The Peerian Journal
Open Access | Peer Reviewed
Volume 10, September, 2022.
ISSN (E): 2788-0303
Website: www.peerianjournal.com
Email: editor@peerianjournal.com

Convection of Agricultural Products Moisture Transfer During Drying

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Abstract. In the article, the absorption of moisture on the surface of the product into the sorbent-hygroscopic material when the sorption-contact (due to mutual contact) method is used in the drying process of agricultural products, as a result of which the mass transfer process accelerates, depends on the moisture diffusion coefficient of the material, moisture retention and temperature gradients.

Keywords: Drying; convective; air temperature; humidity; gradient; hygroscopic; fabric; sorption-contact; sorbent; colloid; capillary; pore; sorption - desorption; diffusion.

In the convective drying of agricultural products, the temperature gradient moves the moisture flow from inside the tissues of the agricultural products to its surface, i.e., a flow in the opposite direction to the moisture flow driven by the moisture storage gradient occurs.

Krainov A.Yu. According to the classification, since agricultural products are colloidal capillary - porous bodies, the transfer of moisture from the product is expressed by the following formula [1, 2, 3, 4, 5]:

$J = -a_m \rho_0 (\Delta U + \delta \Delta Q)$, (1)

where, J is mass transfer rate, kg/m2 s; am - moisture diffusion coefficient, kg/m2;ρ_o - mass of absolute dry matter per unit volume of wet material, kg/m3;ΔU - namlik sali gradients, kg/kg·m;ΔQ - temperature gradient, oC/oC·m;δ - heat-mass conductivity coefficient of the material.

The analysis of expression (1) shows that the speed of the mass transfer process depends on the moisture diffusion coefficient of the material, moisture storage and temperature gradients. It should be taken into account that the directions of humidity and temperature gradients are opposite. It can be seen from the above that it is advisable to use the convective drying method for

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drying agricultural products with evenly distributed moisture. It is known that moisture Wkt in agricultural products is mainly located in the tissues of the products. During convective drying of products, the moisture in the layers of the product tissue moves to the surface of the product Wkt, and the surface moisture is equal to Wpv. Since Wkt□Wpv, the moisture in the products moves due to the difference in moisture components (moisture moves from a high humidity environment (product tissue) to a low moisture Wpv environment (product surface) and under the influence of temperature gradient. During drying of agricultural products, sorption - contact (due to mutual contact) when the method is used, the moisture on the surface of the products is absorbed into the sorbent - hygroscopic material. The sorption - contact drying method of products is based on the principle of mutual distribution of moisture between the surface of the product and the sorbent, for a given situation, moisture exchange between the hygroscopic material and the surface of the product occurs. the natural distribution of moisture between them occurs in the interaction of materials with similar properties. In this case, moisture is exchanged mainly by mutual sorption - desorption. These materials tend to hydrothermal equilibrium, which is determined by the difference in moisture transfer potentials. in the state of hydrothermal equilibrium of the bodies in contact with each other, their moisture transmission potentials are equal, but their relative moisture storages are not the same, and their ratio is proportional to the ratio of moisture capacities [6,7].

$$Q_1 = Q_2 = \frac{U_1}{U_2} = \frac{C_{M1}}{C_{M2}}, \qquad (2)$$

where, Q1 is the moisture transfer potential of the hygroscopic material;

Q2 - moisture transfer potential of the product; U1 - moisture retention of hygroscopic material, kg/kg; U2 - moisture retention of the product; kg/kg; CM1 - moisture capacity of hygroscopic material; CM2 - moisture capacity of the product to be dried.

Let's see how the sorption-contact drying process of agricultural products works. Hygroscopic material - the initial moisture content of the sorbent is zero, and the products have a certain moisture retention Wkt. The starting moment of time $(\tau=0)$ and when the product does not stick to the hygroscopic material - the sorbent, the moisture concentration of the product $W_{кт}= C_{к2}$ is equal to, and the moisture concentration of the sorbent - hygroscopic material:

$$W_{гм} = C_{гм1} = 0 \quad (3)$$

where, Wkt is the moisture content of the product being dried, %; Wgm - hygroscopic material - moisture content of the sorbent, %. During the drying process of agricultural products to the initial time after placement on hygroscopic material-sorbent $\tau \geq 0$ close contact occurs. When the sorbent - hygroscopic material comes into contact with the product - during adhesion, its humidity increases due to the absorption of moisture from the product, as a result, the moisture content of the product begins to equalize with the hygroscopic material - sorbent and equalizes at a certain time, as a result, the product humidity decreases, i.e.:

$$W_{гм} = W_{кт} \neq 0$$

The rate of mass transfer from the surface of agricultural products to the sorbent-hygroscopic material is written by the following expression [7, 8, 9, 10]:

$$\frac{dW}{dt} = k\left(W_{km} - W_p\right), \quad (4)$$

Here $dW/d\tau$ - mass transfer (moisture transfer) speed;

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k **-** the coefficient taking into account the sorbent properties of sorbent-hygroscopic material with the sorbent properties of agricultural products for exactly similar conditions; $W_{кт}$ - moisture content of the product before sorption drying,%; W_p - balanced moisture retention of products, %.

(4) the analysis of the expression shows that the speed of mass transfer depends on the sorption characteristics of the hygroscopic material. (4) the analysis of the second part of the expression shows that the drying of agricultural products depends on the $W_{кт}$ VA sorbent-hygroscopic materialning birlamchi namligiga $W_{гм}$ depends Drying process $W_{кт} > W_{гм}$ also happens, that is, hygroscopic material - sorbent absorbs moisture from the product being dried, $W_{кт} = W_p$ and when it is, the state of equilibration begins, the drying process stops.

Thus, $(W_{кт} - W_p)$ the greater the difference, the faster the drying of agricultural products in the sorption-contact process.

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