PROTIQ

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3D PRINTING WITH RENEWABLE MATERIALS

PA 11 AS A MORE SUSTAINABLE AND ECONOMICAL ALTERNATIVE

MAX WISSING
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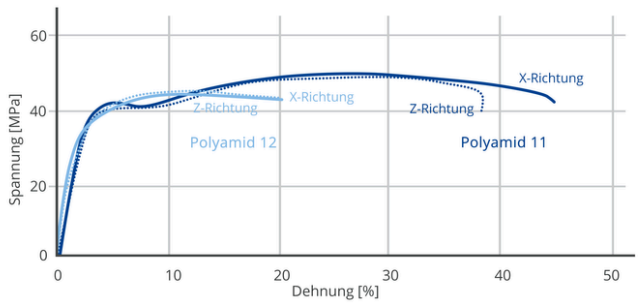
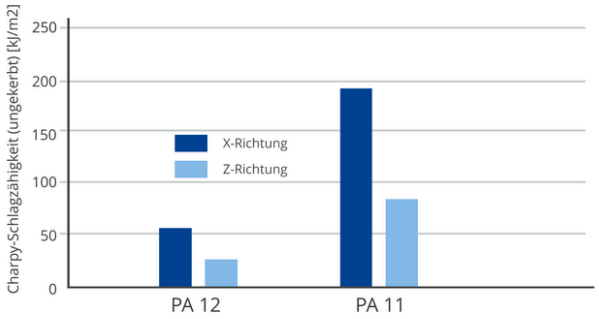
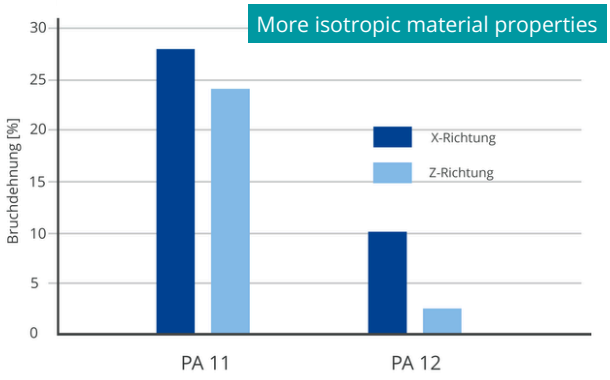
Higher elongation at break with the same tensile strength

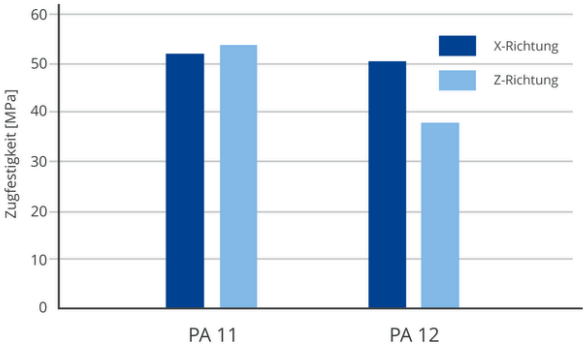


Higher impact resistance



More isotropic material properties





In the industrial use of additive manufacturing based on the SLS or MJF process, mainly polyamide plastics are used. MJF process, mainly polyamide plastics are used. The engineering plastic PA12 is the widely used standard. The new bio-based material PA11 shows great potential to replace PA12, which is produced from crude oil, as the new standard. Material production without petroleum and better mechanical properties open up a number of new fields of application and enable more sustainable production.

The PROTIQ Marketplace is an online platform for industrial 3D printing, where numerous service providers offer a bandwidth of different additive manufacturing processes and materials. The online marketplace focuses on the requirements of industrial customers, who are characterized by high quality standards and maximum transparency. Based on their uploaded 3D data, customers receive an automated offer from various service providers within minutes and can then order directly online within a few minutes.

As a subsidiary of Phoenix Contact, the eponymous PROTIQ GmbH is also represented on the marketplace with its own production facility. The company focuses on powder-bed-based additive production processes for the manufacture of high-quality plastic and metal components. In general, components manufactured in this way are particularly suitable for use under high mechanical loads, while at the same time requiring a high level of detail resolution and complexity.

Production of larger quantities with the SLS process

Selective laser sintering (SLS) and the multi-jet fusion process (MJF) have established themselves as the industrial standard for powder bed-based concepts. Both additive production methods work with fine plastic powder that is melted locally by a laser or a powerful light source. Three-dimensional components are created layer by layer within just a few hours. The major advantage over other production methods is that no support structures are required during the printing process as the surrounding powder is not melted. In this way, highly complex components can be produced that would not be possible with any other production process. Furthermore, the components to be produced can be nested and positioned on top of each other in the machine, which makes the production of large quantities particularly productive and economical. In the SLS and MJF process, the plastic polyamide 12 (PA12) is generally used as the standard material. Additively manufactured components made from this material can be found in many technical areas, such as mechanical and plant engineering, construction, prototypes and series applications.

Less process waste with bio-based plastic

The engineering plastic PA12 has high strength and rigidity, but only moderate elongation at break and toughness. For this reason, although the components can absorb high forces, they are prone to brittle splinter fractures under sudden loads. This limits the use of PA12 components in safety-relevant areas. In addition, the issues of sustainability and resource conservation are becoming increasingly important, especially in the production of petroleum-based plastics such as PA12. On the one hand, the fossil source material is fundamentally problematic.

On the other hand, additive manufacturing of PA12 produces up to 50 percent of the unmelted powder as so-called waste powder, which cannot be reused.

In the field of industrial 3D printing, this problem is recognized by material and system manufacturers as well as processing companies. PROTIQ relies on the new, innovative plastic PA11, as it does not require the use of crude oil in its production. Instead of fossil raw materials, the polyamide plastic is made from renewable castor oil. In addition, the plastic powder can be reused to a greater extent in additive component manufacturing, resulting in less process waste.

This approach is not only sustainable, but also increases economic efficiency. Through further optimization of the process and its extensive expertise, Protiq has even succeeded in almost completely eliminating the formation of waste powder in its own production based on PA11. In addition, there are now companies in the additive market that specialize in the recycling or further processing of used powder. In the best case scenario, the powder can be fed directly back into the additive production cycle.

Significantly higher impact resistance and impact strength

The powder material PA11 is marketed by well-known companies such as BASF and EOS and can be processed using the machines of many system manufacturers. The material offers users of additively manufactured components made from PA11 additional advantages.

In contrast to the well-known PA12, PA11 has a high elongation at break, which is why it does not fail as a brittle fracture. This is particularly noticeable under impact loads due to its significantly higher impact resistance and impact strength. In this way, additively manufactured components made of PA11 can also be used in areas that have to ensure personal safety in the event of a crash. Potential new areas of application include, for example, car passenger compartments and orthopaedic orthoses worn on the body.

In tensile tests, the static strength of the two materials proved to be almost identical, making it easier to replace the existing PA12 components with PA11 variants. In comparison, PA12 also has a melting point of 230°C, which is around 20°C higher. The material portfolio includes various additives for specialized applications with special requirements. For example, the PROTIQ Marketplace also offers PA11 components with additional certifications with regard to electrical dissipative (ESD) or flame-retardant properties (UL94V-0).

Carbon fibers added to the starting powder further increase the strength and rigidity of the components. The use of blue-coloured material, in conjunction with the option of chemically smoothing and sterilizing the components afterwards, allows certified use in the food industry (EU Regulation No. 10/2011 and FDA 21 CRF). The additives added to the powder material allow the components to be detected using X-ray equipment or metal detectors, so that quality control in food production can be automated.

The bio-based plastic PA11 used for additive manufacturing opens up numerous new fields of application and possibilities. Due to the advantages described above compared to the widely used plastic PA12, PA11 has great potential to establish itself as the new standard in 3D printing.

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