A new type of hanging box extrusion tablet press

Tian Huina, Yu Jiang, Gao Wei, Han Bangkuo

(Dalian Rubber & Plastics Machinery Co. LTD., Dalian 116036, Liaoning, China)

Abstract: The 416 hanging box extrusion tablet press revolutionizes the traditional structure by incorporating multiple new technologies. Its tablet pressing device utilizes dual motors and dual reducers, which are respectively fixed on the upper and lower rollers, resulting in a compact structure that saves floor space and meets users' needs for cost reduction and efficiency improvement. Simultaneously, the overall technology of the machine has been enhanced, addressing several persistent issues related to product quality. With its advanced technology and high technological added value, this machine holds promising market prospects.

Key words: hanging box; compact structure; cost reduction and efficiency improvement; technical improvement

Classification number: TQ330.46 **Article number:** 1009-797X(2026)05-0011-06

Document code: B **DOI:** 10.13520/j.cnki.rpte.2026.05.004

A typical mixer production line mainly consists of a mixer, an extrusion calender or an open mill, and a rubber sheet cooler. The irregularly shaped rubber compound, which has undergone plasticizing and mixing (including final mixing) in the mixer, must be extruded through an extrusion calender or an open mill, then cooled by a rubber sheet cooler, coated with a release agent, dried, laminated, or sliced, to complete the process of the rubber mixing production line.

In the early days, the tablet pressing work of the downstream auxiliary equipment of the internal mixer was completed by two to three open mills. The main disadvantages of open mill tablet pressing include large footprint, low automation level, low production efficiency, high labor intensity for workers, serious environmental pollution, and the quality of rubber mixing directly affected by the level of worker operation. With social changes, there is increasing emphasis on environmental and humanistic needs, as well as quality stability worldwide. Therefore, extrusion tablet presses have emerged. Especially with the improvement of the mixing capacity of the internal mixer itself, the dependence on downstream auxiliary equipment for supplementary mixing has decreased. Therefore, extrusion tablet presses have not only become the standard equipment for plasticizing and masterbatching in recent years, but are also increasingly applied in the final mixing process.

1 Development of "Dalian Rubber & Plastics" extrusion press

"Dalian Rubber & Plastics" is the earliest company in China to design and produce extrusion presses, and it has been the pioneer in technological advancements for each generation. Over the past 35 years, through the joint exploration and research of several generations of the company, Dalian Rubber & Plastics has successfully developed four generations of extrusion press technology: single screw, parallel twin screw, conical screw, and triple conical screw. The performance of the products has been continuously improved and optimized. Especially in recent years, through multiple rounds of equipment optimization, the overall performance of the

Biography: Tian Huina (1977-), holds a bachelor's degree and is a senior engineer in mechanical design, primarily engaged in the mechanical design and development of rubber mixing machines and rubber extrusion presses.

extrusion presses has reached the world's advanced level for the same period, and its market share has gradually increased. It has become the largest manufacturer of extrusion presses in China in terms of production volume.

Currently, the fourth-generation three-cone extrusion tablet press from Dalian Rubber & Plastics primarily consists of an extrusion device, a tablet press device, a feeding chute, a base, a transmission system, and a cooling system. The motor and the extrusion and tablet press reducers are connected by an elastic coupling, while the tablet press reducer and the roller are connected by a universal joint, as shown in Figure 1.

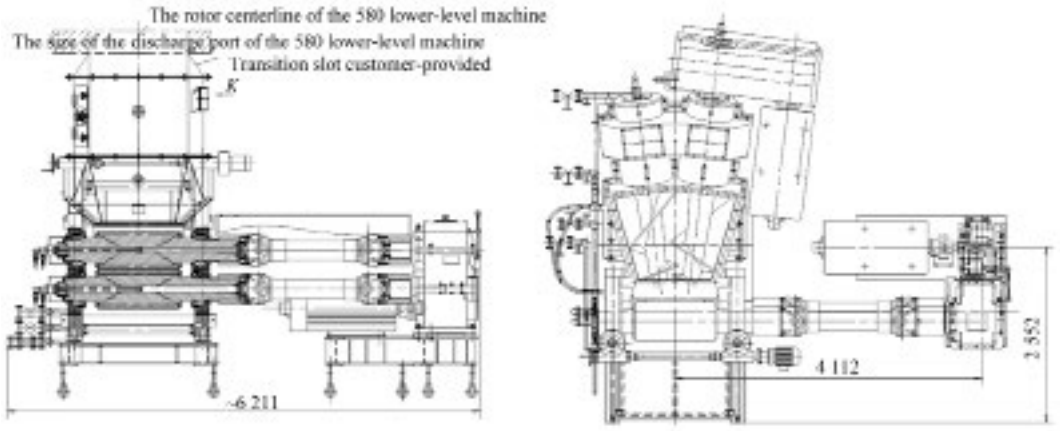

Figure 1 Standard structure of a three-cone extrusion tablet press

2 Emerging market demands

Currently, the tablet pressing device of Dalian Rubber & Plastics' standard extrusion tablet press operates by driving the relative rotation of two rollers through a motor, a dual-output shaft reducer, and a universal joint coupling. The tablet pressing motor and reducer are mounted on a single tablet pressing transmission base. This structure occupies a large area. However, customers currently have the demand to reduce costs and increase efficiency, and some customers want to replace their old open mill products with more environmentally friendly and highly automated extrusion tablet presses. However, due to the limited space of the old factory building, it is not possible to adopt this traditional structure of extrusion tablet press.

In response to market demand, and against the backdrop of technology localization, we have comprehensively benchmarked similar imported units. For the extrusion press with specification 416, which has the largest market demand, we have initiated the development of a 416 hanging box extrusion press. This equipment can expand the product types of Dalian Rubber & Plastics, filling a domestic gap. The equipment structure is compact, saving factory space. At the same time, the overall technology has been upgraded, reducing product costs and enhancing the market competitiveness of the products. The overall structure of the product is shown in Figure 2.

Figure 2 New 416 hanging box extrusion tablet press

3 Research and development process of a new type of hanging box extrusion tablet press

The research and development process of the new hanging box extrusion tablet press is shown in Figure 3.

4 Technological innovation points of the new hanging box extrusion tablet press

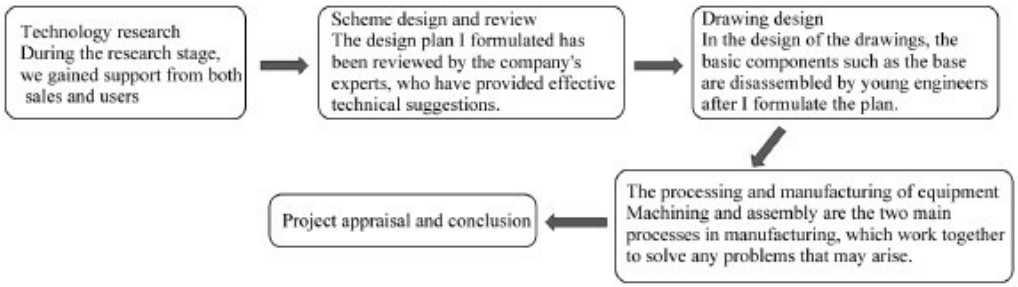

Figure 3 Project tackling process

4.1 Technological innovation of tablet pressing device

The key and difficult point in the development of this new hanging box extrusion tablet press is the tablet pressing device. In order to meet the needs of users and save floor space, various structures were considered, and this solution was ultimately confirmed: the upper and lower rollers of the tablet press are driven by motors through reducers, and the motors and reducers are hung together on the upper and lower rollers, located on both the left and right sides, as shown in Figure 4.

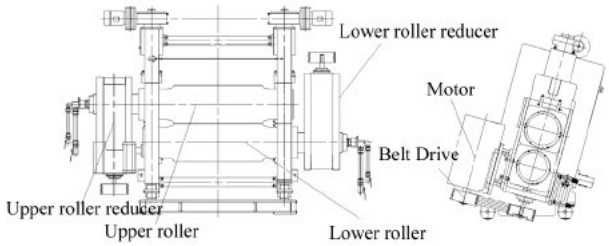

Figure 4 New structure of tablet pressing by hanging box extrusion tablet press

The motor is connected to the reducer via a belt, and the reducer is fixed to the roller through a shaft. The motor is mounted on the reducer. By tensioning the belt, the motor can rotate around the rotating shaft. After adjusting to the appropriate position, it is secured tightly with bolts.

For this new tablet pressing structure, the tablet pressing motor and reducer weigh approximately 2450kg and need to be hung entirely on the roller. The design of the roller is particularly important, considering the working conditions. The roller is made of chilled cast iron, which is wear-resistant and corrosion-resistant. Two structures, hollow roller and drilled roller, are designed. Based on the tensile strength and allowable stress values of chilled cast iron, calculations and ANSYS stress analysis were conducted in the early stage, as shown in Figure 5.

Figure 5 Force analysis of roller

The analysis results indicate that the maximum shear stress occurs at the suspension point of the long-axis end reducer, which cannot meet the operational requirements. Furthermore, the hollow roller exhibits better stress performance compared to the drilled roller. Therefore, the hollow roller is adopted. Based on the calculation and analysis results, the design scheme is adjusted. Finally, a transition shaft structure is adopted at the stress concentration point of the suspension reducer, as shown in Figure 6.

The transition shaft in the figure has been redesigned,

utilizing 42CrMo material and undergoing quenching and tempering treatment to enhance its tensile strength and allowable stress. Subsequently, a force analysis was conducted, and the calculations met the operational requirements of the working conditions, as shown in Figure 7.

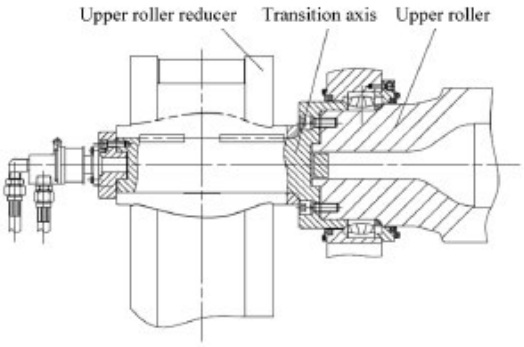

Figure 6 Roller transition shaft structure

Figure 7 Force analysis of the transition shaft

The extrusion tablet press adjusts the roller gap between the upper and lower rollers by moving the upper roller, thus ensuring that the thickness of the extruded rubber sheet meets the requirements. In the new tablet pressing structure, the upper roller reducer and motor are both mounted on the upper roller, and the weight of the upper roller and bearing seat adds up to 4,050 kg. To ensure the stability of the upper roller with the reducer during movement, a new guiding mechanism has been designed, as shown in Figure 8.

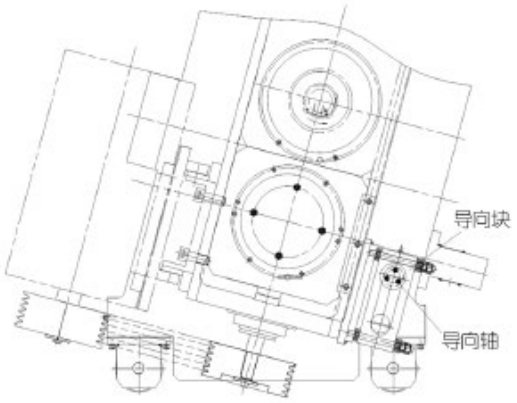

Figure 8 New guiding mechanism

The guide block is connected to the reducer, and the guide shaft is fixed on the left and right supports of the tablet press. When the upper roller drives the reducer and motor to move upwards together, the guide block slides along the guide shaft, which not only serves as a guide but also prevents the reducer from rotating around the roller shaft due to the inclination angle of the tablet press.

In addition, the adoption of the new hanging box structure, seemingly simple, encompasses many important design focuses. For example, during the movement of the reducer, in order to reduce vibration, the guide connecting bolt adopts a disc spring design; the entire pressing device has increased weight, and when it comes to maintenance or replacement of rubber compound for cleaning, the pressing device adopts a hydraulic push-out mechanism; a belt drive is used between the motor and the reducer, and through calculations and tests, the overall V-belt is more stable than a single belt.

4.2 Technological innovation of extrusion device

The traditional extrusion device structure involves the extrusion motor driving the long screw to rotate through a reducer, which in turn drives the short screw to rotate in the opposite direction via a speed ratio gear. This method ensures the synchronization between the long and short screws, as shown in Figure 9.

In this traditional transmission method, the extrusion motor and the extrusion device are mounted on the same large base. Due to the processing errors and cumulative assembly errors of the reducer and various extrusion components, the mounting holes for the extrusion motor need to be matched during assembly, which results in high work intensity for assembly workers. Moreover, the entire base, reducer, and barrel require high machining precision for their mounting holes, making machining difficult and costly. The large width of the entire base not only increases processing costs but also transportation costs.

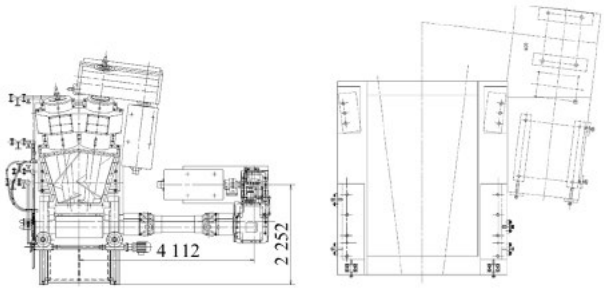

Figure 9 Traditional extrusion device and large extrusion base

The newly developed extrusion device incorporates a novel vertical reducer. The extrusion motor is inputted from the side of the reducer, and both the extrusion motor and the extrusion reducer are mounted on separate bases, as illustrated in Figure 10.

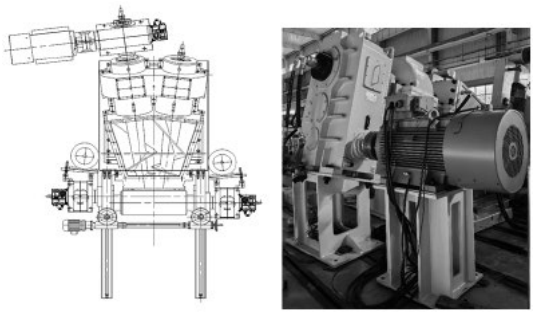

Figure 10 New extrusion device structure

The motor base and the reducer base of this structure are processed independently, making the processing simple and convenient, and the installation and debugging difficulty low. During assembly, the installation accuracy of the reducer and screw only needs to be ensured for the motor and reducer. After ensuring the installation accuracy of the motor and reducer, adjustment pads can be added between the motor, reducer, and their respective bases. This not only solves the troublesome problem of matching the motor mounting holes in traditional bases, but also reduces the processing difficulty of extruding large bases in traditional structures. The problems of welding and processing errors between the motor base plate and the host machine base plate, which often occur in traditional structures, no longer exist. At the same time, the new extruded base occupies less space, is convenient to transport, and the transportation cost is correspondingly reduced.

4.3 Improvement of overall technical quality

In the development of this new product, not only were new structures adopted for the extrusion and tablet pressing devices, but also technological upgrades were made to the entire machine. Based on issues identified during the use of previous products, targeted technical improvements were made.

4.3.1 Improvement of the flow channel of the rubber retaining plate

Addressing the issue of glue beads and glue edges present in current extrusion tablet presses, this unit adopts a new runner design. By employing a pressure release method at the end of the runner, the problem of glue edges is reduced;

4.3.2 Improvement of positioning of the barrel and the rubber stopper

The barrel and the rubber guard plate are connected using a key connection, achieving high positioning accuracy and solving the problem of the rubber guard plate being displaced due to stress during use. This prevents the rubber guard plate from scratching the roller after displacement. Additionally, traditional rubber guard plates and barrels are connected using locating pins, which means that the original pin holes cannot be reused when replacing spare parts. It is difficult and time-consuming for users to re-drill the pin holes on-site. With the key connection, users can replace the rubber guard plate spare parts more conveniently. They only need to ensure the machining accuracy of the key slot of the spare part rubber guard plate and replace it with a new one on-site.

5 Market prospects of the new hanging box extrusion tablet press

This new product features small footprint, energy saving, and environmental protection, and is one of the main

conventional equipment for the internal mixer line in tire factories, conveyor belt factories, and large rubber product factories, with strong versatility.

Currently, some users with product upgrading needs have a strong demand for hanging box extrusion tablet presses due to the limited space of their old factories. There are also many users in emerging markets who, for the purpose of cost savings, have been inquiring about the availability of hanging box extrusion tablet presses. The market prospects for this new product are promising.

6 Conclusion

Technological innovation and industrial upgrading are important means to conserve resources.

The new hanging box extrusion tablet press has significant advantages over conventional products, making it possess higher technical added value and capable of generating greater economic benefits. Moreover, the newly developed hanging box extrusion tablet press eliminates the need for a tablet press transmission base and universal coupling, and the transmission side of the tablet pressing part has been reduced from occupying 4.5 m^2 to approximately 2 m^2. This saves about 60,000 yuan per unit in foundation and factory construction costs. For users with multiple production lines, reducing the factory area corresponds to a reduction in the factory footprint. The cost savings on land vary depending on different provinces and cities, representing a huge expense savings for users. At the same time, it promotes the rational allocation and utilization of land resources, and also contributes to the efficient use of social resources, creating greater social benefits.