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GET TO KNOW THE TYPES OF RICE DRYING EQUIPMENT

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Abstract
Currently, great attention is paid to energy-saving devices, including energy-saving grain dryers. In addition, the issue of improving the quality of drying and accelerating the drying process is still relevant. One of the most important aspects of improving the dryer is combining the benefits of multiple dryers to create combined energy efficient dryers. This article examined energy-efficient rice dryers as well as the available literature. Combines all relevant information for drying rice and for comparison by technology. Energy for a number of drying technologies, consumer data is summarized from published literature and normalized for comparison. Performance indicators are given in the industrial or laboratory conditions in which a large part of the source data is created. Our analysis shows that combined grain dryers reduce drying time compared to other types of dryers as well as provide quality drying. Combined grain dryers usually have high energy efficiency when drying steps are included.

Keywords: Drum dryer, shaft dryer, abstract boiling dryer, pneumatic dryer, conveyor dryer, combined dryer, rice, moisture, drying period, drying method.

Introduction

According to statistics from food and agricultural organizations, there are seven countries where more than 75% of the population depends on rice for basic food. Asian countries have the largest share in world rice production. According to the latest official data, China was ranked first in the world in rice production in 2020, followed by India and Bangladesh, which have reached the production of more than 211 million tons of rice. Rice grains are grown in the largest cultivated areas in the northern regions of the Republic of Uzbekistan [1, 2]. In Northern Uzbekistan, the collection of rice is carried out mainly in late August and early September. During this period, the humidity of the shawl, usually from 18% to 36% [3]. At the same time, the moisture content of rice stems can increase by up to 75%, which leads to a decrease in the cleaning efficiency of combines. After the rice is cleaned, it requires drying. Agricultural grain is dried for long-term storage after harvesting. Drying cereals is considered one of the most important processes, improving the quality of cereals, ensuring the receipt of quality products from them. When drying grain, taking into account its properties reduces storage costs-usually in villages the rice is dried in sunlight by spreading it through natural roads i.e. to the lands. But as a result of the decrease in air temperature and rainy autumn, drying agricultural products in drying devices is much more necessary.

According to the physical essence, drying is considered a complex diffusion process [4], the speed of the process depends on the rate of diffusion of moisture from within the drying

material into the surrounding mukhit. For this reason, the drying process is a combination of heat and mass exchange processes.

Drying is not only a teplophysical process, but also a technological process. A drying technique is used to organize the process. There are many drying styles, separated into classes. When the drying process is carried out by a mechanical method, it is possible to remove the free-bound moisture on the surface of the material, but the tightly bound moisture inside the material is removed to the surface of the material by the method of heat transfer. The given heat changes the aggregate state of the water inside the material, that is, it moves from a liquid state to a gaseous state. Well, the given heat is spent on the evaporation of water inside the material.

The more important the drying of agricultural grains, the more important it is to study the important parameters to take into account in the drying process. It serves to properly and qualitatively design and carry out the drying process. Mathematical expressions of changes in parameters help to properly organize the drying process.

Material and methods. In the last twenty years, the publication has studied literature. Particular attention is now paid to combining drying methods in one device, having studied them in depth. This type of drying is called a combined method. Rice grains are dried through a variety of methods. Research has focused on identifying important computable parameters in rice drying, such as: the amount of moisture extracted, the amount of moisture evaporated, the work requirement on the moisture content of the drying device, the indicator of flat rice drying, etc. Drying devices are divided by the features of the structure – shaft, abstract boiling layer, infrared beam, drum, pneumocorticist, tape, combined types.

1. Shaft grain dryers.

Shaft grain dryers are a common grain dryer and are characterized by their convenience, simplicity, high work productivity. We can see these grain dryers in stationary and portable cases. There are many types of Shaft grain dryers, which are mainly divided into straight-flow and recirculating types. Shaft grain dryers are vertically arranged, designed to carry out drying by letting the grain to be dried from the top fall in a dispersed hole, and from the bottom a hot air or air-gas mixture. We can see the general view of this grain cracker in Figure 1 below. Many scientific studies have been carried out with the aim of improving shaft grain dryers. Considering that the used heat agent exiting the dryer chamber raises the outside air to a temperature even higher than 40°C, it is possible to carry out drying using the used heat agent again.

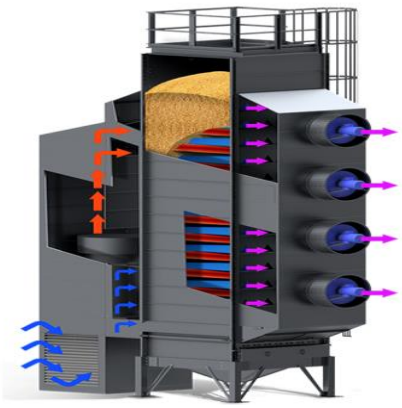

Figure 1. General view of the shaft grain dryer.

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Integrated outer body for re-circulation of used air in drying zone, used hot and cold air purifier cyclones, heater, heat exchanger installed, used hot and cold air returned to drying and cooling zones respectively after cleaning in Cyclones, shaft dryer has the ability to ensure the uniformity of drying and cooling of different crop grains, comparable energy consumption is low, gabarite size will also be small [5-6].

2. Abstract boiling dryers.

Abstract boiling dryers are now from a wide range of developing types of dryers. During the drying process, the interaction surfaces of the particles of the material being dried and the drying agent are much larger, resulting in an increase in the evaporation of moisture from the material, while the duration of drying is reduced, that is, it takes several minutes. The drying process occurs when, under the influence of the sent drying agent, the drying material begins to dry to a suspended state, and the dried part of the material is slowly expelled through the pouring part. The conical construction of the dryer chamber helps to evenly dry the grains being dried. It is also possible that the number of cameras is several, which complicates the construction of the dryer, in combination with the fact that it requires a drying agent and a lot of electroenergy, it is advisable to apply for materials that require long drying, with greater resistance to internal diffusion of moisture. It is also possible to combine the processes of drying and cooling the material in them [5-6].

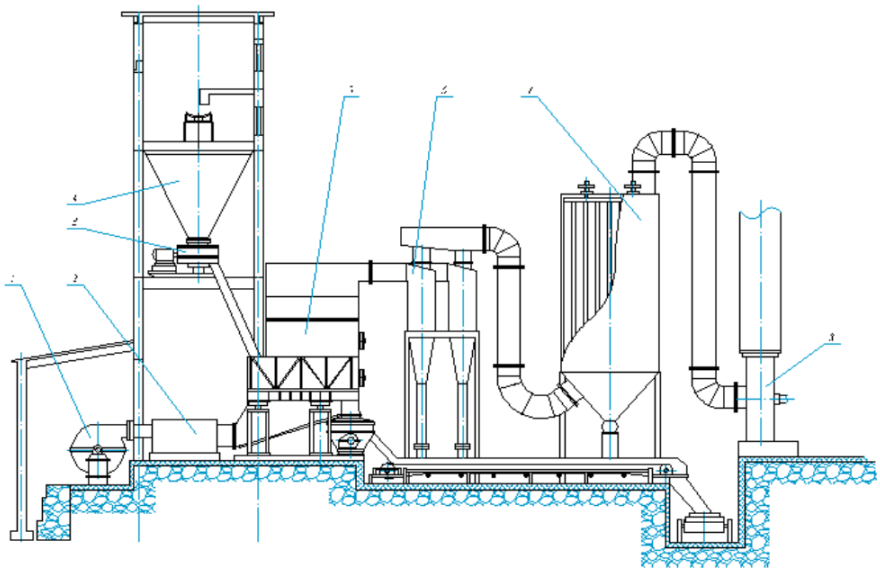

Figure 2. Abstract boiling dryer

In the dryer, the values of the working parameters can have their effect on the heat transfer coefficient of the particle of the material being dried. For example, if the height and diameter of the abstract boiling layer change, there will be no effect on the coefficient, but if the abstract boiling temperature increases, the coefficient of heat transfer for small particles increases, decreases for large particles.

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3. Pneumatic dryers.

Pneumatic dryers are based on the construction of dried grains in suspended Holda using a thermal agent, drying is carried out in pneumogas and recirculation pneumogas dryers. The dryer has a drying tube, with the help of a heated air fan in the calorifier, which is fed to this tube at great speed, a drying grain-containing bunker is installed at the bottom of the tube (Figure 3). In the calorifier, the heated air is generated in a few seconds and rises to the pipe, the dried grain is kept in the upper part of the pipe for some time until it dries, and then expelled in a dry state. The dried heated grain is fed into a refrigerated spilling bunker in a cyclone, using a split air vent which is pumped into the atmosphere through a filter [5-6].

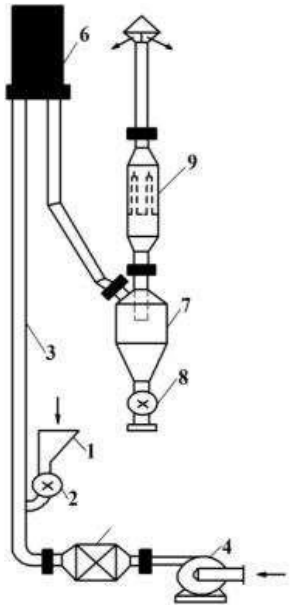

Figure 3. Pneumatic dryers.
1 – hopper; 2 – feeder; 3 – pipe dryer; 4 – fan; 5 – heater; 6 – collector; 7 – cyclone; 8 – unloading device; 9 – filter

The length of the pneumatic grain dryer drying pipe can be up to 20 m, the rate of heated air flow given to the pipe is 10 – 30 M/s. Because the drying process takes a very short time, the free-bound moisture in the drying grain evaporates and escapes. For this reason, dryers of this type are initially used as dryers. The dimensions of the grain particles being dried are defined to be no more than 8-10mm, and as the grain particles decrease in size, the energy expended also decreases. In addition, in pneumatic dryers, the diameter of the drying pipe D and the diameter of the material being dried have an effect on the drying process of changes in the values of DS and the ratio D/D, that is, if the value of the diameter of the groove increases, the speed of the material particle and gas flow decreases.

4. Conveyor grain dryer

Conveyor dryers consist of Chambers in which conveyors are located, which are provided with ventilation gills. Drying the grain is carried out through a clean air heated using Steam or fire, the heating temperature depends on the type and humidity of the grain being dried. There are

single-layer and double-layer types of conveyor dryers, in which the grain being dried is mixed and falls from one tape to another (Figure 4).

It is not difficult to understand the principle of operation of a conveyor drying device. On the grain coming on the conveyors(transporters), the fan sends out the heated air in the heat generator, goes through the drying and cooling chambers and into the drain channel in a dried state.

Currently, scientific research on conveyor grain dryers has developed a digital model of predicting changes in product moisture and temperature along the length and height of the drying product layer, specific models for improving the drying system, as well as intellectual control methods for controlling the dryer.

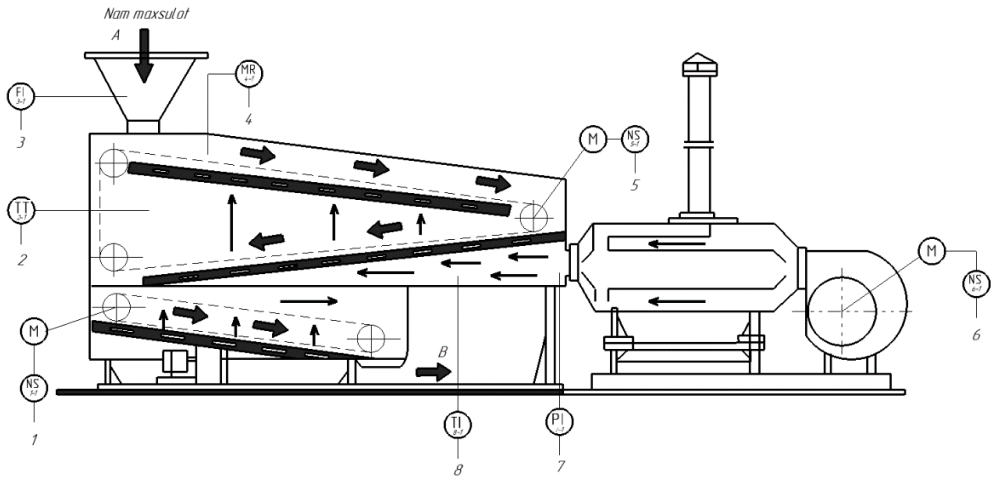

Figure 4. Conveyor grain dryer scheme

Conveyor grain dryer has a number of advantages over shaft and drum dryers, that is, different materials can be dried in different sizes in conveyor dryer, productivity is easy, grain layers can be mixed during drying process, dryer structure allows visual observation and adjustment of grain drying and movement, and working organs are very convenient for service. The fact that conveyor dryers are bulky is their main drawback, in addition, a relatively large number of moving nodes and spare parts increase the requirements for the strength of the structure and reduce its performance reliability. Dryers are more often perceived as an additional means of drying cereals and seeds.

5. Drum dryers

The most common drum dryers when drying cereals consist of three main parts: a drum, a hearth (calorifer) and a cooling chamber. Dryers of this type can be performed in the form of a single groove or several grooves inserted into each other. The axis of the drum, equipped with metal plates, moves the grain to a spiral upward at an angle of up to 6° with respect to the horizontal. A gas heated at a speed of 2-3 m/s moves forward along the drum (Figure 5). Having reached the corner of the slope, the grain is freely poured into the cooling chamber. The speed of rotation of the drum (on average 1 to 8 per minute) is determined by its slope angle and the time of the food grain in the apparatus (15-20 minutes), when it is recommended that the temperature of the drying Gas be kept in the range of 180-250°C. Depending on the size of the grain to be dried, the pumps inside the drum will be different. The dryer is based on the drying

of the second side of the drum by sending a heated mixture of Hava or havo-gas into the drum at the same time as turning the drum of the drying grain, which is supplied by one side of the rotating drum [4,5,6,7,8].

A simplified scheme of drum dryer operation is shown in Figure 5.

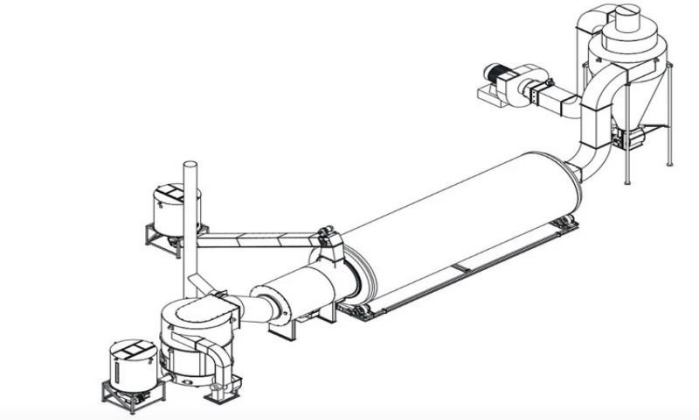

Figure 5. Drum dryer

The following are the advantages of drum dryers:

- compactness, simplicity and accessibility as mobile devices;
- high drying speed, productivity and uniformity;
- keeping the drum voltage at 100 kg/m3 or more moisture;
- economic efficiency and financial benefits.

There is a lot of information in the literature on the improvement of their construction and drying technologies to increase the efficiency of drum dryers, but the disadvantages of this type of dryers are such as the inability to obtain seed grains with a high germination rate, adjust the grain drying time and the speed of movement, which depends on the intensity of drying agent.

Table 1 below lists drying technologies and their main characteristics.

	Drying Technology	Key Characteristics
1	Sun Drying	Simple and low-cost method; highly dependent on weather conditions (outside of research scope)
2	Infrared Dryer	Energy-efficient; short drying time; can lead to uneven drying
3	Microwave Dryer	Rapid and uniform drying; high initial investment cost
4	Vacuum Dryer	Low-temperature drying; preserves color and flavor; requires a high initial investment cost
5	Combined dryer	Combines several drying technologies to improve drying quality. Energy efficiency is high and has flexibility
6	Solar-Assisted Dryer	Kam operatsion xarajatlar; ekologik jihatdan barqaror; ob-havoga bog'liq samaradorlik.
7	Pneumatic Dryer	Rapid drying; high versatility; efficient heat distribution.
8	Drum dryer	Compactness, simplicity, drying speed, high productivity
9	Abstract boiling dryer	Uniform drying of grains, combined drying and cooling
10	Conveyor dryer	Different materials can be dried in different sizes, productivity is easy
11	Shaft dryer	Simplicity, high productivity

Results

As a result of taxing the above dryers, I was convinced that any dryers also have both positive and negative drying options. It is possible to dry quickly in some dryer, but the quality of the grain can be adversely affected. Therefore, timely drying of grain and seeds grown in agriculture reduces their losses in processing. For this reason, the creation and implementation of safe, stationary and portable compact drying apparatus with a simple structure, capable of drying quickly and qualitatively, while maintaining a high level of substances contained in cereals and seeds, is considered an important work. It turns out that it is necessary to develop a drying device by combinating the above dryers.

Discussion

The analysis of scientific and technical literature relating to the research carried out in recent years on the development of high-quality processing techniques and technologies of agricultural cereals indicates that significant theoretical and practical results have been achieved in this field. Many works dedicated to the development of new constructions of agricultural grain drying devices have been published, drying technologies have been developed, the scale of practical issues solved is growing. To solve the issues related to the provision of seed and grain products with drying and processing technology, A.N. Chenin, W.V. Kafarov, P.D. Lebedev, A.S. Ginzburg et al., N. from scientists of our country.R. Yusupbekov, H.S.Nurmohammedav, DC.N. Mukhitdinov, Dj.P. Mukhitdinov and others contributed.

The results achieved by them in the development of new structures of grain drying devices, studying and substantiating their parameters, improving drying efficiency, developing promising technology and technical means for drying, optimization of drying processes, simulation, development of developments dedicated to solving the problems of accelerating heat and mass exchange in the drying process were introduced into production.

Conclusion

The results of the research can be concluded as follows: improving the efficiency and energy consumption of the drying process by improving the structure and technological process of the rice grain drying apparatus, creating combined grain dryers and substantiating its parameters.

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