In a highly competitive market place, tablet presses had to evolve to meet the changing needs of pharmaceutical manufacturers. Today’s top machines accelerate changeover, run faster, and simplify maintenance. This article highlights some of the most important features and options.

Not long ago, people treated tablet compression as an art, and some veterans of pharmaceutical manufacturing may recall press operators who had a knack for making good tablets by “feel” or some sixth sense. It seemed like they could make tablets from fairy dust if you could get it on the press. But that’s not how it is anymore. Today, tablet compression is high-tech, and productivity is higher than ever, even when run by operators without a lifetime of experience or a magic touch.
As times have changed, so have many of the variables that contribute to successful tablet compression. Pharmaceutical and nutraceutical preparations have improved and in many cases their potency has risen significantly. That fact, coupled with a regulatory climate that has—by necessity—become more stringent, have made any form of guesswork or operational “feel” out of place. The standard now: Precise, efficient manufacturing at high speed.

Tablet press manufacturers have responded to the need for more speed and better efficiency with a variety of new features and upgraded processes. They center around three areas: changeover, operation, and maintenance.

**Changeover**

The importance of being able to thoroughly clean a tablet press after a campaign and quickly prepare it to run another cannot be overstated. Today’s most advanced tablet presses are recipe-driven, meaning that once the parameters for successfully compressing a particular tablet are in the control system, operators don’t have to re-enter data the next time they run that product. The result is a streamlined process with better product yield and less waste.

Many manufacturers are opting to use “quick-change” kits, which assemble all the product-contact components used by the press during a campaign. These typically include items that are quick to remove and install, such as the product hopper, feeder, scrapers, take-off assembly, and re-circulation components. Quick-change kits allow operators to switch rapidly between products. They also allow you to clean the product-contact components from the previous campaign offline and prepare them for use in another quick-change kit.

Removable turret assemblies are a big part of reducing changeover times, because they eliminate the most labor-intensive part of any changeover: Cleaning and setting up the punches and dies at each individual station. With a second turret cleaned, tooled, and ready for action, you can quickly and simply remove the dirty turret, clean the interior of the press, and start manufacturing. It makes a huge difference in how quickly companies can get their presses back into service for a new campaign.

Everyone using a tablet press should stay in touch with their preferred vendors to learn what new features are available and whether they come only with a new press model or can be retrofit. Tablet press suppliers often improve the components on existing models and those improvements can have a big impact on your operation. Examples include components that optimize how the feeder operates and adjusts, paddle wheels of different shapes and styles, and seals that contain dust better and thus increase yields and reduce the time needed to prepare the press for a new campaign.

Some tablet press options have revolutionized the concept of changeover. The tedious task of removing and reinstalling the tooling—the single-most time-consuming part of changeovers—is a good example. That job can be made much faster and easier by eliminating individual dies in favor of robust segments that have the product cavities machined into them.

**Operation**

Assuming a powder or granulation flows well enough to reach the material hopper of a tablet press, the next sub-assembly it encounters is the feeder. It’s difficult to overstate the importance of the force feeder to the operation of a modern press. It’s the critical component for moving the product from the hopper and into the die cavities in the correct amount, often at high speed. That’s why the top tablet press manufacturers offer not only operational improvements to feeders, but also enable you to adjust them much more easily than before.

Another improvement pertains to monitoring the relative standard deviation (RSD) of compression force as the tablet press operates. RSD correlates strongly with how consistently die cavities are filled. If the RSD is erratic, or high—i.e., in excess of around 3.5 to 4 percent—then the operator must adjust the feeder speed in order to stabilize or even improve the process. Today, that adjustment is simple because most modern presses use feeders with drives that are independent of the machine’s main motor. In fact, many presses enable you to change the rotational direction of the feeder paddles and/or change the paddles themselves. Different paddle configurations, i.e., flat-faced spokes versus cylindrical ones, can have very different effects on different products.

It is also critical for operators to understand that when it comes to compression force, it’s possible to apply too much when seeking to hit the target tablet characteristics. It’s understandable that operators would opt to apply more than enough force because many new presses can produce very high forces. But the maximum force the press can generate is rarely, if ever, needed to achieve the target tablet hardness. In fact, applying too much force is counterproductive: Instead of making better tablets, you’ll damage the particles you’re compressing, which could lead to softer, not harder, tablets.
In many cases, in fact, it’s not how hard you can compress a product that results in sufficient tablet hardness, but how long the product is compressed at peak force, which is known as dwell time. This can be fine-tuned by selecting punches with the appropriate head flat. The length of this surface at the top of the punch determines how long the product remains under compression. To prolong dwell time, some tooling vendors offer punches with extended head flats. These longer flats can also produce incidental advantages, including less wear to compression rolls and ejection cams.

While not strictly related to tablet press performance, the amount of floor space today’s equipment requires is smaller than ever. That means better efficiency in the use of GMP space, which is at an all-time premium. Today, relatively small presses are easy to install in tight confines and can produce tablets at a rate formerly possible only using much larger machines. Anybody involved with planning a manufacturing facility should take notice.

Another operational improvement concerns bi-layer tablets. If any aspect of tabletting resembles an art, this is it. Operators must not only maintain target tablet specifications as the press operates at high speed, but they must prevent poor bonds between layers, cross-contamination between the two products, and poor yields. To make the job easier, new presses allow you to rapidly and accurately sample the first layer without allowing partial tablets to reach the discharge chute for acceptable tablets. New presses also control the weight of each layer of the tablet, not just the overall weight. They do this by using the punch penetration of the first layer as a means to trigger compression force control. Furthermore, the additional compression stations that the presses use to make bi-layers can be used either to lightly compress (tamp) the first layer of a bi-layer or serve as an additional pre-compression station for mono-layer tablets. It’s a way to increase dwell time without using special punches.

Maintenance

Once your company has made a substantial investment in a state-of-the-art, high-speed modern tablet press, the next step is keeping it in tip-top shape. No piece of equipment can be run hard day in, day out without being maintained. While today’s presses perform better than ever, they’re still a mix of high precision and tank-like strength that requires regular preventive maintenance.

The term preventive maintenance is used so often, that people can forget what it’s all about: reducing the need for regular maintenance. The point is to pay close attention to the press so that unplanned events—and unplanned downtime—are kept to a minimum. And while it’s important to maintain the entire press, it makes sense to pay very close attention to everything within the compression zone, the site of the most important actions.

Check the punch seals and scrapers regularly, and when you need to remove and install punch seals, use the tools recommended by the tablet press manufacturer or supplier. Seals on the underside of the feeder, especially those enclosing the fill channel, warrant extra attention. A good rule of thumb is to assume that any moving part in the compression zone—but especially those above or near the die cavities—must be monitored closely. The objective is to ensure that only the intended product can make it into the cavities, nothing else.

Some manufacturers offer upper punches that accept bellows seals, which are accordion-like and completely enclose the space between the bottom of the upper punch barrel (near the tip) and the bottom of the upper punch section of the turret. These seals greatly reduce the possibility that contaminants—which usually appear as dark specks on the tablet—can reach the die cavities. The risk of such contamination tends to increase with the speed of the tablet press and its run time, especially if the lubrication settings aren’t maintained as the press manufacturer recommends.

Modern presses owe their phenomenal precision at high speed to many different electronic components, which must be checked and maintained regularly, just like the...
mechanical parts. How well the electronics operate will largely dictate how quickly a press can run and still attain the target tablet specifications and how accurately it can reject out-of-specification tablets. Some of the most advanced presses have user interfaces that provide real-time data specific to things like amplifier settings and status lamps, which allow you to calibrate from the terminal itself.

Cams are another component critical to effective press operation, and some, such as fill cams, are directly related to how precisely and accurately the press achieves the target results. Regular inspection is the key, and it’s simple: Visually inspect the cam for excessive wear. Some press manufacturers offer tools that measure the rate of wear. Furthermore, some presses also use binary-code button arrays and/or RFID chips that enable you to make specific components, such as fill cams and take-off assemblies, part of the product recipe, thereby facilitating repeatability in setup and operation.

The compression rolls also require preventive maintenance. If a roll fails or is in poor condition, it cannot perform what is the single-most important function of a tablet press: compression. Look at the surface of the compression rolls for any sign of irregularity or damage. It takes just one bit of metal transferred from the roll surface to a punch head to start a vicious cycle that will destroy both quickly. With older presses, maintenance technicians dreaded the day a roll had to be changed, but today’s compression roll carriers enable you to change a roll in 30 minutes or less.

**Training is the glue**

Improvement in any one of the three areas discussed above—changeover, operation, and maintenance—will improve productivity, but the goal is to optimize all three simultaneously. That requires good, consistent, and comprehensive training, ideally by the tablet press manufacturer, who trains—and re-trains—its own people on using factory methods. After training by the manufacturer's specialists, you and your colleagues should be able to:

- Create product recipes quickly
- Harness the powerful capabilities of the user interface
- Implement a force-based RSD and use it to indicate die-fill consistency
- Understand feeder options and how to use them, including how to correlate feeders to weight control and how feeder speed relates to die filling
- Determine how best to compress challenging products, such as multi-layer tablets and those that need a long dwell time
- Calibrate and maintain all devices related to regulating fill depth
- Develop effective, comprehensive standard operating procedures for such tasks as machine use, cleaning, and turret removal/installation
- Implement thorough preventive maintenance procedures
- Optimize the use and inspection of tooling and foster an understanding of how best to use new tool designs.

**Evolution by necessity**

Tablet presses have historically represented one of the most significant equipment-based investments any pharmaceutical or dietary supplement manufacturer will make. It's no surprise then that they expect the presses to run faster, with greater precision and versatility and for longer periods of time. Tablet press makers have responded by offering high-speed, modular, and robust equipment. In a highly competitive market like that for tablet presses, evolution never ends and changes can be sudden and dramatic. The challenge is to ensure that the people who operate and maintain the presses do those jobs as efficiently as possible.

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*Matt Bundenthal is direct sales and communications manager for Fette Compacting America, 400 Forge Way, Rockaway, NJ 07866. Tel. 973 586 8722. Website: www.fetteamerica.com.*