

Optimized for Speed, Quality and Consistency

Satisfying the growing demands of lightweight, one-piece closures in beverage packaging

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To effectively meet all of the demands of high output beverage closure production, manufacturing systems need to produce high quality parts with repeatability, high yields, low scrap and tight tolerances. To maximize productivity, manufacturers also require high speed systems that are optimized for closure applications. But producing a high volume of closures is one thing – the real challenge is producing high quality, lightweight closures consistently and reliably.

Rising resin and transportation costs, growing environmental awareness and consumer demand are creating an ever-increasing need for lighter weight closures. It is out of this need that the popularity of one-piece closures has developed. One-piece closures are typically lightweight, making them not only more cost-effective, but also more environmentally sustainable. They have also evolved sufficiently to be able to replace two-piece closures for the majority of applications. Unlike a two-piece closure, a one-piece closure does not use a liner so it requires less material to manufacture and has reduced conversion costs because there is no lining process required. In fact, one-piece closures have about a 10% to 15% cost benefit to manufacture in comparison to two-piece closures due to the faster cycle times, higher efficiency and sheer material savings that can be achieved. All of these factors are making one-piece closures the preferred beverage packaging alternative among beverage closure manufacturers.

There is also a growing demand for highly productive systems that are able to produce closures at a high volume, with no compromise on part performance or quality. As the weight of closures becomes increasingly lighter, even more stringent care must be taken in the design of the manufacturing system to achieve tighter tolerances for high quality parts and less scrap.

There are two primary technologies for molding closures – injection molding and compression molding. Injection molding technology for the first plastic beverage closures was used in the early 1970s and compression molding was introduced in the mid-1980s.

Both approaches have developed over the years, resulting in the introduction of new and innovative technologies and higher speed systems. These advancements have allowed manufacturers to build higher precision tooling for more complex part designs while enabling faster cycles. While

each technology has its benefits, there are significant differences among the two molding methods.

Compression molding involves using heat and pressure to squeeze a material within a mold to obtain a desired shape. Resin is extruded, cut and then placed directly into an open mold cavity. Multiple individual molding stacks (cavities) are arranged on a rotary turret and each mold cavity is filled individually. A mold is then closed, pressing down onto the plastic, causing it to flow throughout the mold. While the mold is closed the plastic solidifies. The amount of pressure, temperature and time that is applied while the mold is closed varies both with the design of the part and the material being molded.

The injection molding process begins in a similar way to compression molding with resin pellets being fed into a hopper and then melted using a screw and barrel. With injection molding, however, the screw not only melts the material, but reciprocates back and forth. As molten resin is delivered to the front of the screw as it turns, the screw moves backward. When the precise amount of plastic has been melted, the screw stops turning and then advances to inject the plastic into the mold filling multiple cavities simultaneously. During the filling process, the mold is clamped shut to counter the force caused by the pressure of the plastic being injected into the mold. Once the plastic has cooled, the part is removed from the mold.

Tight tolerances for increased flexibility

While both injection and compression molding technologies can manufacture one-piece designs, injection molding's ability to achieve tighter part tolerances on more complex parts means greater consistency in part dimensions. Injection molding technology introduces resin into the mold in the liquid phase rather than semi-solid as with compression molding. As a result, more technical designs are possible, providing virtually unlimited flexibility with part design and shape. It is this flexibility and versatility that ultimately makes injection molding a lower risk capital investment.

An example of the level of quality required in closure molding is the closure's plug seal area where imperfections and flow lines can cause closures to leak. With injection molding, it is possible to achieve tolerances for one-piece plug seals that are better than +/- 0.1 mm because injecting molten

material into the mold allows the plug seal to form precisely and applying pressure to the molten material allows it to be “packed out.” Because compression molding maintains lower resin temperatures, the material must be squeezed into the cavity under semi-solid flow – this can impact surface finish and dimensional consistency. Injection molding also allows resin to crystallize after it has been shaped through the cavity, which leads to greater dimensional stability of the part and less risk of leakage.

Improved productivity for lowest part cost

Color change is another major consideration when comparing the productivity of beverage packaging systems and again, there are variances between injection and compression

molding techniques. While it is technically faster to switch from one color to another with compression molding, there is more flexibility with the injection process to fine tune part dimensions and make process adjustments that can compensate for different shrinkage behaviors. Also, with today’s colorants, injection molding is able to maintain cycle times within a few tenths of a second from one color to the next.

With either process, it is also possible to optimally sequence color changes to reduce color change time. In the event of downtime, injection systems can shut down a single cavity without wasting material. This is also possible with compression molding, but the pellet must be cut and scrapped, which creates waste. While changing a single tool stack is relatively quick for compression molding, in the case of a complete mold product change, injection molding is significantly faster. Typically, all of the tooling sub-components in an injection molding system are conveniently held within two assemblies. This expedites the removal and installation of the complete mold.

While compression molding tends to have lower energy consumption because of lower processing temperatures and related cooling, this is just one contributor to part cost. While both injection and compression molding are able to produce one-piece closures, the compression molding process generally requires a slitted tamper-evident band that adds a step in the production process. Injection molding has the capability

to produce either slitted or a finished “molded-in” tamper band that can reduce weight

Meeting industry demands

In comparison to alternative manufacturing technologies, injection molding helps closure manufacturers achieve the highest productivity levels while still allowing for tighter tolerances and significantly more flexibility with part design.

Some suppliers are responding to this demand by offering injection molding systems that are specifically designed for beverage closure manufacturing. Husky Injection Molding System’s HyCAP is one example of a system that is specifically optimized to meet the challenging demands of manufacturing lightweight beverage closures. Husky also has the benefit of more than 40 years in the closure market and has been a leader in the closure hot runner market for more than 30 years, as well as having the complementary knowledge of being the market leader in manufacturing PET preforms.

Regardless of supplier, today’s manufacturers demand fast systems that are specifically optimized for the unique needs of closure manufacturing. The systems that will successfully meet these demands are built to produce lightweight, high quality parts with superior repeatability, higher yields, less scrap and tighter tolerances. For manufacturers, working with an experienced partner is the key to achieving all of these goals successfully.

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