CHEMICAL AND TECHNOLOGICAL SYSTEMS

DOI: 10.15587/2312-8372.2019.169748

IDENTIFICATION OF THE BEHAVIOR OF PROPERTIES OF A COLD-HARDENING GLASS-LIQUID MIXTURE WITH PROPYLENE-CARBONATE DIFFERENT IN DOSING COMPONENTS

page 4–9

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The object of research are models that describe the effect of liquid glass and propylene carbonate as a hardener of the molding mixture on its properties. One of the most problematic places is determination of the behavior of the properties of the mixture under conditions of deviation from the optimal values of the content of liquid glass as a binder and propylene carbonate as a hardener. The definition of such behavior is important because it will improve the processes of regulating the loading of mixers in automated systems for the manufacture of the mixture in foundries.

The methods of canonical transformation of response surfaces are used, describing the effect of the content of liquid glass and propylene carbonate on the following properties of the mixture: survivability, compressive strength after 1 hour, after 3 hours, after 24 hours, crumbling. The mechanisms of chemical reactions that lead to the process of mixture curing are described and the possibility of obtaining qualitative characteristics of the mixture is substantiated by analyzing the chemistry of the process.

An analytical description of the response surface in the stationary region in the factor space transformed after the standard procedure «liquid glass content – propylene carbonate content» is obtained in canonical form. Such a transformation allows to estimate the nature of the response surface by analyzing the ratios of the eigenvalues included in its canonical description in terms of size and sign. Such an approach used has an important feature, since it allows one to directly determine the behavior of the properties of the mixture in the event of deviations from the optimal values of the content of liquid glass and propylene carbonate.

This makes it possible to determine measures or technical solutions for the work or to improve the systems for regulating dosing processes in automated systems for the production of a mixture in foundries. At the same time, adaptation to any known dosing systems of binder and hardeners of cold-hardening mixtures is possible. This opens up prospects for stabilizing the quality of the molding or core mixture and improving the quality of shaped castings for mechanical engineering, in particular, responsible and basic cast parts of internal combustion engines (ICE).

Keywords: cold-hardening mixture, propylene carbonate, liquid glass, properties of the mixture, dosing of components, canonical transformation of the response surface.

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MEASURING METHODS IN CHEMICAL INDUSTRY

DOI: 10.15587/2312-8372.2019.169696

IMPROVING THE ACCURACY OF CLASSIFYING RULES FOR CONTROLLING THE PROCESSES OF DECULFURATION AND DEPHOSPHORIZATION OF Fe-C MELT

page 10–18

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The object of research is the process of functioning of the chemical-technological system of two series-connected units, designed to produce Fe-C melt. This process is evaluated on the basis of the classification rules, which makes it possible to identify that component of the system, according to which the deviations of the operating mode from the normal by chemical analysis of the content of sulfur and phosphorus are revealed. Such consideration allows determining the completeness of the desulfurization and dephosphorization processes of the Fe-C melt. One of the most problematic places is the lack of systematized data on the procedures for determining possible deviations from the normal mode of functioning of the aggregates in terms of the completeness of the desulfurization and dephosphorization processes.

In the course of research, the methods of parametric classification were used, which allow one to obtain an analytical description of the discriminant function and, based on a comparison of its values at a given point in the space of factor-attributes with a threshold value, assign an object to one of the classes. In this research, each of the classes characterizes an aggregate of a chemical-technological system for the content of sulfur and phosphorus in the Fe-C melt.

The obtained results allow to state that it is possible to construct a broken curve separating classes using the methods of parametric classification. This is due to the fact that the proposed five-step procedure for selecting the input data area makes it possible to remove one of the restrictions on the use of parametric classification methods, namely, the requirement of equality of covariance matrices. The proposed procedure has a number of features, in particular, the choice of the input data area for calculating the coefficients of the discriminant function and threshold values is determined through the vertices of the plans for the full factorial experiment. This ensures the possibility of obtaining one hundred percent accuracy of classification in areas corresponding to its plan. Compared to the results of the construction of classification rules for the total sample of data, that is, for all points of the space of factor-attributes, and not only for points of the chosen plan, this does not have significant advantages. But from the point of view of obtaining the form of a separating curve other than linear, this can be beneficial if the input data samples are not well separated.

Keywords: chemical-technological system, Fe-C melt, classifying rules, statistical classification, discriminant function.

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REPORTS ON RESEARCH PROJECTS

DOI: 10.15587/2312-8372.2019.168150

RESEARCH OF OPERATING MODE OF RHOMBIC GRAVITATIONAL PNEUMATIC CLASSIFIER

page 19–21

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The paper discusses the technology of obtaining organic and organo-mineral granules of prolonged action. It is found that the granular marketable product must meet certain requirements for particle size. Consequently, the separation unit (classification) in the developed technological scheme plays a very important role in the process of obtaining commodity pellets. The object of research is the process of classification of granular organic fertilizers in the rhombic gravitational pneumatic classifier. The study is aimed at establishing the optimal mode-technological parameters of the «rhombic» pneumatic classifier. For this, a physical model of the process of pneumatic classification of dispersed particles (granules) in a rhombic form is studied, which explains the conditions for the separation of a polydisperse mixture into narrower fractions, the formation of a suspended layer of material. As well as a cyclic mechanism for loading and unloading the suspended layer. In addition to ensuring the purity of the product, the apparatus should also have a low hydraulic resistance and low power consumption. For physical modeling, a laboratory bench of a rhombic gravitational pneumatic classifier is used, on which a number of experiments are performed on the selection of the optimal separation mode and product purity. Rational use of the working space and effective ways to influence the flow of material within the same building allows to obtain the required separation parameters. Carrying out the classification process in the «rhombic» pneumatic classifier can effectively remove up to 99 % of particles less than 2 mm in size from the granulated product. At the exit of the apparatus, let's obtain a marketable product with a particle size of 2–4 mm in an amount of 99 %, which corresponds to the standard requirements for a qualitative particle size distribution. Such an effective separation in this apparatus is due to its shape (optimal opening angles and closure of the «rhomb» of the case), which contributes to the rotation of the material flow and leads to an additional reseeding. The absence of contact elements inside the device significantly reduces its hydraulic resistance and reduces energy consumption.

Keywords: process of pneumatic classification of dispersed particles, rhombic form, particle size distribution, hydraulic resistance, granular product.

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DOI: 10.15587/2312-8372.2019.166312

INTENSIFICATION OF WASTEWATER PURIFICATION OF MUNICIPAL SOLID WASTE LANDFILLS

page 22–24

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The object of research is the wastewater of municipal solid waste landfills and the effectiveness of using a combination of various technological methods, in particular, a combination of reagent and biological methods to bring the quality of filtrate to regulatory requirements. In particular, a reduction in the negative impact of wastewaters of MSW landfills, which contain toxic organic substances, on the environment and human health is achieved.

In the course of the research, a comparative analysis was performed of the effectiveness of using conventional and activated coagulant solution of aluminum sulfate. A certain dependence of the activation parameters and the efficiency of cleaning the filtrate of landfills are obtained. To achieve the aim set in the work, the chemical composition of the landfill filtrate was studied at different stages of operation and the parameters of the reagent wastewater treatment of landfill sites were optimized. And also studied the kinetics and revealed the laws of the coagulation process when the coagulant solution is activated.

When conducting research, the proposed technology was tested, pilot tests were carried out and an analysis of the technical and economic efficiency of the technology implementation was given. When performing experimental studies, a set of methods for determining pH levels, COD (chemical oxygen demand), BOD (biological oxygen demand), etc. was used. High efficiency of using the reagent method in combination with biological treatment for filtration waters characteristic of the methanogenesis stage was proved. The proposed technology has a number of features, in particular, during the activation of the reagent solution, a magnetic field is applied, as a result of which a change in the structure of the solution and the formation of additional coagulation centers are observed.

The paper presents the results of a study of the technological and economic efficiency of the proposed technology, in particular, it has been proven to reduce operating costs when introducing the considered technological scheme and the proposed hardware design. Compared with other known technologies that involve the stage of reagent cleaning, this will allow to intensify the coagulation process and reduce the estimated dose of coagulant by 25–30 %, without degrading the quality of cleaning.

Keywords: municipal domestic waste landfill, activated coagulant solution, ionic associates, anodic-dissolved iron, coagulant dose.

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DOI: 10.15587/2312-8372.2019.168744

INVESTIGATION OF SOLVENT SUBLATION OF COBALT IONS FROM WATER SOLUTIONS

page 25–27

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The object of research is solvent sublation in the cobalt – sodium dodecyl sulphate system. The study of solvent sublation of wastewater from heavy metal ions is small and fragmented and unsystematic. Therefore, the study of the solvent sublation process, as a method of purification of waste water from heavy metals on the example of cobalt ions (II) is promising. In this work, model cobalt aqueous solutions with a concentration of 20 mg/dm^3 were investigated using anionic surfactant, sodium dodecyl sulfate and isoamyl alcohol as the organic phase. The following rational process conditions were obtained: pH 10 molar ratio Co^{2+}: surfactant = 1:2, air consumption – 45 cm^3/min, temperature – 20 °C, extractant volume (isoamyl alcohol) – 10 cm^3, process duration – 20 min. Under these conditions, the extraction degree of cobalt ions in isoamyl alcohol was 85 %. The process is described by a first order kinetic equation. Process rate constants are calculated. The importance of research is emphasized by the fact that solvent sublation has a number

of features and advantages. In particular, the possibility of multiple concentration of pollutant ions in small volumes of organic solvent and the possibility of its further regeneration. It uses a much smaller amount of organic solvent and the process is not limited by the distribution constant (as compared to the extraction method). Solvent sublation is also characterized by the absence of foam (as compared with the flotation method) and the absence of large amounts of wet sediment (as compared with the reagent method). The proposed method provides a sufficient level of wastewater purification from metal ions, and can also be applied in local wastewater purification systems with subsequent return of water to the process. This will reduce the costs of water consumption, wastewater discharges into water bodies, as well as limit the release of harmful substances into the environment. In addition, the characteristics of solvent sublation can regenerate the extractant and surfactant.

Keywords: extraction of cobalt ions, solvent sublation wastewater purification, sodium dodecyl sulphate, isoamyl alcohol.

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DOI: 10.15587/2312-8372.2019.171230

EVALUATION OF THE EFFECT OF INDUSTRIAL ENTERPRISES ON THE ENVIRONMENT AND EFFICIENCY EVALUATION OF ENVIRONMENTAL PROTECTION ON THE EXAMPLE OF «TOCHPRIBOR» LLC (KHARKIV, UKRAINE)

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Issues of the impact of environmental pollution on living organisms and the human body in particular are still largely open and require further study. Therefore, the object of research is the impact of industrial enterprises on the environment. The paper assesses the impact of industrial enterprises on the environment and the effectiveness of environmental measures on the example of «Tochprylad» LLC (Kharkiv, Ukraine). The assessment will provide an opportunity to calculate the resulting economic effect from these activities in the studied enterprise. After analyzing the data on emissions provided by «Tochprylad» LLC, it is determined that the maximum surface concentrations of pollutants emitted into the atmosphere by the enterprise's sources are small compared with the maximum permissible concentrations (MPC). Therefore, measures to reduce emissions to the standard level are not provided. Extreme exposure through increased pollution of urban runoff is possible if there is a disruption in the operation of sewage treatment plants; therefore, it is necessary to periodically control the inflow of sewage to treatment and the operation of treatment facilities. Currently, the level of contamination of soil and plants with heavy metals contained in industrial emissions of «Tochprylad» LLC as a whole does not exceed the maximum permissible values. Considering the non-agricultural nature of the use of the land of the sanitary protection zone of the plant, a re-examination of the soil for pollution, according to expert judgment with the existing production technology, is recommended not earlier than 15–20 years later. In order to reduce the anthropogenic impact of emissions on the environment, it is necessary to improve the production technology and the system of gas and dust emissions at «Tochprylad» LLC. In the study of «Tochprylad» LLC it is found that in wastewater there is an excess of toluene, chloride and iron. Therefore, additional wastewater treatment is proposed. The economic effect of the proposed additional wastewater treatment is 5398.32 USD/year.

Keywords: industrial emissions into the environment, impact of environmental pollution on living organisms.

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