

Tablet compression

changing trends, more demands.

The market for tablet compression technology and the demands placed on equipment manufacturers have changed quite significantly in recent years. This has been driven by a number of factors. Firstly, the pharmaceutical industry has seen a significant shift of investments in solid dosage production equipment towards generics and contract manufacturing. As the companies in this segment of the market are, by nature, strongly focused on cost reduction, a big emphasis is placed on productivity, flexibility and process yield (i.e., minimal product loss). Equipment cost and reliability, as well as fast on-site assistance have also become key selection criteria. research and development based companies have also been forced to follow this cost reduction trend.

Secondly, the meteoric growth of new pharmaceutical markets in the Middle East and the Far East (e.g., India, China, South Korea) has led investments in solid dosage equipment in these regions to surpass the investments made in North America and Europe. This puts an increased pressure on equipment price and has resulted in several Western based companies moving the design, manufacture and assembly of their equipment to Asia.

Finally, with the increased potency of new APIs, there is a growing need for better protection of the operator against the effects of pharmaceutical product processing. Operator exposure can be reduced either through the use of Personal Protective Equipment (PPE) or by making the equipment highly contained. The latter approach is the preferred solution, primarily for ergonomic reasons and because it offers a more efficient way of protecting the environment in general, as well as the facility and other personnel.

Technology breakthroughs

Although the operating principle and fundamental design of the rotary tablet press have not changed for decades, multiple machine design improvements have been developed and implemented by various suppliers to reduce cost and lead time, and more importantly, to increase productivity, flexibility and safety performance.

The initial emphasis of innovation was on reducing the amount of time required for machine cleaning and product changeover. The first significant change was the “exchangeable turret”, introduced to the market by Fette in the early 1990s and now available from nearly all suppliers. While this machine feature offers great flexibility with regard to the tooling types that can be used on the same machine, the time saved for cleaning and format changeover is limited; after removal of the turret, the complex inside of the tablet press still needs to be cleaned. Therefore, openness of structure and accessibility were further improved (e.g., the XL range by Korsch). Taking a different approach to the challenge, IMA came up with a revolutionary design without exchangeable turret, but with centrifugal die filling and Clean-In-Place capability. Whilst in early 2000, GEA Courtoy introduced the “Exchangeable Compression Module”, a concept that made extremely fast product changeover possible thanks to off-line cleaning, and also offered an increased level of dust containment compared with conventional removable turret machines.

In more recent years, various improvements in machine designs have been made to increase the instantaneous output of tablet presses. To achieve this, it was necessary to enhance the efficiency of the forced paddle feeders to guarantee uniform die filling — and consequently tablet weight stability — at these higher outputs. The next step was to increase the number of punch stations on the turret (e.g., die plate segments by Fette; exchangeable die disc with die shells by GEA Courtoy) and/or to increase the rotation speed of the turret. When increasing the rpm of the turret, the compression dwell time for each individual tablet shortens, often resulting in insufficient hardness, capping or lamination. Methods that have now been developed to maintain a longer dwell time include air compensation and, to a lesser extent, larger compression rollers and punches with special head design.

The last 10 years have also seen a significant effort to design complete tablet production lines to handle potent and toxic drugs. As the powder in-feed, tablet handling, sampling and tablet collection all have to be performed under “high containment” conditions, it became imperative to design complete lines integrating the peripheral equipment, such as powder discharge station, tablet de-duster, metal detector, dust extractor and tablet analyser. Initially, the most common technique was to build isolators around the equipment and provide wash-in-place capability. However, the latest design trend is toward containment at the source and off-line washing, as these concepts allow equipment to be smaller, easier to install and operate, and lower priced.

Drawbacks

The main shortcoming of modern tablet presses is their lack of advanced process control. Most tablet presses are equipped with only one feedback control loop, which is based on main compression force measurement as an indirect estimation of tablet weight. Re-correction of this loop is achieved through tablet sampling: 20 tablets every 15 to 30 min are sampled while the machine runs at 200000 tablets/h. This naturally calls into question the statistical relevance and accuracy of this method. Only very few new methods of process control and new types of sensors are being offered for on-line monitoring and controlling of other tablet CQAs, such as hardness, API content and dissolution time.

Where to next?

In its continuous quest for cost reduction, the pharmaceutical industry will continue to push for a further increase in operational efficiency. This can be accomplished through higher speeds, faster cleaning and product changeover, and fully automatic unmanned operation. Flexibility will also be developed further as the complexity of tablets increases, with the emergence of special tablets, such as multiple-layer tablets and core-coated tablets.

But most of all, future developments should focus on advanced process control to guarantee improved and constant tablet quality. This is one of the basic requirements to help realise two crucially important new concepts, which will shape the future of solid dosage production: continuous processing and real-time release. The implementation of new control strategies and the implementation of new types of sensors into tablet presses are vital means to this end. With the advent of promising new devices such as NIR sensors, progress is being made, but these are just the early stages of the new developments that are required.

by **Jan Vogeleer**

Managing Director of GEA Courtoy nv

courtoy@geagroup.com

www.gea-ps.com