

9.1 Liquid State Forming

Injection Molding

Perhaps no other process has changed product design more than *injection molding*. Based in hot chamber die casting technology for metals, the polymer materials developed and other recent developments for this process have allowed designers near total design freedom.

While there have been many new and exciting developments in injection molding, the process is still relatively new and continues to evolve. Early in its development, injection molding had several major limitations such as incomplete knowledge of the process and a limited selection of materials, some of which had serious drawbacks. The process often misused and there was a justifiable perception that the materials would not last or would not be durable enough to meet expected demands. Also, there were high tooling costs with long lead times.

Most of the problems have disappeared, especially with the spectrum of materials now available, as well as the constant development and highly sophisticated use of the basic process. Computer aided design (CAD) and rapid prototyping (RP) have drastically shortened the lead times for tooling and EDM has almost eliminated tool machining errors. Computer simulation programs are able to predict nearly all aspects of the molding process and with three dimensional modeling and rapid prototyping, it is possible to avoid or correct almost all the problems before the tooling begins.

Today, injection molded products cover the entire spectrum of product design, from consumer products; business, industrial, computer, and communication equipment; and medical and research products; to toys, health and beauty products, and sports equipment. The most striking aspect of the new developments is the shrinking of time for production parts. Twenty-four hours is now possible.

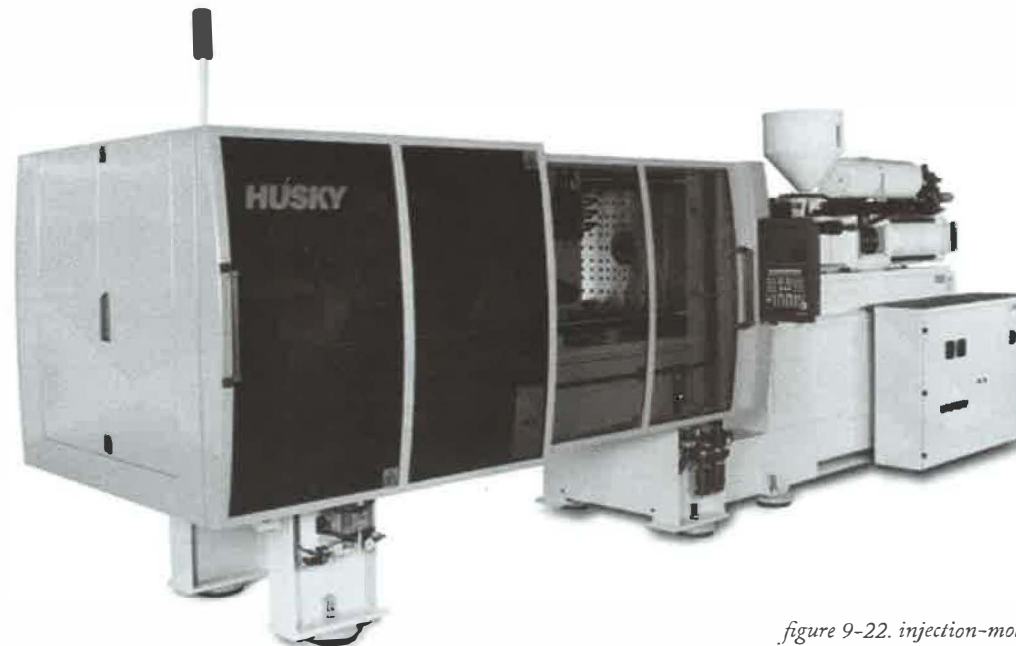


figure 9-22. injection-molding machine (courtesy Husky)

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Molding

Injection molding is a high-rate production process with molds made of type "P" tool steel. In the process, pellets are fed through a hopper into a heated barrel, where they are mixed with additives and melted. The melted resin is then injected into the mold cavity. Older machines use a single stage plunger, much like die casting machines, to create the required pressure to inject the resin into the mold. These machines are still used to produce marbled products. Co-injection is a variation for molding parts with different colors and/or other features. In this process, a two stage plunger is used. Automobile rear-light covers, instrument panels, and control knobs with a different color lettering is commonly made using these machines.

Current machines use reciprocating single or twin screws to create the force required to inject the liquefied materials into a mold cavity at pressures of one ton psi. After a thermoplastic part cools or thermosets are cured, the mold is opened and the part is ejected. Elastomers also are injection molded in these machines.

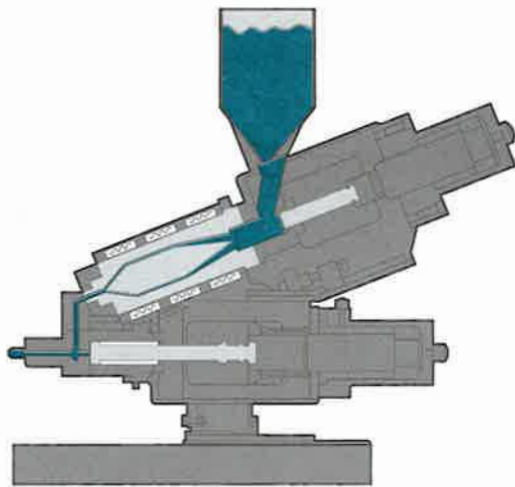


figure 9-23. two-stage plunger machine schematic

figure 9-24. SMAU Dies Company two stage machine

