Journal of the Technical University of Gabrovo, Vol. 51'2015 (3-5)

ИЗВЕСТИЯ
на Технически университет
Габрово

Раздел 1
МАШИНОСТРОЕНЕ

Section 1
MECHANICAL ENGINEERING

DEVELOPING A NEW TYPE HAMMER MILL WITH A COOLING SYSTEM

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Article history: Received on 19 February 2015, Received in revised form 15 May 2015, Accepted 04 June 2015

Abstract. *The article discusses the development of a new type of hammer mill with a cooling system. Shows the construction of a hammer mill comprising a housing, with the loading and unloading openings are rotor with hammers classifier and guide elements. It is shown that housing for cooling fluid such as cold water, the mill further provided with a cavity formed by a cylindrical outer wall of the mill housing. The results are compared with the results of the available technology of obtaining powder. Obtained powders such indicators, such as low humidity and maximum preservation of nutritional properties of the original product.*

Key words: mill, cooling, hammer, powder, jerusalem artichoke, grinding process,

INTRODUCTION

Grinding is the process of destruction of pieces of solid material at critical internal stresses created as a result of any load and exceeds the applicable limits of safety. Stresses in the material can be created by mechanical loading, temperature effects, ultrasonic vibrations and others. The most widely used in modern production methods have mechanical grinding.

By the method of impact on the ground material distinguish grinders, destroying the material compression (jaw crushers, cone and roll crushers) and blow (rotary and hammer mills).

In the jaw crusher grinding the material occurs mainly in the crushing chamber between the cheeks at they approach each batch. During the withdrawal of the movable jaw fixed shredded material falls out of the crusher. Simultaneously, chunks compression takes place relative movement, whereby the pieces are worn. When working surfaces the grooved grinding cheek pieces of material can also be accompanied by cleaving and fracture.

In cone crushers destruction of material is crushing, fracture and abrasion movable cone inside the still. Thus there is a periodical approach and move away from the working surfaces of the cones, in principle, both in jaw crushers. In the roller crushers material is ground in the narrow space between rotating towards each other by crushing rolls. When using the grooved rolls and gear material is ground and cleaving and fracture.

In rotary and hammer crusher impact action grinding of the material is due to the impact on pieces of rotating hammers or beat, as well as collisions with discarded chunks reflective elements of machines.

In ball mills the material is ground in a rotating drum by blow grinding bodies falling from a height. In addition, during the relative movement grinding of bodies and particle material abrasion occurs last.

In vibratory mills grinding material carried in a drum filled with grinding bodies, blow and abrasion at high frequency vibrations the housing.

In a jet mill grinding material abrasion occurs when particles collisions between themselves and with the walls of the working chamber at the chaotic motion of particles in a gas stream of high turbulence.

Machines for grinding is divided into crushers and grinders.

For constructional features distinguish crusher: jaw, roll, cone, impact action (rotary and hammer). Finger shredders and runners occupy an intermediate position between the crushers and mills, as they can be used for fine crushing and coarse grinding for.

Mills is divided into drum (low-speed), roller, swing, ring and other (average course), hammer, vertical shaft (drums), and vibrating jet.

STATEMENTS

Condition problem based on the analysis of the progressive development in the world. Developed by scientists TSTU method for producing powders from artichoke after the drying and grinding unit with a cooling system is a solution to the actual problem.

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Traditional forms of storage and transportation of plant materials (in bulk and frozen, canned in the form of juices, pastes, etc.) related to the preservation of limited time, even in the organization of storage conditions in a narrow range of optimal parameters of the environment in the vaults, and a large amount, makes their preservation and transportation complex, costly, cumbersome and energy intensive. In this inevitable loss of both the product and its valuable components during storage and exposure to moisture and the internal temperature.

The need to intensify the grinding process can be achieved only on the basis of deep knowledge of both principle and construction related equipment and features of its operation.

According to the purpose grinding machines are divided into the crusher of large, medium and fine crushing and mill fine and superfine grinding.

In the main method of mechanical impact on the material grinding machine can be divided into split, crush, crush-istirayusche, drums, percussion, and colloidal abrasive grinders. Depending on their construction jaw crushers, cone, roll and hammer mills, disintegrating and dismembratory, drum, ring (roller-pendulum), ball vibration and jet mills. On food enterprises was widespread impact crushers - machine impact action, used to produce a mixture of finely divided ground particles. They are effective in destruction of brittle materials (sugar, salt, grains, etc.)., And less effective in wet grinding products with a high fat content. In such machines, the destruction the product is the result of blows to his steel hammers, punches product particles of housing crushers and wear them on punched sieve, are a major part of the crusher housing [9].

Existing methods for producing powders consist of two stages: drying and grinding, are cumbersome in hardware design, energy efficient, long-lasting [2,3,7,10].

For grinding high sugar raw materials can be used an effective way of grinding materials in the field of agriculture, as well as in the food and chemical industries.

Hammer mill comprising a housing having a window unloading, cover with a hopper, a classifier, a motor, a rotor with hammers, the axis of which is offset relative to the axis of the housing to form a crescent gap, wherein the rib has a different height. Qualifier formed as a trough and arranged in the housing between the two lower adjacent ribs, and the ribs are fixed on the inner surface of the housing. This device allows to reduce specific energy consumption, improve comfort and safety of operation. However, it has complicated structure and high complexity in operation. Furthermore, it is intended primarily for feed processing [8].

On the basis of literature review task of expanding technological capabilities and improve the efficiency of a hammer mill at high sugar refining raw mill housing by removing its caramelization and adhesion of the particles are ground to the inside of the body and to the surfaces of the working parts, the use of elements to cool her housing.

The task is achieved by the fact that in the known hammer mill comprising a housing with a loading and unloading openings are rotor with hammers classifier and guide elements according to the proposed design, it is provided with a cavity for the supply of cold water formed by mounting on the outer side of the wall a cylindrical mill body, around its perimeter, sealed housing, wherein, in the cavity formed symmetrically on both sides of the horizontal center line on the wall of the housing at an angle of 15º to the outer wall of the housing taken along a flexible metal plate, each of which rests on the screw mounted behind it in the housing wall, to allow adjustment of the angle of inclination of a flexible metal plate to the outer wall of the housing, within ± 10º.

Cold fluid supplied under pressure from the tap water, thereby resulting in a cavity encountering resistance metal plates, creating a limited space (gap) through angle plates and the rough surface of the outer wall housing encountering resistance begins to stir, giving turbulent flow. This process improves heat transfer between the water and the wall of the cylindrical body, thereby causing cooling of the housing wall and adjacent thereto, and calibration sieve materials present in the grinding step. Lowering the temperature to 90 °C is adopted in the prior art technology, to 55-60 °C in the apparatus authors caramelization avoids high sugar and feedstock, thereby eliminating sticking mass on the ground of the calibration screen, the inside of the cylindrical body and lamellar grinding hammers that promotes the expansion of technological capabilities and efficiency of the mill, because no longer need frequent stops for its purification. Moreover, the cooling process by grinding the raw material contributes to the conservation of valuable components of the product in high sugar raw materials, is also a positive effect. On this basis it is possible to conclude that the results obtained through the use of development in the solution of the problem.

Fig.1 shows the hammer mill, which contains the motor, a cylindrical body, the support leg, hammer plate, hammer rotor regulating damper with a hopper (throat), pipe supply and drain the coolant discharge neck, disk rotation axis, a cooling jacket for creating a cavity, a cooling chamber, a sieve gauge, flexible plate with an adjustment screw and a rough outer surface of the cylindrical body of the mill.

Fig. 1. *Appearance of developed a hammer mill with a system of water and air cooling of stainless steel*

Because artichoke relates to products with a large number of natural poly saccharides inulin and inulin caramelization starts to occur at a temperature of 70-80 ºC and in conventional grinding mills is carried out at 90 ºC in order to preserve the properties of the final product and exclude caramelization authors maintained at a temperature by cooling the body in the proposed device, ensuring that it is in the process within 55-60 ºC. The resulting finished powder has a particle size of about 3 mm, the mass fraction of about 6% moisture, and a mass fraction of total sugar - 70%, which corresponds to the technical requirements TU 9164-001-17912573-2001.

Furthermore, when checking on the work after calibrating sieve plate hammers and internal walls of the body were found adhering ground raw material, which indicates the absence of caramelization of the product during the processing of raw Jerusalem artichoke at low temperatures. Developed hammer mill can also be used for crushing any other type of high sugar feedstock.

Developed by the authors enable hammer mill due to the turbulent flow of cooling water unit, passed through the cavity created by the outer side of the cylindrical housing and a casing for chopping at high temperatures sugary products 50-60º, prevent caramelization process, and hence the mass of particles sticking to the inner Chopping parts unit and thus improve the efficiency of the hammer mill by reducing the number of stoppages for cleaning of the internal parts of the mill and, in addition, to obtain quality final product.

This allows for process and also other high sugary foods.

On an experimental basis of Tashkent State Technical University with a positive result were carried out technological tests installation hammer mill proposed design.

Elements mill having contact with raw food, food made from materials approved standards [4].

Jerusalem artichoke powder method of harvesting is the most promising, efficient and compact way to a long, lossless, storage and transportation of raw materials. Furthermore, as raw material for this technology, along with natural whole raw materials may be used for other production residues root crop processing. Microfine powder from tubers of Jerusalem artichoke has all the properties of the feedstock and, as a concentrate, has much biological activity [1,5,6].

CONCLUSIONS

Thus, the results obtained are compared with the results of the available technology of obtaining powder. The optimum parameters mode installation of a new mill in comparison with the parameters of other plants. Separation method is applied in the separation of powder into components.

Low humidity powders favors their long-term storage without losing quality. Powders have high organoleptic properties and nutritional properties maximally preserve the original product.

Develop optimal mode installation options hammer mill with a cooling system in comparison with other parameters settings. Solved the problem by creating a mill with air and water streams, with adjustable turbulence that will save energy and cold water. The results of work on the production of dried Jerusalem artichoke, which can be recycled and produce powders, capacity up to 20 kg/h.

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