

## THE EFFECTIVENESS OF OPEN SPACE FIRE EXTINGUISHING WITH FLAMMABLE LIQUID FIGHTING AEROSOLS (p. 4-11)

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Extinguishing flammable liquids in open space has always been a difficult task, since this type of fire is fast developing, and its consequences are catastrophic. The paper describes the peculiarities of fire extinguishing with powder agents and compares the latter with aerosol fire extinguishers. We have devised experimental methods and experimental samples of an aerosol fire extinguisher and a generator for its supply in cases of extinguishing open fires from flammable liquids on the front and quenching the flame from the middle of the hearth. The experiment has revealed the required rate of the aerosol supply, which amounts to about 8 g/cm<sup>2</sup> and is much lower than that of the powder flow. It is also proved that fire extinguishing is most effective when an aerosol fire extinguisher is supplied from the center of the pan and under the flame.

The experiment has revealed the intensity of the pan side heating and cooling in the process of aerosol fire extinguishing. We have found that the temperature for re-ignition of a combustible mixture at the sides of the heated pan is significantly higher than the temperature for its auto-ignition, the average supply time is about 45 seconds for the experimental aerosol fire extinguisher and 25 seconds for the aerosol generator, and the fluid re-ignition in the pan is almost impossible.

The use of aerosol fire extinguishers for extinguishing fires of flammable liquids in the spill and in the open space would reduce the time for extinguishing and improve the efficiency of fire quenching.

**Keywords:** aerosol fire extinguisher, fire extinguishing/fire quenching, fire extinguisher, fire extinguishing aerosol generator, aerosol-forming composition, desensitization.

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## SYSTEM ANALYSIS OF NATURAL- TECHNOGENIC SAFETY ELEMENTS OF THE LARGEST UKRAINIAN HYDRO-COMPLEXES (p. 12-21)

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Issues of natural-technogenic safety (NTS) of hydro-complexes is an important component of the national security system of the country, and operative decision-making in this area is one of the major factors of sustainable development

of Ukraine. At the same time, the problem of different subordination of the hydro-complex parts, inherent in Ukraine makes it difficult, and sometimes impossible to operatively estimate the real safety of the complex engineering facilities for further management decision-making.

The aim of the research was to develop an effective, representative and easy to use method for multi-criteria integrated assessment of NTS problems at 18 largest Ukrainian hydro-complexes as complex natural-industrial geological-engineering systems.

The expert method of pairwise comparisons in combination with the analytic hierarchy process (AHP) was used in the research.

The values of the integral danger index (IDI) and priority measures to prevent threats to NTS were defined for each of the studied facilities. Also, the global priorities of factors and prevention measures for all of the studied facilities in general were identified.

Expert surveys were conducted in 2003 and in 2013. The data obtained allowed to track trends and changes in estimating the situation in the area of operation of the largest Ukrainian hydro-complexes in the long retrospective.

**Keywords:** Ukrainian hydro-complexes, threat factors, integral danger index, threat prevention measures.

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#### INFLUENCE OF WASTEWATER CONTAINING HEXAMETHYLENEDIAMINE ON THE LIVELIHOODS OF HYDROCOLES OF ACTIVATED SLUDGE (p. 21-26)

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The data regarding the ability of hydrocoles, immobilized on the carrier VIYA in bioreactors to exist in the real conditions of the aerobic process in biological pipelines in industrial wastewater treatment from hexamethylenediamine – chemical fiber production waste were obtained. The long-term keeping of these wastes in storage ponds threatens the environment since there are the signs of destruction of the coast covering, a risk of toxic substances getting into groundwater. Treatment of these wastes by means of the biological pipeline, the aerobic process in which is carried out using microorganisms, immobilized on the carrier VIYA from existing aerotanks is proposed. Process quality control was carried out using the quantitative accounting of the organisms of activated sludge on the conventional five-point scale. Two kinds of hydrocoles: small colorless filaments and unicellular alga *Navicula* from diatoms turned out to be the most resistant to hexamethylenediamine. Process quality control for changing the content of nitrite and nitrate ions with time during the first four weeks revealed their reduction respectively from 75.5mg/dm<sup>3</sup> to 11.3mg/dm<sup>3</sup> and from 867mg/dm<sup>3</sup> to 219mg/dm<sup>3</sup>.

**Keywords:** activated sludge, aerobic process, wastewater treatment from hexamethylenediamine, process quality control.

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## ENVIRONMENTAL ASSESSMENT DEVELOPMENT OF ANTHROPOGENIC OBJECTS USING COMPARATOR IDENTIFICATION METHOD (p. 27-33)

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The relevance of the paper is in implementing a complex method of natural and industrial objects state assessment in order to predict its impact on the functioning of the natural environment (NE) and making administrative decisions based on solving the problem of ecological and socio-economic and environmental security.

The paper provides complex methodological grounds of natural and man-made objects quality assessment introducing the synergetic and entropy-information system analysis component. The paper shows that the socio-environmental aspect of security is to be determined by the compliance of the state of the technological systems with limited impact on the natural components of the research object.

Considering “technological system – environment” objects in a large amount of heterogeneous initial information the paper suggests a complex methodological support of quality level assessment of complex systems based on a combination of the principal components and comparator identification methods, which reduces the number of the analyzed factors (the size of the task) without losing the information content. The abilities of this methodical approach in establishing destabilization state system factors are examined which provides the basis for making a balanced management decision, that is self-regulatory mechanisms of state stabilization and introduction of hazards eliminating measures.

The paper provides the algorithm of the complex methodological support for environmental assessment of the system object as a sequence of the principal components method and the environmental comparator method which was used to create an analytical sample for analysis. The software is provided as mobile applications for user-oriented gadgets running on Android ranging from the Android 4.1 version and up to Android 4.4 (KitKat). Practical realization of quality assessment methodological support of complex systems with elements of comparator identification is carried out analysing the ecological condition of natural and industrial areas and dangerous industrial Kharkov region objects.

**Keywords:** naturally man-caused object, ecological, safety availability assessment, complex methodical support.

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## REMOVAL OF CHROMIUM(VI) AND URANIUM(VI) FROM AQUEOUS SOLUTIONS BY THE IMMOBILIZED NANOSCALE Fe<sup>0</sup> (p. 34-40)

Viktoriia Tobilko, Oleksandr Makovetskyi, Irina Kovalchuk, Borys Kornilovych

Using the macro-electrophoresis method, electro-surface properties of the synthesized composite sorbents were experimentally determined. It was found that their surface has a mosaic structure that contains functional groups, different in chemical behavior, causing the sorption properties.

The physicochemical characteristics of the processes of water purification from chromium(VI) and uranium(VI) compounds using sorption-reduction materials based on the nanoscale Fe<sup>0</sup> and clay minerals were investigated. It was found that the composite sorbents exhibit a high sorption capacity with respect to heavy metals in the anionic form. The removal efficiency of chromium and uranium from water is significantly affected by the pH of the aqueous medium and the content of the immobilized nanoscale Fe<sup>0</sup> in the composite. The possibility of using highly dispersed sorbents in deep water purification from heavy metal ions was shown.

**Keywords:** immobilized nanoscale Fe<sup>0</sup>, sorption capacity, chromium(VI) and uranium(VI) compounds, electro-surface properties.

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### IMPROVING THE ENVIRONMENTAL SAFETY OF DRINKING WATER SUPPLY IN KHARKIV REGION (UKRAINE) (p. 40-49)

Oleg Tretyakov, Tamara Shevchenko, Vitalii Bezsonnyi

The current poor state of water bodies testifies to the fact that the problems of water protection from pollution and depletion have not been solved and even significantly aggravated, especially in recent years. We have studied the quality of water and the ecological state of surface sources of drinking water supply in Kharkiv region and made a retrospective analysis of the chemical composition of the waste water that was released into the Siversky Donets by the Izyum Municipal Industrial Water Supply and Sewerage Company from 2008 to 2014.

We have revealed the sustainable trends of worsening efficiency of wastewater treatment plants in the sanitation system of Izyum, which has, consequently, led to a significant deterioration in water quality and ecological state of the Siversky Donets that is the source of drinking water for settlements of three regions of Ukraine: Kharkiv, Donetsk, and Luhansk.

We have suggested the basic ways to improve the water quality in the Siversky Donets and the ecological state of the entire region, which include: (1) a major reconstruction of sewage treatment plants in Izyum in order to improve the ecological state of the Siversky Donets basin and achieve the required quality of the surface water sources as well as (2) provision of a system of the state continuous monitoring of surface water in the Siversky Donets basins, within Kharkiv, Donetsk and Luhansk regions, to promptly identify the polluting enterprises, institutions and organizations and timely use the leverage provided by the current legislation of Ukraine.

**Keywords:** surface water, chemical analysis, drinking water, waste water/sewage, hardness salts, nitrates, phosphates, sulphates, water quality indices.

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### DETERMINATION OF THE AROMATIC HYDROCARBONS IN PETROLEUM PRODUCTS (p. 49-53)

Natalia Amirulloeva

Comparative assessment of modern physicochemical methods for determining the aromatic hydrocarbons in diesel fuel was performed. In order to control the quality and the environmental characteristics, the structural-group and frac-

tional compositions of the sample of commercial diesel fuel were identified. Pre-separation of the diesel fuel containing these compounds was carried out by column chromatography. The qualitative and quantitative analysis of the diesel fuel and the resulting fractions was conducted by mass spectrometry and gas-liquid chromatography. Analysis of these products by UV-spectroscopy allows direct determination of aromatic hydrocarbons with the satisfactory convergence of the results.

On the example of diesel fuel, a systematic approach in determining the group composition of multi-component objects was shown. A set of the methods applied can be used for identifying the organic substances of unknown composition, solving scientific and technical tasks, such as qualitative and quantitative analysis of commercial petroleum products, monitoring of natural objects. The complex of methods and systematic approach for investigating complex mixtures allows to increase the reliability and validity of the results.

**Keywords:** diesel fuel, component composition, mass spectrometry, UV-spectroscopy, gas liquid chromatography, liquid column chromatography.

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### OVERVIEW OF DIRECTIONS OF IMPROVING THE SIMULATION OF SEVERE ACCIDENTS BASED ON THE EXPERIENCE OF THE TREE MILE ISLAND NPP (p. 54-59)

Igor Kozlov

After the accident at the 2nd unit of the Three Mile Island NPP (USA) in 1979, scientists and experts of the world nuclear community came to the unequivocal conclusion on the need for deeper study of the causes and consequences of severe accidents.

Simulation and analysis of severe accidents are the fundamental basis of guidelines/instructions, regulating the

strategies and actions of the emergency management staff. Therefore, the simulation adequacy and validity of emergency processes determine the effectiveness of management strategies of severe accidents.

An overview of known results of numerical simulation of the severe accident at the TMI-2 NPP, as well as the simulation results of containment destruction processes in severe accidents in tank reactors was presented.

Based on the analysis, the basic directions of improving the methodological support in the simulation of steam-gas explosions taking into account the reasonableness of the choice of modes and conditions of using the calculation methods (codes) with their subsequent verification and validation based on the example of the Fukushima severe accidents were determined.

**Keywords:** simulation, steam-gas explosions, severe accidents, core, reactor vessel, containment.

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