" d.o.o. Štefanec
2.	Type	"C20"
3.	Serial number	Prototype solid fuel burning appliance
4.	Year of manufacture	2022
5.	Nominal heat output	15 kW

4. MEASUREMENT POINT DESCRIPTION

The measuring plane and the measuring point are determined by the flat vertical part of the flue duct to which the device is attached. The flue duct has an internal diameter of 0,16 m and a length of 1,9 m.

5. MEASUREMENT METHODS

The process of measuring pollutant emissions in the air from the outflow of the stationary source was carried out in accordance with the HRN EN 15259 and according to standard HRN EN 16510-1:2018. Measurement of mass concentration of solid particles, total organic gaseous carbon (OGC) and the water vapor content of waste gases was carried out according to HRN ISO 9096, HRN EN 13284-1, HRN EN 12619:2013 and HRN EN 14790:2008.

1. HRN EN 15259:2008 – Air quality – Measurements of stationary source emissions – Requirements sections and sites for the measurement objective, plan and report (EN 15259:2007).
2. HRN EN 16510-1:2018 – Residential solid fuel burning appliances
3. HRN EN 12619:2013 (EN 12619:2013) – Stationary source emissions – Determination of the mass concentration of total gaseous organic carbon – Continuous flame ionization detector method (EN 12619:2013)
4. HRN ISO 9096:2017 (ISO 9096:2017) – Stationary source emissions – Manual determination of mass concentration of particulate matter
5. HRN EN 13284-1:2017 (EN 13284-1:2017) – Stationary source emissions – Determination of low range mass concentration of dust – Part 1: Manual gravimetric method (EN 13284 -1:2017)
6. HRN EN 14790:2017 (EN 14790:2017) – Stationary source emissions – Determination of the water vapor in ducts – Standard reference method (EN 14790:2017)

6. MEASURING EQUIPMENT

The measurement of the total organic gaseous carbon concentration (OGC) is performed by an automatic total carbon sampling device with a flame ionization detector (FID). The measurement of the solid particle concentration in waste flue gases and the determination of the water vapor content is performed by an automatic isokinetic sampling device with a heated sampling probe and an "S" Pitot tube for measuring the flow rate. The determination of the solid particle mass on the sampled filters is determined by analytical scale and the determination of the accumulated moisture mass by digital scale.

1. Portable Total Hydrocarbon Analyzer with flame ionization detector, manufactured by "Raffisch" Poing, type RS 53-T (P5 104), serial number 1/09/11 with a sampling probe, manufactured by "M&C Products Analysentechnik", type PSP 4000-H, serial number 2235/2007968 and the sampling line, manufactured by "Winkler", serial number 1003012962.
2. Automatic isokinetic sampler, manufactured by "TCR Tecora", type Isostack Basic HV, serial number 005835T with a heated sampling probe, a heated sampling filter box, and Pitot-tubes of type "S".
3. Analytical Balance, for measuring the mass of solid particles in waste flue gases, manufactured by "Mettler Toledo" Switzerland, type AG204 DeltaRange, serial number SNR 1117251334, TDNR 21415132-9.
4. Digital scale "Bizerba", type EC 100E, serial number 1701489, measuring range 20-3000 g.

7. MEASUREMENT CONDITIONS

The fuel gas sampling procedure is defined according to the standard HRN EN 16510-1:2018 Residential solid fuel burning appliances. According to the customer's requirements, four measurement cycles were performed - measuring the concentration of OGC during the complete combustion interval from 40 to 44 minutes and sampling of particles for 30 minutes. For the particles measurement the waste gas sampling was performed at a flow rate of 9 litres per minute under standard conditions (273 K and 101,3 kPa) in accordance with the requirements of standard HRN EN 16510-1:2018 by using a 10 mm diameter nozzle.

8. MEASUREMENT RESULTS

The results of individual measurements of a given cycle are shown in table 8.1 and 8.2 as the mean values of the intervals converted to the volume units of dry waste gases under standard conditions (273 K and 101,3 kPa) and the reference oxygen content (13 vol%).

The results of measuring the oxygen concentration and temperature were taken from the Faculty of Mechanical Engineering and Naval Architecture.

Table 8.1 – results of emission units and measurement parameters – particles (half - hour intervals – 30 minutes)

Emission units and measurement parameters	Unit	Results of individual measurements			Mean value
		1. cycle 14. ¹⁴ -14. ⁴⁴	2. cycle 15. ⁰⁹ -15. ³⁹	3. cycle 16. ⁰⁹ -16. ³⁵	
1. Atmospheric pressure	kPa	102,0	102,0	101,9	102,0
2. Oxygen content of the dry flue gases	vol. %	13,72	13,31	12,92	13,5
3. Flue gas temperature (in the measurement plane)	°C	168,5	175,8	179,6	175,8
4*. Volume fraction of water vapor in flue gases	vol. %	6,9	6,9	6,9	6,9
5*. Sampled particle mass (filter and solution)	mg	7,6	5,4	7,7	9,1
6*. Standard volume of dry gas	m ³ _n	0,2753	0,2733	0,2704	0,2722
7*. Standard particle mass concentration	mg/m ³ _n	27,6	19,8	28,5	33,3
8*. Standard particle mass concentration for O _{2,ref} 13%	mg/m ³ _n	30,3	20,6	28,2	36,4

* The measurement results refer to the accredited method

The measurement results refer only to the prototype testing device in question during measurements.

Table 8.2 – results of emission units and measurement parameters – OGC (complete combustion cycle; 40 to 44 minutes)

Emission units and measurement parameters	Unit	Results of individual measurements				Mean value
		1. cycle 14. ¹¹ -14. ⁵³	2. cycle 15. ⁰⁵ -15. ⁴⁹	3. cycle 16. ⁰² -16. ⁴⁵	4. cycle 16. ⁵⁹ -17. ³⁹	
1. Atmospheric pressure	kPa	102,0	102,0	101,9	101,9	102,0
2. Oxygen content of the dry flue gases	vol. %	14,52	14,13	13,85	13,9	14,1
3. Flue gas temperature (in the measurement plane)	°C	164,6	171,3	174,2	178,0	172,0
4*. Volume fraction of water vapor in flue gases	vol. %	6,9	6,9	6,9	6,9	6,9
5*. Standard OGC mass concentration (wet conditions)	mg/m ³ _n	17,8	15,8	10,4	15,3	14,8
6*. Standard OGC mass concentration for O _{2ref} 13%	mg/m ³ _n	23,6	19,8	12,5	18,5	18,6

* The measurement results refer to the accredited method

The measurement results refer only to the prototype testing device in question during measurements.

9. DISCLAIMER OF LIABILITY

The measurement results shown in tables chapter 8. relate exclusively to the prototype source (chapter 3) for measurement conditions during measurement (chapter 7). For any changes we do not take responsibility.

Čakovec, October 24th, 2022

Technical Manager:



Emil Novak, dipl.ing.stroj.

Za "Međimurje ZAING" d.o.o. Čakovec:



Ivan Kovačić, dipl.ing.sig.
CEO

Examiners:



Emil Novak, dipl.ing.stroj.



Goran Kovačić, bacc.ing.evol.sust.

LABORATORIJSKI IZVJEŠTAJ br. 456/22

Datum: 09.11.2022.

OZNAKA UZORKA NARUČITELJA:	Briketi
VRSTA UZORKA:	Drvni briketi
NAZIV I ADRESA NARUČITELJA ISPITIVANJA:	Fakultet strojarstva i brodogradnje, Laboratorij za toplinu i toplinske uređaje, Ivana Lučića 1, Zagreb
ISPORUČENA KOLIČINA UZORKA:	2,5 kg
DATUM DOSTAVE UZORKA U CKTL:	04.11.2022.
PERIOD ISPITIVANJA:	04.-08.11.2022.

REZULTATI ANALIZE:

Red. broj	ZNAČAJKE KVALITETE	Jedinice	ISPITNE METODE	REZULTAT	
				suh	dostavno
1.	Sadržaj ukupne vlage (M) *F ☐	mas. %	HRN EN ISO 18134-1:2015	-	9,3
2.	Sadržaj pepela (A) *F ☐	mas. %	HRN EN ISO 18122:2015	0,5	0,5
3.	Sadržaj sumpora (S) *F ☐	mas %	HRN EN ISO 16994:2015	0,012	0,011
4.	Sadržaj klora (Cl) *F ☐	mas %	HRN EN ISO 16994:2015	0,003	0,003
5.	Sadržaj ugljika (C) *F ☐	mas. %	HRN EN ISO 16948:2015	50,6	45,9
6.	Sadržaj vodika (H) *F ☐	mas. %	HRN EN ISO 16948:2015	5,8	5,2
7.	Sadržaj dušika (N) *F ☐	mas. %	HRN EN ISO 16948:2015	0,15	0,14
8.	Ogrjevna vrijednost, gornja *F ☐	MJ/kg	HRN EN ISO 18125:2017	19,65	17,82
9.	Ogrjevna vrijednost, donja *F ☐	MJ/kg	HRN EN ISO 18125:2017	18,39	16,45

NAPOMENA: ☐ su označene akreditirane metode prema HRN EN ISO/IEC 17025:2017

*F su označene metode iz fleksibilnog područja akreditacije

- Ispitni rezultati odnose se samo na ispitivane uzorke.
- Ispitni izvještaj ili njegovi dijelovi se ne smiju preslikavati, osim u cijelosti, uz odobrenje tehničkog voditelja laboratorija.

Izvještaj odobrila:
Voditeljica laboratorija:
dr. sc. Marija Trkmić, dipl. ing.

KRAJ IZVJEŠTAJA

HEP PROIZVODNJA

CENTRALNI KEMIJSKO-TEHNOLOŠKI LABORATORIJ

ZAGREB, Zagorska ulica 1

Tel/fax 01/3093-939

cktl@hep.hr

LABORATORIJSKI IZVJEŠTAJ br. 457/22

Datum: 09.11.2022.

OZNAKA UZORKA NARUČITELJA:	Pepeo od izgaranja
VRSTA UZORKA:	Pepeo
NAZIV I ADRESA NARUČITELJA ISPITIVANJA:	Fakultet strojarstva i brodogradnje, Laboratorij za toplinu i toplinske uređaje, Ivana Lučića 1, Zagreb
ISPORUČENA KOLIČINA UZORKA:	150 g
DATUM DOSTAVE UZORKA U CKTL:	04.11.2022.
PERIOD ISPITIVANJA:	07.11.2022.

REZULTATI ANALIZE:

Red. broj	ZNAČAJKE KVALITETE	Jedinice	ISPITNE METODE	REZULTAT
				dostavno
1.	Sadržaj ugljika (C)	mas.%	HRN EN ISO 16948:2015	9,22

NAPOMENA: Ispitni rezultat odnosi se samo na ispitivan uzorak.

Ispitni izvještaj ili njegovi dijelovi se ne smiju preslikavati, osim u cijelosti, uz odobrenje tehničkog voditelja laboratorija.

Izvještaj odobrila:
Voditeljica laboratorija:
dr. sc. Marija Trknić, dipl. ing.

Trknić

KRAJ IZVJEŠTAJA