# Summary

    The production of class A parts from compression molding is well established. Improvements are still possible, but the use of this molding system for production of plastic body panels and for other automotive parts will continue to grow as the advantages of plastic molding over metal parts are further recognized.

    In compression molding, the mold is open when the material is introduced. This open mold arrangement has the advantage that molds can be simple and charging done either manually or automatically, as desired. Open-mold charging means that the flow of the resin is short, normally just that required to fill the mold. Hence, resins mixed with fillers and long fiber reinforcements can be used in compression molding.

    Transfer molding differs from compression molding in that the mold is closed when it is charged. The resin is preheated in a transfer chamber to the proper viscosity before being forced by a plunger into the mold cavities. Transfer molding uses a runner and sprue system to move the material from the transfer chamber to the cavities. An excess of material is usually charged into the transfer chamber to ensure that the mold is completely filled. This excess material, which is cured because the transfer chamber is heated, is called the cull. Transfer molding gives better resin control than compression molding because the resin is usually lower in viscosity during the mold-filling stage. This high resin control and the closedmold arrangement lead to the extensive use of transfer molding for the encapsulating of parts (many of them electrical) and the molding of handles.

    The molds used in compression molding and transfer molding consist of two halves that mate to form the part between them (like a waffle iron). Molds must withstand considerable pressure and so are made from tool steel. Surfaces are usually polished and may be chrome-plated.

    The force for the molding is supplied by presses, which can be massive, depending on the size of the part to be molded. The important size considerations for determining the required molding force are the projected area and the depth of the part. Other considerations include the resin type and the nature of the fillers and reinforcements that may be present. Most thermoset materials can and are molded by compression molding and transfer molding. Fillers and reinforcements are often added to lower the cost or to modify the mechanical and physical properties.

    Reaction injection molding (RIM) is similar to transfer molding in that a thermoset liquid is injected into a heated mold. The difference is in the nature of the thermoset liquid. In RIM, the liquid is a mixture of two materials that react on mixing and form a solid material. Polyurethanes are the most common.

     Sintering is a process for forming powdered thermoplastic resins and involves three steps: preforming, fusing, and finishing. Preforming can be done on presses similar to those used in compression molding and transfer molding. The preforming step compresses the bulk resin into a preform that is 90% of the density of the finished part. (If additional processing is not required, the preforming step is called cold forming or solid-phase forming, depending on whether the forming mold is heated.)

    The fusion step in sintering is accomplished at temperatures below the melting or decomposition points of the resin. At these temperatures, the resin particles soften and coalesce, with the aim of forming a solid mass that has a low void content. After careful cooling, which sets the crystallinity of the part, the part is removed from the mold and machined to finish the shaping operation.

## 18.9.1. Questions

1. Calculate the size of the press required to mold a part using a multicavity transfer mold in which the part size is 2.5 inches by 2 inches. The mold contains four cavities. There are four runners, each of which has a diameter of 0.375 inches and a length of 1.5 inches. The sprue has a projected area of 0.25 square inches. Assume that a transfer pressure of 8,000 psi is needed. 2.
2. Discuss the differences in resin orientation that would be expected in a part made by transfer molding and a part made by injection molding.
3. Explain how both undercuring and overcuring can cause part cracking on removal from the compression molding process.
4. Explain why coining can be used to make more complicated shapes than can conventional sintering.
5. Describe poker chipping, and explain how it can be prevented.
6. Why not eliminate the cull and save this extra material when doing transfer molding?
7. Why can't the cull, sprue, and runners from a transfer molding operation be re­ processed as regrind like runners in an injection molding operation?
8. Describe the defect that will most likely occur if the press used for transfer molding is undersized in clamping pressure.
9. What is the major advantage of a flash-type mold-closure system in compression molding? What are the disadvantages?
10. What is meant by cryogenic flash removal?

## 18.9.2. References

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