Review of Formnext 2022

Print-Ready for Series Production

To an increasing extent, additive manufacturing is finding its way into series production. Particularly so, if the application benefits from the special strengths of additive manufacturing. This was clearly shown at last year's Formnext. Also various developments in the materials sector show that the processes are suitable for mass production.

T-Crow night vision camera: except for the electronic components, the entire stand is produced additively.

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3D printing has come of age. This was impressively demonstrated last year at the Formnext in Frankfurt/Main, Germany. More than 800 exhibitors showed what additive manufacturing is capable of. Correctly applied, it can contribute towards the decentralization of processes and production, make supply chains more resilient, and promote resource-conserving production. And something else became clear: it is no longer limited to prototyping. Meanwhile, industry is busily working on the transition to mass production.

Some 30,000 exhibition visitors were able to see this at the Formlabs booth. Based on various customer applications, the company – whose portfolio includes materials as well as 3D printers – demonstrated what is possible by means of additive production methods, and also in what quantities. Since its founding in 2011, the company's 3D printers have produced more than 100 million parts. The case studies ranged from Vital Auto's vehicle components up to high-performance prototypes for sporting goods from Black Diamond Equipment. Also present at the booth: the developers of XSpecter's camera accessories, who use Formlabs' SLA and SLS technology for the production of their end-user components (**Title figure**).

3D-Printed Spare Parts for Daimler

Also the Deutsche Bahn relies on the competence of the Berlin-based company Formlabs. Already in 2015, the railway corporation had used 3D printing for the first time to manufacture spare parts for its trains. Up to the end of 2017, about 2000 spare parts were produced in this way. It all started with a simple 3D-printed coat hook. But from this very straightforward spare part, things developed towards more complex items. Meanwhile, and in addition to the coat hook, the range of 3D-printed parts includes ventilation grids, headrests, junction boxes, transverse damper brackets, and many others.

Also Wibu-Systems succeeded with such a major coup. For a long time, the company has belonged to the pioneers of the Industry 4.0 vision, and has refined its CodeMeter protection and licensing technology into a business enabler with intelligent licensing models. For example, it enables pay-per-use or subscriber licenses to be visualized (**Fig. 1**). At the Formnext, Wibu presented two success stories, in which CodeMeter contributed in the establishment of new business models in the field of additive manufacturing.

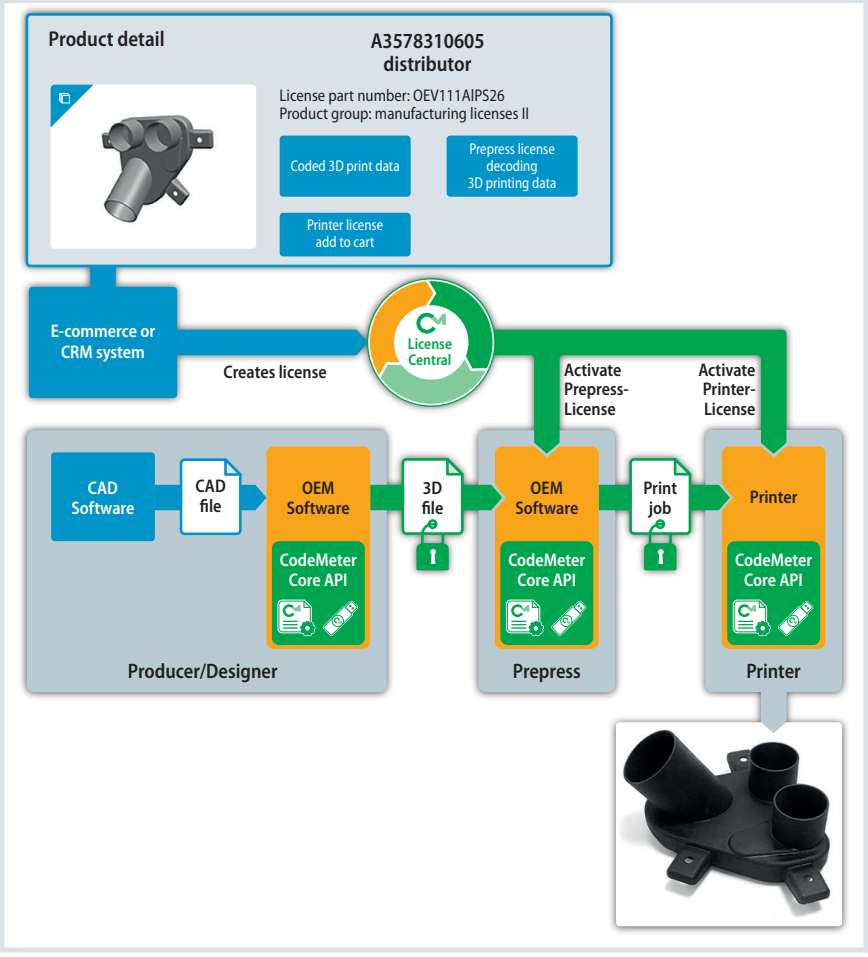

Fig. 1. Without in-betweens: by means of 3D printing, customers can produce licensed spare parts themselves. © Wibu-Systems

Omniplus is a service provided by Daimler Buses for commercial bus operators, and is also service partner for the Mercedes-Benz and Setra brands. In order to offer spare parts to customers quickly and flexibly, Daimler Buses has opted for digitalization, and offers an increasing number of spare parts and components in the form of 3D-printable files in its new print shop.

Daimler Buses, Farsoon Technologies, and Wibu Systems worked jointly on the online shop, in which the offered objects are encrypted via CodeMeter. During purchase, two licenses are created: customers receive a preparatory license to prepare printing, and a printing license for the number of objects to be printed. CodeMeter was integrated directly into Omniplus, where it will ensure fast and reliable order handling, delivery, and invoicing.

"The spare parts are immediately available worldwide, and cost-intensive stockpiling is superfluous, thereby ensuring faster parts availability, the elimination of complex supply chains, plus cost savings", are advantages explained by Stefan Bamberg, Senior Key Account & Partner Manager at Wibu. This is not only of interest for bus operators. "Our business model can be implemented for any other industrial sector – not only for spare parts", says Bamberg. Rapidly increasing digitalization causes increasing amounts of know-how to be transported in the form of data. "This data must be protected, and the possibility of monetizing the data utilized", he adds.

Fig. 2. The three discharge units of the Freeformer 750–3X have a more compact design than the 300–3X version, and can therefore be arranged more closely together. © Arburg

Large Build Chamber, Greater Freedom

"As the leading international event, the Formnext is definitely one of the »

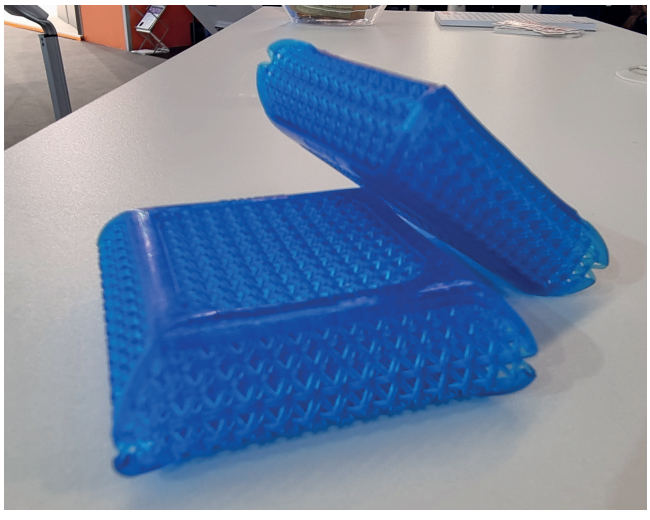

Fig. 3. Henkel has developed special 3D-printable acrylic resins for medical technology applications. They are certified as biocompatible.
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most important trade fairs for us and our markets", explains Dr. Victor Roman, company manager of Arburgadditive. Particular focus was placed on the new Freeformer 750–3X, whose large build chamber is ideally suited for fast series production of large components or several items per build job (**Fig. 2**).

Among the numerous technical novelties compared with the predecessor version is a new plasticizing unit: now, more compact and slimmer melt pressure generators for dosing and injecting are used, fitted with servomotors from AMKmotion, a company of the Arburg family. The entire system, i.e. material preparation and discharge units, was pressure-optimized and matched to the AKF additive manufacturing process. Hereby, focus is on precision and repeatability of the melt output, which in turn serves to ensure the creation of uniform, constant drops. Moreover, the three discharge units are positioned more closely to each other and in a more compact way. Compared with the Freeformer 300–3X, their design is 100 mm "slimmer".

The trend in industrial additive manufacturing is clearly moving towards high efficiency in daily production, both in the manufacture of larger single components as well as the manufacture of several articles in clearly moving in the direction of high cost-effectiveness in day-to-day production, both in the manufacture of larger individual parts in a single work cycle. And precisely these demands are met by the Freeformer 750–3X. The system also closes the gap between pure prototyping and the production of functional small series. Because not only has the part size grown, but also the building speed. The granulate hopper volumes were doubled, and accessibility in the area of the maintenance flap was improved. All this provides even more individuality, functionality, improved user-friendliness, lower costs, and freedom in part design, as well as effective acceleration of output.

Materials for Series Production

The increased use of additive manufacturing for series components also has an effect on the materials used – for example, the demands on their mechanical properties, chemical resistance, and long-term behavior are increasing. After all, the components are no longer scrapped after a few tests, but must remain in service for longer periods.

Apart from higher demands, certifications are required in many areas. Moreover, component designers and processors need reliable data about important characteristics. Therefore, during the past years, material producers have had their 3D printing materials certified to an increasing extent for different industries e.g. in the automotive and railway sectors. Meanwhile, the companies also provide data sheets with material properties.

Certified and Traceable Materials

For example, Henkel offers photopolymers that are certified for railway applications or medical technology (**Fig. 3**). According to the company, comprehensive material tests have also been conducted during the past years, in order to provide customers with the requested material data. Similarly, analyses of the long-term behavior of the polymers were carried out. With photopolymers for instance, statements about light stability are very important. Also traceability is an increasingly important topic. Essentium for example not only ensures traceability for its printers and materials, but recently also for its filament spools (**Fig. 4**).

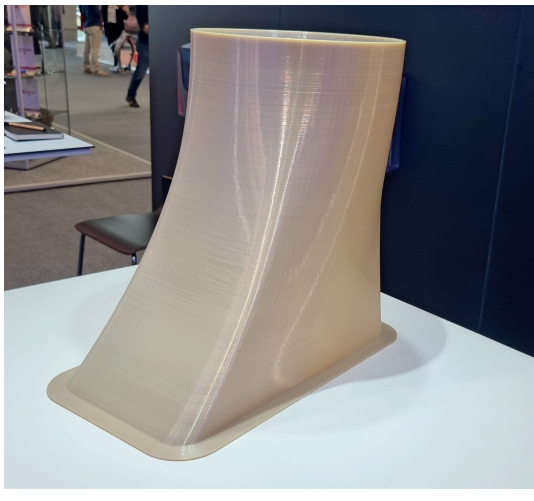

Fig. 4. This large ventilation duct was printed for the US Air Force using materials from Essentium. The duct is the replacement for a metal component. © Hanser/F. Streifinger

The Future of Industrial Manufacturing

For four days, the Formnext 2022 turned Frankfurt/Main, Germany, into the capital city of global industrial 3D printing, and this time, the trade fair was really in tune with the times. Numerous new presentations demonstrated how additive manufacturing can contribute towards the decentralization of processes and production, make supply chains more resilient, and promote resource-conserving production.
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Fig. 5. In future, the PAEK introduced by Solvay is said to permit components made of the high-performance thermoplastic to be printed at lower temperatures. © Hanser/F. Streifinger

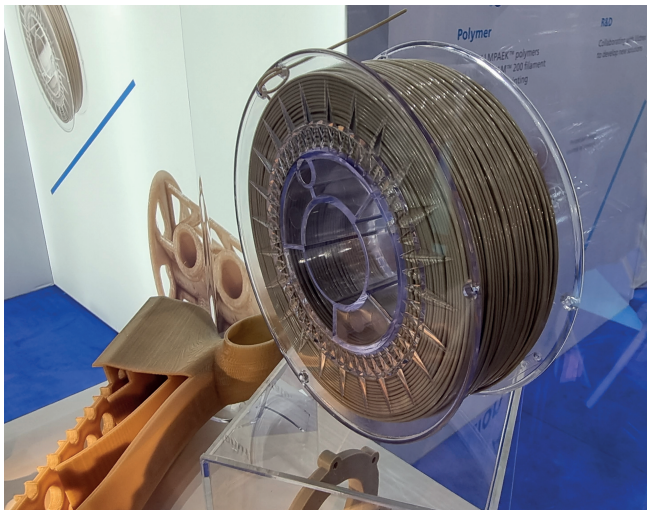

Fig. 6. The material presented by Victrex solves a 3D printing problem with PEEK: low tensile strength along the z-axis. This is enabled by the material's lower crystallization speed. © Hanser/F. Streifinger

Interesting advances were also shown with printing materials in the polyetheretherketone (PEEK) range. This high-performance thermoplastic is extremely popular for applications in fields such as aerospace and medical technology, with very high demands on the material. However, 3D printing with PEEK represents a large challenge for processors. Because the polymer has a very high melt temperature – usually above 340 °C – a correspondingly high printing temperature is required.

PAEK: Lower Melt Temperature and Slower Crystallization

Improvements in this respect are promised by a polyaryletherketone (PAEK) introduced at the Formnext by Solvay. According to the company, its melt temperature is considerably lower than for PEEK. Consequently, it can be processed more easily and at lower temperatures. At present, the material is still in development (**Fig. 5**). It is to be introduced to the market in the course of the year, and will serve in the performance range between PA12 and PEEK.

Also plastics producer Victrex showcased a PAEK with lower melt temperature (**Fig. 6**). It lies at 305 °C instead of 343 °C, as is the case for the company's standard PEEK for 3D printing. Furthermore, the material is claimed to address a processing problem of PEEK: excessively fast crystallization. This represents a problem for the layer build-up normally used by most additive processes. The reason is that the printed layer has crystallized before the next layer is printed. This leads to a weaker bond between layers, with an increased risk of delamination. Therefore, 3D-printed PEEK achieves a considerably lower tensile strength along the z-axis than is usually the case with the polymer. Named Victrex AM 200, the new PAEK crystallizes slower than conventional PEEK. Consequently, the bond between the printed layers is improved and therefore also tensile strength along the z-axis. This is claimed to result in values around 70 MPa for the material.■

Melanie Ehrhardt and Florian Streifinger, editors

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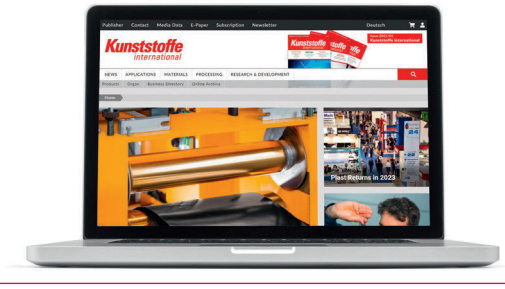

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