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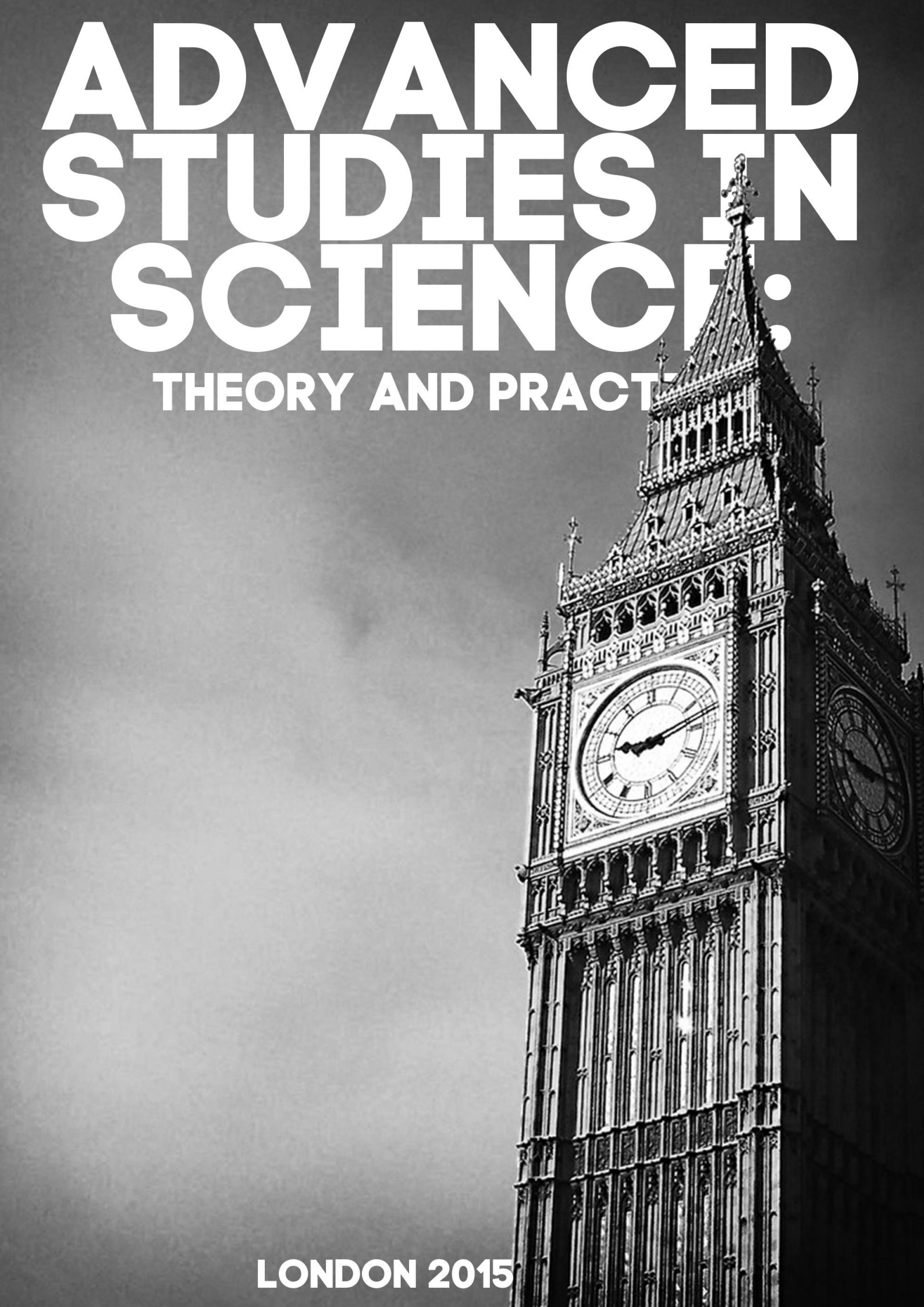

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Contents

Part 1. Law

Kirillova, E. A. Some Issues of Cross-Border Inheritance. 9-11

Latypov, V. S. Some Questions of Application of Special Knowledge in Criminal Trial of Russia. 12-14

Nizamova, G. K. On the Question of Legal Nature of Actually Existing Contractual Relations. 15-17

Part 2. World & Russian History

Gerasimova, E. V. Russian Imperial Libraries in the United States: Research Potential and Outlook for Digital Reconstruction. 19-23

Guliyev, R. A. The Republic of Azerbaijan in International Customs Relations: The Protection of Material and Cultural Wealth 24-28

Krylova, V. K. I Admit. I Badly Fought for Our Estimates. 29-34

Zueva, L. I., Yerzhanova, M. Y., & Denivarova, N. V. Kazakhstan Historiography of Labor Camps in the Scientific Literature at the Turn of 20th-21st Century. 35-40

Part 3. Political Science & Philosophy

Bulygin, V. R. The Role of National Branding in Contemporary International Relations. 42-45

Krasnova, A. G. Pharisaism as a Source of Negative Phenomena of Social Religious Life in Modern Christianity: Conceptual Foundations. 46-48

Makukhin, P. G. The Evolution of the Positivist Credo “Science is a Philosophy Itself and Modern Arguments to Overcome It: The “Fullness” of Science with Philosophical Ideas. 49-56

Popova, A. S. Analysis of Jack Welch and Sergey Galitsky’s Activity as Leaders Based on Situational Theories 57-65

Popova, A. S. A New Unipolarity: Does the World Need the USA, and Does the USA Need the World? 66-71

Shpilkin, Y. I. Eurasianism is the Fourth Political Theory. 72-75

Part 4. Education & Interdisciplinary Studies

Danilov, D. L., & Shmantsar, M. V. The Conference as a Scientific Event: Case Study Research Design. 77-81

Kapitonova, N. D. An Overview of the Higher Education System in Germany. 82-85

Part 5. Ethnic Studies

Glazko, S. V. The Color Opposition "Black/White" in the Evenks Traditional Culture: Multi-level and Symbolic Load. 87-91

Part 6. Philology & Literature

Abramov, V.Y., & Husnullina, Y.A. Socio-Linguo-Cultural Concept "Virtual Community": Structure and Content. 93-98

Alekseyev, A. A. The Concept of Polypropositional Sentences. 99-102

Grigorieva, N. I. Proverbs in the A. S. Pushkin's Story "The Capitan's Daughter." 103-105

Kozhanuly, M., & Kozhan, M. Manifestation of Kinesic and Proxemic in Kazakh Business (Based on Kazakh Proverbs, Sayings and Syllables of Speech). 106-110

Maimakova, A. D. The System of Notations of Non-Blood (Inherent) Relationship in the Russian and Kazakh Languages. 111-117

Matkarimova, A. I., & Toshtemirov, E. N. Linguocultural Features of the Semantic Field of "Respect" in Different Systems of Languages. 118-121

Ospanov, B. Ye. Motives of Humanism in the Works of the Syrland Poets-Storytellers 122-127

Renanski, A. L. In Search of the Highest Truth. 128-137

Sagiryan, I. G. Author's Retreat in the Aspect of the History of Metatext. 138-142

Titova, T. O. Scientific and Technical Discourse: Linguistic and Technical Synergy. 143-146

Part 7. Pedagogy & Psychology

Bobrova, E. P. The Algorithm for the Formation of Verbal Communication Skills among Children of Senior Preschool Age with General Underdevelopment of Speech. 148-154

Datchenko, S. A. Prerequisites of Emergence and History of Development of Modern Psychophysiological Technology Biofeedback. 155-158

Dzhansarayeva, R. Y. Criminal Law and Criminological Measures to Prevent Criminal Consequences of Illegal Migration: Relevance of Research. 159-166

Kuralbayeva, A. A. Integrated Subject Lessons in Elementary Classes. 167-173

Lomonova, M. F. Theoretical Concepts of Constructing a Model of the Hermeneutic Approach in Vocational Teacher Training as a Humanitarian-Oriented Technology 174-177

Panova, O. S. The Use of the Method of Conjugate Impact in the Training Process of Young Sprinters On the Stage of Initial Specialization. 178-187

Popova, L. G. Cultural Memory of Words and Languages of Comparison. 188-190

Shadinova, G. A. The Fear of Motherhood among Women of the East and the West Today. 191-195

Tsoy, E. V., & Kim, Y. V. Transformation of the System of Education as the Key to Successful Bevelopment of the State. 196-200

Part 8. Economics

Adamovskaya V. S., & Cherednichenko, A. A. The Complex Calculation of Enterprise's Economic Security Level. 202-206

Ayrapetyan, S. S. Investments in a Stable Future. 207-212

Druzhynina, Y. O. Assessing the Social Destructive Impact of the Project Implementation. 213-219

Klimova, N. V., & Hutova, I. M. The Import Substitution as a Consequence of the Application of Sanctions to Russia and the Current State of the Food Processing Industry. 220-227

Komarevtseva, O. O. Simulation Modeling of Financial Flows in the Economic System of the Municipality. 228-232

Kot, N. G. Financial Potential as Indicator of Enterprise Success. 233-236

Kozlov, V. A. & Korobkova, N. P. The Economic History of the East: Problems of Designing. 237-241

Israfilov, N. T., Popova, A. L., & Israfilova, E. I. Principles of the Institute of Insolvency in the Transition to the Market. 242-250

Polyanskaya, I. G., & Yurak, V. V. Assessment of Institutional Capacity of the Arctic Subsurface Resource Management by Using the Fuzzy-Set Theory. 251-260

Potapova, N. V. Controlling of Responsibility in the System of Investment Management 261-264

Shamkhalova, S. O. The Expansion of the Advertising Market Opportunities of Azerbaijan in Modern Conditions. 265-268

Toktobekova, M. A. Enhancement of the Role of Mortgage Lending in the Development of the House Building as a Priority Sector of the Economy. 269-273

Vardiashvili, N. N. Modeling of Production and Financial Sustainability of an Enterprise. 274-279

Part 9. Mathematics

Korolev, V. S. How to Count All Real Numbers: A New Algorithm of Comparison of Infinite Sets. 281-287

Part 10. Biological Sciences, Farming & Environment

Anikina, I. N., & Adamjanova, J. A. New Aspects of Regulation of Plant Growth in Vitro. 289-294

Bogdanov, A. N., & Tomchuk, A. G. The Comparative Efficacy of Nonsteroidal Anti-Inflammatory Drugs and Corticosteroids in the Treatment of Acute Low Back Pain. 295-299

Ibrayev, I. K., & Ibrayeva, O. T. Arrangement for Operational Ecological Monitoring. 300-307

Voronetsky, V. I., Shvetc, O. V., & Skleymina, A. V. New Cottage Settlements as a New Ecological Niche of Local Avifauna 308-311

Part 11. Nuclear Physics and Technology

Bedenko, S. V., Plevaka, M. N., & Gritsuyk, S. V. The Neutronic Analysis of Systems "Dry" Storage of Spent Nuclear Fuel. 313-319

Part 12. The Eurasian Educational Space

Bukessova, R. M., & Bissalieva, N. S. Reading of the Scientific and Technical Literature in English as a Factor of Improving Teaching English for the Students at the Technical College. 321-324

Tanatova, A. D. The Motivation for the Successful Activity as a Factor in the Optimization of Educational and Cognitive Sphere of Students 325-333

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ARRANGEMENT FOR OPERATIONAL ECOLOGICAL MONITORING

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ПРЕДЛОЖЕНИЕ ПО ОПЕРАТИВНОМУ ЭКОЛОГИЧЕСКОМУ МОНИТОРИНГУ

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Aim of the work is the elaboration of an effective system of pollution sources operational monitoring and taking forehanded warning and correcting measures in order to prevent excessive emissions and pollutants discharge.

Key words: ecological monitoring; man-made impact; emissions; discharge; standard; maximum allowable; environment protection activity; instrumental gauge; measuring unit; observation; estimation; prognosis; correcting and warning activities.

Цель работы заключается в разработке эффективной системы оперативного мониторинга источников загрязнения и принятия своевременных предупредительных и корректирующих мер с целью предотвращения чрезмерных выбросов загрязняющих веществ.

Ключевые слова: экологический мониторинг; антропогенное воздействие; выбросы; сброс; стандарт; предельно допустимый; деятельность по охране окружающей среды; инструментальный датчик; единица измерения; наблюдение; оценка; прогноз; деятельность по коррекции и предупреждению.

Introduction

In order to create a reliable basis for constant decreasing of the man-made impact of a metallurgic plant on the environment, it is necessary to implement ecological control and ecological management into the practical environment protection activity. And scientifically grounded planning of the environment protection activity is impossible without proven, reliable and valuable information.

The idea of the monitoring became world-wide spread by the beginning of the '70s last century after limitation of the world biosphere resources was admitted and it was oriented primarily to observation of such global processes as economical development, changes in the environment.

The system of repeated observations of one or more environmental components in time and space with distinct aims in accordance with beforehand prepared programs was called the environmental monitoring (Svyatov, Ibraev & Filippov, 2002; Makarov, n.d.).

The first concept of monitoring was developed by Yu. A. Izrael. In accordance with it "… it is more correct to define monitoring as an observations system which allows distinguishing changes in the biosphere caused by the human activity…"

Initially, the definition of ecological monitoring was given by the UN environment secretariat (SCOPE) in 1973 as "a system of repeated observations of the environment in space and time with specific aims and according to beforehand prepared programs". The concept of ecological monitoring was further developed in the following years. Yu. A. Izrael (1974, 1979) accentuated that monitoring is "observing sources and factors of man's impact – chemical, physical, biological- and effects caused in the environment, and first of all, observing reactions of biological systems to this kind of impact". V. A. Kovda and A. S. Kerzhentsev (1983) define monitoring as "an integrated system of observation, estimation and prognosis of changes in the biosphere under the influence of natural anthropogenic factors". B. V. Vinogradov (1984) generalized the definition of the ecosystem monitoring as "a system of observations of the ecosystem condition, record of their current structure, control of their dynamics, mainly anthropogenic, prognosis of their changes, and finally, management and optimization."

Hereby, according to the definition of monitoring, the following main elements are included into it:

1) observation of factors of impact and the environment condition;

2) prognosis of its future condition;

3) estimation of the factual and anticipated conditions of the environment.

The OEM system supplies solution of the following primary objectives:

1) control and estimation of the ecological situation:

- collection and processing of the information about the current condition of the environment components at the Aksu ferroalloy plant (AFP);

- accumulation and storage this information for a long period of time;

- data structuring and sorting , and affording access to it upon request in a convenient for a client form;

- regular distribution of the on-line information about the ecological situation (report, bulletin, pollution grid which characterize the current condition of the environment components);

- revealing of the dangerous pollution levels and location of polluted areas on the territory (operational analysis);

- record of possible resources and parameters of pollutants emissions into atmosphere (coordinates, composition, intensity and etc.);

2) assistance in taking decisions:

- supplying ecological service staff and administration of АЗФ with demanded for taking decisions accurate operational ecological data;

- assistance in taking scientifically proven decisions on rational exploitation of natural resources, elaboration and conducting environment protection activities, operational management of ecological situation.

- revealing of emergency and extreme ecological situations, estimation of their character and scale of their impact on the area and the population, informing the persons in charge of taking decisions and providing recommendations on localization and accident damage removal.

3) analysis of retrospective:

- providing upon clients' request data about concentration of pollution and the preceding moments of time that clients appeal to (both detailed and average according to demanded time intervals and spatial scale);

- revealing of dynamics and tendencies of the ecological situation development, examination of correlations and possible reasons of one or another change of the situation;

4) prognosis:

- estimation of possibilities of the ecological situation development in the nearest and long-term prospects;

- carrying out of an analysis to prove reliability of the prognoses that were done.

5) estimation of ecological consequences of the taken decisions:

- modeling of the pollutants distribution processes in the environment in various conditions in order to analyze the ecological situation, to make a rational choice of the nature protecting activities , to study probable ecological circumstances of the taken decisions.

Nowadays, in terms of preparation of the ecological management system for the certification according to ISO 14001, there functions a system of the operational ecological monitoring (OEM) of the condition of the environment components. The OEM system was elaborated under the demands of the international standard ISO 14001 and the demands of the Republic of Kazakhstan regulation in the sphere of the environment protection (*Law of the Republic of Kazakhstan…,* 1997).

The OEM system includes a measuring unit, facilities of communication, processing and allocation of the data which is fulfilled with the automated data system of ecological risks management (ADS ERM) [4]. It supplies intellectual processing of the monitoring data in the course of the ecological processes. ADS ERM was put into operation in 2000 and in Kazakhstan it is one of the first completely automated monitoring systems of ecological risks management in metallurgic manufacture.

The main principle of creating a system of the operational ecological monitoring of the environment components condition is operational ecological control as a management instrument of the ecological safety and ecological risks of the plant and the adjacent territory, and the chief means of realization of the principle is integrated processing of dissimilar information about the ecological situation on the controlled territory.

The program of the operational monitoring of the environment is comprised taking into account specific peculiarities of a definite division of the plant and it includes the following:

- monitoring of emissions of particulate pollutants, manganese, ferrum, chrome +3, +6 sulphur dioxide, hydrogen sulfide, carbon monoxide, nitric oxides into atmosphere.

- control of the working parameters of the gas-cleaning system to check its running order and efficiency;

- monitoring of the air quality (dust and gas content) in the working area, depending on the character of the production process;

- monitoring of the meteorological parameters of the working places, their illumination intensity;

- monitoring of the quality of the atmospheric air on the territory of the plant and by the flame to examine pollutants content;

- monitoring of the cleaning systems work and waste discharge at the plant;

- monitoring of the solid wastes, sludge of the gathering ponds and their influence on underground and ground water;

- inspection of the abidance by operating rules and effectiveness of the aspirating and gas-cleaning systems work;

- control of fulfilling the MPE (maximum permissible emission) standards at the emissions sources of the plant.

At present, the measuring unit of the OEM is being realized by the laboratory of the environmental protection (LEP) which is the centre of the operational monitoring of the plant at the present

stage and it is one of the most important units in the ecological management system at the Aksu ferroalloy plant (AFP), which is a branch of "Kazchrome "TNC" JSC.

Results of the research

There was implemented "process" approach of arranging and carrying out the OEM to resolve problems in integrated way.

The fundamental difference of the "process" approach from the functional one is that the main attention of the management is not focused on the independent processes (procedures), but on the interfunctional processes (procedures), which combine separate functions into common currents and they are aimed at the final results of the activity of the plant. Herewith, the increased focus is not on the vertical ties in the organizational structure, which are usually more well- functioning, but on the horizontal ones, which are weaker and hence they constitute real danger for the organizational structure stability and the effective ecological management of the plant.

Transfer to the "process" approach allows regarding the OEM activity carried out within the frames of the ecological management in dynamics, rather than in statics.

The "process" approach implies a "system" approach to management of processes which proceed during putting into practice the OEM at the plant and it supplies coordination and correlation of the processes and defining of contact points between them.

Management of the OEM process includes following functions:

- planning, arranging and carrying out the monitoring;
- control of fulfilling the quality and reliability of the monitoring results and their accordance with the standards of the statuary indicators;
-processes and procedures regulation if any nonconformities are revealed.

Control of carrying out and regulation consists in constant analysis and estimation of the performance and effectiveness of the process. In order to improve the procedures and results of the OEM, a principle of constant improvement in accordance with circulation in quality by Deming (PDCA conception) is used.

PDCA conception (plan- do- check- act) is a dynamic cycle as applied to the OEM includes planning and preparation of the facilities and measuring systems- carrying out the monitoring of the environment components itself , which are influenced by the plant- control of precision and errors of measurements, specification and accordance of the monitoring results with statuary indicators and level of acceptable or allowed pollution, conducting activities for improving the OEM practice in the sphere of precision and objectivity of the measurements and decreasing of pollution level to the statuary indicators.

The block- diagram of the arrangements of the operational ecological monitoring process is shown in the picture. The whole OEM process consists of a number of correlated procedures or steps, where output of one procedure is input of the next one. The input of the OEM process is adherence to the demands of legislative and statuary documents and the international standards [3,4] of carrying out the constant monitoring of the environment components, that are changed during the manufacturing activities of the plant on production and services output, and also during the life cycle of the manufactured products and wastes of own production.

Like any management process, the OEM includes planning and preparation for monitoring, which is reflected in procedures 1-6 (picture). The OEM planning includes checking of the environment components, resources, test points, ingredients of the pollutants that are subjected ecological control in accordance with the demands of the ecologic legislation taking into account the peculiarities of the plant activity and aspects of the influence of the plant on the natural environment (block 1). The next procedure (block 2) is analysis of the OEM results of the preceding period of time and comparing of them with the demands of legislative and statuary documents, comments and offers issued while conducting the external audit by independent audit organizations and the authorities of the regional or republican ecological control. The input of the given block is the inventory results of resources of pollution and the ingredients of

the pollutants of the plant, which was carried out in the preceding year. If the main components of the natural environment, ingredients and test points are transformed, changes are put into the schedule of the OEM conducting (block 3). The following procedure is updating the components, ingredients and test points of the OEM conducting (block 4) and elaboration of the OEM program, schedules, selection schemes, their coordination with the regional authorities of ecological control (block 5). Before the monitoring, the necessary procedure is preparation of the facilities and measurement systems (checking and calibration of the MS, repair of the facilities and devices) (block 6).The process of operational monitoring of specific natural environment components is shown in the blocks 7-10. At the Aksu ferroalloy plant, the OEM is put into practice in following directions: monitoring of emissions into atmosphere, control of working parameters of the gas-cleaning, aspirating and ventilating systems (block 7); monitoring of the outside air quality at the industrial site and by the plume of the plant, monitoring of waste water and underground water quality (block 8); monitoring of air quality (dust and gas content) in the working area; monitoring of meteorological parameters of the working places, their illumination (block 9); monitoring of the service and working rules of the gas-cleaning and aspirating systems, waste treatment facilities and reverse cycles of the plant; monitoring of industrial waste formation and recycling (block 10).

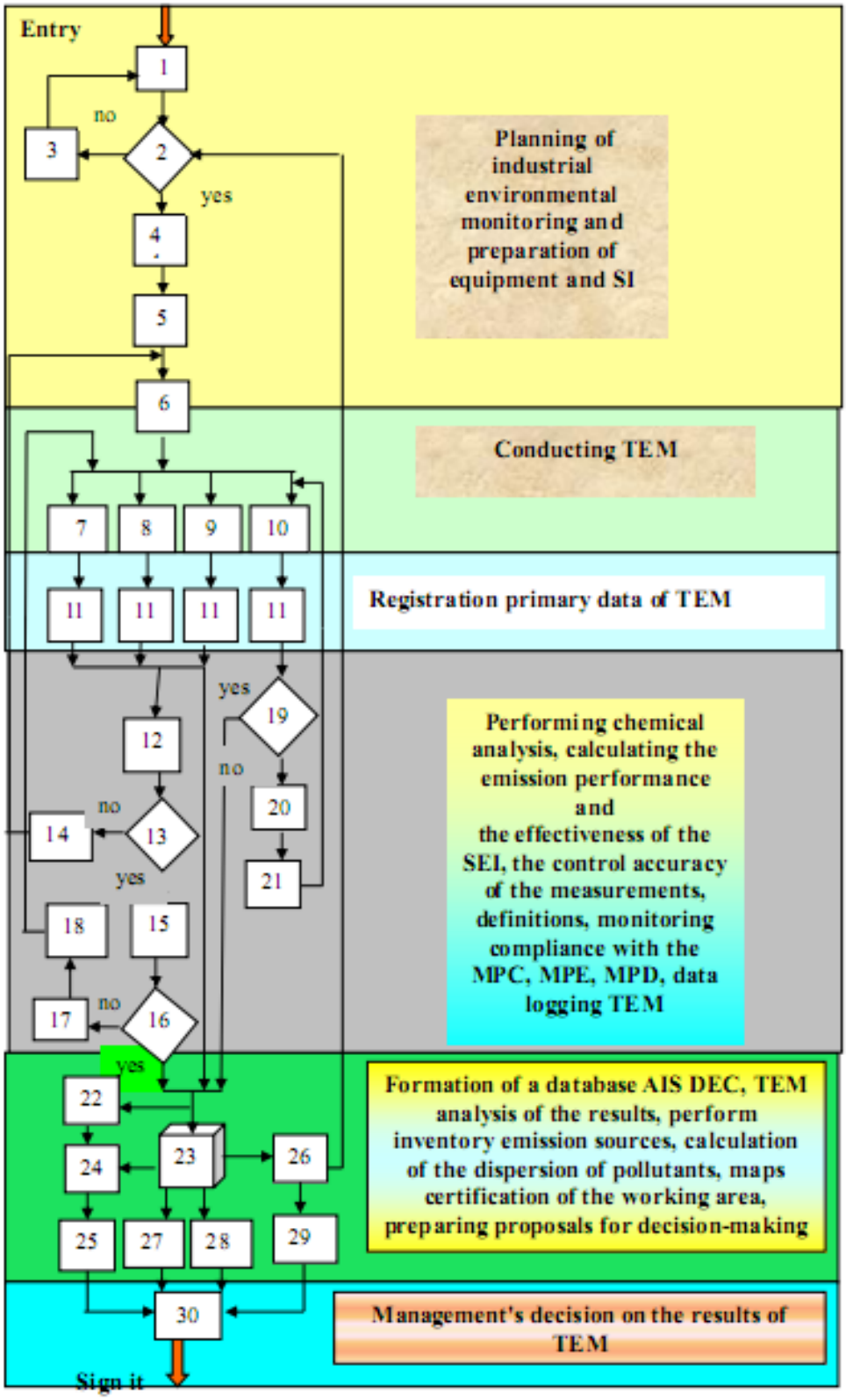
Like any managing process, the results of the fulfilled monitoring are documented during the OEM conducting, in particular, recording of the monitoring data in a register book or monitoring reports- primary (block 11), final (block 15) and in the computer database (block 25).

The block 12 shows procedures of making an analysis of air samples, atmosphere, technological gases, waste and underground water, fulfilling of gas-dynamic characteristics of the gas streams and calculation of the GCP (gas cleaning plant) working effectiveness, productivity of the ventilating systems.

During the OEM practice, fulfilling of the procedures is controlled by methods of the constant analysis and estimation of measurements and specifications productivity and effectiveness. Regulation of the OEM process provides correction of the non-conformities which appear during the operation (by means of correcting activities) and improvement of the process. The main way of improving is minimizing the instability of the measurements and specifications results and increase of the inaccuracy level.

So, in the suggested process approach of the OEM organization, there is provided the control of the instrumental measurements precision and inaccuracy and the results of defining the chemical analysis of the samples, which is shown in block 13. In the block 13, there are calculated the measurements inaccuracy and the results of chemical analysis of the natural environment ingredients and they are compared with the acceptable limits of precision and inaccuracy. Block 13 has two outputs, so when the measured levels of the physical parameters and results of a chemical analysis do not answer the demanded precision and inaccuracy of the definitions, there are elaborated correcting and warning activities in order to eliminate revealed non-conformities, which is shown in block 14, moreover, the output of the block 14 is directed to the input of the block 6 and the procedures 7-11 are repeated. If precision and acceptable inaccuracy are satisfactory, the results of the OEM are documented (block 17), the OEM data is registered in the register books and the computer database (block 25). At the ФАЗ there is developed and implemented monitoring data system of the ecological risks management (ADS ERM) (Svyatov, Slazhneva, Korchevskiy, Svyatov, Slazhneva & Korchevsky, 2001).

The process approach provides making an analysis of factual pollution level of the environmental components, checking of compliance with the maximum permissible concentrations (MPC), maximum permissible emissions (MPE), maximum permissible discharge MPD), project (passport) effectiveness of the gas cleaning plant (GCP) and productivity of the ventilating systems, control of following the rules of the GCP operation, ventilating systems, circulating systems, which is shown in the blocks 18, 21. In the case when the real level of the environment components pollution goes beyond the permissible limits of the MPC, MPE, TAE (temporarily approved emissions) or low factual effectiveness of the GCP work and productivity of the ventilating systems take place or the their service regulations are violated, a order is issued to a subdivision where a non-conformity is revealed with pointing the reasons of a non-conformity and terms of their correcting.



Picture 1. A block diagram of the process of organizing industrial environmental monitoring at AFP.

A plant subdivision with revealed non-conformities on the acceptable limits of the MPC, MPE, TAE and violation of the rules of the GCP operation, ventilating systems, circulating systems, works out and puts into practice correcting and warning activities (blocks 18, 20), after which new procedures to monitor the

given environmental components are carried out, that is outputs from the blocks 20, 23 go to the inputs of the blocks 7, 8,9,10 and the OEM process is repeated.

The next procedure of the process approach of the OEM arrangement is to summarize and analyse the monitoring data and the level of the natural environment components pollution, which is shown in the block 24.

After formation of the ADS ERM database, a current account on the OEM for an analyzed period is written and is brought to the plant administration (block 26). According to the results of the OEM conducting and the revealed deviations and non-conformities, there are issued offers to the administration about taking decisions concerning the violators of the environmental protection legislation (block 27).

Using the monitoring database with the help of the ADS ERM maps of the plant subdivisions attestation are developed (block 29), calculation of pollutant ventilation and building the fields of the harmful elements distribution in the atmosphere and soil of the adjacent territory (block 30).

At the end of the report year, an inventory of the resources and pollutants ingredients is made up (block 28), the results of which are used while planning the OEM for the following year (block 3) and they are recorded in the report on the resources and ingredients inventory (block 31).

According to the results of the environmental components monitoring, resources and ingredients inventory, maps of the working area attestation, the pollutants ventilation and offers of the laboratory concerning the revealed non-conformities, the administration specifies the prior organizational- technical activities to reach the acceptable level the pollution index for specific resources and plant subdivisions (block 32).

The result of the OEM process is an integral program of the activities for minimizing pollution of the environmental components of the plant.

Conclusion

Thus, there is a process approach to the management of the operational ecological monitoring (OEM) suggested, which includes the following functions: planning; organization and carrying out the monitoring; control of the performance quality and reliability of the monitoring results; checking of accordance with the demands of the statuary indicators; regulation of the processes and procedures in case of non-conformities.

The suggested OEM system – a process approach of organization and carrying out the operational ecological monitoring is put into practice in the system of the environment control according to ISO 14001-96 at the Aksu ferroalloy plant, a branch of the “Kazchrome “TNC” JSC, for which there is issued a standard of the plant СТП 2/30-2004 “Natural environment monitoring. Data record.”

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