ABSTRACT AND REFERENCES

ECOLOGY

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IDENTIFICATION OF SPECIAL FEATURES IN THE ELECTROLYSISCAVITATION WATER TREATMENT IN POOLS (p. 6-15)

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We developed an innovative technology of electrolysis-cavitation water purification and water treatment in pools. This method belongs to the group of physical water purification methods and its advantage is the absence of the need for costly chemical disinfectants and a degree of water purification from biological and organic pollutants of up to 97–98 %. A typical electrolytic water treatment process, based on electrolysis disengagement of sodium chloride with the formation of reactive sodium hypochlorite, is complemented by the operation of water cavitation disinfection from organic and biological pollutants. Prior to the electrolysis, the cavitation treatment of water in pools reduces by 75–80 % the degree of its contamination, reduces approximately by two times the need in disinfectant produced by electrolysis installations. This proportionally reduces by 45–50 % the duration of energy-consuming electrolysis equipment operation and reduces by one-third the costs of electricity for water treatment operations.

For cavitation disinfection of water in pools, we have devised a new design of an industrial variant of the vibrocavitator with a resonance effect, studied the conditions for disturbing the cavitation processes within it, and developed a procedure for the design and calculation of its main components and parts. The block of vibrocavitators that precedes electrolysis water treatment ensures the oxidation of organic impurities in polluted water, including urea, to 75–77 %. The degree of biological water disinfection in this case reaches 80–82 % with a capacity of 3–3.5 m^3/hour.

The power of electromagnets in a vibrocavitator drive is 1–1.5 kW, which is an order of magnitude less compared to the power of electrolysis installations. Given this, the proposed phased cavitation and electrolysis water treatment reduces the total energy consumption for a water treatment operation. For standard pools with a water volume of 3,000 m^3 with electrolysis water treatment, the introduction of additional cavitation treatment will make it possible to reduce monthly energy consumption for a water treatment operation by about 1,200–1,500 kW.

We have considered the legal aspects for implementing the proposed solutions in terms of the production implementation of the electrolysis-cavitation water treatment process and improving the safety of users of water procedures and services.

Keywords: cavitation water treatment, electrolysis water treatment, biological pollution, organic impurities, chemically active radicals.

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DETERMINING THE EFFECT OF MULTIFUNCTIONAL PARTITIONS ON NOISE LEVEL AT "OPEN SPACE" OFFICES (p. 16-26)

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Multifunction partitions and their influence on noise levels were explored. It was emphasized that the existing systems of classification of building partitions explore them based on the convenience of their use, material, design, etc. At the same time, not enough attention was paid to their impact on the indicators of a decrease in noise levels in office premises.

Partitions are made of different materials, having different properties; they are different in shape and enclosure of premises or workspace at different distances from the floor. In such cases, there arises a complicated problem of selecting certain types of partitions, which, as shown in the research, make it possible to solve the problem of optimizing working conditions and reduce the negative effect of noise on the health of employees. The performed research showed that the set problem of noise reduction through the use of partitions can be solved. The factors that should be especially taken into consideration include the height of a partition (degree of enclosure of the height of premises by a partition), material of partitions, existence of technological openings and the geometry of their location. It was revealed that double-layer walls, made of heavy materials (density ≈2,500 kg/m^3) and 100 % premises enclosure by height, can reduce the noise level by 2–3 times (from 90 dBA to 30–45 dBA). Glass partitions (glass pipes) of moderate heaviness (≈1,200 kg/m^3) reduce noise by 1.5–1.6 times. If enclosure of premises is not complete or there are openings, ventilation shafts, etc., the effect of influence of partitions decreases considerably, reducing it almost to zero. Significant influence of partitions takes place in the frequency range of 200–3,000 Hz at noise level of 40–60 dBA.

Noise was explored in the premises of the "Open space" type, where various options of partitions were applied (glass pipes in metal casings, ceramic panels, foam plastic panels). The research found that partitions can have a significant impact on noise indicators, but only on condition of complete enclosure of premises by height, closed doors and construction channels in walls. It was established that the material of partitions does not affect noise indicators if the degree of premises enclosure is not complete (less than 100 %).

The studies proved the relevance of scientific substantiation of partitions' application and of determining the relations of premises enclosure with the factors that affect employees with a view to improving their working conditions. Improvement of working conditions, in turn, will make it possible to decrease professional diseases, minimize turnover, and increase work efficiency.

Keywords: "Open space" office, workspace localization, construction partitions.

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DEVELOPMENT OF A TECHNOLOGY FOR UTILIZING THE ELECTROPLATING WASTES BY APPLYING A FERRITIZATION METHOD TO THE ALKALINE-ACTIVATED MATERIALS (p. 27-34)

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The study reported in this paper reveals the effective way of recycling water treatment products by using them as a component of alkaline cements and concretes based on them. Large-scale utilization of products from waste water purification in the composition of building materials has traditionally been limited given that heavy metal compounds are included in the composition of waste. Materials that are created using such a waste are traditionally considered to be dangerous for human health and the environment. Application of alkaline cements as matrices for binding these wastes and related products makes it possible to solve the task on reliable binding of heavy metals. It was experimentally determined that the main crystalline phases are calcite, quartz, hematite, coesite, and diopside. Also defined is the presence of gelatinous neo formations that are capable of subsequent recrystallization into zeolite-like structures. Such a composition of neo formations provides the involvement of heavy metal ions into the structure of the received material. Compressive strength of alkaline-activated systems that employ water treatment products (industrial wastes of galvanic production) reaches 40 MPa in standard mortars. Application of the developed cements in concretes makes it possible to achieve the strength of 45 MPa without changing the technological process of concrete preparation. The leaching of heavy metals from the matrix of alkaline cements was studied following the aging of up to 28 days by using atomic absorption spectroscopy. The study performed has shown that the alkaline cement matrix is characterized by high immobilizing properties relative to the heavy metal compounds (the level of immobilization of heavy metals ions is up to 99 %) and allows the use of industrial waste water purification products in the composition of alkaline cements and concretes based on them. Application of such an approach will not only solve the environmental problems related to disposing of hazardous products from water treatment, but would also make it possible to obtain building materials for general purposes with high operational properties.

Keywords: industrial waste water, ferritization technology, alkaline cements, ferritic precipitations, leaching of heavy metal ions.

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INFLUENCE OF TESTING SAMPLES' PARAMETERS ON THE RESULTS OF EVALUATING THE FIRE-PROTECTIVE CAPABILITY OF MATERIALS (p. 35-42)

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Test methods given in EN 13381-4:2013 and EN 13381-8:2013 standards serve to assess the fire-protective capacity of materials for steel structures. The results of the tests determine data on minimum thickness of fire-protective materials used further in design of steel structures. The tests are very time consuming. They require significant costs for creation of standardized samples and conduction of tests. At the same time, there are methods, which propose to use samples of reduced sizes and of other shapes than sizes and shapes of standardized samples. There is an actual question about possibility of application of methods with samples of reduced sizes as an alternative to EN 13381-4:2013 and EN 13381-8:2013 methods.

The study investigated the convergence of results of assessment of the fire-protective capacity of two types of fire-protective materials for steel structures obtained in tests on standardized samples and tests on samples of reduced sizes. We established that values of the minimum thickness for reactive fire-protective material obtained from the test data on samples of reduced sizes are

predominantly larger than values for standardized samples. Values of the minimum thickness for passive fire-protective material obtained using standardized samples are mainly large. The difference between the minimum thickness of reactive fire-protective material obtained on samples of reduced size and standardized samples reaches 79.0 %, and it is 62.5 % for a passive fire-protective material. Such difference of values indicates that it is impossible to use samples of reduced sizes for assessment of the fire-protective capacity of materials for steel structures for all ranges of reduced thickness of a steel profile, critical steel temperature and the normalized threshold of fire resistance of structures listed in EN 13381-4: 2013 and EN 13381-8: 201.

Keywords: fire-protective capacity, fire-protective material, critical temperature, threshold of fire resistance, steel structure.

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DEVELOPMENT OF A METHOD FOR PREDICTING THE RECURRENCE OF STATES OF ATMOSPHERIC AIR POLLUTION CONCENTRATION IN INDUSTRIAL CITIES (p. 43-48)

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This paper reports the method developed for predicting the recurrence of states related to air pollution at industrial cities based on the modified window measure. The new scientific result implies that dangerous states of the urban air pollution should be identified and predicted based not on the prediction of the concentration of pollution as it is, but based on forecasting the recurrence of states of the concentration of atmospheric air pollutions. The proposed prediction method makes it possible to operatively forecast not only the clear but also hidden dangerous states of air pollution at industrial cities.

This provides for an overall improvement in the effectiveness of interventions to prevent hazardous contamination of the atmosphere and the environment. The results of experimental testing indicate the feasibility of the proposed method. It was established that in the test interval of monitoring (between counts 12–36) there were sharp characteristic changes in the predicted measure for the recurrence of state. It is noted that such changes are the predictors of hidden events involving hazardous air pollution at industrial cities. It was experimentally found that a more accurate forecast is ensured for the forecast horizon d=1 (6 hours). It is shown that in the considered case, in order to ensure the reliability of forecasting laminar states in the contaminated atmosphere, the smoothing parameter to be selected should not be less than 0.8. It is noted that in order to predict dangerous states of the atmosphere pollution based on the dynamics in the prediction of a state recurrence measure, there is no need in the information about meteorological conditions at the time of forecasting and in the future. This is the main distinguishing feature and advantage of the proposed prediction method. A given method for RS forecasting proves to be invariant to urban configuration, the types of stationary and mobile pollution sources, as well as meteorological conditions.

Keywords: air pollution, recurrence of state, window measure, recurrence prediction, hidden hazardous states.

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EFFECT OF A FLAMERETARDANT COATING ON THE BURNING PARAMETERS OF WOOD SAMPLES (p. 49-54)

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The studies of influence of wood fire protection on ignition have established parameters of flame propagation and combustion suppression which makes it possible to influence this process. It was proved that fire protection consists in creation of a layer on the material surface which prevents the material from warming up to its critical temperature. Experimental studies confirmed that the untreated wood specimen ignited under thermal action resulting in its combustion with a burnout rate of 18 g/(m^2·s). With an increase in intensity of combustion of the ignition gas mixture by 25 % and 50 %, rate of the specimen weight loss increased by 1.4 times and 1.8 times, respectively. In the case of wood impregnation, the rate of weight loss was reduced to 4.8 g/(m^2·s) due to decomposition of flame retardants under thermal action with release of non-combustible gases which inhibited material oxidation and formed a coke layer. When treating wood with an inorganic coating, a heat-resistant ceramic film is formed on the wood surface which reduces the burnout rate 3.8 times. But with an increase in intensity of combustion of the igniting gas mixture by 50 %, the wood specimen has ignited which was reflected by increase in the weight loss rate. Application of organic-mineral coatings under thermal action has resulted in formation of a layer of foamed coke, inhibition of heat transfer from high-temperature flame and reduction of burnout rate to 3 g/(m^2·s). This has made it possible to determine conditions of change and inhibition of the combustion parameters for fire protection of wood by creation of a barrier for thermal conductivity. The results of comparison of experimental data on the wood burning rate with the derived analytical equations have shown conformity between them. Thus, there are grounds to assert about the possibility of directed regulation of processes of wood fire protection by using flame retardant coatings capable of forming a protective layer on the material surface that reduces the wood burnout rate.

Keywords: protective means, fire resistance, weight loss, surface treatment, wood burnout rate, efficiency of protection.

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IDENTIFICATION OF PROPERTIES OF RECYCLED HIGHDENSITY POLYETHYLENE COMPOSITES WHEN FILLED WITH WASTE MUD SOLIDS (p. 55-60)

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The possibility of increasing recycling volumes of drilling waste using as a filler for producing polymer composites is considered. As a result of the research, modification of recycled high-density polyethylene with waste mud in the form of fine filler particles is carried out.

Recycled high-density polyethylene polymer composites, filled with drilling waste with a content up to 30 % are obtained. As a result of the study, regularities of changes in impact strength, ultimate bending and water absorption, depending on the waste mud solids (WMS) content in the recycled polymer are found.

It is shown that the introduction of WMS in the form of fine filler particles in recycled high-density polyethylene significantly increases their strength characteristics without a substantial deterioration in water absorption (up to 2.9 % when filled with waste up to 30 %).

It is found that the optimum content of drilling waste in recycled high-density polyethylene polymer composites is 20 wt %. At the same time, the maximum values of impact strength and ultimate bending are achieved for the composite with bentonite clay WMS up to 63.3 kJ/m^2 and 200.1 MPa, and for the composite with salt WMS up to 38.1 kJ/m^2 and 207.4 MPa, respectively. The resulting polymer composites outperform the known similar polymers with the use of such fillers as talc and kaolin. This allows recommending joint recycling of drilling and polymer waste.

Keywords: polymer composite, filler, waste mud, structural modification, impact strength, breaking stress.

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