MATHEMATICAL MODELING HIGH-TEMPERATURE DRYING BIOMASS IN TECHNOLOGIES OF MANUFACTURING BIOPALIVA

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Goal. High temperature drying of biomass at temperatures 300-500ºC is accompanied by the process of its thermal decomposition, the initial stage of which is characterized by the decomposition of hemicellulose with the release of oxygen-containing gases and pyrogenetic moisture, which contributes to increasing the caloric content of the dry residue and biofuels in general, respectively. At the next stages of thermal decomposition, at temperatures above 270°C, cellulose and lignin begin to decompose, and these processes in the presence of air are exothermic for all types of biomass and their passage can lead to a rapid increase in temperature and a significant loss of the combustible component. Therefore, when developing the technology of high-temperature drying biomass, it is important to observe the condition of passing the first stage of its thermal decomposition and completion of the process upon reaching the temperature of the beginning of the subsequent stages of destruction.

Results of work. The beginning of the thermal decomposition of hemicellulose in the drying of wood and vegetable raw materials is characterized [1] by a sharp change in the effective energy of activation of the microparticles of the bound substance. Thus, the process of thermal decomposition, as well as the processes of diffusion and evaporation [2], is activating. The activation energy necessary for the transition of the hemicellulose particles to the free state is much higher [1] than the activation energy of the bound water particles. This will have an impact on the dynamics of high-temperature drying of biomass. Possibilities of experimental methods for studying the kinetics of drying in small particles are substantially limited. In this work a mathematical model of dynamics of heat and mass transfer, phase transformations, shrinkage and thermal destruction during drying of biomass particles in the form of a hollow and solid cylinder is constructed. The mathematical model includes the energy transfer equations and of the mass liquid, vapor and air phases in the body. Upon reaching the thermodestruction temperature material, in the expressions for the intensity of evaporation [3] and for the diffusion coefficient of the liquid phase [4], the value of the activation energy of water changed by a value corresponding to the temperature interval of decomposition of hemicellulose [1].

Conclusions. Consideration in the mathematical modeling of the effect on the heat-mass transfer of phase transformations, shrinkage of the material and the phenomenon of thermal decomposition will allow to intensify biomass dehydration and improve the quality of biofuels.

1. Korinchuk D.N. Non-isothermal analysis of components of composite fuels based on peat and biomass. Power engineering and automation. 2018. No 1. P. 56-71.

2. Nikitenko NI, Snezhkin Yu.F., Sorokova NN, Kolchyk Yu.N. Molecular Radiation Theory and Methods for Calculation of Heat and Mass Transfer. K .: Scientific Opinion, 2014. 744 p.

3. Nikitenko NI, Investigation of the evolution dynamics of condensed bodies on the basis of the law of the intensity of the spectral radiation of particles. IFJ 2002. T.75, No. 3. P. 128-134.

4. Nikitenko N.I. Problems of radiation theory of heat and mass transfer in solid and liquid media. IFJ. 2000. T. 73, No. 4. S. 851-839.