

The material

Polyamides are subdivided into various basic types. PA 6, PA 66 and PA 12 have established themselves as the most important for technical applications. Apart from the standard versions there are a large number of polyamides from which the basic types are specifically treated with additives for the requirements of special applications.

In the production of semi-finished products, a distinction is made between the manufacturing processes of extrusion and casting. The performance of extruded polyamide semi-finished products, however, has various disadvantages. The limits of manufacturing size are reached quickly. In addition the properties of the extruded materials are negatively affected because this process remolds the materials under temperature/pressure. The extrusion screw and tooling also cause shearing stress and breaks in the polymer matrix. Polyamides manufactured in monomer casting show a higher degree of crystallinity and thus have much better material properties than the extruded types.

In any case, all polyamides share, independently of their manufacturing process, a large number of basic properties specific to the material.

The key properties of polyamide are:

- High mechanical strength, hardness, rigidity and toughness
- High mechanical damping properties
- Good fatigue resistance
- Very high wear resistance
- Good sliding and emergency running properties
- Good machining properties

Extruded polyamides

Polyamide 6 (PA 6) is the best known extruded polyamide and offers a balanced combination of all typical polyamide material properties. Compared to the cast variants however, it absorbs more moisture, has much lower wear resistance and less dimensional strength. Furthermore, because of the manufacturing process, only a limited size range and unit weight can be produced. This restricts the design possibilities of the user.

The main properties of PA 6 are:

- Good mechanical strength
- high impact resistance
- good damping properties

Typical application examples are:

- Gears
- hammer heads
- impact and shock resistant components

Polyamides (PA)

Polyamide 66 (PA 66)

is used in smaller dimensioned applications and offers higher rigidity and wear resistance compared to PA 6. Compared to the cast variants, this material also displays higher water absorption. As regards to the other properties, PA 66 is comparable to the standard cast type **LINNOTAM**, but is far more expensive. As with PA 6, the manufacturing process limits the size and unit weight which can be produced, and this restricts the user's design possibilities. Therefore PA 66 in practical application is replaced to a large extent by the more economical **LINNOTAM**, which can also be produced in almost unlimited weights and sizes.

The main properties of PA 6 are:

- Good mechanical strength
- high impact resistance
- good damping properties
- good wear resistance

Typical application examples are:

- Friction bearings
- slide plates
- gears

Polyamide 66 + 30% Glass fibre (PA 66 GF 30)

Compared to unreinforced PA 66 an improved tensile/compressive strength, rigidity and dimensional stability are achieved due to the glass fibre as well as lower water absorption. Glass fibre reinforced Polyamide 66 is therefore particularly suitable for components where higher loads occur and/or increased demands are placed on the dimensional stability.

Polyamide 12

has very good impact behaviour, it is tough and is dimensionally stable due to its very low water absorption. It is available in small quantities as semi-finished products, but is not generally considered for construction applications due to its high price (3-4 times more expensive than PA 6).



LICHARZ
LiNOTAM

The competitive edge through engineered components made of plastic

Cast polyamides

Cast polyamide is a partially crystalline thermoplastic which is produced by means of anionic polymerisation of the raw material Caprolactam. In a pressureless casting process the liquid monomer is polymerised via a controlled chemical reaction directly to a semi-finished product or mould.

LINNOTAM is the new brand name of the exceptionally effective cast polyamides from LICHARZ.

Polyamides from the **LINNOTAM** brand produced by means of this process

- are mostly free of internal stresses
- display a high degree of crystallinity
- can be manufactured as semi-finished shape or near net shape component
- can be machined to almost any form
- can be manufactured in almost unlimited weights and dimensions

By means of additives, e.g. oil, solid lubricants or heat stabilisers, and modifications to the polymer matrix, the typical properties of cast polyamide can be aligned and adjusted for specific applications. Thus a tailor-made range of material can be offered for a wide scope of applications.

LINNOTAM is available in four other versions:

LINNOTAM*GLIDE*: Optimum anti-friction characteristics over the entire service lifetime.

LINNOTAM*HiPERFORMANCE*: The high-performance triple: dimensionally stable, fatigue-resistant, with excellent damping. Versions designed for special requirements include, for example, low water absorption, good resistance to hydrolysis and high impact strength.

LINNOTAM*DRIVE*: Ideally suited for the transmission of power and torque.

LINNOTAM*CUSTOM*: Your requirements are unique and individual. Ask us. We have the technical capabilities, the experience and the capacity to develop the perfect solution.

Further special settings can be made and delivered on request.

LINNOTAM

Standard quality for high wear demands on parts in machine and plant engineering.
Colours: natural, black, blue

Due to its balanced mechanical properties and its excellent mechanical features this standard quality manufactured in a monomer casting process is the ideal construction material for a wide range of applications.

LINNOTAM offers compelling advantages compared to extruded polyamide 6 due to

- better mechanical strength
- lower moisture absorption
- better creep resistance
- better dimensional stability
- higher wear resistance

Very good friction characteristics

make **LINNOTAM** a classic friction bearing material for highly loaded machine parts. These include bushings, slide and guide plates as well as gears and sprockets. Generally, an initial lubrication during assembly is sufficient due to the low coefficient of friction. In many cases lubrication can be dispensed with altogether.

High abrasion and wear resistance

at low to medium speeds, in particular under demanding conditions (e.g. dust or sand in the bearing), complete the scope of **LINNOTAM** as a friction bearing material. Under demanding conditions a significantly longer service life can be achieved compared to conventional bearing materials such as cast iron, steel or bronze.

Good damping properties

for the reduction of vibration and noise is of particular interest when using ropes and sheaves. **LINNOTAM** reduces the vibrations that are transferred from metallic rollers via the roller to the bearing, bearing to the shaft and from there to the machine frame. Friction bearings made of **LINNOTAM** reduce the vibrations affecting the machine frame. This results in the prolongation of the service life of the machine and machine components. Furthermore, measures to reduce the operating noise level of the machine are supported and enhanced.

Low specific weight

Component weight is less compared to metallic materials. This is of particular interest when centrifugal forces result from rotating components. These centrifugal forces are considerably reduced due to the lower component weight, resulting in fewer imbalances and accompanying vibrations. Often the significant weight reduction also lessens the required drive power and the handling and assembly of large parts is made much easier.

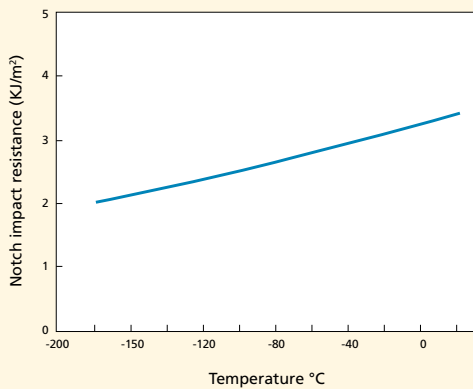
Good machinability, dimensional stability and low residual stress

enable the manufacture of complex components and the use in all areas of design. Machining can be performed with standard tools and conventional machines for working wood and metal. High feed rates and cutting speeds facilitate cost-effective production.

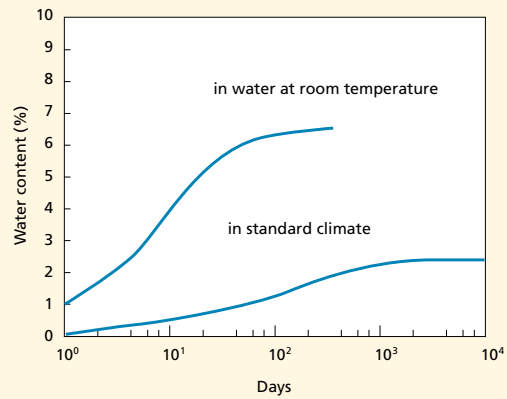
Changes in material properties

due to temperature, environmental conditions and moisture content must be taken into account. An increase in temperature coupled with high moisture content makes the material elastic. Tensile and compressive strength as well as the modulus of elasticity and hardness decrease. Simultaneously, the impact strength and elongation increases. The material assumes a strong, tough, elastic character. The change in length at elevated temperature or increased water content must also be considered. The following charts illustrate the relationship.

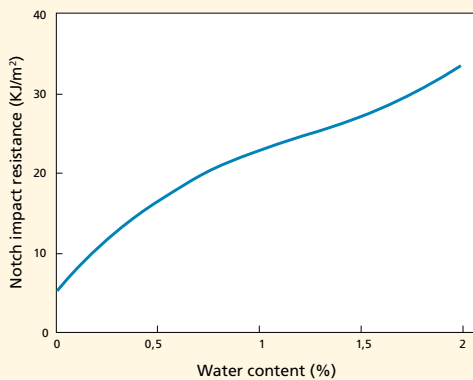
Notch impact resistance of LINNOTAM at low temperatures



Water absorption of LINNOTAM in water at room temperature and standard climate (Test piece: standard small rod)



Notch impact resistance of LINNOTAM with different water contents



LINNOTAM HS

Primarily comparable to the standard quality but with the heat aging stabiliser it is better protected against thermal-oxidative degradation.

Colour: black.

LINNOTAM MoS

Primarily comparable to the standard quality, however the molybdenum disulphide gives increased crystallinity.

Colour: black, anthracite.