

Intermediate plates for multicomponent injection molding of thermoplastics

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ABSTRACT: The economic significance of special approaches to injection molding is growing as a consequence of rising costs and the opening of new applications for plastic formed parts. Along with multicomponent injection molding machines and tooling, 2K intermediate plates are needed for these technologies, thus making it possible to implement sandwich injection molding with little effort. The advantages of these intermediate plates include low installation effort as well as simple control of the injection piston by means of the melt pressure. The 2K intermediate plates can be installed on virtually any multicomponent injection molding machine up to 4000 kN of clamping force, regardless of the manufacturer or how the injection units are arranged. Experience from production use and new injection molding technologies, such as gas or water injection, led to further developments and new variations of the 2K intermediate plates.

Key words: Multicomponent Injection Molding, Intermediate plates

1 INTRODUCTION

The processing of thermoplastics in injection molding is well suited for combining several different plastic melts in a single process. These special approaches to injection molding are economically and functionally advantageous and improve the characteristics of the formed parts consisting of several plastic components. In these procedures, while the melt is being injected into the cavity both identical as well as different materials are combined. Coinjection molding has been well described in the literature, e.g., in [1]. With multicolor or multicomponent injection molding technology, several variations are distinguished depending mainly on the number of injection points on the formed part and the time sequence of the injection of the plastic melt (parallel or sequential). The 2K intermediate plates were designed for the sequential "sandwich" injection and for interval molding. "2K" stands here for 2 plastic melts. By

using these 2K intermediate plates, multicomponent injection molding machines which are designed for producing parts using overmolding can be easily retrofitted without additional machine modifications or changes in the controller. 2K intermediate plates are used both as original equipment and as retrofits on injection molding machines.

2 SANDWICH MOLDING

In sandwich molding, two plastic melts are injected into each other so that the core components are completely encased ("sandwiched") by a skin component. The core and skin components may consist of the same or different plastics. Depending on the use of the various core and skin materials, the advantages of this process include ability to incorporate different combinations while reducing costs.

In order to combine different plastics, the following applications for simple (packaging) or for more sophisticated technical formed parts such as required

by the automobile industry are seen:

- Porous structure of the core material by introducing propellants, smooth decorative finishes
- Fiber-filled material in the core, non-reinforced material for the surfaces
- Electrically conducting core materials, insulating material for the skin



Fig. 1. Photographs of cut plastic moldings showing various materials

The use of recycled material for the core and new material for the skin results in significant cost savings, since the former is much less expensive than new material.

Decorative effects for visible molded part surfaces, including a reproducible but variegated color “marble” structure is also possible using the 2K intermediate plates. Mixtures and 2-color streaks can also be achieved by means of one or more quick successive injection sequences or intervals for the melt components which differ only in their color.

3. ENGINEERED DESIGN OF THE 2K INTER-MEDIATE PLATES

The 2K intermediate plates consist of a steel plate whose dimensions and hole pattern are customized for the injection molding machine. The steel plate is bolted on to the nozzle-side platen, and the mold is attached to the intermediate plate either directly or using clamps.

Inside the steel plate is an attachment which is axially movable and thermally isolated from the plate and containing two pistons. The nozzle is positioned at the sprue bushing by means of the horizontal injection unit. After the nozzle is retracted from the sprue bushing, the entire attachment is restored to its start position by means of two compression springs to prevent hardening of the melt in the nozzle from remaining in the cold mold too long. The movement of the pistons is controlled

only by the pressure in the melts. This ensures at the same time that the other melt is always sealed off during injection and no mixing of the plastic melts in the nozzle takes place.

The pistons, in combination with the compression springs which force them back to the start position after pressure has decreased, also assume the function of a sprung shut-off nozzle. The spring force on the pistons is slight compared with the injection pressures. For additional injection of gas or water into the melt or when using propellants for the core material, a hydraulic lock for the control pistons was developed.

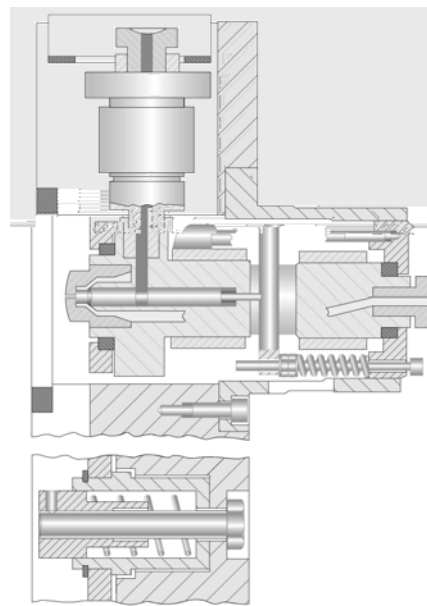


Fig 2. Cross-section image through the plate

Another process advantage is that the injection of the various melts is not tied to a particular injection unit on the machine. Which melt in the part is skin and which the core is determined solely by the injection sequence: the skin is always injected first.

To avoid marks on the surfaces of the parts, the melts should be injected so that the melt front is always moving in the cavity during injection, i.e., the speed of the melt is always > 0 . This simply requires of the controller that it injects the skin and core materials simultaneously. The machine controller can also “seal” the injection point if the injection sequence is skin-core-skin.

The proportion of core material in the formed part depends on its geometry and the plastics used. In general the proportion lies between 30% and 50 % of the formed part weight.

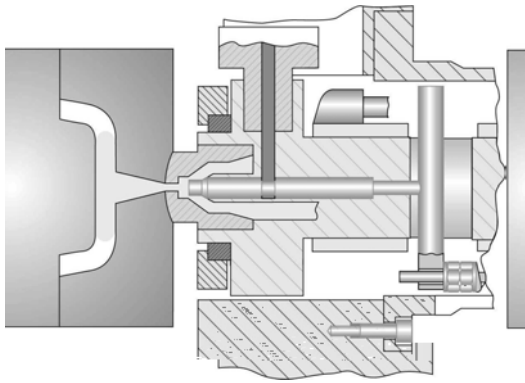


Fig. 3. Skin melt injection

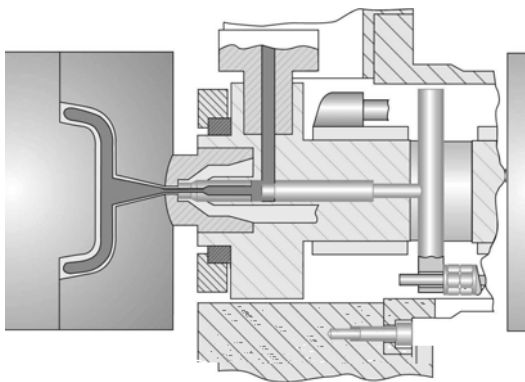


Fig. 4. Core melt injection

The user enjoys the following benefits when using these 2K intermediate plates:

- Very low installation effort, comparable with simple changing of a mold
- No additional hydraulic, pneumatic or electric drives
- Injection molds (cold runner) can be used without any modifications
- No additional signals for the machine controller are necessary
- No restrictions in the technical parameters of the individual injection units
- Rapid color changing
- Integrated shut-off nozzle function
- Processing of skin and core material through both injection units
- Simple function monitoring

4 PRACTICAL EXPERIENCE FROM ACTUAL PRODUCTION

These 2K intermediate plates have been used for

approx. two years on injection molding machines built by various OEMs having various arrangements of the second injection units and for various applications, especially for the production of technical formed parts.

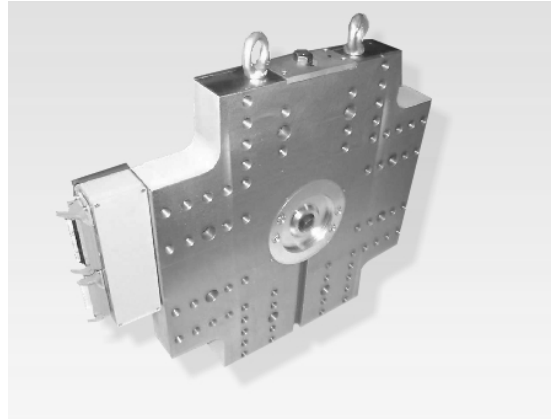


Fig. 5. Front side (mold) of the 2K Intermediate Plate

A “critical” point in using is the connection of the sprue bushing with the nozzle on the 2K intermediate plate. In contrast to standard injection molding, where good access to the nozzle is provided, this area is no longer accessible after installing the mold. This means precise checking of the positions of nozzle and sprue bushing is required.

The melt transport parts of the 2K intermediate plates are made of high-alloy, corrosion- and abrasion-resistant steels, resulting in long service life especially when processing recycled or filled materials.

A consequence of the simple construction of the 2K intermediate plates is good process consistency.



Fig. 6 Range of multi color molding (1/10/50100/150...)

Practical experience has resulted in improved melt transport in the nozzle area (avoidance of streaks), and pressure losses have been reduced by optimizing the melt channels.

For special applications the 2K intermediate plates have been developed with a reduced plate thickness of 80 mm, with an additional insulation plate and cooling circuits. Sensors can be used to monitor the nozzle position.

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