

WAYS TO IMPROVE THE OPERATION PROCESS OF ROLLER-DIE PRESS-GRANULATORS

Komar A., engineer

Dmytro Motorny Tavria state agrotechnological university, Zaporizhzhia, Ukraine.

Problem statement. The results of research on resource conservation and energy efficiency of complex technological processes widely used in industry have shown that in the agro-industrial complex one of the technological processes that meets the criteria of resource conservation and energy efficiency is press granulation. In press granulators, agricultural raw materials are processed in the production of granulated compound feed and their individual components, in the production of fuel pellets from agricultural waste, and also for the purpose of obtaining granulated intermediate products. At the same time, press granulation is an energy-intensive process, and the relevance of its improvement is quite high. One of the feasible ways to improve the press granulation process is to develop new and optimize existing designs of press granulators. [1-3].

Main research materials. In Ukraine and abroad, roller-matrix press granulators are most common. One of the feasible ways to improve the press granulation process is to develop new and optimize existing designs of press granulators. However, a review of scientific sources gives reason to believe that over the past twenty years, the designs although domestic and foreign ring die pressing mechanisms have reached a higher technical level, their structural features have changed insignificantly. (advance) between the matrix and each of the pressing rollers, it follows that the working process of all existing and newly designed ring die pellet mills is characterized by lateral extrusion of the product. Lateral extrusion – the movement of the material in the direction of the ends of the working bodies and its extrusion beyond the contact area - is especially pronounced in the lagging zone and less intense in the extrusion zone into the die dies. The intensity of the transverse flow of the material is determined by its stress state in the wedge-shaped space, and also depends significantly, like the stress state itself, on a number of factors: structural and mechanical (rheological) properties of the processed product (yield limits under compression, contact friction coefficient), design parameters of the pellet mill [3].

As a result of lateral extrusion of the material, the productivity of the pellet mill is significantly reduced. Part of the material extruded beyond the working area is sent for repeated compression, which increases the energy consumption for granulation. When improving the granulation process in ring-die pellet mills, the process of lateral extrusion and the disadvantages associated with it have not yet been taken into account by either domestic or

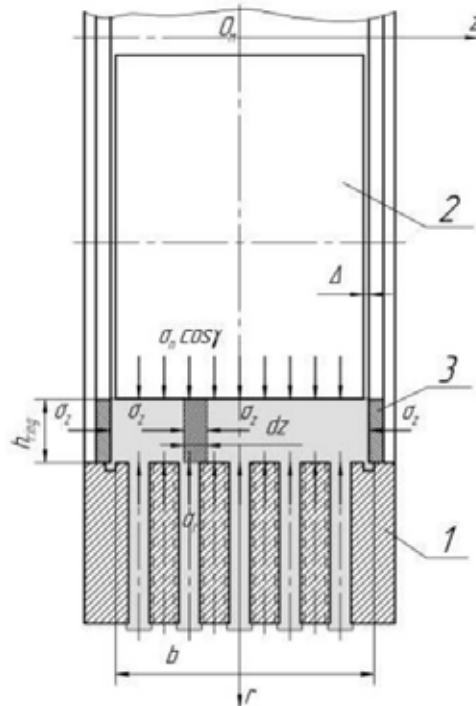
foreign specialists. From the analysis of the area of extrusion into the dies and the advance zone) between the matrix and each of the pressing rollers, it follows that the working process of all existing and newly designed ring-die pellet mills is characterized by lateral extrusion of the product. Lateral extrusion - the movement of the material in the direction of the ends of the working elements and its extrusion beyond the contact area - is especially pronounced in the lag zone and less intense in the extrusion zone into the die. The intensity of the transverse flow of the material is determined by its stress state in the wedge-shaped space, and also depends significantly, like the stress state itself, on a number of factors: structural and mechanical (rheological) properties of the processed product (yield limits under compression, coefficient of contact friction), design parameters of the press granulator [3]. As a result of lateral extrusion of the material, the productivity of the press granulator is significantly reduced. Part of the material extruded beyond the working area is subject to repeated compression, which increases energy consumption for granulation. When improving the granulation process in press granulators with a ring matrix, the process of lateral extrusion and the associated shortcomings have not yet been taken into account by either domestic or foreign specialists.

The pressing process without lateral extrusion is possible only under conditions when the contact surfaces of the working bodies of the pellet press form a closed contour of the cross-section of the product layer. This can be ensured by creating additional contact end surfaces that allow the implementation of a flat deformed state of the pressed material in the zones of lagging and extrusion into the die dies. An important task of studying the multiparameter nonlinear process of press granulation in a roller-matrix pellet press is its mathematical description. The mathematical model of the pressing process should reflect the energy state of the "pellet press - waste material" system, which acts as its internal characteristic.

In pellet presses with an end limitation of the wedge-shaped space between the working bodies, mechanical energy is transferred to the pressed material through the contact surfaces of the matrix, pressing rollers and limiting rings. It is advisable to consider the stress state of the elementary volume of the product on these surfaces as a measure of the transferred energy, which is the basis for determining the parameters of the effect characterizing the granulation process. Thus, it is necessary to describe the stress state of the pressed material in the wedge-shaped space between the working parts of the pellet press [4].

Under the conditions of a flat deformed state, supplied with limiting rings, the displacement w , M , of the product along the Oz axis are equal to zero. In a closed wedge-shaped space, compression of the transverse deformation of the elements occurs, each of which, in accordance with Fig. 1, can be distinguished in the layer of pressed material by two sections perpendicular to the Oz axis and located at a distance dz from each other. In the skin, due to these retinas, the movement of w is caused by normal axial

stresses σ_z , Pa.



1 - ring matrix; 2 - roller that presses; 3 - limiting ring

Fig. 1. Cross-section of a layer of pressed material in a closed wedge-shaped space of a pellet press:

Visnovki. It has been established that one of the important ways to improve the process of press granulation is the development of new and optimization of existing designs of press granulators.

References

1. Komar A.S. The feasibility of granulating and briquetting animal feed and poultry feed. Технічне забезпечення інноваційних технологій в агропромисловому комплексі: Мат. IV Міжнар. наук.-практ. конф. мол. учених. Запоріжжя: ТДАТУ, 2023. С. 195–196.

2. Комар А.С. Аналіз конструкцій пресів для приготування кормових гранул та паливних брикетів / Н.І. Болтянська, А.С. Комар // Науковий вісник ТДАТУ. Мелітополь: ТДАТУ, 2018.- Вип.8. Т.2. - С. 44–56.

3. Болтянська Н.І. Обґрунтування шляхів вдосконалення процесу гранулювання у прес-грануляторах з кільцевою матрицею / Н.І. Болтянська, А.С. Комар // Вісник ХНТУСГ ім. П. Василенка: Наукове фахове видання. Вип.199. Харків: 2019. С. 176-185.

4. Скляр О.Г., Скляр Р.В. Шляхи підвищення якості виробництва біодобрив. Запоріжжя: ТДАТУ, 2024. Вип. 14, том 2. №3. DOI: 10.32782/2220-8674-2024-24-2-2.

URL:

<https://oj.tsatu.edu.ua/index.php/visnik/article/view/808>