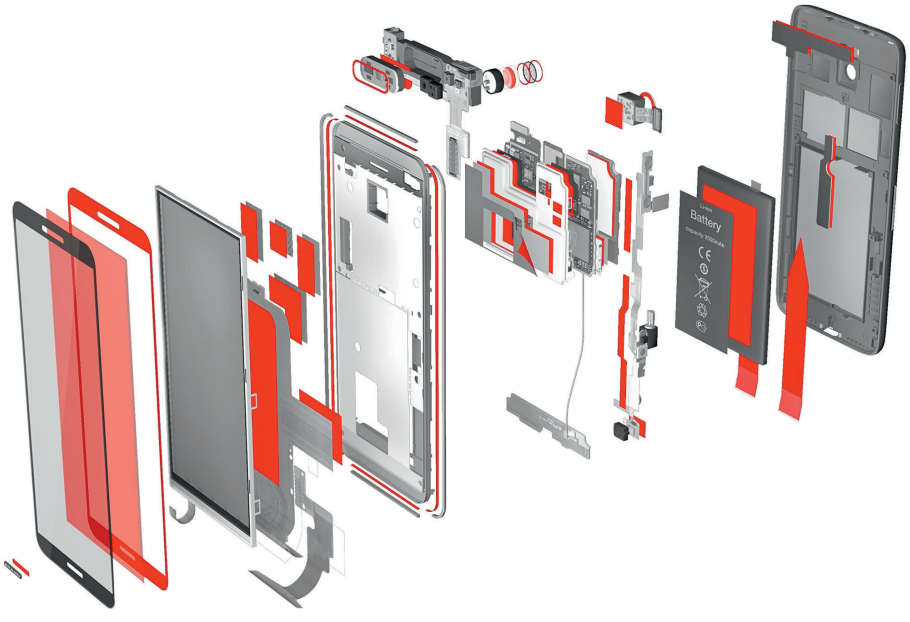
What Holds the World together

tesa Uses Freeformer for Novel Bonding Applications

Almost everyone around the world knows the tesa brand and regularly uses the adhesive tape of the same name – tesafilm. However, around 75 % of self-adhesive system solutions are industrial applications. At the company's headquarters in Norderstedt near Hamburg, Germany, researchers develop e.g. adhesives for smartphone components and investigate the added value that additive manufacturing with plastics freeforming can bring.

To start with, nobody knew whether the Freeformer could process adhesive compounds as well as plastics. That's why we initially decided on a rental model, and have been working with a Freeformer 200–3X in our technology center since June 2019," explains Frank Virus, Technology and Product Development at tesa. "Our focus is on process development and material certification. The results in pilot production were so compelling that we purchased another a large Freeformer 300–3X."

In order to be able to set up more-sustainable processes – more on this later – and modify new geometries faster, Frank Virus and Technology Manager Manuel Bendeich (**Fig. 1**) set themselves the goal of making modified natural and synthetic rubbers, which are adhesive at room temperature, and making them amenable to industrial additive production. In order to be able to process these materials using Arburg Plastic Freeforming (APF), important preliminary work was necessary, in that the team had to find formulations that would allow the adhesives to be granulated. To achieve this, the surface is irradiated and physically deactivated, for example. "We managed to do this surprisingly quickly and well," says Frank Virus. The Freeformer processes the various pellets of adhesive extremely precisely and reproducibly in the screw chamber at up to 150 °C (exact temperature depends on the viscosity).



"Printed" pressure-sensitive adhesives can be used, for example, to bond smartphone components together, without producing any waste © tesa

New Formulations for Pelletizing Adhesives

What is special, is that the focus is on only one or a few layers. For some products the layer thickness is only about 300 µm. Since this requires completely different parameters than the production of conventional plastic components using the APF process, a separate standard for material certification had to be found. Although this first step is time-consuming, because excellent print quality has to be achieved from the very first layer, it is then a simple matter to transfer the standard later to comparable formulations and viscosities.

"Unconventional thinking and working is what is driving us forward through the entire project," comments Manuel Bendeich. "The support we get from Arburg is fantastic! The Freeformer experts work in agile teams like we do. There is always someone on hand to help us with advice and creative ideas in application development, meaning that we can develop intelligent new solutions and set up pilot projects on an equal footing."

For quality tests, the new material formulations are "printed" in narrow strips (**Fig. 2**.). After initial quick tests, the force required to peel the adhesive film from different surfaces such as ABS, glass or aluminum is measured with a testing machine at constant speed and peel angle. If the adhesive film is applied to paper, it can be removed without damage and incorporated into products.

Fig. 1. tesa experts Frank Virus (left) and Manuel Bendeich process pressure-sensitive adhesive using the Freeformer © tesa

Fig. 2. Peeling off a strip as a quick test proves that the adhesive test strips adhere excellently to the ABS base plate © Arburg

Waste-Free and Shock-Absorbing

tesa experts see great potential for additively manufactured adhesive products in the glass cover molding of smartphones (**Fig. 3**). Traditionally, large, fully coated sheets of a defined thickness are provided for bonding the glass cover to the shell, and frames that are adhesive on both sides are punched out. Over 90 % of the source material must be disposed of as waste. Alternatively, if you punched four bars, gaps would be created in which water, dust or light could penetrate.

The APF process is a much more sustainable and resource-saving alternative. "It would allow us to use 100 per cent of the adhesive material in the product without any waste," says Frank Virus, who would also like to create added value with extra functions: "Formulations with foamed layers have a shock-absorbing effect and ensure that the glass doesn't break as quickly. The material starts to foam as it exits the nozzle. Inside the machine, foaming is largely suppressed by high material pressures. The difficulty here lies in achieving a uniform structure. We are working on this. We are also testing structures that will have a damping effect without being foamed." Sandwich-style tapes with a middle layer of ABS or PLA that mechanically reinforces the adhesive tape are also conceivable.

Although the APF process is significantly slower than punching, the time and cost of molds is eliminated. And because fewer transport routes, logistics and feeding systems are required, the overall process is also significantly leaner. One or more Freeformers could instead be integrated directly into the fully automated production line.

Exploiting the Third Dimension

Besides sustainability, another important argument for industrial 3D printing is the possibility of exploiting the third dimension. Instead of having to work with predefined material thicknesses, the layer thickness and geometry of APF components can be varied as desired, with increments and depressions becoming possible. "This gives our customers a whole new freedom of design," argues Frank Virus. One of the first applications could be planar brand emblems done in polymer that are bonded to the curved panels of vehicle bodies.

His vision is for tesa's customers to integrate Freeformers into their process lines themselves and then additively manufacture the desired adhesive products directly on site – with complete system solutions from tesa that are precisely tailored to their respective requirements. ■

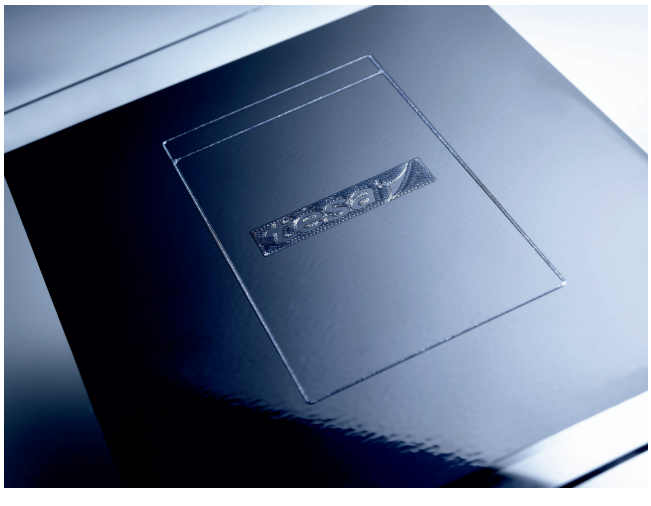


Fig. 3. A special kind of APF product: with the frame made of pressure-sensitive adhesive, smartphone glass covers with large surfaces can be bonded securely and without waste. The layer thickness is only about 300 µm © Arburg

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