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Ecological engineering as an effective method of ensuring company ecological safety

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Abstract. The article aims to consider the concept of "environmental engineering" in the context of environmental activities in the Russian Federation. Authors of this article set as an example the work of the company OJSC Udmurteft, which activity is connected with the development of such a segment as environmental engineering. As a result of the analysis, authors prove that to quickly prevent the negative impacts of industrial enterprises on the environment in this area, it is necessary to carry out permanent environmental controlling.

1. Introduction

Ecological engineering (ecoengineering) is carried out in certain organizational and legal forms of purposeful actions and results in the creation of new production facilities to minimize damage in the field of environmental protection and the use of natural resources, characterized by the mandatory participation of the state and the presence of special entities such as the polluter-organization of environment (customer) and specialized engineering organizations performing design engineering, manufacturing and supplying technical systems for its protection (contractor).

In fact, environmental engineering allows to implement the idea of sustainable development of any industrial enterprise that can simultaneously reduce the harmful effects on the environment and improve the efficiency of technological processes.

Considered in the context of environmental activities in the Russian Federation ecological engineering is a priority for the country development.

The President of the Russian Federation Vladimir Putin at the Meeting "On the set of measures to improve the environmental situation in Russia" which was held in March 30, 2011 said that "the main task is to create an effective system of environmental safety in the country, one that would effectively cope with the existing problems and at the same time effectively respond to emerging issues and new challenges in this area There is always a tension between nature development and preservation. It has always been, is and will be, but we need to find this balance".

2. Models and methods

Odum (1962) was among the first to use the term 'ecological engineering', which was viewed as 'environmental manipulation by man using small amounts of supplementary energy to control systems in which the main energy drives are still coming from natural sources' [1]. In more recent years, Mitsch and Jorgensen (1989) have defined ecological engineering as 'the design of human society with its



natural environment for the benefit of both'. Among the characteristics of this form of engineering are the use of quantitative approaches and ecological theory as well as the view of humans as part of, rather than apart from, nature. Ecological engineering is a conscious human activity and should not be confused with the more recently developed term 'ecosystem engineering'. This refers to the way in which other species shape habitats via their intrinsic biology rather than by conscious design. For example, termites alter the structural characteristic of soils, and such ecosystem engineers thereby moderate the availability of resources to other organisms [2].

Recently, Parrott (2002) has discussed the ecological engineering field as having evolved to incorporate a growing number of practitioners whose endeavour is the 'design, operation, management and repair of sustainable living systems in a manner consistent with ecological principles, for the benefit of both human society and the natural environment'. Possibly, however, the most elegant definition of ecological engineering comes from Chinese approaches where a long history of complex land use systems was, in the closing decades of the 20th century, formalised into a 'design with nature' philosophy. The existence of the well-established periodical *Ecological Engineering: The Journal of Ecotechnology* is evidence of the level of activity in this research field. This title reflects the synonym for ecological engineering, 'ecotechnology'.

The contrast between ecological engineering and other fields, such as theoretical and applied ecology, has been explored by Mitsch (1991). In its role of supporting the design of ecosystems it draws from both theoretical and applied branches of ecology.

Existing ecosystems modified in an ecologically sound manner to reduce an environmental problem, has particular relevance to ecosystems. Pimentel (1989) identified several 'ecotechnological principles' that underpin productive, sustainable ecological engineering systems [3]:

- adapting and designing the ecological engineering system to the environment of the region;
- optimising the use of biological ecological engineering system;
- developing strategies that induce minimal changes to the natural ecosystem to protect the environment and minimise use of non-renewable resources. As there is a large number of regulatory standards and various requirements, the formation of an ecological engineering segment as an activity designed to review and modernize industrial and civil facilities from the point of view of its ecological safety was quite logical.

OJSC Udmurtneft, being the largest oil producing company in the Udmurt Republic, is aware of the nature and extent of the impact of its activities, products and services on workers and the environment. The company also understands its responsibility for ensuring trouble-free production activities at hazardous production facilities, safe working conditions for employees, the preservation of the natural environment, and the health of the population living in the areas where the Company operates.

Goals of OJSC Udmurtneft are the following:

- no occupational injuries and occupational diseases;
 - no accidents and fires;
 - consistent reduction of negative impact on the environment.
- To achieve these goals OJSC Udmurtneft undertakes the following obligations:
- to manage environmental processes, protect and restore of natural resources, rehabilitate of territories contaminated as a result of past economic activities;
 - to continuously improve management system and indicators in the field of industrial safety, labor and environmental protection.

In accordance with its obligations and strategic goals, OJSC Udmurtneft has the following objectives:

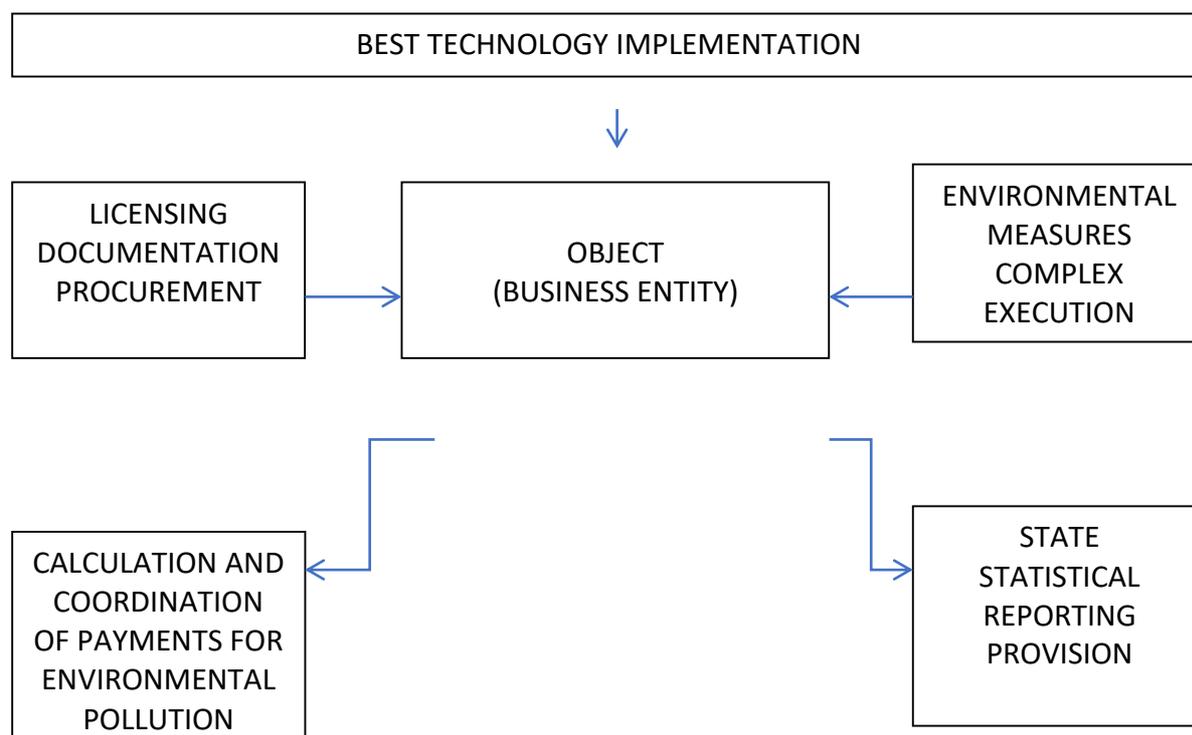


Figure. 1. Scheme of the best technological introduction.

- to ensure systematic planning of production activities through the application of program-target management methods, taking into account applicable requirements in the field of industrial safety, labor and environment protection;
- to develop, implement and apply advanced technologies that contribute to the prevention of industrial injuries and occupational diseases, fire and emergency situations, and, in case of such a situation, ensure its localization and elimination, as well as mitigation of its consequences for people and the environment;
- to develop, implement and apply advanced environmental protection technologies and management practices, innovative high-tech solutions to reduce the negative impact on the environment, a phased reduction in the specific consumption of natural resources, materials and energy with maximum output and services;
- to develop, implement and improve procedures for managing counterparties that provide services (performing work) at the Company's production facilities, in terms of industrial safety, occupational health and the environment;
- to improve the efficiency of measures to manage the integrity of production facilities.

3. Results and discussion

The implementation of the best current technologies in the activities of OJSC Udmurtneft is a fundamental criterion in the oil extraction. Currently, OJSC Udmurtneft has developed and approved all the necessary permits in the field of environmental management and the implementation of purposeful programs to improve the pipeline reliability.

As part of the said course of the economic activity OJSC Udmurtneft are implementing various technologies that allow reducing the cost of equipment operation, which entails a reduction of the negative impact on the environment. For example, for the past period of 2015 compared to the same period of 2014, as a result of the implementation of the purposeful program to improve the pipeline reliability. OJSC Udmurtneft was able to reduce the number of pipeline failures by 15.8%. The decline

in failures caused a decrease in the amount of sludge formation by 42% compared to the same period in 2014.

The work in the field of environmental protection, industrial safety and labor protection at the facilities of OJSC Udmurtneft is one of the priority activities. Over the past period, environmental disasters of natural and man-made disasters have not been recorded at the mine fields of OJSC Udmurtneft; the emergency releases and discharges of pollutants into the environment have not been allowed. Ecological engineering includes several activities.

Moreover, it is necessary to carry out permanent environmental controlling to quickly prevent the occurrence of negative environmental consequences of industrial enterprises in this area.

4. Conclusion

The implementation of projects to improve the pipeline park provides a radical improvement of the environmental situation, the removal of social tensions, increasing the level of environmental population safety, introducing the "best current" technologies and equipment, reducing environmental fines, improving the image and increasing the investment attractiveness of the region.

The competent assessment depends on the relevance of data on the current environment state, as well as forecasts for major changes in the situation. To obtain operational information, OJSC Udmurtneft applies environmental (production and environmental) monitoring.

The environmental monitoring is based on the following necessary actions:

- obtaining measurement information on the state of controlled natural environments;
- assessing the ecological state of natural environments, analyzing the current environmental situation and predicting the dynamics of its development;
- timely making decision to prevent negative impact on the environment;
- confirming the established emission and discharge standards;
- providing the production control results to state environmental authorities.

The correct assessment of the current enterprise activity regarding environmental safety is impossible without a comprehensive audit.

The environmental audit includes the following aspects:

- verification of the enterprise's activities regarding compliance with environmental standards and requirements;
- development of recommendations for environmental activities;
- independent assessment of environmental costs;
- control of resources (financial, technical, personnel) allocated for environmental protection;
- establishment of the transparency of environmental performance to management;
- argumentation for making informed decisions in the field of environmental activities;
- reduction of administrative costs, prevention of fines from public authorities;
- optimization of environmental charges;
- rapid adaptation to changes, including in environmental legislation and related areas.

The activities of OJSC Udmurtneft in the field of industrial safety, occupational health and the environment comply with the requirements of international standards ISO 14001 "Environmental Management System" and OHSAS 18001 "Professional Health and Safety Management System".

According to the schedules in 2014, 49 internal audits were conducted in 13 departments and services and in 36 production departments of the Company's departments. The audit covered all elements of international standards ISO 14001: 2004 and OHSAS 18001: 2007. Thus, the implementation rate of planned audits was 100%.

In the first quarter of 2015, Bureau Veritas Certification Russia conducted a recertification audit of the Integrated Industrial Safety, Health and Environment Management System (IIS ISLPE) of the Company for compliance with the requirements of international standards ISO 14001: 2004 “Environmental Management System” and OHSAS 18001: 2007 “System occupational health and safety management.” The Company also noted the high level of professionalism and responsibility of employees in the issues of FT, OT and OS, the use of modern technological solutions for oil production, which reduce risks and potential environmental impact on the environment.

Thus, as there is a large number of regulatory standards and various requirements, it was quite logical to form an environmental engineering segment as an independent market segment.

References

- [1] Howard T Odum 1963 Man and Ecosystem *Proceedings, Lockwood Conference on the Suburban Forest and Ecology, in: Bulletin Connecticut Agric. Station*
- [2] Bergen S D *et al.* 2001 Design Principles for Ecological Engineering *Ecological Engineering* **18** 201-10
- [3] Mitsch W J and Jorgensen S E 1989 *Ecological Engineering: An Introduction to Ecotechnology* (New York: John Wiley & Sons) pp 3-12