

TEST REPORT NR. LX5397.1/03

Internal measurements in the Exhaust emissions of CHP Energy of the SW GmbH & Co.KG in Hunteberg (Bohmte) by using Rapeseed oil raffinate various proportions with water.

Operator

SW Energie GmbH&Co.KG
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49163 Hunteberg(Bohmte)

cert. experts

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Report Date

04.11.2009



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1) Definition of the measurement

1.1 Client

SW Energie Gmbh & Co. KG

Michelsweg 4

49163 Hunteburg (Bohmte)

1.2 Operator

SW Energie Gmbh & Co. KG

Michelsweg 4

49163 Huntrburg (Bohmte)

Tel-Nr 0 54 75 – 12 75

State Lower Saxony

1.3 Location

End Not reported

Corridor Not reported

Parcel Not reported

1.4 Facility

Combustion engine system according § 4 BlmSchG (1) in Connection with subparagraph 1.4(b), column 2 of the Appendix of 4. BlmSchV (2).

1.5 Date of measurement

15.10.2009

Date of last measurement 23.09.2009 – 24.09.2009

Date of next measurement Not reported

1.6 Occasion of measurement

Internal measurement in connection over trials with other fuel compositions

1.7 Task

During the operation of a CHP in the use of rapeseed oil refined in various proportions with water soliter the concentrations of selected air pollutants are measures in the exhaust; limit considerations soliter not be.

1.8 Device under test

Carbon monoxide (CO)

Sulfur Dioxide (SO₂)

Nitrogen oxides (NO and NO₂,Expressed as NO₂)

Total organic carbon (collectes-C)

Carbon dioxid (CO₂)

1.9 Conducted local inspection before measurement processed

A site visit was in connexion with the first measurement and mutiny on 08.10.2009 performed.Mess conditions with regard to the inlet and outlet line according to the requirements of () were not available.

1.10 Measurement plan coordination

A measurement plan accordance VDI guideline 2448, BL.1(6) was not created.Die approach to measurement has been agreed with the operator (Mr.Witte,SW Energy GmbH & Co. KG).

1.11 At the Sampling involved Persons

Dipl.- Ing. Dieter Ahlers (ZECH Engineering mbH, Lingen)

Dipl.- Ing. Jürgen Ritter (ZECH Engineering mbH, Lingen)

Dipl.- Ing. Lars Schlüter (ZECH Engineering mbH, Lingen)

1.12 Participation of further institutions

None

To document the engine performance and exhaust gas temperature - curves were employees of the company van Meegen spot. The records are contained in the Appendix 2.

1.13 Responsible Experts

In the course of short-term target announced the professional responsibility following individuals should be transferred:

Dipl - Ing Dieter Ahlers Ahlers@ZechGmbH.de

Dipl - Ing Jürgen Ritter Ritter@ZechGmbH.de

2.) Description of the plant and substances handled

2.1 Type of Plant

Combustion plant according to 4 BImSchG [1] in conjunction with paragraph 1.4 (b), column 2 of the appendix of the 4th BImSchV [2]

2.2 Facility Description

Combustion system for the operation of vegetable oil. More details are available.

2.3 Description of emission sources

Source	Name	Height above ground	Emitting surface	Easting / Northing	Construction
Nr.		(m)	(m²)	(m)	
1	chimney	ca.10	0.035	not available	Steel

Table 1: Emission source

2.4 Declaration according to permit of the possible application materials

Vegetable oil

2.5 Hours of Operation

The plant will be operated continuously (8.760 h/a).

2.5.1 Total Operating Time

see 2.5

2.5.2 Emission time data for operators

see 2.5

2.6 device for detecting and reducing emissions

2.6.1 Device for collecting emissions

The exhaust flow of the system is initially routed through an exhaust pipe heat exchanger (AWT) for generating heat, and then led into the atmosphere.

2.6.1.1 System for emission collection

see 2.6.1

2.6.1.2 detection element

see 2.6.1

2.6.1.3 Fan identification data

no fan available

2.6.2 Device for reduction of emissions

there are no facilities to reduce emissions so far.

3.) Description of sampling sites and measurement cross-section

3.1 Specified the place of sampling and measuring cross section

Designation of the measurement (source)	chimney
Diameter / size equal to the measurement point [m]	0.21
Cross-sectional area [m ²]	0.035
Length of the inlet section (ES) [m]	approximately 2
Inlet section, according to [3]	5 x d
Compliance with ES, according to [3]	yes
Length of the outlet section (ES) [m]	about 6
Outlet section, according to [3]	5 x d
Compliance with AS according to [3]	yes
Number of measuring axis [unit]	1
Number of data points per measurement axis	2
Location of measurement points per Aches [cm]	3/18
Number of measuring orifices [piece]	2
Size of the measuring orifices [mm]	ca. 50(2)
Corner gas exhaust duct to the central axis <15 ° met [3]	Yes
Point of negative flow [3]	No
Ratio $\frac{V_{max}}{V_{min}} < 3: 1$ [3]	1 : 1
Δ_p (Dynamic pressure) > 5 Pa [3]	yes

Table 2: Information concerning the measurement cross section

4. Measurement methods and analysis, equipment

4.1 Determination of emission interface conditions

4.1.1 Flow rate in the emission line

Pitot tube (after Prandtl) from Company Gothe in conjunction with a micro manometer

Make / Type:	HMG, 3
Range:	0 - 10 hPa
Limit:	0.01 hPa

The velocity profile is given in Annex 1.

4.1.2 Dynamic and static pressure

Pitot tube (after Prandtl) of Company Gothe in conjunction with a micro manometer under consideration of the applicable ports

Make / Type	HMG3
Measuring range:	0-10 hPa
Limit:	0.01 hPa

4.1.3 Air pressure equal to the sampling point

Barometer

Production/ Type: Company No. Lambrecht. 2039

4.1.4 Exhaust gas Temperature

Thermo couple (NiCr / Ni, type K) with measured sensor

Make / Type: Digital	- A 305 Thermometer
Measuring range:	- 50 ° C to + 1,300 ° C
Compensation:	0.1 ° C
Accuracy:	± 0.2% 0 C to 1,000 0 C

4.1.5 Water vapor content in exhaust gas (flue gas humidity)

The flue gas humidity was determined by adsorption on silica gel (with color) and afterwards gravimetric determination.

4.1.6 Exhaust density

Calculated, taking into account the exhaust units:

- * Oxygen (M^2)
- * Carbon dioxide (CO^2)
- * Atmospheric nitrogen (with 0.933% Ar)

and the exhaust gas temperature, flue gas humidity and pressure conditions in the channel.

4.2 Continuous measurement

recorded every second, the following parameters:

- * Organic compound links, indicated as Ges - C
- * Carbon monoxide (CO)
- * Nitrogen oxides (NO and NO^2 , expressed as NO^2)
- * Carbon dioxide (CO^2)
- * Oxygen (O^2)

4.2.1 DUT (device under test)

Total organic carbon, total – C

4.2.1.1 Measurement Methods

Measurement of hydrocarbon - concentration using flame – ionization detector (FID) according to VDI guideline 3481, sheet 4 [4].

4.2.1.2 Analyzers

Manufacturer:	Sick Maihak GmbH
Type:	Model 3006 (Ba 3006)
Serial no.:	09 130 026
Year:	04/2009

4.2.1.3 Set measuring range

measuring range:	2, (0-100 ppm)
Detection limit:	<1.5% of full scale

4.2.1.4 Aptitude check

The device is tested for suitability and GMBI. 1996 announced.

4.2.1.5 Measurement schematic construction

Sampling probe:	not heated
Dust Filter:	heated to 180 ° C
Sample gas line from gas treatment:	not applicable
Sample gas pipe to gas processing:	not applicable
Active ingredient of the gas-carrying parts:	titanium, stainless steel, Teflon
Sample Gas:	not applicable; the test gas is the FID directly and through a heated wet sampling line (3 m length) are available.

4.2.1.6 Check the device characteristic curve with the following gases

Zero gas:	ambient air through activated carbon filters
Test Gas:	79.6 ppm
Manufacturer:	Westfalen AG
Production date:	05/09
Stability guarantee:	24 Monte
traceable certified:	No

4.2.1.7 90% of the total set up time of measurement setup

The 90% response time is test gas introduction once, by the sampling probe determined before the start of sampling and was about 20 s. Simultaneously checked the tightness of the entire sampling device.

4.2.1.8 Registration of measurable Values

The registration of data takes place continuously on an electronic data acquisition (data acquisition program "Anacomp" of the company Breifuss, Harpstedt).

4.2.2 DUT (device under test)

Carbon monoxide (determination of mass concentration of carbon monoxide (CO), reference measurement methods: Non-dispersive infrared spectrometry according to DIN EN 15058 [7])

4.2.2.1 Measurement method

For CO analysis of the PG 250 operates on the principle of non-dispersive infrared energy with wavelengths that are specific to the molecule. This will in turn feed via a solenoid valve sample gas and reference gas (zero gas) with constant flow rate and fixed-time interval of the cell. It is absorbed by the component to be measured, in contrast to the comparative zero gas, more infrared energy, so the detector measured in the infrared light intensity is modulated. The amplitude of this signal change is the basis of this method.

In the infrared IR light source is produced, the cell happens and then passes into a detector. If the cell of zero gas flow through more IR light reaching the detector. In contrast, less IR light reaches the detector if the sample gas flows through the cell. The degree of slowdown is proportional to the measured gas concentration in the cell.

The detector includes a movable diaphragm, the pressure changes in the optical cell absorbs. Is there a difference in the absorbed energy between measuring and measuring and a reference gas, a pressure change occurs within the detector, which is covered by the membrane. This oscillation is electrically processed and displayed as a result.

This occurs no membrane vibration when the sample gas concentration remains the same, i.e. sample gas concentration is equal to the reference gas concentration or gas flow is stopped. In this case, the Power of the output signal is equal to zero and virtually any drift.

Infrared wavelengths by optical filters are removed, the conformity with the wavelength of the measured component, or with this overlap. This cross-sensitivities can be largely avoided.

It is simultaneously recorded with this arrangement, the concentration of SO₂.

4.2.2.2 Analyzers

Manufacturer:	Horiba Ltd.
Type:	PG 250
Serial no.:	XXJ 25 XFP
Year:	10/2008

4.2.2.3 Set measuring range

Measuring range 1:	(0-200 ppm)
Output:	4 to 20 mA
Reproducibility:	0.5% of full scale

4.2.2.4 Aptitude check

The device is tested for suitability and GMBI. 2001 announced.

4.2.2.5 Design of Measuring Station

Sampling probe:	Heated
Dust Filter:	aut heated 180 ° C
Sample gas pipe to gas processing:	Non-heated 180 ° C
Sample gas pipe to gas processing:	Not heated
Active ingredient of the Gas-carrying parts:	titanium, stainless steel, Teflon
Sample Gas:	the test gas is made of the sample gas (type PSS-5 / 3, manufactured by M & C) via heated sample line (3 m) available outlet dew: +4 ° C

4.2.2.6 Check the device characteristic curve with the following gases

Zero gas:	nitrogen (5.0)
Test gas:	418 ppm CO
Manufacturer:	Westfalen AG
Production date:	05/09
Stability guarantee:	24 months
traceable certified:	No

4.2.2.7 90% of the total set up time of measurement setup

The 90%-response time is greatly simplified by testing gas introduction into the sampling probe emitted off operations before the start of sampling and was ca.20s. This was also reviewed de resistance of the entire sampling device.

4.2.2.8 Registration of measurable results

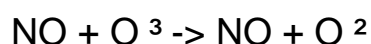
The registration of measured data is continuously over an electronic data acquisition (data acquisition program "Anacomp" of the company Breitfuss, Harpstedt).

4.2.3 DUT (device under test)

oxides (determining the mass concentration of nitrogen oxides (NO_x), reference measurement methods: chemiluminescence according to DIN EN 1492 [8]).

4.2.3.1 Measurement method

The basic principle used here for detection of nitrogen oxides, the chemiluminescence (CLD), is based on the reaction of nitrogen molecules (NO) with ozone (O³). Nitric oxide is oxidized and there is NO² excited that) the excitation energy in the form of light (luminescence) immediately provenance.



This reaction is extremely fast and only the existing NO participates unaffected by other gases present. Therefore, the light emission of chemiluminescence is proportional to the concentration of NO.

The sample gas, which is conducted for NO_x determination of the NO / NO converter, is supplied via a fixed dilution of the cell. The necessary ozone supply air is sucked through a filter, cooled by an electric radiator and also fed into the measuring chamber. The chamber is then the luminescence according to the reaction between the sample gas and O³ measured by photodiode.

4.2.3.2 Analyzers

Manufacturer:	Horiba Ltd.
Type:	PG 250
Series No:	25 XXJ XFP
Year:	10/2008

4.2.3.3 Set measuring range

Measuring range 4:	(0-250 ppm)
Power of the output:	4-20 mA
Reproducibility:	0.5% of full scale

4.2.3.4 Aptitude check

The device is tested for suitability and GMBI. 2001 announced.

4.2.3.5 Design of measuring station

Sampling probe:	Heated
Dust filter:	heated 180 ° C
Sample gas line from gas treatment:	heated to 180 ° C
Sample gas pipe to gas processing:	not heated

Active ingredient of the gas-bearing parts: stainless steel titanium, Teflon

Sample Gas: the test gas is made of the sample gas (type PSS s5 / 3, manufactured by M & C) for heated sampling line (3m) available sample outlet dew + 4. ° C

4.2.3.6 Check the device characteristic curve with the following gases

Zero gas: nitrogen (5.0)

Test gas: 298 ppm NO

Manufacturer: Westfalen AG

Stability guarantee: 24 months

traceable certified no

4.2.3.7 90% of the total set up time of measurement setup

The 90% response time is determined by test gas introduction into the Sampling probe determined once before the start of sampling and was about 20 s. It was also verified the integrity of the entire sampling device.

4.2.3.8 Registration of measurable results

The registration of data takes place continuously on an electronic data acquisition (data acquisition program "to Acomp" the a. Broad foot, Harpstedt).

4.2.4 DUT (device under test)

Sulfur dioxide (SO² Measuring - concentrating on the principle of non-dispersive infrared absorption).

4.2.4.1 Measurement method

For the SO₂ analysis of the PG 250 operates on the principle of non-dispersive infrared absorption. Molecules that consist of different atoms, which absorb infrared energy at wavelengths that are specific to the molecule. This will in turn feed via a solenoid valve sample gas and reference gas (zero gas) with a constant flow rate and fixed-time interval of the cell. It is to be measured by the component, in contrast to the comparative zero gas, more

Infrared energy is absorbed, is measured in the detector so the modulated infrared light intensity. The amplitude of this signal change is the basis of this method.

In the infrared IR light source is produced, the cell happens and then passes into a detector. If the cell of zero gas flow through more IR light reaching the detector. In contrast, less IR light reaches the detector if the sample gas flows through the cell. The degree of slowdown is proportional to measuring gas concentration in the measuring cell.

The detector proposal contains a movable diaphragm, the pressure changes in the optical cell absorbs. Is there a difference in the absorbed energy between measuring and reference gas, a pressure change occurs within the detector, which is covered by the membrane. These oscillations supply is electrically processed and displayed as a result.

There will be no diaphragm vibration when the measuring gas concentration remains the same, i.e. measuring gas concentration is equal to the reference gas concentration or gas flow is stopped. In this case, the output signal is zero un virtually no drift.

By optical filters to remove infrared wavelengths that are consistent with the wavelength of the measured component, or with this overlap. This cross sensitivities can be largely avoided.

It is simultaneously recorded with this arrangement, the concentration of CO with.

4.2.4.2 Analyzers

Manufacturer:	Horiba Ltd.
Type:	PG250
Serial no.:	25 XXJ XFP
Year:	10/2008

4.2.4.3 Set measurement range

Measuring range 1:	(0 - 200 ppm)
Power of the output:	4-20 mA
Reproducibility:	0.5% of full scale

4.2.4.4 Aptitude Check

The device is tested for suitability and GMBI. 2001 announced.

4.2.4.5 Design of measuring station

Sampling probe:	Heated
Dust Filter:	heated to 180 ° C
Sample gas line from gas treatment:	heated to 180 ° C
Sample gas pipe to gas processing:	not heated
Active ingredient of the gas-carrying parts:	titanium, stainless Steel Teflon
Sample Gas:	the test gas is made of measuring gas treatment (type PSS 5 / 3, manufactured by M & C) via a heated sampling line (3m) available (3m) made available outlet dew: +4 ° C

4.2.4.6 Check the device characteristic curve with the following gases

Zero gas:	nitrogen (5.0)
Span gas:	159 ppm SO ₂
Manufacturer:	Westfalen AG
Production date:	05/09
Stability guarantee:	24 months
Traceable certified:	No

4.2.4.7 90% of the total set up time of measurement setup

The 90%-s response time is the introduction of test gas sampling probe determined once before the start of sampling and was about 20 s. It was also validated the density of the entire sampling device.

4.2.4.8 Registration of measurable values

The registration of data takes place continuously on an electronic data acquisition (data acquisition program "Anacomp" of the company Breiffuss, Harpstedt).

4.2.5 DUT (device under testing)

Carbon dioxide (determining the volume concentration of carbon dioxide (CO₂) using non-dispersive infrared spectrometry).

4.2.5.1 Measurement method

The CO₂ - analyzer uses two pyroelectric sensors. The main sensor measures contained component CO₂ attenuated infrared energy.

The other, the reference sensor, uses light energy to determine the wavelength difference for CO₂ - absorption.

Cause the infrared rays are passed through the gas measurement cell and are absorbed by the CO₂, decreases the signal of the main sensor.

Accordingly, we obtain the CO² - signal by calculating the difference between the signal of the reference sensor and the main sensor.

After it is determined by dividing the CO² -signals by the reference signal, taking into account a correction of the light fluctuations by contamination analyzer etc., and then converts the signal output.

4.2.5.2 Analyzers

Manufacturer:	Horiba Ltd.
Type:	PG 50
Serial no.:	25 XXJ XFP
Year:	10/2008

4.2.5.3 Set measuring range

Measuring range 1:	(0-20 vol - %)
Power of the output:	4-20 mA
Reproducing Ability:	0.5% of full scale

4.2.5.4 Aptitude check

The device is tested for suitability and GMBI. 2001 announced.

4.2.5.5 Design of measuring station

Sampling probe:	Heated
Dust Filter:	heated to 180 ° C
Sample gas line from gas treatment:	heated aut 180 ° C
Sample gas pipe to gas processing:	not heated
Active ingredient of the gas-carrying parts:	titanium, stainless steel, Teflon

Measuring gas preparation: the test gas is made of measuring gas treatment (type PSS 5 / 3, manufactured by M & C) via a heated sample line (3 m) available outlet dew: +4 ° C

4.2.5.6 Check the device characteristic curve with the following gases

Zero gas: nitrogen (5.0)
test gas: 16 Vol. -% CO²
Manufacturer: Westfalen AG
Production date: 05/09
Stability guarantee: 24 months
traceable certified: No

4.2.5.7 90% of the total set up time of measurement setup

The 90% setting time is uniquely determined by test gas introduction into the sampling probe before the start of sampling and was about 20 s. It was also verified the integrity of the entire sampling device.

4.2.5.8 Registration of measurable values

The registration of data takes place continuously over a electronic data acquisition (data acquisition program "Anacomp" the Fa. Breitfuss, Harpstedt).

4.2.6 DUT (device under testing)

Oxygen (O²) (determining the volume concentration of oxygen (O²)
Reference measurement: The paramagnetism according to DIN EN 14789).

4.2.6.1 Measurement method

The exhibition of the oxygen concentration is based on the susceptibility of oxygen) (paramagnetism. At tension straps attached to a barbell is the turning point in their one and absolutely proportional. Mirror owns. The oxygen paramagnetism in consequence of his aim to the homogeneous magnetic field of the cell. The O_2 - molecules thereby exert a torque on the dumbbell. In an electric current is generated, which flows through a wire loop is placed around the bar. The resulting compensation current is a measure of the oxygen concentration

4.2.6.2 Analyzers

Manufacturer:	Horiba Ltd.
Type:	PG 250
Serial no.:	25 XXJ XFP
Year:	10/2008

4.2.6.3 Set measuring range

Measuring range 3:	(0-25 vol -%)
Output:	4-20 mA
Reproducibility:	0.5% of full scale

4.2.6.4 Aptitude Check

The device is tested for suitability and GMBI. 2001 announced.

4.2.6.5 Design of measuring station

Sampling probe:	Heated
Dust Filter:	heated to 180 ° C
Sample gas line from gas treatment:	heated to 180 ° C
Sample gas pipe to gas processing:	not heated
Active ingredient of the gas-carrying parts:	titanium, stainless steel, Teflon

Measuring gas treatment: the sample is made of gas measuring gas treatment (type PSS-5 / 3, manufactured by M & C) via a heated sampling line (3m) are available, outgoing gas dew point: + 4 °C

4.2.6.6 Check the device characteristic curve with the following gases

Zero gas: nitrogen (5.0)
Test gas: ambient air
Manufacturer: Westfalen AG
Manufacturing date: 05/09
Stability guarantee: 24 months
traceable certified: No

4.2.6.7 90% of the total set up time of measurement setup

The 90% setting time is uniquely determined by test gas introduction into the sampling probe before the start of sampling and was about 20 s. Dabei was simultaneously checked the tightness of the entire sampling device.

4.2.6.8 Registration of measurable values

The registration of data takes place continuously on an electronic data acquisition (data acquisition program "Anacomp" the Fa. Breitfuss, Harpstedt).

4.3 Discontinuous measurement method

Not applicable

4.3.1 Gas and vapor emissions

Not applicable

4.3.2 Special exhaust toxic ingredients

Not applicable

4.3.3 Smell emissions

Not applicable

5.) Operating conditions of the facilities during the measurements

5.1 Production Plant

During the internal emission measurements (Experiments 1 to 3) the facility was operated for the purpose intended for trouble free use part load range as Operators information (150 KW).

The operating conditions during the experiments are shown in Table 3 (page 30).

The production of rapeseed oil-water mixture was has been done by employees of the egm International GmbH and was monitored and documented by employees of the ZECH Engineering GmbH. A photographic documentation of a sampling approach (mixture of raffinate rapeseed oil / water) to the task in to the engine of the CHP is listed in Annex 2. The egm fuel was made from rapeseed oil and water with the addition of carbon dioxide (CO²) with a transparent vortex converter (egm-technology) and submitted batch mixed to the CHP engine combustion

5.2 Flue gas cleaning facility

Emission control systems are not available

6. Compilation of the results

The fuel lines were purged before each test with the egm fuel.

6.1 Assessment of the operational conditions during the measurements

During the individual tests the operating conditions were recorded by an employee of the Zech Engineering Company Ltd., and are expressed as in the table below.

Attempt	1	2	3
Fuel	Rapeseed oil	Canola oil/ water (1:1)	Rapeseed oil/ water (1:3)
Time	12:06 – 12: 36	13:24 – 13:54	18:09 – 20:00 *
Performance [KW el.]	147	150	150
Temperature before AWT [C°]	447	430	429
Exhaust gas temperature at the measuring [C°]	158	173	172
Flue gas humidity [g/m ³]	52	49	48
Fuel Consumption	20,0	21,1	22,5 **

* Interruption of 19:02 clock to 19:35 clock by electronic engine shutdown.

** Extrapolated to the end of the experiment, consumption of 15.30 kg to 19:02 Clock

Table 3: Operating data while it attempts

The so called egm fuel from rapeseed oil, tap water and carbon dioxide gas has been produced before each experiment and has been supplied then to the engine over the fuel flow unit which consist of fuel pump, pre heater and fuel filter.

The preparation was taken as follows:

The desired proportions of water and rapeseed oil were measured and filled into a template container. Over two cycles the mixture is drawn with a pump system, and mixed in a transparent vortex converter (egm technology). One cycle was dosed additional with carbon dioxide (CO₂) from a pressure bottle. The exact amount of added carbon dioxide was not measured. After information by operator were added about 5 liter per minute during the mixing process. By the mixing process was a homogeneous milky suspension was produced, which was then directly fed to the engine for combustion. The production of a batch lasted around 30 minutes. The applied electrical power of the two pumps was, according to Mr Tauchert (company van Meegen) per pump 1 kW. During preparation of the third batch was due to a malfunction of the mixing system only over a period of 10 minutes dosed additional carbon dioxide (CO₂).

6.2 Measurement results

During the measurements was taken reserve samples of the supply and return of the motor fuel used as to document the operating conditions.

At the end of the trial day, was taken a sample of engine oil and a gas sample taken from the carbon dioxide pressure bottle.

An analytical determination of these samples has not been done until now, at the request of the operator.

To exclude a load of the engine inlet air with "carbon sources" (total-C), this entry was also examined by FID in the form of a short-term measurement (about 1 minute). The concentration of this snapshot of total-C was below the detection limit of 2mg/m³ what from can be inferred that the engine was not fed by a gas mixture transferred by the intercooler.

The following table summarizes the measured air pollutants compared with the various experimental conditions. It is to apparent that in the exhaust of the CHP motor, was measured no significant changes in air pollutant emissions during the measurement period.

Attempt	1	2	3
Time	12:06 – 12:36	13:24 – 13:54	18:09 – 20:00*
Exhaust temperature [°C]	158	173	172
Airflow [m ³ /h]	897	932	172
CO [mg/m ³]	81	61	93
CO ² [Vol.-%]	8,3	8,4	8,0
NO x [mg/m ³]	3.334	2.773	3.263
So ² [mg/m ³]	<6	<6	8
O ² [Vol. - %]	10,3	10,1	10,6
total –C [mg/m ³]	20	22	34

* Interruption from 19:02 till 19:35 o'clock by electronic engine shutdown.

Table 4: Summary of the measured air pollutant emission

6.3 Measurement Uncertainties

For assessment of the measurement uncertainty (MU) the complete procedure is divided in following modules:

- I Module trace gas (M1 = Fault Module 1 in %)
- II Module continuous gauge (M2 = Error Module 2 in%)
- III Module sampling point (M 3 = Fault Module 3 in%)

In the following, according to the requirements of DIN EN ISO 20988 [5] are listed the estimated measurement uncertainties. The measured concentrations of pollutants are fraught with an error, caused by the uncertainty.

- I For the module trace gas, the measurement uncertainty of trace gas concentration is according to the manufacturer - Analysis Certificate - 2%.
- II For the continuous measurement device is specified in the aptitude test report, a measurement uncertainty of 3% of measuring value.
- III For the module sampling point, we estimate a measurement uncertainty of 5% for this sampling point values.

From these values results in accordance with $MU = \sqrt{M_I^2 + M_{II}^2 + M_{III}^2}$ one total measurement uncertainty of 6.2%.

6.4 Plausibility Check

A plausibility check is not possible for the pollutants identified in connection with the improvement of vegetable mixtures based on present knowledge.

The exhaust concentrations of the various pollutants are in all the experiments in the same order of magnitude (Experiment 1 with pure rapeseed oil, test 2 and 3 with egm-fuel as a mixture of rapeseed oil, water and carbon dioxide; Table 4.) A change of pollutants in the exhaust gas in due to change of input materials was not detected.

Further perceptions can possibly be gained from the investigations of the retained samples.

The results of these experiments can not be explained with physical and chemical principles by us.

The previous measurement report has been prepared in good faith and conscience with the greatest care. The test report consists of 36 pages and 3 facilities.

Lingen, 04.11.2009 the DA / Sc
ZECH Engineering Company Ltd

7.) Literature

- [1] BImSchG - Federal Pollution Control Law to protect against harmful environmental impacts caused by air pollution, noise, vibration and related events, 26 September 2002
- [2] 4. Regulation on Implementation of the Federal Pollution Control Act, (4.BImSchV) Regulations requiring a permit premises; March 14th 1997
- [3] DIN EN 15259 air quality - measurements of emissions from stationary sources, January 2008
- [4] VDI Guideline 3481, Sheet 4, measuring the concentration of total carbon and methane - C with the flame ionization detector (FID), February 2007
- [5] Air Quality -DIN ISO 20,988 guidelines for the estimation of measurement uncertainty "- German version EN ISO 20,988: September 2007
- [6] VDI Guideline 2448, Sheet 1, planning of sample measurements of emissions at stationary sources, April 1992
- [7] DIN EN 15058 emissions from stationary sources - Determination of mass concentration on carbon monoxide (CO) - Reference method: Non-dispersive infrared spectrometry: German version E 15058:2006, September 2006
- [8] DIN EN 14792 emissions from stationary sources - Determination of the mass concentration of nitrogen oxides (NOx) - Reference method: chemiluminescence; German version EH 14792:2005, April 2006.

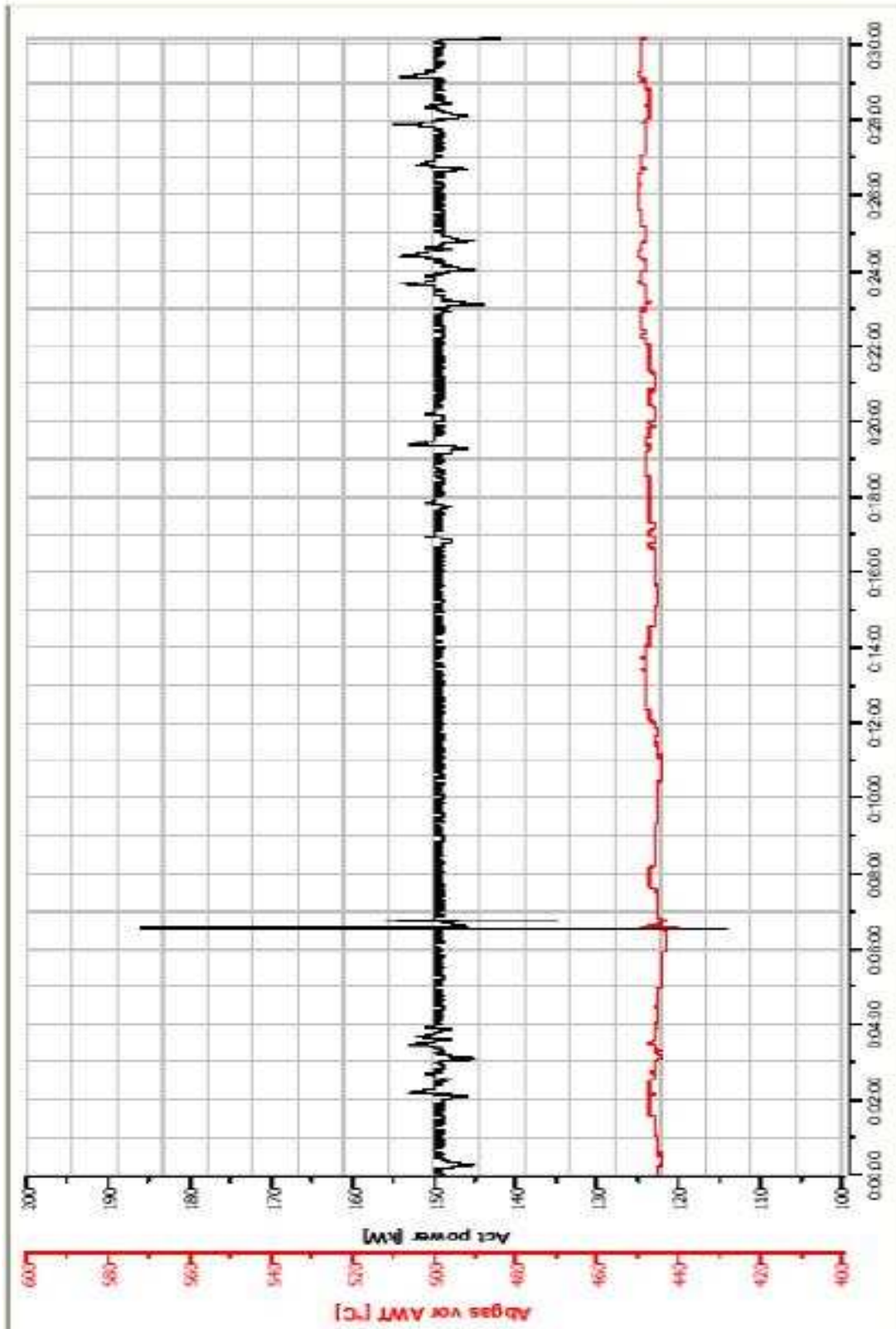
8.) Plants

Appendix 1: Performance-and exhaust temperature curves of the CHP-Moors, provided by the company van Meegen, Vechta

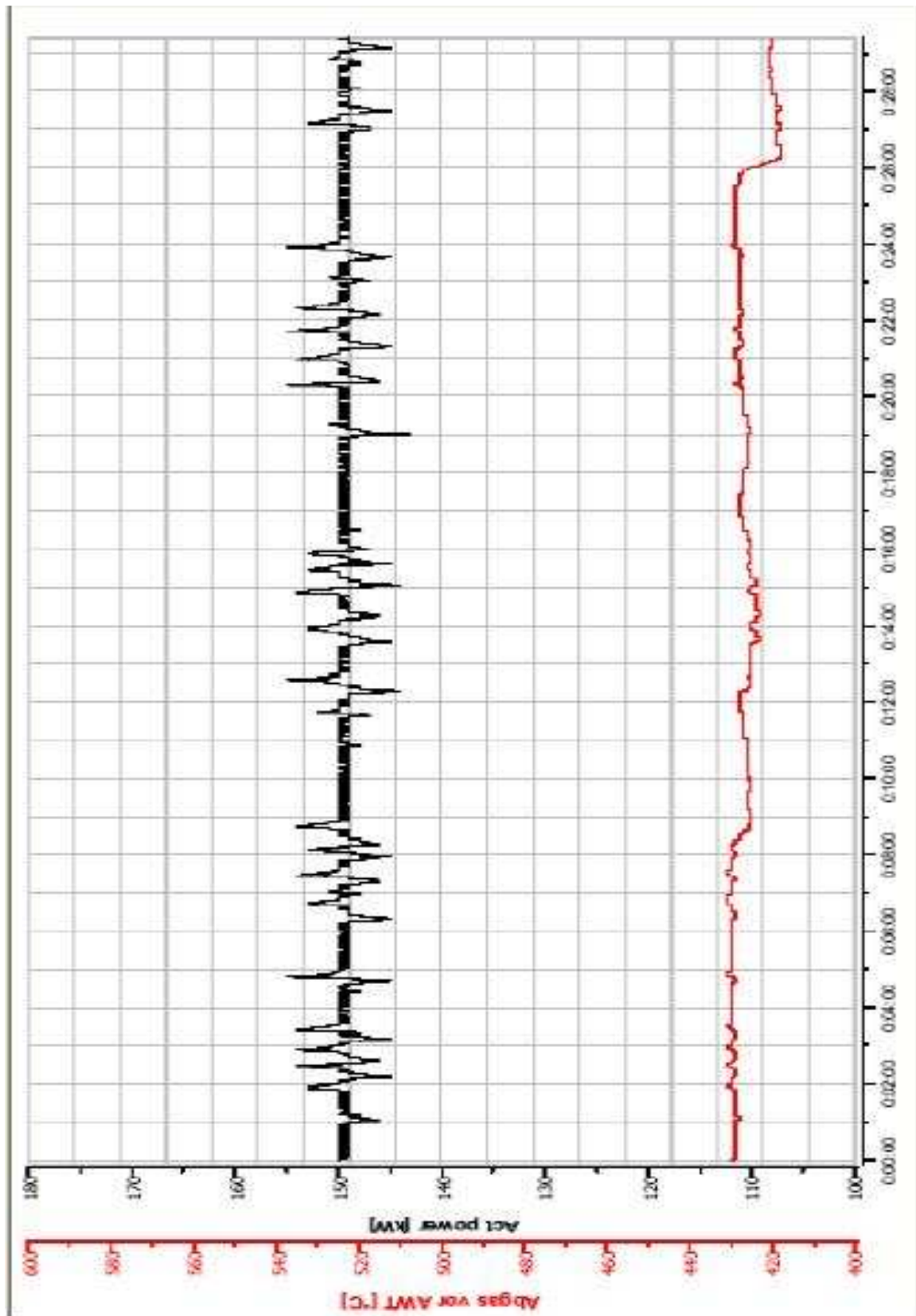
Appendix 2: Photo documentation vegetable oil mixture preparation

Appendix 3: Graphs of the measured concentrations of pollutants in the exhaust gas of the CHP

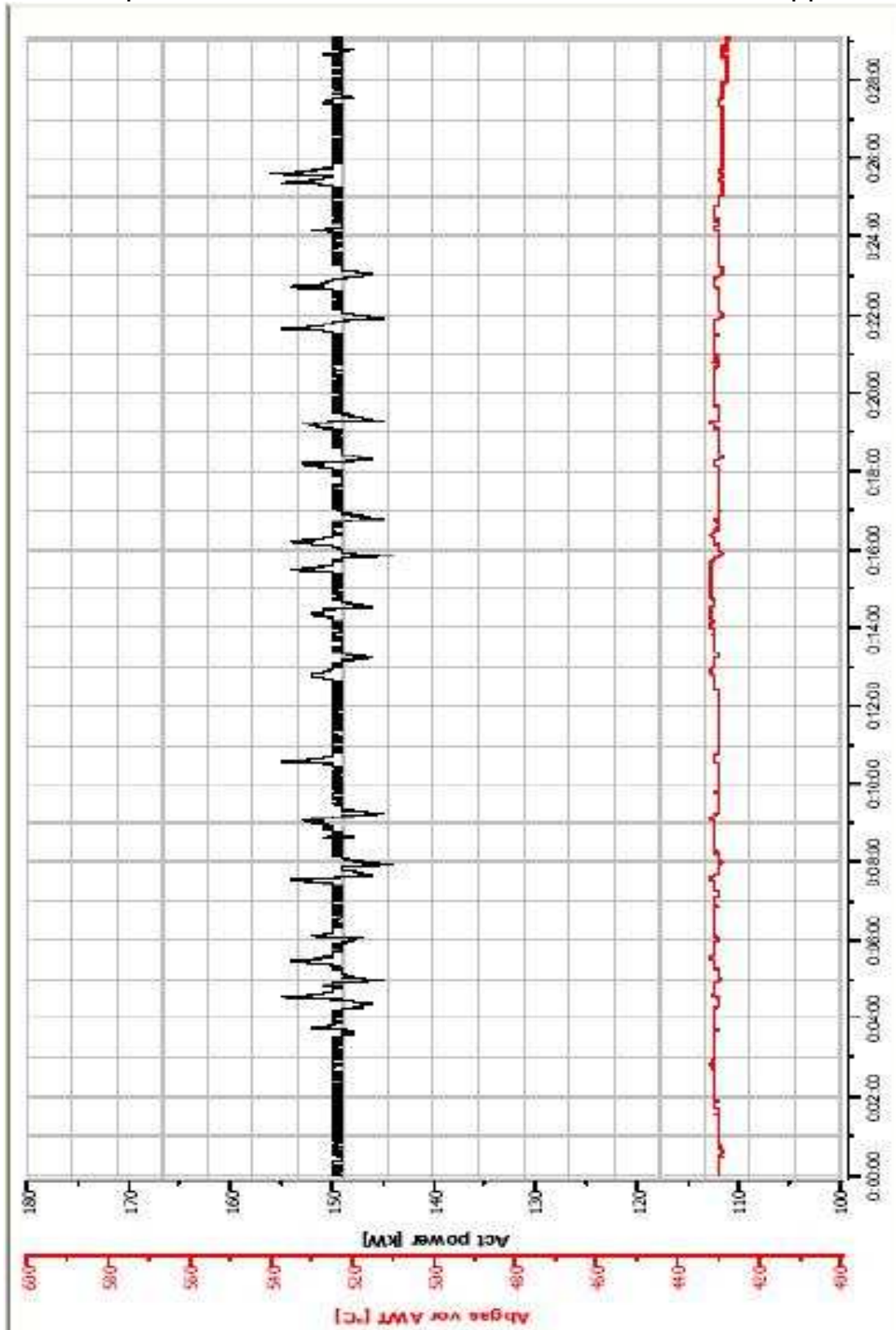
Appendix 1: Performance and exhaust temperature diagrams of the CHP engine, provided by the company (van Meegen, Vechta)



* **Chart 1:** Performance and exhaust temperature diagram of the CHP Mortor (provided by F. van Meegen, Vechta) during tests 1



* **Chart 2:** Performance and exhaust temperature diagram of the CHP Mortor (provided by company van Meegen, Vechta), during Test 2



* **Chart 3:** Performance and exhaust temperature diagram of the CHP Mortor (provided by company van Meegen, Vechta) during test 3

Appendix 2: Photo documentation blending rapeseed oil



Figure 4: Blending Rapeseed Oil

Appendix 2:



* **Picture 2:** Composite Drum with Vortex Converter to produce the egm-fuel

Appendix 2:



* Picture 3: Composite Drum with pump system for producing egm-fuel

Appendix 2:



* **Picture 4:** Rapeseed oil is filled in the composite drum

Appendix 2:



* Picture 5: beginning of the blending process of egm-fuel

Appendix 2:



* **Picture 6:** Result of the blending process of egm-fuel

Appendix 2:



* **Picture 7:** Decanting the egm-fuel in small containers

Appendix 2:



***Picture 8:** View of the filling station in front of the fuel transport unit of the consumption (egm-fuel was adjusted with a scale)

Appendix 2:



* **Picture 9:** Fuel transport unit with fuel pump, preheating (copper pipes for hot water supply) and fuel filters.

Appendix 2:



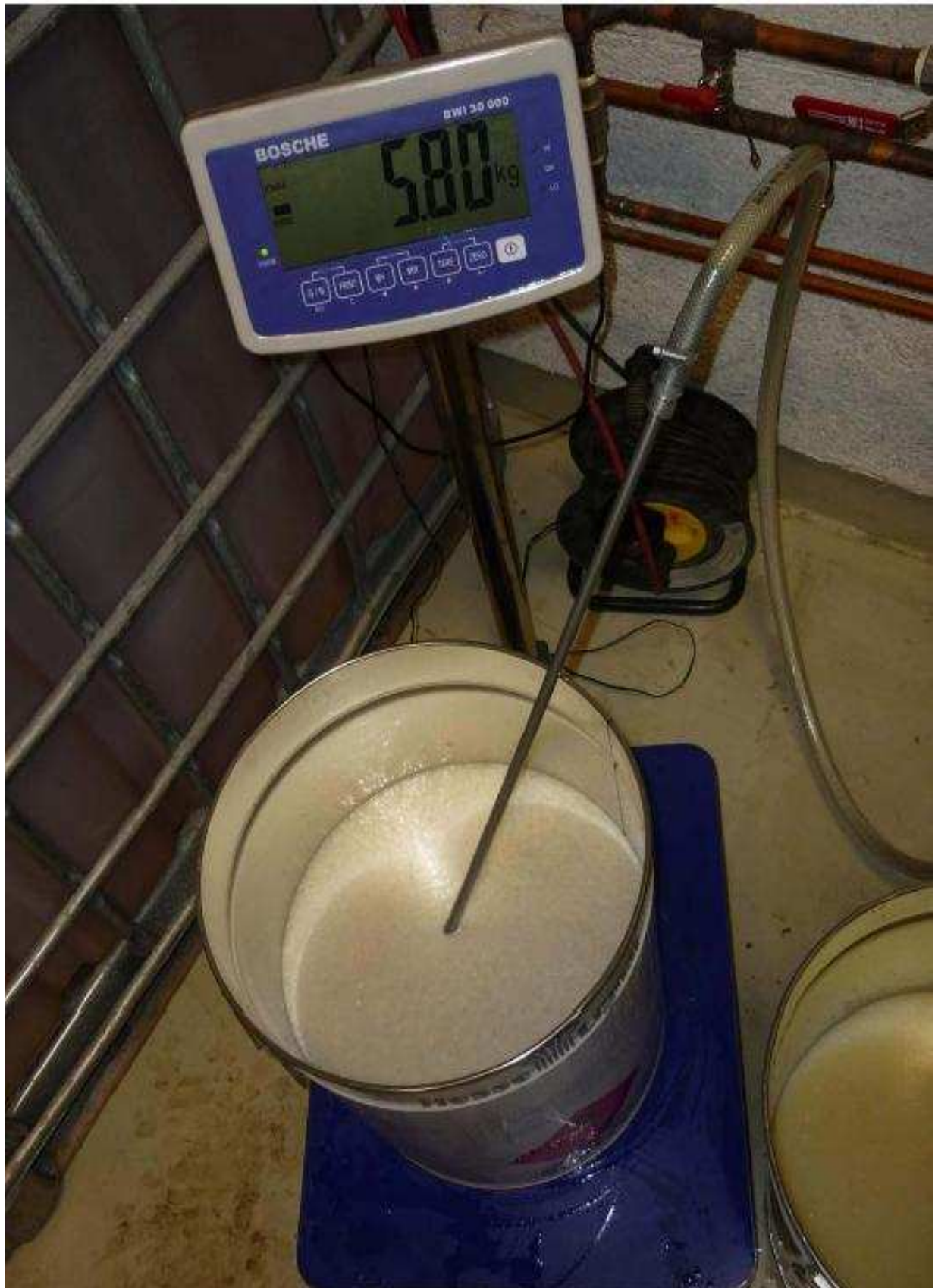
*** Picture 10 :** View details of fuel transport unit, into the open pre heater with the fill pipe (left) and the two level contacts

Appendix 2:



* **Picture 11:** Flush the fuel line, the entire pipeline system was flushed with the respective fuels. The picture shows the sampling point at the fuel return line.

Appendix 2:



* **Picture 12:** Pumping of egm- fuel with a lance from the small containers during the test

Appendix 2:



*** Picture 13:** View of engine with heated supply and return line.

Appendix 2:



* **Picture 14:** sampling point for the continuous metering of air pollutant concentrations and exhaust flow

Appendix 3: Graphs of the measured concentrations of pollutants in the exhaust gas CHP

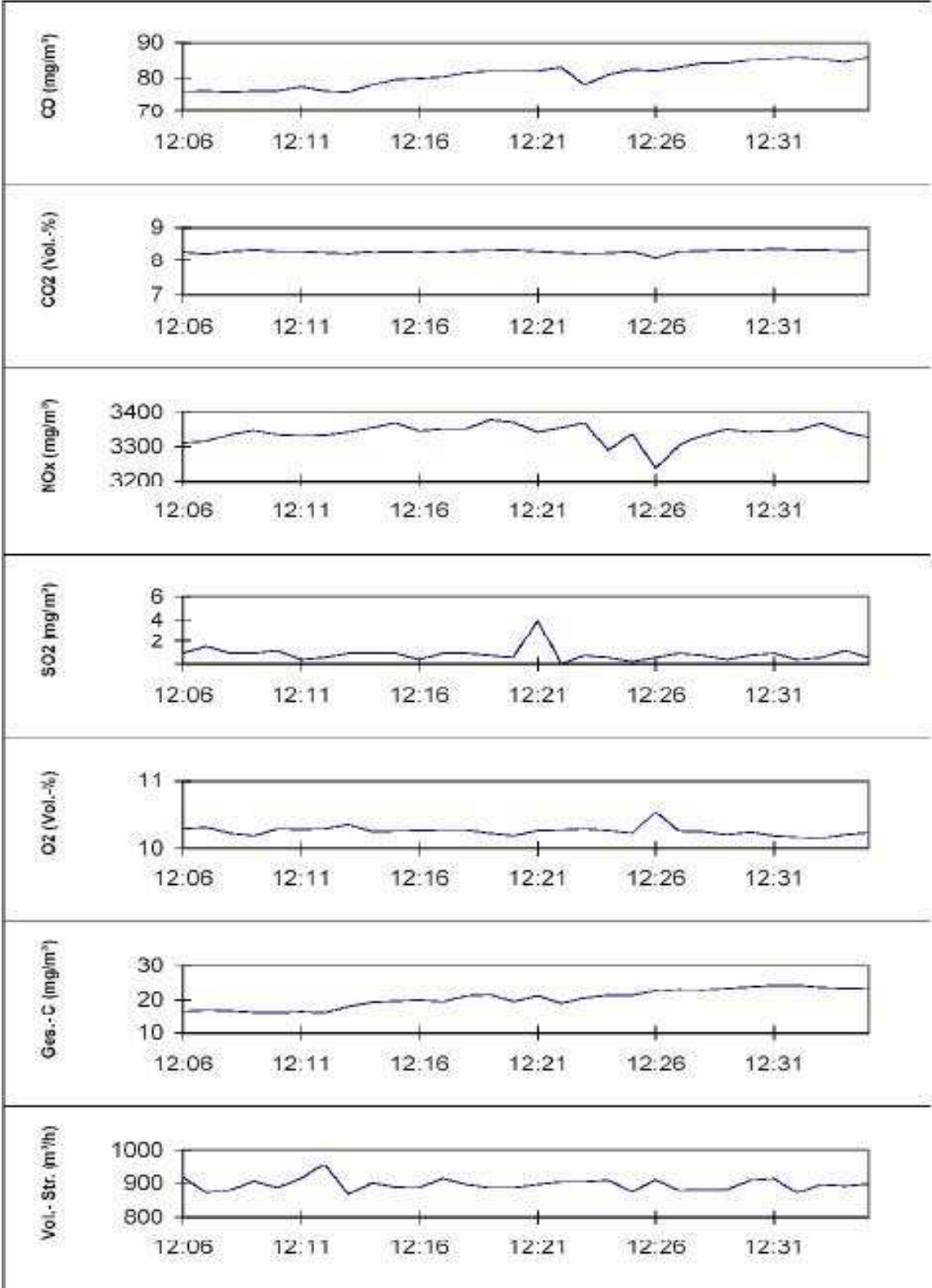


Figure 1: magnitude of the measured concentrations of pollutants in the exhaust gas CHP (test 1)

Appendix 3:

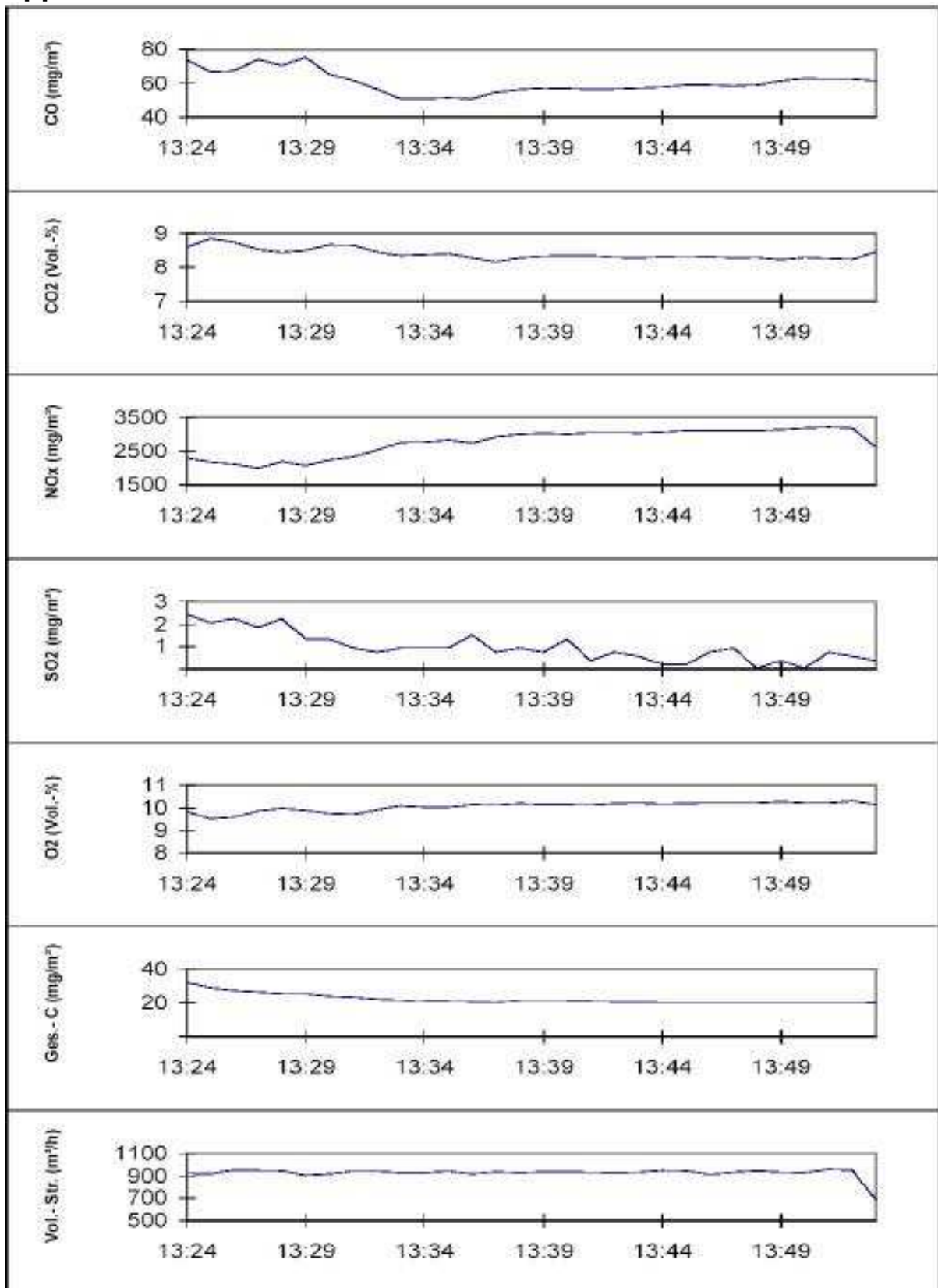
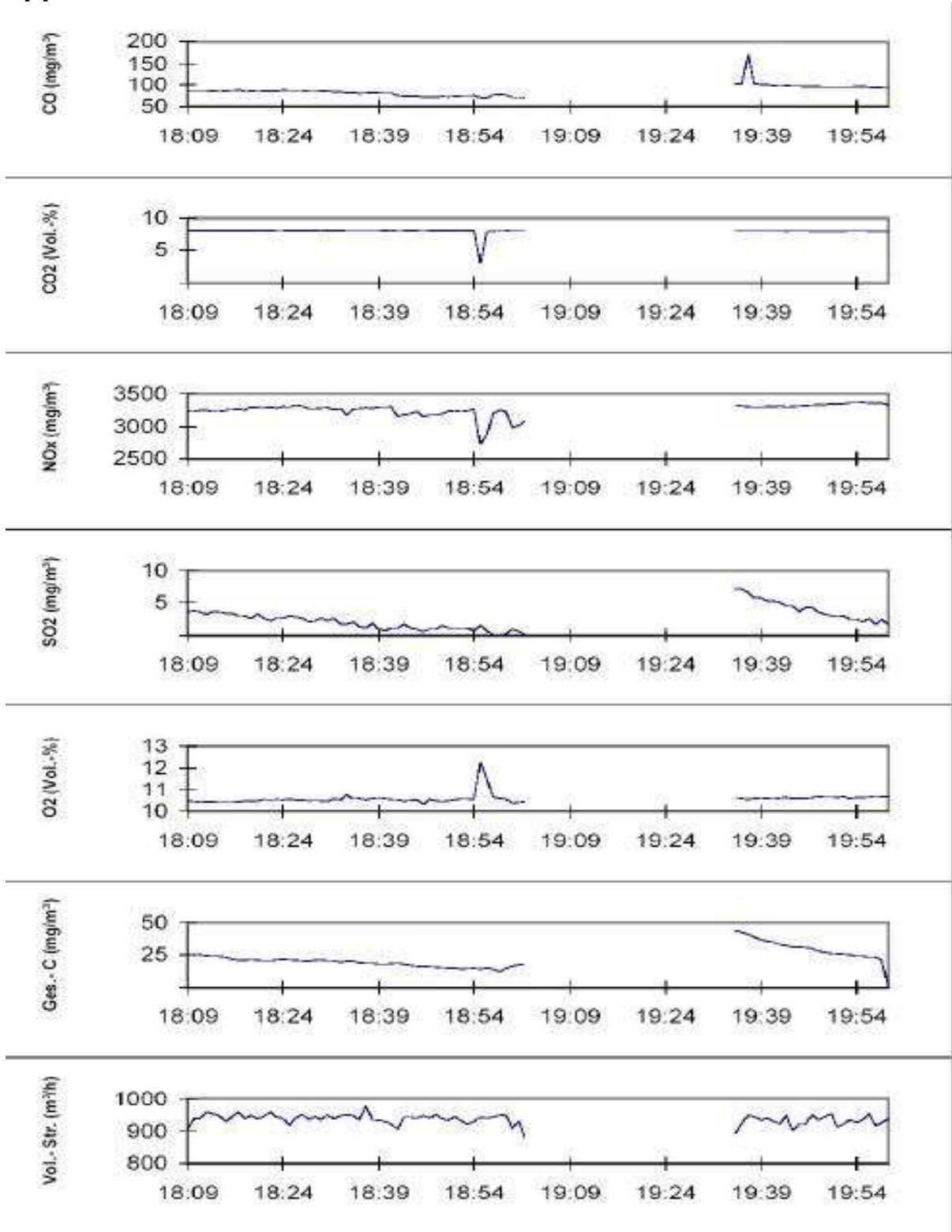


Figure 2: magnitude of the measured concentrations of pollutants in the exhaust gas CHP (test 2)

Appendix 3:



Note: break from 19:02 until 19:35 Clock Clock by electronic engine cut-off

Fig.3: magnitude of the measured concentrations of pollutants in the exhaust gas CHP (test 3).