

Assembly Injection Molding

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Introduction

With SIMTEC's Liquid Silicone Rubber (LSR) processing know-how and technology, it is now possible to integrate functions of parts with complex design, challenging geometry, and tight tolerances, into one assembly. Assemblies are injection molded employing the same material or a combination of materials to enhance their functioning. Assembly injection molding is primarily completed by either *two-shot injection* or *over-molding* processes. These are highly sophisticated molding processes that provide increased design flexibility for making multi-material, multi-color and multi-functional components at a competitive cost. The process is ideal for function and part integration into one single component. By employing the right technology and know-how, assembly injection molding comparatively offers several benefits over traditional processing techniques.

These include eliminating of:

- Assembly steps and assembly lines
- Quality checks for several parts
- Independent tools for each material
- Multiple validation costs needed for each independent tool

Additional benefits are:

- Increased and sustainable quality levels
- Optimized part design
- Reduced material consumption
- Reduction of capital investment due to part and function integration
- Reduction of procurement costs by dealing with one source

There are many applications where assembly injection molding of LSR and thermoplastics and/or metals plays a significant role in the industry. These include:

- *Sanitary articles* - Showerheads and diffusers.

- *Personal care articles* - mascara applicators, electric shaving machines, and toothbrushes.
- *Health care articles* - valves, flow meters.
- *Electronic and communication devices* - soft-touch interfaces.
- *Food contact applications* - infant feeding items, juice dispensers, coffee makers, and dairy product dispensers and filling machines
- *Automotive applications* - connectors, soft-touch components, navigation system aids.

Process

Assembly injection molding requires the use of a two-shot LSR/substrate processing line. This technology enables us to achieve the best performance out of materials with complementary chemical and physical properties. By employing this technology the necessity of post molding assembly lines and or secondary operations such as surface treatments are reduced or eliminated. Either a rotating mold or transfer tools are needed to enable the production of ready components in one cycle. Both kinds of tools are in operation at SIMTEC.

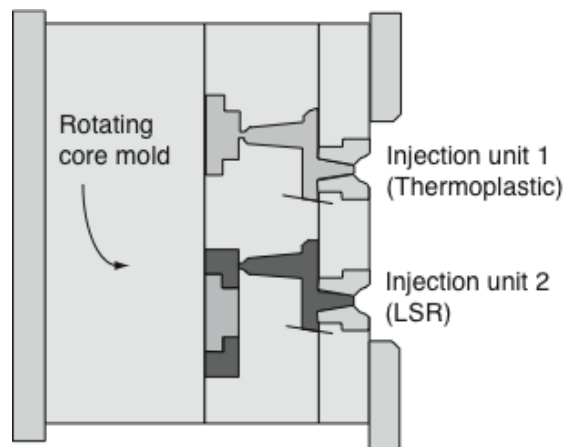


Figure 1: Schematic diagram of a rotating mold used to produce multi-component injection molded parts.

Assembly injection molding is a special process used

in the plastic processing industry and it encompasses over-molding, multi-component injection molding, two-shot injection molding, multi-shot injection molding, and is sometimes referred to as an *in-mold assembly* process. However, this process is different from co-injection molding which also incorporates two different materials into a single molded part. To be specific, co-injection molding involves the sequential and/or concurrent injection of two dissimilar but compatible materials into a cavity to produce parts that have a sandwich structure with the core material embedded between the layers of the skin material. On the other hand, for assembly injection molding, a thermoplast is first molded and then transferred to a different cavity to be molded with LSR inside a cavity defined by the surfaces of the insert and the tool. The adhesion between the two different materials can be mechanical and/or chemical as needed.

Conventional assembly injection molding dates back several decades. This process has since advanced to allow consistent, cost-effective production of multicolor or multifunctional products in a variety of innovative and commonly used methods. The decision of choosing a suitable molding technique depends on the production volume, quality requirements, and the molder's experience and know-how. For example, one can use two separate molds and a stand alone single material conventional injection molding machine for producing assembly injection molded parts via over-molding. In this approach, the insert is first molded and then transferred to a second mold, where it is overmolded with a second polymer or elastomer. The disadvantage of this approach is that it involves additional steps to transfer and load the prefabricated insert into the second mold. However, if the part weight and cycle time are radically different for each material, then this is a viable and economically advisable way of manufacturing the assemblies.

Another method employed for assembly injection molding calls for a rotating mold and multiple injection units, as shown in Fig. 1. Once the insert is molded, a hydraulic or electric servo drive rotates the core and the part by 180 degrees (or 120 degrees for a three-shot part), allowing alternating polymers to be injected. This is the fastest and most common method because two or more parts can be molded every cycle. Utilities for the rotating mold (i.e., cooling water, compressed air, or special heating) are connected through a central rotary union. If there is a family of parts that requires rotational transfers, it is more economical to have the frictional capability built into the machine (and pay for it once) than it is to buy a family of molds with the capability in each.

Another variation of multi-component injection molding involves automatically expanding the original cavity geometry using retractable (movable) cores or slides while the insert is still in the mold. This process is called *core-pull* or *core-back*, as shown in Fig. 2. In this case the core retracts after the insert has solidified to create open volume to be filled by the second material within the same mold.

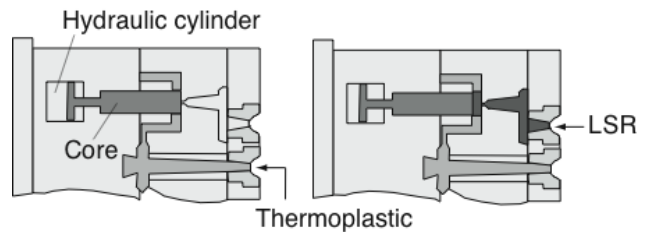


Figure 2: Schematic diagram of multi-component injection molding using a *core pull* or *core back* technique.

Material selection is vital for multi-component injection molding. A thorough analysis needs to be conducted to determine material compatibility, chemical and wear-resistance, environmental performance, and other program-specific requirements. One of the benefits of employing LSR is that flexible transparent – or if need be, high-transparent – thermoplastics can be molded onto a rigid substrate to create a soft-touch feel thereby improving the handling in a finished assembly. Experience has already been gained at SIMTEC with the two-shot injection molding of several thermoplast materials and LSR. Our Technical Bulletin Vol. 1, Issue 2 further elaborates on the state-of-the-art technology for two-shot injection molding.