DRYING INSTALLATION FOR GRANULAR PRODUCTS IN THE SUSPENSION LAYER

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Abstract: Applying internal heat source (high frequency currents) to dry granular wet products, namely grape seed in the suspended layer allows the adjustment of the drying time, hence the duration of thermal treatment, for each particle by automatically removing it from the respective area of the drying chamber. In order to study the kinetics of the given drying process, a drying facility for wet granular particles in the suspension layer was made.

Keywords: Seeds, grapes, suspension layer, drying.

Introduction

Currently, viticulture has not lost its relevance in Moldova, and grapes continue to enjoy increased popularity. However, it was found that unique benefits in nutrition, cosmetics and treatment of multiple diseases and seeds of grapes, often neglected. Grape seed is rich in strong antioxidants (as proanthocyanidin) and natural biologically active compounds such as calcium and potassium, contain large amounts of vitamin E. Increased antioxidant properties of grape seeds helps to destroy free radicals in the body, which, in turn, helps to avoid premature aging. The tocopherol (vitamin E) plays an important role in vital processes, which take place permanently in the human body.

Considering that grapes contain up to 7% of seeds, as a result of their processing, they are obtained in the Republic of Moldova approx. 18-20 thousand tons of grape seed. Industrial processing of grape seeds reflects a number of specific technological operations including drying **[1, 2]**. One of the methods to intensify the drying process of grape seed is drying in the suspended layer with the application of internal heat sources - microwaves. This method involves increasing the quality of the dry product and reducing energy consumption, because each seed is dry in part.

Materials and methods

For the design of the drying instalation described below, was used 3D design software SolidWord.

Computer simulation of the dynamics of the drying agent along with grape seeds the various forms of the work chamber was done using the ANSYS software using the laws of numerical methods.

As the source of thermal energy, has accepted a 900 W magnetron type Panasonic 2M210-M1.

Results and discussions

For the kinetics study the drying process of granular products in the suspended layer, a drying installation has been made (Figura 1). As a source of heat the energy of high-frequency electromagnetic fields was used, which allows the product only to be heated, thus excluding heat losses removed from the working chamber with the drying agent (the air) and minimizing those from insulation to the environment. At the same time the given method of application of thermal energy allows location of the heating process (drying) only in the field of electromagnetic field formation, which coincides with the suspension zone (floating) of wet granules, thus ensuring a good self-selection of dry particles.

The drying installation is made up of the casing 1 (figure 1) on which the construction elements are mounted, namely: the product feed unit made up of the rotor 5 powered by the electric motor 12; the drying agent feed system (air), made up of the fan 4 driven by the electric motor and the air filter 11; the aerodynamic tube 6 with tapered section on which the drying chamber is mounted 8 equipped with a magnetron 7; the exhaust system consisting of discharge pipe 9 and the cyclone 10.

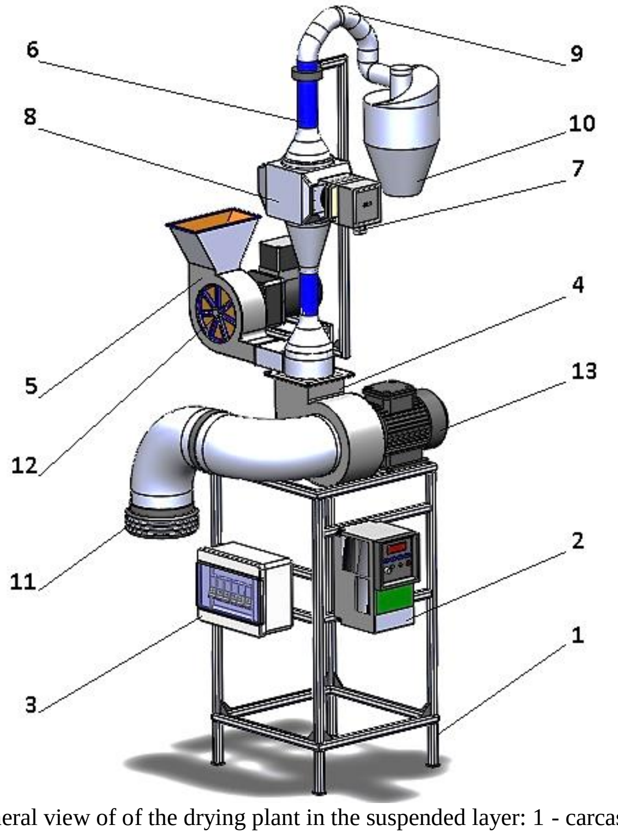

Figure 1. General view of of the drying plant in the suspended layer: 1 - carcase; 2 – frequency converter; 3 – control panel; 4 - fan; 5 - rotor; 6 – aerodynamic tube; 7 – magnetron; 8 – drying chamber; 9 – discharge pipe; 10 - cyclone; 11 - filter; 12 – electric motor; 13 – electric motor;

The instalation is equipped with temperature and humidity sensors mounted at the inlet and outlet of the aerodynamic tube 6. The air speed is adjusted by changing the fan speed 13 with the help of the frequency converter 2. Product temperature in the microwave heating area is measured with the type thermocouple EC060V, measurement error ± 0,99ºC. Decrease in mass of product is determined by periodic extraction of samples in the drying zone and their subsequent weighing on electronic scales type JJ2000B, measurement error ± 0,01g.

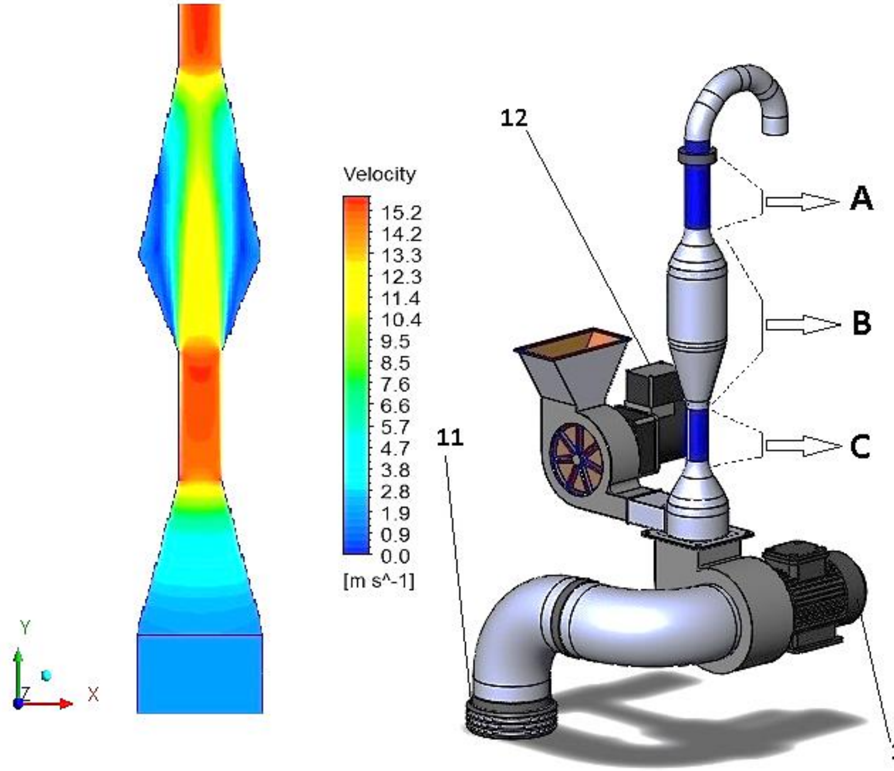

Figure 2. Variation of linear velocity across the entire section of the trizonal tube.

The geometric shape of the aerodynamic tube 6 was done as a result of computer simulation of the flow dynamics of the air-seeds mixture due to the reasons for obtaining it in the drying zone of a stable layer of suspended seed (figure 2). Thus, in zones B and C the mixing´s speed is maximum (cca. 15 m/s), so the particles run through them without being held back, and in Zone B (consisting of a loudspeaker and confuser), due to the slow widening of the speaker diameter, the air velocity decreases up to the wet weight of the wet seed (8,5 m/s) [3, 4]. Due to inertia forces, the area in which the air velocity equal to that of the water is established of wet seeds was obtained in the second half of the confuzor. Namely here and product heating takes place in the microwave field. With drying (decreasing mass) of the particles, floating speed decreases, thus, already dried particles are entrained by the air flow and displaced from the heating zone. Due to the further narrowing of the confuser, air speed increases, which provides for a better traction of dry granules, which is subsequently removed from the tube aerodynamically due to the increased speed of the mixture in zone A [5].

The laboratory installation works the following way. The wet granules are loaded through the rotor 5 in the lower zone of the aerodynamic tube, from where they are taken over by the air flow flowing from the fan 4. In the area B (in the middle of the confessor) the wet granules stop and pass into suspension, being in a Brownian state of motion. An electromagnetic field is formed in the given area, which undergoes heating in volume granules blown by air, drying them. The dry granules, losing weight rises to the upper area of the confuzor where it is trained by the airflow with increasing speed and via tube A are circulated in the cyclone 10 in which separation of the dry air product takes place.

Conclusion:

The proposed laboratory allows research on the kinetics of the drying process of wet granular products in the suspended layer and subject to microwave application thermal treatment. The air velocity can be adjusted within the limits 0 – 20 m/s, air temperature within the limits 20 – 100 ^{O}C, magnetron power 900 W. The instalation enables the online registration of temperature, air velocity and humidity at the inlet and output and periodic recording of the product mass decrease. Application of new drying method in suspended layer, in the food industry will contribute to increasing the quality of the drying products by optimizing the duration of thermal treatment.

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