

## THERMODYNAMICS OF BIOMASS-BASED ON SOLID FUELS

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### ABSTRACT

In this paper, solid fuels made of plant biomass were studied as an alternative to fossil coals. For this purpose, experimental and calculation methods were applied to determine the standard change of internal energy or specific energy of combustion ( $\Delta_c U_i^0$ ), standard enthalpies of combustion ( $\Delta_c H_i^0$ ) and formation ( $\Delta_f H_i^0$ ) for individual components of plant biomass (lignin, cellulose, hemicelluloses, extractives, etc.), as well as of some additives of solid biofuels. The experiments were carried out using an oxygen bomb calorimeter, whereas calculations were performed by the equation:  $\Delta_c U_i^0 = E(c + 0.295h - 0.42o)$ , where  $E = -413$  kJ/mol,  $c$ ,  $h$  and  $o$  is number of atoms C, H and O, respectively, in molecule of organic substance or in repeat unit of polymer. Using the results obtained for individual components, the standard thermodynamic characteristics (TDC),  $Y^0$ , of various biomasses and their based fuels were found according to additivity rule, as follows:  $Y^0 = \sum w_i Y_i^0$ , where  $w_i$  is weight part of the component in the biofuel. The results revealed that calculated TDC the solid fuels were close to experimentally obtained characteristics. The obtained data evidence on adequacy of the additivity rule to evaluate the TDC of solid biofuels. It has been also found that fuel pellets consisting of plant biomass and additive of plastic binders are the most promising solid fuels, since they provide a higher value of thermal energy and increased energy density than the biomass only.

## MODELING OF THE SOL-GEL PROCESS FOR OBTAINING THIN FILMS WITH HOMOGENEOUS PRECIPITATION OF HYDRATED OXIDE PARTICLES ON THE SUBSTRATE SURFACE

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### ABSTRACT

This article analyzes the regularities of precipitation of solid colloidal particles of hydrated metal oxides on the surface of various substrates. Two models of this process are proposed. The proposed  $\alpha$ -model is a process of continuous nucleation of interaction centers, at random points of a free surface throughout the process. The proposed  $\beta$ -model provides for the instantaneous nucleation of these centers when they are randomly distributed over the entire surface of the substrate. Based on the proposed models, the average values of the following values are calculated: the thickness of the gel film; its roughness and specific surface area. The calculations carried out in the article showed that these parameters are universal functions of the degree of filling of the surface and do not depend on the specific model of the mechanism of the process.

## **APPLICATION OF HOMOGENEOUS PRECIPITATION OF HYDRATED ALUMINA FOR PRODUCTION OF COMPOSITE MATERIALS**

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### **ABSTRACT**

The paper presents the results of studies of the process of hydrated alumina homogeneous precipitation. The variants of this process are considered. As the most convenient embodiment of this process, precipitation of hydrated alumina from its salts using auxiliary substances. As such auxiliary substances, it is proposed to use urea. Urea hydrolysis proceeds slowly even with heating, which allows a homogeneous precipitation process under the most mild conditions. It is shown that the process of hydrolytic precipitation in the aluminum salt-urea system proceeds according to the dissociative mechanism  $S_N1$ . For  $S_N1$ , a two-step mechanism is characteristic, in which the first step is slow monomolecular hydrolytic dissociation, followed by a rapid coordination reaction with the second reagent. To determine the nature of the interaction of the aluminum salt with alkaline agents, experiments were conducted on potentiometric titration of the aluminum salt with solutions of ammonia and sodium hydroxide in the presence of various amounts of ammonium chloride and urea. When titrating with sodium hydroxide solution, the process proceeds to the formation of sodium aluminate, titration with a solution of ammonia produces a precipitate of hydrated alumina. Addition of ammonium salts shifts the equilibrium of the hydrolysis reaction towards the formation of aluminum hydroxide. The presence of urea virtually does not affect the course of the deposition process. To determine the uniformity of the formed sediment, the laser radiation scattering method. For these purposes, a special installation has been created that allows the capillary to be scanned through a focused laser beam. The homogeneity of the hydrated alumina precipitate formed was shown. Studies have been carried out on the use of homogeneously precipitated aluminum hydroxide as a binder in lightweight fibrous refractory materials. The process of precipitation of aluminum hydroxide particles proceeds primarily on the filler fibers, covering them with a thin film. The resulting film acts as a gluing agent. After drying and calcination, the gel deposited by the thin film becomes a solid that binds the fibers into a single monolith. The resulting materials have a developed specific surface area and porosity.

## **TOOLS OF THE MANAGEMENT OF AN ACCOUNTING SYSTEM**

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### **ABSTRACT**

The relevance of the topic is determined by the needs to continuously create and implement incremental and breakthrough productive and technological innovations supporting the balance of demand and supply on products market. The aim of this research is to develop the management of an accounting system based on digital mathematical models which are designed by a mathematical analogy with technical thermodynamics. According to these methods and approaches, the manufacturing-technological system is considered as two-level equilibrium

operating and innovative cycles of converting manufacturing and innovative capital of a manufacturing-technological system (MTS) into monetary capital in the form of manufactured and sold products. In the first-level MTS the technological processes not having market cost are converted into the required consumer properties of technological stage products having competitive market cost and in the second-level MTS the technological processes are converted into consumer properties of final products having competitive advantages in the form of market added value. As a result, the research of technological conversion processes in the first-level MTS established the management accounting law ensuring the required market cost of technological stage products. Process approach to designing the management accounting and innovative activity of equilibrium operating and innovative conversion cycles allowed us to formulate the conditions of innovation improvement and development the manufacturing-technological systems of engineering business. The results of this research can be used in engineering business enterprises having two-level MTSs as well as in designing the production organization based on a management accounting system and innovation activity ensuring the sale of products with added market value. Further research will be aimed at improving the conversion mathematical model for other structures of MTSs.

## **MASS TRANSFER IN THE PROCESSES OF CASCADE SEPARATION OF BULK MATERIALS**

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### **ABSTRACT**

Theoretical notions of mass transfer processes in cascade separation of bulk materials have not been adequately developed as yet [1]. In this paper we have derived linear difference equation of the second order for a cascade with initial feeding top any stage proceeding from mass exchange regularities. The solution of these equations has allowed us to determine quantitative dependences of the material distribution over the cascade stages, which serve the basis of the method of predictive estimate of the process results. We have also examined the model of the material distribution coefficient formation at individual cascade stages. We have checked the adequacy of this model to experimental data. It is noteworthy that the obtained theoretical results are phenomenological, i.e. they can be applied to the processes of separation of different physical nature, e.g. of isotopes, liquid media, gases, etc.

## **TOPOGRAPHIC ANALYSIS OF THE DEFECTS DENSITY DISTRIBUTION IN $\text{Ge}_{1-x}\text{Si}_x$ MONOCRYSTALS**

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### **ABSTRACT**

By the local electroreflectance method the topographic analysis of  $\text{Ge}_{1-x}\text{Si}_x$  monocrystal surface was performed. The influence of the surface orientation on defects density distribution was found. Topographic maps of the defectiveness distribution on the crystal surfaces with (111) and (110) orientations were constructed and visualized.