PLASTIC MOLDS AND DIES

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INTRODUCTION

The development of the plastics industry takes up a prominent place in the industrial production all over the world. According to statistical data, the plastics production was about 1.5 million tons in 1950 and 14.6 million tons in 1965. According to the data found in technical journals, the production has been growing ever since, and a tenfold increase in production will occur within another 15 years.

However, it is not sufficient to develop only the quantity and quality of the raw material basis, but it is necessary to ensure expansion of the processing as well. There are two possibilities open for this purpose: either the number of the processing machines will have to be increased, or a better utilization of the existing machine tool should be taken care of.

The first method would tie down substantial material means, consequently, its application is limited. The desired result is relatively easier ensured by the second method: with the application of well-designed, well-constructed, and automated molds and dies.

In view of the above, perhaps it is not an exaggeration to state that one of the key points of the whole industrial development is the high-standard design and up-to-date construction of the plastic molds. This is the only way to satisfy the fast-increasing demand for direct or indirect plastic products arising in practically every industrial product.

The design of up-to-date molds is a matter of training and practice. This may require a long time even if given a suitable technical book; however, this is a scarce item. Hence, there is an urgent need for a book that, in addition to the information related to mold design, includes all of the following calculations: strength, caloric, electric, and economic. To date, the designer has only been able to find these calculations scattered here and there in domestic and foreign journals. This book should also discuss and present the most practical solution of each problem using properly detailed examples. The authors hope that this book will help to overcome the existing deficiency. It is up to the reader to decide to what extent this objective was accomplished.

Finally, we should like to mention, that since the book was first published in Europe, it employs the European projecting method and metric technical units. Since there are various systems of measures being used all over the world, we present a conversion table in the Appendix in order to facilitate the use of the calculations presented in this book.

SUMMARY OF THE MOST FREQUENTLY USED PLASTIC FORMING PROCESSES

Plastics are formable with the proper tools in hot or cold conditions. Hence, the tools should be grouped accordingly. The tools to be used for hot material molding are primarily determined by the material. Several variations of this process are known. It is the task of the processing technologist to select the most convenient method. If none of the hot molding processes are suitable for attaining the given object, cold "machining" remains as the last resort: chipping (material separation) or stricking.

Metal-working machines are used for chipping, but the tools should be designed in accordance with the properties of the plastic material.

Compression, injection molding, extruding, etc., molds (i.e., plastic processing machines and practically designed compression, injection molding, extruding, etc., molds) are required for hot molding. The procedures most frequently used for the hot molding of plastics can be found in the following table.

The Most Common Methods for Hot Molding of Plastics

Method	Characteristic of Technology	Type of the Applicable Plastic Material	Shape of the Applicable Plastic Material	Notes
Compression molding	Cold or slightly preheated material is shaped in a hot mold with a high specific pressure.	Thermosetting	Powder or preheated pellet	Oldest processing method. Used for the production of shaped pieces.
Transfer molding	Cold or slightly preheated material is pressed with a high specific pressure from the pot of the hot mold into the mold cavity.	Thermosetting	Powder	For the production of shaped pieces. It is more productive than the compression molding and stricter tolerances may be kept.
Injection molding	Heat-softened material is injected by a high specific pressure into the cooled mold cavity.	Thermoplastic	Powder or grain	For the production of the shaped pieces.
Intrusion	Material is injected into the slightly open mold, then the mold is closed.	Thermoplastic	Powder or grain	Higher internal pressure is attainable than at the injection molding, thus, the produced pieces will have less wall thickness.
Extrusion	Heat-softened material is forced with high pressure through the profile-forming orifice.	Thermosetting or thermo-plastic	Powder or grain	For the production of rods, pipes, strips, or thicker fibers.
Hot drawing	Preheated, softened material is shaped by cold or warm molding at the beginning, and subsequently cooled mold with low specific pressure.	Thermoplastic	Sheet or film	Production of hollow pieces, boxes, etc.; "hot drawing."
Blowing	Heat-softened material shaped with low specific air-pressure in cold (cooled) mold.	Thermoplastic	Sheet, film, or extruded pipe	Production of hollow pieces, bottles, etc.
Casting	Melted material hardened at room or higher temperature without applying pressure.	Thermosetting	Liquid or melted	For production of shaped pieces or blocks.

Pressing	Material of pulpy consistency or laminated material pressed to the wall of the mold by a rubber bag filled with vapor or compressed air. Hardened in furnace or autoclave.	Thermosetting	Pulpy or laminated paper, veneer or fiberglass panel	For the production of large products (e.g., boat hulls).
Vacuum forming (compressed air forming)	Preheated softened panel formed by vacuum or compressed air between the mold and panel.	Thermoplastic	Sheet or film	For the production of thin-walled large pieces.
Rolling	Cold or slightly preheated material rolled to panel or strip by opposite cylinders in counter motion.	Thermoplastic	Powder or grain	For production of sheets and strips.
Fiber processing	Melted plastic or solution pressed through holes of appropriate diameter into air or liquid acting as solidifier or precipitator.	Thermoplastic	Melt or solution	Proper fiber thickness is attained by drawing in one or several stages.
Dipping or coating	Preheated, mostly hollow mold dipped into melted or dissolved plastic, the adhered material is gelatinased at suitable temperature.	Thermoplastic	Melt or solution	For production of boots and other thin-walled objects.
Spraying	Melted material blown onto the object to be coated by the application of hot air flowing at high pressure, where it settles and constitutes a continuous layer.	Thermoplastic	Powder	For coating of tanks, tubs, etc.