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Assessment of Ecological Processes in Industrial Activities in Perm Krai

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The article analyzes the initiatives to establish environmental monitoring in the Russian Federation. It offers the definition of environmental monitoring and the stages of its forming. The causes of complexity in collecting and analyzing ecological indicators are discussed. The project of Territorial Information and Analytical Center (TIAC), which, unfortunately, has not yet been established is considered. The important role of environmental performance as the primary means of environmental assessment, environmental reporting and improvement of environmental policy is defined. It is concluded that the economic environmental behavior is largely determined by the system of indicators to measure. To increase stability, it is necessary to use not only those negatively affecting the environment, which are prevalent in modern statistics (emissions, waste, energy, water), but also indicators characterizing environmental behavior of economic agents.

Key words: Sustainable development, Greening, Environmental monitoring, Sustainability, Ecological indicators.

The problem of "sustainable development" is one of the most pressing problems in today's Russia. The relationship between economic development and the deterioration of the environment is obvious, so there is a need for a reasonable combination of interests in maximizing profits, material well-being and environmental requirements.

Therefore, there is an urgent task of transition to sustainable development at the state level as well as at the region level. Based on the unity of ecological, social and economic systems, we highlight priority of the environmental aspect, as in connection with the critical environmental situation in the country as a whole there is a need to form an environmentally balanced economic development. Historically, the concept of "sustainable development» (sustainable development) is connected with environment[1].

Greening is one of the key socio-economic problems concerning interests of each subject of the present economic system (households, enterprises, state). In all developed countries environmental information has been the subject of special attention of the government at all levels.

As L.M. Bulgakov and R.N. Plotnikova define it greening of economy is understood as the process of introducing environmental factors into the analysis of economic development indicators[2, p.21].

Greening of industry is a complex of legal, management, technical, technological and other

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measures to promote a sustainable ecological social economic system. Sustainable development refers to the process of change in which exploitation of natural resources, direction of investments, orientation of technological development, personal development and institutional change are consistent with each other and strengthen the current and future potential to meet human needs and aspirations. Currently, the greening of industry is mainly carried out extensively (by cleaning emissions and discharges) rather than by preventing them. Therefore, the development of low-waste and resource-saving technologies is an important area of ecological and economic development. [3, p.64]

DISCUSSION

A.E. Yermolayeva determines greening of industry as a system of measures to reduce environmental risks, to improve safety and energy efficiency and sustainable development (satisfies the needs of the present, but does not compromise the ability of future generations to meet their own needs). [4, p.11]

From the point of view of V.N. Belyaeva and E.A. Ilinbaeva greening of production creates new windows and opportunities for economic development. First of all, it concerns the creation of a modern recycling industry, new opportunities in the development of agriculture (biofuels) and carbon-depot plantations ("Kyoto forests"). Thus, greening of economy is not only a special focus of the business and economic policy, but also a common characteristic of innovative economic development closely related to 11improving the efficiency of resource use. [5, p.151]

Back in 1993, the Government of the Russian Federation initiated the establishment of the Unified state environmental monitoring system and published Russian Federation Government Resolution #1229 of 24.11.1993. One part of this monitoring was a system of observations on workplace, along with observations of the processes in nature and human environment.

Environmental monitoring is a set of systems for monitoring environment interrelated in terms of information, but separate organizationally and methodologically. They include monitoring environment, particularly in the vicinity of anthropogenic impact sources, and influence of these sources on the environment. Interaction through the generation and exchange of information should generate a new quality different from a simple summation of activities elements [6, p.23].

In 1997 in the Declaration of Environment Protection Ministers (Aarhus, Denmark) upgrading coordination mechanisms of monitoring systems in the European region by means of reporting in the field of environmental protection, improving social access to reliable environmental information and forms of displaying this information were considered a priority direction. In chapter 17 of the Declaration improving reporting in the field of environmental protection has been proclaimed as a priority [6].

In order to harmonize approaches to monitoring and assessment of environmental protection, within the framework of the "Environment for Europe" in Russia in the early 2000s there was organized a special working group to monitor the environment in the Committee on Environmental Policy of UNO. The third section of the Declaration of the 5th Ministerial Conference "Environment for Europe", held in Kiev in May 2003, endorsed the recommendations to improve national monitoring and information systems on the environment as well as " Guidelines to prepare reports on the state of environment in these countries " in the CIS countries (including Russia). The guidelines identified four main groups of indicators:

1) Indicators to describe environmental impact;
2) Indicators to describe the state of the environment;
3) Indicators to describe the consequences for the environment;
4) Indicators to describe the measures taken [7, p.3].

O.A. Novoselova, deputy head of planning and coordination of environmental activities of the Ministry of environmental protection activities of Russia noted that the aim of the project is to support the reform of the management for environmental monitoring in the Russian Federation at the federal and regional levels by improving mechanisms for data collection and processing and orienting comprehensive

information about the environment for decision makers [6, p. 4].

Even then, it was noted that the complexity of monitoring and evaluation of the dynamics of environmental indicators is that in Russia there is no single body responsible for the development and collection of indicators. Monitoring of environmental pollution is realized by Roshydromet; Ministry of Natural Resources of Russia conducts monitoring of water bodies, forests, biota; geological monitoring controls the anthropogenic impact of economic entities on water, air, soil, forests. Russian Ministry of Health monitors the sanitary-epidemiological situation. Land monitoring is conducted by Roszemcadastre. Monitoring is also carried out and the polluting enterprises themselves [8, p.8].

In 2001-2003 in Russia a project of the TACIS program "Environmental Monitoring Systems in Russia" was realized which was aimed at improving the environmental monitoring system. This project was carried out by the German Society for Technical Cooperation in consortium with Alstom Consulting on environmental issues and energy conservation. The aim of the project was to develop proposals and guidelines on the harmonization of approaches to monitoring in Russia and in the EU and obtaining in Russia data comparable with the data of the EU countries. To implement the project two pilot regions - Kaluga and Perm regions - were selected. In Perm region the system of air monitoring was chosen as the object of study. The project was planned to replicate the experience in other regions with a view to interoperability of information resources and to obtain aggregate information on the environmental condition of the territory. It was noted that the environmental monitoring system is an essential element ("supporting framework") of the management system, reducing costs in a challenging economic environment, better responding to environmental and social problems. It was planned to create a Territorial Information and Analytical Center (TIAC) Perm region, but, unfortunately, it has not still been established.

In 2007 "Recommendations to Governments of Eastern Europe, Caucasus and Central Asia on application of environmental indicators and the preparation of reports on their basis about environmental protection" also noted the important role of ecological indicators as the main means of assessing environmental condition, environmental reporting and improvement of environmental policy. It was emphasized that properly selected indicators based on sufficient series of data can show key trends, help describe causes and effects of environmental conditions, allow not only observe and assess the implementation of environmental policy, but also help to improve it as well as policies important for the environment industrial sectors. These indicators set priorities and quantitative targets and help to assess their compliance with international obligations.

In paragraph 7, the context of the policy states that government Statistical Service should develop and introduce into practice classifications relevant to International Standard Industrial Classification (ISIC) of all types of economic activities of the United Nations. International standard classifications should be recognized and used by all agencies involved in data collection and processing as well as in publication of environmental and statistical reports. Point 12 point determines the need to create national electronic data banks (databases), containing information on environmental indicators and ensure free access to them with the help of modern information technologies, including the Internet.

The criteria for selecting indicators:

- Relevance to national priorities and building resilience;
- International comparability;
- Changeability -indicators should be assessed in terms of cost-effective methods (possibly internationally agreed) to provide necessary data (measurements and / or calculations);
- Ability to predict fulfillment of the objectives of environmental-economic policies and determine the effectiveness of the measures taken to protect the environment;
- Information, i.e. ability to raise the level of public awareness about the state of the environment;
- Reliability [9].

Organization of monitoring carried out by the enterprises themselves, is of great importance that goes beyond just technical solutions, and therefore its results should pay a significant

contribution to the overall management of the quality of the environment. Management decisions regarding sources of pollution give quick and tangible results.

Different evaluation and monitoring systems form different economic behavior of subjects. Inclusion into the integral index of indicators aimed at higher sustainability of a particular company and, consequently, of the economic system as a whole will promote positive (greening) economic behavior. Measurement of the indicators negatively affecting environment, predominating in statistics (emissions, waste, energy and water consumption) do not stimulate economic business entities to protect environment.

One important greening aspect is positioning the current state of enterprise environmental subsystem which should be carried out through a system of indicators characterizing the environmental sustainability of businesses.

The assessment basis of environmental sustainability divides environmental indicators into two sets: positive and negative. The former are presented as the processes that contribute to resilience, their dynamics can be characterized as the more the better. The latter, in contrast, must go down, they are regarded as uncomfortable conditions reducing the possibility of sustainable development.

The integral resulting process is formed of interaction of positive and negative processes. The resulting Positive and negative processes are represented by their statistical series. Accordingly, the integral index is calculated as a sum of the weighted positive and negative characteristics.

The indicators are constructed in such a way as to provide quantitative characteristics of environmental problems, they rely on the database of state statistics.

Indicators should be designed for through management, including national, regional and local levels.

In this study it is proposed to monitor the state of ecological subsystem of industrial enterprises on the following parameters:

- Emissions of air pollutants from stationary sources;
- Production and consumption waste;
- Electricity consumption;
- Recycling;
- Waste disposal;

Let us move on to the analysis of the indicators characterizing the ecological subsystem of Perm region industrial enterprises. The analysis was conducted on the basis of official statistics on mining and manufacturing industries.

Historically, according to the structure of economy, population and the way of life Perm region is a typical industrial region of the Urals.

Economy Perm region is predominantly industrial. The share of industry in

GRP reaches 44% (in the Russian Federation - 31%)[10].

Describing the major environmental problems of modern economic systems at different levels of the hierarchy it should be noted that most of these problems are due to anthropogenic influences, and, above all, large-scale emissions of pollutants that negatively affect the biosphere processes. In various parts of the world humanity is faced with such phenomena as acid rain and ozone depletion, climate and weather anomalies, and others.

In recent decades, special interest and attention are given to environmental problems caused by the continuous growth of specific pollutant emissions that cause changes in regional and global processes. Among these substances are greenhouse gases. Increase (or decrease) of their concentration in the atmosphere greatly influence temperature characteristics of the planet's climate. Finding ways to reduce impact of this anthropogenic component on climate began 20 years ago. The UN conference in Kyoto (Japan) was devoted to this issue in 1997 [11, P.31].

Russia, along with such countries as Canada, the Netherlands, Saudi Arabia, Singapore, Belgium and Kazakhstan was among the first ten countries with extremely high levels of emissions.

Currently, the chemical pollution of the natural environment is becoming threatening and can lead to irreversible processes in ecosystems not only at the regional level but also at the global one. As a result of anthropogenic activities tens of thousands of organic and inorganic substances emitted by various industries come into the atmosphere, hydrosphere and soil. A special danger is presented by substances produced in high-temperature technological processes in metallurgy and chemistry, from waste incineration, etc.

RESULTS

The dynamic analysis of pollutant emissions from stationary sources in Perm region indicates that the emissions decreased by 23.3%. However, emissions from mining and processing enterprises of Perm region increased from 2005 to 2012 by 14, 3 % (from 163481 ton to 182614 tons). The share of emissions attributable to mining and processing enterprises in the total volume of emissions from stationary sources increased from 36.8% to 53.5%. This changed the ratio of emissions of enterprises in mining and manufacturing industries. So, if in 2005 this ratio was 44.7% and 55.3% accordingly, in 2012 it amounted to 63% and 37%, which is due to the increase of emissions of mining companies by 57.3% and reducing emissions of the manufacturing industry by 20.6%. Dynamics of atmospheric pollutant emissions from mining and manufacturing enterprises is presented in table 1.

The next indicator to characterize environmental subsystem of industrial enterprises is electricity consumption.

From 1860 to 1985 energy consumed by mankind increased by 60 times, mostly by industrial countries. Europeans consume 10-30 times and North Americans 40 times more energy than the countries of the third world. [12, P. 156].

Energy consumption is an important indicator of sustainable development of industrial enterprises. As modern researchers say energy resource since the second half of the last century energy resource has been the determining one [13, C. 13].

Analysis of electricity consumption by enterprises of the Perm region from 2005 to 2012 shows its decrease by 4.5% from stationary sources (from 13530,9 mln w- h to 12920,5 mln w-h).

The share of mining and manufacturing industries in 2005 accounted for 85.6% of the total electricity consumption, in 2012 - of 82.8%.

In 2005 in the structure of mining and manufacturing industries 91.4 % were consumed by manufacturing. In 2012 the structure changed, and the share of manufacturing had only to 86, 6% of electricity consumption. This change occurred due to the fact that the power consumption at mineral extracting enterprises increased by 44.3% from 2005 to 2012 (table2).

The third indicator reducing the environmental sustainability of industrial enterprises is production and consumption waste.

In natural ecosystems waste is not accumulated but decomposed and recycled becoming a part of natural cycles. Mankind used to get rid of waste through natural processes, but technological progress has led to the fact that presently the environment receives an enormous amount of waste, beyond the capability of natural ecosystems. The problem is exaggerated by the

Table 1. Dynamics of atmospheric pollutant emissions of from mining and processing enterprises of Perm region from 2005 to 2013, tons

	2005	2006	2007	2008	2009	2010	2011	2012
All stationary sources	444459	427276	392054	371685	319816	322678	373675	341029
All the mining operations and processing production	163481	166961	150599	148149	152192	155417	204742	182614
Mining	73091	81603	70284	72278	89524	91068	132931	114981
Manufacturing, Including	90390	85358	80310	75871	62668	64349	71811	67633

Table 2. Energy consumption in mining and manufacturing of Perm krai, mln kwt/h

	2005	2006	2007	2008	2009	2010	2011	2012
From stationary sources, total	13530,9	13794,9	13883,9	14462,4	12314,2	12546,6	13396,9	12920,5
Mining and manufacturing, total	11583,2	11466,4	11591,9	11423,7	9741,1	10526,6	11100,8	10705,2
Mining	991,8	1033,7	986,5	987	1028	1083,4	1131,3	1431,6
Manufacturing	10591,4	10432,7	10605,4	10436,7	8713,1	9443,2	9969,5	9273,6

Table 3. Production and consumption waste forming in Perm krai industry (tons)

	2007	2008	2009	2010	2011	2012	2013
From stationary sources, total	709553840,6	731780462,2	752329942,7	781451418,4	780104754	798958577,1	765554005,8
Mining and manufacturing, total	698258102,2	720033629,4	740354136,1	761421359	762594156	781666485,4	753329861,9
Mining	304241343,2	318079146,1	332924877,4	341836603,3	672560951	691885042,4	661477283,5
Manufacturing	394016759	401954483,3	407429258,7	419584755,7	90033205,2	89781443,04	91852578,4

Table 4. Waste forming in Perm krai industry (tons)

	2007	2008	2009	2010	2011	2012	2013
From stationary sources, total	12168590	12746495	10446159	12653428	16774811	15797426	14815325
Mining and manufacturing, total	11503475	12218406	9930406	12122558	15485592	14751487	13546123
Mining	6494444,971	8557764,153	7597866,151	9270038,083	12210583,7	12512954,91	11819040,25
Manufacturing	5009029,879	3660641,492	2332539,429	2852519,946	3275008,66	2238532,164	1727082,928

Table 5. Waste neutralizing in Perm krai industry (tons)

	2007	2008	2009	2010	2011	2012	2013
From stationary sources, total	139294,287	9482,144	91543,671	212556,224	256335,441	373403,8844	414218,6632
Mining and manufacturing, total	12042,6	7855,831	19227,178	38203,207	23469,37	23509,425	54967,9962
Mining	11,488	6,633	6,707	1,700	145,619	0,551	0,51
Manufacturing	12031,112	7849,198	19220,471	38201,507	23323,751	23508,874	54967,4862

production of an increasing number of substances, which are hardly dissolved in natural processes. Nature does not have appropriate decomposers [14, p. 217].

The largest share of waste is accounted for stationary sources. In 2007 it reached 98,4%. In 2013 the situation did not change, the share of stationary sources in the economy of the Perm region accounted for 99% of all waste. From 2007 to 2013 waste of production and consumption from stationary sources increased by 7.9 %. The increase was due to mining enterprises. In the period analyzed (from 2007 to 2013) the ratio of mining and manufacturing enterprises in the waste share changed. In 2007 43.6% of waste was accounted for mining enterprises, 56, 4% - for processing. In 2013 the structure significantly changed. The contribution of mining companies in the waste amounted to 88%, processing – to 12%. Thus the contribution of mining and manufacturing companies in GRP of Perm region rose: mining industries - from 15.7% to 17%, manufacturing - from 29.4 % to 34 %.

At mining enterprises the amount of waste increased by 2.18 times, and in manufacturing industry has decreased by 4.29 times (table.3)

Recycling of waste products, associated and secondary products is a huge reserve of saving natural resources. Recycling is 2-3 times cheaper than concentrates derived from natural raw materials and minerals. [15, p. 40].

The analysis showed that a very small portion of the existing production and consumption waste is used by industrial enterprises in Perm region. In 2007 only 1,72% of waste from stationary sources was utilized (total waste in 2007 was 709,6 million tons, only 12.2 million tons were recycled). In 2013 the share of recycled waste increased slightly and was 1.94% (total waste was 765.6 million tons, 14.8 million tons were recycled). In 2007 in both mining and manufacturing industries 1,65% of waste was recycled (total waste in 2007 was 698,3 million tons, 11.5 million tons were recycled), in 2013 1.8% were recycled (total waste in 2013 was 753,3 million tons, 13.5 million tons were recycled). In 2007 in mining industry 2,14% of waste were recycled (total waste in 2007 was 304,2 million tons, used Savana 6.5 million tons), 2013 - 1,79% (total waste in 2013 was 661,5 million tons, 11.8 million tons were recycled). In 2007 in manufacturing industries 1.27% of waste were recycled (all waste in 2007 was 394 million tons, 5 million tons were recycled), in 2013 - 1,85% (total waste in 2013 was 91.9 million tonnes, 1.7 million tons were recycled) (table. 4).

In 2007 139294,3 tons of production and consumption waste from all stationary sources of Perm Krai were neutralized, which was 0.02% of the total amount of waste. In 2013 414218, 7 tons of waste were neutralized which amounted to 0.06% of the total volume of waste. The amount of production and consumption waste in the region from 2007 to 2013 grew by 7.3% from 2007 to 2013, the amount of neutralized waste grew only by 2,98%.

In total in 2007 12042,6 tons of waste from mining and manufacturing industries were neutralized , which amounted to 0.01% of the total amount of waste from mining and processing enterprises. In 2013 54968 tons of waste were neutralized (0.01% of the total amount).

At the mining enterprises the amount of waste in 2007 was 304241343,2 tons and only 11,5 tons were neutralized. In 2013 the amount of waste generated was 661477283,5 tons, and only 0,51 ton was neutralized. Thus, waste generation increased by 2.18 times, and the amount of neutralized waste decreased by more than 22 times.

In 2007 in manufacturing industries 12031,1 tons of waste were neutralized, which amounted to 0.01 % of the total amount of production and consumption waste of manufacturing industries.

In 2013 54967,5 tons of waste were neutralized, which amounted to 0.06% of the total amount of waste in manufacturing. From 2007 to 2013 the total amount of waste in manufacturing industries decreased by 4.3 times, the amount of neutralized waste increased by 4,57 times (table 5).

Analysis of environmental sustainability indicators suggests that the process of greening is developing very slowly which allows to characterize systems of industrial enterprises as unsustainable.

CONCLUSION

The ecological assessment system must provide opportunities for:

- Systematic observation in the enterprise

area
- Obtaining reliable information about pollution sources
- Providing information to support the development of environmental protection measures and assessment of their effectiveness
- Optimization of economic efficiency (the ability of the tax and amortization benefits, attracting subsidies)
- Determining the impact of enterprises on environment and health in the enterprise area.

To improve the assessment it is necessary
- To improve legislative and normative-methodical base;
- To develop information flow schemes enabling communication at all levels: micro, meso and macro.

Effectiveness of monitoring depends on the completeness of the environmental situation assessment which determines the necessity to take into account a greater number of indicators. On the other hand, these estimates should be used to solve specific management problems (there is no point to spend significant financial resources to collect data that are not used).

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