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# More Cost-Effective Than Metal

Polyamides



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Special reprint

**Polyamides.** The substitution of metals has been one of the most important drivers for the growth of the use of plastics for many years. Particularly in the high-performance segment, polyamides with different forms of modification can cost-effectively replace conventional die-cast metals, while at the same time reducing the weight.



High-performance polymers such as polyphthalamides are increasingly being used to replace die-cast metals (figures: Ems-Chemie)

# More Cost-Effective Than Metal

ALBERT FLEPP

High-performance polyamides are increasingly being used as substitutes for conventional die-cast metals and enabling savings in cost and weight to be achieved. These objectives are also fulfilled by the Ems-Grivory polyamides from Ems-Chemie AG, Domat/Ems, Switzerland. They are employed wherever there is a need on the one hand to reduce the production costs, and on the other hand also to increase the performance of the finished products. Such materials are in demand particularly in the fields of automotive, electrical engineering, telecommunications, machine engineering, industry and plumbing. The main product families in the field of metal substitution include Grivory GV, a partially crystalline polyamide with partly aromatized constituents, and Grivory HT, a high temperature-resistant, polyphthalamide-based polyamide (PPA).

A particular feature of polyamides is their moisture absorption. It is determined by the chemical composition, namely by the ratio of the CH<sub>2</sub> to the CONH groups. At the same time it is also dependent on the ambient conditions such as relative humidity and temperature. The moisture absorption influences to a great extent the

mechanical properties of the material and the dimensions of the finished part.

Compared with standard polyamides such as PA6 and PA66, the Grivory polyamides absorb less moisture. Rigidity and strength therefore remain practically constant. Grivory GV is suitable for use up to a continuous working temperature of 80°C, while the high temperature-resistant PPA Grivory HT even briefly withstands temperatures of up to 250°C. The PPA Grivory HT3 was developed to meet the highest demands on resistance to hydrolysis and chemicals and for dimensional stability. By contrast with Grivory HT1 and HT2, unreinforced Grivory HT3 can also be processed by extrusion. In addition HT3 makes an active contribution to reducing

CO<sub>2</sub> emissions, as the base polymer is made from renewable raw materials.

## Wider Use Thanks to Additional Properties

For Grivory applications, the primary demand in most cases is that for strengths comparable with those of metals. Additional properties round out the demand profile. These include e.g. formulations with reduced warpage, improved flow behavior or with optimized sliding properties important for moving functional parts.

Grivory GVX and HTVX which are based on a new reinforcement technology open up additional efficient engineering possibilities. For example, transverse strength and rigidity can be significantly increased with this technology.

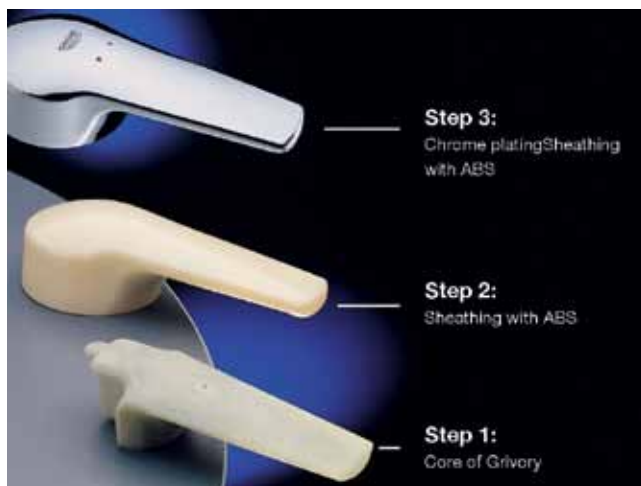


Fig. 1. Adjustment lever subject to high mechanical loads made from PPA, sheathed with ABS and chrome plated

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**Fig. 2. Bracket for a car windshield washer made from fiberglass-reinforced PPA, with bearing bushes of carbon fiber-reinforced PPA and damping bearings of TPE**

gy. Parts subject to internal pressures and high tangential stresses can therefore be produced with lower wall thicknesses. The result for the injection molder are shorter cycle times. The ultimate customer profits from a lower part weight with improved properties. Further benefits of the Grivory GVX and HTVX products include on the one hand the reduced shrinkage in transverse direction resulting in significantly less warpage, and the optimized flow behavior that is a precondition in particular for thin-walled parts.

### Reducing Processing Costs

Complex parts made from combinations of different Grivory products or from Grivory with other polymers can be produced cost-effectively by special forms of injection molding.

For example, Grivory GV and HT are extremely well suited to multi-component injection molding. Here Grivory grades with different material properties can be combined with one another, while combinations of Grivory with polymers of different chemical composition are also possible. An adjustment lever subject

to high mechanical loads, for example, comprises a core of Grivory GV to achieve the demanded strength. It is sheathed with ABS in a rotational mold before receiving a high-gloss chrome plating (Fig. 1). Adhesion between the polymers used is not necessary here in all cases.

A further example of a combination of Grivory with a polymer from another producer is the bracket of a windshield washer for a leading German automobile manufacturer (Fig. 2). The bracket is made of fiberglass-reinforced Grivory GV-5H. The bearing bush for optimum sliding and wear behavior is made from carbon fiber-reinforced Grivory GC-4H. A thermoplastic elastomer (TPE) is used for the two damping bearings. The whole bracket is produced in a single step using a rotational mold and an injection molding machine with three injection units.

A further advantage of the products as materials presented here compared with metal is the reduction in the part costs. Parts of Grivory GV/HT can be injection molded ready for use, i.e. the time-consuming refinishing by deburring of mechanical dressing to achieve the necessary tolerances or surface finishes is eliminat-

ed completely. At the same time the use of these high-performance polyamides by comparison with die-cast metals allows longer mold service lives to be achieved, enabling a cost reduction of up to 40 %.

### Service and Experience

Apart from a wide range of polyamides with properties very similar to those of metallic materials, Ems-Grivory also provides application engineering services. These start with the part design. The division has its own in-house CAE (Computer Aided Engineering) department that carries out feasibility studies and develops design proposals in advance. Parts made from die-cast metal can seldom be produced from polymers without modification to the design (Title photo, Fig. 3). Here theoretical methods can be employed, such as computations with finite elements

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or rheological simulations, before the mold is produced. The findings from these simulations are input into the mold construction and thus help to avoid faults.

Apart from computation services, support is also provided in the development of new applications for polyamides. Experienced applications developers help with the choice of the right material, draw up cost comparison and support the plastics processing industry with vast expert know-how. The extensive machine park in Applications Engineering with all the relevant processing technologies for thermoplastics allows internal material tests to be carried out and prototypes to be produced for customers.

The optimum product range in combination with string applications engineering support offers the customer a service package covering the complete innovation process – from the initial idea through to series production. ■

### THE AUTHOR

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**Fig. 3. Metal substitution – here with the example of the threaded tube – makes sense both economically and ecologically**

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## **About us**

EMS-GRIVORY is part of the High Performance Polymers business area of the EMS Group and employs more than 800 people worldwide.

The largest development and production site is located in Domat/Ems, Switzerland, with further production sites located in Germany, the USA, China and Taiwan. We provide sales/marketing and technical service functions for all major markets in Europe, Asia and America.

## **Active worldwide, prompt and customer oriented**

The independent business units EMSGRIVORY Europe, EMS-GRIVORY Asia and EMS-GRIVORY America have been established to help us in our quest to further accommodate the special requirements of the different market regions. At the same time, customers worldwide benefit from our close global network in application development, marketing and sales as well as research and development.

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