HEAT-EXCHANGE TECHNOLOGIES AND EQUIPMENT IN DRYING PROCESSES

Sniezhkin Yu.F.

The processes of heat and mass transfer are decisive in the processes of drying. The effectiveness of drying and the economical use of material and energy resources depend on their intensity. So, the effect of temperature on the constant of the rate of chemical reaction, the diffusion coefficient and the temperature conductivity shows that the temperature increase doubles the chemical reaction constant by 3-4 orders of magnitude. And the same temperature increase increases the diffusion coefficient by 5 times, and the coefficient of thermal conductivity is only 2 times. Therefore, in most dryers, the efficiency is approximately 40%.

Developed ways to increase the energy efficiency of dryers, which have 2 main areas - is the preparation of the material for drying and the process of dehydration, the material, which include 12 ways to intensify the entire process of drying material.

The mathematical model and numerical method for calculating the dynamics of heat and mass transfer, phase transformations and shrinkage during continuous drying of colloidal capillary-porous materials (CCPM) have been created. Based on the analysis of Rebinder's number, multistage drying methods have been developed, which intensify the process by 15-25%. To implement this method, zone tunnel dryers have been created, heat losses per 1 kg of evaporated moisture in which are 1,5-2,0 times lower than the existing analogues.

The hygrothermal treatment of CCPM before drying, which inactivates enzymes, and also increases the rate of dehydration by 15-20%, is developed. The method of drying, which combines the first stage dehydration with the hygrothermal treatment and the high-temperature high-temperature drying of the material, allowed to increase the drying rate of the CCPM by 2 times. To implement this method, a multi-zone strainer dryer was created, heat consumption per kg of evaporated moisture in which 1,4 - 2,7 times lower than the existing analogues.

A deodorant condensation method, which uses a heat pump, is developed. The source of low-temperature heat in this method is the waste heat carrier. Specific energy consumption in this method is 2 times lower than with similar convective drying methods.

Created chamber dryer with heat pump, energy consumption per 1 kg evaporated moisture in which 0,3 - 0,7 kWh. A dry-energy complex was developed for the production of electric and thermal energy on the basis of an engine-generator and a heat pump. The proposed complex provides year-round needs of agricultural enterprises in electric and thermal energy, as well as seasonal need for energy carriers for thermal treatment of plant raw materials, primarily grains. The complex provides 0,94-0,96 fuel consumption and reduce energy consumption by removing 1 kg of moisture by 1,6 times.

On the basis of the developed methods of dehydration and new effective dryers, technological lines of processing CCPM for dried products and powders were created. Such technological lines with different dryers have been successfully handed over to several interministerial admissions commissions.

In the world, the process of drying consumes 8-10% of the total energy. In Ukraine, the cost of energy for drying processes, according to our calculations, is 25% in industry and 15% in agriculture in terms of total energy consumption. The main industries in which the widely used processes of drying are construction materials, agro-industrial complex, fuel and wood processing enterprises. The technically achievable energy saving potential of our development is 4,0% in industry at a possible 10%, and 3,0 in agriculture at a possible 6,0%.