CONVECTIVE DRYING THE MULTI-COMPONENT POROUS MATERIALS: SOFTWARE DEVELOPMENT

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Equipment design, such as the shape of chambers for drying and the location of the vents, gratly affect drying efficiency and the quality of the final product. For such devices, it is necessary to develop appropriate software for comprehensive analysis of moist materials and algorithms in accordance with the established characteristics of drying objects. The choice of drying methods is determined by the type of energy interaction between moisture and the material. Additionally, it requires the application of various methods of mathematical modeling for each specific type of drying apparatus, which is associated with different interactions between particle flow and the drying agent (impulse, pseudo-fluidized drying, drying in hydrodynamic active regimes, etc.).

The designs of drying devices provide for various options for thermal treatment of grain: in a dense or loose bed, in a fluidized state [1]. Heat transfer to the grain during heating or removal during cooling is carried out using a gaseous agent (air, combustion gases, water vapor) or by contact. In a general consideration of the issue, two cases are distinguished: processing of a grain bed and processing of individual grains.

When processing individual grains, a loose or fluidized bed is considered. Therefore, the determination of thermophysical properties should be carried out separately for the grain layer and individual grains. The object of study in this case is a capillary-porous body. When analyzing the thermophysical properties of an individual grain, the difference in chemical composition and microstructure of the grain affects the values of thermophysical coefficients. For a complete description of moisture transfer in the grain, it is necessary to know the thermodynamic characteristics of the body (isothermal moisture capacity), kinetic moisture transfer coefficients (moisture diffusion coefficients, moisture conduction), temperature coefficients of moisture transfer potential (heat-moisture conduction), and similarity criteria.

In this work, the software is presented serving as an effective tool for investigation of convective drying of multi-component capillary-porous materials, which is focused on the mathematical modeling of the drying processes of such materials in convective drying chambers. The selection of such equipment best suits the stated objective.

The optimal operating parameters – ambient temperature, air humidity in the chamber, and airflow velocity – should be selected considering the technological changes of the drying material. Moisture removal under heating is determined by the maximum allowable temperature for the given material and the acceptable rate of change of its gradients over time. Temperature and humidity regulation in dryers is achieved by adjusting the temperature based on dry and wet bulb thermometers of the drying agent. The drying process in steam chamber dryers occurs according to the laws governing changes in dry and wet temperatures.

It has been experimentally established that when studying mass transfer and heat conduction of the grain during drying, it is necessary to take into account the heterogeneity of the grain structure, the depth of its placement in the layer, and the main characteristics of the grain and the porous layer, which are done in this work.

The presented software package is used for analyzing changes in moisture concentration and temperature within the grain over time, taking into account the physicochemical characteristics of the grain, the heterogeneity of the structure of individual grains, and the control functions (steam-air mixture and temperature) of the drying environment with oscillating forms of these functions.

Additionally, the software package provides calculations of the stress-strain state of the grain at any moment during the drying process.

The software package is simple and user-friendly. Using step-by-step menus and help prompts, the user configures the calculation of the desired task. They sequentially fill in empty fields, such as "Initial grain temperature" or "Airflow rate", and select the desired action, such as "Input data", that they wish to perform, after which the program performs calculations for the corresponding values.

The calculation software modules can be divided into two groups according to the conditions of their application: programs for calculating moisture concentrations, grain temperatures, and programs for calculating displacements, deformations, radial and tangential stresses in the grain [2]. A common requirement for all groups is the user's necessary completion of all empty fields. After performing the aforementioned actions, the results of solving the problem are obtained in tabular form. It should be noted that if the user does not fill in at least one free field, the program will not start and an error message will be displayed.

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2. *Gayvas B., Kaminska O., Dmytruk A.* Simulation of Crack Resistance of Mustard in Pulsed Drying Mode. International Scientific and Technical Conference on Computer Sciences and Information Technologies, 2020. – P. 91–94.