

Optimised for speed, quality and consistency

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 maximise productivity, manufacturers require high speed systems that are optimised 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

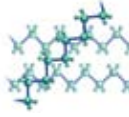
the faster cycle times, higher efficiency and sheer material savings that can be achieved. All of these factors are making one-piece closures the preferred beverage packaging alternative among beverage closure manufacturers.

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 moulding closures – injection moulding and compression moulding. Injection moulding technology for the first plastic beverage closures was used in the early 1970s and compression moulding 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 moulding methods.

Compression moulding involves using heat and pressure to squeeze a material within a mould to obtain



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

The injection moulding process begins in a similar way to compression moulding with resin parts being fed into a hopper and then melted using a screw and barrel. With injection moulding, 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 mould filling multiple cavities simultaneously. During the filling process, the mould is clamped shut to counter the force caused by the pressure of the plastic being injected into the mould. Once the plastic has cooled, the part is removed from the mould.

Tight tolerances for increased flexibility

While both injection and compression moulding technologies can manufacture one-piece designs, injection moulding's ability to achieve tighter part tolerances on more complex parts means greater consistency in part dimensions. Injection moulding technology introduces resin into the mould in the liquid phase rather than semi-solid as with compression moulding. 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 moulding a lower risk capital investment.

An example of the level of quality required in closure moulding is the closure's plug seal area where imperfections and flow lines can cause closures to leak. With injection moulding, it is possible to achieve tolerances for one-piece plug seals that are better than +/- 0.1 mm because injecting molten material into the mould allows the plug seal to form precisely and applying pressure to the molten material allows it to be "packed out". Because compression moulding 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 moulding also allows resin to crystallise 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

Colour change is another major consideration when comparing the productivity of beverage packaging systems and again, there are variances between injection and compression moulding techniques. While it is technically faster to switch from one colour to another with compression moulding, 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 colourants, injection moulding is able to maintain cycle times within a few tenths of a second from one colour to the next.

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

While compression moulding 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 moulding are able to produce one-piece closures, the compression moulding process generally requires a slitted tamper-evident band that adds a step in the production process. Injection moulding produces a finished "moulded-in" tamper band that can reduce weight and eliminates the downstream slitting process. When comparing sheer output, very high productivity workcells are possible with injection moulding, with up to 144-cavity systems to optimise use of capital and floor space. It is important to consider all of these factors when evaluating lowest part cost.

Meeting industry demands

In comparison to alternative manufacturing technologies, injection moulding 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 moulding systems that are specifically designed for beverage closure manufacturing. Husky Injection Molding System's HyCAP is one example of a system that is specifically optimised to meet the challenging demands of manufacturing light-weight 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 optimised for the unique needs of closure manufacturing. The systems that will successfully meet these demands are built to produce light-weight, 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.

Brandenburger Urstromquelle pushes the limits of beverage packaging



Husky HyCAP 300 system specifically optimised for the high output manufacture of lightweight, one-piece beverage closures

BUQ had experienced substantial growth over the last several years and was looking to invest in four new systems, as well as optimise their existing bottles and preforms in terms of resin usage. They considered several suppliers to help them achieve this goal and selected Husky because of the integrated system and application solution they were able to provide.

To maximise productivity and performance, BUQ implemented Husky's HypET High Performance Package (HPP). The end result: BUQ's preform sizes for 0.5- and 1.5-litre bottles are one of the fastest carbonated applications running in the field today.

To reduce their part weight, BUQ took advantage of the EcoBase preform design. To ensure a smooth integration of the EcoBase solution for BUQ's challenging applications, Husky worked closely with the different players in the supply chain. For BUQ's 1.5-litre carbonated application, this resulted in a savings of 0.6 grams per preform in addition to existing preform optimizations.

"By working with Husky, we were not only able to reduce resin usage, but we also improved productivity. This has ultimately allowed us to reduce overall part costs," said Reinhold Jülg, BUQ's Technical Manager.

Achievements at BUQ

Application: 1.5-litre CSD (sparkling water application)
Weight savings: 0.6 grams after base light-weighting

Cavitation	96-cavity
Resin Savings	0.6 grams
Cycle time	9.0 seconds
Weight savings	183 tonnes

Brandenburger Urstromquelle (BUQ), an integrated private label filler that supplies products to large German discount chains, was looking for a solution that would allow them to push traditional PET packaging limits

EcoBase benefits

In addition to being good for business, light-weighting initiatives also help businesses to be more sustainable by providing solutions to reduce their carbon footprint. Husky's EcoBase preform design helps moulders and bottlers reduce their amount of resin usage, yielding significant resin savings.

Husky's EcoBase preform technology incorporates a uniquely shaped base that provides several benefits.

EcoBase provides weight savings of up to 2.5%, offering significant resin savings that can yield an attractive return on investment. This is achieved by an optimised redesign of the preform base, which does not impact the bottle's mechanical integrity.

EcoBase's unique shape improves heat absorption of the preform base between 2% to 3% during blow moulding, providing greater control of the reheat profile in the preform base.

Bottles blown from EcoBase preforms do not have the wasted material typically observed around the injection point, allowing for an optimised preform and bottle base.

