Real spin on this method revolves around automated equipment

A special technology, rotational molding, also known as rotomolding or rotational casting, is used to produce simple to complex hollow plastic parts in a range of sizes that other technologies might not be able to produce.

Rotomolding has the broadest size capability of any plastics process, ranging from small medical components weighing a few grams to 85,000L (22,500-gal) chemical storage tanks. While economical for short production runs from one to several thousand parts, it can equally be configured for large volume requirements of tens of thousands of parts. In many cases, unusually shaped parts with no seams or weld lines which are virtually impossible to fabricate in one piece by other processes can be produced by rotomolding. This flexibility gives designers and end users access to new opportunities to create innovative plastic moldings.

In Europe rotational molding is, according the latest information from analysts at Applied Market Information (Bristol, England), one of the smaller processes for thermoplastics with just more than 300 companies involved. Today, European rotomolders consume nearly 250,000 tonnes of polymer/yr. The largest concentration of European rotational molders is in the UK (19%), followed by Italy (16%), France (13%), and Germany (11%).

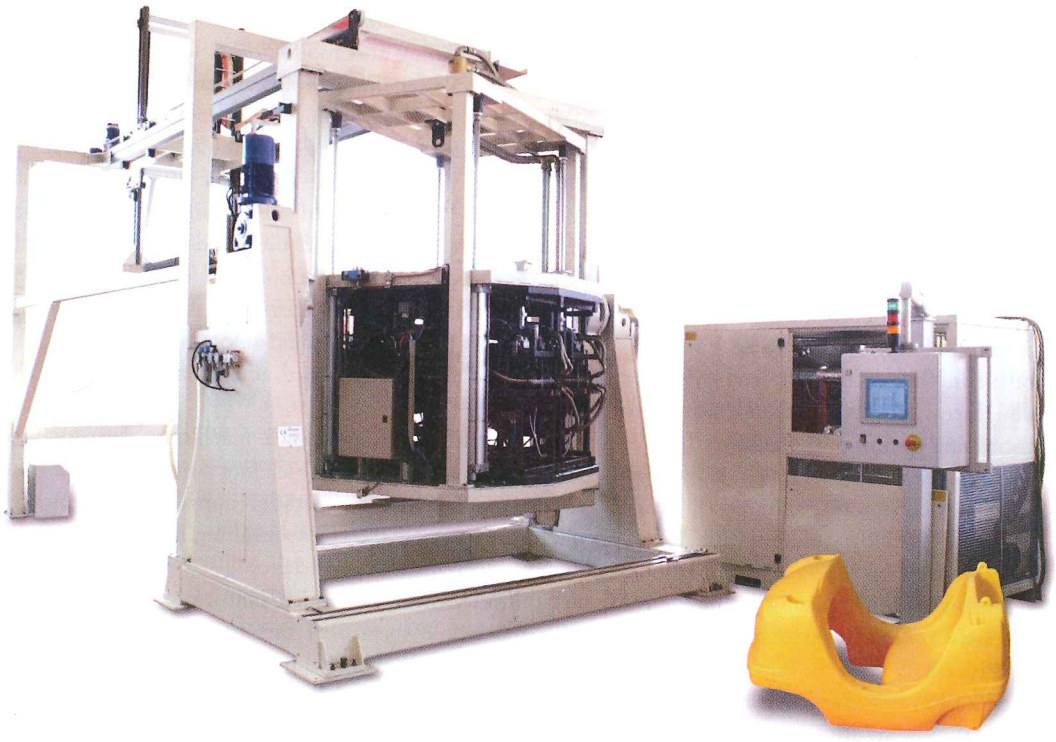
Basic principles

Rotational molding differs from other molding methods in that melting, shaping, and cooling of the plastic all occur after it has been placed in the mold. Polyethylene is the most commonly molded material with around 95% of parts produced globally being made from one of the many grades available.

Molds are relatively low-cost and of thin-walled construction; they are most often produced in sheet metal and either cast or machined aluminum. Machines are also relatively simple, employing forced hot-air heating systems using gas burners and large fans for mold cooling; they can be designed with multiple processing stations to allow each stage of the process to occur simultaneously on multiple arms.

The process depends heavily on operators for mold preparation and unloading and is typically only semi-automatic. It consists of four basic steps:

- Loading: A predetermined amount of resin, either powder or liquid, is deposited in one half of a mold. The mold is then manually closed.
- Heating: The mold is moved into an oven, where it is rotated simultaneously



The Leonardo rotomolding machine is an automatic unit that requires no operator, helps save power, and cuts cycle times.

in two perpendicular axes at relatively low speeds (4-10 rpm), and fans force hot air onto its external surface. Since pressure is typically not used inside the mold, the process of part formation depends on gravity for distribution of the material. High temperature and rotation combine to heat the mold and allow plastic material to build up uniformly in successive layers on the inner surface of the mold to form a part.

- Cooling: After the part has been heated to the correct temperature, the mold is moved into a cooling station to reduce the mold and part temperature to an acceptable level for part removal.
- Unloading: The mold stops rotating and is opened to allow the finished part to be manually removed.

Parts produced retain low levels of molded-in stress, unlike some injection molded parts, and exhibit none of the thinning of external corners associated with blowmolded parts. In fact, external corners that are typically subjected to the highest levels of wear in finished parts tend to be thicker in rotationally molded parts resulting in greater durability. However, tolerances tend to be wider than other processes due to the fact that parts are in contact with the inner surface of the mold only and tend to pull away during the cooling process.

Forced-air heating has many advantages in terms of ease of operation and generally uniform heat transfer. However, deep cores and shielded areas tend to be more difficult to heat and may result in thin areas; molders will often add extra material to compensate thus increasing overall part weight.

Cycle times are relatively slow compared to other processes such as injection molding or blowmolding, but this is compensated by the fact that many different parts can typically be molded at the same time on a single machine.

Process control is improving across the industry but many machines are controlled only by time and temperature during the heating cycle and are subject to variations in ambient temperature during cooling.

Rotomolding advantages

Some advantages of rotational molding include:

- The ability to change colors easily and also to mold multiple colors simultaneously on the same machine
- Adjusting the wall thickness of a part requires only a change in the weight of material added to the mold—no changes to the mold are required
- Thickness can range from 1 mm to 25 mm or more
- Multilayer parts with multiple colors or different materials can be produced
- Graphics and inserts (metallic and non-metallic) can be incorporated into parts during molding

Production alternative

Equipment maker Persico SpA has introduced a new rotational molding approach which results in higher efficiency, improved process control, improved product quality, and reduced labor costs. The Leonardo system is the first fully automatic rotational molding machine that answers the need for more sophistication, technology, and consistent part quality.

It consists of a single molding station with direct heating and cooling of molds using heat transfer fluid. Molds are constructed with integral piping, which allows hot and cold fluid to circulate alternately through the mold as it rotates. No heating ovens or cooling chambers are required, and the mold is not transferred between stations.

Leonardo retains the important basic capabilities of the rotational molding process but has a number of additional advantages:

- No operator is required—the machine is capable of carrying out all the functions of the molding process without human interaction around the clock, resulting in high productivity and consistency
- Controlled heat is applied uniformly over the whole surface of the mold or adjusted in areas that require more or less heat. By improving heat transfer into deep cores, for example, more uniform wall thickness can be achieved in difficult-to-mold parts, which results in lower overall shot-weights.
- Lower molding temperatures can be used so that the risk of material thermal degradation is reduced
- Cycle times can be short because reservoirs of heating and cooling fluid are always available at the required molding and chilling temperatures; heat transfer rates via contact with the fluid are up to 50 times greater than via air.
- Multilayer parts can be produced without interrupting the molding cycle. This allows molders to use thin barrier layers for fuel storage, for example, or to create a stiff or insulated cross-section using an internal foam layer.
- Improved product quality results from reduced dependence on the operator and changes in the factory ambient temperature. Direct temperature control from inside the mold allows the machine to adjust molding parameters to maintain part quality continuously throughout the cycle. This allows proper cure to be achieved (and documented) for every part.
- Venting is automatic, using a patented vent which prevents pressure build-up inside the mold that causes blow-holes at the parting line
- Ancillary equipment such as ejector pins, extraction pins and internal cooling mechanisms can be used more easily as heat is only applied to the mold surface.
- Efficient use of space and energy—Leonardo has a smaller footprint than traditional machines, can produce more parts per mold/24hr, and uses less energy as only the mold and material are heated and cooled, not a large surrounding oven.

This invention is now used by rotomolders in Europe, the U.S., and Australia to manufacture a variety of products including water tanks, fire extinguisher cabinets, fenders, kayaks, toys, pallets, roofs, and other rotationally molded products. Each machine can be designed for flexibility in molding a variety of products with a simple interchange of molds.

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