Faster Development Using Additive Manufacturing

When developing prototypes, Sulzer's development departments are increasingly opting for additive manufacturing processes. Sulzer was the first company to develop and use a new plastic powder and its processing by selective laser sintering for brush production. Thanks to the elasticity of the plastic, the prototypes of Geka mascara brushes can also be used for application tests. Instead of waiting 18 weeks for an injection-molded brush, customers can have the prototypes in their hands after just one week.

1 Prototype of a mascara brush made using the 3D-printing process.

Sulzer has been employing additive manufacturing processes for a long time. The number of materials that can be processed using 3D-printing is constantly increasing. The new materials open up new possibilities in both development and production. The 3D-printing processes are cost-intensive and are predominantly used for producing prototypes or components in small quantities. However, additive manufacturing processes will also be incorporated on the Sulzer shop floor in the foreseeable future.

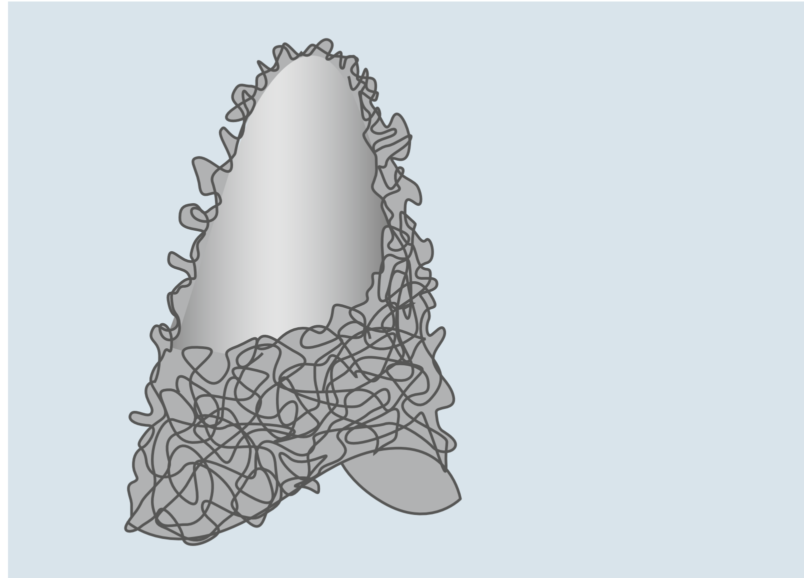
Production of prototype mascara brushes

Sulzer has been using 3D-printing methods to produce prototypes of mascara brushes since 2007. To date, these prototypes have been made using a hard plastic material based on a three-dimensional CAD drawing. Customers had the opportunity to visually assess and physically inspect the brushes. However, the bristles of these prototypes were too hard to be tested in the field.

The development team and the prototype manufacturing team of the Sulzer Applicator Systems division were looking for alternative methods and materials for producing 3D-printed prototypes. In 2015, after a long search, they found a solution. A new type of plastic came onto the market as a powder. It displayed similar chemical properties to the material that had been used in the series production of the injection-molded parts. This particular plastic ensures that each filament has the correct elasticity and stability, i.e., the filaments are rigid enough to separate the eyelashes and yet flexible enough not to injure the user's eyes. Considerable research has been carried out to develop the manufacturing process and to find the ideal settings for hardening the plastic for 3D-printed prototypes. Since 2016, Sulzer has been commissioning an external supplier to make all of its mascara brush prototypes using the developed selective laser sintering method.

3D-printing process allows new possibilities

Selective laser sintering (SLS) is an additive manufacturing process that uses a powdered material to produce solid structures. A power source is required to sinter the powder. A laser provides this power; the beam is aimed at the right point using a mirror system. The component is then built up in layers. The individual layers applied to make prototype brushes (Fig. 1) can be seen in the form of small indentations on the filaments.

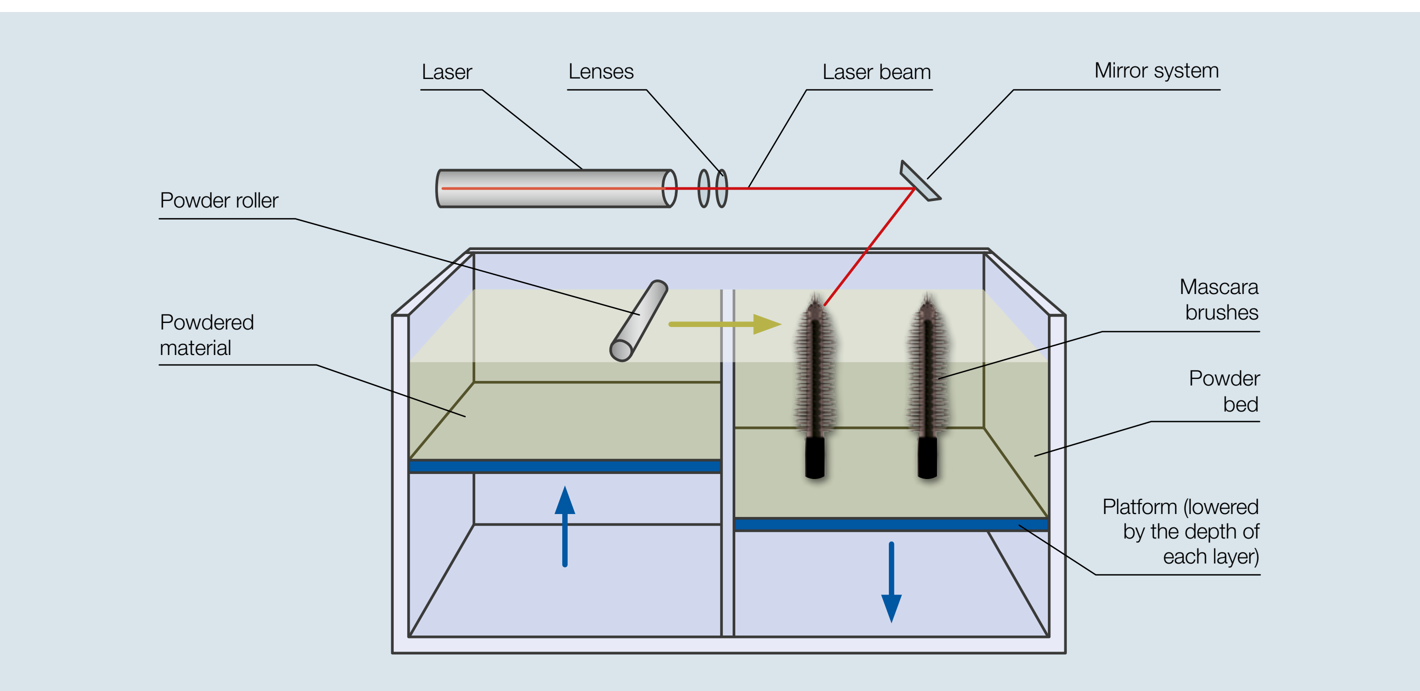


3 Schematic view of a prototype of a mascara brush bristle tip using laser sintering (SLS).

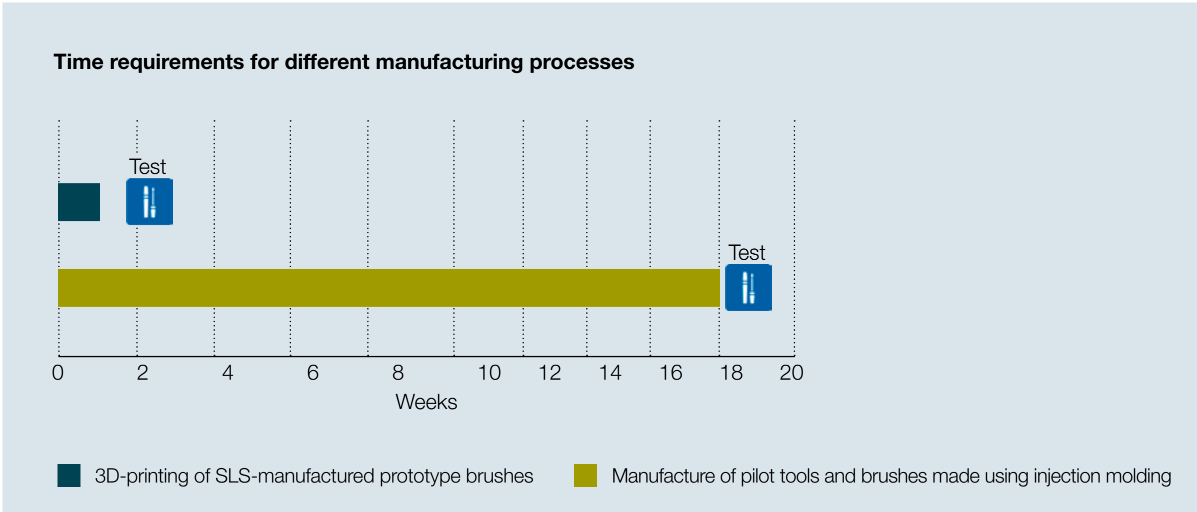
How selective laser sintering works (SLS)

A laser sintering system (Fig. 2) spreads a thin layer of powdered material onto a building platform. A laser beam selectively fuses the material using a mirror system. After the building platform has been lowered, the next layer of powdered material is applied. This process repeats until the entire component has been built up — layer by layer — in the powder bed.

With this technique the components do not necessarily have the same surface structure as parts made using injection molding. Sulzer has advantageously used the special processing capabilities of SLS to create unique new brushes.



2 Functional principle of the selective laser sintering process, also called SLS.



4 Up to 17 weeks can be saved in development time by using 3D-printing.

The technique of 3D-printing makes it possible to create special surface structures and topographies to enhance the wetting and/or makeup capture and storage properties of the brush. Such surface topographies are shown in Fig. 3 in which a part of the bristle tip is cut away to make the special microstructure visible through the shaded bristle core. This figure is taken from a utility model by which Sulzer has secured its intellectual property rights.

Reduced development time

The development process for mascara brushes has accelerated enormously since the incorporation of the additive manufacturing technique. Previously, the team would create drawings, produce visual prototypes using 3D-printing, and then create a pilot brush for the injection molding. This pilot brush had to be made according to the customer-specific adjustments to the drawings. It takes 12 weeks to complete a pilot brush this way, and the process is very cost-intensive. A small hollow cutout called "cavity" has to be milled into the injection molding tool for each mascara filament. It would take 18 weeks before customers were even able to carry out the first application test. Prototypes made using the selective laser sintering (SLS) technique can be produced much more quickly: these are ready in just 5 to 7 working days (Fig. 4).

Streamlined design process

Once the drawing has been created, Sulzer goes on to produce SLS brushes. The customer can then conduct application tests immediately, and if any modifications are required, the drawings are adjusted accordingly without delay. New SLS brushes are then produced and tested.

The surface of the 3D-printed brushes does not necessarily correspond exactly to the injection-molded parts. The amount of mascara that can be applied may not be exactly the same, but the customer can obtain sufficiently accurate results from the prototypes. The customer only gives permission to proceed with the production of injection molding pilot brushes or series brushes when the results of the application tests are satisfactory.

Because there is greater freedom to conduct more application tests with the brushes made using the SLS technique, the development process is that much faster, meaning the products can be launched sooner in the market. In fact, Sulzer can even use the special SLS processing capabilities to create unique new brush surfaces having advantageous properties.

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