„CITERM HEATING SYSTEMS“ ltd.
17 Miroslava Jovanovica street
11160 Belgrade

Report on measurement

OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING THE WORK OF BURNER „CITERM“ TYPE G1P BY WASTE OIL COMBUSTION

Belgrade, november 2009.

User:	„CITERM HEATING SYSTEMS“ ltd. Belgrade, 17 Miroslava Jovanovica street
Object of examination:	Waste oil burner, manufacturer „CITERM“, type G1P
Field of examination:	Physical-chemistry examination of combustion products which occur as a result of a burner’s work
Type of examination:	Concentration measurement of harmful and dangerous pollutants which are emitted into air as a result of a burner’s work
Examination methods:	▪ *ISO 10396 : 1993* Stationary source emissions - Sampling for the automated determination of gas concentrations ▪ ISO 10780 : 1994 Stationary source emissions– Measurement of velocity and volume flowrate of gas streams in ducts
Total pages:	19
Examination date:	05.11.2009.

(place for seal)

Director of Laboratory for ecological examinations

Jovica Novakovic, graduate physical chemist

CONTENTS:

1. PLACE AND TIME OF MEASUREMENT

On basis of „CITERM HEATING SYSTEMS“ ltd., 17 Miroslava Jovanovica street from Belgrade, emission measurements of harmful and dangerous pollutants which are result of work of a burner „CITERM“, type G1P, by waste oil combustion.

Measurements included:

1. Measurement of stationery source physical parameter (temperatue)
2. Measurements of contents of harmful and dangerous which are produced during the work of a mentioned burner.

Measurements were performed on 05.11.2009.

Picture 1. Macrolocation of „CITERM HEATING SYSTEMS“ ltd., 17 Miroslava Jovanovica street, Belgrade

2. DESCRIPTION, TECHNICAL DATA AND PLANT AND DEVICES CAPACITIES

„CITERM HEATING SYSTEMS“ ltd. produces burners and industrial furnices which use middle heavy oil. Production consists of two main parts:

1. Casting of crankcases for burners, which is performed in a foundry of cca. 35 m^2 area, and
2. Production of heaters, heater dishes, assembling and inspection of burner's work, which is performed in a special production plant of cca. 99 m^2 area.

Both of objects (foundry and heater and heater dishes production plant, assembling and inspection of burner's work) are located in Belgrade, 17 Miroslava Jovanovica street.

Technical data for boiler:

- Manufacturer: "GENERATORE D'ARIA LALDA"
- Type: "B23"
- Model: ACR 40 BASIC
- Serial number: 24035000841
- Country of origin: Italy
- Boiler heating power: 46.8 kW
- Capacity (20°C): 2800 m^3/h
- Type of fuel: heating oil

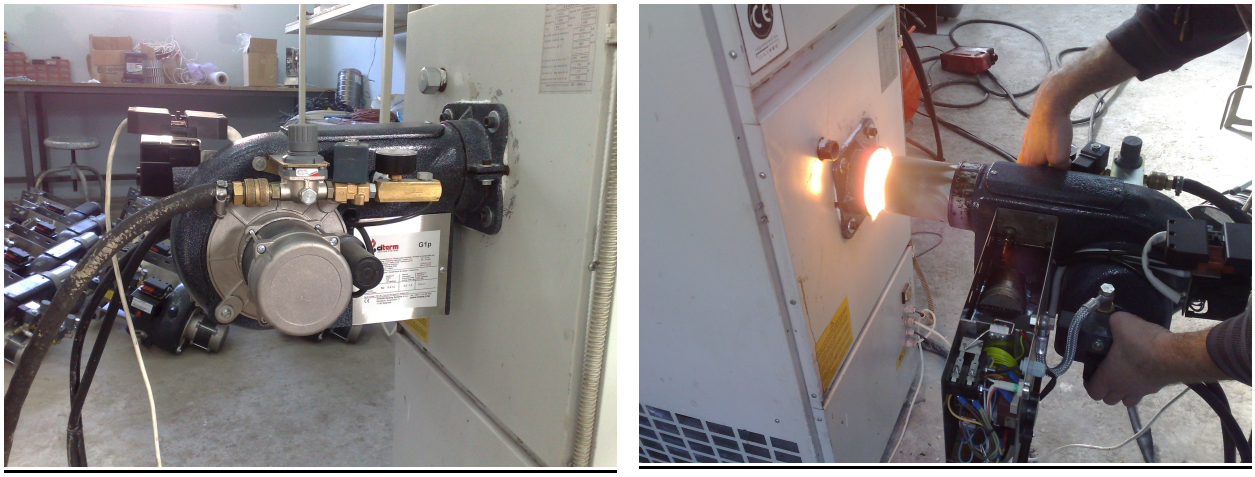
Technical data for burner:

- Manufacturer: „CITERM HEATING SYSTEMS“
- Type of burner: G1P
- Country of origin: Serbia
- Heating power: 37-57 kW
- Fuel consumpton: 3.6 -5.5 kg/h

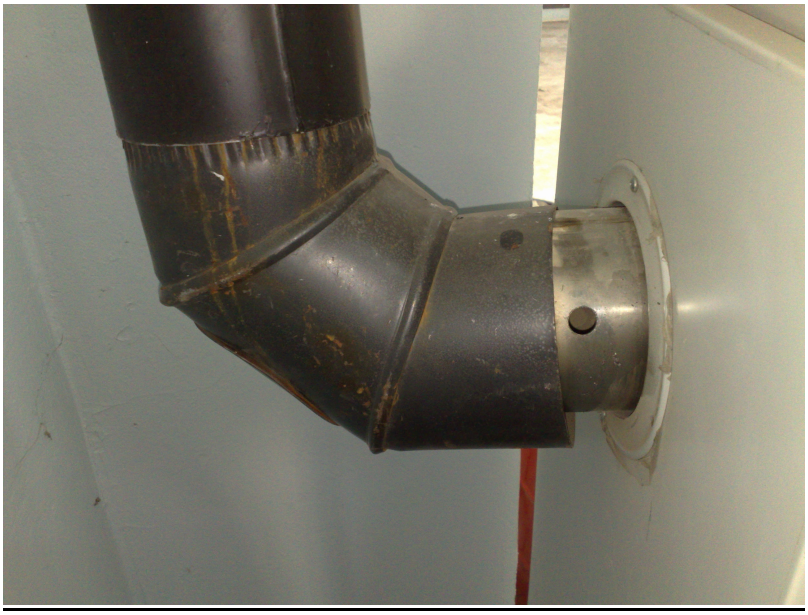
3. POSITION OF MEASURING PLACE

Measurements were performed in ventilation duct, on part which is behind boiler. Ventilation duct is round, with cross-section Ø = 12 cm.

Picture 2. Boiler type “B23”, manufacturer “GENERATORE D’ARIA LALDA”



Picture 3. Burner type G1P, manufacturer „CITERM HEATING SYSTEMS“



Picture 4. Measuring place on ventilation duct of boiler, type “B23”, manufacturer “GENERATORE D’ARIA LALDA”

4. MEASURING PROCEDURES AND TYPES OF MEASURING DEVICES

Measured parameters	Examination method	Measuring device
Outside temperature	ISO 10780 : 1994 Stationary source emissions– Measurement of velocity and volume flowrate of gas streams in ducts	Gas analyzing system MGA 5, MRU GmbH, Germany
Exhaust gas temperature	ISO 10780 : 1994 Stationary source emissions– Measurement of velocity and volume flowrate of gas streams in ducts	Gas analyzing system MGA 5, MRU GmbH, Germany
Mass concentration of carbon monoxide (CO)	ISO 10396 : 1993 Stationary source emissions – Sampling for the automated determination of gas concentrations	Gas analyzing system MGA 5, MRU GmbH, Germany
Mass concentration of nitrogen oxides (nitrogen monoxide and nitrogen dioxide) expressed as nitrogen dioxide (NO_2)	ISO 10396 : 1993 Stationary source emissions – Sampling for the automated determination of gas concentrations	Gas analyzing system MGA 5, MRU GmbH, Germany
Mass concentration of sulfur oxides (sulfur monoxide and sulfur dioxide) expressed as sulfur dioxide (SO_2)	ISO 10396 : 1993 Stationary source emissions – Sampling for the automated determination of gas concentrations	Gas analyzing system MGA 5, MRU GmbH, Germany

5. PLANT AND DEVICES CONDITION DURING MEASUREMENT

During measurement burner worked with its maximum capacity.

6. DATA ON FUEL AND RAW MATERIALS IN TECHNOLOGICAL PROCESS

As a burning fuel, during examined burner's work, waste motor oil was used.
Projected fuel consumpton for burner which was built in boiler during measurement is 3.6 – 5.5 kg/h.

7. MEASURMENT RESULTS

User:	„CITERM HEATING SYSTEMS“ ltd. Belgrade, 17 Miroslava Jovanovica street
Object of examination:	Waste oil burner, manufacturer „CITERM“, type G1P
Field of examination:	Physical-chemistry examination of combustion products which occur as a result of a burner’s work
Type of examination:	Concentration measurement of harmful and dangerous pollutants which are emitted into air as a result of a burner’s work
Location of examination:	Production plant „CITERM HEATING SYSTEMS“ ltd. Belgrade, 17 Miroslava Jovanovica street
Date of examination:	05.11.2009.
Methods of examination:	▪ *ISO 10396 : 1993* Stationary source emissions - Sampling for the automated determination of gas concentrations ▪ ISO 10780 : 1994 Stationary source emissions– Measurement of velocity and volume flowrate of gas streams in ducts

	No.	Name	Manufacturer	Type	Ser.no.	ID no.
Measuring equipment:	1.	Gas analyzing system MGA 5	MRU GmbH, Germany	MGA 5	294825	02

Технички подаци:

Technical data for boiler:

- Manufacturer: “GENERATORE D’ARIA LALDA”
- Type: “B23”
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- Manufacturer: „CITERM HEATING SYSTEMS“
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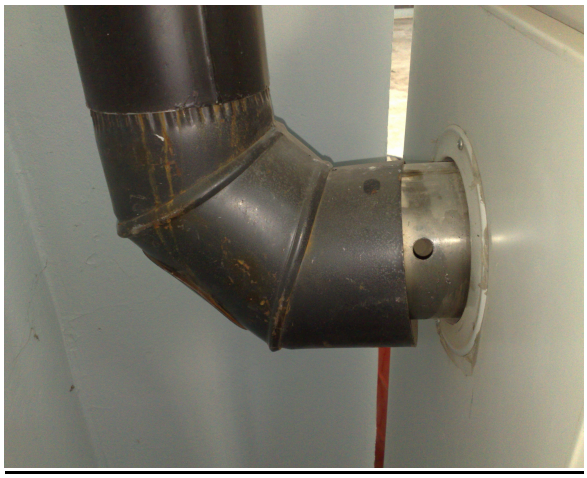
- Country of origin: Serbia
- Heating power: 37-57 kW
- Fuel consumpton: 3.6 -5.5 kg/h

Technical data for ventilation duct:

- Ventilation duct, round cross-section: Ø = 12 cm.

Мерна места:	 **Мерно место на димном каналу котла, типа “B23”, произвођача “GENERATORE D’ARIA LALDA”**

RESULTS OF CONCENTRATION MEASUREMENTS OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING WORK OF BURNER „CITERM G1P“, BY WASTE MOTOR OIL COMBUSTION

(Tables from p.15 to p.18)

TABLE 1. RESULTS OF FIRST SERIES OF CONCENTRATION MEASUREMENT OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING WORK OF BURNER „CITERM G1P“, BY WASTE MOTOR OIL COMBUSTION

No.	Measured and calculated parameters		Results of first series of measurement 05.11.2009. Emission measuring period $13:30^{h}$ - $14:00^{h}$
1.	Outside temperature [°C]		24.9 ± 0.29*
2.	Exhaust gas temperature [°C]		320.3 ± 3.68*
3.	Duct diameter [m]		0.12
4.	Duct cross section area [m^2]		0.011
5.	Mass concentration range of carbon monoxide CO [mg/m^3]	**	45 ± 2.60*
6.	Mass concentration range of sulphure oxides expressed as SO_2 [mg/m^3]	**	476 ± 27.47*
7.	Mass concentration range of nitrogen oxides expressed as NO_2 [mg/m^3]	**	395 ± 22.79*
8.	Smoke gases losses [%]	**	15.6

Legend:
* - measuring insecurity value represents expanded measuring insecurity calculated using cover factor k=2 which corresponds to level of trust of approximately 95 %
**- measuring result expressed concentration in dry exhaust gas, at temperature of 0 °C and under pressure of 1013 mbar, with oxygen content of 3%
Note 1: Measuring results are related only on examined samples.

TABLE 2. RESULTS OF SECOND SERIES OF CONCENTRATION MEASUREMENT OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING WORK OF BURNER „CITERM G1P“, BY WASTE MOTOR OIL COMBUSTION

No.	Measured and calculated parameters		Results of second series of measurement 05.11.2009. Emission measuring period $13:30^{h}$ - $14:00^{h}$
1.	Outside temperature [°C]		25.0 ± 0.29*
2.	Exhaust gas temperature [°C]		323.8 ± 3.72*
3.	Duct diameter [m]		0.12
4.	Duct cross section area [m^2]		0.011
5.	Mass concentration range of carbon monoxide CO [mg/m^3]	**	49 ± 2.83*
6.	Mass concentration range of sulphure oxides expressed as SO_2 [mg/m^3]	**	572 ± 33.00*
7.	Mass concentration range of nitrogen oxides expressed as NO_2 [mg/m^3]	**	396 ± 22.85*
8.	Smoke gases losses [%]	**	15.4

Legend:
* - measuring insecurity value represents expanded measuring insecurity calculated using cover factor k=2 which corresponds to level of trust of approximately 95 %
**- measuring result expressed concentration in dry exhaust gas, at temperature of 0 °C and under pressure of 1013 mbar, with oxygen content of 3%
Note 1: Measuring results are related only on examined samples.

TABLE 3. RESULTS OF THIRD SERIES OF CONCENTRATION MEASUREMENT OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING WORK OF BURNER „CITERM G1P“, BY WASTE MOTOR OIL COMBUSTION

No.	Measured and calculated parameters		Results of third series of measurement 05.11.2009. Emission measuring period $13:30^{h}$ - $14:00^{h}$
1.	Outside temperature [°C]		25.1 ± 0.29*
2.	Exhaust gas temperature [°C]		328.7 ± 3.78*
3.	Duct diameter [m]		0.12
4.	Duct cross section area [m^2]		0.011
5.	Mass concentration range of carbon monoxide CO [mg/m^3]	**	51 ± 2.94*
6.	Mass concentration range of sulphure oxides expressed as SO_2 [mg/m^3]	**	637 ± 36.75*
7.	Mass concentration range of nitrogen oxides expressed as NO_2 [mg/m^3]	**	402 ± 23.20*
8.	Smoke gases losses [%]	**	15.9

Legend:
* - measuring insecurity value represents expanded measuring insecurity calculated using cover factor k=2 which corresponds to level of trust of approximately 95 %
**- measuring result expressed concentration in dry exhaust gas, at temperature of 0 °C and under pressure of 1013 mbar, with oxygen content of 3%
Note 1: Measuring results are related only on examined samples.

TABLE 4. RESULTS OF FOURTH SERIES OF CONCENTRATION MEASUREMENT OF HARMFUL AND DANGEROUS POLLUTANTS PRODUCED DURING WORK OF BURNER „CITERM G1P“, BY WASTE MOTOR OIL COMBUSTION

No.	Measured and calculated parameters		Results of fourth series of measurement 05.11.2009. Emission measuring period 13:30^{h} - 14:00^{h}
1.	Outside temperature [°C]		25.3 ± 0.29*
2.	Exhaust gas temperature [°C]		328.5 ± 3.78*
3.	Duct diameter [m]		0.12
4.	Duct cross section area [m^2]		0.011
5.	Mass concentration range of carbon monoxide CO [mg/m^3]	**	55 ± 3.17*
6.	Mass concentration range of sulphure oxides expressed as SO_2 [mg/m^3]	**	678 ± 39.12*
7.	Mass concentration range of nitrogen oxides expressed as NO_2 [mg/m^3]	**	405 ± 23.37*
8.	Smoke gases losses [%]	**	16.0

Legend:
* - measuring insecurity value represents expanded measuring insecurity calculated using cover factor k=2 which corresponds to level of trust of approximately 95 %
**- measuring result expressed concentration in dry exhaust gas, at temperature of 0 °C and under pressure of 1013 mbar, with oxygen content of 3%
Note 1: Measuring results are related only on examined samples.

Examination performed by:

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Novaković Jovica

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In making of Report contributed:

1. Miroslav Mijatovic, graduate physical chemist

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Issue date of Report on examination: 13.11.2009.

P.S.

Controled and approved by:

Director of Laboratory for ecological examinations

Novaković Jovica

Jovica Novakovic, graduate physical chemist

8. ANALYSIS OF RESULTS OF MEASUREMENT

Based on measured concentrations of harmful and dangerous pollutants produced during work of burner „CITERM“, type G1P, by waste motor oil combustion it can be concluded as follows:

- Measured values of smoke gases losses show efficient combustion, during work with examined burner and with mentioned working conditions;

- Measured values of inorganic gases concentration: carbon monoxide CO, sulphure oxides expressed as SO_2 and nitrogen oxides expressed as NO_2 point out small influence of mentioned inorganic gases on environment, during work with examined burner and with mentioned working conditions.

Director of Laboratory for ecological examinations

Jovica Novakovic, graduate physical chemist