18th INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE SGEM2018

CONFERENCE PROCEEDINGS
VOLUME 18

ECOLOGY, ECONOMICS, EDUCATION AND LEGISLATION
ISSUE 5.1

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ECOLOGY AND ENVIRONMENTAL PROTECTION

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2 July - 8 July, 2018
Albena, Bulgaria

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Published by STEF92 Technology Ltd., 51 "Alexander Malinov" Blvd., 1712 Sofia, Bulgaria
Total print: 5000

ISBN 978-619-7408-46-1

ISSN 1314-2704

DOI: 10.5593/sgem2018/5.1

INTERNATIONAL MULTIDISCIPLINARY SCIENTIFIC GEOCONFERENCE SGEM
Secretariat Bureau

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BEST AVAILABLE TECHNIQUES, EMISSION LIMIT VALUES AND ENVIRONMENTAL SELF-MONITORING REQUIREMENTS: CHALLENGES TO RUSSIAN INDUSTRIES

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ABSTRACT

In Russia, new Integrated Pollution Prevention and Control (IPPC) legislation obliging larger industries to demonstrate compliance with Best Available Techniques (BATs) and to obtain Integrated Environmental Permits (IEPs), introduces also stricter requirements to environmental self-monitoring practices. Environmental self-monitoring is implemented by regulatees subject to environmental permitting, in order to ensure their compliance with regulatory requirements. The key issue for IPPC installations is compliance with Emission Limit Values (ELVs) set in IEPs. At the same time, self-monitoring includes a wide spectrum of activities: monitoring of operations; emissions and other impact factors, in several cases – ambient conditions in the vicinity of the facility concerned, etc.

Self-monitoring reports must be submitted to the competent authorities with a specified regularity, and in a duly aggregate form. Its primary goal is to ensure the earliest possible response to any environmental incompliance and, on the other hand, reduce public spending on governmental monitoring and control. A comprehensive self-monitoring programme should describe monitored parameters, sampling/direct measurement points; safe means of access to sampling points; timing considerations of monitoring and measurements; monitoring methods, quality assurance and quality control arrangements; methods of record keeping, data analysis, etc.

Russian stakeholders actively discuss lists of parameters to be monitored (continuously and dis-continuously), time and funds needed to meet new requirements, and possible derogations. Respective requirements are drafted and have to be passed in 2018. Operators must develop draft self-monitoring programmes and include proposals in their applications for IEPs. Up to now, continuous measurements have not been widely spread in Russia, and only Moscow can be called an experienced region, where all significant polluters operate continuous self-monitoring equipment and report data obtained to Moscow Government. The article discusses challenges to Russian IPPC industries and suggests several win-win solutions that could be used to improve environmental self-monitoring practices of regulatees and decision-making approaches of environmental enforcement agencies.

Keywords: Best Available Techniques, Integrated Environmental Permits, environmental self-monitoring, continuous self-monitoring, marker parameters, Emission Limit Values.

https://doi.org/10.5593/sgem2018/5.1

INTRODUCTION

New environmental legislation being gradually developed, passed and further improved in Russia since 2014, sets requirements for Category I installations (similar to the European Integrated Pollution Prevention and Control installations) to implement Best Available Techniques (BAT) and to obtain Integrated Environmental Permits [1].

In 2015-2017, sector-oriented and cross-sector Reference Books on Best Available Techniques (BREFs) were drawn up by the Russian BAT Bureau and approved by the Federal Agency on Technical Regulating and Metrology [2]. The Reference Book on the Environmental Self-monitoring (Industrial Environmental Control) [3] prepared as the result of the information exchange and reflecting best practices implemented both nationally and internationally [4], was issued in 2016.

In Russia, the environmental self-monitoring has been the responsibility of the regulatees since the 1980s. It primarily relates to measurements of process conditions, process releases and environmental pollution levels, and reporting of the results by the operator to the competent authorities in accordance with requirements specified in laws, regulations, permits or injunctions. However, self-monitoring of an operator's performance with regard to environmental targets, process/plant improvements and overall compliance has also been considered to some extent.

While dis-continuous environmental self-monitoring practices are well-established at most Category I installations, the continuous monitoring forms a great challenge for nearly all industries regulated by the new BAT Law [5]. More than 6,000 installations of a wide spectrum of industrial sectors have about four years to achieve compliance with the new requirements [6]. Tasks to be solved by the 'simpler' productions (such as glass, cement, or ceramic industries, emitting normally 3-4 major pollutants through one stack) differ a lot from those to be cracked by the multi-product chemical industries.

ENVIRONMENTAL SELF-MONITORING FUNCTIONS

In Russia, the environmental self-monitoring is often addressed within 'the production environmental control' linking thereby two types of activities and two functions, namely the self-monitoring one and the control one. Internationally, the environmental self-monitoring is the system of organisational and technical measures put in place and financed by regulatees subject to environmental permitting or general binding rules, in order to ensure their compliance with regulatory requirements [7], including:

- monitoring of: operations; emissions and other impacts regulated by permits; ambient conditions in the vicinity of the industry with a scope that would optimally balance environmental effectiveness with costs of monitoring;
- record keeping of data obtained through monitoring of unforeseen circumstances, non-compliance episodes, corrective measures, and public complaints;
- providing reports to the competent authorities.

It is necessary to mention, that the Self-Monitoring Guide produced by the Organisation for Economic Co-operation and Development [7], states also that the environmental self-monitoring comprises other internal measures, such as providing basic environmental training and conducting self-inspection. The operator should regularly compare self-monitoring data with the compliance objectives and environmental objectives and targets set by the industry to check whether they are being met. The self-diagnostic element will be complemented by self-correction actions. This brings us back to the Russian understanding of the industrial environmental control.

According to the Federal Law 'On Environmental Protection' [8, Article 1], "The environment control is a system of measures aimed at prevention, identification and restraint of violations of environmental legislation, enforcement of requirements, standards and regulatory documents on environmental protection". The same Law [8, Article 67], states that, "The production environmental control is carried out in order to provide measures of environmental protection, efficient use and restoration of natural resources needed for economic activities, as well as to comply with the requirements established by the legislation on environmental protection".

Thus, in Russia, the production environmental control is seen as a system of control measures implemented on site [5]. As it can be seen, there is no contradiction between the two interpretations, and major functions of the environmental self-monitoring are understood identically in Europe (where the IPPC legislation was first passed in 1996) and in Russia.

MONITORING COMPLIANCE WITH THE REQUIREMENTS OF THE ENVIRONMENTAL LIMIT VALUES

As it is mentioned above, the complexity of tasks to be solved by the operators differs a lot depending on the sector and on the peculiarities of the installation itself. In this section, we'll consider environmental self-monitoring challenges being faced by (1) the manufacturers of glass and ceramics and (2) the producers of organic chemicals.

In general, requirements on the operator are included in permits and depend on the scope of the self-monitoring, and cover:

- instrumental measurements;
- process/plant conditions that are relevant to the time when measurements are taken or that may affect releases, such as down-time of plant or percentage of full utilisation of plant;
- data processing and reporting;
- standards and quality assurance.

Environmental self-monitoring techniques will vary depending on the applications and may include the use of:

- fixed, in-situ, on-line continuous reading instruments;
- portable dis-continuous reading instruments;
- laboratory analysis of samples taken by fixed, in-situ, on-line time or flow proportional samplers;
- laboratory analysis of spot samples;
- calculations based on surrogate measurements of flow-rates, raw material contaminants, temperature, pressure, etc.;
- check lists of operation and maintenance of monitoring and other relevant equipment.

Whatever measurement technique is employed, it must conform to a relevant standard method published by the international (ISO, CEN) or national standardisation authorities (GOST in Russia), and should be carried out within a qualified measurement infrastructure [4, 5].

Manufacture of Flat Glass and Ceramics for the Construction Sector

Glass and ceramics manufacturing industries are covered both by the European Union (EU) Industrial Emissions Directive [9] and the Russian Federation BAT-related legislation [1, 6]. While BREF in the Ceramic Manufacturing Industry [10] issued back in 2007, sets environmental self-monitoring requirements *inter alia*, the newer BREF for the manufacture of glass has a special chapter – BAT Conclusions (BATC) – published officially as the Commission Implementing Decision establishing BATs and setting clear requirements to the environmental self-monitoring [11]. Russian BREFs for the production of ceramics [12] and glass [13] do not address the self-monitoring but include lists of marker substances, emissions of which have to be monitored. Marker substances are defined as individual or integral parameters (or substances), characteristic of applied technological processes, which reflect peculiarities of these processes and are significant for assessing production environmental performance and resource efficiency [5].

In the EU, for melting furnace in the flat glass sector, BAT-Associated Emission Levels (BAT-AELs) are set for dust, nitrogen oxides (NO_x), sulphur oxides (first of all – SO_2) as well as hydrogen chloride and fluoride [11]. In Russia, for melting furnace in the flat glass sector, BAT-AELs are set for dust, NO_x, and carbon monoxide (CO). It is argued, that hydrogen chloride and fluoride emissions are not characteristic for Russian glass manufacturers, while BAT-AELs for sulphur oxides are not set to the absence of reliable data [13]. Here we return (1) to the information exchange via which the Russian BAT Bureau could not get the necessary information on the emissions of SO_2 and (2) to the self-monitoring practices of the Russian glass manufacturers who rely on regional laboratories providing regular measurements but submitting data that could not be processed to obtain the sector BAT-AELs or to set the environmental self-monitoring requirements. These facts are addressed both in the sectoral BREF [13] and in the Russian environmental self-monitoring reference report [3]. The EU BATC [11] sets the following requirements to the flat glass manufacturers:

1) continuous monitoring of critical process parameters to ensure process stability, e.g. temperature, fuel feed and airflow;
2) regular monitoring of process parameters to prevent/reduce pollution, e.g. O_2 content of the combustion gases to control the fuel/air ratio;
3) continuous measurements of dust, NO_x SO_2 emissions or discontinuous measurements at least twice per year, associated with the control of surrogate parameters to ensure that the treatment system is working properly;
4) continuous or regular periodic measurements of NH_3 emissions, when selective catalytic reduction or selective non-catalytic reduction techniques are applied;
5) continuous or regular periodic measurements of CO emissions when primary techniques or chemical reduction by fuel techniques are applied for NO_x emissions reductions or partial combustion may occur;
6) regular periodic measurements of emissions of HCl, HF, CO and metals, in particular when raw materials containing such substances are used or partial combustion may occur;
7) continuous monitoring of surrogate parameters (reagent feed, temperature, water feed, voltage, dust removal, fan speed, etc.) to ensure that the waste gas treatment system is working properly and that the emission levels are maintained between discontinuous measurements.

The Russian environmental legislation states only that the flat glass producers must install and start implementing the continuous monitoring equipment and to report data obtained to the environmental authorities [1, 3]. The leading industries rush to develop national guidance for the glass manufacturing sector covering both the IEP application procedure and the self-monitoring requirements. Most flat glass manufacturing installations have been operating since 2008-2012 and constructed in accordance with the EU IPPC requirements. Many operators report that they have the necessary self-monitoring equipment and use it extensively for monitoring technological processes. The ceramic manufacturing sector is reluctant to learn from the glass one; the leading producers claim that improving self-monitoring practices and installing continuous monitoring systems would be too expensive and should be unnecessary since only dust, nitrogen oxides, sulphur oxides and carbon monoxide are emitted and respective BAT-AELs are set by the national BREF [12]. The major sector challenge is seen as withdrawing from Category I [6] and remaining to be single-medium regulated sector.

For glass manufacturers, the major realistic sector challenges include (1) improving discontinuous monitoring practices and (possibly) establishing sector-oriented accredited laboratories to serve the glass manufacturers, and (2) harmonising continuous self-monitoring systems operated by most industries with the national requirements and obtaining the necessary approval of the environmental authorities.

Production of Large Volume Organic Chemicals

Industrial organic chemistry is characterised by the production of a huge variety of compounds in a step-wise manner from a few natural sources of carbon (crude oil, natural gas and coal). Generally, the term 'production of large volume organic chemicals' stands for the wide spectrum of industries manufacturing simple hydrocarbons, oxygen-containing hydrocarbons, sulphurous hydrocarbons, nitrogenous hydrocarbons, phosphorus-containing hydrocarbons, halogenic hydrocarbons, organometallic compounds, surface-active agents and surfactants [14]. The Russian BREF 'Production of Large Volume Organic Chemicals' [15] describes production of major simple hydrocarbons, oxygen-containing hydrocarbons, nitrogenous hydrocarbons and chlorine-containing hydrocarbons.

Considering challenges of the continuous self-monitoring in the production of ethylene oxide (EO) and ethylene glycols (EG), one should remember that the largest Russian producers manufacture 45-300 thousand tonnes of each product annually are located in many regions of the country.

The EU BATC for EO and EG production [14] sets requirements to monitor channeled emissions to air other than from process furnaces/heaters for ethylene oxide, SO_2, CO (from thermal oxidizer), dust, HCl – once every month, Total Volatile Organic Compounds (TVOCs) – once every 6 months. BAT-AEL for emissions of organic compounds to air from the desorption of CO_2 from the scrubbing medium used in the EO plant – TVOC content varying from 1 to10 g/t of EO produced.

Up to now, in Russia, it is not decided which chemicals are to be monitored in the production of large volume organic chemicals. Two options are considered:

1) dust, NOx (as NO_2), CO, SO_2, fluorides, NH_3, H_2S, acetone, xylene, toluene, HCl, Fe_2O_3, hydrocarbons (alkanes and cycloalkanes); channeled emission sources contributing no less than 25 % towards the overall installation emissions of the particular substance have to be monitored;

https://doi.org/10.5593/sgem2018/5.1

2) dust, NO_2, NO, CO, SO_2, fluorides, NH_3, H_2S, HCl, phenol, formaldehyde, benzo[a]pyrene (BAP), ethlybenzene, carbon bisulphide, methanethiol; channeled emission sources contributing no less than 15 % towards the overall installation emissions of the particular substance have to be monitored (provided that the sum total of the emission exceeds 10 tonnes per year).

It is not specified which substances are most characteristic for the technologies applied in the production of large volume organic chemicals sector, which means that there is no answer to the question, if NH_3 and acetone have also to be monitored in the production of ethylene oxide and ethylene glycols. This is why it is rather difficult to substantiate the selection of the emission sources and the contaminants to be monitored.

Here we'll discuss approaches to the selection of the emission sources and substances to be monitored continuously in the production of ethylene oxide and (ethylene glycols (see Tables 1 and 2). Data presented have been obtained as the result of the environmental assessment of a larger chemical installation.

Table 1 – Emissions of pollutants (reported data), calculated from bulk installation emissions value, tonnes per year

Substance	15% of the installation emission	25% of the installation emission	Substance	15% of the installation emission	25% of the installation emission
NO_x (as NO_2)	57.28	95.47	Propylene	4.99	8.31
CO	53.40	89.00	Acrylic acid	1.13	1.88
VOCs	33.95	56.58	Ethylene oxide	1.11	1.84
Ethylene	23.78	39.63	Acrylaldehyde	0.02	0.04
CH_4	11.19	18.66	SO_2	0.02	0.03
Hydrocarbons	11.20	18.66			

Table 2 – Main emission sources

Source No.	Substance	Emission parameters		Source emission, t/year
		mg/m^3	t/year	
1	NO_2	85.4	33.03	164.89
	NO	13.9	5.37	
	CO	326.9	**126.49**	
2	CH_4	176531.3	**55.87**	157.88
	Hydrocarbons C_1-C_5	7730.8	2.45	
	Ethylene	314523.2	99.55	
	Ethylene oxide	45.9	0.01	
3	NO_2	62.2	0.10	2.75
	NO	10.1	0.02	
	CO	1554.3	2.56	
	Ethylene	38.9	0.06	

Analysing the data presented above, we can prioritise both emission sources and pollutants being emitted to the air. Considering this prioritisation, we can recommend installing continuous monitoring system on channelled emission sources No. 1 (heater) and 2, whereas source No. 3 (flare device) shows no significant emissions. It should be noted that all substances in Table 3 according to Russian environmental legislation are subject to continuous (automated) control, which is considered excessive and unnecessary in the EU legal acts [14].

The major challenge faced by the sector is to meet stringent national continuous environmental self-monitoring requirements and to develop sub-sector guidance supporting practitioners substantiating the selection of the emission sources and substances to be monitored continuously. It might be possible to gradually alter the over-generalised requirements by submitting rationales containing data similar to the presented in Tables 1 and 2, reflecting environmental performance of not one but all major installations producing large volume organic compounds to the federal environmental authorities establishing the national requirements.

CONCLUSION

The monitoring of industrial processes, their releases and their impact on the environment are key elements of regulatory control. In Russia, the comprehensive reform of self-monitoring aims first of all, at enhancing the quality and use of self-monitoring data for decision-making.

With regards to the Integrated Environmental Permitting, the most important function of the environmental self-monitoring is the collection, analysis, interpretation and reporting of data confirming the compliance with Emission Limit Values set in the permit. New Russian BAT Law requires Category I industries to install continuous self-monitoring devices and to provide for the online reporting to the regional offices of the environmental authorities. Various sectors consider the Integrated Pollution Prevention and Control and self-monitoring challenges in different ways.

Russian glass manufacturers see the major sector challenges in (1) improving dis-continuous monitoring practices and establishing sector-oriented accredited laboratories to serve the glass manufacturers, and (2) harmonising continuous self-monitoring systems operated by most industries with the national requirements and obtaining the necessary approval of the environmental authorities. The ceramic manufacturing sector is much worse equipped, which is considered to be the reason for trying to avoid both (1) improving dis-continuous monitoring practices and (2) installing the necessary continuous self-monitoring equipment. Taking into account that both sectors manufacture products for the construction sector, it would be strange assuming that ceramic industries face severer economic difficulties than the flat glass ones.

As far as the production of large volume organic chemicals is concerned, Russian operators are ready to develop projects and to install the necessary continuous self-monitoring equipment. They believe that both the Russian and the European experience and requirements should be considered. The major challenge is that requirements being established in Russia is much stricter than the EU ones, and so far, there is literary no experience in the Russian large volume organic chemicals to be learnt and wider disseminated.

REFERENCES

[1] The Federal Law of 21 July 2014 No 219-FZ ‘On introducing changes in the Federal Law ‘On Environmental Protection’ and other legislative acts of the Russian Federation’ (in Russian).

[2] Guseva T., Molchanova Ya., Averochkin E., Begak M. Integrated Pollution Prevention and Control: Current Practices and Prospects for the Development in Russia. Proc. 14th International Multidisciplinary Scientific GeoConference, SGEM 14, Bulgaria. 2014, Book 2. Vol. 2, pp. 391-398. DOI:10.5593/SGEM2014/B52/S20.052.

[3] Information and Technical Reference Book on Best Available Techniques ITS 22.1. General Principles of the Industrial Environmental Control and its Metrological Confirmation. Moscow, 2016 (in Russian).

[4] JRC Reference Report on Monitoring of Emissions from IED-installations. URL: http://eippcb.jrc.ec.europa.eu/reference/BREF/ROM_FD_102013_online.pdf.

[5] Guseva T., Begak M., Molchanova Ya., Vartanyan M., Zhukov D. Improving Environmental Self-Monitoring Practices of Russian Industries. Proc. 16th International Multidisciplinary Scientific GeoConference SGEM 2016, Bulgaria. 2016, Book 5, Vol. 1, pp. 367-374. DOI: 10.5593/SGEM2016/B51/S20.049.

[6] Decree of the Russian Federation Government of 28 September 2015 No 1029 'On setting criteria to categories I, II, III and IV of installations causing negative environmental impacts' (in Russian).

[7] Technical Guide on Environmental Self-monitoring in Countries of Eastern Europe, Caucasus, and Central Asia. OECD, Paris, 2007. URL: https://www.oecd.org/env/outreach/39462930.pdf.

[8] The Federal Law of 10 January 2002 No 7-FZ 'On Environmental Protection' (in Russian).

[9] Directive 2010/75/EU of the European Parliament and of the Council of 24 November 2010 on Industrial Emissions (Integrated Pollution Prevention and Control).

[10] Reference Document on Best Available Techniques in the Ceramic Manufacturing Industry. European IPPC Bureau, 2007. URL: http://eippcb.jrc.ec.europa.eu/reference/cer.html.

[11] Commission Implementing Decision of 28 February 2012 establishing the Best Available Techniques (BAT) conclusions under Directive 2010/75/EU of the European Parliament and of the Council on Industrial Emissions for the Manufacture of Glass.

[12] Information and Technical Reference Book ITS 4 'Ceramic Manufacturing Industry. Moscow, 2015 (in Russian).

[13] Information and Technical Reference Book ITS 5 'Glass Manufacturing Industry', Moscow, 2015 (in Russian).

[14] Commission Implementing Decision of 21 November 2017 establishing Best Available Techniques (BAT) Conclusions, under Directive 2010/75/EU of the European Parliament and of the Council, for the Production of Large Volume Organic Chemicals.

[15] Information and Technical Reference Book ITS 18 'Production of Large Volume Organic Chemicals'. Moscow, 2016 (in Russian).