PROFTECH
SPÓŁKA Z O.O.

PCA
POLSKIE CENTRUM AKREDYTACJI
BADANIA
AB 994

Research laboratory accredited by PCA, Nr AB 994

Scopes of accreditation:

- *concentration and mass measurements of flow of fine particles*
- *measurements of concentration and mass flow of SO_2, NO_x, CO*
- *concentration measurements of CO_2, O_2*
- *concentration and mass flow measurements of OWO*
- *sampling for mass concentration determination of PCDD/PDF and dioxin type PCB*
- *sampling for concentration determination of (As; Cd; Cr; Co; Cu; Mn; Ni; Pb; Sb; Tl; V)*
- *sampling for concentration determination of Hg*
- *sampling and determination of concentration and mass flow of HCl*
- *sampling and determination of concentration and mass flow of HF*
- *sampling for determining the concentration of individual gaseous organic compounds*
- *calibration of Automated Monitoring systems,*
- *QAL2 procedure*
- *annual performance test of Automated Monitoring Systems, AST procedure*
- *noise measurement from machinery, installations and industrial plants*

Chorzów, May 31st 2022
Our ref. No.: PW/54/05/22

Report No PW/54/05/22

on concentration measurements of dioxins and furans emitted into environment from flue gas channel located at UAB KAUNO KOGENERACINĖ JĖGAINĖ, Jėgainės g. 6, Biruliškių k., LT-54469 Kauno raj., Lithuania.

Client name and address: **UAB KAUNO KOGENERACINĖ JĖGAINĖ,**
Jėgainės g. 6, Biruliškių k.,
LT-54469 Kauno raj.

Developed by: mgr Grzegorz Bortel

Calculation and data transfer checked by: inż. Dariusz Guja

Verified by: inż. Dariusz Guja
DYREKTOR
inż. Dariusz Guja

Copy number: 1/3

ul. Kurta Aldera 44
41-506 Chorzów
tel/fax: 0 32 247 37 24

www.proftech.com.pl
e-mail: proftech@proftech.com.pl

NIP: 627 252 46 31
KRS: 0000773369

bank account : PKO BANK POLSKI S.A. O/Katowice : IBAN PL62 1440 1172 0000 0000 0353 4332

List of contents:

1. PURPOSE AND SCOPE OF THE REPORT

Purpose of executed measurements was to determine the concentration and emission of dioxins and furans emitted to environment from flue gas channel located at *at* UAB KAUNO KOGENERACINĖ JĖGAINĖ, Jėgainės g. 6, Biruliškių k., LT-54469 Kauno raj., Lithuania.

Measurements range:

- PCDD/DF emission and concentration.

The measurements were carried out in accordance with the sampling plan and the described sampling methods.

Operating parameters of the technological installation was obtained from the customer's representative.

2. BASIS OF MEASUREMENTS EXECUTION

The measurements were taken according to the Contract No 2022-KKJ-73 dated April 27th 2022.

3. MEASUREMENT TEAM

The measurements taken on May 11th 2022 were executed by the following team:

- Grzegorz Bortel — specialist- measurement team leader,
- Bartłomiej Glik — specialist,
- Karol Sodo — technician.

4. MEASUREMENT RESULTS SUMMARY

Below are presented measurement results summary, full measurement results are presented in chapter no 6, at page 8.

Concentration of the substance in the gas in the reference conditions O2 ref. 11%	PCDDF	ng/m3	**0,0036**
Emission limits	PCDDF	ng/m3	**0,1**
Transgerssion	PCDDF	ng/m3	**-**

5. DESCRIPTION OF THE MEASUREMENT METHOD

Measurement of the gas volumetric flow

The flow rate was determined according to ISO Standard PN-EN ISO 16911-1:2013 „Stationary source emissions - Manual and automatic determination of velocity and volume flow rate in ducts - Part 1: Manual reference method". Gravimetric dust monitor type Megasystem APIS X-1 and type "S" Pitot tube were used for the measurements. Measurement is accredited.

Accreditation range: differential pressure: > 5 Pa

Measurement O_2 content

The concentration of O_2 was determined using gas analyzer HORIBA PG-350E-EU equipped with testing probe 1750 mm long. The measurements were taken according to the procedure described in measurement unit as well as to Polish Standard PN-EN 14789:2017 "Stationary source emissions - Determination of volume concentration of oxygen O_2 - Reference method - Paramagnetism". Measurement is accredited.

Accreditation range: O_2 content: 3-21%

Measurement CO_2 content

The concentration of CO_2 was determined using gas analyzer HORIBA PG-350E-EU equipped with testing probe 1750 mm long. The measurements were taken according to the procedure described in measurement unit as well as to Polish Standard PN-ISO 10396:2001 "Stationary Source Emissions - Sampling For The Automated Determination Of Gas Concentrations ". Measurement is accredited.

Accreditation range: CO_2 content: 0,1-20%

Measurement moisture content

Moisture content was determined using condensation-absorption method. The measurements were taken according to Polish Standard PN-EN 14790:2017. Measurement is accredited.

Accreditation range: H_2O content: 29-250 g/m^3

PCDD+PCDF sampling and determination

PCDD/DF samples were taken according to the requirements of Polish Standard PN-EN 1948–1:2006 „ Stationary source emissions - Determination of mass concentration of PCDDs/PCDFs and dioxin-type PCBs - Part 1: Sampling of PCDDs/PCDFs".

The three stages of PCDD/DF concentration and emission determination:

Stage I - sampling

For the determination of mass concentration of PCDD/DF proper sampling plays important role that affects following stages of the testing. The sampling were performed by means of the filtration and condensation method using PCDD/DF sampling system conformed to European Standard PN-EN 1948-1:2006.

The following page shows the schematic diagram of the sampling system.

Stage II - laboratory analysis

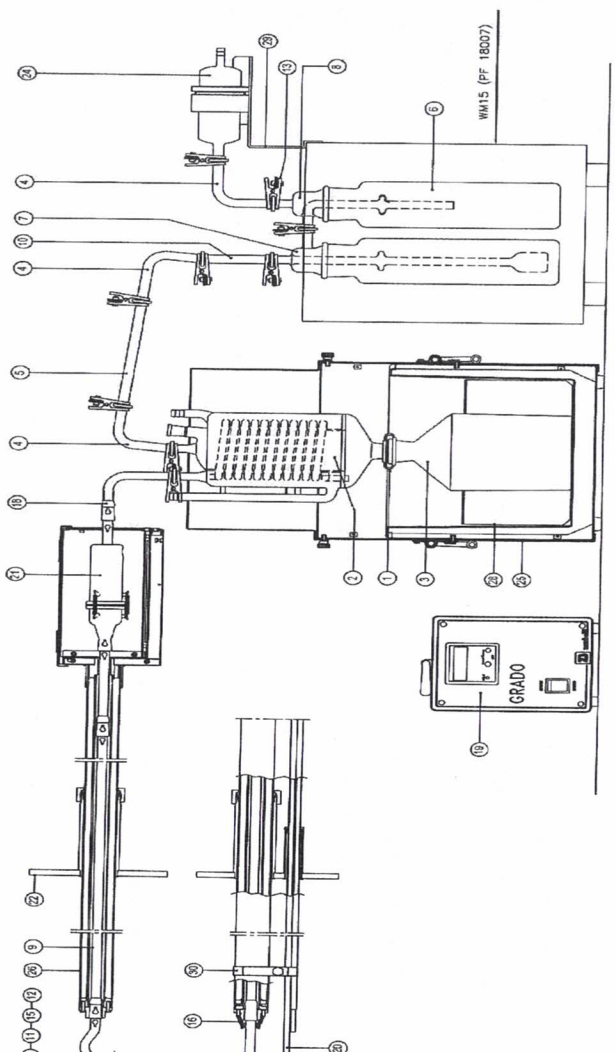
The samples were analysed at the ALS Czech Republic, s.r.o accredited laboratory following the CSN EN 1948-2,3 methodology: The determination of polychlorinated dibenzo-p-dioxine, dibenzofurans in emission samples with the method of isotop dillution using HRGC/HRMS.

The dioxin and furans analyses were conducted at the ALS Czech Republic, s.r.o. Laboratory, specifically accredited for the test by the Český Institut Pro Akreditaci, o.p.s. , Nr L 1163.

Stage III - development and the results and discussion

The last stage includes results collection from the previous stages, emission calculation and PCDD/DF concentration as well as comparison to the standards in force.

Test Report No PW/54/05/22



Opis:

1. ferrule
2. cooler
5,10. aspiration path - tubes
13. clamp
20. Pitot tube „S" - type
25. cooler casing
3. condensation pot
6-8. scrubbers
16. holding springs
21. filter casing
26. heated probe
4,18. aspiration path - elbows
9. aspiration path - probe tube
17. aspiration controller
22. yoke
28. cooler coil
11,12,14,15. – aspiration endings
19. temperature controller
24. gas dryer
29.30. support

6. MEASUREMENT RESULTS

Test Report No PW/54/05/22

1) Plant or unit name[1)]: **Combined Heat and Power Plant**

2) Flue gases cleaning unit[1)]: **bag filters, activate carbon, hydrated lime, scrubber**

3) Emission source load during measurements[1)]: **~76,9% (66,3 MW)**

4) Fuel type or material mass flow in process[1)]: **64% municipal waste, 36% non – hazardous industrial waste**

5) Location of sampling and measurements: **in duct, after flue gases cleaning unit**

Measurement reference number			11-05-01		
Date of measurement			11.05.2022		
Measurement time range			12:53-18:53		
Scope of test		Unit	Results	Uncertainty +/-	Method
Meteorological conditions	Atmospheric pressure	hPa	**1000,7**		
	Ambient temperature	oC	**16**		
Measurement plane	Diameter	m	**2,00**		PN-Z-04030-7:1994
	Area	m2	**3,14**		
Stack gas parameters	Temperature	oC	**57**		
	Static pressure	Pa	**179**		PN-EN ISO 16911-1:2013
	Differential pressure	Pa	**134**		PN-EN ISO 16911-1:2013
	Gas moistness grade X	kg/kg	**0,107**		PN-EN 14790:2017
	Average velocity	m/s	**12,3**	0,6	PN-EN ISO 16911-1:2013
	Chemical composition O2	%	**11,1**	0,3	PN-EN 14789:2017
	Chemical composition CO2	%	**8,4**	0,3	PN-ISO 10396:2001
	Wet gas density during testing	kg/m3	**1,024**		PN-EN 14790:2006
	Gas density in normal conditions	kg/m3 N	**1,251**		PN-EN 14790:2006
	Gas density in conventional conditions	kg/m3 U	**1,330**		PN-EN 14790:2006
Concentration in the gas at measurement conditions	PCDDF*	ng/m3	**0,0028**	0,0009	PN-EN 1948:2006
Concentration in the gas at normal conditions	PCDDF*	ng/m3 N	**0,0035**	0,0011	PN-EN 1948:2006
Concentration of the substance in the gas in standard conditions	PCDDF*	ng/m3 U	**0,0036**	0,0011	PN-EN 1948:2006
Concentration of the substance in the gas in reference conditions O2 ref. 11%	PCDDF*	ng/m3 ref.	**0,0036**	0,0011	PN-EN 1948:2006
Gas volume flow	measurement conditions	m3/h	**138813**	17408	PN-EN ISO 16911-1:2013
	normal conditions	m3N/h	**113645**	14262	
	standard conditions	m3U/h	**96555**	12689	
	reference conditions O2 ref. 11%	m3ref./h	**95589**	12761	
The emission obtained by measuring	PCDDF*	ng/h	**347,60**	115,65	PN-EN 1948:2006
Emission limits	PCDDF*	ng/m3	**0,1**		
Transgerssion	PCDDF*	ng/m3	**-**		

*- the results obtained from the subcontractor (accredited)

[1)]-information obtained from the client

Test Report No PW/54/05/22

Notes:

Normal conditions designate the temperature of 273 K and pressure of 101,3kPa, defining normal cubic meter m^3N. The conventional conditions designate the temperature of 273K, pressure of 101,3 kPa and dry gases (steam contents less than 5 g/kg of flue gas), defining conventional cubic meter, m3U

The specified expanded uncertainty comes from standard uncertainty multiplied by expansion coefficient k = 2, which provides 95% level of confidence for normal distribution. Uncertainty takes into account the sampling and analysis.

Registry of samples delivered to the laboratory: P/88/05/22, P/89/05/22
Date of delivery to the laboratory: 11.05.2022
Date of analysis: 11.05 - 30.05.2022

Field blanks:

ID/ number of sample	Type of substance	The criterion of the blank [ng/m³] 11%O_2	The value of the blank [ng/m³] 11% O_2	Result [+/-]
P/89/05/22	PCDD/DF	0,01	< 0,01	+

Work parameters of measurement system:

PCDD/DF (PN-EN 1948:2006):

sampling method:	condensation - adsorption method		
filter paramethers:	19 x 90 mm, filter efficiency: 99,998 %		
sampling train:	2 measurement axis		
oxygen reference :	11 %		
time of dioxins and furans measerument:	12:53 – 18:53 (360 min)		
nozzle diameter:	6	mm	
probe temperature:	120	°C	
scrubbers temperature	4	°C	
aspired gas volume	5,75	m^3	
average sampling flow	16,0	l/min	
izokinetic ratio:	98,3	%	
leak test:	+ / +		
gas meter temperature	27	°C	
gas meter pressure	0	bar	
spiking pattern:	filter surface		
absorption solution:	100 ml H_2O dest. + 50 ml 2-etoksyetanol		
recovery:	59 %	$^{13}C_{12}$-1,2,3,7,8-PECDF,	/>50%/
	52 %	$^{13}C_{12}$-1,2,3,7,8,9-HxCDF,	/>50%/
	61 %	$^{13}C_{12}$-1,2,3,7,8,9 HpCDF.	/>50%/
TEQ sample mass:	0,019	ng	

H_2O (PN-EN 14790:2017)

sampling train:	2 measurement axis
sampling equipment:	titanium sampling train
	heated probe 2,0 m long
	sampling pump: PT-01
cartridge:	moisture measurement set
number of samplings:	1
sampling time:	30 min
sampling volume:	~2,0 l/min
H_2O maas:	7,5 g
absrobtion efficiency:	97,3 %

Test Report No PW/54/05/22

O_2 paramagnetic (PN-EN 14789:2017):

Range : 0 – 5 % [ ]
0 – 10 % [X]
0 – 25 % [ ]

Calibration gas: O_2 – 9,012% [X] R/07/W
O_2 – 20,018% [ ] R/12/W
N_2 – 99,99% [X] R/17/

Sampling train: 2 measurement axis

Sampling time/ average time: 360 min / 1 min

O_2 concentration measurement (paramagnetic):		HORIBA PG-350E-EU (130/1/AW/21)			
check operation		unit	result	criterion	result +/-
„0" after adjustment, without sampling train		%	0,05	± 0,1 [%]*	+
„0" after adjustment, with sampling train	before measurement	%	0,1	± 0,2 [%]**	+
	after measurement	%	0,15	± 0,2 [%]**	+
„Span" after adjustment with sampling train /standard 9,012 % **R/07/W** analyzer range 25%/	before measurement	%	9,01	± 0,2 [%]**	+
	after measurement	%	9,1	± 0,2 [%]**	+
	before measurement time T90	%	8,2	> 8,12 [%]	-----
		sec.	30	< 200 sec.	+

7. MEASUREMENT DEVICES

Name of measuring device		X1- Apis
Type of measuring device		Isokinetic sampler S/N 0142
Certificate	Calibration No	824-2373/19 824-2374/19 824-2372/19 824-2375/19 G-106/20-66/20
Issued by		INTROL Sp. z o.o. KATOWICE ZAP BESTWINKA
Date of issue the certificate of calibration		27.08.2019 28.08.2019 11.03.2020
Expiration date of the certificate of calibration		-

Name of measuring device		HORIBA
Type of measuring device		PG-350E-EU
Certificate	Calibration No	130/1/AW/21
Issued by		Laboserwis Sp. z o.o. Katowice
Date of issue the certificate of calibration		28.05.2021
Expiration date of the certificate of calibration		-

Name of measuring device		Sampler
Type of measuring device		PT-01
Certificate	Calibration No	851-2463/19 786-2245/19 G-360/19-224/19 R-286/16-186/16
Issued by		INTROL Sp. z o.o. KATOWICE ZAP BESTWINKA
Date of issue the certificate of calibration		29.08.2019 12.08.2019 08.08.2019
Expiration date of the certificate of calibration		-

8. ANALYSIS RESULTS

Attachment no. 1 to the Certificate of Analysis for work order PR2246527

Sample: P/88/05/22

Measurement results PCDD/Fs:

Sample:	P/88/05/22		Final extract [µl]:		60
			Injection volume [µl]:		4
			Acquisition date [d.m.y h:m]:		19.5.22 0:45
2,3,7,8-PCDD/Fs	Result [ng/sample]	Limit of Detection [ng/sample]	Limit of Quantification [ng/sample]	[1]I-TEFs	I-TEQ Upperbound [ng/sample]
2,3,7,8-TCDD	< 0.0017	0.0017	0.0033	1	0.0017
1,2,3,7,8-PeCDD	< 0.004	0.004	0.0081	0.5	0.002
1,2,3,4,7,8-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,6,7,8-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,7,8,9-HxCDD	< 0.019	0.019	0.038	0.1	0.0019
1,2,3,4,6,7,8-HpCDD	< 0.059	0.059	0.12	0.01	0.00059
OCDD	< 0.038	0.038	0.077	0.001	0.000038
2,3,7,8-TCDF	< 0.0015	0.0015	0.0031	0.1	0.00015
1,2,3,7,8-PeCDF	< 0.0051	0.0051	0.01	0.05	0.00025
2,3,4,7,8-PeCDF	< 0.0051	0.0051	0.01	0.5	0.0025
1,2,3,4,7,8-HxCDF	< 0.015	0.015	0.029	0.1	0.0015
1,2,3,6,7,8-HxCDF	< 0.015	0.015	0.029	0.1	0.0015
1,2,3,7,8,9-HxCDF	< 0.015	0.015	0.029	0.1	0.0015
2,3,4,6,7,8-HxCDF	< 0.015	0.015	0.029	0.1	0.0015
1,2,3,4,6,7,8-HpCDF	< 0.024	0.024	0.047	0.01	0.00024
1,2,3,4,7,8,9-HpCDF	< 0.024	0.024	0.047	0.01	0.00024
OCDF	< 0.053	0.053	0.11	0.001	0.000053
I-TEQ from quantified 2,3,7,8-PCDD/Fs -"Lowerbound"					**0**
I-TEQ from 2,3,7,8-PCDD/Fs -„Mediumbound"					0.0097
Maximum possible I-TEQ -"Upperbound"					**0.019**

PCDDs	Result [ng/sample]	PCDFs	Result [ng/sample]
Tetra-CDDs	< 0.037	Tetra-CDFs	0.96
Penta-CDDs	< 0.057	Penta-CDFs	< 0.14
Hexa-CDDs	< 0.19	Hexa-CDFs	< 0.23
Hepta-CDDs	< 0.12	Hepta-CDFs	< 0.095
OCDD	< 0.038	OCDF	< 0.053

[1]I-TEF according to NATO.

Limits of quantification are defined as double of the detection limits.

The limit of detection is defined as the amount of analyte producing a signal with S/N≥3.

The value of the detection limit is mentioned as the actual value at the acquisition date.

Measurement uncertainty is expressed as a double (k=2) relative standard deviation (RSD%), and corresponds to 95% confidence interval.

Estimation of uncertainty of each 2,3,7,8-PCDD/F congener is 30% and total I-TEQ is 20%.

These values were ensured by analyses of certified reference material under conditions of internal reproducibility.

Results marked with "<" are bellow limit of detection or quantification.

"Lowerbound" and "Upperbound" are levels defined in Regulation 2017/644 and EN 1948-4.

"Mediumbound" is levels defined in Regulation 2017/644.

Test Report No PW/54/05/22

Attachment no. 1 to the Certificate of Analysis for work order PR2246527

Sample: P/88/05/22

Standards recovery:

Sample: P/88/05/22

Final extract [µl]:	60
Injection volume [µl]:	4
Acquisition date [d.m.y h:m]:	19.5.22 0:45

Extraction standard	Recovery	Acceptable range [%]		Accept. rec. with respect to	
PCDDs	[%]	Basic	Extended	basic range	extended range
13C12 - 2,3,7,8-TCDD	84	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,7,8-PeCDD	51	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,7,8-HxCDD	81	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,6,7,8-HxCDD	96	50 - 130	30 - 150	YES	-
13C12 - 1,2,3,4,6,7,8-HpCDD	100	40 - 130	20 - 150	YES	-
13C12 - OCDD	85	40 - 130	20 - 150	YES	-
PCDFs					
13C12 - 2,3,7,8-TCDF	68	50 - 130	30 - 150	YES	-
13C12 - 2,3,4,7,8-PeCDF	53	50 - 130	30 - 150	YES	-
13C12 -1,2,3,4,7,8-HxCDF	82	50 - 130	30 - 150	YES	-
13C12 -1,2,3,6,7,8-HxCDF	78	50 - 130	30 - 150	YES	-
13C12 -2,3,4,6,7,8-HxCDF	73	50 - 130	30 - 150	YES	-
13C12 -1,2,3,4,6,7,8-HpCDF	110	40 - 130	20 - 150	YES	-
13C12 - OCDF	94	40 - 130	20 - 150	YES	-

Sampling standard	Recovery	Acceptable range	Rec. in range?
	[%]	[%]	
13C12-1,2,3,7,8-PeCDF	59	> 50	YES
13C12-1,2,3,7,8,9-HxCDF	52	> 50	YES
13C12-1,2,3,4,7,8,9-HpCDF	61	> 50	YES

9. CERTIFICATE OF ACCREDITATION

POLSKIE CENTRUM AKREDYTACJI
POLISH CENTRE FOR ACCREDITATION

Sygnatariusz EA MLA
EA MLA Signatory

CERTYFIKAT AKREDYTACJI
LABORATORIUM BADAWCZEGO
ACCREDITATION CERTIFICATE OF TESTING LABORATORY
Nr AB 994

Potwierdza się, że. / This is to confirm that:

„PROFTECH" Sp. z o.o.
ul. Kurta Aldera 44, 41-506 Chorzów

spełnia wymagania normy PN-EN ISO/IEC 17025:2018-02
meets requirements of the PN-EN ISO/IEC 17025:2018-02 standard

Akredytowana działalność jest określona w Zakresie Akredytacji Nr AB 994
Accredited activity is defined in the Scope of Accreditation No AB 994

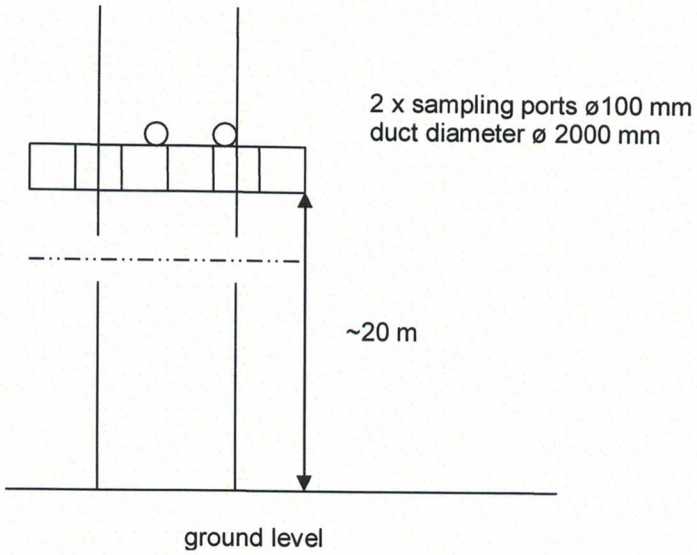
Akredytacja pozostaje w mocy pod warunkiem przestrzegania wymagań jednostki akredytującej określonych w kontrakcie Nr AB 994
This accreditation remains in force provided the Laboratory observes the requirements of Accreditation Body defined in the Contract No AB 994

Akredytacji udzielono dnia 30.01.2009 r.
Accreditation was granted on 30.01.2009

DYREKTOR
POLSKIEGO CENTRUM AKREDYTACJI
LUCYNA OLBORSKA

Warszawa, dnia 9 grudnia 2019 roku

10. MEASUREMENT PLANE SCHEME



Approved by

.....DYREKTOR

Name and Signature

inż. Dariusz Guja

END OF REPORT