FORMALIZATION OF THE PROBLEM OF AUTOMATION CONTROL OF DRYING PROCESS OIL CROPS

Nozimjon Kabulov[1], Nematjon Karimov[2],

Nigora Ruhiddinovna Akbarova[3]

[1]Associate Professor, Andijan Machine-Building institute

[2]Associate Professor, Andijan Institute of Agriculture and Agrotechnologies,

[3]Senior Lecturer, Tashkent Institute of Architecture and Construction.

ABSTRACT

The article studies the drying process of oilseeds, the laws of the kinetics of the drying process, calculate the amount of evaporated moisture from the material and the heat consumption for drying. The general structural scheme of the automation system is given and the controllable parameters of the drying process of oilseeds are determined.

KEYWORDS: ***technological process, automation, control, algorithm, algorithmization, oilseeds, temperature, heat and mass transfer, drying, dryers.***

INTRODUCTION

The drying process is usually understood as a change in the average moisture content $\bar{u}(\tau)$ average temperature $\bar{t}$ bodies the passage of time τ. Average moisture content by volume (%) in what follows we will also denote by W, as is customary in drying technology $[\bar{u}(\tau)=0,01W(\tau)]$.

These regularities of the kinetics of the drying process make it possible to calculate the amount of moisture evaporated from the material and the heat consumption for drying. Local temperature change t passing of time τ, depend on the interconnected mechanism of transfer of moisture and heat inside the moist material and the mass and heat exchange of the body surface with the environment. The mechanism of moisture and heat transfer inside wet bodies, in turn, is very complex, it is determined by the nature of the connection between moisture and wet bodies, therefore the kinetics of the drying process is largely determined by the physicochemical properties of the drying material itself.

Finding moisture fields $u(x,y,z,\tau)$ and temperature $t(x,y,z,\tau)$, the local values of the moisture content and temperature of the dried body are denoted, respectively, by $u(x,y,z,\tau)$ and temperature $t(x,y,z,\tau)$, where x,y,z Cartesian coordinates, τ - time. It is connected with the solution of a system of differential equations of mass and heat transfer under the corresponding boundary conditions. Displaying the method and mode of drying (drying with heated gases, infrared rays, etc.) This system of equations is a system of nonlinear differential equations, and its solution is possible by numerical methods and algorithms, and by machine technology. They are also determined by the laws of moisture and heat transfer inside the body and external moisture and heat exchange with the environment.

PROCESS DESCRIPTIONS

To describe the actual process of mass and heat exchange of bodies with the environment, it is necessary to know the basic laws of the drying process of wet bodies [1]. In addition, for engineering calculations, it is necessary to know the approximation of the ratio between the average moisture content W and time τ, as well as formulas for calculating heat consumption. The process of drying different objects, by different methods, in different modes with different criteria, by different authors and their research has been investigated. The graphical analysis and their graphs characterizing the processes [2,3]. Changes in moisture content and temperature on the surface and in the center of the wet material during the drying process. Fig. 1.

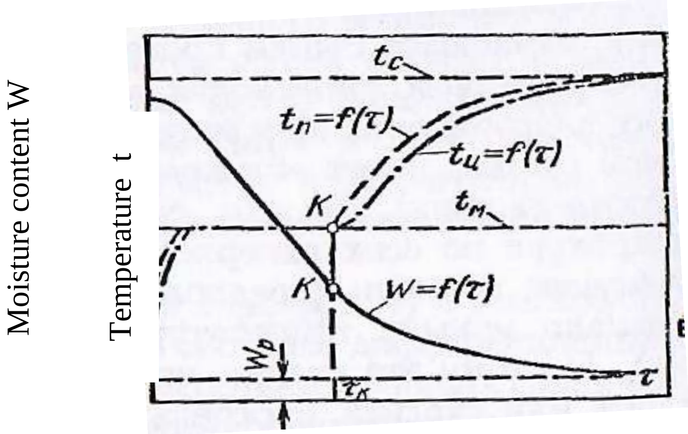

Fig. 1. Changes in moisture content and temperature on the surface and in the center of the wet material during the drying process.

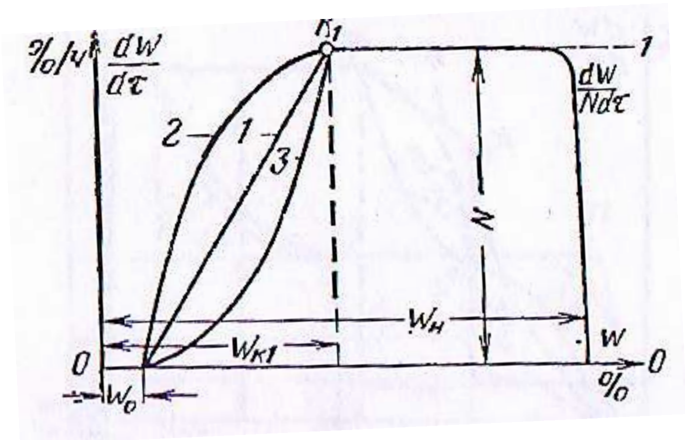

Fig. 2. Typical drying rate curves for wet materials.

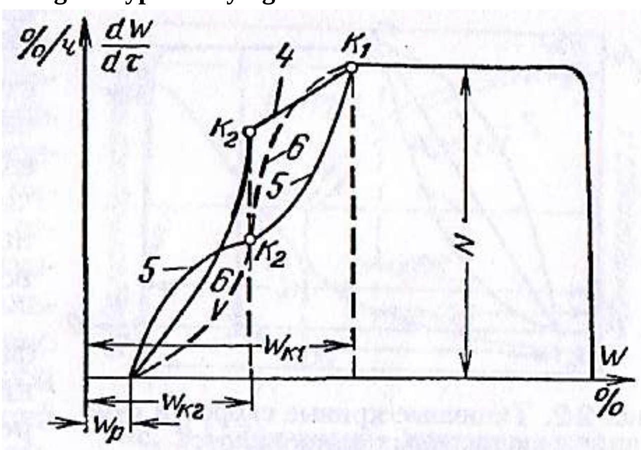

Fig. 3. More complex drying speed curves for wet materials

Temperature curves are of great importance for the drying technology, since the quality of the dried material largely depends on the temperature of the material and the duration of its exposure.

The division of the drying process into two periods based on the nature of the temperature change of materials during the drying process was first proven in work. [1,2]

Materials differing in the nature of the moisture bond give a different shape of the drying rate curve Fig. 2-3. A wide variety of materials can be attributed to the following five typical curves of drying rate is a straight line passing through the points K_1 and W_p such curves of the drying rate give thin samples of fibrous materials this curve of the drying rate, or rather the straight line we will call the curve of the drying rate of type 1.

The next type of speed curve is curve 2. The third type of curve is the drying speed curve. 3. We observe such curves when drying porous materials. Wet materials with more complex structure give in the second period more complex drying rate curves (Fig. 3).

The curve may at first have the form of a straight line, and then turns into a curve facing the abscissa axis, a curve of type 4. When drying bread, curve 5. There is such a curve of the drying rate can be of the form of a curve of type 6. It should be noted again that the curves of the drying rate $dW/d\tau = f(W)$ give only a qualitative picture of the course of the drying process, while a necessary condition is the presence of a small gradient of moisture content inside the body. Therefore, the relationship between the temperature of the material and its average moisture content $t = f(W)$. From fig. 3 it is seen that $dt/dW = const$. M.F. Kazanskaya obtained the relationship between the temperature of the material and time $t = f(\tau)$[3].

Temperature curves are of great importance for the drying technology, since the quality of the dried material largely depends on the temperature of the material and the duration of its exposure. The material temperature is not equal to the air temperature. Temperature curves make it possible to construct the best mode, taking into account the technological properties of the material. [4,5] The design of the drying device and the drying method for oilseeds are determined by the optimal mode for a given material. It is impossible to speak abstractedly from a specific material about the best drying method (drying with heated air, flue gases, infrared rays, etc.), as well as about the best design or type of dryer. (Pneumatic gas dryer, belt, drum, etc.) [6] The above scientifically based analyzes show that the drying processes of oilseeds are complex and multi-stage. [8]

The quality of drying oilseeds depends on many factors such as mass and heat transfer of the material itself, on the design of the drying system (device), 4 drying modes. The control of the drying processes of oilseeds is multi-level, as the internal process of drying the material and the process of the dryer, as they are different, are dried using the furnaces of different dryers, for example, chamber, drum, shaft or rotary, etc. [6].
In production conditions, the parameters of the initial moisture content and the initial temperature of oilseeds have a random character of change; they are attributed to the disturbing effect. Together with indicators of appointment, degree of maturity and condition. They give the initial information for the selection of the drying mode [7]. Four parameters are referred to control actions:

- the temperature of the drying agent at the entrance to the drying zone;
- the degree of opening of the outlet of the drying zone (changes of which provide the required exposure of drying in the zone);
- the operating time of the drying agent in the drying zone (set by turning on and off the exhaust fan);
- the rate of supply of the drying agent to the drying zone (depends on the critical speed of vision of the bulk dried material, in turn, determined by the crop and oilseed variety and its average moisture content in the drying zone).

In order to describe the actual process of mass and heat exchange of bodies with the environment, it is necessary to know the regularities of the drying process of wet bodies [7]. In addition, for engineering calculations and various applications, it is necessary to know the approximate relationships between the average moisture content W and time, as well as formulas for calculating the heat consumption, i.e. balance equation.
Since the listed factors are of a heterogeneous nature, uncontrollable and controllable, it is advisable to divide them into two subsets

$$G = \left(G_1, G_2, \ldots, G_{n(R)}\right) \quad and \quad P = \left(P_1, P_2, \ldots P_{n(R)}\right)$$

Subset G - forms a set of unregulated but measurable parameters of the system, and P - parameters are not only measured, but can be named in a certain way. With their help, regulation, control, mode, process of the drying system is carried out.

Choice of the structure model. The above abstract research and analysis of the results and conclusions of the process of drying, drying of oilseeds, these are the results of numerous scientists and researchers at the centers, allows to determine the control of parameters in the process of drying oilseeds, and to develop an automated process control system for oilseeds, as technical and software, as well as to develop optimal control algorithms of each controlled parameter and control algorithms of the actuator of the drying system [8-10].

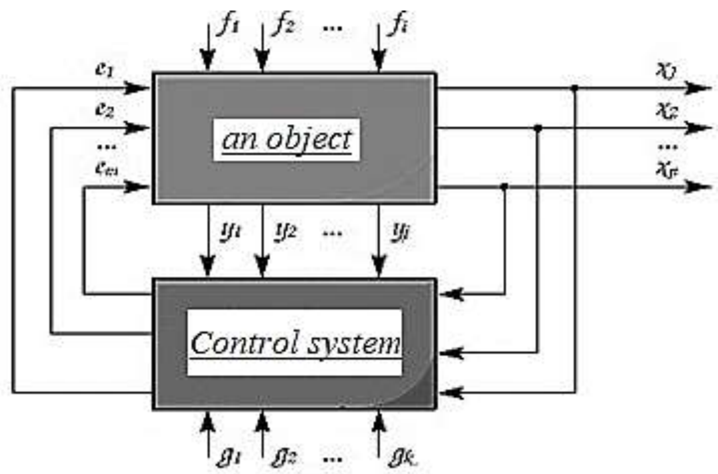

Fig. 4. Structures diagram of the automation system.

In its most general form, the structural diagram of the automation system is presented in Fig. 4. The automation system consists of an object of automation of the control system of this object [9].

Due to a certain interaction between the automation object and the control system, the automation system as a whole provides the required result of the object functioning, characterized by the parameters $x_1, x_2, \ldots, x_n$

This parameter can include, for example, values that characterize the expedient end product of the technological process, individual parameters that determine the course of the technological process, its efficiency, ensuring trouble-free operation, etc.

In addition to these main parameters, the operation of the integrated system of automated process control systems for drying oilseeds is characterized by a number of auxiliary parameters $y_1, y_2, \ldots, y_n$. This must also be controlled and regulated. Such a number of parameters include the value characterizing the operation of technological mixture preparation units, pumps and other elements of the dryer. These installations are only required to supply raw materials and energy carriers with the specified parameters. In this case, the dosage of the supply of raw materials and energy carriers is carried out by means of control related to the technological unit. In the process of operation, the APCS system receives disturbing influences $f_1, f_2, \ldots f_n$ deviating parameters $x_1, x_2, \ldots, x_n$ from their required values. Information about current values $x_1, x_2, \ldots, x_n$, $y_1, y_2, \ldots, y_n$. Enters the control system and is compared with the values prescribed by it $g_1, g_2, \ldots, g_n$ as a result of which the control system generates control actions $\varepsilon_1, \varepsilon_2, \ldots, \varepsilon_m$ to compensate for deviations in output parameters.

CONCLUSIONS

The automated process control system for drying oilseeds consists of several control sections connected to each other in the form of units, furnace fans, a drying chamber, an agent, etc. They should be interconnected with each other. Each section corresponding to the technological process has been developed a control algorithm, an algorithm for controlling the relationship of each section and, in general, an algorithm for controlling the drying system. Functional diagrams of the ACS of the dryer and algorithms will be reported separately.

The influencing parameters in the process of drying oilseeds have been determined. The general block diagram of the automated control systems for the technological process of drying oilseeds is presented. Algorithmization of control of each influencing parameters in the process of drying oilseeds.

REFERENCES

1. *Yusupbekov N.R., Sh. M. Gulyamov, A. N. Yusupbekov, N.A.Kabulov. Simulation of Sophisticated Chemical-Technological Complexes/ Advances in Intelligent Systems and Computing. Springer Nature, Prague, Czech, 2019.-Vol.1095. -PP. 588-595.*
2. *Дульнев Геннадий Николаевич, Теория тепло- и массообмена. – СПб: НИУ ИТМО, 2012. – 195 с.*
3. *Кабулов Н. А. Идентификация модели функционирования сушилки конвективного действия //Главный редактор: Ахметов Сайранбек Махсутович, д-р техн. наук; Заместитель главного редактора: Ахмеднабиев Расул Магомедович, канд. техн. наук; Члены редакционной коллегии. – 2021. – С. 55.*
4. *Лыков А.В. «Теория тепло – массопереноса», Гостехиздать 1966.*
5. *Любошиц И.Л. сб. «Теория тепло – массоперенос», Т.И.М.Л., 1963.*
6. *Казанский М.Ф., ЖТФ. 19.743, 1999.*
7. *Шервуд Т.К., Сушка твердых тел, Гос.издат., 1936*
8. *Лыков А.В., «О термо диффузии влаж.ЖПХ т.д», стр. 19-54, 1935 г.*
9. *Кабулов Н. А. Системы управления технологическими комплексами при переработке масличного сырья малыми партиями //Universum: технические науки. – 2020. – №. 12-1 (81).*
10. *Исаев М.Д. «Технология сушки зерна и семян» служба информационно-консультационного обслуживания АПК РТ с/х, 2017.*