

DSM Somos[®]

The Part We Play

November, 2006

Driving the Market Forward: Multiple Routes to Innovative Performance

This year, Somos continues to drive the stereolithography market forward with the commercialization of four new products designed to expand the capabilities of the RP industry: ProtoGen O-XT™ 18120, ProtoGen O-XT™ White 18420, ProtoCast™ AF 19120 and NanoTool™.

The first three of these products, all based on the Somos Oxetane Advantage™, expand the range of material offerings for low water-absorbing SL resins designed to perform like ABS—the most widely used engineered plastic in the world...

(see inside)



Staying Ahead of the Competition with ProtoTool™ 20L

INSIDE

Driving the Market Forward with New Somos Materials

Finding Success with Rapid Tooling



Unlimited. **DSM**

Driving the Market Forward: Multiple



ProtoGen O-XT™ 18120 & 18420

ProtoCast™

High Accuracy

ProtoGen O-XT translucent (18120) and white (18420) materials deliver extremely high accuracy during builds due to very low differential shrink. The linear shrinkage for typical unfilled resins ranges in the order of 0.002"-0.0035". ProtoGen resins, however, exhibit linear shrinkage of less than 0.001"—a value typically only seen in highly-filled composite resins.

ProtoGen materials provide considerable processing latitude on both large frame machines and in applications such as master patterns and fit-and-function models. In addition, ProtoGen parts can be drilled and tapped without breakage, making further improvements in accuracy and design flexibility possible during post-machining.

Excellent Sidewall Quality

Because ProtoGen materials produce excellent sidewall quality, less secondary finishing is required to remove layer lines—an extremely valuable cost-savings benefit. In addition, ProtoGen parts are very easy to sand, making them the material of choice for parts finishers.

High Heat Deflection

Finally, with a heat deflection temperature of 68-74°C* (standard ABS-like resin values: 45-55°C) ProtoGen materials deliver a reduced risk of part warpage in high heat environments, including storage or shipping. This makes them particularly suitable for producing master patterns for silicone molding—where their ability to retain a high degree of stiffness in thin sections, or above room temperature, creates more accurately finished cast urethane parts.

* at 0.46 MPa, with UV post-cure

"The ProtoGen materials exhibit the lowest differential shrink of any unfilled SL resin we've seen to date... Another winner from DSM."

— Phillip Conner, RP Operations Manager, Accelerated Technologies, Inc.

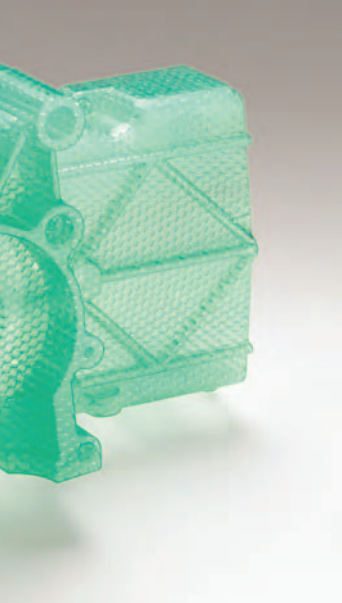
Antimony Free

ProtoCast AF is another exciting Oxetane Advantage material born out of Somos' effort to help select industries improve their processes via optimized SL resins.

While WaterShed 11120 has long been an SL material of choice for investment casting applications, Somos research recently revealed that the ash from burnout of typical SL investment cast patterns—which can negatively affect metal castings by leaving pit marks—is largely due to antimony oxide formation which comes from the photoinitiator used in almost all epoxy and hybrid SL resins on the market today.

As a solution, the fully antimony-free ProtoCast AF was formulated. As an oxetane resin, ProtoCast exhibits low water absorption for high dimensional stability and high green strength for reduced warpage during the resin draining process. But it is the absence of antimony that gives ProtoCast its most significant advantage for investment casting.

Routes to Innovative Performance



AF 19120



NanoTool™

Studies with Express Pattern and foundries have shown the residual ash of ProtoCast AF to be <0.01% at 1500°F, versus <0.3% for WaterShed at the same temperature. Initial casting trials were conducted by Express Pattern in conjunction with Somos and reported at this year's ICI conference in Milwaukee, WI (see back page). Markets that will benefit most from this material are those requiring large investment cast patterns such as aerospace, automotive, Formula 1 and other motor sports industries.

It's the absence of antimony that gives ProtoCast its most significant advantage for investment casting. Studies with Express Pattern and foundries have shown the material's residual ash to be less than 0.01%

ProtoComposite™ Performance

Heavily filled with non-crystalline nanoparticles, NanoTool is a composite resin with a flexural modulus of 10,500 MPa, a heat deflection temperature of 260°C (after thermal post-cure) and linear shrinkage of less than 0.001”.

Excellent Sidewall Quality

NanoTool's high modulus and superior sidewall quality make it extremely attractive for applications that require smooth, highly finished parts—such as in wind tunnel testing for Formula 1, rapid tooling for injection molding, and metal plating for prototyping metal cast parts.

Easy Cleaning

Unlike other composite resins which require more extensive time and care to remove residue, NanoTool parts are extremely easy to clean and finish.

Metal Plating

NanoTool's properties also make it an excellent resin for metal plating—a growing application which saves time and money as an alternative to fully metal prototypes.

"The issue of part cleanliness becomes extremely important when plating composite resins, because the RP parts will not metallize completely if residue is present," says Sean Wise, President of RePliiForm, Inc.

DSM Somos, in conjunction with RePliiForm, is currently studying the metal plated strength improvements achievable with NanoTool. To date, flexural modulus values of **>55 GPa** have been reached based on a metal-to-resin volume ratio of ~1:4! The technology, coined "MC²", is sure to make life easier for prototyping metal parts. Look for more on MC² in upcoming newsletters.

"NanoTool delivers superior sidewall quality, excellent detail resolution, and is very easy to grind. Overall handling is very similar to a non-filled resin."

— Ralf Deuke, Director, Alphaform AG

Somos ProtoComposites™:

Helping Barco Stay Ahead of the Competition in a Fast-Moving Market

Belgium-based Barco N.V., a world leader in the development of display and visualization solutions, stays ahead of its competition by consistently leading the way in new product development.

Whether it's high-tech cockpit displays for the Airbus A380, or the latest generation of digital cinematic systems and screens (Barco is one of only three Hollywood-approved providers), the company's winning development strategy includes innovative, high-performance prototyping materials for its design projects.

Before introducing the revolutionary and award winning iCon H600—the first of a new family of high-definition 16:9 network centric projectors—Barco commissioned prototype optical frames made from Somos ProtoTool™ 20L to optimize the fit between the electronics and hardware, as well as evaluate the design and software.

"I'm always on the lookout for new materials, both for production as well as for research and development," says Barco Technology Manager Bart Van den Bossche. "From the outset, ProtoTool struck me as particularly interesting. It combined a high-degree of accuracy with a modulus of around 10,000 MPa and a working temperature resistance of up to 270°C—which would be necessary for the area around the lamps. In terms of rapid prototyping technology, this is about as close as we can get to imitating the polymers and alloys (such as magnesium and aluminium) that Barco uses in production."

While the stiffness of ProtoTool proved invaluable in enabling Barco to evaluate the optical components of the iCon H600, Van den Bossche says he was most impressed by the material's stability over time.

Access to advanced Somos stereolithography materials such as ProtoTool™ 20L helped display and visualization solutions-provider Barco (www.barco.com) cut the time and cost of bringing new concepts to life. A ProtoTool prototype of the revolutionary Barco iCon H600-projector was used for testing 8 hours a day, for 200 days, during the evaluation phase of its development.



"In order to evaluate and optimize the software, we ran the ProtoTool prototype iCon H600 for 200 days, 8 hours a day," he says. "Even at this level, the geometry of the housing remained constant, allowing us to continue using the same prototype for ongoing fit and function tests."

Access to Somos advanced stereolithography (SL) materials such as ProtoTool 20L continues to help Barco cut the time and cost of bringing new concepts to life. In the case of the iCon H600, the company would have had to otherwise rely on investment casting for their prototype—adding 3 to 4 weeks to the process.

Using ProtoTool helped Barco stay one step ahead of their growing competition, including major global players such as Sanyo, Sony, Panasonic and Sharp. "When Barco introduced its first LCD projector from the 5000 series in 1992, we had a total of three competitors," says Van den Bossche. "Today, there are approximately three hundred. Designing with the most advanced prototyping materials available continues to be a key strategy for our success."

Barco's iCon H600 network centric visualization system won the SCN Best Video Projection Product Award at InfoComm 2005. More about Barco can be found at www.barco.com.

Rapid Tooling with composite SL resins is gaining momentum. Since Somos published several stories on it last year, more OEMs and service bureaus throughout the world have begun using the technology.

The ability to apply stereolithography technology to rapid tooling applications is due largely to the development of composite SL materials—highly filled resins that produce parts with extremely high stiffness, excellent accuracy (linear shrinkage <math><0.001\text{''}</math>) and the ability to withstand very high temperatures (>250°C). With the help of these advanced materials, distinct advantages of composite SL tooling are beginning to surface.

One frequently cited advantage is the use of composite SL tooling in conjunction with machining to increase productivity at conventional moldmaking shops. Here, hand-loaded inserts can be built via stereolithography while the shop is otherwise concentrating on machining the core and cavity.

Another advantage is cost reduction. Machining small, detailed molds can be both expensive and time consuming. “For example, to machine the mold used to produce the bottle cap pictured here (see Figure 1) would take a typical machine shop 1-2 weeks and cost approximately \$3,000,” says one source extensively using Somos composite resins for tooling.

“By contrast, three different versions of this mold could be grown at the same time on 3D Systems’ Viper™ SLA®, with the molds ready in less than 3 days, at a fraction of the cost. And that includes the finishing required to fit the inserts into the MUD frame and for the silicone oil treatment.”

As a result of these and other advantages, rapid tooling via stereolithography is becoming increasingly popular. Though size and feature limitations do exist, SL tooling is already proving increasingly valuable for industries such as consumer products, medical, electronics and automotive, where tool sizes of less than 4" x 4" are common.

Finding Success with Rapid Tooling



Figure 1 (above): Polypropylene Injection molded bottle cap. Mold made from NanoTool™.

Figure 2 (left): ABS trim plate molded from Somos NanoTool™. Part courtesy of University of Kentucky Center for Manufacturing

NanoTool™ Fuels More Success...

This year, the Somos ProtoComposite™ lineup—which includes ProtoTool™ 20L and NanoForm™ 15120—was strengthened by the much anticipated addition of NanoTool™.

“NanoTool offers the processing ease of NanoForm with the stiffness and abrasion resistance of ProtoTool,” says Somos Marketing Manager Eva Montgomery. “But it’s the exceptional sidewall quality of NanoTool parts that sets this material apart from any resin developed to date—and makes it particularly suitable for rapid tooling.”

When comparing plastic parts produced from composite tooling, NanoTool part quality outperforms that of all other composite SL resins to date. “The sidewall quality of NanoTool is so good that the mold shop doesn’t have to sand the layer lines as much as they would with the other two composite resins,” says Montgomery. The resulting plastic part has a smoother surface which looks more like a part made from a metal mold.”

Another advantage of NanoTool is the minimal finishing time it requires.

In some cases, SL moldmakers have had to adjust the parting line surface, but in most cases the molds were nearly ready to use right out of the stereolithography machine.

In general, people who have experience with other filled SL resins and then tried NanoTool confirm that the NanoTool molds require less time and labor to finish. In many cases, the molds were just water honed—making NanoTool even more attractive for tooling.

To learn more about NanoTool for rapid tooling applications, contact your DSM Somos account representative. Or, contact one of the following service bureaus currently running NanoTool for parts:

University of Kentucky,
Center for Manufacturing
www.mfg.uky.edu

Paramount Industries
www.paramountind.com

Fineline Prototyping
www.finelineprototyping.com

Somos Teams with Express Pattern to Report on ProtoCast™ AF 19120

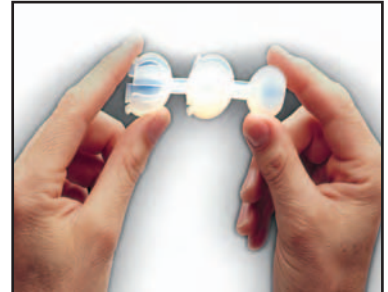
DSM's revolutionary new ProtoCast™ AF 19120 is the world's first completely antimony-free SL resin. Developed specifically for investment casting applications, ProtoCast AF produces significantly less ash than typical SL resins—reducing the risk of antimony contamination and thus paving the way for investment casting of a broader range of metals, including titanium and some superalloys.

In their recent paper delivered at the Investment Casting Institute (ICI) Conference in Milwaukee Wisconsin, Somos Technical Service Manager Brian Bauman and Express Pattern Partner Tom Mueller reported on laboratory and foundry test results of both WaterShed 11120 and ProtoCast AF in areas critical to investment casting performance. Most notably, the paper reported results of testing to identify critical burnout process parameters. The following conclusions were drawn from the initial results:

ProtoCast AF is a significant advancement in SL Resins for investment casting:

- **Antimony Free**
 - No risk of detrimental effects on metal properties
 - No environmental issues
 - No Antimony Oxide formation
- **Lower Residual Ash Content**
 - Over 50x lower ash at 1500°F burnout
 - 40% ash reduction at 1800°F burnout
- **Improved Accuracy from Lower Shrink**
- **Higher HDT for Dimensional Stability**
- **Lower Viscosity for Reduced Mass Patterns**
- **Ability to Build Thinner Hollow Walls**

To get a copy of Brian and Tom's paper, or for more information about ProtoCast AF, please email us at: aaron.boruch@dsm.com or visit www.dsmsomos.com.



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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:

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