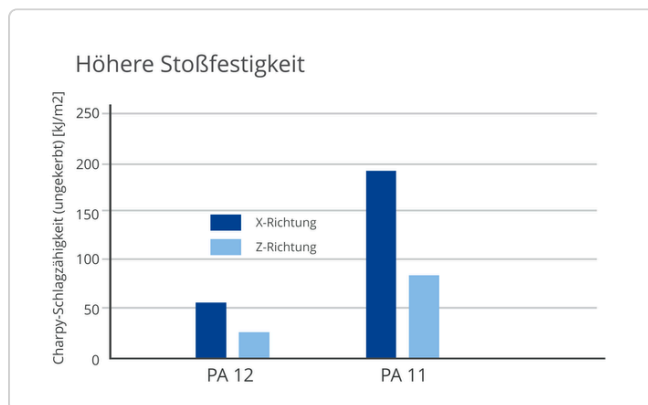


# PA 11

## as a more sustainable and more economical alternative

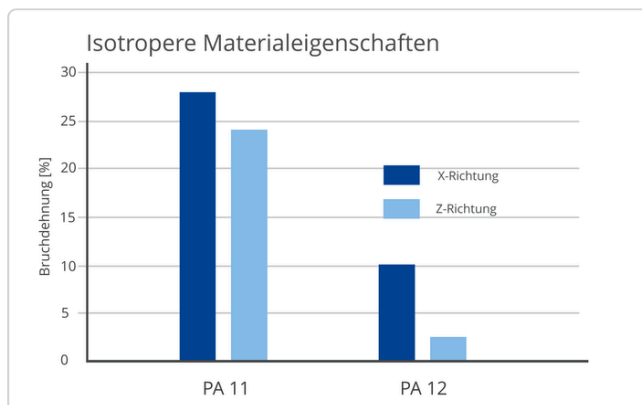
(A technical article from 2023, author: Max Wissing, Technology Manager Additive Manufacturing, PROTIQ GmbH, Blomberg)

In the industrial use of additive manufacturing based on the SLS or MJF process, polyamide plastics are mainly used. The engineering plastic PA12 is the widespread standard here. The new bio-based material PA11 shows great potential to replace petroleum-based PA12 as the new standard. Producing the material without petroleum, together with better mechanical properties, opens up a range of new fields of application and enables more sustainable manufacturing.



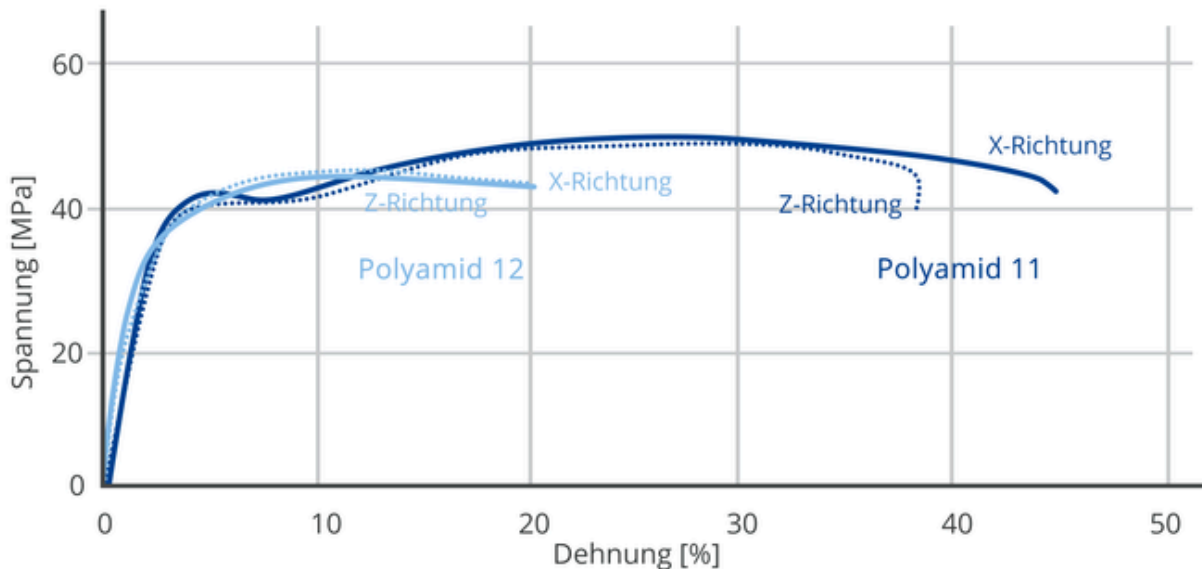
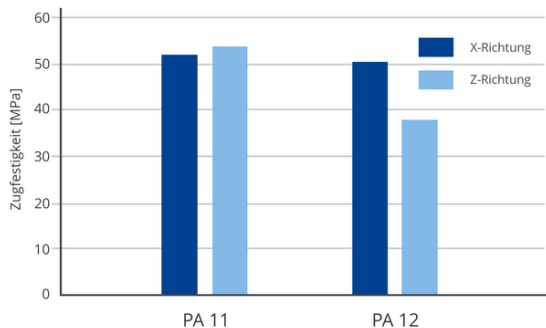
The PROTIQ Marketplace is an online platform for industrial 3D printing on which numerous service providers offer a wide range of different additive manufacturing processes and materials. The online marketplace focuses on the requirements of industrial customers, which are characterized by high quality standards and maximum transparency.

Based on their uploaded 3D data, customers receive an automated quote from various service providers within minutes and can then order directly online within just a few minutes. As a subsidiary of Phoenix Contact,



PROTIQ GmbH, which gives the platform its name, is also represented on the marketplace with its own production. The company concentrates on powder bed-based additive production processes for manufacturing high-quality parts from plastic and metal. In general, parts manufactured in this way are particularly suitable for use under high mechanical loads where high detail resolution and complexity are required at the same time.

## Höhere Bruchdehnung bei gleicher Zugfestigkeit



### Producing larger quantities with the SLS process

Among the powder bed-based concepts, selective laser sintering (SLS) and the Multi Jet Fusion process (MJF) have become established as the industrial standard. Both additive production methods work with fine plastic powder that is melted locally by a laser or a powerful light source. In this way, three-dimensional parts are built layer by layer within a few hours. The major advantage over other manufacturing processes is that, thanks to the surrounding unmelted powder, no support structures are required during the printing process. This makes it possible to produce highly complex parts that would not be feasible with any other production

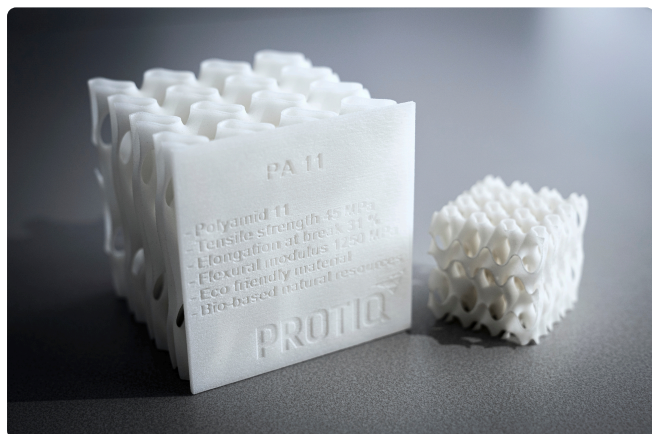
process. Furthermore, the parts to be manufactured can be nested inside one another and stacked on top of each other in the machine, which makes producing larger quantities particularly productive and economical. In the SLS and MJF processes, the plastic polyamide 12 (PA12) is generally used as the standard material. Additively produced parts made of this material can be found in many technical fields, for example in mechanical and plant engineering, in construction, and in prototypes and series applications.

### Less process waste with the bio-based plastic

The engineering plastic PA12 offers high strength and stiffness, but only moderate elongation at break and toughness. For this reason, although the parts can absorb high forces, they tend toward brittle splintering fractures under sudden impact loads. This limits the use of PA12 parts in safety-relevant areas. In addition, sustainability and the conservation of resources are becoming increasingly important, especially in the production of petroleum-based plastics such as PA12. On the one hand, the fossil feedstock must fundamentally be regarded as problematic.

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

In the industrial 3D printing environment, this problem is recognized by material and machine manufacturers as well as by processing companies. PROTIQ is relying on the new, innovative plastic PA11 here, because no petroleum is used in its production. Instead of fossil raw materials, this polyamide plastic is made from renewable castor oil. In addition, a larger proportion of the plastic powder can be fed back into additive part production, so that less process waste is generated. This approach is not only sustainable but also increases cost-effectiveness. Through further process optimization and its extensive know-how, ProtIQ has even succeeded in almost completely avoiding the generation of waste powder in its own PA11-based production. Moreover, there are now companies in the additive market that specialize in the reprocessing or further processing of used powder. In the best case, the powder can thus be fed directly back into the additive production cycle.



## Significantly higher impact resistance and impact strength

The powder material PA11 is sold by well-known companies such as BASF and EOS and can be processed on the machines of many equipment manufacturers. For users of additively manufactured PA11 parts, the material

offers additional advantages. Unlike the familiar PA12, PA11 has a high elongation at break, which is why it does not fail by brittle fracture. This is particularly noticeable under sudden impact loads in the form of significantly higher impact resistance and impact strength. As a result, additively manufactured PA11 parts can also be used in areas that must ensure personal safety in the event of a crash. Potential new fields of application arise, for example, in orthopedic orthoses worn on the body.

In tensile tests, the static strength of the two materials proves to be almost identical, which makes it easier to substitute existing PA12 parts with PA11 versions. By comparison, PA11 also has a melting point which is around 10°C higher. For specialized applications with particular requirements, the material portfolio includes various additives. On the PROTIQ Marketplace, for instance, PA11 parts are also offered with additional certifications with regard to electrically dissipative (ESD) or flame-retardant properties (UL94V-0).

Carbon fibers additionally incorporated into the base powder further increase the strength and stiffness of the parts. The use of blue-colored material, combined with the option of chemically smoothing and sterilizing the parts afterwards, permits certified use in the food industry (EU Regulation No. 10/2011 and FDA 21 CFR). Additives mixed into the powder material allow the parts to be detected by 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. Owing to the advantages described over the widely used plastic PA12, PA11 has great potential to establish itself as the new standard in 3D printing.

### Further information:

[protiq.com](https://protiq.com)