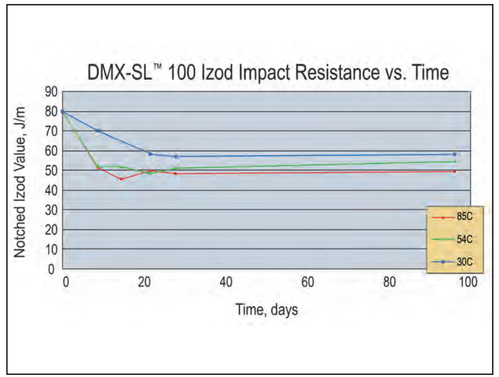
Long Term Stability:

*Tackling the **next hurdle** in direct manufacturing*

As the use of rapid prototyping parts moves from short-term (weeks) to longer-term use (months or years), it's becoming increasingly important for engineers to have confidence in the long-term stability of the plastics that will be used.

Currently, most RP resin manufacturers report initial test data for their products, but information on longer-term performance has not been a key SL resin criterion. With the introduction of DMX-SL™ 100, DSM Somos has addressed this need by thoroughly testing the long-term stability of the resin in such important areas as impact resistance over time, changes in modulus and elongation, and humidity effects.



Longer-Term Notched Impact Resistance Testing

One of the most important features of DMX-SL 100 is its high impact resistance, allowing parts made from this material to withstand breakage. But how does it behave longer term?

To answer the question, Somos tested DMX-SL 100 via the notched Izod impact resistance test (ASTM method D256) over 3 months. Test bars were conditioned at three different temperatures: 30°C, 54°C and 85°C for accelerated aging studies (see graph 1). Each data point represents 5 test specimens tested at room temperature.

The results showed that, while the impact resistance of DMX-SL 100 decreased over time, it leveled off after approximately three weeks. In addition, the impact resistance began at 0.8 J/cm and, after three months, ranged from 0.49 J/cm for the 85°C test condition to 0.60 J/cm for 30°C.

"This is significant because it shows that although the impact resistance decreases, the values do not differ greatly with different temperature conditions," says Somos Product Development Manager Brian Bauman.

DMX-SL HIGH IMPACT

Longer-term performance has not been a key SL resin criterion for most RP resin manufacturers to date. With the introduction of DMX-SL™ 100, Somos has addressed this need by thoroughly testing its long-term stability in such important areas as impact resistance over time, changes in modulus and elongation, and humidity effects.

"In addition, the ending value is still greater than the initial impact strength of traditional ABS-like SL resins, which typically range from 0.2-0.3 J/cm."

Impact resistance over time is just one test that DSM Somos has used to determine how suitable DMX-SL is for direct manufacturing applications. As previously mentioned, other aging data on such important properties as elongation, modulus and humidity resistance has also been collected. To view, log on to www.dsmsomos.com.

As rapid prototyping transitions to direct manufacturing, design engineers will certainly require additional test requirements in the months and years to come. If there is a particular test method you would like to see Somos use in testing SL resins' suitability for end-use applications, we'd like to here about it. Contact your Somos Account Representative, or Product Development Manager Brian Bauman at brian.bauman@dsm.com.

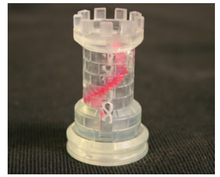
"Functional Works of Art" Win at 3DSUG Competition

Our Q1 2007 issue of "The Part We Play," reported that hydroprinting, when paired with Somos resins, can transform RP models into "functional works of art." In March, we earned the medal to back up that claim!

At the recent 3DSUG Meeting in Daytona, Florida, the Executive Board kicked-off their "1st Annual Technical Competition," recognizing outstanding conceptual and finishing work in SL, SLS, and 3D printed parts. An impartial panel of senior industry professionals judged and scored each entry.

Winner of the "Finishing Competition" division was Shawn Zindroski of Morpheous Prototypes LLC, with their "functional work of art"—a faucet assembly made from Somos Proto-Gen™ O-XT 18120 with a hydro-printed stone backsplash and nickel-plated neck & handle.

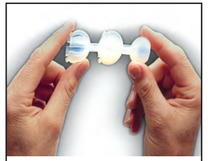
In addition, Francisco Medina of the University of Texas El Paso won the Technical Competition with a rook (photo) that was run using multiple



Somos resins: WaterShed® (body), ProtoTherm™ (inner stairs), and Somos 14120 (double helix supports).

Finally, Larry Monahan of Becton Dickinson was also honored with an award for his rapid tooling work which accelerated the development of a medical device, made possible through the use of NanoTool™.

Log on to www.dsmsomos.com today to learn more about the award-winning parts you can produce with Somos resins.



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:

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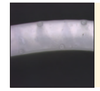

INSIDE

Unlimited. DSM

Somos DMX-SL™ 100: Taking Stereolithography One Step Closer toward Direct Manufacturing...

Technology **Breakthrough**

After much anticipation, DSM Somos unveiled DMX-SL 100—the "X factor"—at this year's 3DSUG conference in Daytona, FI (for users of stereolithography equipment).

Since that time, demand for DMX-SL has been the strongest Somos has ever seen for a newly-introduced resin. But what is DMX-SL 100? Why are people talking about this innovative SL material and how does it take stereolithography one step closer to direct manufacturing? Read on to learn more.

The current state of direct manufacturing with SL

The rapid prototyping industry has grown from the technology of solid imaging. The utility of being able to create a three dimensional object from a CAD rendering has been limited only by the physical performance of the imaged resins.

While the mechanical performance of SL resins has improved dramatically in recent years, the engineering plastic properties required for full direct manufacturing—that is, cost effective direct building of custom plastic parts without the need for tooling—has remained elusive. Though stereolithography has successfully been used to date for some specific direct manufacturing applications (i.e. hearing aid shells and interior products such as custom lamp shades), this use has been largely limited by material properties.

"Current SL resins on the market (and there are over 40 between Somos and other suppliers) are more brittle than traditional engineered plastics such as polypropylene, ABS, polycarbonate and nylon," says Somos Technical Service Manager Brian Bauman. "In addition, SL parts often become even more brittle over time, which is unacceptable for direct manufacturing applications."

At right and below: DMX-SL™ 100 produces durable, high-accuracy parts with a smooth surface finish.

The limitations of SL resins lie in their photopolymer technology: they require light to initiate the chemical reaction that turns liquid to solid. Once light is removed, the reaction should stop—but in reality, "dark" reactions can proceed slowly, causing property changes.

The useful lifetime of parts made from these types of resins is limited. Therefore, while SL resins perform well in rapid prototyping applications, their usefulness for direct manufacturing has been restricted to parts that do not require much durability.

Technology breakthrough

Determined to bring an SL solution to market, DSM Somos combined the efforts of the Somos R&D team with the extensive resources of DSM Corporate Research to develop the industry's first SL resin targeted for high durability (prototyping) applications and direct manufacturing.

After three years of significant development and testing efforts, Somos DMX-SL™ 100 has been introduced as a significant new chemistry platform for direct manufacturing development. It is the first resin in what will be a new Somos family of products based on this innovative chemistry platform.

DMX-SL is based on a unique technology which produces resins with extremely high impact strength and resistance to breakage, thus making it very different from traditional SL resins.

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The material has a stiffness similar to standard ABS-like SL resins but with more than twice the impact strength—meaning the resulting parts are extremely durable. DMX-SL parts approach the durability of parts made from other RP technologies but with the accuracy of stereolithography.

Mark Jones, SLA Manager at Laser Reproductions in Gahanna, OH, (www.laserrepro.com) says "DMX-SL is rigid yet bendable—the perfect combination. In addition, the parts are easy to finish. Compared to typical SL materials, DMX-SL is heads above the competition."

Somos agrees, "We believe Somos DMX-SL 100 is a revolutionary product for the RP industry, "says Somos Marketing Manager, Eva Montgomery . "Other RP technologies that utilize molten or sintered thermoplastics have traditionally been chosen when part durability was critical, but with a sacrifice in part aesthetics or dimensional consistency. With DMX-SL, RP users can now have custom-built parts that are durable, accurate and have excellent detail—a development that brings SL one step closer to direct manufacturing."

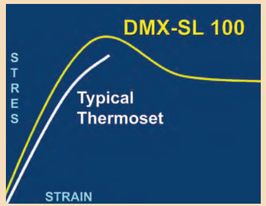
DMX-SL 100 parts are now commercially available. To find a service bureau running this advanced resin, log on to www.dsmsomos.com.

A **novel chemistry** for unique mechanical performance

"DMX-SL 100 looks and feels like a true production plastic—more so than any other resin on the market today."

That's just one of the reactions that Somos repeatedly hears when customers handle DMX-SL parts for the first time. And there's a good basis for this reaction. Because of DMX-SL's novel chemistry, its mechanical performance more closely mimics that of engineered plastics than of traditional SL resins.

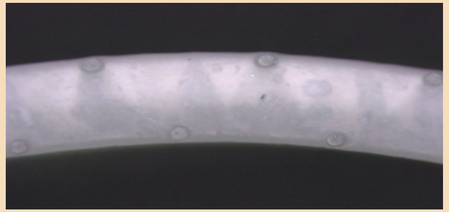
DMX-SL 100 features exceptional toughness, a high tensile modulus (average range 2000-2400 MPa), and thermoplastic yield characteristics.



"SL resins are thermosets, and the higher modulus versions typically exhibit brittle fracture failure mechanisms," says Somos Product Manager Brian Bauman. (See graph). "DMX-SL, however, behaves more like a typical engineering plastic, meaning the material is stiff and tough with a ductile failure mechanism."

The significance is that the yielding characteristic of this new resin requires more energy before break, which translates to toughness. DMX SL also exhibits stress whitening when highly loaded—similar to behavior seen in engineering plastics before they break (Picture 1). Typical SL resin fractures exhibit more glassy behavior; this difference in fracture behavior is another indication of how tough DMX-SL is, as compared to other SL resins.

While DMX-SL is not indestructible (no plastic is) it's tough enough for the industry to take notice. Service bureaus running DMX-SL have already reported that their customers are requesting RP parts made from this material rather than traditional SL resins because the parts have the accuracy of stereolithography (SL) but a durability that's closer to engineered plastics. Some are even beginning to rethink their ideas on the utility of SL for direct manufacturing—which is exactly the direction this new chemistry platform is heading.



Picture 1: DMX-SL stress whitening

SL Accuracy, Sintered-Like Durability

With SL accuracy and sintered-like durability, DMX-SL is targeted for applications that would traditionally utilize SLS or FDM—but where design engineers require a more accurate surface finish than either of those two methods can achieve.

It's well known in the RP industry that when comparing stereolithography (SL), selective laser sintering (SLS) and fused deposition modeling (FDM) methods, SL produces the most accurate parts with the best surface finish. However, for end-uses requiring high durability, SLS and FDM methods have been favored over SL due to their use of engineering plastics which tend to be tougher than typical SL resins.

Somos DMX-SL™ 100 recalibrates the differential between SLS/FDM and stereolithography with a unique combination of high modulus, tensile strength and impact strength. It's properties compare closely to other engineering plastics built via the SLS or FDM process (see table).

With SL accuracy and sintered-like durability, DMX-SL is targeted for applications that would traditionally utilize SLS or FDM, but where design engineers require a more accurate surface finish than can be achieved by either of the two methods. Examples include duct work, connectors, automotive assemblies, housings, and more. These are applications that do not require high temperature performance or resistance to moisture.

DMX-SL 100 is sure to change the way design engineers think of stereolithography. Find out for yourself by requesting a product sample today. Contact DSM Somos at 847-608-2596.

Physical Property Comparison
DMX-SL™ 100 vs. FDM and SLS:

	Strength at yield, MPa	Strength at break, MPa	Modulus MPa	Elongation, % at yield	Elongation, % at break	Impact Strength Notched Izod, J/m
DMX-SL 100	**40-43**	**28.4**	**2300**	**3%**	**16%**	**70**
DuraForm® PA[1]	N/A	43	1586	N/A	14%	32
DuraForm® EX[1]	37	48	1517	5%	47%	64
Polycarbonate[2]	*****	52	2000	*****	3%	54
ABS[2]	*****	22	1627	*****	6%	107

[1] Data from 3D Systems Data Sheets
[2] Data from Stratasys Inc. Data Sheets