

High-Speed Machine with a Small Footprint

Engel Duo Speed Expands the Machine Portfolio for Packaging Applications

The new injection-molding machine Engel duo speed combines productivity and efficiency with short cycle times in a high clamping force range. The two-platen machine is thus making inroads into a range of packaging applications that were formerly the domain of toggle machines. Available with clamping forces from 4000 to 11,000 kN, the new large machine type is mainly targeted at manufacturers of pails as well as storage and transport containers.

If you want a somewhat larger sized pail: the duo speed large machine was developed specifically for manufacturing pails and transport boxes © Engel



Two-platen injection molding machines have the advantage of a compact footprint, which ensures a higher overall efficiency in many applications. However, this machine type has until now reached its limits at very short cycle times, such as are typical for many pack-

aging applications. While a toggle system needs a single drive axis for closing the mold and building up the clamping force, with a two-platen machine, this sequence is composed of three individual movements: rapid closing, locking movement and building up clamping force. In

total, eight hydraulic cylinders are necessary, whose switching and transition times prolong the cycle time.

Thanks to the steady enhancement of its two-platen technology, Engel Austria GmbH succeeded in breaking the sound barrier of 2 s for the dry cycle time.



Fig. 1. The new duo speed is tailored for packaging and logistics applications, based on over 25 years' experience with large two-platen machines. Over 10,000 injection-molding machines of the duo series are in use around the world © Engel

The new duo speed injection machine thus permits short cycle times to be combined with a small system footprint, even in the unit-cost-sensitive area of packaging (**Fig. 1**).

Over 25 Years of Experience with Two Platens

Technically speaking, the duo speed is based on the platform of the two-platen large Engel duo machine, which has a proven track record of over 25 years. It is one of the fastest two-platen injection molding machines on the market, which explains its great success in the automotive industry and other industries, such as telecommunications, electronics and white goods.

To extend the range of applications, both the moving and stationary platen are precisely adapted to the packaging producers' requirements. The dry cycle time could be shortened by up to 25%. According to Euromap6, the duo speed 400, with a clamping force of 4000kN, achieves a dry cycle time of 1.9s and the largest available model, the duo speed 1100, with 11,000kN clamping force, is also one of the fastest machines in this market segment with a dry cycle time of 2.9s.

Predictive Movement Sequences Shorten the Cycle

To reduce the dry cycle time as much as possible, the developers focused on the individual movement sequences, such as mold closing, locking and clamping-force build-up. The key to this lies in the predictive movement control patented

by Engel, which permits overlapping of movement sequences [1, 2]. Thus, the cycle-time relevant locking process now takes place completely in parallel with the rapid movement and the clamping-force build-up (**Fig. 2**). In addition, the seamless transition from rapid movement to clamping-force build-up also shortens the time for clamping-force build-up. Another positive side effect is the smoother movement sequence.

With the aid of predictive movement control and other optimizations, Engel also shortened the sequence of clamping-force reduction. The clamping force is usually reduced during the cooling time, as long as the mold remains closed anyway. With short cycle times, however, it is important to maintain the clamping force for as long as possible – this only works if the clamping-force reduction phase is kept very short without prolonging the cycle time.

The short dry cycle times also contribute to the improved opening and closing movements, which saves time especially with the large opening strokes as are used for pail production (**Title figure**) and require the use of stack molds. When Engel developed the duo speed, it had its sights set on multicavity molds from the beginning, with their greater demands on the clamping force distribution. The mold-mounting platens were optimized using FEM simulations such that the clamping force is distributed uniformly over the entire mold mounting area, which ensures a constant high part quality.

Smart Pump Control Improves Energy Efficiency

In the packaging industry, the cycle time is the measure of the efficiency of production and ultimately of the package- »

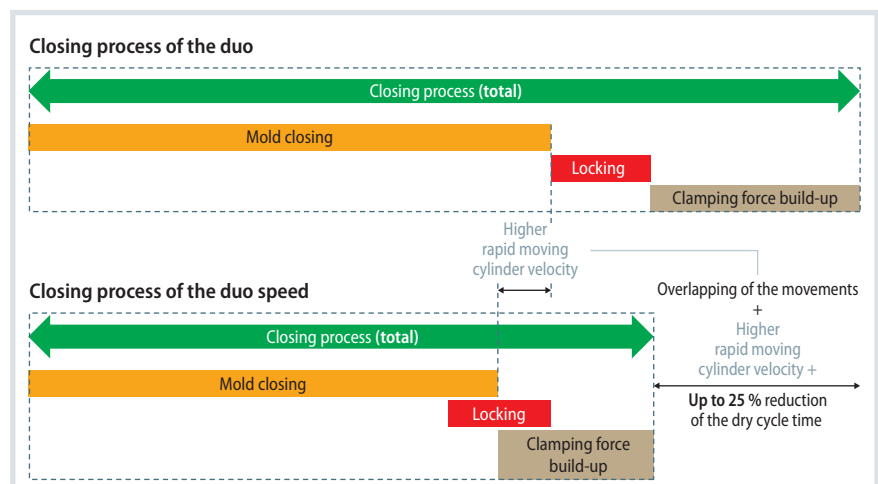


Fig. 2. Due to the overlapping of machine movements, the dry cycle time is reduced by up to 25% depending on machine size Source: Engel; graphic: © Hanser



Fig. 3. The skinmelt technology hides the recycle beneath a virgin-material surface – for example for transport boxes © Engel

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ing manufacturer's competitiveness. But the quality of the product must not be overlooked. Stability and smooth running of the injection-molding machine are important quality-critical requirements. For this reason, the drive of the moving mold half was not realized by means of hydraulic accumulators as is normal for packaging machines but via a smart pump control.

In combination with the proportional valve at the moving mold half, the pump control offers the possibility of setting an optimum movement sequence for the given parameters. The result is a good balance between speed and smooth running. Only the pressure actually required is provided. Here, too, the pump control – along with the ecodrive servohydraulics – makes an important contribution to the machines' high energy efficiency. Compared to accumulator operation, the energy consumption for the closing and opening movement is halved. The overall energy consumption of the machine is about 20% lower.

Furthermore, wear of the mechanical components is reduced. Over 25 years of experience with this kind of machines permits a very robust machine design and high availability.

Unlimited Possibilities also at the Injection Unit

The most important innovation at the injection unit is the speed unit. Originally

developed for the e-speed series, it is designed for high requirements on the dynamics and especially high injection speeds, even with relatively large screw diameters. This unit series is now also optionally available for the duo speed. Compared to the injection unit used as standard, the high-speed unit permits twice the injection speed, with velocities up to 800 mm/s, and therefore shorter cycle times for applications with even higher requirements on the dynamics. Despite enhancements in the area of reduced wall thicknesses and longer flow paths, there are no longer any restrictions at the injection unit. The unit operates with accumulators that charge automatically on demand, which saves 5 to 10% energy compared to conventional solutions.

In the case of plasticizing, which is particularly energy intensive, an electrical screw drive provides high efficiency. Here, the plasticizing unit operates independently of the hydraulic movements, such as mold opening and closing. The new model is already equipped with a barrier screw and ring-check valve optimized for polypropylene (PP) and polyethylene (HDPE). Screw drives targeted at PP and HDPE are optionally available.

The small footprint of the duo speed refers to its energy-efficient mode of operation, but is also to be understood quite literally. The two-platen machines are significantly shorter than toggle machines

of comparable clamping force – with a larger maximum opening stroke. The stroke is only limited by the tie-bar length, not a toggle. The larger opening strokes benefit large molds for, e.g., large pails, as well as the automation for demolding injection molded parts.

Larger Opening Strokes Create More Freedom

Engel is a one-stop supplier of integrated system solutions consisting of an injection molding machine and robot. For manufacturing pails and transport boxes, linear robots of the viper series are used. The advantages of the integrated solution are, e.g., integration of the control systems of the two systems with a uniform operating logic and CE certification of the entire system. Since the machine and robot access the same database, they can match their move-

ment sequences precisely to one another, which shortens the handling times.

Equipped for Recyclates

Sustainability has long played a principal role in the packaging industry. As a system supplier, Engel sets up the duo speed for recyclate processing if requested by the customer. Process technologies for manufacturing multilayer and multicomponent products such as coinjection or the skinmelt process [3] newly developed by Engel make it possible to increasingly use reprocessed plastic waste for manufacturing plastic parts, which places particularly high requirements on surface quality, product protection or consumer safety (Fig. 3).

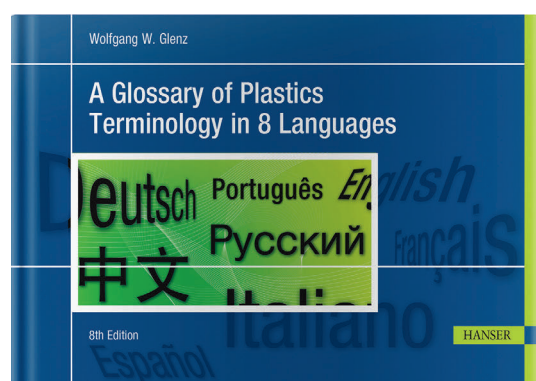
At Engel's large machine plant St. Valentin, Austria, the new injection molding

machine is ready for customer tests. The same applies to machines with coinjection and skinmelt technology packages. Engel's application technology supports packaging producers in adapting the injection molding machine to the specific product requirements and industrial circumstances, in order to minimize cycle times and produce consistently high part quality.

By expanding its portfolio, Engel can exploit all the potentials for efficiency and quality improvement with an ideal solution for thin-walled packaging, through closures, up to thick-walled large containers. While the duo speed is designed for large-volume and long parts, the e-speed covers the field of thin-wall applications with very short cooling and cycle times. The e-cap, too, was targeted at requirements in the packaging industry specifically for manufacturing closures of all kinds. ■

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