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QUALITY ASSURANCE OF EMISSION MEASUREMENT

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SUMMARY
This paper presents review of available equipments, methods and standards used to ensure emission measurement quality at emission sources.
Industrial emission monitoring at source is monitoring of releases from the plant to the environment. Methods of gas concentration measurement include automatic measuring of CO, O_2, NO, NO_2, NO_x, H_2S, SO_2, CO_2, C_xH_y, HCl, HF and VOC. Methods of dust and heavy metals concentration measurement include automatic isokinetic sampling by appropriate equipments.
Quality assurance of emission measurement can be carried out by competent operators, equipment and methods in accordance with standard method of measurement, certified instruments, certification of personnel and accredited laboratories.

Keywords: emission measurement, equipment, method, standard

1. INTRODUCTION

Quality assurance of pollution prevention and control in Serbia means: best available techniques applications, competent authority and personnel on all competence levels, limit emission values directives for air and water, competent laboratories for emission control and monitoring to the air, water and soil and adequate pollutants cadastre existence.
Sampling and monitoring of emissions to the environment should be carried out according to national or international standard methods. Important parameters that can be used for the control of process or abatement should be monitored. Continuous monitoring of key parameters should be carried out if practical.
Environment protection is more and more important in the society. Beside general legislation, environment protection is controlled by [2]:

- regulations in the field of: - spatial planning,
  - environment protection;
- technical regulations and quality:
  - measuring instruments and units of measurement,
  - technical regulations and norms,
  - Standards.

2. EMISSION MEASUREMENT

Emission monitoring is monitoring of industrial emissions at source, i.e. monitoring of releases from the plant to the environment. There are several requirements to accede the quality assurance of emission measurement:

- standard methods of measurements
- certified instruments
- certification of personnel
- accredited laboratories

Emission measuring is conducted by authorized expert institution, following the Regulation on the Limit Values of the Emission, Methods and Deadlines for Measurement and Keeping Records ("Official Bulletin" of the Republic of Serbia, No. 30/97 and 35/97).
The organization conducting emission measurement submits its report on individual measuring to the environmental inspection - within 30 days from conducting the measurement. In case of exceeding emission limit values, the organization conducting measurement is obliged to report on that to the responsible inspection organ, and to the polluter immediately.
In Mine and Metallurgy Institute (MMI) Bor there is the Laboratory for analyses gas flow parameters in industrial terms (LAG) which performs emission measurement at source, according to an appropriate, defined and agreed sampling program and according to recognized measurement protocols (norms or demonstrated analytical methods or calculation/estimation methods).
Main air polluting substances which are determined on source emissions are shown in table 1.

Table 1. Main air polluting substances

Pollutant	Formula
Sulfur dioxide and other sulfur compounds	SO_X
Carbon monoxide	CO
Oxides of nitrogen and other nitrogen compounds	NO_X
Volatile organic compounds	VOC
Chlorine and its compounds	HCl
Fluorine and its compounds	HF
Hydrogen sulfide	H_2S
Hydrocarbon compounds expressed as	CH_4
Metals and their compounds (heavy metals)	-
Dust (particulates)	-

2.1. Measuring Instruments and Units of Measurement

One of approaches to monitor parameters is direct discontinuous monitoring technique. This technique considers:

- instruments used for periodic campaigns,
- laboratory analyses of spot samples.

The instruments are portable and are carried to and set up at the measurement location. A spot sample is an instantaneous sample taken from the sampling point. The quantity of sample taken must be enough to provide a detectable amount of emission parameter.

The sample is then analyzed in the laboratory providing a spot result, which is representative only of the time at which the sample was taken [1].
Measuring instruments used for pollutants emission measuring by appropriate accredited laboratory are shown in table 2.

Table 2. Measuring instruments used for pollutants emission monitoring and measurement ranges

Instrument / unit	Measured component / parameter	Range	Description
MRU VARIO Plus Industrial, portable gas analyzer	O_2	0-21 %	Electronic gas analyzer for semi-continuous and automatic measurement of gas component concentrations in flue gases
	CO	0-100.000 ppm	
	NO	0-5000 ppm	
	NO_2	0-1000 ppm	
	SO_2	0-5000 ppm	
	H_2S	0-1000 ppm	
	CO_2	0-20 %	
	HC (as CH_4)	0-2,5 %	
	Air temperature	0-100 ^oC	
	Gas temperature	0-1100 ^oC	
	Diff.pressure	± 100 hPa	
VOC Pro Portable Photo-ionization Monitor	VOC	0,5-2000 ppm	Measures the concentrations of airborne gases and vapors that can be ionized by a photoionization detector
Isostack Basic HV - TCR TECORA with components	Dust (particulates)	0,005 - 10 g/m^3	Isokinetic automatic sampler
	Chlorine and its compounds (HCl)	1 -10 mg/m^3, (50 l - 200 l) (30 min - 1 h)	
	Metals and their compounds (heavy metals)	-	

2.2. Technical Standards and Norms for Stationary Source Emissions

Measurement of air polluting substances at source emissions with used instruments which shown in table 2 considers following:

- direct discontinuous monitoring technique and
- technical standards and norms which shown in table 3.

2.3. Emission Limit Value (ELV)

Emission limit Value (ELV) is the mass, expressed in terms of certain specific parameters, concentration and/or level of an emission, which may not be exceeded during one or more periods of time [3].

Test results obtained by measurements and calculations made in accordance with used standards shall include following items:

a) Date, time and place of the measurements;
b) Conditions of the object to be measured: type of the source of generation, conditions in the source of generation during the measurements, sampling location, shape and size of the duct, number and position of sampling points;
c) Condition of the gas in the duct: pressure, temperature, water content, composition, density, velocity, flow rate;

Table 3. Technical Standards and Norms for Stationary Source Emissions

Air, emission Determination domain: physical-chemical determination, sampling			
Determ. matter	Determination Species	Used technique	Determination method (standard, norm)
Waste gas	O_2	Electrochemical	ISO 10396:1993 - Sampling for the automated determination of gas emission concentrations for permanently-installed monitoring systems
	H_2S		
	NO_2		
	SO_2		
	CO		
	CO	NDIR	
	CO_2		
	HC as CH_4		
	VOC	Photo-ionization	
	^oC air	PT2000	ISO 10780:1994 - Measurement of velocity and volume flow rate of gas streams in ducts
	^oC gas	PtRhPt thermocouple	
	Diff. (Gauge) pressure	Piezoresistiv	
	Gas velocity	Calculation	
	Flow gas		
	Dust	Isokinetic sampling	ISO 9096:2003 Manual determination of mass concentration of particulate matter
Waste gas	HCl		EN1911-1 - Manual method of determination of HCI. Sampling of gases EN1911-2 - Manual method of determination of HCI. Gaseous compounds absorption EN1911-3 - Manual method of determination of HCI. Absorption solutions analysis and calculation
	HF		ISO 15713 - Sampling and determination of gaseous fluoride content
	Heavy metals		EPA 29 - Determination of metals emissions from stationary sources

d) Condition of sampling: method of measuring particulate concentration, size, type and material of separator, suction nozzle diameter, suction flow rate for isokinetic sampling at each point, result of check on isokinetic sampling at each point, time required for sampling, sample gas volume, static-pressure at gas metering device, volume of gas drawn, particulate mass collected;
e) Particulate/other pollutant concentration;
f) Particulate/other pollutant mass flow rate.

There are different types of units applied to emissions:

- concentrations units (mass per unit of volume: mg/m^3 or volume per unit of volume: vol.%),
- units of load over time (short time base: kg/h, kg/day or long time base: t/year),
- specific units and emission factors (based on the unit of product: kg/t of product or based on the unit of input: g/GJ (thermal input) or efficiency of abatement equipment: mass balance (% = g/g = in/out),
- thermal effect units (temperature: ºC, K, or heat per unit of time: W),
- other emission value units (velocity: m/s, flow: m^3/s),
- normalized units - normalized data are standardized to a particular temperature and pressure m^3 = actual cubic meter at actual process conditions (T, p), Nm^3 = normal cubic meter at 0 ºC, 1013 mbar [1].

3. CONCLUSION

According to the Environment Protection Act, air quality is monitored by measuring emission and imission. Emission measuring is conducted by air polluters (companies and other subject that are the air polluters). The air quality control is performed by:

- Systematic measuring of the emission;
- Monitoring and investigating the influence of the air quality on the environment (climate, human health and forest ecosystem);
- Reporting on measuring, monitoring and research results [4]

Quality assurance of emission measurement can be carried out by competent operators, equipment and methods in accordance with standard method of measurement, certified instruments, certification of personnel and accredited laboratories.

4. REFERENCES

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