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Plastics Insights

MATERIALS – PROCESSING – APPLICATIONS

Cost Efficiency Meets Performance

The Economically Attractive Alternative to PPS

With a new material development, EMS-Grivory is introducing a high-performance alternative to polyphenylene sulfide (PPS) that is specifically designed for metal replacement applications. The high-performance polymer enables more economical component production – among other things through simplified processing, lower weight, and fewer rejects. This opens up attractive substitution potential, particularly for cost-critical structural components in automotive and mechanical engineering.

Design freedom: The structure of the Grinova H polymer can be flexibly adapted to specific requirements, for example for complex geometries such as undercuts.

The combination of easy processability and balanced material properties reduces overall costs in component manufacturing. At the same time, the mechanical, chemical, and thermal performance level for demanding applications is maintained. The material-specific adaptability also supports the realization of complex part geometries, which provides greater freedom of design and makes it possible to meet functional requirements more precisely.

Thanks to the highly efficient EMS Application Development Center, including CAE-supported simulation and feasibility analyses, tailor-made solutions can be realized at an early stage of development. This allows materials to be optimally adapted to perfectly suit each customer application, saving further development time and costs.

Although the material generally involves higher material costs, these are quickly amortized through reduced maintenance costs, higher component reliability and a longer part life. Overall, Grinova H is a convincing choice – in particular for companies looking for process optimization, while at the same time ensuring more economic manufacturing in the long-term.

High-Performance Polymers in Comparison

In a comparison with conventional engineering polymers, Grinova H and PPS high-performance materials provide exceptional resistance to solvents, oils, fuels and hydrolysis. **Figure 1** illustrates the most important properties of these high-performance polymers in the context of technical applications.

Compared to PPS, Grinova H offers significantly higher mechanical properties – particularly in terms of the balance between stiffness and toughness. In a comparison of relevant grades of both polymer families, Grinova H achieves around 30 % higher tensile strength at break with almost 20 % more elongation at break at a room temperature of 23 °C (**Table 1**).

Even in simple loading cases, such as screw connections, the material achieves a high level of strength. The pull-out force of a M4 threaded bushing made of

Info

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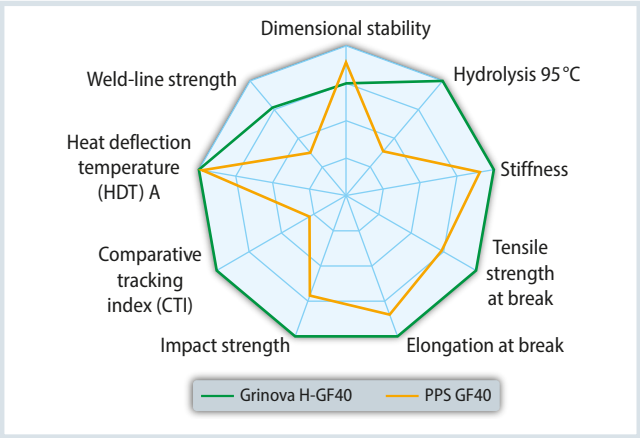

Fig. 1. A comparison of the basic properties of Grinova H and PPS. Source: EMS-Grivory. graphic: © Hanser

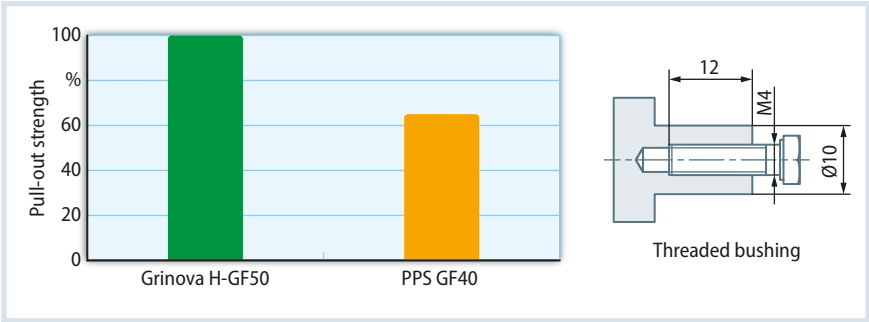

Fig. 2. The pull-out strength of a M4 threaded bushing made of Grinova H-GF50 is 35 % higher than that of PPS-GF40. This is a clear advantage for use in mechanically stressed connections.

Source: EMS-Grivory. graphic: © Hanser

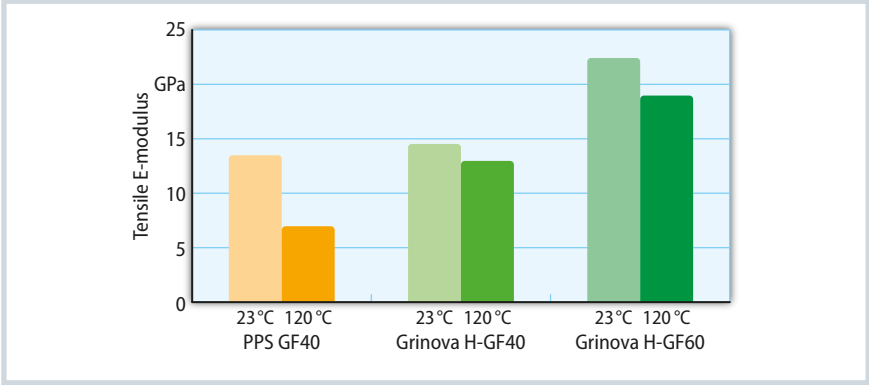

Fig. 3. A comparison of the modulus of elasticity at 23 °C and 120 °C (in GPa) shows that the material maintains higher stiffness and mechanical strength even at higher temperatures. It also makes a higher degree of reinforcement with glass fibers possible, which means that the ratio of rigidity to toughness can be further optimized in a targeted manner. Source: EMS-Grivory; graphic © Hanser

Grinova H-GF50 is 35 % higher than that of PPS-GF40 (**Fig. 2**).

Grinova H also continues to perform well at elevated temperatures. At 120 °C, it is has 85 % higher stiffness than PPS with an identical glass fiber content of 40 %.

The material allows a higher degree of reinforcement to be used, enabling targeted adjustment of mechanical properties, particularly in terms of stiffness and toughness (**Fig. 3**).

Another advantage of Grinova H polymer lies in its high modifiability allowing the polymer structure to be specifically adapted to the respective mechanical, thermal or processing requirements. The ductility of the material for example, can be specifically increased providing an advantage for complex geometries such as fittings with undercuts, requiring optimized demolding. This provides greater freedom of design in structural engineering (**Fig. 4**).

Stable Material Performance under Hot Water Conditions

In demanding applications where components are permanently exposed to high temperatures and a humid environment, in cooling circuits with water-glycol mixtures or sanitary applications for example, the question is often posed: Which material can withstand such stresses in the long term?

The material demonstrates high toughness under sustained thermal and hydrolytic stress. **Figure 5** illustrates the remaining fracture energy of 4 mm thick DIN tensile bars after continuous exposure for 12,000 hours in 95 °C hot water. Compared to PPS-GF40, this results in approximately 70 % higher remaining fracture energy, which indicates favorable long-term behavior under hot water conditions.

These results verify that hydrolysis-stabilized Grinova H is an extremely robust and high-performance alternative to PPS, providing clear advantages in terms of durability and impact strength for applications where components are exposed to hot water or glycol mixtures.

Robust and Durable under Pressure

In applications under internal pressure, the creep strength of a polymer material is a key factor for the service life and operational reliability of a component. In areas such as fluid technology in the sanitary industry, household appliances or in the automotive industry, these mechanical load cases are typical operating conditions. Which is why choice of a specifically suitable material is of crucial importance. A recent comparative test on a cylindrically shaped pressure vessel with one hemispherical end shows: Grinova H-GF40 demonstrates high endurance under constant internal pressure of 102 bar. The results speak for themselves, with Grinova H-GF40 achieving creep strength values approximately 17 times higher than those of PPS-GF30 (**Fig. 6**).

Technical Processing Differences

When processing Grinova H and PPS composites, material-specific characteristics must be taken into account. In contrast to Grinova H, PPS has a greater

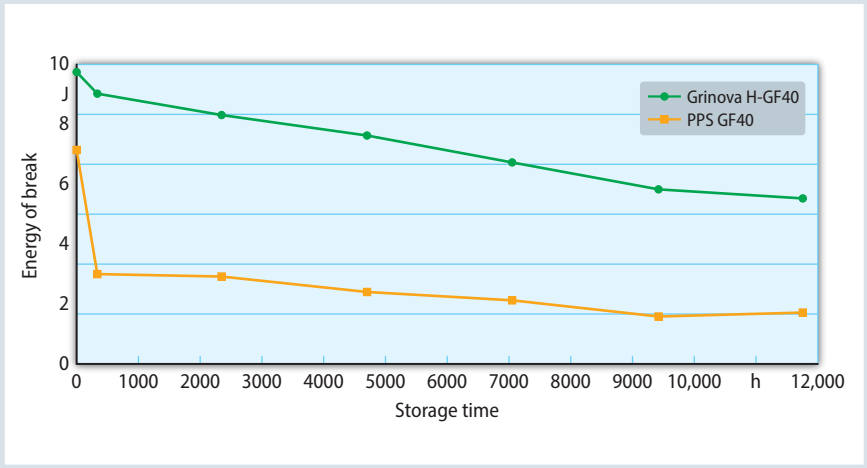

Fig. 4. Energy at break of 4 mm thick DIN shoulder bars after storage in 95 °C hot water.

Source: EMS-Grivory; graphic © Hanser

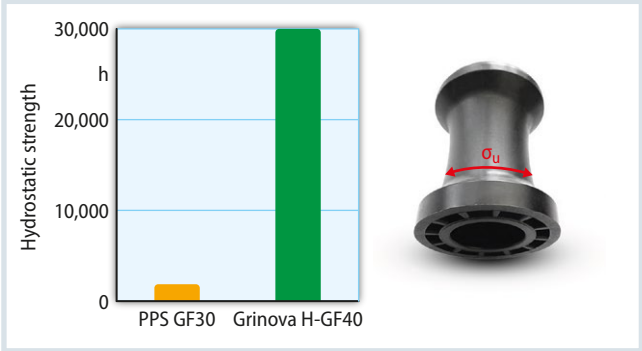

Fig. 5. EMS test specimen 4 mm wall thickness: Creep strength at 23 °C and an internal pressure of 102 bar (42 MPa circumferential stress) in contact with water on one side.

Source: EMS-Grivory; graphic: © Hanser

Property conditioned	Unit	Grinova H -GF40	PPS GF40
Melting point	°C	325	280
Glass transition temperature	°C	145	90
Modulus of elasticity	GPa	15	16
Tensile strength at break [MPa]	MPa	230	190
Elongation at break [%]	%	2	1.7
Heat deflection temperature HDT/A 1.80 MPa	°C	280	270
Impact strength Charpy 23 °C	kJ/m^2	70	50
Comparative tracking index CTI	V	600	175
Density	g/cm^3	1.53	1.67
Water absorption 23 °C, ISO 62	%	3	0.02
Flammability (UL 94), 1.5 mm	-	HB	V0

Table 1. Comparison of the fundamental physical properties of Grinova H-GF40 and PPS-GF40.

Source: EMS-Grivory

tendency for formation of blowholes, which is why optimized venting and precise control of the mold and melt temperatures are essential in order to avoid defects inside the component.

The very good flowability of PPS leads to an increased tendency for formation of flashing at parting or venting edges. This can lead to increased mold wear as well as higher maintenance costs. In some cases, design adjustments are necessary, such as using rounded geometries instead of sharp edges.

Depending on the application, subsequent mechanical processing such as grinding or milling may be necessary to remove flashing. The use of Grinova H minimizes this flashing, making post-processing unnecessary.

Further advantages become apparent under mechanical stress. The combination of high stiffness, toughness and superior tensile strength at break makes Grinova H the preferred choice for applications where high strength and durability are required. Grinova H from EMS-Grivory with its headquarters in Domat/Ems, Switzerland, shows high robustness, outperforming PPS in terms of stiffness and creep strength, especially under extreme conditions, such as high temperatures up to 140 °C and humid environments. The same company also produces a PPA called Grivory-HT. The use of Grinova H enables EMS-Grivory to further expand its position as a leading PPA supplier.

Both materials cover a wide range of properties and provide opportunities for cost and weight reduction as well as energy savings.

Additional grades are available within the product family, such as Grinova S for applications with increased requirements for surface quality and scratch resistance, and Grinova T for applications with high creep resistance and toughness. ■