DEVELOPMENT OF A SOLAR WATER HEATING CONVECTIVE UNIT FOR DRYING MEDICINAL PLANTS

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ABSTRACT--*This article outlines the approach selection dryer for drying capillary porous medicinal plants convection method in large volumes. When collecting medicinal herbs need to know where to focus the useful elements and in what period of plant development, their concentration is maximum, the most widely used medical plants in traditional medicine. Various types of drying equipment convective type. Is a schematic drawing of container-convection dryer, data components and parts. It is shown that the current state of the problem, the causes and the sound data to the chosen methodology is summarized.*

Keywords-- *medical plants, solar water heating drying equipment, temperature, process, heating agent.*

I. INTRODUCTION

Solar energy is one of the most promising directions for the development of renewable energy sources. The amount of solar energy supplied to the Earth exceeds the energy of all world reserves of oil, gas, coal and other energy resources, including renewable ones. The potential of solar energy is so great that, according to existing estimates of solar energy entering the Earth every minute, it is enough to satisfy the current global energy needs of mankind throughout the year.

The use of renewable energy sources for the Republic of Uzbekistan is relevant both for the purpose of ensuring energy security and improving the social and living conditions of the population. The main components of renewable energy sources in the republic are solar energy, hydraulic wind and geothermal energy, as well as biomass energy.

The territory of the Republic of Uzbekistan (447.4 thousand square kilometers, of which 70% is desert territory), is located in relatively favorable climatic climatic conditions. The energy potential of which is 98.5% of renewable energy sources combined, and it is considered the main determining factor in planning the share of the use of renewable energy sources in the overall energy balance of the Republic.

The Republic of Uzbekistan is located in relatively favorable climatic conditions for the use of solar energy for the processing of medicinal herbs.

The rational use of wildlife is today one of the most important modern tasks. In turn, the need for the medical industry in plant materials is constantly increasing, and today, special attention is paid to the safety of medicines used in medical practice in connection with anthropogenic pollution of plant materials.

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Around the world, forests, agricultural plantations and agroforestry systems play a key role as livelihoods for the rural population, providing them with jobs, energy, nutritious food and other products and ecosystem services. They hold enormous potential in terms of ensuring sustainable development and creating a green economy. However, practical examples of using this potential are not enough. Such practical examples are extremely relevant when developing a sound forest management and forest management strategy, as well as to ensure that the benefits received from forests are taken into account in the post-2015 development agenda, not only environmental, but also in terms of resolving social issues in general [1].

In our republic, medicinal plants are mainly grown in forestry, which are located in mountain and foothill areas. Since in such places the climate is volatile, problems with electricity can often be encountered. Each year, over 850 tons of medicinal plants with a wide variety of useful properties are simultaneously ripened for the season, to which a special approach of the drying method is necessary. Medicinal plants grown in our republic are distinguished by their beneficial properties that are not found in other countries of the world. Until today, for the development of container-convective drying plants, there were devices for drying lumber, fruits and vegetables in which electricity is used as a heat agent. Based on such drying plants, other private entrepreneurs produced mini-container dryers for food products [2, 3].

Medicinal herbs contain at least one substance with medicinal properties. This substance or substances are often unevenly distributed over the tissues and parts of the plant. Therefore, when collecting medicinal herbs, you need to know where the beneficial elements are concentrated and in what period of plant development their concentration is maximum.

II. RESULTS

Since ancient times, traditional medicine uses more than 10 thousand plant species in the treatment of various diseases in the form of tinctures, lotions, squeezes and extracts from medicinal herbs [4,5].

Today in our country about 300 species of plants are considered official, and according to the current regulatory documentation for medical purposes, 220-230 types of medicinal plants are used. Of these, about 130 are processed by the chemical and pharmaceutical industry and about 90 species of medicinal plants after primary processing enter the pharmacy network.

Forest products as medicinal plants, or rather medicinal raw materials, are almost never used fresh. The most common method that preserves the physiological activity of medicinal plants is drying. In this case, heat transfer and diffusion movement of moisture occur in the substance. All medicinal raw materials are dried immediately after collection. Removing water from plant cells can stop enzymatic processes. The drying temperature can be in excess of 60 - 70 degrees, provided that the properties of the medicinal substances contained in the medicinal raw material do not change from this. After drying, the medicinal raw material perfectly retains its properties even with possible short-term damping during storage [6].

In the general technological chain, drying of medicinal herbs is a very responsible and important operation. With improper drying, you can not only significantly reduce, but completely destroy the medicinal substances contained in the raw materials. Each plant is a kind of natural laboratory in which complex biochemical processes take place continuously throughout the life of a plant. The formation of carbohydrates, proteins, fats, organic acids, alkaloids, glycosides is non-stop, all kinds of processes of splitting and formation of new compounds are continuously being performed, etc.

Effective application of the drying process is impossible without the use of modern high-intensity dryers. Among the known designs of dryers in food technology, convective dryers are widely used, in which the dried material flows around a stream of a heated drying agent - air, flue gases, etc. All convective dryers differ: by the way the process is organized (periodic and continuous); in the direction of movement of the dried material and drying agent (direct-flow and counter-current); by pressure in the drying chamber (atmospheric and vacuum); by type of drying agent (air, gas, steam) [7]. A special place among the existing designs of dryers is occupied by convective dryers, the distinguishing features of which are the simplicity of their designs, the possibility of smooth control of the drying mode, convenient loading of wet material and their relatively low cost. Based on a search from the patent and technical literature, the following, original designs of convective drying apparatuses were selected.

Convective dryer developed by A.A. Fedyaev maintains a predetermined temperature regime, is equipped with axial fans, in addition, a distribution device is installed on the false ceiling in the supply zone of the drying agent, which directs 1/3 of the volume of the drying agent in the region of the area of the upper stack package, while the distribution device is made in the form of a plate, initially parallel to the false ceiling, at the end of which the plate is bent according to a parabolic law, the end of which ends on the upper axis (middle) of the first package, and not the shown (imaginary) line of continuation of the plate abuts against the lower part of the upper package on the side directed towards the drying agent [8].

Portion mini dryer of the Russian Company Newtekhagro LLC, which is a modular version of container drying facilities with heat-insulating panels. The basic module consists of four drying chambers with a certain number of pallets for the material to be dried. A heat generator for heating and transporting air is located in the rear of the dryer, in a separate chamber. It is connected to the drying chamber by a channel system. The air flow is vertical along the long side of the container [9].

Based on the above data from convective drying plants, it can be judged that the plants are not designed and not adapted to the characteristics of the characteristics of materials of plant origin with medicinal properties to ensure maximum preservation of biologically active substances. In addition, the plants have a complex technical solution, including thermal insulation panels in the dryer design, which is not cost-effective for such a small drying volume.

Convective dryer for drying fruits and vegetables I.P. Slobodyanika contains a chamber with horizontal trays paced in it, with perforated bottoms adjacent to the duct, a fan, inlet and outlet nozzles for a drying agent, which creates difficulties for the processing of products and is not adapted to the characteristics of the characteristics of medicinal plants, in particular, to ensure maximum biological safety active substances [10].

To dry medicinal plants in large volumes under natural conditions or in mini devices requires a lot of labor and manual labor, since the drying process takes a long time in such conditions. For this reason, the beneficial substances and biologically active substances present in the composition lose their properties and activity. Due to the long drying process, the raw material undergoes various microbiological, biochemical and enzymatic changes that lead to their deterioration. In fig. Figure 1 shows the developed container-convection drying plant that has an important role to solve existing problems [11-13].

The proposed solar water heating drying equipment is shown in fig. 1. and consists of a drying chamber 1, a chassis 2, an integrated control panel with a current inventory 3, a tray for processed raw materials 4, the frame of the chamber 5, the inner grid 6, the outer lining 7, a ventilation pipe 8, a tier with a limiter 9, a bracket for attaching an irradiation unit 10, an irradiation unit for infrared radiation 11, a door 12, a heating boiler 13, a gas boiler 14, a thermometer 15, an insulating layer 16, a steering wheel for locking a door 17, an internal ceiling chamber 18, automatic burner device 19, expansion barrel 20, heat exchanger system 21, ball valves 22, pipelines 23, boiler door 24, battery heat 25, steam vent (air vent) 26, circulation pump 27, chimney (gas duct) 28, solar collector 29, vibrator 30.

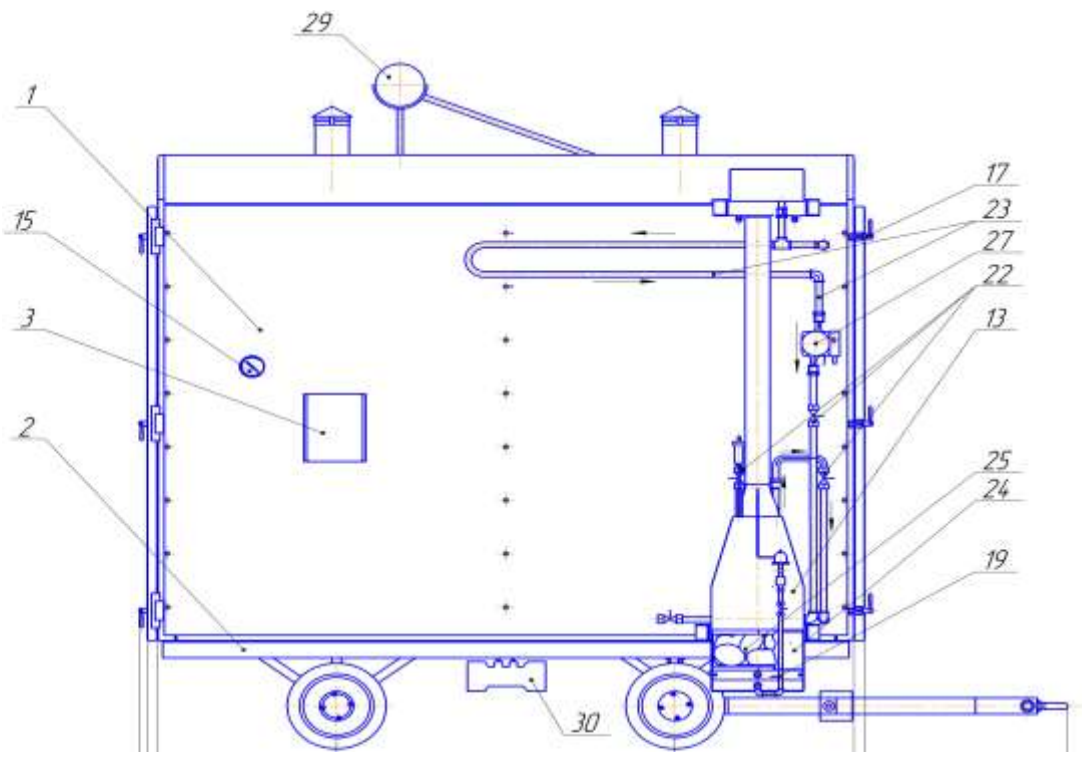

Figure 1: Scheme of the main type of solar water heating dryer

Trolleys are placed pallets with stainless mesh bottom with raw materials cleaned and prepared for drying. With the doors open, the containers are convection-heated in a drying chamber loaded with carts. Tightly close the installation door with a valve. A gas burner device is switched on, through which hot air flows through a valve. Hot air is distributed from the nozzles through the pipes to the chamber area. The supplied hot air passes through the heat-conducting pipes, heating the inner chamber and thereby the raw materials intended for drying. The accumulated steam from the evaporation of moisture from the raw materials is removed using fans and exhaust pipes. To ensure uniform heat flow, an air recirculation fan operates in the chamber. The recirculation of the heat agent between the pallets ensures uniform heating of the raw materials. During the drying process, the thermal agent is controlled by a temperature regulator; as a result, it does not allow the air flow to overheat the raw materials from a given temperature.

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III. DISCUSSION

A special solar water heating dryer runs on natural gas or solar energy. It is known that from 1 m^3 of gas it is possible to obtain 34.02 MJ of energy or 9-10 kW / h. Fuel consumption for drying raw materials - flowers is 7 m3 of gas, at 4-5 hours of operation, 15 m3 of gas is consumed for fruits and tubers at 8-10 hours of operation, and 4 m^3 of gas is consumed for drying grass at 2-3 hours of operation. If you use electricity to dry the above products, 36 kW/h will be consumed for each hour of operation.

In a container-type solar water heating dryer, the coolant is carried by a line of heat-conducting pipes. Metal tubes and withstand prolonged exposure to active elements released from the product during the drying process. Each heat transfer pipe is equipped with manifolds with flanges for connection to a furnace boiler. Heat transfer pipes are attached to the frame of the drying chamber by means of special fasteners. The circulation of the heat agent - hot air is carried out using fans and using the law of physics spontaneously, as a rule, hot air rises from the bottom up, since the boiler is located at the bottom of the container - dryer.

To intensify the drying process, air circulation can be carried out forcibly, providing sufficient air exchange inside the container chamber of the intended purpose using a fan. A fan is installed to the bottom of the dryer container for air supply. The circulation volume of each fan is 780 m^3/h, depending on the total volume of air circulation to the chamber, it is 1560-6240 m^3/h.

Air exchange fans are located on the side (if necessary, can be installed on the roof) of the drying chamber to direct air movement and serve to maintain air exchange between the chamber and the environment.

The dryer contains removable drying chambers with pallets 800x1000x50 mm in size, 16 pieces are arranged vertically on each trolley. The usable area on each pallet with a mesh bottom is 0.8 m^2. The distance between the pallets is 200 mm. Carts on the camera move with the help of small wheels.

After loading the raw materials into the chamber, the furnace nozzle is ignited and the air temperature in the dryer is raised to 65-70 °C. In order to maximize the preservation of the final product during the drying process, the temperature is maintained automatically using a thermostat, which is located in the chamber.

The intervals of loading and unloading of products depend on the duration of drying of the raw materials. For example, as a raw material, flowers are dehydrated for 4-5 hours, if fruits and tubers - 8-10 hours, and also if herbs - 2-3 hours.

With controlled blowing with hot air with the help of fans and drying temperature, layer-by-layer distribution of nutrients occurs faster and better.

IV. CONCLUSION

The essence of the installation is that the installation takes into account the adsorption properties of substances of saturated drying products, that is, determine their own rates of adsorption and desorption of substances in the wet state, in accordance with which establish the drying mode of the product. As a result of such drying, a product is obtained with a layer-by-layer distribution of the substances contained in the product, which allows maximum preservation of useful biologically active substances of the products.

Thus, the advantage of the proposed solar water heating installation is that when using the proposed installation, it is possible to obtain drying products enriched with substances dissolved in fresh vegetables, fruits and medicinal herbs, with a predetermined distribution by volume of the product. That is, as a result, a product with predetermined properties is obtained. Another clear advantage of the installation is the use of a container to increase the efficiency of the drying process and the use of natural gas or solid fuel. In addition, low-temperature dehydration of products allows you to maximize the preservation of useful biologically active substances in the final products.

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