

FLEXIBILITY FROM DESMA

German machine manufacturer Desma has always been a major innovator, particularly in the field of PU and TPU moulding machines. While the basic technologies of injection moulding as a process are long established, refinements continue to be made to increase the capability, output and flexibility of these complex machines. At the Center for the Polyurethanes Industry (CPI) Conference in September, Christian Decker, Managing Director of Desma and Bjoern Dormer, Manager of the Technical Department, outlined two of the latest developments.

EFFICIENT MOULDING OF THERMOPLASTIC SOLES

Flexibility in the production of TP (thermoplastics) and TPU (thermoplastic PU) soles for footwear is influenced by the time needed to affect changes in the material itself,

whether they are of colour or some other property. A frequent requirement for small lot production means these changes must be made with as little delay as possible and with a minimum of waste as both have a serious impact on the overall cost of production. Desma has now developed a new process with limited time and material loss within the change of the colour and/or additive of the TPU and/or the compound itself.

During the plasticising of the compound, the liquid colour paste or additive is injected into it during the hot thermoplastic phase. The volume of additive is metered via a special dosing system and at a constant percentage using a dosing unit capable of handling four different additives. Recirculating these additives between the injecting unit and their respective tanks guarantees they remain stable and air-free at all times. To understand how this works, it is best to first see how the actual processing of TP and TPU is performed.

ALL IMAGES: DESMA



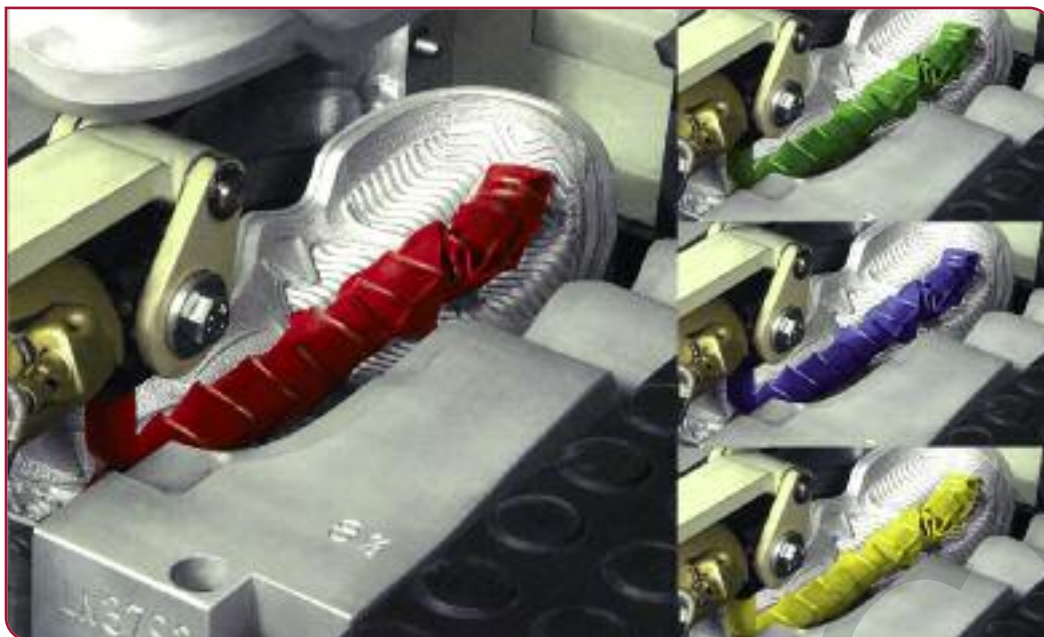


Figure 1 – The DESflow process.

THE DESFLOW PROCESS

The process used is basically quite simple in that it involves pouring a hot liquid thermoplast on to the bottom plate of the mould cavity and then pressing it into the edges of the mould (*Figure 1*). A key advantage of this method is that the TPU is not injected through any runner channels so no friction is created that would impart stresses to the material itself. This in turn means that the final moulded sole has better properties compared to one produced by conventional injection technology.

Further advantages are that the DESflow principle creates less waste and that a lower mould clamping force can be used. As can also be seen in *Figure 1*, the material is well distributed throughout the mould cavity which means that it does not have to be forced to flow over the whole cavity in order to fill it, thus saving cost in terms of both machine and moulds, and also allowing the latter to be made from aluminium rather than steel.

Another plus point is a reduction in flow marks because of the better pre-distribution of the material within the mould as against injection through a thin runner channel system. Desma also uses a specific type of TPU screw for smooth heating and plasticising of the compound. The key feature that makes this possible at high speed is the special design of the 24D/65mm screw whereby it is both longer than usual and also has a continuously changing twin thread zone.

PROCESSING AND VARYING THE ADDITIVES

The most important factor here is that the additives are mixed into the melted phase of the TPU and not before. This gives the producer the flexibility to decide the final properties or colour of the sole while at the same time using only one type of TPU. Natural TPU is fed into the main hopper where it is melted by the special screw described. Once melted and ready for pouring, it is forwarded to the injection valves of the

additive mixing zone. As it passes this zone, the appropriate valve(s) open and the selected additive(s) are injected into the melted TPU stream. Both materials are then thoroughly mixed and poured into the mould cavity. *Figure 1* also shows four different colours achieved this way using a single natural compound.

Up to four different types of additive can be used at a time and may involve a colour, stabiliser, plasticiser, electro-static stabiliser, anti-static chemical or even UV-protection. This flexibility in the additive dosing makes a wide variety of fine tunings possible. For instance, it is now possible to adjust Shore hardness so that the shoemaker uses just one Shore hardness material, such as 50 Shore A, and adjusts it to the required hardness during the production process.

Take for example, a production run where the same sole design is required in more than one Shore hardness; at the beginning of the run a hardness of 65 Shore A is specified and, later on, one of 45 Shore A. Normally, it would be

Figure 2

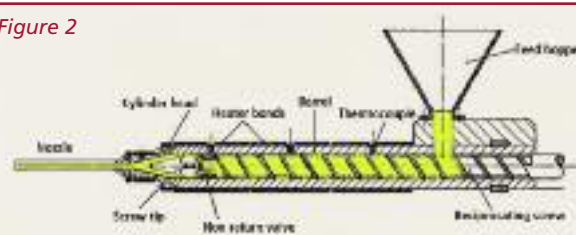


Figure 2a – Standard TPU unit.

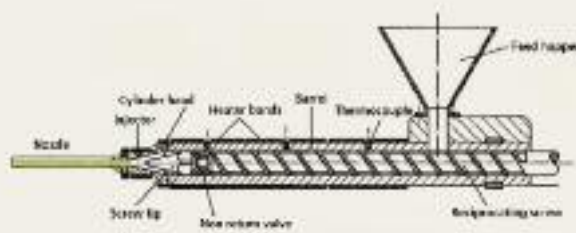


Figure 2b – DESMA TPU unit.



Figure 3 – Casting a PU spot in a sports shoe sole.



Figure 4 – Micro-dot mixing head.

necessary use two different TPUS, with all the associated down time and waste involved in purging the screw and changing over the compounds. This is no longer necessary as, by merely choosing the right additive, the Shore hardness can be immediately introduced into the base compound. The same principle applies to any other additive no matter what properties are needed.

Another big plus for the system can be seen in *Figure 2*. In diagram *2a*, mixed material fills the entire length of the screw as in normal practice. In diagram *2b*, it only fills the final 450mm and this is what allows the use of natural material and rapid changes to it with little waste (there is only about 200 grams of material behind the nozzle), as well as the independent dosage of additives.

CASTING OF MINI SPOTS

Another area where the need for manufacturing flexibility has increased involves outsoles and footbeds featuring a number of different colours and/or technical areas that add some advantage in terms of performance or comfort. Desma has developed a new mixing head with special features that make a previously complex and expensive manufacturing process much simpler and allows manufacturers to quickly follow any new trends in the market place.

In the struggle to achieve sales in a tough global market, footwear manufacturers are continually seeking new ways to make their products stand out from those of competitors. Colour and performance are seen as two key areas and ones that are closely related to the nature and design of the sole.

A further new development from Desma is a micro-dosing head for small spots or profiles to be cast into the open mould cavity. With a mixing head having a throughput of between 1 and 8 grams/sec, it fills an important niche in the company's range. *Figure 3* shows the accuracy with which the robotic micro-dosing head can cast a small PU spot into the appropriate section of the mould cavity.

Details of the mixing head can be seen in *Figure 4* where it is mounted on a six-axis industrial robot. The head itself is approximately 300mm high and has a rather special collection of pipes. Accurate control of all the liquids is

essential so the control of pressure within these pipes has to be quite sensitive. Their small diameter, coupled to the low overall pressure at which the head operates, makes this possible.

The specially designed valves, each with its own individually controlled parameters, provide the option of individual cycle monitoring which greatly increases the quality of the end product. Combined with all the other available parameters of the machine and mixing units, the shoemaker is offered an extremely broad range of possible functions. Output on a 60 station rotary machine for a 190gram PU sole with 12gram PU spots is claimed to be 139 pairs per hour as against 259 pairs for 200gram single colour PU, at 85% efficiency in both cases.

This micro-dosing head can also be used to produce other products, such as footbeds, or for other technical applications. The growing popularity of ergonomic footbeds with different performance areas is creating a natural demand for small mixing heads for the user of polyester polyurethanes. A good example of this is where one new product line is using polyurethane gel-technology as a viscoelastic top footbed support with a high Shore hardness shank-support underneath and a performance damping spot at the heel (*Figure 5*). 📌



Figure 5 – Examples of ergonomic footbeds