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AUTOMATIC CONTROL SYSTEM OF ELECTRIC DRIVE OF THE BLOWER OF DRYING CHAMBER

Su Zhifu
Supervisor – Pauliukavets S.A., PhD, associate professor

The growing worldwide trend towards the development of technologies and measures that ensure the efficient use of energy resources, as well as the increasing requirements for the environmental friendliness of building materials and products, lead to the increasing use of wood as an alternative source of raw materials in the production of building materials and products.

In addition to the environmental friendliness and manufacturability of wood, which allow it to be used in low-rise construction and the construction of spatial structures, the advantages of wood as a material should also include the replenishment of the resource base.

Energy consumption for the processing of wood raw materials and the manufacture of structures is 8-10 times lower than when working with metal material, and 3-4 times - with reinforced concrete.

Wooden products are widely used in the construction of civil, administrative and industrial buildings according to various design schemes, including spatial ones.

Modern technologies for the production of building materials and wood products make it possible to achieve high levels of stability of their shape and size. Existing weather-resistant bioprotective compositions allow wood to compete on equal terms with steel and reinforced concrete structures. Often, building materials and wood products benefit from lower production costs.

The primary type of raw material in woodworking is large assortments from logging industries - sawlogs, sleepers, pulpwood, firewood, etc., on the basis of which specific industries are distinguished - sawmilling, sleeper sawing, production of plywood, veneer, boards, etc. On the basis of these secondary materials, industries are distinguished building structures, joinery, finishing materials, sets of wooden houses. Each of the productions is distinguished by its own specifics, with technologies and equipment inherent only to them, and relevant reference and regulatory documents.

Common for all industries using secondary raw materials for the production of materials and products is the presence in the processing technology of the drying process, the purpose of which is the transformation of wood from natural raw materials into an industrial material with a radical improvement in its biological, physical-mechanical, technological and consumer properties.

Of all the stages present in the technology of production of building materials and wood products, the drying process is the most energy-intensive and time-consuming.

According to published data, 100% chamber drying consumes 70-75 percent of heat and 40-50 percent of electrical energy of the total energy consumption. The duration of the process, depending on the breed, thickness and quality requirements of the material, can reach 50% of the total duration of the technological cycle.

In the light of the increase in tariffs for thermal and electrical energy, measures aimed at reducing the energy intensity of drying plants and increasing their productivity are becoming increasingly important and directly affect the competitiveness of the products of enterprises of building materials and wood structures.

Solving the problem of reducing the energy intensity of the drying process and increasing the productivity of drying plants involves taking measures aimed at improving the technology of wood drying, improving existing and creating new designs of drying plants, optimizing the automatic control of the drying process of wood materials.

At present, the automation of the process of drying materials from wood is reduced to the following operations: maintaining the parameters of the drying agent specified in accordance with the regime; change with a given frequency of the direction of movement of the drying agent; a decrease in the speed of movement of the drying agent upon reaching a certain moisture content by the dried material; automatic transition of the installation, upon reaching the transitional humidity by the dried material, from one stage of drying to the next stage; timely termination of the drying process when the material reaches the final moisture content.

The current level of development of technical means of automation, namely the existing programmable automatic controllers and remote-action humidity sensors, make it possible to implement a multi-stage wood drying process that provides the required level of drying quality and drying plant performance.

The condition of the multi-stage drying process leads to an increase in the number of transitions during which the control object is in a state of non-stationary movement, which in turn leads to an increase in unproductive losses due to the unknown trajectory of the control object, which ensures the lowest possible heat loss to the environment.

In addition, there is the problem of selecting the coefficients of settings for automatic controllers, which is more empirical than analytical in nature, and based on the desire to achieve the desired quality of the transient process of the system without taking into account the energy parameters of the system.

It should also be noted that the determined regulator tuning coefficients have a limited scope, from the position of matching the quality of the transient process of the system to the desired one, since they do not take into account changes in the dynamic properties and parameters of the control object. This leads to an increasing discrepancy between the dynamic characteristics of the automatic control system during its operation and the desired characteristics and leads to excessive energy consumption.

Based on the foregoing, the organization of automatic control of wood drying should be carried out from the standpoint of energy efficiency. At the same time, it is advisable to solve the problem of synthesizing the optimal control law for a separate wood drying unit from the standpoint of a certain optimality criterion, subject to the technology requirements.

As the literature review has shown, in the practice of automation of thermal processes, many estimates (criteria) of the optimality of systems have been developed and a wide variety of mathematical models of control objects have been created. If a unified approach based on material and energy balances is successfully used to create mathematical models, then the optimality criteria are formulated only on the basis of the experience of developers of control systems in accordance with specific technological requirements.

To this it should be added that the formulation of the criterion and the construction of the model are not considered by the developers as a single process. This leads to serious difficulties in solving optimal control problems and creating control devices, the law of operation of which practically does not take into account the properties of control objects. It is desirable that the criterion makes it possible to analytically solve the optimal control problem.

The construction of a mathematical model of wood drying, taking into account the previously formulated optimality criterion, makes it possible to obtain a model of the control object, which, together with the optimality criterion, allows analytically solving the problem of optimal control, determining the optimal trajectory of the object and synthesizing a control device, the algorithm of which takes into account the properties of the control object to the maximum for achieving the goal of management. This approach provides significant advantages in the design and use of optimal systems. Thus, the problem of synthesizing energy efficient systems with the listed properties is relevant.

The purpose of scientific work is to improve the methods for calculating automatic control systems for an electric motor in order to obtain mechanical characteristics close to the constant power line, which will ensure reliable operation of the drying chamber.

Installation for drying by hot air of any kind of wood. The installation is a drying oven with independent air-heating and auxiliary equipment. A convenient oven for wooden pillows (Fig. 1) is a chamber 1 with an iron floor, into which a trolley 2 can be rolled in with pallets of sawn timber installed on it.

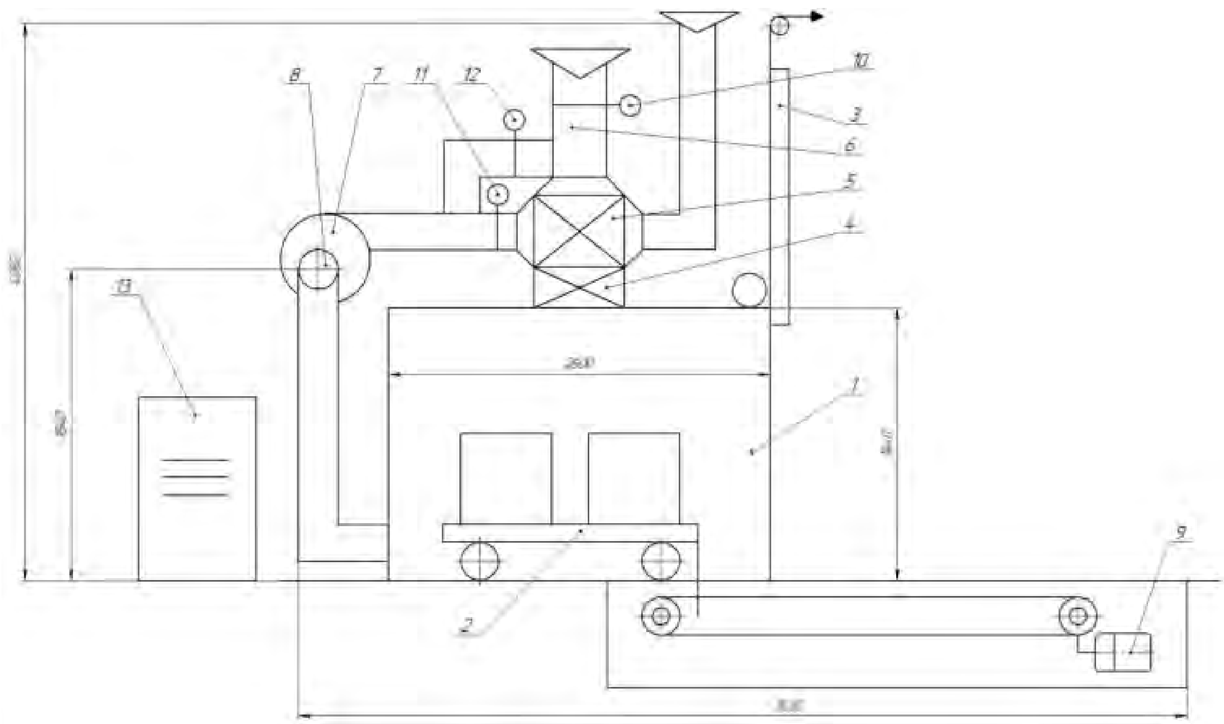

Fig. 1. Scheme of the oven for drying.

Fig. 1 shows: 1 – furnace chamber; 2 - trolley; 3 - furnace door; 4 – electric heater; 5 – air heater; 6 - pipeline system; 7 – turbine; 8 – turbine drive; 9 – trolley drive; 10, 11,12 – shutters; 13 - electrical cabinet.

The trolley drive 9 consists of an electric motor, a gearbox and a chain drive. Doors of a chamber steel, lifting with the drive from the electric motor. A heater 4 with tubular electric heaters is installed in the ceiling of the chamber. To the left of the heater there is a turbine 7 driven by an electric motor 8. The air from the turbine, heated in the heater, passes into the air heater 6 in the ceiling of the chamber and blows over the products installed for drying. After that, through the hole at the floor of the drying chamber through the air duct system 6, the air returns to the turbine. The temperature in the chamber is controlled automatically according to the temperature sensors installed in the chamber.

Depending on, their readings turn off or turn on the sections of the heater. The air saturated with solvent vapors is removed from the furnace, and the turbine sucks in clean air from the workshop. The amount of inlet and outlet air is regulated by the position of dampers 10,11,12 in the air duct.

In accordance with the terms of reference, an automated electric drive for the turbine of a kiln for drying wood and wood products was designed.

In the course of designing, the design of the furnace was studied, the drying process was analyzed, and the kinematic diagram of the turbine electric drive was analyzed.

A literature review on the topic of the project was carried out, requirements for the designed electric drive were formulated and a functional diagram of the electric drive was developed.

The selection of the motor with subsequent checks of its heating and overload capacity confirmed the correctness of using an asynchronous motor with a squirrel-cage rotor type AIR71A2 with a power of 0.75 kW in the electric drive.

In the designed electric drive of the turbine of the wood drying kiln, a frequency converter of the VLT Micro Drive FC51 type, 1.5 kW with scalar control is used.

The conducted simulation of the electric drive confirmed the correctness of the calculation of the regulators of the automatic control system.

Automation of the wood drying oven was carried out using a programmable controller of the PR102 type (the OWEN company) as a control element.

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СИСТЕМА АВТОМАТИЧЕСКОГО УПРАВЛЕНИЯ ЭЛЕКТРОПРИВОДА ВИБРОПРЕССА ДЛЯ ИЗГОТОВЛЕНИЯ ТРОТУАРНОЙ ПЛИТКИ

У Цзяньфэй
Научный руководитель – Павлюковец С.А., к.т.н., доцент

В последнее время бетонные тротуарные плитки стали показателями современного уровня качества строительных изделий для благоустройства