Starlim concept puts a new twist on lighting with LSR

LSR World photo by David Vink

ON DISPLAY

Roland Pirsic demonstrates the company's new lighting product.

By David Vink
LSR World

Marchtrenk, Austria-based injection molder Starlim Spritzguss GmbH has unveiled a highly flexible innovative lighting concept made from liquid silicone rubber that provides precise and diffuse illumination.

Roland Pirsic, vice president of business development and project development, presented the concept at the biannual silicone elastomers conference organized by SKZ Süddeutsches Kunststoffzentrum in Würzburg, Germany.

The flexible LED-illuminated light panel is designed with translucent LSR. This provides homogenous white and diffused LED light over a large surface, including when it is curved or twisted, with various possible degrees of flexibility, depending on the Shore A hardness of the chosen LSR.

The panel can take the form of different surface structures, whether as design features or to raise wear resistance, Pirsic said. Surface activation can used as preparation for further process stages, he added.

After demonstrating flexibility of the "Flexilight" prototype, the highlight of Pirsic's presentation, causing both amusement and amazement among conference participants, was when he picked up a hammer and struck the LSR panel several times.

This was a convincing demonstration of the robustness of the new approach, as the panel remained not only physically intact, but also fully illuminated.

Pirsic said that when the panel does finally fail, there is no way it is going to break into splinters, as would be the case with less resilient materials like glass or thermoplastics.

Beyond the SKZ conference, Pirsic was recently featured as the inventor of an October patent submitted by Audi AG for vehicle interior illumination integrated into door, seat and roof lining lighting systems. The application includes silicone for the optical light guide.

BUILDING BLOCKS

Building up of a lattice structure "net cube" in Wacker's ACEO technology.

LSR DROPS INTO 3D PRINTING DEMAND

Wacker Chemie photo

By David Vink
LSR World

Würzburg, Germany — Two presentations at the biannual SKZ Süddeutsches Kunststoffzentrum Silicone Elastomers conference in Würzburg addressed recently introduced liquid silicone rubber 3D printing systems.

Florian Liesener, manager of the new ACEO 3D printing business unit at Wacker Chemie AG in Burghausen, Germany, classified the company's new drop-on-demand (DOD) material dosing of silicone in viscous paste form.

He pointed out that DOD differs from the commonly used fused filament fabrication (FFF) used in fused deposition modeling (FDM) from extruded plastic filaments.

Samples included a branched blood vessel model and an ear implant, as well as net cube cubic lattice grid structures with crosswise superimposed beams, the latter described as an example of "producing the impossible."

For Wacker, opening the ACEO campus with its Open Print Lab in mid-2016 preceded the world premiere of the company's package of 3D printing LSR materials at K 2016.

Liesener called ACEO "a true system solution" with the ACEO campus functioning as a service provider, also via a worldwide web shop.

Bernd Pachaly, Wacker's silicones research head, said the ACEO research team started developing a 3D printing system for LSR in 2014. The company compared the process to squeezing toothpaste out of a tube, with the LSR material shear thinning for easy flow when under pressure, then sitting firmly in position when higher viscosity returns with removal of shear force.

ACEO prints "voxels" (volume elements) in its contactless DOD system, followed by curing activation of each layer by ultraviolet light in less than one second. The printed part is subsequently post-cured at elevated temperature. A water-soluble support material enables overhangs and cavities and is rinsed away by hand from fully cured parts.

Liesener said ACEO offers LSR materials for 3D printing that result in cured parts between Shore A 10 (soft) to Shore A 80 (hard). A variety of colors are available.

Food contact and biocompatibility test data are expected in the third quarter. Work continues on material developments, with completion dates for optical transparency expected in 2017, adhesion in 2018, media resistance in 2019 and electrical conductivity in 2018/2019, Liesener said.

Liquid additive manufacturing

A presentation by Patrick Beyer and Hans Peter Wolf, silicon rubber R&D managers at Dow Corning Corp. in Wiesbaden, Germany, covered the company's new liquid additive manufacturing (LAM) process.

Dow started LAM development in 2015, together with two Germany-based partners: 3D FFF printing machinery producer German RepRap GmbH in Feldkirchen, and dosing system producer ViscoTec Pumpen- und Dosiertechnik GmbH in Töging am Inn.

ViscoTec has also been assisting Wacker Chemie in its 3D-printed LSR development.

LAM is based around Dow Corning's special LC-335 3D-printable LSR material with Shore A50 hardness. Printed parts exhibit overall 20 percent lower mechanical properties than injection molded LSR, tensile strength being 30 percent lower and tear strength 10 percent lower, Breyer said.

The LC-335 ran live at the SKZ conference, producing transparent shoe inner soles on a German RepRap X400 pre-series modified FDM printer.

The X400 was fitted with a ViscoTec Visco-Duo FDD 4/4 2-component FDD fluid dosing and deposition dispenser. Wolf stressed that the open structure on the X400 would change later to a closed housing based on German RepRap's X500 type of FDM machine.

The X400 running in Würzburg offers build volume of 260 x 320 x 200 mm, building parts in 0.1mm thick layers from a 0.4 mm diameter nozzle at speeds of 10-150 mm per second, with maximum equipment travel speed capable of reaching 300 mm per second. There are also options for 0.2 and 0.3 mm nozzle diameters and a second extruder for the unspecified support material.

Wolf said there is potential for customers to have individual LSR inner soles printed for their shoes in shoe stores.

Other 3D LSR solutions

Oliver Franssen, senior global marketing leader at LSR supplier Momentive Performance Materials GmbH in Leverkusen. Germany, told *LSR World* that Momentive has been supplying LSR to Sterne SAS in Cavaillon, France, as a silicone processor that has introduced its own LSR printing technology in September 2016.

Sterne's SiO-Shaping 1601 system involves deposition of 100 percent UV-cured transparent and opaque colored silicone in hardness of Shore 30A-60A in minimum layer thickness of 0.25 mm in a printer with maximum build volume of 250 x 200 x 100 mm. Sterne claims the material obtains "100 percent of strength and elongation properties of injection molded LSR."

Sterne General Manger Céline Laget points out that 3D printing plastics does not result in parts with molded LSR properties, and material manager Anthony Pellafol adds that the process can produce complex LSR parts in high precision.

One of the other silicone-based solutions mentioned in passing by Florian Liesener of Wacker Chemie's ACEO business campus in his presentation at the SKZ conference included the Picsima 3D printing system developed by Fripp Design & Research Limited in Rotherham, England. Fripp says its development of 3D printing two-component room temperature vulcanizing (RTV) silicone arose from requests from Manchester Metropolitan University for a process to produce ocular prostheses and from Sheffield University for soft tissue prostheses.

Picsima produces single-softness parts down to Shore A10, with multiple softness also intended in future. The process does not need support materials, Fripp says, claiming uniqueness for the way in which the silicone is polymerized.

Parts have been produced with 0.4 mm layer thickness in a printer with build volume 100 x 100 x 30 mm. Although the company says it wants to sell 3D printers for its process, "it will require a serious injection of working capital to achieve this."

Liesener also referred to Japanese microscope producer Keyence in Osaka offering silicone for 3D printing on its Agilista 3D printers.

NAME GAME

Promotion of Wacker's ACEO technology on 3D-printed LSR.

Wacker Chemie photo

The company compared the process to squeezing toothpaste out of a tube, with the LSR material shear thinning for easy flow when under pressure, then sitting firmly in position when higher viscosity returns with removal of shear force.

SKZ CONFERENCE REVIEW

By David Vink
LSR World

Ursula Nollenberger, product director LSR components at Trelleborg Sealing Solutions, focused on wine bottle stoppers at the SKZ Süddeutsches Kunststoffzentrum Silicone Elastomers conference, held March 22-23 in Würzburg, Germany.

Options included a thermoplastic grip with a lower section overmolded with LSR, and two all-LSR corks, one in a more flexible material.

The simulation showed unacceptably high insertion forces for the LSR/thermoplastic and the rigid all-LSR stopper, while the softer all-LSR stopper had an acceptably low 32 N insertion force.

LSR/thermoplastic and rigid all-LSR stoppers withstood higher pressures, even though the 1.1 bar level for the rigid all-LSR stopper would be good for a sparkling wine, Nollenberger said. The ability of the softer all-LSR stopper to withstand 0.64 N was rated acceptable for conventional wines.

A wine bottle stopper made from LSR materials.

LSR World photo by David Vink

Material developments

Oliver Franssen at Leverkusen, Germany-based LSR producer Momentive Performance Materials talked about using self-lubricating LSR to seal automotive connectors.

Franssen said there is a trend toward replacing separate round seals around each wire with one larger surface area rectangular mat-shaped seal sealing a number of wires.

One development goal, Franssen said, is to obtain LSR with 10 percent compression-set after 24 hours at 175° C, without tempering the material. Low compression-set is particularly beneficial in enabling mat-shaped connector seals to be re-used a number of times, Franssen said.

Udo Wachtler, technical manager at Wacker Chemie AG in Burghausen, Germany, talked about new LSR products with electromagnetic shielding properties, as well as a new high flexible modulus Elastosil LR 3003/90 grade.

He also referred to hard/soft two-component combinations.

Dow Corning Corp.'s R&D manager Patrick Beyer discussed a similar development, an "ultra hard" Shore A90 grade, Silastic LC 8800-90.

He said the material possesses "a unique combination of elasticity and strength."

Arburg

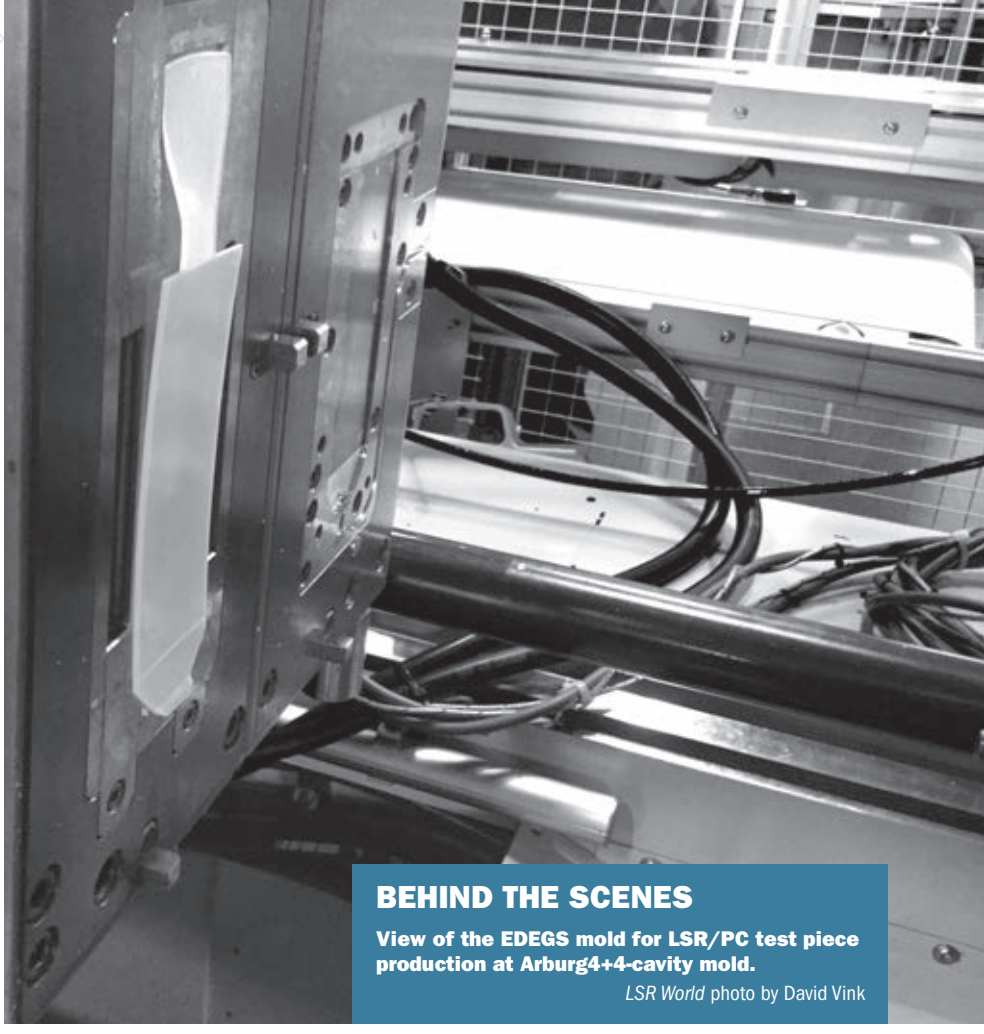
Continued from page 9

enous LSR density in injection molding machine screws.

In a poster shown at the March 2017 Silicon Elastomers conference in Würzburg, Germany, 2KM stated that the hybrid drive SilcoStar 924/904 units use 90 percent less energy than pneumatic units, as do hydraulic drive 922/902 and all-electric drive e-Flow models.

Michael Hartung of the Institute for Materials Technology at Kassel University showed the innovative way in which the PC is activated in the mold by short-wave (200-280nm) 9-Watt UV-C radiation applied within the mold area by the robotic handling gripper. This results in high adhesive bonding strength of around 2.25 N/mm between LSR and PC, through formation of functional groups on the thermoplastic surface.

Hartung's colleague Ralf-Urs Giesen presented further details on the process and results one week after the Arburg open house at the SKZ Silicon Elastomers conference in Würzburg.



BEHIND THE SCENES

View of the EDEGS mold for LSR/PC test piece production at Arburg4+4-cavity mold.

LSR World photo by David Vink

Cooperative research

In his introduction to the subject, Giesen described how this work has been undertaken in the "Unipace" facility at IWS. Unipace was founded by Kassel University and with pharmaceutical company B. Braun Melsungen AG in 2013, as a cooperative application development center activity conducting research.

This covers both LSR and HCR silicones as well as thermoplastics on equipment that includes four injection molding machines, three of which equipped for molding LSR. Unipace has eight scientific and technical staff, supported by six student assistants. A planetary dissolver has been added at the end of March, and Giesen said there were plans to soon start using software from Sigmasoft to simulate molding of LSR parts.

Giesen explained that although LSR bonds strongly to nylon and PBT, it requires special grades containing adhesion promotion additives to achieve LSR/PC bonding. Unipace has therefore sought to achieve LSR/PC combinations using standard LSR grades from Dow Corning, Wacker Chemie and Momentive. It has been doing this with UVC-C in-mold treatment that does not involve heat entering the thermoplastic and that also allows for partial bonding where required, by selectively desisting from treatment of some areas.

Giesen mentioned that alternative techniques known to work with LSR/PC include using an adhesive layer and treatments such as Plasamtreat's Openair low-pressure plasma, as well as corona and flame or silica coating treatments. The UV-C treatment can be applied as pre-treatment, with separate 9,000-hour lifetime UV lamps or with such lamps integrated in the linear robotic handling system or by grippers operating in the mold, the latter as shown at Arburg.

Although Unispace uses an EDEGS mold in its LSR/PC work, other equipment differs from that shown at the Arburg open house, namely use of LSR 200 ELA 200 and EMT dosing equipment from respectively German suppliers Reinhardt Technik GmbH in Kierspe and EMT Dosiertechnik (Efficient Metering Technology) in Werdohl.

The entire LSR/PC process, for which Unipace has applied for a patent, involves overall cycle time of 60 seconds, including around five seconds of pre-treatment within the mold area with the robotic handling system and with another five seconds needed to move the molded PC plate from one cavity to the other and 45 seconds for PC and LSR injection and LSR curing stages.

Based on work with LSR from Wacker Chemie and Makrolon brand PC from Covestro, it was found that while LSR bond strength to PC drops slightly after five second UV-C exposure and is at a similar level for LSR/nylon. Giesen showed a chart, however, in which the LSR/PA bond strength rose well above that for LSR/PC at 30 seconds, reaching around 3.25 N/mm. He concluded however that 5-10 second radiation time suffices to obtain good adhesion of LSR to PC and PC/ABS.

Giesen pointed to a particular advantage of the process: its low cost compared with other bonding processes such as plasma treatment. There are also no health risks beyond a 5-10 centimeters distance from the UV-C source, he stated. Adhesion has remain high after 12 months and UV-C treated PC granulate has also been found to enable high adhesion to LSR after it was sent for a trial at an external molding processor, Giesen said.

Standing the heat

LSR helps engine compartment housing stand up to high temperatures

By David Vink
LSR World

LSR World photo by David Vink

Two-component LSR/GF-PA molding displayed by KraussMaffei at the 2017 VDI Plastics in Automotive Engineering Congress.

Cordula Regensburger, a product and technology management specialist at injection molding machinery producer KraussMaffei Technologies GmbH in Munich, Germany, described at the SKZ Süddeutsches Kunststoffzentrum Silicone Elastomers conference, held March 22-23 in Würzburg, Germany, selection & development of a production cell to mold two-component LSR/glass-fiber-reinforced nylon automotive engine compartment housings, such as one carrying a circuit board.

One such part that KM features is a fuse cover-box. The part represents a trend toward replacement of thermoplastic elastomer molded-on seals with LSR seals, which stand up better to rising engine compartment temperatures.

Regensburger reviewed means of producing such two-component parts, including using two molding machines, before showing the final preferred minimum footprint customer solution: using a reversibly rotating turntable table mold and two injection units mounted "piggyback" on KM's CXZ160-750/180 Multinject 2-platen hydraulic drive molding machine.

The cell was also fitted with a KM LRX250 linear handling robot. Thermal separation of the injection units with insulation sleeves prevents premature LSR cure before the material reaches the mold cavity, Regensburger revealed.

As the housing is produced in different sizes, shot weight of the primary nylon thermoplastic component is in the 60 to 100 gram range, with 10 to 20 grams for the secondary red self-adhesive LSR seal component. Four inserts are overmolded in the part, which also has been designed to optionally apply a membrane by ultrasonic welding.

The production cell includes a fully automatic test station with membrane seal pressure testing and a camera and 3D scanning system part inspection, controlling 175 different dimensions.

Regensburger said injection of the LSR at the higher (hot) position and nylon at the lower (cool) position is "preferred by mold makers, also as it means larger volume part being injected in the lower position."

Michael Pühringer, technical and design manager at Wolfern, Austria-based mold maker Ebner-Tec Solution GmbH, provided further details of the application, talking of the importance of a highly even surface for support of the circuit board, with deviation required to be <0.2 millimeters. The distance between the seal around the internal perimeter of the housing and the circuit board support area has to be within tolerance of ±0.05mm and the surface profile precision <0.1 mm.

High demands set on the part made repeated mold filling and warping simulation essential for both the polyamide as well as the LSR prior to cutting tools, and the optimum injection point was also important to reach the objective of obtaining the best possible result on the first trial parts, without having to regrind the mold tool. Two independently adjustable needle valve nozzles for LSR injection were used to ensure even filling of the separate LSR areas on the part, involving volumes of 7.2 and 3.6 ccm.