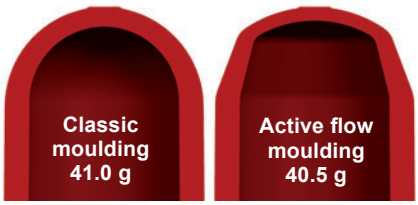
From the idea to cooperation on material savings

Let's move to lose weight

3% less PET per preform, less energy for reheating, less shear and lower injection pressure: movable cores in preform moulds bring many benefits. Mould specialist MHT Mold & Hotrunner Technology AG is cooperating with GR8 and is using the Active Flow Molding technology to produce preforms with thinner bases.

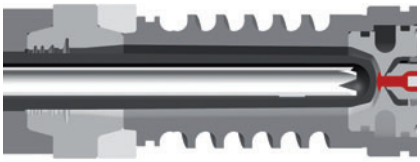
Have you ever made the effort to open a bottle with an extremely short thread? Then you will know that the possibilities for saving material in this area are practically exhausted. But there is still potential in the preform bases, which are often thicker than they need to be for the stability of the bottle and use more PET material than necessary. Active Flow Moulding (AFM) offers the possibility of reducing the wall thickness in the first moulding phase by using movable cores in the mould. Mould manufacturer MHT, based in Hochheim, Germany, and R&D company GR8 from Arundel, UK, are working together to bring this technology to market. They have produced several different preform designs and supplied them to customers for blow moulding tests.

There have already been successful tests with Pepsi in Geneva and Moscow, but further tests in Russia have been prevented for the time being due to the war with Ukraine. AFM technology is particularly interesting for large beverage brands with their own PET production, as they can benefit from the material savings directly in the preforming process. If the weight of the preforms in a mould with 96 cavities can be reduced from 41 to 40.5 g and 1,000,000 cycles are carried out, that is 48 t of PET! Normally, a weight reduction of up to 3% is possible.

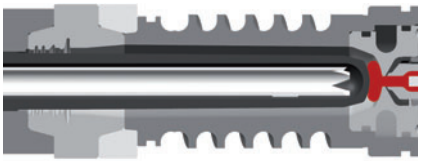


Comparison: conventional round base (left) and Antiflex base (right)

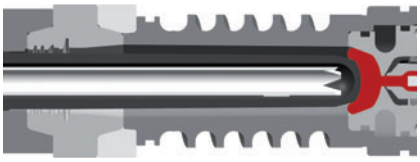
The main feature of AFM is that the cores are movable, which results in a similar mechanism to injection compression moulding. The whole thing works as follows: Firstly, the molten plastic pushes the core back during the injection process and the available sprue opening increases. The plastic flows in more easily, the flow path ratio is more favourable, the injection pressure drops (by around 9% in current tests) and the shear is reduced. Once the preform is almost completely filled, the core moves forward (up to 6 mm) through the still liquid plastic melt into the end position. Excess material at the base is pressed into the wall and the thread is completely filled to the top. The thin base is achieved during the primary moulding process and therefore bears little stress.



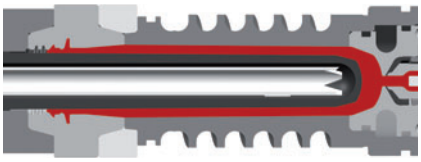
1. Valve stem open during injection (the jagged contour lines in the core represent the cooling tube)



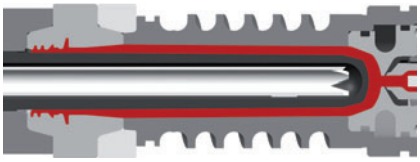
2. The molten plastic pushes the core backwards, resulting in a larger opening, reducing injection pressure.



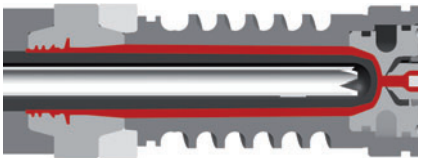
3. Injection takes place



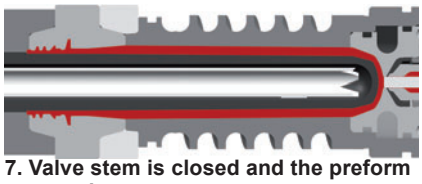
4. The preform is almost filled.



5. The core travels forwards.



6. Core in its end position: the base is thin, the preform, including thread, is completely filled



7. Valve stem is closed and the preform removed

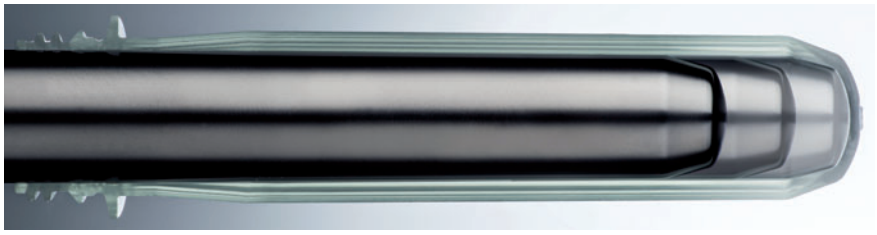
Another advantage compared to classically moulded preforms: a high wall thickness at the base can sometimes have a detrimental effect on the subsequent blow moulding process, especially if the blow moulding machines run at high speeds. The output per blow mould is therefore significantly higher for preforms produced using AFM technology. In addition, less energy is required to reheat the preform.

The core contour has a cone at the tip, the Antiflex base. This prevents so-called core displacement, which can lead to problems, particularly with thin-walled applications.

Very long, thin cores tend to bend due to the injection pressure so that they are no longer perfectly centred in the cavity, resulting in uneven wall thicknesses. In tests, MHT and GR8 achieved extreme concentricity with a preform weighing 43 g and 135 mm long.

AFM can be used in existing PET injection moulding machines with an external power unit. A further collaboration with machine manufacturer Sacmi led to the result that AFM can be used in their machines without additional equipment. As stretch blow moulding and filling processes always take place after preform production, it is important to incorporate these into a new process. MHT has been part of the Krones Group since 2018 and therefore has the relevant expertise on its doorstep. Customers have the option of mapping preform production with this technology at MHT in a prototyping process or, if required, carrying out all laboratory and stretch blow moulding tests at Krones. Initial tests on the stretch blow moulding machine have already been carried out and have shown improved basic stretching. The joint development team is planning further trials - and then nothing will stand in the way of introducing AFM to the preform market.

www.mht-ag.de



Peter Clarke from the R&D company GR8 Engineering about the project

Having seen an interesting post on the subject of material savings in preform production, we contacted the post creator Peter “Plastic Pete” Clarke from the R&D company GR8 Engineering Ltd. and exchanged ideas, first in writing, then by telephone. It quickly became clear that there was an interesting story and an issue to be addressed here, namely a fundamental question for all material processors: in an age of bottle necks with minimal heights and thin-walled bodies, how can the use of PET materials in bottle production be reduced even further without significantly compromising the consumer and user experience?

Peter Clarke, Head of Creative Engineering at GR8 Engineering Ltd.

Peter, the Head of Creative Engineering at GR8 and the source of the idea, had the topic on his radar long before the utilisation of lightweight and material savings reached the current level. “We had a mould with a single cavity built back in 2007 to test the process,” he explained. “As explained by MHT, the method is that the core moves back slightly during injection and then moves forward to complete the filling and packing, making the preform base thinner and allowing the resulting material to flow into the preform wall. We have experimented with hydraulic control, springs and a combination of both, all of which actually work. The best method, however, is a mechanical spring behind the core that resists the flow of material through the pusher and a hydraulic control that moves the core forward towards the end of the filling process.”

GR8 produced the 135 mm preforms mentioned by MHT with a wall cross-section of 1.5 mm and an L/T of 90:1. The process was also used in the production of equal-length preforms with a wall cross-section of 3.3 mm within a cycle time of 12 s, with the material being processed at 255 °C using secondary cooling in the robot removal. “We then developed the aforementioned Antiflex method, where the geometry of the base of the preform is configured to self-centre when the core is pushed forward towards the end of the filling process,” Peter Clarke continued.

Another improvement was the introduction of Back Flow Assist to eliminate the crystallinity of the gate, particularly in the gate opening area. The geometry of the gate area is designed in such a way that excess material flows back through the gate when the core is pushed forwards. The reheating of the long, thinner-walled preforms would also allow energy savings of around 40%, as PTI’s experience has shown, says Peter.

The partnership with MHT began in 2016, when the mould manufacturer built a 4-cavity mould and modified one of its injection moulding machines so that AFM technology could be used. Since then, thousands of preforms have been produced with AFM. “Our main customer was Pepsi, with preform tests carried out by PTI in Geneva,” said Peter. Further testing took place in Moscow and around 20,000 preforms were produced for shipping, but since Russia’s war of aggression, AFM technology has lost momentum, Peter continued, and is now on the lookout for other potential customers.

https://shorturl.at/bkuER