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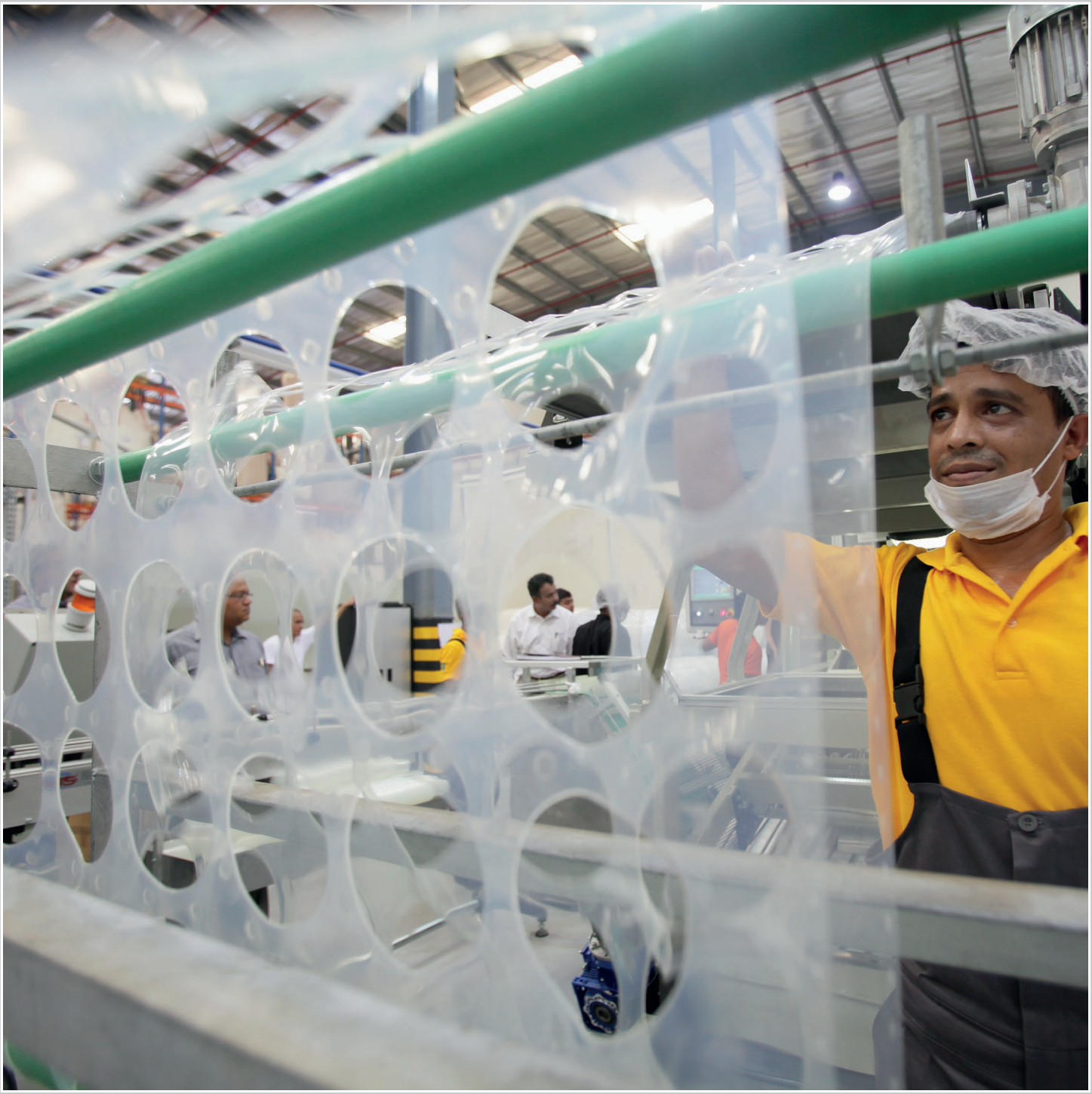

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Precise and pulsation-free feeding

Gear pumps with herringbone gearing for extrusion of biaxially stretched Polyester films

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In order to achieve optimal results when extruding biaxially stretched Polyester films, the polymer melt must be fed into the tool very precisely, and, above all, without pulsation. Pumping and pressure fluctuations in the extruder can have negative results such as air pockets and inconsistent film. As a result of steadily increasing quality standards and the demand for increasingly thinner films, gear pumps are being installed between extruders and tools. The function of the force-feed gear pump is less to increase the pressure more to precisely feed in the polymer melt.

Although the gear pump enables consistent feeding, the pump itself naturally causes pulsation. During the pumping process, the chambers between the gears that are filled with the product open so that the product in the spaces between the gears leaks into the pressure side in sudden bursts. Previously, attempts were made to solve this problem by using special gear pumps with three shafts. In this technique, the flow of the polymer melt is split in two and the second flow is pumped at a time delay from the first flow. This does not reduce the pressure peaks caused by the spur gearing, however, it merely doubles the frequency. Depending how precise the resolution is, the pumping may appear to be pulsation-free.

Because of the problem just described, *Witte Pumps* chose another approach. In order to achieve optimal results, the overall pulsation – that is, the amplitude of the pressure fluctuations – must be reduced.

Figure 1 shows the qualitative differences between spur gearing, helical gearing and herringbone gearing. Herringbone gearing is equivalent to double helical gearing and combines a number of advantages. The reduction in shear stress on the polymer, the low temperature increase and the minimal pulsation ensure that the product is pumped in a particularly gentle manner. Thanks to the herringbone shape, the product is very gently removed from the spaces between the gears and evenly extruded to the pressure side.

On the basis of these findings, *Witte* cooperated closely with the customer to convert a system for film extrusion that was already in use. The herringbone-geared *Witte* pump was designed to have the exact same total length and product connections as the previous pump. This eliminated the necessity of complicated, expensive modification of the heated product lines. Because the new pump required less installation space, the housing was equipped with an additional adapter plate.

Special focus was placed on the design of the shafts and the friction bearings (*figure 2*). The wear-resistant combination of materials in the ionitrided shafts made of 1.2343 (H11) and the bearings made of 1.3343 (M2) tool steel has thoroughly proven itself in polymer applications. Unlike products from other providers, these herringbone-geared shafts are produced in one piece.

With assembled gears, it's impossible to completely avoid a small gap between the two helical-geared gear rings; this would create a ridge in the middle of the film, greatly reducing its quality. The friction bearings also play a key role in the pump's functionality. Naturally, these tool-steel bearings have polished surfaces. The patented *Witte* lubrication groove offers a tried and tested advantage for high and ultra-high viscosity polymer melts.

Another function of the bearing lubrication flow that should not be overlooked is discharging the heat generated by the friction of the bearings.

The performance data clearly shows the superiority of the *Etru 716-8* with herringbone gearing (*figure 3*). Films with layer thicknesses of between 12 and 125 micron were produced using the two systems, and the results compared. Whereas the old system often produced flawed films, the quality of the films has been improved considerably; air pockets and impurities have been virtually eliminated. At the same time, the production speed has been increased from 420 m/min (1378 fpm) of film to 440 m/min (1444 fpm), and the amount of defective products has been reduced by 60%.

The design of the pump, particularly in terms of the friction bearings and the shafts, has significantly increased system availability. Another aspect that is particularly important is the cost of repairs. In addition to simplifying maintenance, the reduced number of wearing parts has also decreased the repair costs. ■

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Figure 1:
Comparison of pulsation with spur gearing, helical gearing and herringbone gearing.
Y-axis: pressure,
X-axis: time.

Figure 2 (bottom):
Detailed view of herringbone gearing and friction bearings.

Figure 3 (right):
Extru 716-8 (110/110) with herringbone gearing.