TILTING TECHNOLOGY: THE NEW PRECISE AND REPRODUCIBLE CENTERING METHOD FOR RING-SHAPED DIES

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Abstract

Ring-shaped die heads serve for the extrusion of various types of semi-finished products such as tubes, pipes, foamed films or sheets, blown films or cables and also to produce hollow parts using the extrusion blow molding process. The patented tilting technique was originally designed for the sole purpose of improving the sealing and centering of ring-shaped dies. The method achieves this aim by applying simple elastic tilt joints between the head and the die. In order to seal the parting line reliably, an easy bayonet lock is used to compress the tilting joint in a defined manor.

Introduction

The technical solution is not at all convincing that is applied for the production of capillaries, tubes, pipes, blown films and for extrusion blow molding since ring-shaped dies are used. Axially positioned screws are difficult to operate to shift the die. They do not allow for a sensitive adjustment of the die in regard to the pin. But this is the prior requirement to be fulfilled in order to achieve optimum centricity of the thickness distribution in the final product. Beyond that it is of extreme importance that a position that once has been reached can be reproduced at any time. The conventional centering solution is far away from fulfilling these requirements. In the contrary it is even not possible to measure the relative position between the die and the pin after it has once optimized. That is the reason why after a head has been cleaned the complicated time consuming and costly centering procedure has to be done always again, starting with the task to pre-center the die. So an improved solution to center the die was overdue since a long time.

The requirements for an ideal solution are easy to formulate. The head has to be designed in a way that the die or the outer ring can only be mounted to the head in a centred position. In this case the head can immediately be heated up and the production can start without any delay after the die has reached the operating temperature. And naturally the solution must allow for an extreme precise centering which can be easily automated. In the case once it is automated naturally every position that has achieved can be exactly reproduced at any time.

New solution

Naturally in the past attempts have been made to find a better technical solution to center a die. A construction can be found in the patent literature [1] where the die is not shifted but where a tilt joint is used. But the metal tilt joint construction which is proposed affords a very precise manufacturing. It is not only rather expensive but also very sensitive to leakage. That is the reason why it is hardly found in the market. The new solution also uses a tilt joint [2]. What has changed is the form and the design of the tilt joint. Instead of the mechanical joint which is costly to manufacture an extreme cheap elastic tilt joint is used (Fig. 1). A close fit between the dieand the head is possible when using a tilt solution as the die has no longer to be shifted relatively to the head. The enormous advantage is

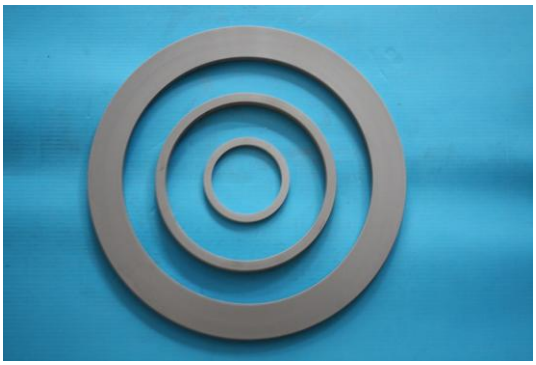

Figure1 Rubber tilt joints of different geometries which seal the dividing plane between the die and the head and which in the same time allow for a sensitive tilting of the die

that the die by itself is centred immediately after it has been mounted to the head. Additionally a bayonet closure has been proved to be very comfortable in combination with a tilt joint as the die can be mounted and disassembled from the head with one simple turn (Fig 2).

A further advantage is that every existing annular head can be easily retrofitted with a tilt joint. Even an automatic adjustment is possible. To achieve this simply two stepper drives have to be attached to the

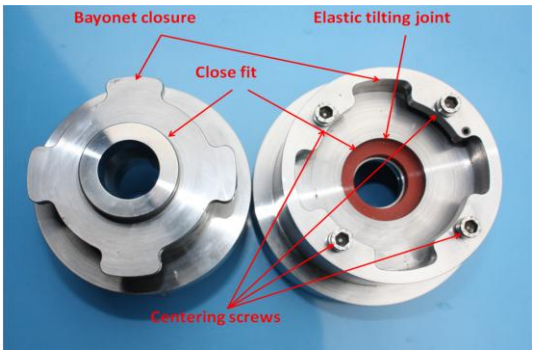

Figure 2 Dividing plane of a tilting die with the tilt joint in a groove of the head (right side) and the die with the bayonet closure (left side)

head. Fig. 3 shows a retrofitted blow moulding head where the stepper drives are mounted to the head in a 90 degree arrangement. The drives can realise adjustments as small as 0.001 mm with an extreme precision due to the small steps and the additional transmission ratio of the worm gear. Now it is possible to reproduce any situation or position which has been existed before an adjustment has been done. It can be precisely centred from the control cabinet without being forced to stop the process. A once achieved optimal position can immediately reproduced when starting the machine

Figure 3 Head for extrusion blow molding retrofitted with a tilting die which is adjusted by two stepper drives arranged in a 90 degree angle to reach every relative position in regard to the pin

after the die had been taken off for instance for cleaning.

The tilting technology also enables to design heads where the flow channel gap at the exit of the die can sensitively be adjusted in a certain range. This allows always for the use of the optimum gap for the production of pipes or tubes having the same diameter but a varying wall thickness or to produce slightly different diameters without changing the die. Fig. 4 shows such a die which is additionally equipped with a Flex Ring sleeve in order to further reduce asymmetric thickness variations around the circumference of the tube.

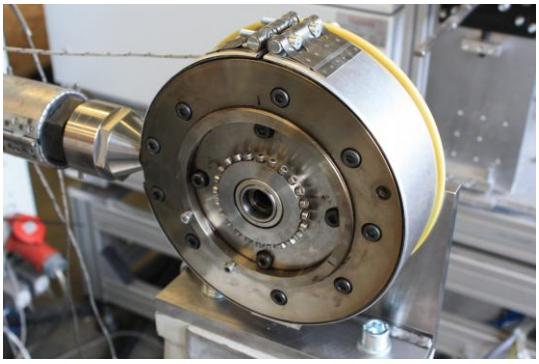

Figure 4 Tilting tube die equipped with a Flex Ring and 24 adjusting screws to locally fine tune the flow channel gap, 4 tilting screws to sensitively tilt the die and an adjusting ring to alter the flow channel gap at the exit of the die

Fig. 5 shows a conventional head for the production of 110 mm pipes during operation that has been retrofitted with a tilting die. An additional ring has been mounted to the head in order to achieve the close fit between the head and the die. In the same time it builds the one side of the bayonet closure. Accordingly the flange of the die builds the second part of the bayonet closure. Furthermore small adjusting screws are positioned in the axial direction to

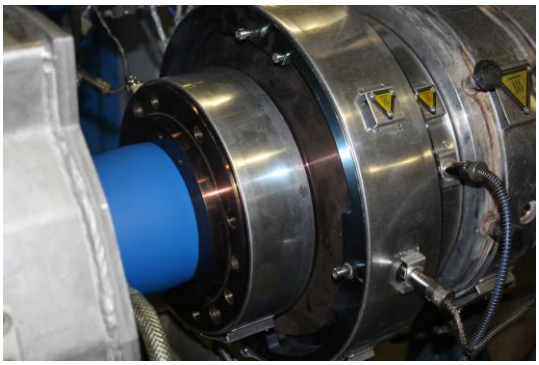

Figure 5 Tilting die in operation that has been mounted to the head with the help of a bayonet closure

enable a fine tuning of the position of the die in regard of the pin. When starting the production the die was first centered using the still existing conventional centering screws of the head. When a centricity of 0,3 mm was reached the operator stopped his attempts to further optimize the position of the die. The danger to achieve a less good position with the next adjustment was too great according to his opinion.

So to further optimize the centricity the axially positioned tilting screws were used. With three further sensitive adjustments a centricity of 0.1 mm was reached. Fig. 6 shows a photo that has been

shot from the monitor of the online thickness measuring system that was installed in the line.

Figure 6 Photo showing the excellent centricity that has reached with the help of the tilting technology

Conclusion

Throwing the fear of plastics experts in the wind to use rubber materials within a head a surprising easy and improved possibility has been opened up to facilitate and to enable a more precise centering of an annular die. In mechanical engineering it is state of the art to seal a dividing plane by using a rubber sealing. By placing a rubber sealing also in the dividing plane between the head and the die the flow channel can securely sealed. Additionally it can be taken advantage of a certain remaining elasticity in the rubber sealing to further compress it at location over its circumference. When this is done at a certain location the die tilts in regard to the head. This is much easier and much more precise compared to the conventional solutions to center the die. Furthermore it makes the centering procedure reproducible and it allows for an automated centering. Nevertheless the cost to fabricate a tilting die is less compared to the conventional solutions.

References

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2. H. Groß, Tilting Technique Improves Centering and Other Features. magazine Kunststoffe international, Carl Hanser Verlag München Wien, volume 102, issue 3/2012, page 21-23