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- Thermoplastic Injection Molding
- Metal Injection Molding
- Rotational Molding
- Liquid Injection Molding

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PRODUCTION MANUFACTURING SOLUTIONS

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Rotational Molding / RotoMolding

Rotational molding, which is also commonly referred to as "rotomolding" or "rotational casting," is a common means of creating plastic parts that's increasingly gaining traction as an alternative means to plastic injection molding and other plastic producing processes.

A big reason is because parts that are challenging or impossible to create via plastic injection molding, blow molding and thermoforming - such as hollow parts, partially enclosed parts, large and small parts and parts with other complexities - can be crafted via the process.

Rotomolding was actually invented in the 20th century, but didn't gain traction as a production process until the 1960s. Today, it continues to advance as a viable process for plastic part creation. **Rotational molding machines create parts by rotating parts on an axis,** which thereby force the plastic material to stick to the walls of the mold - hence why it's an ideal process for creating hollow parts.

The process uses resin powder, rather than plastic pellets. The resin then heats in the mold as it is being rotated. Unlike other plastic part producing processes, ASH® Industries rotational molding can efficiently and affordably produce both short-run and long-run production runs.

Advantages

Here's a look at some of the advantages of the rotomold process:

Cost effective:

As we hinted at in the opening, rotomolding is a cost-effective production process. Up front costs to create the mold are comparatively lower than other plastic production processes and tooling costs are also affordable. Molds are typically lightweight and no cooling is necessary, either.

Effective for short runs:

Many plastic production processes are best for long run part production. That's not the case with rotational molding. That's because the up front tooling costs and molding costs are cheaper than comparable methods, so you don't need to justify larger up front costs with longer part runs to get your money's worth.

No size limitations:

Unlike other production process, there's a lot of part flexibility when it comes to rotational molding - both large and small parts can be made. Multiple cavity molds can also be used in production runs, which is advantageous. Containers and barrels are a common application of the process. To give you a better idea on the size range, consider that hollow barrels can be made ranging from 5 gallons to 22,000 gallons. That's a big part range.

Hollow part creation:

As we noted in the opening, rotomolding is an ideal process for the creation of hollow materials, such as trash cans, construction barrels, storage tanks and containers, covers, housings, water softening tanks, battery cases and much more. But it can also be used to create parts that aren't hollow or aren't as hollow, such as under the hood automotive parts, surf boards, pool tables, cribs and children toys.

Eco-friendly:

The process is eco-friendly, as only the material that needs to be used is used. There's no wasted material in the process.

Quality finish:

Rotational molding also requires minimal post production part finishing, which also helps separate it from competing plastic production processes.

Limitations for RotoMolding

As we previously mentioned, every part production process has its shares of pros and cons. While we already listed the pros in the above section, rotomolding isn't without its share of disadvantages as well. For instance:

Long manufacturing times:

There's a reason why rotomolding is comparatively cheaper than other production processes. And one of the reasons for this is that part runs generally take much longer to complete than these other such processes. So while using rotational molding is cheaper, you'll likely have to sacrifice time to market speed.

Material limitations:

Not every plastic material can be used to create parts in the rotomolding process. Polyethylene is the most common.

Complexities:

While parts are open to a lot of design freedom via the rotational molding process, the process sometimes struggles with some of the more intricate features, like ribs and undercuts.

Design Considerations

Our ASH® rotational molding offers almost endless potential as far as design capabilities are concerned.

For instance, the process can maintain uniform wall thicknesses better than other plastic parts. It also thrives at producing parts with double wall thicknesses and is ideal for molding thicker corners. Wall thicknesses and part piece weight can also be easily controlled via the process.

The ASH® Industries Process

Polyethylene is the most common plastic that is processed via rotomolding. However, the process has given way to several more materials recently. These include PVC, nylon, polypropylene and plastisols.

One thing to keep in mind, however, as far as materials are concerned is that the process is one of the faster growing part production methods - so it's likely that engineers will incorporate more materials into the process as technology continues to advance.

Why Choose ASH® for Rotational Molding

State-of-the-art-Equipment

- Top of the line equipment

Quick Turn-around Times

- Subtext explaining

Superior Quality

- Subtext explaining

ASH® Roto-XL Molding

- Subtext explaining

Metal Injection Molding (MIM)

MIM works similar to the other injection molding processes - powdered metal is combined with a binding material and then injected into a mold where it's left to form and curate.

The end result is a metal part. The process is ideal for the short and long-run production of metal parts, especially those that are smaller in size and more detailed in terms of properties. Here's a closer look at the MIM process:

Step 1: Mixing and Granulating

The first step in the metal injection molding process is determining the material and feedstock that is going to be used to create the parts. We talk more about materials below but generally this consists of fine powdered metals - a powder that is fine enough to create the features that are necessary. After the metal powder is determined, it's mixed with a thermoplastic binder (often which takes up 40 percent of the total feedstock), heated so that the metal grains bond with the binder and then fed into the injection molding machine.

Step 2: Molding:

The next step is the molding process, where the material is again heated and then injected into the machine for the molding process, which is the point where the part is created.

Step 3: Binder Removal

After the part is ejected, the next step is to remove the binder. That's because the final part is about 20 percent larger than the intended end part. Hence, in order to get it to actual size, the binder needs to be removed.

Step 4: Sintering

The final step in the process involves sintering, where the remaining binder is removed from the part and the metal is fused to create the part, the end result being a net shape or close to net shape final part. Further post-sintering operations may also be necessary to properly create the final part, which can add some further steps and complexities to the process.

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All in all, MIM is comparable to creating products from bar stock metal, both in terms of tensile strength and design capability.

Advantages

Check out the advantages of the ASH MIM process:

Design Complexity:

If you're satisfied with the design freedom you get from plastic injection molding but want to craft metal parts, then MIM could be right for you. That's because the two processes are quite similar in terms of design complexity. With MIM, cross holes, angle holes, splines, undercuts, side holes and grooves are all possible. Additionally, with MIM you can create whole parts that would often have to be created separately and assembled in post production.

Small Size:

Remember, MIM uses very fine powders to create fully dense metal parts. Hence, the process is best for small parts, typically those that weigh between 0.1 and 250 grams.

Production Volume:

MIM can be a very cost effective process, but only if the right number of parts are needed (not to mention if parts are the right size). Typically, the cost benefits are most noticeable and most worth it when part runs are between 10,000 and 20,000. Anything fewer than 10,000 and the potential cost savings from using MIM might not be evident at all.

Properties:

As we've already noted, MIM is able to create fully dense or near fully dense metal parts when the process is complete, if the process is carried out correctly. It's particularly beneficial for parts that are too small or too detailed to machine out of bar stock. For comparison's sake, it's estimated that the part density is 98 percent via MIM, compared to 100 percent via conventional machining processes.

Economical: Unlike machining, MIM doesn't cut away existing metal - it uses only the amount of materials that is necessary to create the product. Nothing is wasted.

Limitations for Metal Injection Molding (MIM)

MIM isn't a process for every part run. Talking with an ASH specialist will help you decide which process is right for you. Here are some of the process limitations you should be aware of:

Post Processing:

For instance, one of the steps in the MIM process is binder removal, as in removing the excess binder that still exists on the metal material after it has been formed in the mold. The final part is roughly 20 percent larger than what it likely is intended, so there's a lot of post-processing work involved. Additionally, that might not be even all the post-processing that's needed. Aside from the sintering process, additional steps may sometimes be required, adding time to the process.

Cost:

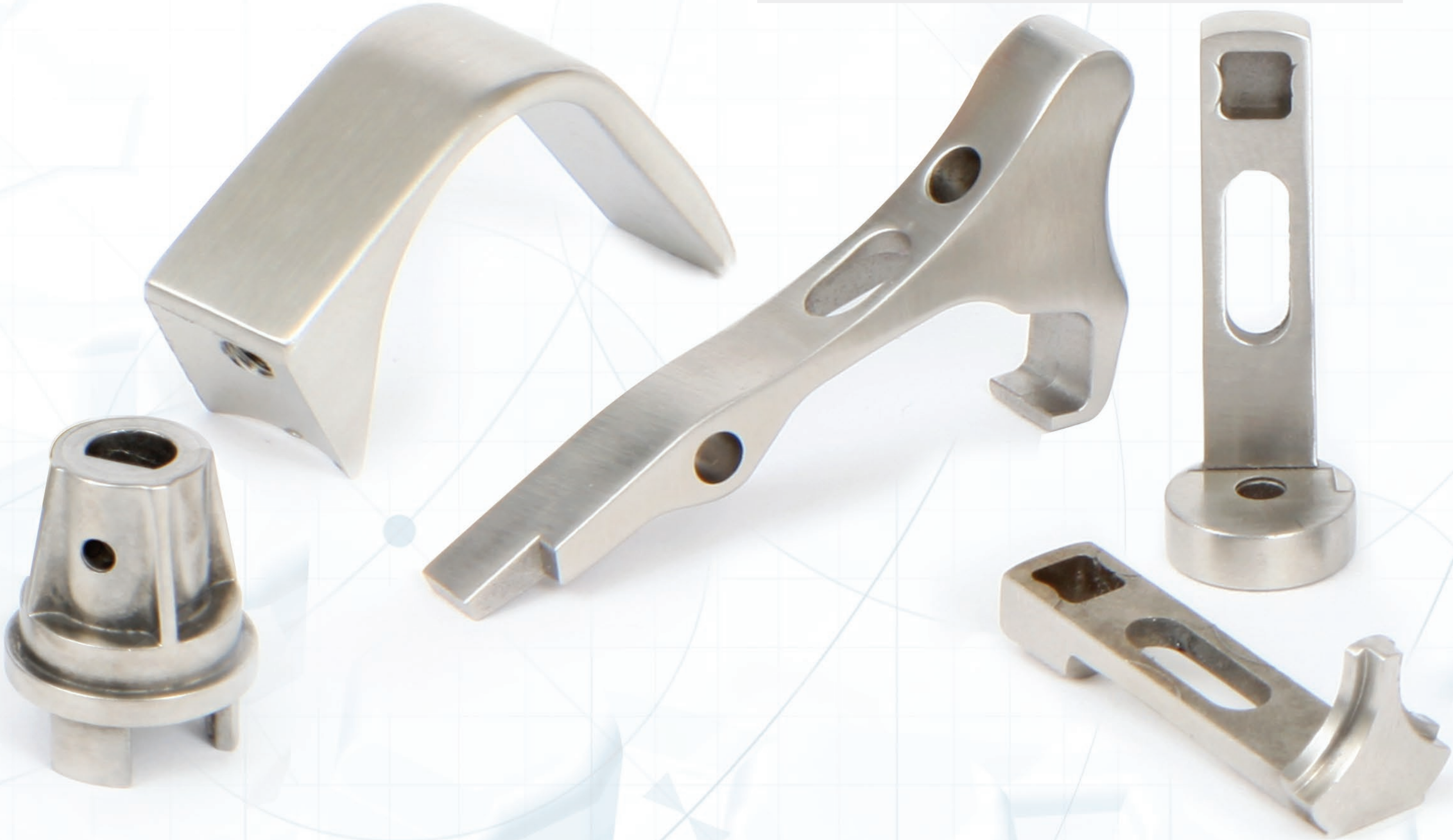
Not only is it necessary to create a mold, which adds to the up front costs of MIM, but any parts that are larger than 100 grams of weight can add further costs to part runs, which might not make it suitable for your product order. In fact, while MIM is ideal for smaller, more intricate pieces, it's the opposite when it comes to larger metal pieces. If your product consists of a bigger product, MIM is probably not right for you.

Design Considerations

We covered some of the design considerations in the "Advantages" section here, but it's worth repeating. To recap, MIM is best utilized with part runs that are between 0.1 and 250 grams in weight - products that are larger are likely not worth the cost savings that you're likely to save using MIM compared to other metal production technologies. Additionally, there are some other design considerations to consider, such as wall thicknesses of at least 0.13 mm and wall thicknesses no larger than 12.7 mm.

Materials

The most common materials to use are iron, low alloy steels and stainless steels. However, there's a range of other alloys that MIM can also use to effectively create parts, such as aluminum, cobalt, copper, carbide, precious metals and nickel metals.



Thermoplastic Injection Molding

Thermoplastic injection molding is a manufacturing process that creates fully functional parts by injecting plastic resin into a pre-made mold.

Thermoplastic injection molding has several sub categories, such as rapid injection molding, which is best utilized in fine tuning prototypes prior to a product being given the go-ahead for production. Another sub category, production injection molding, is best utilized for full product runs.

Developers utilize the thermoplastic injection molding process for many applications, as it can produce anything form car door panels to cell phone cases with **good accuracy and surface finish.** What's more is that it's the industry standard for producing plastic parts, so developers can be certain they're putting out a quality product if they go this route in the development process.

How it Works

- A mold is made based off a CAD file. That's the laborious part of the process as it takes time to create the mold. Such molds are typically made from aluminum or steel.
- After the mold is created, the thermoplastic resin is injected into it and then left to cure and form the part. The material is first fed into a heated barrel before being launched into the mold to cold and cure.
- Following curing, the part is removed from the mold and the process starts over until the part run is completed.

Advantages

Accuracy: Thermoplastic injection molded parts are able to be produced with pin-point accuracy, which is a major advantage over other prototyping processes like 3D printing.

Surface Finish: Thermoplastic injection molding can finished with a variety of general and engineering-grade resins. The process is also able to create parts with pristine surface finishes, which makes the production process viable to create not only prototypes, but small and large production runs.

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Quick Turn-around Times
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Rough or pebble textured surface finishes can also be created.

Speed: Parts that are thermoplastic injection molded are typically turned around within days. If it's used for prototyping, this allows developers to make design changes quickly, thereby enabling it to go to market sooner. And if the process is being used for manufacturing, runs can be completed within days, so they're able to be on store shelves sooner. The longest part of the injection molding process is the time that needs to be spent creating the mold. However, molds can also be created to fine-tune prototypes and then used again for a manufacturing run.

Predictor of manufacturability: We already discussed how thermoplastic injection molding can be utilized for prototyping purposes. And here's why - parts can not only be completed and turned around quickly with days, but the two benefits of the technology mentioned above, accuracy and surface finish quality, make the process a great predictor of manufacturability. Often times, developers will order several early prototyping runs on other technology, then use thermoplastic injection molding to validate product design prior to green-lighting the product for manufacturing. Since parts can be crafted in several different resins, developers will also experiment with surface finishes and materials to see what they want to manufacture in.

Limitations

As we previously noted, every production process has its share of pros and cons. Here's a look at some of the cons of thermoplastic injection molding:

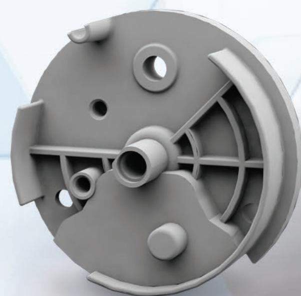
Cost: The biggest downfall of the process is arguably cost. That's because the tooling and time needed to create the mold is expensive, meaning that developers will be paying for these up-front tooling costs.

Speed: Whether speed is a pro or con varies based on what thermoplastic injection molding is being used for. If it's being utilized for early prototypes, speed is a con. Why? Because compared to other prototyping technologies like 3D printing, it's a much slower and more expensive process. 3D printing, conversely, takes hours to create one-off parts, where thermoplastic injection molding can do so in days because there's tooling involved.

Flaws: Like all production technologies, thermoplastic injection molding can produce bum parts. These may be caused by a variety of factors, including defects in the tooling, poor product design, too hot of thermoplastic resin material, injection speeds that are either too fast or too slow, a lack of venting in the tooling, debris on the tool surface and a lack of proper cooling around the tool.

Design Considerations

We've already covered how thermoplastic injection molding can produce parts with very good accuracy, which thereby makes the process an ideal one for both prototyping and manufacturing runs. However, in order to produce the best possible parts, product design has to meet minimum and maximum requirements regarding thickness. Specifically, the thermoplastic injection molding process is able to create parts within 0.2 mm tolerance. Furthermore, the process can produce more advanced parts with tolerances as precise as 5 micrometers regarding diameter and linear features. Surface finish accuracy is typically anywhere from 0.5 to 1 micrometer in accuracy.



Materials

Thermoplastic injection molding can be accomplished with just about any engineering-grade plastic resin. But that's not even including more general resins. Engineering grade resins are typically utilized to create final prototypes before manufacturing, while general resins are used to craft early prototypes or parts of a product that are of lesser importance. When we talk about general resins, we're referring to the likes of ABS, nylon, PET, polypropylene, polyethylene and TPE. Engineering-grade resins consist of lexan, noryl, valox and ultem. As we previously mentioned, the plethora of pastic resins that can be processed via thermoplastic injection molding allows product developers to experiment with different materials and surface finishes for their products.

To recap, thermoplastic injection molding can be implemented for prototyping, short-run and long-run manufacturing due to its speed, quality of finished parts and the variety of general and engineering-grade resins that parts can be produced. But like all production processes, mistakes can happen, potentially delaying your product order. That's why it's important to go with a trustworthy, experienced company for your part production needs.

Liquid Injection Molding (LIM)

Liquid injection molding, or LIM, is a production process commonly used to make rubber parts or to make parts that need to withstand extreme conditions, regardless of the industry.

The process is an injection molding process at heart, meaning that materials are injected into a pre-made mold, where they're then left to sit and curate. Then, the process repeats itself until the part run is complete.

LIM is ideal for creating rubber parts or parts that need to withstand extreme temperatures

While LIM is **best used for short and long run part production**, it can also be utilized in the final stages of the prototyping process as well, as the process permits engineers to experiment with different material configurations to fine tune the product before it is green-lit for production. Plus, since a mold needs to be created for the process to take effect, **product developers can save time and money by using LIM for both final prototyping and production processes.**

How it Works

There are two main types of LIM process - injection molding of silicone rubber, or LSR, and injection molding of fluoro liquid silicone rubber, or F-LSR. The former is the most common method that product developers take in producing rubber parts while the latter type is used to craft more high performance parts in industries ranging from automotive to aerospace.

LIM, however, is a complex process which relies on a lot of different variables for part runs to be successful. For instance, important components of LIM machines include the likes of:

- **Injectors:** These devices pressurize the liquid material.
- **Metering Units:** In order for LIM to be successful, there needs to be a catalyst and a base forming silicone material. Metering units help ensure that these two materials maintain a constant ratio while they're in the process of being released.
- **Supply Drums:** These components, which are also commonly referred to as "plungers," are the mixing containers.
- **Mixers:** These combine the materials before they're injected into the designated mold.
- **Nozzle:** These carry out the injection into the mold.
- **Mold Clamp:** This is what secures the mold during the production process, as well as what opens the mold back up when the process is completed.

Advantages

LIM is ideal for creating rubber parts or parts that need to withstand extreme temperatures. Seals, o-rings, isolators, electronic components and other parts in the aerospace and automotive industries are common applications. Here are some of the advantages of the LIM process if your product run:

Durable: LIM parts are able to hold up to extreme temperatures, which make them **ideal for parts under the hood of cars or near engines on airplanes**. LIM parts are also often fire retardant and won't melt away or warp like those that are created via similar injection molding processes, such as plastic injection molding.

Tensile Strength: To piggyback off of the above advantage, **LIM parts are strong which makes them applicable for a variety of industries.**

Flexibility: Remember, LIM parts are typically rubber. And **one characteristic of rubber is its flexibility.**

Accuracy: Another big advantage is the **high level of accuracy** that LIM parts are produced with.

Automation: LIM is a process that can run around the clock with **minimal supervision**.

Limitations

Like any production process, LIM isn't without its disadvantages as well. For instance, LIM is a process that takes a high level of expertise to carry out, as there are numerous points during the fabrication process where things can go wrong, potentially dramatically impacting the quality of the part run. Perhaps the biggest concern that must be taken into consideration is the potential for leaks during the process. Remember, LIM is a liquid process, so there's always the chance that the mixture could leak at some point in the process if all of the production components aren't carefully inspected and fine tuned prior to a part run. This often occurs when the part material mixture seeps through cracks or gaps during the process. To help combat this, ASH uses high quality sealants and sealers to keep everything in place where it needs to be. **LIM isn't an ideal process for every part application.** For instance, there are greater up front costs for part runs because a mold has to be created. That's why it's best used for short or long run manufacturing and/or to fine tune prototypes prior to manufacturing. The latter is important because engineers are able to experiment with different material configurations, surface finishes and additives to get the part that they want before green-lighting it for production.

Design Considerations

Generally speaking, **design considerations for LIM are about the same as design considerations for plastic injection molding**. However, there are a few points to note:

Liquid silicone rubber, while it doesn't shrink inside the mold like thermoplastic parts do, it can shrink up to 3 percent after its ejected from the mold and is left to finish curing.

Venting: Venting is a crucial part of mold design in the LIM process. That's because it's important to avoid air entrapments, which can lead to flawed parts.

Materials

The **most common material used in the LIM process is liquid silicone rubber.** It's a high-purity platinum core silicone that's able to create the highly durable parts that are utilized in so many industries. For example, liquid silicone rubber is especially cherished in the medical industry, as tools and instruments made from the material are biodegradable, well made and reduce the risk of contamination. Fluoro liquid silicone rubber is another material that is making headway via the LIM process, especially when it comes to automotive parts, smaller parts or parts that require extreme precision.