APPLICATION BRIEF

RTV Molding with FDM Patterns

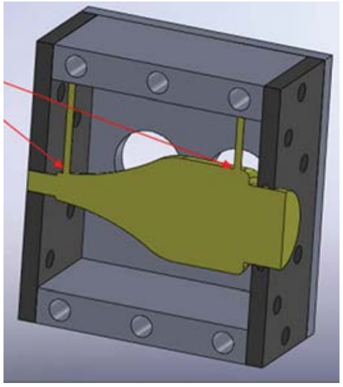
Overview

Room temperature vulcanization (RTV) molding is an affordable solution for prototyping, functional testing, and short-run production applications. RTV molding can be used to produce small quantities and offers lead times of three to seven days at well under the cost of machining or injection molding. RTV molds are made by pouring liquid silicone rubber over a pattern. The resulting firm but flexible mold can reproduce extremely complex geometry and intricate detail with tight tolerances. The molding process uses urethane thermoset materials that are available with a vast array of mechanical, thermal and electrical properties. RTV molds are typically used for quantities of up to 100 parts. Multiple silicone rubber molds are an option for larger quantities.

Application Outline

The traditional approach is to machine patterns for RTV molds. This method is expensive, requires lead times of one to two weeks, and limits the complexity of the geometry of the molded parts. Another problem with machined patterns is that substantial lead times are required even to make design changes.

Fused Deposition Modeling (FDM) provides an alternative method for producing RTV patterns that can provide dramatic time and cost savings. FDM technology is an additive manufacturing process that builds plastic parts layer by layer, using data from computer-aided design (CAD) files. FDM makes it possible to produce a pattern that can also be used as a prototype for customer review with a typical leadtime of only 24 hours. FDM materials have the strength and heat resistance needed to withstand the mold making process. The strength of the pattern makes them easy to extract without damage so that they can be reused to make subsequent molds.



CAD model of FDM pattern

FDM patterns shown with textured and smooth surface

Silicon mold box with alignment pins

BENEFITS OF FDM
• Lead times reduced by 50% to 80%
• Cost reduced by 40% to 75%
• Inert, will not inhibit curing
• Stable, will not distort with heat
• Durable, extractable without breakage
• Dissolve-away internal cores

BEST FITS
• Complex, intricate pattern designs
• Challenging characteristics - Thin walls - Internal cavities
• Multiple (duplicate) RTV molds required
• High cure temperature RTV rubber
• Design changes are likely
• Large, bulky patterns

RTV MOLDING WITH FDM PATTERNS

Producing urethane castings from an RTV mold is a three-step process. The first step is to make the pattern. The second step is to make a rubber mold. Typically the pattern is combined with a parting surface, and silicone rubber is poured over this combination to make one half of the mold. The process is repeated to make the second half of the mold. The third step is casting the urethane part in the mold.

RTV silicone mold for overmolding operation

Finished overmolded harness.

Process Overview

Incorporate any desired modifications in the CAD model prior to creating the STL file for the pattern. The most common changes are shrinkage compensation and removal of features that will be machined after casting. When preparing the file, use optimal orientations for surface finish and "enhanced" mode for building patterns. After the FDM build, remove the support structures and finish the pattern to the desired smoothness. To expedite the finishing process, consider using the Finishing Touch Smoothing Station or solvent dipping if the pattern is made from ABS, ABS*plus*, ABS-M30 or ABSi. ABS*plus* and ABS-M30 are stronger versions of ABS while ABSi is optimized for impact strength. If the pattern is constructed from polycarbonate (PC) or PC-ABS, consider solvent dipping. Next, use a combination of sanding, filling and priming to smooth the pattern surface.

Internal geometries that would normally lock a part in the rubber mold can be produced using FDM by creating a soluble core for the insert that defines the cavity in the urethane casting. To create the soluble core, use CAD software to create a negative of the internal geometry that is required in the final part and add features to locate and support the core. Soluble cores are created using custom groups in Insight build preparation software that reverse the build and support material, using a soluble material for the core. The soluble core is placed in the mold cavity prior to molding. After the part is removed from the mold, it can simply be placed in a tank containing WaterWorks solution and the internal soluble core will be dissolved away - leaving the desired cavity or other internal geometry. See the RTV MOLDING WITH SOLUBLE CORES application guide for more information.

Customer Story

Coho Design specializes in rapid prototyping services and also provides solid modeling, product development and consulting services. Recently, a military subcontractor was asked by a customer to completely encapsulate an electrical connector for underwater use. The project needed to be completed in less than a week. The original equipment manufacturer (OEM) that supplied the connector said the best they could do was to deliver 10 parts in 14 days at a cost of $1,011 or $101.10 per part.

After winning the contract to encapsulate the parts, Ed Huber, President of Coho Design, started by modifying the customer's computer- aided design (CAD) file to account for the shrinkage of the RTV mold. Then he produced the pattern in the shape of the finished connector with its overmolding. He built a mold box, add the FDM , added gate and vent rods, and then poured the RTV rubber. After the mold had cured, he placed a connecter in the mold cavity and then poured urethane potting compound into the mold to seal the part. After a couple of hours, the electrical connector was removed from the mold, flashing was trimmed, and the part was ready for testing. Everything looked good so the customer gave Coho Designs the go-ahead to make the rest of the parts.

"Using an FDM pattern substantially reduced the time and cost required to overmold the electrical connectors," Huber said. "We met the customer's delivery time requirements by producing finished parts in only three days. We charged the customer only $500 for 10 parts or $50 per part, less than half the price that was quoted by the OEM. If there had been design changes, the use of an FDM pattern would have allowed us to react by quickly changing the geometry of the overmolded part."

How Did FDM Compare to Traditional Methods for Coho Design?

METHOD	COST	PRODUCTION TIME
Machined Pattern	$1,011	14 days
FDM Pattern	$500	3 days
Savings	$511 (51%)	11 Days (79%)

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