Injection Molding with Somos ProtoComposite™ SL Resins

(continued from front cover)

process), plus very low shrinkage, moisture absorption and coefficient of thermal expansion (for high accuracy).

"What intrigued me was the promise of a new, resilient SL material, combined with the reliable machine accuracy now available with the 3D Systems Viper—two critical components missing from prior rapid tooling art," says Williams.

Paramount agreed to begin experimenting with Somos composite materials for rapid tooling applications and recently presented results of three case studies in a paper titled, "Injection Molding with Composite Stereolithography Resins." One of those case studies is presented here.

Case Study
Paramount had been working with a product development team at a division of Ingersoll Rand (IR) for nearly a year developing a new line of high-speed, hand-held air grinders. The new product line was being engineered to transition from machined metal components to lower-cost injection molded thermoplastics. The predominant resin used was a Nylon-6, with 33% glass filler—a material typical for robust and abusive industrial environments.

When production tooling was near completion and first articles began arriving from IR's China supplier, a problem was discovered. The main body housing is cylindrical with compound surface geometry on the exterior surfaces—but the surface geometry was interpreted incorrectly based on the 3D CAD data sent to their supplier. This error translated to the inside of the body housing.

The IR engineering team considered their options. They could request the vendor to correct the body housing, but this decision would put them 4-5 weeks behind schedule. Testing the part using RP materials, or cast urethane, was not an option. Nothing but Capron would work, as motor speeds of 30,000 rpm and accelerated air velocities could create temperatures challenging for most thermoplastics.

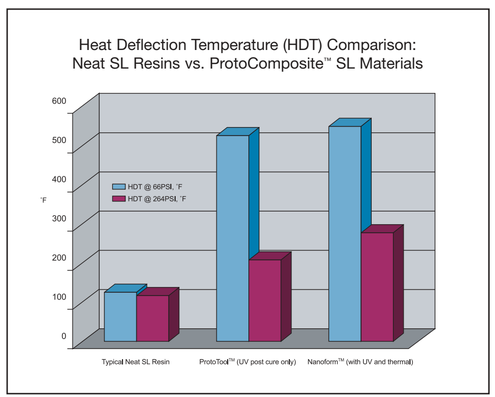
The team discovered they might be able to modify an internal part called a "cage" to compensate for the error, but the theory needed to be tested. They needed at least two parts molded in Capron to verify their design concept. If it worked, they would have their China vendor change the Cage tool. Choosing this option would allow them to begin assembly 2-3 weeks sooner.

Somos ProtoTool 20L™ was used to create a mold designed with a tunnel gate. A machined metal insert was added to counter the abrasiveness of the glass filler, which would have quickly deteriorated the SL resin in this high pressure, high flow area.

Paramount was able to deliver the SL molded parts within two weeks from first receiving 3D data. The parts measured well within nominal manufacturing tolerance for injection molding (+/- .005 In/in) and the customer was able to use them successfully for their engineering pilot performance evaluation.

When queried about the usefulness of the parts, the customer described them as "quite functional" and relayed that they were being used in an engineering pilot build along with other production molded components.

Below: The standardized HDT test provides a comparative measure of resistance to flexural deformation under specific test conditions. Composite materials such as ProtoTool™ 20L and Nanoform™ 15120 exhibit heat deflection temperatures ranging from 100% to 500% higher than those of neat SL resins, depending on the standardized load condition—low vs high.



Rapid Tooling: We Want to Hear From You!

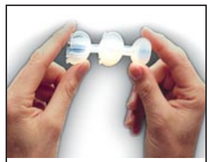
Last month, a rapid tooling survey was conducted at the SLA User's Group meeting in Tucson, AZ to gain more understanding of the key issues facing the market today. Questions centered around preferred tooling methods, desired turnaround times and specifics about mold requirements.

To entice attendees into taking the survey, we held a drawing for a 4GB iPod® mini, valued at $199.00. Twenty-eight responses were received and Les Nielson of Moeller Design was the lucky drawing winner.

This month, DSM Somos is repeating the rapid tooling survey (and the iPod drawing) and we want to hear from you! The survey is currently downloadable from www.dsmsomos.com and will also be available at Somos' booth (#442) at the SME show, May 9-12, in Dearborn, MI. Respond by May 23 and you'll be entered to win an Apple 4GB iPod® mini music player. The winner of the drawing will be contacted by phone or email on May 24.

Look for results of our rapid tooling survey to be published in the next issue of "The Part We Play."

PRSRT STD
U.S. POSTAGE
PERMIT NO.82
PAID
ST. CHARLES, IL



Kim Axiotis
Editor

The Part We Play is published by DSM Somos as an information resource for the rapid prototyping industry. Reader inquiries and suggestions for content are welcomed and should be directed to:

DSM Somos®
Two Penn's Way, Suite 401
New Castle, DE 19720 USA

Phone: 302/326-8100
Fax: 302/326-8121

Website:
www.dsmsomos.com

DSM Somos
Published by DSM Somos for the Solid Imaging Industry
The Part We Play
Quarter 2, 2005

DSM Somos® ProtoComposites™ and Rapid Tooling

Stereolithography for rapid tooling is getting a second look as evidenced by several new commercial applications. While neat SL resins of the past couldn't offer the mold life necessary for the effort, the commercial successes of new Somos ProtoComposite™ materials such as ProtoTool 20L™ and Nanoform™ are demonstrating new potential for time and cost savings.

As Somos commits itself to developing the SL rapid tooling market, we recognize the tide of skepticism that must be challenged. We also realize that success will depend not only on the introduction of technologically advanced resins but also on the creation of a network of "experts" experienced in the design and handling of composite tools.

In this issue of "The Part We Play," we'd like to introduce you to a few such emerging experts who are successfully using Somos resins for rapid tooling applications. We invite you to learn from them and explore what these materials might do for you.

Finally, if you'd like to learn more about Somos' rapid tooling activities, please contact us.

–Jim Reitz
Business Director, DSM Somos

Injection Molding with Somos ProtoComposite™ SL Resins

When DSM Somos approached Paramount Industries, a full-service design house in Langhorne, PA, with a vision for using ProtoTool 20L™ to make injection molds, the irony was that Paramount's RT experience included everything *but* SL resins.

"Today, High Speed (HS) CNC machining is our rapid tooling standard," says Paramount President & CEO Jim Williams. "During the last 30 years, we've developed products using cast epoxy composites, cast aluminum, cast S7, spray-metal, cast beryllium, KelTool, SLS RapidSteel™ and machined tools."

But the thing that caught Paramount's attention was the exceptionally high heat deflection temperature of the composite ProtoTool 20L material as compared to neat SL resins. "A major reason for the previous failures of unreinforced SL resins in injection molding has been their inability to withstand elevated temperatures. ProtoTool's low pressure HDT is almost 500ºF—a temperature that exceeds the processing temperatures of many commonly molded engineering thermoplastics."

In addition to its ability to withstand high temperatures, ProtoTool's high ceramic content also offered increased hardness (providing abrasion resistance and durability during the molding

(continued on inside)

INSIDE

DSM Somos® ProtoComposites™ and Rapid Tooling

Secrets to Success with SL Rapid Tooling from Eagle Design & Technology

Eagle Design & Technology Inc. of Zeeland, MI provides design work, rapid prototyping and rapid tooling for a variety of industries. For five years, the company has successfully used standard SL resins such as Somos 7100 and 9100 for rapid tooling. Eagle Design President Bruce Okkema recently shared with us the secrets of their success in this area where many have tried but failed….

Q: What criteria do you take into account when deciding which rapid tooling method to recommend to your customers?

A: First, we look at the desired turn-around time. SL tools typically take 2-3 days to complete, whereas aluminum (Al) tools can take 2-5 just to get the Al stock. Also, if the customer is looking for less than 100 pieces, SL tooling can be the tool of choice.

Q: What kind of thermoplastics have you been able to run?

A: We tend to stick with polypropylene, ABS, polystyrene and thermoplastic elastomers. All of these work well with SL. We usually stay away from polycarbonate and Nylon due to their higher processing temperatures.

Q: To what mold size do you typically limit your work with neat SL tooling?

A: We limit to designs up to 5"x8".

Q: How accurate are SL molds and the subsequent injection molded parts as compared to Aluminum molds?

A: Where CNC machining can produce 0.002"/in tolerances, SL is closer to 0.005"/in—however in many cases the tolerances are much better than 0.005"/in for SL. In general, with neat SL resins there is more thermal expansion than Al, resulting in slightly higher variability. But parts coming off both SL and Al inserts are within the specs required for injection molded parts.

Q: How would you compare the time needed for post-processing between the two types of molds and is there a cost savings with SL?

A: Both SL and Al molds require similar amounts of prep time for the injection molding press. However, for the type of parts we select SL tooling for, SL is 20-30% less expensive overall to build than CNC machined Al.

Q: What industries have been most prone to requiring the fast turnaround of SL tooling?

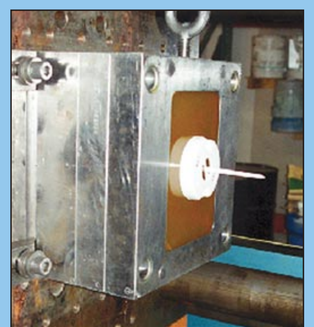
A: The automotive industry seems to require the fastest turnaround time, with items such as buttons, knobs, seals, gaskets being perfect candidates for SL tooling.

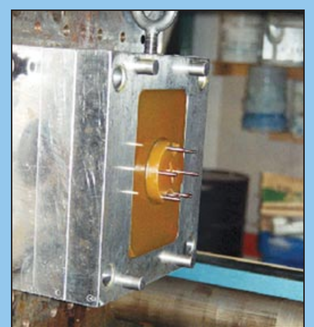
Q: What other molding processes has SL tooling been used for?

A: We've had success making both thermoform and vacuumform tools out of SL.

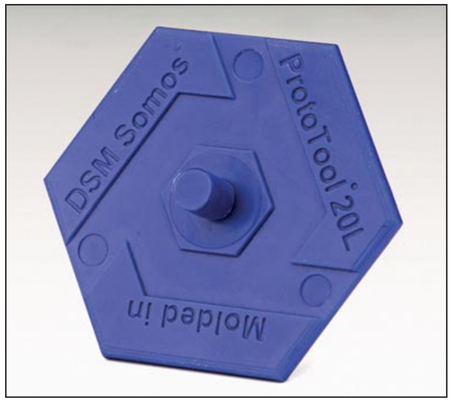
Q: What interests you about Somos ProtoTool 20L™ and Nanoform™ composite resins and what benefits do you expect to see from them over neat SL resins?

A: These filled resins should provide a more accurate mold that has less dimensional shifting after thermal treatment than neat SL resins. Also, the higher heat deflection temperature should expand the market to people who need more than 100 parts. The molds should be more robust, thus reducing the risk that the SL mold will crack or deteriorate before the complete order has been fulfilled.





Left: Ejector with part and sprue
Right: Ejector advanced



Somos Kicks Off SL Rapid Tooling Round Table...

Based on recent survey results, today's rapid tooling market has an estimated value of approximately $1B. This includes money spent on CNC machined aluminum, RTV silicone and epoxy casting. As OEM's are continually pressed for faster new product introductions while at the same time trying to cut costs, stereolithography coupled with ProtoComposite™ materials offers a promising solution. The drivers for SL tooling are, of course, time and money, without compromising accuracy or reliability.

Building reliable SL molds and effectively processing them in an injection mold press, however, requires multiple skills for success. While both ProtoTool 20L™ and Nanoform™ 15120 have shown time/cost savings in commercial and non-commercial applications, there is still much to be learned about where this technology can best fit in the rapid tooling arena.

For this reason, DSM Somos is kicking off a 6-month rapid tooling development initiative using a round table concept to expedite the learning process. The idea is simple: a respectable number of SL users are already using SL tooling, but the full potential of this technology has not been explored. We'd like to connect OEMs with rapid toolers, SL service bureaus and universities to address and define issues. From these experiences, we can improve the market's understanding of design factors for ProtoComposite tooling, reliability of molds, accuracy of parts and gain more accurate time/cost savings.

If you're interested in rapid tooling technology and would like to be part of our round table initiative, contact Eva Montgomery, Market Development Manager-Rapid Tooling at 847-468-7741 (eva.montgomery@dsm.com).

Saving Time & Money with ProtoComposite™ Hand-loaded Inserts in Aluminum Tools

Mark Tobler at General Pattern (GP) in Blaine, Minnesota has been using SL resins to direct build hand-loaded inserts for approximately 4 years. The company began with neat SL resins then moved on to Somos ProtoComposite resins because of their high heat deflection temperatures and stiffness. "Neither ProtoTool nor Nanoform broke when they became hot and they last longer than traditional SL inserts," says Tobler.

Hand-loaded inserts are removed from the mold together with the part and replaced before the next injection. The main factors GP takes into consideration when deciding whether to machine an insert or have it directly built out of a ProtoComposite material are timing and geometry.

Many times they will build the inserts via SL while the real inserts are being machined. In this way, the SL inserts are used as bridge tooling so they can get a jump-start on the injection molding process. GP is typically able to produce at least fifty injection molded parts before the aluminum inserts are ready. Depending on how many parts are ultimately needed, they may decide to forego the machining step altogether.

GP has found success in using both ProtoTool™ and Nanoform™ resins for parts with larger design features and where protrusions have no larger than a 2:1 aspect ratio. Total insert size tends to be small—on the order of approximately 1" x 1".

The inserts are hand-loaded and therefore do not require a special fitting to the Aluminum mold itself. They do, however, build the insert slightly oversized at the bottom so it can be sanded for a better fit. Stairstepping lines are also sanded to reduce the possibility of sticking.

To speed up the injection molding process, GP builds at least two inserts at the same time. When one insert is pulled out with the IM piece, another one is immediately placed into the mold.

Since build sizes are small, multiple inserts can be built at the same time via SLA, thus improving time-savings versus machining even further. For example, with a 1" x 1" size, 10-20 ProtoComposite inserts can be built within a day on one platen. In aluminum, the same inserts may each require 3-4 hours of machine time.

To date, Tobler has not experienced any problems with differences in thermal expansion coefficients between Nanoform inserts and the aluminum mold. Suitable thermoplastics have included polypropylene and ABS—however, GP has found that filled injection molding materials can shorten the inserts' life by 50%.

Having successfully incorporated Somos ProtoComposite resins into their rapid tooling process, GP is now currently investigating their applicability for building cores and cavities.

General Pattern builds Nanoform™ hand-loaded inserts for various industries including automotive, consumer products and medical.