System aspect course of creation of information and analytical system of environmental monitoring and control

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System aspect course of creation of information and analytical system of environmental monitoring and control

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Abstract. Objects of oil production have significantly changed natural landscapes of the district, breakouts of oil pipelines cause irreparable harm to the nature. Due to rather strong anthropogenous loading it was necessary to take measures for control of negative impact on the environment. Resolution No. 485-p of December 23, 2011, was accepted in 2011 at the level of the district Government. According to this resolution the local environmental monitoring has to be carried out by sampling, sample analysis in a chemical laboratory and presentation of results. The final results of the monitoring have to stimulate nature users to improve their own and use newer technologies, which will promote improvement of the environment condition.

1. Introduction
Khanty-Mansi Autonomous Area – Yugrais is one of the main territories in Russia in oil production. Long years of exploitation of oil and gas fields in the district affected the condition of the environment. The process of oil production and pumping represents a danger to the environment.

The final data of environmental monitoring have to concentrate in a uniform resource and give a clear concept of the qualitative changes in the natural environment condition.

The purpose of this paper is to show a possibility of use of elements of Information and analytical system of “Environmental monitoring and control” (EMC) for an assessment of the environment condition in the areas of oil production.

2. The automated systems of environmental monitoring (EM)
At present, the precision mechanical engineering has reached the level when very compact and at the same time functional electronic circuits are produced. It allows one to create the difficult automated and multilevel systems on the environment control.

The automated system of environmental monitoring is complex technical and software tools which is intended for continuous control of environment condition, both in territories of separate industrial facilities, and in territories of regions [1-3].

The system of environmental monitoring has to accumulate, systematize and analyze information about: environment condition; reasons of observed and probable changes of a condition (sources and factors of influence); admissibilities of changes and loadings on environment in general; the existing
biosphere reserves [3, 4].

The basic functional elements of modern automatic systems of monitoring are:

- Sensors of the environment parameters – temperature, concentration of salt in water, metals in the water environment, concentration of the main pollution of atmosphere and waters.
- Autonomous power supply on the basis of perfect accumulators or solar batteries.
- The radio-transmitting and radio-receiving systems operating at a rather short distance – 10-15 km.
- The compact radio stations transferring to hundreds and thousands of kilometers.
- The satellite communication systems, which are often connected with systems of global positioning (for example, GPS).
- Modern computer technology, including mobile devices.
- Special software [4].

At present, automated systems exist in industrial enterprises, where environmental control is a necessity. These are nuclear power plants, oil and gas processing complexes, enterprises of metallurgy and chemical industry.

In particular, now, the installations produced by the Scientific and Production Firm “DIEM” operate at the Astrakhan and Orenburg gas chemical complexes, in the territory of “GAZPROM DOBYCHA ORENBURG”, as well as in the Republic of Tatarstan. These installations carry out environmental control on the production. They include both stationary, and mobile posts of observation. A part of works is made manually, for example, air sampling. Meteorological parameters, radiation background and indicators of water objects condition are automatically controlled. The data after processing in the ecological laboratory come to the database where it is possible to track information at various levels.

According to the laws and departmental norms existing in Russia, any production activity that affect the environment condition has to be accompanied by environmental control and monitoring, i.e. systematic observations of sources of anthropogenous influence, the level of pollution of environment components, influence of pollution on a condition of biological objects [4-6].

The system of environment monitoring has to be able to interconnect the obtained natural data on separate sections and fields of knowledge in order to receive the most realistic picture of the happening changes of environment condition for elaboration of operational security measures [5-7].

In various regions of Russia the separate modules or projects of modules of Geoinformation systems (GIS) which have limited functionality and which are not adapted for the solution of other regions tasks and areas are developed [3,5]. The researches of A.Yu.Ivanov and V. V. Zatyagalova (2007) in the field of GIS application in monitoring of oil spills in the marine environment can be such examples. It is also possible to note GIS for Tyumen region described by A. A. Tigeev.

Use of regional GIS is necessary for the administrative and nature protection organizations for environmental management optimization. The data of the regional GIS have found application in the development of numerous projects for field arrangement and pipeline laying in the north of Western Siberia [3-7].

Today modern monitoring systems are the most available means for control and management of the environment quality for the city with the developed industry and transport infrastructure. The purposes of creation and development of environmental monitoring systems are the most full information support of administrative decisions in the sphere of protection and improvement of the environment, integration of the ecological information obtained by various departments and introduction of modern calculation and analytical methods for complex assessment of environment condition of a city [1].

The system of environmental monitoring is being developed for the Khanty-Mansi Autonomous Area in the research laboratory of Surgut state university. The main activity of developers is creation of the territorial automated information and analytical system (TAIAS) for ecological monitoring of environmental pollution in the territory of Khanty-Mansi Autonomous Area which is based on land means of obtaining of ecological information. This system allows one to quickly obtain the data about environment condition in the territory of the Khanty-Mansi Autonomous Area, to predict emergence
and development of ecological situations, and also to form recommendations about management of an ecological situation [2, 5-7].

At the same time, now in many regions of Russia, there is no uniform system of expeditious environmental monitoring of natural and anthropogenic complexes. There are only separate systems of expeditious or conditionally expeditious monitoring of environment condition. There is a need of consolidation of the existing centers of reception, storage and data processing both of Earth remote sounding, and land observations for creation of uniform available system of environmental monitoring. This task can be solved by means of creation of the uniform center of collecting, storage and information processing from sources of land observation and materials. In the future with introduction of these data to geoinformation systems (GIS) supporting modern cartographical information and WEB technologies, there is an opportunity to make an assessment of the environment condition in the real time that eventually allows one to quickly react to the arising negative impacts and to develop optimal administrative and managerial solutions at various levels of executive power of the region [3, 7-11].

Ltd. Bureau of Information Technologies «Air-Soft» company has developed the “Information and Analytical System of Environmental Monitoring” (IASEM) intended for data collection of environmental monitoring. Electronic mechanisms of information obtaining from stationary points of constant control (territorial meteorological stations, hydrological alignments), departmental information systems, as well as from statistical and cartographical sources are assembled in this system. This system also assesses the ecological situation in the region and finds the reasons caused changes in the environment condition. The system transfers monitoring data to geoinformation systems for creation of cards of ecological situation. In general, IASEM provides an idea of the ecological situation at the global level across the region. This system functions in Krasnodar Territory and carries out the tasks set by the Russian Federation Government Decree No. 681 of August 9, 2013 “About the state environmental monitoring and the state fund of data of the state environmental monitoring” (URL: http://mprkk.ru, Ministry of Natural Resources of Krasnodar Territory).

There is an information system in the field of environmental monitoring which is offered by “Prime Group” and “OTOIL” companies. It implements such functions as: assembly of monitoring data from stationary observation points at the enterprise, from hydrometeorological stations, and information obtained by means of Earth remote sounding; the analysis of the received data is carried out; reports providing and payments calculation for negative impact on the environment. Application of such system is possible at industrial enterprises for association of information necessary for reporting and payment documentation in an enterprise

3. Conceptual model of information and analytical system of environmental monitoring and control (IAS “EMC”)

Decision on creation of IAS “EMC” has been made in order to automate the process of environmental monitoring and control. The main goal of IAS “EMC” is the centralization of the process of collecting and analysis of environmental monitoring data, as well as the development of operating solutions for stabilization of ecological situation in the considered area (figure 1).
Figure 1. IAS “EMC”.

The main objectives of IAS “EMC”:
1. Implementation of the centralized environmental monitoring and control over the environment pollution.
2. Collection, analysis and systematization of EMC data.
3. The account and control of the territories participating in EMC.
4. Creation of objective picture on levels of ecological impact of the enterprises on the environment and population health, including complex risks assessment connected with their functioning including in comparison with other technological hazards caused by existence in regions of polluting enterprises of other industries and agriculture.
5. Provision of information and analytical support of adoption of administrative decisions taking into account the ecological component of production process.
6. Automation of activity of EMC specialists.

The main program and technical requirements to IAS “EMC” are:
1. The system has to web-focused and available from any computer having Internet access.
2. The possibility of role demarcation of access on the basis of access rights matrix has to be realized in the system.
3. The possibility of secure access to information of limited access on the specialized https protocol has to be realized in the system.
4. The system has to own reference books with a possibility of replenishment.
5. The functionality of history accumulation of work with objects has to be provided in the system.
6. The system has to support data export/import in the standard formats of exchange.
7. The system must have an opportunity to prepare reporting analytical information (figure 2).
8. The system must have the pda-version for mobile devices.
Environmental monitoring requires not only a prepared result. Important stages of environmental monitoring are field works, laboratory researches, cameral data processing and interpretation of data (report preparation). The customer is not always able to trace these stages. There are many important components which it is necessary to systemize on each stage.

The implementation of each information and analytical system is a process that depends not only on the quality and degree of automation implemented in the system. In this regard, the development of IAS “EMC” was conditionally divided into stages. The purpose of the first stage is the creation of help system for the maintenance of basic registers of environmental monitoring.

The first stage involves the definition of monitoring points, their description, drafting of the sampling act, the nomination of points on the map, the development of research route. Completion of the field stage leads to the presence of photographs confirming the sampling. These all components of the field stage are scattered and do not give a general picture. The information of the common database of points for each monitoring object makes it possible to see the general picture of the research and to obtain a certain database of the work performed for the report.

The second stage includes laboratory studies. At this stage, it is also important to collect the final results of the component chemical analysis in a common database for further interpretation.

Cameral work includes comparison of the obtained data from maximum permissible emissions (MPE) and definition of integral indicators. The integral indicators will give a possibility to evaluate the obtained data and make a conclusion about the degree of pollution of the study area.

It is necessary to provide access to the section for the customer representative, who using login / password could monitor the research results.

The task of the new section is the generalization and coordination of the results of field research with laboratory processing, as well as regular informing the customer about the work progress.

Transport, which operates in the fields, should be equipped with a tracking system via satellite navigation. Such a measure serves both for security purposes and for monitoring movement in areas of increased danger.

The purpose of this section is to provide users with access to the movement routes in the fields.

The program where the record about transport movement is being kept reports the data in the format of MS Excel tables and in the form of a traced route on the map (Figure 3). The period selection for which it is necessary to display the data is envisaged for each type of report.
The authors propose to create a register in the new section of IAS “EMC”, where the operator will record MS Excel files and graphic materials displaying the transport movement.

It is necessary that the files are generated in a common table after downloading. At loading-forming of record the line “car” should be filled from the drop-down list. For this purpose it is required to create the register “The accounting of motor transport” to which this line will refer.

4. Conclusion
The system “Environmental Monitoring and Control” was successfully created and implemented. New elements have been developed, which allow one to expand the system capabilities at their implementation.

The proposed section on laboratory analysis unites the obtained monitoring data in a uniform database, where it is possible to track the trends in the changes of the values of the determined indicators in the samples. The accumulation of such data is the basis for a multidimensional assessment and further construction of complex models of changes occurring in the environment in the territory of the licensed sites.

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