ABSTRACT AND REFERENCES

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USE OF UNCERTAINTY FUNCTION FOR IDENTIFICATION OF HAZARDOUS STATES OF ATMOSPHERIC POLLUTION VECTOR (p. 6–12)

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The use of estimation of the values of the uncertainty function to identify hazardous states of an arbitrary atmospheric pollution vector is considered. At the same time, it is proposed to estimate the uncertainty function in a fixed-width window moving along the trajectory of the state vector. This allows not only identifying the occurrence of hazardous states of atmospheric pollution, but also determining their radial velocity relative to the monitoring post. Zero radial velocity of hazardous states of atmospheric pollution allows identifying current states of no pollution dispersion in the atmosphere. These states turn out to be especially dangerous, since they lead to the accumulation of pollution and an increase in their concentration in the atmosphere. Verification of the possibility of using the uncertainty function to identify hazardous states of the atmospheric pollution vector was carried out using experimental data. At the same time, formaldehyde, ammonia and carbon monoxide were considered as hazardous components of the state vector of atmospheric pollution. The verification results generally indicate the possibility of using the uncertainty function to identify hazardous states of the atmospheric pollution vector. The use of uncertainty function is found to be invariant with respect to the irregularity of recording of atmospheric pollution at stationary monitoring posts. It is shown that the use of uncertainty function enables the identification of hazardous states characterized not only by exceeding the maximum permissible concentrations, but also by the zero radial velocity relative to the monitoring point. It is experimentally found that in order to identify hazardous states of atmospheric pollution, the window length should be from 4 to 8 readings

Keywords: atmospheric pollution, pollution concentration, uncertainty function, radial velocity, state vector

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DETERMINATION OF THE LAWS OF THERMAL RESISTANCE OF WOOD IN APPLICATION OF FIRE-RETARDANT FABRIC COATINGS (p. 13-18)

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The creation of environmentally safe fire-retardant materials for wooden building structures will allow influencing the processes of heat resistance and physicochemical properties of the protective coating during its service life. Therefore, there is a need to study the conditions for forming a barrier to thermal conductivity and determine a mechanism of inhibiting heat transfer to the material. In this regard, a mathematical model of the thermal conductivity process when using fire-retardant fabric as a coating is developed, the solution of which allows obtaining changes in the thermal conductivity of the material. According to experimental data, it is calculated that the thermal conductivity coefficient during fire protection in the temperature range from 0 to 110 °C increases due to water evaporation and then gradually decreases to 0.25 W/(m·°C), which corresponds to the value of coked foam. It is proved that the process of temperature inhibition consists in the formation of soot-like products that insulate the wooden structure. This made it possible to determine the conditions of fire protection of wood, formation of a barrier to thermal conductivity using fire-retardant fabric. Experimental studies confirmed that the wood sample with fire-retardant fabric withstood the temperature effect, namely, under the influence of the heat flux, the coating swelled, heat insulation continued for 900 s. Estimation of the maximum possible temperature penetration through the coating is carried out. It is found that when creating the sample surface temperature, which significantly exceeded the ignition temperature of wood, the temperature under the fabric did not reach the ignition temperature, and on the unheated surface it did not exceed 100 °C.

Thus, there are reasons to argue about the possibility of directed control of the processes of wood fire protection using fire-retardant coatings capable of forming a protective layer on the material surface, which reduces the burnout rate of wood

Keywords: protective means, fire resistance, weight loss, surface treatment, wood burnout, fire-retardant fabric

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EXTRACTION OF IRON-CONTAINING CATALYST FROM CHLORORGANIC WASTES GENERATED BY ETHYLENE CHLORINATION (p. 19–26)

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The technologies for extracting an iron-containing catalyst from process streams of direct chlorination of ethylene, as well as methods for the disposal of organochlorine wastes from vinyl chloride production, are considered. Problems arising from thermal waste disposal necessitate studies on the extraction of iron compounds from organochlorine by-products of the ethylene chlorination process. X-ray fluorescence analysis found that the composition of the burning sludge, as the main elements, includes iron – 33.25 % and chlorine – 32.69 %. The extraction of iron compounds with aqueous and aqueous acidic media under mechanical stirring is studied. It is shown that the addition of hydrochloric acid to the solution does not contribute to an increase in the degree of extraction of iron compounds. It is found that an increase in the duration of extraction and the temperature of this process provides a degree of extraction of iron compounds of more than 80 %. The process of separation of an aqueous-organic emulsion, which is formed during extraction, by sedimentation, filtration and centrifugation, is investigated. It is found that at a temperature of about 80 °C there is an effective and rapid separation of the aqueous and organic phases as a result of sedimentation. Based on the obtained experimental results of the extraction study, a functional scheme for the extraction of an iron-containing catalyst is proposed, as well as ways to solve technological and environmental problems that arise during the combustion of organochlorine wastes from vinyl chloride production. The scheme provides for the use of the heat of hot organochlorine wastes for the extraction of iron compounds with industrial water. In addition, the use of the heat of the gases generated during the combustion of organochlorine wastes is provided for heating air, which low-boiling components from these wastes are blown off. In the future, this air is used to burn organochlorine wastes purified from iron compounds

Keywords: organochlorine wastes, vinyl chloride, burning of organic waste, burning sludge, extraction of iron-containing catalyst, extraction

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CHOOSING THE PHYTOREMEDIATION TECHNOLOGIES FOR CLEANING VARIOUS TYPES OF WASTEWATER (p. 27–37)

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A methodological approach has been devised for determining the priority phytoremediation technology for the treatment of wastewater from settlements, based on the hierarchy analysis method (MAI). The proposed approach makes it possible to involve experts from municipal authorities of a settlement to substantiate decisions on managing the environmental safety of surface water bodies adjacent to the selected settlements.

The criteria (groups of factors) have been proposed, which reflected the input and output parameters of a treatment system, conditions at a construction site of treatment plants, and the requirements for phytoremediation technologies. Experts in various professional aspects gave their judgments regarding the priority of advantages of the mentioned criteria. The multidisciplinary experts' judgments, which reflected the specific features of phytoremediation and the conditions for a would-be location of treatment plants, processed according to the scientifically based MAI procedure, formed the basis for decision-making on the choice of a priority phytoremediation technology under specific conditions.

The advantages of the proposed methodological approach include a possibility to link the entire array of the necessary information to a single algorithm for substantiating a solution. The information differs both in its content (environmental, biological, urban planning, social and economic) and in the form of its representation (the data on direct measurements, statistical and forecast estimates).

The proposed methodological approach has been tested based on an example of choosing the phytoremediation technologies for treatment plants at three different types of facilities such as an industrial enterprise, a residential building, and a city hospital. The obtained results demonstrated an acceptable level of conformity, which testifies to their reliability.

The devised methodological approach is useful for making managerial decisions on the choice of technology for the phytoremediation at treatment plants in order to substantiate their improvement or to build new plants.

Keywords: environmental safety, phytoremediation and its technologies, higher aquatic plants.

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ENGINEERING METHOD FOR DETERMINING RATIONAL FIRE PROTECTION PARAMETERS OF WAREHOUSES (p. 38–45)

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A mathematical model and methodology has been developed to determine the optimal amount of means of a fire-prevention system for protecting warehouses in enclosed spaces, on the basis of which it is possible to determine measures to improve this system, taking into account the value of the probability of its failure acceptable for the warehouse. The essence of the developed methodology is to determine the required number of fire protection equipment in accordance with the standards, to determine the probability of failure of fire protection and to determine the optimal number of fire protection equipment to ensure the value of the probability of failure within acceptable limits. The optimization criteria selected direct losses from the fire and the costs of fire and rescue units to extinguish it. The function of the goal of this model is to reduce the probability of failure of the fire system of the object to a value less than or equal to the permissible. The input data when using the mathematical model is the estimated number of fire protection equipment in accordance with the norms and standards.

The developed methodology allows predicting the probability of failure of the fire system to implement the fire safety of the objects of protection and its consequences for people and material values, which is very important to ensure the possibility of quick response in case of fire. Also, the result of applying the technique is the optimal amount of firefighting equipment at the facility, providing an acceptable value for the probability of failures. This technique is applied on the example of an existing logistic warehouse on which fire protection systems are mounted. Simulation results show that at the facility it is necessary to increase the number of fire detectors up to 70 pieces, smoke control devices – up to 3 pieces, vertical curtains – up to 4, equip aeration lamps in the amount of 4 pieces, and increase the number of evacuation exits - up to 10.

Keywords: fire protection system, fire damage, fire protection costs, probability of system failure.

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THERMOTECHNICAL PROPERTIES OF THE FIRE-EXTINGUISHING POWDER FOR EXTINGUISHING MATERIALS BASED ON MAGNESIUM ALLOY CHIPS (p. 46–53)

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The article addresses the relevant issue of determining the thermotechnical characteristics of the fire-extinguishing powder for thermal insulation of the fire center of materials based on magnesium alloy chips to prevent fire development and propagation and its effective extinguishing. To solve this problem, laboratory and field experimental studies of the heat-insulating ability of the fire-extinguishing powder of combined effect were conducted. As a result, we obtained the data on the temperature in the center of the fire of materials based on magnesium alloy chips and outside during their suppressing by the fire-extinguishing powder with a combined effect. In this case, the temperature of the non-heated side of the fire-extinguishing powder layer does not exceed 170 °C at the average temperature of the fire center of 740 °C, which indicates high insulation capacity of the powder and, consequently, its high fire-fighting efficiency in extinguishing the fires of materials based on magnesium alloy chips. The obtained temperature data were used to determine the thermophysical parameters of the layer of the fire-fighting powder using the created mathematical model of the heat transfer process in the powder layer at the heat insulation of the fire center. To create a mathematical model of the heat transfer process, the main provisions during consecutive consideration of several experimental situations were stated. The first experimental situation meets the conditions of the stationary thermal process, and other experimental situations meet the conditions of the non-stationary thermal process. These experimental situations were created with the help of changing the thickness of the fire-fighting powder layer at different parameters of its feeding to the fire center. The mathematical model of the process is based on the use of the differential equation of heat transfer at its approximation by the method of finite differences. At the same time, it is believed that the heat transfer conditions at the boundary between the non-heated side of the insulating layer of the fire-extinguishing powder and the environment in each experimental situation are the same.

Using the created model, the coefficient of heat transfer between the non-heated side of the insulating layer of the fire-extinguishing powder and the environment was determined. It amounted to 395.7 W(m^2·°C). The dependence of the effective thermal conductivity coefficient on the thickness of the insulating layer was explored. It was shown that this dependence can be approximated by linear dependence $\lambda(\delta)=-0.016+93.907\cdot\delta$ (δ is the thickness of the layer of the fire-extinguishing powder in meters).

After conducting the necessary calculations, we obtained the value of the required thickness of the layer of fire-extinguishing powder δ=45.2 mm.

Keywords: fire-extinguishing powder, metal combustion, magnesium alloys, insulating layer, intensity of extinguishing.

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