Progressive Metal Replacement

Two New Polyamide Grades Will Make Engineering Components More Cost-Effective

With wide-ranging and specific property modifications, plastics can take more and more applications away from classic metal components. Polyamides and polyphthalamides, in particular, also are extending the performance spectrum, as two new variants show.

The polyamides Grivory G5V and Grivory HT6 are the latest product developments for metal replacement from Ems-Chemie AG, Domat/Ems, Switzerland. With these high-performance polymers, engineering designs can be implemented very successfully and cost-effectively. Both product families extend the range of application for polyamides to higher service temperatures and allow economic production of lightweight components that until recently could only be made from metal materials.

Grivory G5V was developed for applications in the temperature range from 80 to 100 °C. Its elastic modulus in the conditioned state at 80 °C is 45 % higher than that of conventional Grivory GV grades (**Fig. 1**). This can be attributed, among other things, to reduced moisture absorption, which also ensures improved dimensional stability.

Service Temperatures up to 100 °C

The higher resistance to elastic deformation of Grivory G5V makes it possible to design components with thinner walls. This is also helped by its 35 % better creep resistance compared to Grivory GV, which saves component costs and weight (**Fig. 2**). The property profile of the new grade also includes easy processability and constant properties in dry and moist conditions.

The target applications of the new polyamide Grivory G5V are structural components in automotive interiors, such as instrument panel supports, air vent lamellas, and seat shells, as well as functional components in mechanical engineering, furniture fittings, and fixing elements. Grivory G5V is available in three variants. The basic version Grivory G5V-5H should be first choice because it covers the majority of applications. Grivory GV XE 11607 was developed for components that have to meet high requirements in terms of surface quality, isotropic shrinkage behavior, and long flow paths. The long fiber-reinforced grade GV XE 16157 (GF60) is particularly suitable for components required to absorb very high impact energy in a crash situation.

Higher Performance from 120 °C and Lower Component Costs

With its improved property profile at high temperatures, Grivory HT6 (PA6T/8T/X) extends the range of polyphthalamides (PPA). Without compromising on processability and with the usual PPA melting point of 320 °C, Grivory HT6 has around 50 % higher stiffness at 140 °C (**Fig. 3**) than the Grivory HT1 (PA6T/6I) grades. With a heat deflection temperature of 250 °C,

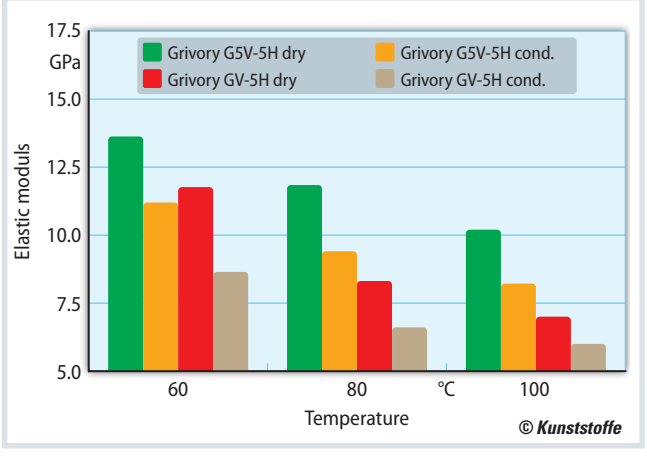

Fig. 1. Grivory G5V has significantly better mechanical properties between 60 °C and 100 °C than the familiar Grivory GV (source: Ems-Chemie)

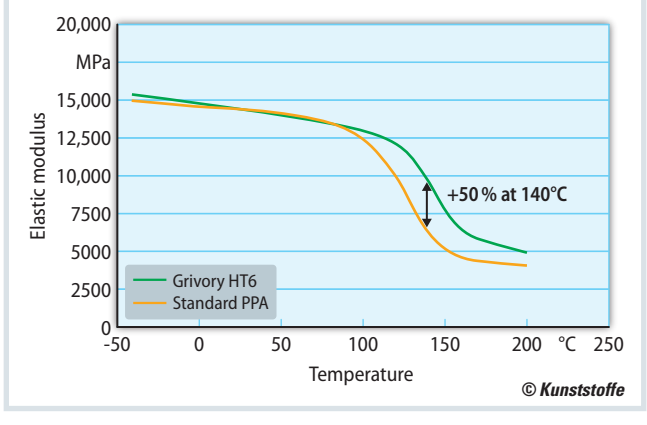

Fig. 2. At 140 °C, Grivory HT6 has about 50 % higher stiffness than standard PPA (source: Ems-Chemie)

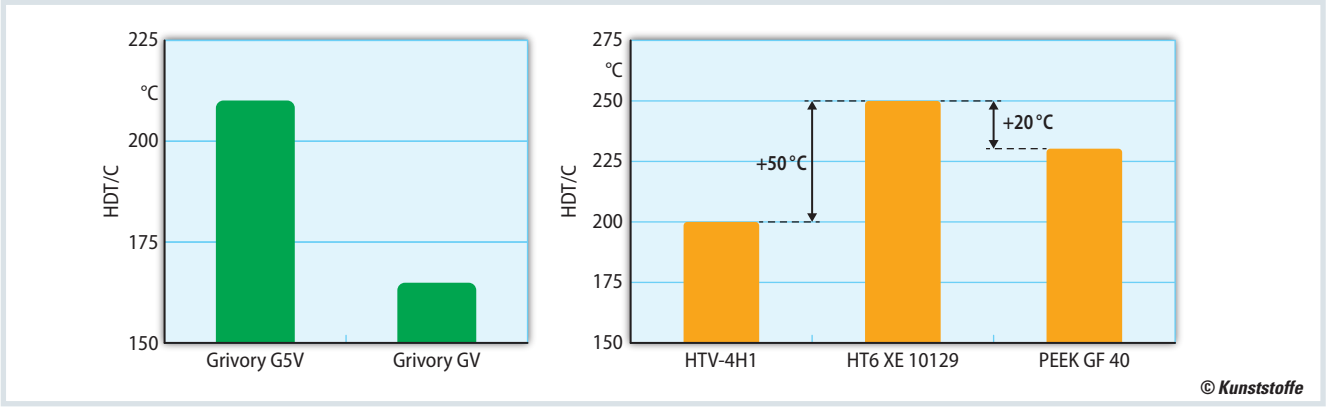

Fig. 3. The new polyamide grade G5V has a significantly higher heat deflection temperature (210 °C) than the standard GV variant. The PPA Grivory HT6 not only has a 50 °C higher heat deflection temperature than standard polyphthalamides but also beats the high-performance plastic PEEK (source: Ems-Chemie)

Grivory HT6 even exceeds the performance of a polyetheretherketone (PEEK) by 20 °C. On account of its very good endurance under high loads and temperatures, the new polymer has an extreme creep-resistant. At 150 °C, it has a 165 % higher creep modulus (after 10,000 h) than conventional PPA (**Fig. 4**). Grivory HT6 is the polyamide with the highest mechanical performance capability at high temperatures. This provides a higher load-bearing capacity above 120 °C and also makes it possible to design components with thinner walls.

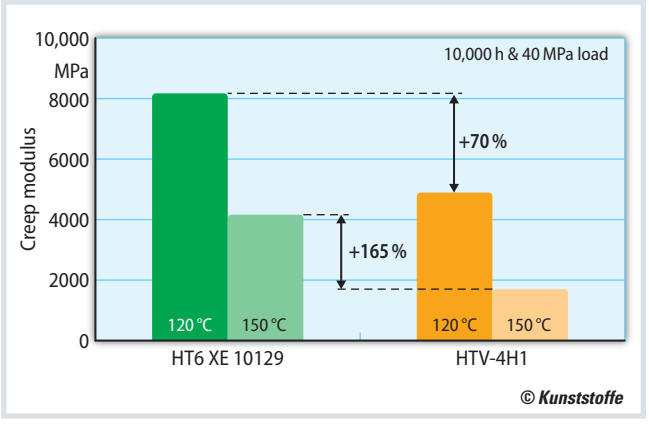

Fig. 4 . At 150 °C, Grivory HT6 has 165 % higher and at 120 °C 70 % higher creep resistance than standard PPAs (© Ems-Chemie)

Simulation Example

A cover for a pressure-stressed transmission component demonstrates the material properties in a simulation. The maximum service temperature is 140 °C with an internal oil pressure of 20 bar. The leaktightness of the cover under pressure stress is ensured with a maximum deflection of 0.3 mm.

As compared with the use of a standard PPA, wall thicknesses can be reduced and ribs saved thanks to the higher stiffness of the polymer at 140 °C. This cuts the weight of the transmission component from 101 g with standard PPA to 70 g with Grivory HT6. Faster cooling due to thinner walls reduces cycle time in the injection molding process by 35 %. As a result, the newly designed simulation component based on Grivory HT6 can be produced some 26 % more cheaply than with standard PPA for the same deformation.

Grivory HT6 is suitable for applications in which currently used PPAs or high-performance materials such as PPS and PEEK reach the limits of their mechanical load-bearing capacity. Target applications include clutch system components, gear- and structural components, underbonnet supports, as well as components requiring very high mechanical load-bearing capacity and creep resistance in the industrial and consumer goods sectors.

Currently, the material is available with 40, 50, and 60 % glass fiber-reinforcement and two different heat stabilizers (product designations: Grivory HT6 XE 10129 (GF40H), Grivory HT6 XE 11602 (GF50H), Grivory HT6 XE 11627 (GF60H)). An electrocompatible stabilizer (X stabilizer) is used mainly for applications in a moist environment that have to withstand an electrical voltage and high service temperatures (product designations: Grivory HT6 XE 11600 (GF40X) and Grivory HT6 XE 11601 (GF50X)). Other products with improved surface quality and impact strength are in the process of development.

In 1994, Ems-Grivory launched its PPA. The Swiss company regularly invests in expansion of its production capacity. Since 2010, it has more than doubled its PPA capacity. A further expansion phase is currently under way in Domat/Ems. When this plant is commissioned at the start of 2020, Ems-Grivory's polymerization and compounding capacity will be increased by more than 50 %. ■

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Service

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