GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 11, Issue 09, Sep. (2023)

FUNDAMENTALS OF THE THEORY OF THE PROCESS OF GRINDING GRAIN INTO ROTARY MACHINES

Э. Х. Нематов
PhD, доцент,

Н.О. Каландаров
докторант
Ташкентский Государственный Технический Университет им. И.Каримова

ABSTRACT

In flour milling, the degree of grinding of grain and its particles in a roller machine is estimated by the recovery factor *ki,* which is a function of the gap between the rollers b and is expressed by the following exponential relationship:

$$k_и = Ae^{-Bb}$$

where, b is the gap between the rollers (m), *e-base* of the natural logarithms, A and B are the coefficients that depend on the structural and mechanical properties of the grain and the geometric and kinematic parameters of the rollers.

It has been established that the value of the recovery coefficient with a constant gap between the rollers is influenced by the initial particle sizes of the crushed product. In this case, the value ku is directly dependent on the particle size of the source material.

In flour milling, grain is crushed in machines with a corrugated or rough (smooth) surface of the rollers. In order to intensify the grinding process, increase the efficiency of the use of sieving machines for simple and two-grade grinding of wheat and rye, in addition to roller machines, scourge machines are installed for processing products after roller machines or upper sieves. For the production of oatmeal and corn flakes, as well as for the separation of the embryo, roller machines (flatteners) with smooth rollers operating at the same circumferential speed are used. The main working bodies of the roller mill are cylindrical rollers of equal diameters, rotating around parallel axes in opposite directions, one towards the other, with different angular velocities.

The destruction of particles occurs under the action of their compression and shear. Depending on the structural and mechanical properties of the particles and the ratio between the size of the inter-roller gap b *and the* size of the particles to be crushed, *their* destruction can occur both in a single pass between the rollers and repeatedly, which determines the degree of grain grinding. The elements of the working surface of the mill rollers can be grooves applied by cutters to the surface, as well as microsurface irregularities resulting from abrasive grinding or electrospark treatment. The characteristics of the working surfaces of the rollers depend on the set of requirements for individual technological operations that make up the grain grinding process. On torn systems, rollers with corrugated surfaces are used, and on grinding systems, both rough and corrugated rollers are used when grinding grains and dunsts.

The capacity of the roller mill is the actual throughput when a predetermined degree of grinding of grain or intermediate grinding products is reached. The throughput of a cooperating pair of threaded rollers can theoretically be determined by the formula

GALAXY INTERNATIONAL INTERDISCIPLINARY RESEARCH JOURNAL (GIIRJ)
ISSN (E): 2347-6915
Vol. 11, Issue 09, Sep. (2023)

$$Q = 3.6 \cdot \rho \cdot l(b+h)v_n \cdot \psi$$

where, ρ the density of the crushed product (kg / m3 l), the length of the drum (m), the size of the gap between the rollers (m), the height of the grooves (m), to determine the throughput of non-threaded rollers in the formula value b . h $h=0$ ψ volumetric filling factor of the zone, the v_n average velocity of the product in the grinding zone (m/s).

The velocity of the product in the grinding zone in the first approximation can be considered equal to half the sum of the circumferential velocities of the fast-rotating and slow-rotating drum. However, in the zone of grinding smooth rollers, it is determined by the formulas

$$v_n < \frac{2v_б}{i+1}\cos\alpha$$

$$v_n < \frac{2v_м}{i+1}$$

where $v_б$, , the circumferential velocity of the rapidly rotating and slowly rotating drum (m/s), $v_м$ the degree of grinding, the i angle of capture of the product by the rollers (deg). α

The speed of the grain in the grinding zone depends on the mutual arrangement of the grooves of the rollers. Moreover, with an increase in the ratio of the circumferential velocities of the rollers (at a constant speed of a rapidly rotating drum), the speed of movement of grain in the grinding zone decreases. This circumstance made it possible to assume that the particles of the product move at different speeds when leaving the grinding zone. Small fractions move in the interriffle space of the "fast" and "slow" rollers with velocities equal to each other, respectively velocities of these rollers, and the remaining particles of the product move in the space of the inter-roller gap at a speed that is greater $v_м$ than the speed of the "slow" drum and less than the speed of $v_б$ the "fast" drum. In accordance with this, the product velocity (m/s) at the outlet and grinding is equal to

$$v_n = k_1 \cdot v_б + k_2 \cdot v_2(x) + k_3 \cdot v_м$$

where $v_2(x)$, the velocity of the product in the space of the roller gap (m/s), k_1 , , k_2 the k_3 coefficients showing which part of the product moves respectively with the velocities of the "fast" and "slow" rollers and with the velocity $v_2(x)$.

Moreover, the distribution of velocities in the gap space is conventionally taken in a straight line. Taking into account the assumptions made, the following dependence is obtained:

$$v_n = k_1 \cdot v_б + k_2 \frac{v_б + v_м}{2} + k_3 \cdot v_м$$

The coefficients k_1 , , depend on the pitch P k_2 of the grooves, their height h, k_3 the location of the grooves and the filling factor of the intergrooved spaces (depressions between the grooves) and are expressed by the following dependencies:

$$k_1 = \frac{0.432 \cdot P \cdot h \cdot l \cdot \psi_1 \cdot z_1 \cdot v_б}{Q_ф}$$

$$k_3 = \frac{0.432 \cdot P \cdot h \cdot l \cdot \psi_3 \cdot z_2 \cdot v_м}{Q_ф}$$

$$k_2 = 1 - k_1 - k_3$$

where, , the z_1 number of grooves per 1 cm of the circumference z_2 of the rollers, , the coefficients of filling the interriffle spaces of the "fast-rotating" and "slowly rotating" rollers and the filling factor of the zone of the inter-roller gap, ψ_1 the actual productivity of the roller machine (kg / day), ψ_3 the length of the drum (m). $Q_ф$ l

Experimental studies of the grinding process in roller mills with various combinations of the relative arrangement of the groove show that the mutual arrangement of the grooves affects not only the quality of grinding, but also the productivity of the roller machine.

Obviously, the degree of grinding of the product depends, ceteris paribus, on the number of effects of *Rz grooves on the product* during τ of its stay in the grinding zone, determined by the length of the processing path. The zone of influence of the grooves on the product will be the arc L of the circle.

$$L = \frac{\pi \cdot R \cdot \alpha}{180}$$

where, R is the radius of the drum (m), α is the angle of the arc (deg).

To determine the number of effects of the grooves of the "fast" drum on the product, you need to know the transit time of the product in the working area

$$L = v_n \cdot \tau$$

where, τ is the time of passage of the product in the working area (s).

During this time, the number of grooves z of the "fast" drum (or the number of impacts Rz,

$$R_z = (v_б - v_м) \cdot \tau \cdot z = \frac{v_б - v_м}{v_n} L \cdot z$$

Substituting the value of L from the formula and the value from the formula into the equation v_n , after the transformation we get

$$R_z = \frac{2\pi}{180} \cdot R \cdot z \cdot \frac{i-1}{A_i + 1} \cdot \alpha$$

Assuming that the limit value of the angle α is equal to the angle of friction φ=arctgf, we finally get

$$R_z = \frac{2\pi}{180} \cdot R \cdot z \cdot \frac{i-1}{A_i + 1} \cdot arctgf$$

The equation shows that for rollers with a certain number of grooves z *by 1 cm and with a constant differential, the number of impacts Rz remains constant. It follows that* R z can increase or decrease at constant R and z only with an increase or decrease in the coefficient of the ratio of speeds of fast and slowly rotating rollers (differential between roller gears) *i.*

REFERENCES

1. Antipov S.A. Machines and apparatus of food production: a textbook for universities: in 3 books: Book. 2, T.1 Ed. acad. Russian Academy of Agricultural Sciences V.A. Panfilova, Prof. V.Y. Grudanov. — Minsk: BGATU, 2008.
2. Butkovsky V.A., L.S. Galkina, G.E. Ptushkina. Modern equipment and technology of flour production. – M.: DeLi print, 2006.
3. Demsky A.B., Vedenev V.F. Equipment for the production of flour, cereals, animal feed. Handbook. – M.: DeLi print, 2005.
4. Tarasov V.P. Technological equipment of grain processing enterprises: Textbook / Altai State Technical University named after I.I. Polzunov. - Barnaul: AltSTU Publishing House, 2002.