

# Korean Mobile Phones

One of the largest Korean manufacturers of plastic injection molding machines is Dongshin Hydraulic Co., Ltd., located in South Korea. Systems for the production of mobile phone housings are the main focus of the latest machine development. This involves high-quality plastic parts, which demand high process stability and product quality. Dongshin produces hydraulic and electrically-driven injection molding machines. Hydraulic machines feature a good price/performance ratio and are excellently suited for generating high pressure. Electrical machines are proven through high precision, low operating costs and capability for clean room operation.

## Electric or Hydraulic?

The accuracy of hydraulic axes varies according to the compressibility of the oil, aging and the non-linearity of the actuators.

Electrically-driven servo axes feature higher rigidity than hydraulic axes, are less subject to aging and provide higher precision movement-guidance due to the high resolution of the rotary pulse encoder, resulting in higher product quality.

Further arguments for electrical injection molding machines include the lower sound level and the better cleanliness, which is a requirement when manufacturing high-value plastic articles for electronic or medicinal technologies.

In Japan, electrical machines have prevailed as a result of domestic legislation. Manufacturers of injection molding parts often use multistory buildings. There

is a particularly high fire hazard in these factories due to earthquakes. This results in special, expensive safety measures for the operation of oil hydraulics. The use of all-electric machines reduces the expenses for fire precautions and makes the process of obtaining permits much easier.

Korea currently imports approximately 200 to 300 electrical machines from Japan yearly. Due to the significant market share of electrical machines and the comparatively high quantities, Japanese machines feature a high level of technology. To cover the demand domestically, all Korean manufacturers have been hard at work lately with the concept of the electrical machine.

## Hybrid Solutions

Dongshin found a good compromise between the technical advantages

Injection and clamping unit on a Dongshin (Korea) injection molding machine, featuring a B&R automation solution.



of electrical drive technology and the cost-effective hydraulic drive solutions. The injection movement, as the most important axis, is driven electrically to meet the highest quality demands. The other movements, for which speed is the main concern, are performed hydraulically to save on expenses.

Therefore, the control solution developed for the hydraulic machines had to be further adapted for electrical axes.

The concept of the B&R controller is so flexible, that it is perfectly suited for hydraulic machines, all-electric machines and hybrid concepts. One controller consists of a computer unit and the specific I/Os, which can be adapted flexibly to the application. The software can be configured for different axis variations. The complete solution from B&R can be applied both to hydraulic as well as electrical machines. This is a considerable advantage, particularly for machine manufacturers who manufacture both systems.

## Decisive for the Quality Injection

Naturally, the injection axis is the most important axis in a plastic injection molding machine. This axis is mostly responsible for the quality of the end product. One of the most significant quality characteristics of the end product is the smooth and reproducible injection movement, which is performed in two phases. In the first phase, the injection takes place according to the speed profile until the shape takes form. The second phase, with the complete shape and increased pressure, involves a dwell-pressure phase of predefined pressure over a specific period of time, in which the shrinkage of the plastic is compensated for.

## The Controller Makes the Difference

The first quality criterion for the injection axis is the precision and reproducibility of the injection procedure using accurate movement-guidance. Exact pressure and movement control is achieved using high-resolution inputs combined with a particularly short scan-time.


The second quality criterion is the

accuracy and speed for the detection of the switch point, the transition from the speed phase to the pressure phase. High speed signal recognition with optimized evaluation algorithms meets this demand perfectly.

## Linear Closing

The clamping unit is another important axis. Mechanically, the opening and closing is often performed using a toggle joint. As an alternative, the movement can also be performed using hydraulic cylinders. The toggle joint is excellently suited for these quick movements and a fast pressure build-up.

However, the transfer function for a toggle joint is extremely non-linear. If the crosshead of the toggle joint moves a few centimeters, the half of the form also moves by a factor of that distance, depending on the position of the moveable plate. This movement must be able to be reproduced exactly throughout the entire geometric relationship. The B&R controller makes the complex transfer function linear throughout the entire area.

Users of the injection molding machine optimize the opening movement of the shape so that only the distance needed to remove the parts is moved. At high production speeds the clamping unit, with its considerable mass, would move the moveable plate over the desired end point due to its inertia. The B&R controller contains field-tested ramp generators with special stop functions. This allows the machine operator to optimally set the desired movement without time-consuming corrections. 

The **process of extrusion** is used for the continuous production of plastic parts, such as pipes or profiles. The plastic granules are mixed and liquefied using a worm gear. The resulting plastic liquid is then shaped accordingly. The systems from **Kumsan Precision Co., Ltd.** for manufacturing window profiles connect several machines in a network, to enable operation from a master-operator station.



With **blow molds**, a tube is extruded and the form is closed around it. The tube is then filled with air to match the shape for making bottles or other hollow containers as end products. The machine from **Kyungwon Hydraulic Machinery Co., Ltd.** was created with the basic functions of a standard solution in an extremely short commissioning time of 3 weeks.



In the next stage of development, work will be made on a machine with Parison Control. The wall thickness of the extruded tube will be adjusted at certain locations according to the characteristics of the material to account for the various stretching in the form. This will make it possible to produce end products with various shapes and uniform wall strength.