Energy Efficiency – the Response to Increasing Electricity Prices

Servo Drive Technology's Differences and Advantages Compared to Other Technologies

Increasing energy costs go hand in hand with a growing public awareness and sensitivity to environmental and climate protection. Plastics processors, too, face new challenges from the German energy revolution. The injection molding machine manufacturer Boy has tailored its choice of products to this challenge, promising that, with the use of a servo drive, processors can obtain energy savings of up to 55 % compared to conventional machines with hydraulic flow control and variable delivery pump.

According to EU Directive 2012/27/EU Article 8, all companies with at least 250 employees or an annual turnover of over EUR 50 million are obliged since the preceding year to conduct an energy audit and repeat it every four years. The energy audit must conform to DIN EN 16247-1 and be based on current operating data. The only companies exempted are those who have installed an energy or environmental management system that meets standards such as DIN EN ISO 50001. Otherwise they face severe fines.

This so-called "energy efficiency directive" has the purpose of creating a common framework for energy efficiency measures in the European Union. It obliges all companies of the aforementioned size and greater to pursue energy saving policies. An obvious approach is to reassess the drive technology of one's own machinery or at least take it into account when making new purchases (**Fig. 1**).

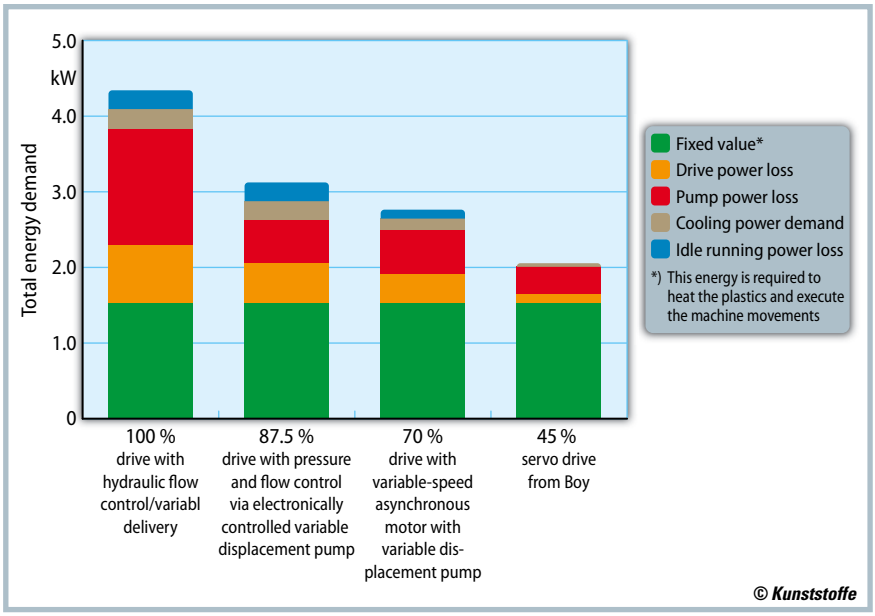

Fig. 1. The example cycle performed on a Boy 35 E (cycle time: 16 s with 4 s cooling time) illustrates the potential of servo drives for saving energy (source: Dr. Boy)

Development of Drive Technology

In the 1980s, a drive with hydraulic flow control (variable delivery pumps) was introduced (**Fig. 2**). This assembly group includes a variable displacement pump, but the result of the hydraulic flow control is that the system only responds very sluggishly. A large number of comparative tests indicate that injection molding machines with this technology consume many times more energy than state-of-the-art drive systems. In addition, there is a high demand for cooling capacity, since the continually running asynchronous motor, together with the pump, emits a great deal of heat to the hydraulic fluid. Due to the high energy demand, the heat emission from the machine is also greater. Nevertheless, many companies still use this technology today.

In 1995, the described variant with hydraulic flow control was superseded by a more efficient drive with DFE pump (**Fig. 3**). This solution has the advantage that the electronic pressure and flow control of the variable displacement pump shortens the response time considerably. From the idle state to the maximum volumetric conveying rate, this drive takes approximately 150 ms. When no pump capacity is needed, the DFE pump switches to idle mode. This has the disadvantage that the electric motor continues to run. Due to the greater variability, the energy demand of this drive is about 87.5 % of its predecessor with hydraulic flow control – but still significantly higher than the servo drives that are available nowadays.

A drive with a variable-speed asynchronous motor with variable dis- »

Economical Hydraulic Oil

Boy EconFluid is a high-performance hydraulic fluid with considerable energy savings potential. The viscosity of the high-performance fluid is optimized in two ways: At low temperatures it is more free-flowing, while at higher temperatures it remains more viscous than comparable standard fluids. The fluid formulated with "Dynavis technology" (addition of an additive, manufacturer: Evonik Industries AG, Essen, Germany) consequently reduces the hydraulic losses within the injection molding machine; because of the lower heat development, this additionally reduces the energy to be removed via the cooling circuit. In the test of a Boy 35 E with the "EconFluid" option, an energy saving of up to 10 % could be obtained by exchange of the hydraulic fluid. EconFluid is optionally available for all Boy injection molding machines with immediate effect.

↘ www.dr-boy.de

The Author

Axel Ifland, M. Eng., is a mechanical engineer at Dr. Boy GmbH & Co. KG, Neustadt-Fernthal, Germany; a.ifland@dr-boy.de

Service

Digital Version

↘ A PDF file of the article can be found at *www.kunststoffe-international.com/1310903*

German Version

↘ Read the German version of the article in our magazine *Kunststoffe* or at *www.kunststoffe.de*

Fig. 2. The 1980s: Drive with hydraulic flow control (© Dr. Boy/Bosch Rexroth)

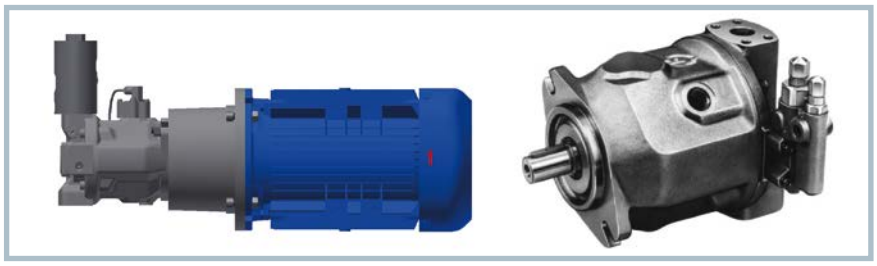

Fig. 3. From 1995: Drive with pressure and flow control via electronically controlled variable displacement pump (© Dr. Boy/Bosch Rexroth)

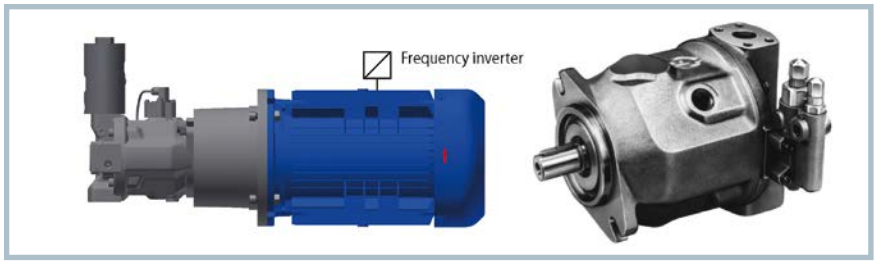

Fig. 4. Servo "predecessor": Drive with variable-speed asynchronous motor with variable displacement pump (© Dr. Boy/Bosch Rexroth)

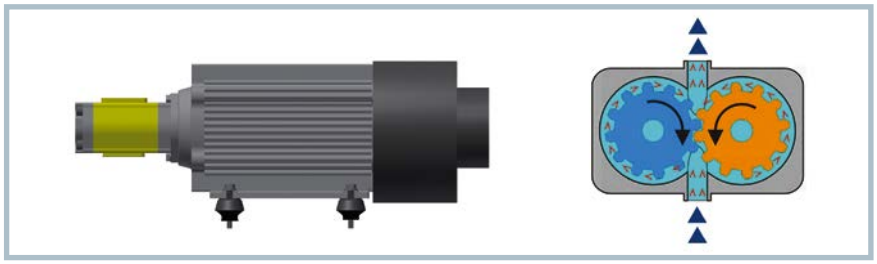

Fig. 5. Servo drive with fixed displacement pump: When no pump capacity is required, the servo motor switches off (© Dr. Boy)

placement pump (**Fig. 4**) has been marketed under the term "servo" in recent years and installed in injection molding machines. However, the technology has little in common with a genuine servo drive, since the variable-speed asynchronous motor only permits a choice between multiple predetermined operating points, not an adjustment to zero rotational speed. The disadvantages of this model compared to a modern servo drive are its much lower dynamics and higher energy consumption of about 70 % compared to the drive with hydraulic flow control mentioned above.

The Most Efficient Option: the Servo Drive

In the case of a modern servo drive with fixed displacement pump (**Fig. 5**) which Dr. Boy GmbH & Co. KG, Neustadt-Fernthal, Germany, was the first European injection molding machine manufacturer to launch on the market in 2008, flow control is achieved by changing the rotational speed. This model generates high dynamics; the maximum rotational speed from idle state is achieved in less than 70 ms. When no pump capacity is required, the servo motor switches off and consumes no energy. The result is a significantly reduced energy demand, which is only 45 % compared to the drive with hydraulic flow control, and provides more cycles/minute (**Fig. 6**).

The use of variable displacement pumps has so far always required a constant oil temperature of about 40 °C, since the viscosity-sensitive behavior of the hydraulic components only permitted a small temperature window for flow control. The servo-motor pump drive can be operated over a greater temperature

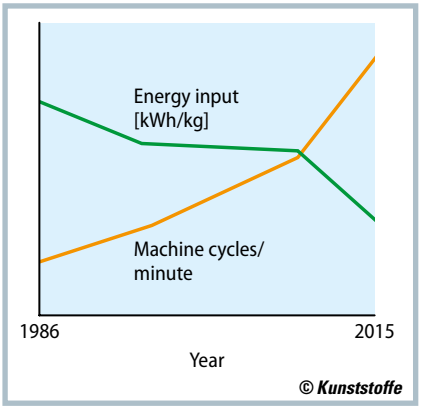

Fig. 6. Development of machine efficiency using the latest drive technology (source: Dr. Boy)

range and already starts at a lower temperature of 27 °C. This saves the user time and energy for starting up the machine. When the new Boy EconFluid is used (**Info box**), the start-up temperature can be reduced to as low as 18 °C, so that oil heating is not needed at all in most cases.

Besides the high saving potential due to the lower energy input and the shorter start-up times, the user benefits from lower maintenance costs, a halving of the noise emission, higher part quality thanks to better reproducibility, and longer lifetime of the hydraulic fluid. Since less heat is introduced into the oil, the cooling water demand is also reduced.

Growing Importance of Life Cycle Costs

In future, customers will not only base their purchasing decision on the initial costs, but the life cycle costs will play an important role. The energy costs over the entire running time thus form a crucial criterion for decision making. For operating the precisely working injection molding machines of the E-series – from the Boy 25 E with 250 kN clamping force to the Boy 100 E with 1,000 kN clamping force – they are very low. And low machine hour rates are the basis for even more cost-efficient parts production.

But the lowest machine price is not necessarily the most economical offer, as was experienced by Ulrike Steiner, Managing Director of the Battenberg-based Cena Kunststoff GmbH: "In our production, we exploit every opportunity to make savings. The continually growing energy and raw materials costs, in particular, bring us to use the most efficient machines and technologies. The Boy E-series machines with servo drive achieve about 55 % lower energy demand for parts production compared to a hydraulic standard machine".

Summary

It is essential that injection molders make a contribution to the energy revolution by using energy-efficient machines. By using injection molding machines with a servo drive, a high degree of energy can be saved compared to the previous models (**Fig. 1**). With every kilowatt hour saved, a servo-motor pump drive reduces the environment burden by about 600 g of CO_2 emissions – a positive contribution to resource conservation. ■

With Updated Software Package

Auxiliary Injection Unit E-Multi Enhanced

Milacron Holdings Corp. announced that the company's auxiliary injection unit, the E-Multi, has received several enhancements and an updated software package. The E-Multi is an all-electric, servomotor driven, mold or platen mounted, fully mobile auxiliary injection unit for multi-material or multi colored applications.

The mold-mounted E-Multi EM1 model has received a new carriage that provides enhanced utility and a compact fit of the unit into the molding area. Along with the new carriage the EM1 has a relocated spring pack to provide increased tie-bar clearance and increased mechanical nozzle protrusion adjustment from ±5 mm to ±15 mm.

The new E-Multi EM1 and EM2 Mold Mounted models with servo carriage are designed for applications requiring sprue-break (the ability to retract the nozzle each cycle away from the melt inlet). This significant advancement allows these new models to be utilized for applications where injection at the parting line is required or in applications where the melt inlet moves relative to where the secondary injection unit is located, increasing the E-Multi's already impressive flexibility. This is a breakthrough for customers looking to modernize their current injection molding lines allowing for immediate part changes.

The larger E-Multi EM3 and EM4 models are now capable of being outfitted with the radial option. E-Multi Radial mounts to the top of the stationary platen and allows the E-Multi unit to rotate to the "Parked Position", providing unobstructed access to the mold mounting face for quick mold change. Servo sprue break motion is standard. The EM3 and EM4 units are capable of shots of 57cc to 499 cc.

In addition, Milacron has released the latest version of the E-Multi software (V1.34) and is now shipping on all new E-Multi systems. The software release has 68 new features and enhancements:

- Automatic Carriage calibration,
- safety ramp control for high-speed injection,
- new E-Radial control,
- control of Varian Rotary Table,
- co-injection integrated as standard option,
- smartMold Communications.

The new software also incorporates features such as varian rotary table movement, radial and co-injection capability, providing the user even more control through one unit.

The E-Multi lineup now has four core models, EM1, EM2, EM3 and EM4. This range is available with many options and customizations (© Milacron)

To the manufacturer's product presentation:
www.kunststoffe-international.com/1231784