По результатам, представленным на графике для цилиндрического цильпебса (рисунок 3) и на графиках (рисунок 4), видно, что с увеличением массы исходного продукта эффективность помола снижается. Это связано с тем, что энергия разрушения затрачивается на большее количества материала и время помола для получения готового продукта одинакового дисперсного состава возрастает. Например, для фракции с размером частиц 200 мкм через 5 минут помола составила 1:7 – 10,9%, 1:5 – 14,4 и 1:3 – 15,2%. Для других мелющих тел была получена аналогичные картины результатов. Данные экспериментальные данные показали, что рационально применять цилиндрический цильпебс с загрузкой исходного продукта в соотношении 1:7.

По результатам работы можно сделать вывод, что эффективность помола в вибрационной мельнице напрямую зависит от мелющей загрузки и степени загрузки помольного объема. Для достижения наилучших результатов необходимо тщательно подбирать этот параметр, учитывать характеристики материала и цели измельчения. Оптимизация мелющей загрузки может значительно повысить производительность и снизить затраты на энергоресурсы.

ЛИТЕРАТУРА

1. Ходаков, Г.С. Физика измельчения / Г.С. Ходаков. – М.: Наука, 1972. – 278 с.

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RESEARCH AND DEVELOPMENT OVERVIEW OF TABLET PRESS

A tablet press is a machine that presses particles or powdered materials in the die hole. Tablet press is mainly used for the production of tablets. With the development of market demand, the application scope of tablet press is more and more wide, no longer simply limited to Chinese and western medicine tablets, more widely used to suppress daily necessities, health food, chemical tablets. Realize high efficiency, low cost tablet press product design has become the main development trend. In domestic pharmaceutical enterprises, medium speed tablet press is still the mainstream equipment, and the feeding mechanism of tablet press is one of the main components [1].

Now, the cam is mostly used as the feeding mechanism, which makes full use of the characteristics of small cam mechanism members, small space

volume and high-speed start stability. Among them, the use of flat disc cam mechanism occupies a considerable proportion, so the study of it is more representative.

Tablet press is widely used in pharmaceutical tablets, which is the core equipment of tablet pressing process, so developed countries have conducted a lot of research on the development of tablet press technology. After the large-scale technical transformation in the past few years, the domestic tablet press is also developing towards high output, standardization and multi-functional development. Chinas rotary tablet press technology level has been greatly improved, but there is still a gap compared with advanced countries, especially some high-grade tablet press in the output, automatic control and other aspects of the gap is relatively large.

At present, there are many kinds of press, according to different classification methods of press has different kinds. The press is divided into single press according to the number of punches. And multi-stamping machine. The multi-punch tablet press is also known as the rotary tablet press. Pictures of single and multi-stamping machine are shown in figure 1 and figure 2.

Figure 1 − Single-punch tablet press

Single stamping sheet machine is mainly composed of die, filling regulating mechanism, feeding mechanism, hopper, pressure regulating mechanism, sheet mechanism, through the cam (or eccentric wheel) linkage mechanism (and similar to punch working principle) of driving up and down die operation, make the upper and lower die produce relative movement to achieve the suppression of the tablet.

Figure 2 − Many-punch tablet press

Multi-stamping sheet machine is mainly composed of working turntable, feeding mechanism, filling regulating mechanism, feeder, scraper, up and down punching guide device and pressure regulating mechanism. The working turntable is composed of three parts: the punching die of the stamping sheet machine is installed on the rotating working plate, which is moved up and down by controlled by the fixed guide rail. The working rotation drives the die to rotate synchronously and rise, and the powder or particulate material is continuously added. The upper die and the lower die are equipped with a pressing wheel, and the material is continuously pressed through the pressing wheel to complete the whole pressing process.

High-speed rotary pressure press has made great progress in output, pressure signal acquisition and other technologies, and the highest output is generally more than 300 000 pieces/h. For example, GZPLS-620 series high-speed rotary tablet press of Beijing Sinopharm Longli Technology Co., LTD., PG 50 series high-speed rotary tablet press of Beijing Aviation Manufacturing Engineering Research Institute, etc. 4. But at present, there are less than 10 domestic manufacturers of high-speed rotary tablet press, and their maximum output can only reach 700 000 pieces/h. And the maximum output of foreign advanced technology has exceeded 1 million pieces / h, in order to increase the output, many foreign tablet machine more and more, more and more digits, now the product models and characteristics of high speed tablet machine produced by some foreign companies are listed in table 1.

Table 1 − Model and characteristics of foreign tablet press products

Production company	Product model	Country	Maximum production (ten thousand/h)	The biggest rush digit capacity	Switch-table speed (r/min)	Prepressed (kN)	Principal pressure (kN)
FETTE	3090I	Germany	113	79	15–120	100	100
FETTE	4090I	Germany	150	122	10–68	160	160
Korsh	XL800	Germany	102	95	5–90	100	100
Courtory	ModulD	Belgium	107	89	−	10	100
Manesty	Xpress700	Britain	101	81	−	100	100

Recently, FETTE (Germany) has improved the rotary tablet press by using a segmented matrix disk instead of traditional dies.

Instead of 47 dies and 47 screws, only 3 segments are used, which provides clear advantages such as:

•high productivity − up to 311 thousand tablets per hour;

•less time spent on changing the product − no need to adjust individual dies;

•reduced cleaning time, since the number of parts is reduced and there are no holes that are difficult to clean;

•lower tablet ejection force - due to reduced friction against the matrix walls;

•5-6 times longer service life due to segments made of high-alloy steel and lower friction forces;

•reduction in product loss up to 50% due to the absence of sharp edges and the presence of a smooth surface of the matrix disk.

Due to its obvious advantages, the presented innovative technology has been successfully implemented in pharmaceutical production.

In recent years, the performance characteristics of tablet presses have significantly improved due to progress in mechanical engineering and electrical engineering. The super-powerful machines that have appeared are capable of producing huge quantities of tablets. The security of tablet presses is becoming increasingly important. For many foreign and domestic companies, an increasingly important criterion in the operation of equipment is ease of cleaning, so many pharmaceutical companies use WiP (Wash in Place) technology, which reduces cleaning time several times.

At present, foreign tablet press technology is developing towards intelligent, flexible and precision. In recent years, the design, production and manufacturing level of domestic tablet press lave been improved, but there is still a big gap compared with foreign countries. The development of domestic tablet machine has a long way to go, requiring continuous efforts to improve the workshop environment, improve tightness, achieve multi-process integration; improve production efficiency, reduce operator contact with drugs

and equipment, optimize the pharmaceutical environment; the control technology connected with the whole tablet production line is the future development trend; in domestic pharmaceutical enterprises, medium speed tablet machine is still: he mainstream equipment, high speed, high efficiency tablet machine is not required by Chinese pharmaceutical enterprises, but the goal of the pharmaceutical industry to improve the efficiency [1, 2].

REFERENCES

1. On the present situation and development trend of tablet press in China. Electromechanical Information / Jiang Hui, Lu Huixia, Jumah Masoud, Chen Qingqing, Zhou Jianping. − Pharmacy Teaching and Research Section, China Pharmaceutical University, Nanjing, Jiangsu, China. – 2010,05. – P. 73–76.

2. Development status and trend of single-punch tablet press / Yang Daan, Zhao Sheng ton, etc. − Precision Forming Engineering, 2011,3 (3). – P. 56–61.

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DEVELOPMENT TREND OF DRUM MILLS

The origin of roller mills can be traced back to ancient times. As early as the Neolithic era, humans began using stones and wooden sticks to grind grains, which can be considered the most primitive form of mills. Over time, mill designs evolved. Mill technology advanced significantly during the Industrial Revolution, and in the early 1800s, the first modern drum mill was introduced, using a metal drum instead of the traditional stone mill. This innovation greatly improved the efficiency and quality of grinding.

At the beginning of the 20th century, as industrialization accelerated, the design and function of drum mills continued to improve. Engineers began to investigate ways to optimise the shape, material and speed of the drum to suit different types of raw materials and product requirements. After the Second World War, the range of applications for drum mills expanded rapidly, from the initial processing of grains to a wide range of industries, including ore processing, chemicals and building materials.

In recent decades, with the development of automation technology and material science, the performance and efficiency of roller mills have made another qualitative leap. The introduction of computer control systems has made the operation of mills more precise and efficient, while the application of new wear-resistant materials has significantly extended the service life of the equipment.