Dear Readers and Business Partners

It takes much more than a good product portfolio to be able to stay competitive in the dynamic plastics market. Development partners are needed who provide ideas, help to create innovative products and offer solutions to problems. EMS-GRIVORY has consistently followed this path for decades and, together with customers, has regularly surprised the plastics world. In this way, last year EMS-GRIVORY received multiple awards at the 18th Award Night of the Society of Plastics Engineers.

Our target is tailor-made solutions. To achieve this we not only offer the widest range of polyamides in the market, but also a comprehensive scope of services with which we can accompany you and your project from the idea right up to serial production – worldwide! The researchers and development engineers at EMS-GRIVORY create products and processes which completely satisfy market demands and customer wishes. We can provide support in mould construction as well as in prototype manufacture and testing. We have a wealth of experience in simulation calculations and component optimisation which is continually being expanded. In combination with our high-performance materials, this makes exceptional component designs possible. This means you get much more than just a plastic, but an integral system solution with added value with regard to cost savings, weight reduction and freedom of design.

Let yourself be inspired by the exciting highlights we will present at the K 2019. We will show you how you can realise advanced metal-replacement projects at elevated temperatures using Grivory G5V, Grivory HT6 and Grilon TSG-W3. In addition, we can give you insights into our application development centres worldwide and we will also present the latest development grades of our tried and tested classic, Grilamid TR, which opens up new extremely challenging and sustainable medical applications.

These and other innovations are described in the following pages. I wish you interesting reading and a fascinating visit to the K 2019.

We look forward to hearing your challenge!

CHRISTIAN MORF
Vice President Marketing and Sales

Higher performance in water
Plastic materials which are permanently resistant to hot water, steam or cooling agents are in great demand for automotive cooling systems, sanitary applications or various other applications in industry and the consumer goods sector. An excellent resistance to hydrolysis is, therefore, a basic requirement for use in these challenging applications.

More on page 6.

Global development partner
EMS-GRIVORY is a competent and reliable partner for the development of challenging components and active worldwide. As development partner for customer-oriented solutions, EMS-GRIVORY has independent application development centres in the most important markets Europe, Asia and America. Particularly in the USA, application development is being strongly expanded.

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 EMS-GRIVORY is market leader in the field of high-performance polyamides and sells a range of more than 100 products under the trade name Grilamid TR. These products are transparent high-performance polyamides containing no BPA, which are manufactured using thermoplastic processes.

**Polymers in medicine**

Polymers are today among the most often used materials in the field of medicine. Medical products made of polymer materials are very versatile. They are used, for example, for disposable articles such as syringes, containers, catheters and face masks as well as prostheses and implants. Medical instruments or certain components of these instruments are also made of polymer materials. Used in these innovative instruments, polymers make medical work easier. At the same time, they also contribute to safety of patients and doctors as they are resistant to breakage. Conditions under which the polymers are used are often very demanding – surgical instruments for example, or applications involving direct contact with disinfectants or other chemicals. Demand for tailor-made polymer materials optimised for specific uses is steadily growing. On the downside, quantities of waste material to be disposed off has increased greatly due to the use of one-use articles. For this reason, EMS-GRIVORY has expanded the product family of transparent Grilamid TR with new and innovative products.

**Resistance is required**

The number of plastic articles which fail in use is large. Doctors complain of failure of plastic components after they have been exposed several times to contact with solvents. These components then develop cracks, the colours fade and in the worst case, they break while in use. A variety of chemicals can have different effects on plastic materials. A particular plastic material may be resistant to one kind of chemical (i.e. no loss of property values or colour changes) but will break when exposed to another chemical. This phenomenon can occur when medical equipment is repeatedly exposed to disinfectants. Only through use of the correct polymer materials can a solution to the problem of the increasing number of defect components in medical instruments be found. Transparent plastics such as PC, ABS, PMMA, PS and SAN, as well as some semicrystalline materials are sensitive to stress cracking. Due to their high resistance to chemicals, Grilamid TR products from EMS exhibit no stress cracking and, in this way, contribute to a longer working life for medical applications.

**Tailor-made Grilamid TR products**

Products from the Grilamid TR product range are first choice for applications involving transparency, break resistance and resistance to chemicals. The latest additions to the Grilamid TR range have property profiles precisely modified to suit the field of application or use, but also the popular standard grades are supporting the continual further development of medical products. The following is a list of the most important Grilamid TR products for medical applications:

- **Grilamid TR 55** is a transparent high-performance polyamide with outstanding resistance to hot water and hydrolysis.
- **Grilamid TR 90** is a transparent high-performance polyamide with excellent flexural fatigue strength, impact strength and resistance to chemicals.
- **Grilamid TR 60** and the new Grilamid TR XE 11292 are transparent high-performance polyamides with excellent flexural fatigue strength and improved resistance to alcohol.

### Reusable instead of disposable

**Grilamid TR — innovative material for medical applications**

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- Grilamid TR 55 is a transparent high-performance polyamide with outstanding resistance to hot water and hydrolysis.
- Grilamid TR 90 is a transparent high-performance polyamide with excellent flexural fatigue strength, impact strength and resistance to chemicals.
- Grilamid TR ICR 12 and the new Grilamid TR XE 11292 are transparent high-performance polyamides with excellent flexural fatigue strength and improved resistance to alcohol.
Grilamid TR 60 and the new Grilamid TR FE 11292 are transparent high-performance polyamides with excellent heat distortion behaviour and resistance to chemicals. In addition, the products can be sterilised and are excellently suitable for use in combination with silicon (LSR).

The above-mentioned Grilamid TR products satisfy all requirements of European guidelines or handling of water and foodstuffs as well as the American guideline FDA CFR 21. They also correspond to the testing requirements as per United States Pharmacopoeia (USP) Class VI and are certified according to the 3-A Sanitary Standard.

Reusable instead of disposable

Increased demand for polymer materials in disposable articles also results in large amounts of waste. To prevent this, EMS-GRIVORY has developed a transparent high-performance polyamide which can be sterilised several hundred times and, therefore, is reusable.

Reusable medical products or instruments do, however, involve a certain risk of cross-contamination. Steam sterilisation (so known as autoclave treatment) is a suitable method for safe sterilisation whereby saturated steam in a temperature range from 120°C to 148°C is used under high pressure for a stipulated length of time. It is for exactly this process that EMS-GRIVORY has developed the new high-performance polyamide Grilamid TR FE 11292, which is suitable for repeated steam sterilisation. This makes Grilamid TR FE 11292 the first transparent polyamide worldwide which can be repeatedly subjected to steam sterilisation.

The field of use of the new Grilamid TR FE 11292 is greatly diversified. Due to its crystal-clear transparency, high mechanical strength and toughness as well as its good resistance to chemicals, Grilamid TR FE 11292 can be used for multiple applications requiring high transparency such as transparent pump housings, filters, steam valves, containers boxes and toolboxes, ventilation masks, sights windows and much more. EMS-GRIVORY stands for reusable instead of disposable.

Grilamid TR paired with LSR

Back injection moulding using hard and soft plastics has, over the last years, become a basic technique for use by designers of medical components. Liquid silicon rubber (LSR) used in medical applications provides advantages compared to other soft materials such as TPE and TPU, with regard to chemical and heat resistance and flexibility. Despite all these advantages, however, it can be difficult to achieve permanent bonds. EMS-GRIVORY offers two transparent high-performance polyamides which are excellently suited for back injection moulding to LSR. Grilamid TR 60 with a Tg of 190°C and the recently developed Grilamid TR FE 11292 with a Tg of 200°C are the products of choice. The good resistance to temperature provided by Grilamid TR 60 and Grilamid TR FE 11292 makes it possible to use higher curing temperatures and thus, reduce cycle times. The components retain their dimensional accuracy and show no distortion or warpage.

Innovative application examples realised using Grilamid TR

An indication of how designers of medical products use Grilamid TR to develop innovative devices for use in the field of health and medical care can be seen from the examination of some current medical and health products and the materials of which they are made. A non-invasive nasal breathing mask sets a range of demands to be satisfied by the product developer – who selected Grilamid TR 60, which has good resistance to chemicals for sterilisation (washer at doctors’ for 12 minutes) and satisfies all requirements with regard to bio-compatibility. Grilamid TR 60 also offers the high heat distortion temperature (170°C), necessary to achieve high bonding strength (≥70 N tensile strength) to liquid silicon rubber. The recently developed Grilamid TR FE 11292 is currently being considered for similar applications.

A further example is the fascial closure system for minimal-invasive surgery of a post-operative trocar hernia. Grilamid TR 55 was chosen in order to provide the necessary properties such as mechanical strength and toughness, low weight and good resistance to chemicals.

In a third example, Grilamid TR 90 was chosen for a bone cement application system as it provided several important properties to complete the task. Grilamid TR 90 provides mechanical strength and toughness, good resistance to chemicals and high transparency – and satisfies bio-compatibility standards. The resulting device provides doctors with an application system which is tailor-made for the requirements of orthopaedic operations where precise application of bone cement is needed.

RONNY EBLING
Product Manager Grilamid TR

Ultra-light weight material for glasses

Grilamid TR – nearly weightless

The outstanding properties of Grilamid TR – low weight, extreme toughness and high resistance to chemicals and weathering – predetermine this material for high-quality sun and sports glasses. Now, water athletes have one reason more to use glasses made of Grilamid TR. Thanks to a new specifically modified Grilamid TR product, glasses can now be made which are so lightweight, that they float on the surface of water – while still maintaining the material properties required for use in water sports. So there is no sinking feeling when the glasses fall off due to high winds or strong waves.

Low density compensates additional weight

Thanks to the low density of 0.93 g/cm³ (when processed correctly) even watertight designs have enough buoyancy to compensate for a weight gain from painting, hinges and lenses. In order to profit fully from the property profile of this innovative product, lightweight high-performance Grilamid TR should be preferred instead of heavy polycarbonate. This new product is also available in a bio-based variant with the same properties, but with a significantly reduced CO₂ footprint.

NIKITA GNATENKO
Application Development Optics

Grilamid TR XE 3805 – Grand Entrance at the K 2019

Protective glasses in record time

EMS-GRIVORY offers its partners not only materials with outstanding properties, but also innovative system solutions for complex optical components. The idea of manufacturing a pair of glasses quickly and inexpensively as a one-piece injection moulded component with excellent eye protection and wearer comfort, was realised in a development project together with the partner companies uvex and Arburg.

A range of different design possibilities and gate positions were generated and evaluated. The final, chosen variant with only one central gate positioned at the lens surface, avoids the formation of weld lines, but requires long flow paths leading to high filling pressures and induced component tension, which may have a negative influence on mould surface reproduction. This means that the optimal relationship between filling pressure, component flow path lengths and optical properties needs to be achieved.

EMS material satisfies all requirements

The temples, which transfer stress smoothly to the centre part and must fulfil a hinge-like function, must have high deformability and outstanding recovery properties while maintaining high component strength. Also required are UV protection up to 400 nm and excellent impact strength to ensure protection of the eyes. The material used, Grilamid TR XE 3805, satisfies these requirements and, in addition, also has optimal optical properties. These one-piece polyamide glasses will be manufactured as sunglasses lens category 2 in less than one minute per pair in a highly-automated manufacturing cell, tested, laser-printed and given to interested visitors at the Arburg Stand during the K 2019.

RUDI PORTMANN
Head of Computer Assisted Technical Service
Grivory GSV and Grivory HT6 are the latest EMS-GRIVORY product developments for metal replacement. With these high-performance materials, designs with the best technical and economic perceived value can be realised. Both product families extend the range of use of polyamides to higher temperatures and allow cost-efficient and weight-reducing manufacturing of components to be achieved, which was previously only possible using metals.

**Grivory GSV – ideal up to 100 °C**

Grivory GSV was developed for use in applications in the temperature range from 80 to 100 °C. The modulus of elasticity in a conditioned state is 45% higher at 80 °C in a conditioned state than that of Grivory GV. This is due, among other things, to the reduced moisture uptake, which additionally guarantees improved dimensional stability. The higher resistance to elastic deformation allows a component layout with thinner walls to be achieved, which is also promoted by a 35% improved resistance to creep compared to Grivory GV (Fig. 2). This allows part cost and weight savings to be achieved. The simple processability and consistent property values in both dry and moist environments round off the property profile of Grivory GSV. Designated end applications for this material are structural components in automotive interiors such as instrument panel support, air vents or seat shells as well as functional components for mechanical engineering, furniture fittings or fastening elements.

**The Grivory GSV product assortment:**
- The basic variant Grivory GSV-5H is the first choice and covers the majority of application areas.
- Grivory GV VE 1160° was developed for components with high requirements on surface quality, isotropic shrinkage behaviour and long flow paths.
- With the long-glass fibre reinforced grade GV VE 11615 (GF60), EMS rounds off the current GSV product profile. This material is particularly well suited for components which have to absorb very high impact energy in a crash scenario.

Grivory HT6 – more performance above 120 °C

Grivory HT6 (PA6T/8T/X) is used everywhere where today’s polyphthalamides or other high-performance materials such as PPS and PEKK reach the limits of their mechanical loading. Grivory HT6 has the best creep strength of any PPA on the market. This material is striking with its enormous long-term strength values despite high loads and temperatures. A 165.5% higher creep modulus is achieved after 100 000 hours at 150 °C as with conventional PPAs (Fig. 3).

Grivory HT6 is also the polyamide with the highest mechanical performance at elevated temperatures. This allows, on the one hand, higher loading at 120 °C and, on the other hand, makes a layout for new, thinner-walled components possible. As a consequence, part costs and component weight can be significantly reduced (Fig. 4+6).

**New definition of performance**

With its improved property profile at high temperatures, Grivory HT6 sets new standards in the PPA product family. Without limitations from processing and with a standard PPA melting point of 320 °C, Grivory HT6 is characterised in comparison to Grivory HT1 by around 50% higher stiffness at 140 °C (Fig. 3). With a heat deformation temperature of 250 °C, this product even exceeds the performance of PEKK by 20 °C (Fig. 7). Focus end applications for Grivory HT6 are clutch system components, gears, engine-room structural components and brackets as well as components in the fields of industry and consumer goods with the highest resistance to mechanical loading and creep.

**Grivory HT6 product assortment**

Grivory HT6 is currently available with 40, 50 and 60% glass-fibre reinforcement and with two different heat stabilisers. For X-stabilisation, so-called electro-compatibility stabilisation is used, mainly for applications in moist environments where resistance to electrical current and high operating temperatures is required. Further products with improved surface quality and higher impact strength are currently being developed.

**Expansion of production**

In 1994, EMS-GRIVORY launched the market introduction of the high-performance design material Grivory HT (PPA). In the meantime, EMS-GRIVORY has become the manufacturer with the widest PPA product range and market leader in Europe. EMS-GRIVORY regularly invests double-digit million amounts in the expansion of production capacity. Between 2010 and today, EMS has more than doubled its PPA capacity. A further expansion stage is currently being realised at Domat/Ems, Switzerland where the startup of production in early 2020, will achieve a significant increase in polymerisation and compounding capacity.

**HT6 products available**

- Grivory HT6 XE 10129 (GF40H)
- Grivory HT6 XE 11600 (GF40H) *
- Grivory HT6 XE 11601 (GF50H) *
- Grivory HT6 XE 11602 (GF50H) *
- Grivory HT6 XE 11627 (GF60H) **
- Grivory HT6 XE 11635 (GF40H) **

* electro-compatible stabilisation
** electro-compatible stabilisation & hydrol stability

**Grivory HT6 reduces cost and lowers weight for the selected gear cover, wall thicknesses could be achieved which are 27% lower than compared to a standard PPA, leading to a weight saving of 31%. The cycle time is 33% shorter allowing cost savings of 26% to be achieved**
**Grilon TSG-W3: Excellent resistance to heat-ageing**

Heat stabilised grades in the Grilon product family are used with great success in the field of automotive manufacturing. They come up trumps, above all when used in turbo-charging air systems. Grilon TSG-W can be used without restrictions at temperatures up to 190°C, at temperatures up to 210°C, Grilon TSG-W2 is ready for use. These two materials have already been used to realise many challenging applications in air-guide systems. The automotive supplier Mann+Hummel for example, uses Grilon TSG-35/4 W2 for selected resonators, angled connectors or turbo-charged air cooler end caps for PSA (Peugeot Citroën). The EMS material trumps up here not only with its good temperature resistance, but also with its excellent surface quality and easy processing. Grilon TSG-35/4 W2 replaces PA66 in these applications, leading in addition to past cost reductions.

**No compromises with the new generation**

Based on constantly increasing application requirements, especially for turbo-charged air systems, EMS-GRIVORY has developed the third generation of the TSG-W product range. Grilon TSG-W3. This material has excellent resistance to heat ageing at temperatures up to 230°C. Grilon TSG-35/4 W3, for example retains more than 75% of its tension at break property values after 3000 hours storage at 230°C. In this way, even at 230°C, it has a heat ageing behaviour comparable to that of high heat-stabilised polyphthalamides. The excellent surface quality is identical to that of the Grilon TSG-W2 generation and reduces loss of pressure in turbo-charged air systems while making post-treatment of sealing parts unnecessary. This means that Grilon TSG-W3 is predestined for applications in turbo-charged air systems such as, for example, turbo-charged air cooler end caps, charged air pipes, resonators or rapid connectors.

The new Grilon TSG-W3 grade closes the gap between the Grilon TSG W products in the first two generations and the high heat-stabilised High-Heat Polyamide Grivory HT2VSHH, thus completing the product portfolio for applications in the temperature range between 150°C and 250°C.

**Tailor-made metal replacement to satisfy highest demands**

Get a handle on it with Grivory GV-5H

Bojo Tools is an American hand tool manufacturer specialised in the design and manufacturing of high-quality composite plastic tools. Together with EMS-GRIVORY, the company has developed a product line based on the advantages provided by Grivory GV-5H. Using this material, which is reinforced with 50% glass fibres, Bojo makes spanners and socket wrenches – otherwise typical applications requiring metal.

**High material requirements**

These tools, made of EMS materials, are used in the automotive, aviation and aerospace industries. In automotive applications, they are used for work on anodised or chrome-plated components to prevent scratching caused by conventional metal tools. Avoidance of scratches is also an absolute must in the aviation and aerospace industries. When working with these highly sensitive components it is also important that no metal particles break off from the tools – a further decisive advantage in favour of composite polymer tools. And not least, the electrical insulating properties of these products are also a significant requirement.

**Optimal product properties**

Bojo Tools decided on EMS material Grivory GV-5H because this provides the optimal property portfolio to satisfy these highly demanding tasks. The partially aromatic Grivory GV-5H has the necessary stiffness and strength, in both dry and moist conditions. In addition, it also has high creep resistance, excellent dimensional stability, very low density compared to metal and – despite the high glass-fibre content – a very good surface finish.

DARRYL GOODWIN
Head of Sales EMS-GRIVORY America

**Flying high with EMS-GRIVORY**

Ultra-lightweight and high-strength EMS materials for the ANAFI 4K drone from Parrot

The French drone manufacturer Parrot is intent on providing customers with continually longer flying time. To achieve this, continually lighter weight materials are used as the weight of the drone has a direct influence on the maximum flight time. The weight also has a big influence on the flying behaviour, i.e. agility, of the drone. Along with lower weight, the latest materials used must also show improved performance with regard to stiffness and strength.

**Grilamid – excellent property portfolio**

In its new ANAFI 4K drone, Parrot makes use of several materials from EMS-GRIVORY. Various Grilamid grades are used as their polymer matrix already has low density, good UV stability and very low moisture uptake. The frame and covers of the arms on the top side of the ANAFI 4K are made of the new, “Low Density” Grilamid LXE 114S4, while the frame and covers on the underside are made of Grilamid LV2 ANZ. The camera bracket and internal parts of the drone are made of high-stiffness Grilamid LCL3H.

THOMAS SCHNELL
Application Development Industry & Consumer goods

**Top material & service**

Grilamid LXE 114S4, recently used for the first time, has a density of 1.02 g/cm³ and a modulus of elasticity of 8300 MPa (in a conditioned state). This fine balance between stiffness and low density has been achieved through a combination of carbon fibres and a “Low-Density” additive. The high performance polymers as well as the support provided by the EMS-GRIVORY application development department were the decisive factors for success of the ANAFI 4K, the drone with the lowest weight in its category.
Higher Performance in Water

In vehicle cooling systems, sanitary applications or other applications in industry and the consumer goods sector, plastic materials face challenging requirements with regard to their long-term resistance to hot water, steam or cooling agents. Excellent resistance to hydrolysis is therefore a basic prerequisite for use of a material in these challenging applications. With Grivory HT “High Hydrolysis Resistance”, EMS-GRIVORY has launched a product line which opens up new possibilities for applications involving permanent contact with water. Grivory HT “High Hydrolysis Resistance” is characterised by maximum hydrolysis resistance even at elevated temperatures. For example tensile test bars made of the Grivory HT1VA grade (4% standard for aging at water) show 30% higher remaining strength values after storage in hot water at 95 °C for 12 000 hours than a traditional PPA.

Resistance and efficiency
Grivory HT “High Hydrolysis Resistance” is available in two varieties: for applications in automotive manufacturing or for use in contact with foodstuffs or drinking water. Regarding the first area, these products are especially well suited for the manufacture of components for use in engine cooling systems which need to satisfy the highest requirements. Mann+Hummel, for example, makes a cooling water valve for Hyundai-KIA U engines out of Grivory HT1VA-35 HYS. Along with the excellent resistance to hydrolysis at high temperatures, other decisive requirements for use in this kind of application were outstanding resistance to cooling agents and high dimensional stability – requirements which are completely fulfilled by Grivory HT1VA-35 HYS. A further reason for selection of Grivory HT1VA-35 HYS for this use is its optimised deformability which allows complex component geometries or undercut to be made, so increasing the efficiency of the injection-moulding process. Further products are: HT1VA-45HYS, HT1VA-4H, HT1VA-3H and Grivory HT XE 10814 Brown-Black 8325 (latex transparent).

Interesting product for electromobility
Grivory HT “High Hydrolysis Resistance” is not only suitable for use in vehicles with classical internal combustion engines. Heat management is particularly important in electrical vehicles, whereby liquid cooling systems based on water are used. The combination of electrical conducting paths and electronic components is possible without problem as the available “electrically friendly” stabilisation systems prevent problems with salt efflorescence andcorresponding corrosive effects in warm and moist conditions.

Hot water and steam
With the “TVA” products approved for use in contact with foods, fluids and drinking water, Grivory HT “High Hydrolysis Resistance” can be used for a variety of applications. Two grades with differing amounts of reinforcement are available: Grivory HT1VA-4 FWA (40% glass fibres) and Grivory HT1VA-5 FWA (50% glass fibres). In comparison to the standard Grivory HT1VA-4 FWA grades suitable for use in contact with foodstuffs and drinking water, these two products provide significantly higher toughness and reliability and extend the limits of use with regard to temperature and duration of working life.

These products have already been successfully launched on the market. Grivory HT1VA-4 FWA is used for fluid connections and a distribution block for fully automated coffee machines. The components involved cyclic exposure to water and steam.

Getting a grip

The ITW Company makes an external car door handle from Grivory GVX and Grilon BG which is used for the Jaguar X-pace and Land Rover Velar vehicles. This so-called “Flush Handle” is electrically activated to pop up from the inactive basic position level with the surface of the car body to be ready for use. Reliable functioning under a range of varying climatic conditions in a temperature range from -40°C to +80°C was the central requirement for this challenging door opening mechanism. Using a specially developed type of glass fibre reinforcement, Grivory GVX provides high dimensional stability and extremely low warpage, which are prerequisites for successful interaction of the components where tolerances are critical. The complex internal workings and electronics of the door handle are reliably protected by a housing made of Grilon BG. This application took third place in the SPE category “Body Exterior”.

A hot job

The Melta Company makes a turbo-actuator using Grivory HTV. This completely all-plastic solution is the development of the second generation of turbo-actuators for control of variable turbine geometries and also provides weight and assembly cost reductions to be achieved. With a high distortion temperature of 280°C (HDT/A), Grivory HTV provides the basis for the required high stiffness and strength values. The robust polymer component even makes a 35°C higher working temperature and transfer of even higher torque values possible, allowing higher working temperatures of the engine and higher charging pressure to be achieved. The two shells of the actuator are laser-welded with a special colour adjustment being developed to make this possible. In visible light the colour appears black, in the relevant wave range of 700-1100 nm during laser welding however, it is transparent.

The turbo actuator made it right to the top in the category “Electrochemical/Optical Parts” and was awarded first prize.

Sitting made easy

The sport seats in the new Opel Insignia GSI model are the result of cooperation work between EMS, the Lear Corporation and the automotive manufacturer OPEL based in Rüsselsheim, Germany. The back support and seat shell for a sports seat are made of Grivory GVL HP. The special long-glass fibre reinforcement of the material forms a fibre skeleton during the injection-moulding process, thus significantly increasing the notched impact strength values and allowing clearly higher energy absorption in the case of a crash. Compared to a similar metal version, an enormous weight saving of two kilograms was achieved. With comprehensive CAE calculations and technical support during processing, EMS-GRIVORY made realisation of this very challenging application possible. The back support and seat shell made of Grivory GVL convinced the jury with an intelligent and exceptionally innovative use of plastic materials in this highly complex application was awarded not only the “Innovation Award” in the category “Body Interior”, but also the “Grand Innovation Award” for excellent innovation over all categories.

Many automotive applications are realised with materials and know-how from EMS-GRIVORY. These regularly attract a great deal of attention among the experts in this sector and also win highly prestigious prizes – as at the 18th SPE Award Night of the “Society of Plastics Engineers”, where EMS-GRIVORY won several awards.

Award-winning in Automotive

Highly innovative applications using EMS polymers

Grivory HT «High Hydrolysis Resistance»

Cooling water valve made by Mann+Hummel using Grivory HT1VA-35 HYS.

Grivory HT «High Hydrolysis Resistance» provides significantly improved weldline fatigue strength.

Number of cycles until break [n] 100 000 1 000 100 10 1
Preconditioning in water at 125 °C [h] 500 1000 1500

Contact us and get a quotation
www.emsgrivory.com

MICHAEL HOFFMANN
Automotive application development

HIGHLY INNOVATIVE APPLICATIONS USING EMS POLYMERS

AWARD-WINNING IN AUTOMOTIVE

ALBERT FLEPP
Product Manager Grivory HT

Seat shell and back support made of Grivory GVL HP, at right the complete seat.
LFT polyamides – The solution for crash-relevant applications

The long glass and carbon fibre (LFT) reinforced granulates from EMS-GRIVORY are already well established for use in applications at high temperatures and with simultaneous high mechanical loading. Whether better property values at the same temperatures or the same property values at higher temperatures are required, LFT polyamides offer a superior overall package compared to short-fibre reinforced products. Especially with compounds containing a high degree of reinforcement where addition of further quantities of fibres is not possible, the corresponding long fibre reinforced grades can provide the required performance.

Special fibres for more Also part of the project was to achieve serial manufactur-

ing necessary.

But EMS didn’t stop there. With the new High Performance (HP) materials, key properties such as toughness and impact strength were increased further compared to standard long-glass reinforced products. This is thanks to use of special fibres which are impregnated in an optimal way on the production lines of EMS-GRIVORY using a complex pultrusion process, and can therefore, realise their complete performance capabilities in the components manufactured. These products can be easily identified by the designation HP in the grade names and are available as the well-

known EMS polyamides Grilon TS (PA66 + PA6) and Grivory GV (partially aromatic polyamide). From today, other grades based on the new Grivory G5V (GV especially optimised for use in warm, moist environments) are also available as HP grades. These grades open up new application possibilities e. g. in vehicle interiors with requirements for heat resistance at temperatures above 80°C but using the same simple processing methods, in comparison to widely used short-fibre reinforced polyamides.

Safety guarantee High stiffness values combined with good crash properties make it possible to re-

place metal in extremely complex and safety-relevant components. The instrument panel support of the BMW M4 GTS model, made of Grivory GV-4H HP, replaces a complicated welded construction with dozens of individual components. The support, made of long-glass fibre reinforced polymer satisfies the same requirements as the construction made of metal, while allowing a weight reduction of 1.6 kg to be achieved.

Technology that fits In 2018, EMS-GRIVORY was also able to convince a global OEM in the cost-driven car seat market of the advantages of long-glass fibre technology. In intensive cooperation with the supplier Lear Corporation, a sport seat for the Opel Insignia GSI series with a very distinctive design was developed using Grivory GV-HP. This seat fulfills all requirements of the German AGR Healthy Back Campaign (Akton Gesunder Rücken) and all demands of the experienced racing driver Volker Styczek. Thanks to the use of compatible assembly sets taken from the standard Opel Insignia seats, it was possible to design a plastic shell seat for this sports model providing an economic solution which is simple to implement. The main driver behind the new seat development was the weight re-

duction achieved of 2 kg per seat with no compromises in design or performance being necessary.

Reliable and handy EMS high-performance polyamides for an innovative rapid charging system

The Swiss cable specialist, Huber+ Suhner, relies on longglass fibre technology (LFT) from EMS-GRIVORY for the main components in its RADOX® HPC high-power charging system. The extremely tough long-glass fibre reinforced and flame pro-

tected high grade Grivory GV-4H VO makes reliable use of this car charging station system pos-

sible in rough daily use. Also part of the charging system is a liquid-cooled cable. Thanks to the act-

eve cooling process, this cable can have a significantly smaller diameter than the throughput performance would make you believe, and is therefore, easier to handle. The cooling lines in this cable are also made of an EMS material: Grilamid L.

Short changing times possible The High Power Charging System, with up to 500 A and 1000 V, developed by Hu-

ber+Suhner allows particularly rapid and, therefore, user-friendly charging times which no longer differ greatly from a filling time with liquid fuel – even the batteries of larger electric vehicles can be charged up to 80% in less than 15 minutes.

Innovative premiere in automotive interiors Lever handle made of Grilon BG-50 S in MuCell process

The Swiss company EJOT is making the first serial lever handles for steering column adjustment involving specific requirements for strength and surface quality, using the MuCell injection moulding technology (physical foaming). The objective of the project was to achieve serial manufactur-
ing of a lever handle satisfying all technical requirements such as minimum abrasive force levels in horizontal and vertical directions, maximum crash energy of a knee impact including a defined breaking line for fracture behaviour and a very aestheti-

can surface quality for all visible areas.

Higher performance thanks to Grilon BG-50 S Thanks to use of Grilon BG-50 S, the ne-

cessary requirements were able to be sat-

tisfied very well. This material is a heat-stab-

ilised PA6 injection moulding grade with 50% glass fibre reinforcement. It is charac-

terised by high stiffness, excellent surface quality, good flow behaviour and good processability. The material can also be used in MuCell processes, allowing further weight savings to be achieved and result-

ing in components with very low warpage.

KLAUS-JÜRGEN STEFFNER Application Development Industrial & Consumer Goods

TOBIAS ZUND Sales Manager Switzerland
**Mercedes continues to rely on Grilamid TR Piano Black**

A touch of class

Unconventional air vents and stylish background lighting are an eyecatcher in every automotive interior. Mercedes is setting new standards for air vents while still remaining faithful to the tried and trusted style with piano-gloss optics. The new Mercedes A and B Classes keep the round design, but are equipped with an integrated lighting system which goes well with the interior. Also new is the striking adjustment mechanism for the air flow. The dial-like vent, which is operated via a rotary knob, provides a high recognition factor.

**Convincing properties**

With this application Mercedes continues to place its trust in Grilamid TR XE 4139 (Piano Black) due to the excellent property profile of this material. The amorphous polyamide from the Grilamid TR 30 product family provides perfect, high gloss surface quality. The high scratch resistance of the material means that no additional lacquering process is required, saving manufacturing costs and time. As air vents often come into contact with sweat, various cosmetic creams and cleaning agents during use, high demands are made on their resistance to chemicals. Grilamid TR XE 4139 satisfies these without any danger of clouding, opacity or tension cracking.

**Light, lighter, feather-weight**

Walking aids made of Grivory GCL-3 H

“Light, lighter, feather-weight” is the slogan used by the Ganymed Company to advertise the current additions to the product range of walking aids, many times award winners. Following the models Independent, Benchmark and Masterpiece, customers have also been able to order the Carbon model, made of polyamide reinforced with long carbon fibres, since the end of 2018. Just like the first three models, which are made of Grivory GXV-65 H, Ganymed also used the same design for Carbon, which is based on findings from biomimicry or bionics – i.e. taking nature as role model.

**High weight savings thanks to a new material**

Through an intensive cooperation with the Computer Assisted Technical Service (CATS) of EMS-GRIVORY during the development phase, it was possible to achieve the very gracious design of the walking aid with the support of results from a range of simulation processes. Carbon already indicates the new material used with its name. Grivory GCL-3 H was selected in agreement with the engineers from the Application Development department of EMS-GRIVORY. This material is characterised by very high stiffness and strength, excellent notched impact strength values and exceptionally good dimensional stability. The key property however, is its very low density. In this way, Ganymed was able to achieve a weight saving of 27% compared to the previously used materials.

The appearance of the new walking aid is rounded off with printing using the so-called wate transfer printing process which gives it the typical carbon-fibre optic often used in racing sport designs.

**Great honour for EMS**

EMS receives the Supplier Excellence Award from ITRON, Inc.

EMS has been honoured with the “Global Supplier Excellence Award 2018” by ITRON, Inc. [USA]. EMS received this renowned award due to its exceptional service and product quality, high innovation capacity and ongoing technical further development.

**Important step in the US market**

ITRON, EMS customer and strategic development partner since 1997, is a global technology corporation based at Liberty Lake, Washington, and leading in the field of energy and water resource management. “This award is a further step in the EMS strategy towards further developing our growth potential in America as well”, stated a pleased Magdalena Mantullo, CEO of the EMS Group.

High-performance polymers from EMS have held a leading position with replacement of brass in sanitary applications involving hot and drinking water for some time now. Using EMS materials, sanitary manufacturers can achieve cost savings of up to 60%.

**Grilon TSGL-50/4 V0 promotes safety**

Flame-protected long glass fibre polyamide for industrial circuit breakers

Schneider Electric puts its faith in EMS-GRIVORY’s long-fibre technology for replacement of thermostetting materials in their innovative NSXm series of compact circuit breakers. This globally marketed compact circuit breaker provides protection for cables and motors up to 160A and has a circuit breaking capacity of 70kA/415V.

For the centrepiece of the circuit breaker – the switching cell – Schneider Electric chose flame-protected and long glass fibre reinforced Grilon TSGL-50/4 V0. With this high-performance material it was possible to overcome previous limitations of the thermosetting materials and to achieve thin-walled and complex geometries. Compared to the old design series, this made installation space savings of more than 25 % possible.

**Convincing properties**

Grilon TSGL-50/4 V0 convinced Schneider Electric with its strong property portfolio. Decisive for the choice of material were the large freedom of design, the high impact strength of the material and its capacity to withstand the explosive pressure build-up during the switching process. In addition, the EMS material had very good heat ageing behaviour at working temperatures of up to 120 °C, good dimensional stability even in moist and warm climate zones, good electrical properties and halogen-free flame protection. Not least, use of Grilon TSGL-50/4 V0 made an economic injection-moulding process possible and provides superior recyclability.

EMC CHEMIE (North America)
**Optimal performance thanks to EMS-GRIVORY**

**Intelligent noise reduction using CAE**

Computer Aided Engineering is an indispensable tool supporting component design which EMS-GRIVORY has been using for more than 30 years. Along with FEM calculations and Moldflow analyses, EMS-GRIVORY also developed and uses its own tool called EMS Resonator Tuning System or ERTS. This calculation tool is brought into use when the topic is vehicle noise reduction with resonators.

**Quiet please!**

This is also referred to as Noise Vibration Harshness (NVH), a general term for all audible and perceptible vibrations felt and heard during driving a vehicle. NVH is an important quality indicator of a vehicle – the better the quality, the lower the noise levels. In order to eliminate these vibrations as far as possible, measures are taken such as, among other things, the installation of noise-damping components called resonators. One well-known application field for these components are turbochargers which are equipped with resonators to eliminate the annoying “turbocharger whistle”.

**Squaring the circle**

Using ERTS, EMS-GRIVORY’s Computer Assisted Technical Service (CATS) is able to make precise and accurate calculations to achieve an optimal reduction of NVH with the most efficient resonator layout possible. ERTS works via artificial intelligence, thus allowing the development process to involve a high degree of automation and EMS-GRIVORY to achieve the near impossible: Maximum possible noise damping simultaneously with the most compact design possible. This is not only works in computers is illustrated by two examples.

**Project competition won**

Shanghai INNORLAS is a supplier to the Chinese automotive manufacturing industry. At the end of 2017, EMS-GRIVORY was invited by them to join a development project for SAIC Volkswagen. More exactly, this involved the development of new resonators. Various competitors were also involved in this development project. Thanks to use of ERTS and the excellent cooperation with Shanghai INNORLAS, EMS-GRIVORY was able to proving the supplier with a convincing solution. Today, the optimised resonators made of a suitable high-performance polymer from EMS (Fig. 1) are installed in a variety of SAIC Volkswagen models.

**Successful partnership**

Zotye Automobile is a Chinese car manufacturer which markets its vehicles under the three model names “Zotye”, “Jiang-Nan” and “Traum”. EMS-GRIVORY has worked together with this partner since 2018 and, in the meantime, has developed a series of resonators. Here also ERTS was used successfully and was a decisive factor to reduce vibration in the Zotye Automobile defined frequency range (Fig. 2).

**Expanded testing capacity**

Unique chlorine resistance testing equipment in Research & Development

Disinfection of drinking water by chlorination is widespread in many countries worldwide. In order to sell FWA products successfully in these countries, testing of the resistance to chlorine in water is an absolute necessity. EMS, therefore, has designed and constructed its own testing equipment which simulates exposure of material samples to chlorine under realistic practical conditions.

**Extreme storage tests**

The testing parameters at 60 °C and immersed to provide contact on both sides of the test bars are selected in order to eliminate these vibrations as far as possible, measures are taken such as, among other things, the installation of noise-damping components called resonators. One well-known application field for these components are turbochargers which are equipped with resonators to eliminate the annoying “turbocharger whistle”.

**Resistance forecast**

The chlorine resistance testing unit provides researchers and designers at EMS-GRIVORY with an early comparative forecast of the resistance of the materials tested. In order to isolate the influences of chlorine, findings are adjusted according to those obtained from reference samples stored in water.

**Expanded of the Colour-Service in China**

New laser-marking machine in Suzhou

Since the beginning of 2019, EMS-GRIVORY has been using a laser-marking system with a Nd:YAG laser at its Suzhou location in China. This is an important supplement to the range of customer services offered by the Colour Service. Customer machine settings can be taken over and optimised and the colour-service team can now adjust the required colours even better for optimal laser marking. This makes it possible to achieve black or white laser markings on materials with a high degree of reinforcement, such as Grivory GVX-7H for example, reinforced with 70% glass fibres.

**Fig. 2:** The target defined by Zotye Automobil was a noise reduction (Transmission Loss) of at least 15 dB in a frequency range from 1200 to 3500 Hertz. The original design only achieved the required reduction from 2500 Hertz (red line lying above the target line). The optimised design developed using ERTS from EMS-GRIVORY, achieved practically the whole target range.

**Fig. 1:** The resonator developed by EMS-GRIVORY for SAIC and made of Grilamid LV-3H

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**Original test bars (transparent) and test bars made of Chlorine-resistant Grilamid TR (at left) compared after different storage times at 60 °C and with 10 ppm chlorine.**

**Fig. 2:** The target defined by Zotye Automobil was a noise reduction (Transmission Loss) of at least 15 dB in a frequency range from 1200 to 3500 Hertz. The original design only achieved the required reduction from 2500 Hertz (red line lying above the target line). The optimised design developed using ERTS from EMS-GRIVORY, achieved practically the whole target range.

**C. T. LIAO**

TCS Manager EMS-GRIVORY (Taiwan)

**YULU FENG**

Colour Service EMS-GRIVORY Asia
Comprehensive and global support

EMS-GRIVORY is your global development partner

EMS-GRIVORY is active worldwide and a competent and reliable partner for the development of challenging and highly stressed components made of high-performance polymides. As development partner, EMS-GRIVORY owns independent application development centres for the specific requirements of customers in the most important markets of Europe, Asia and America. In the USA in particular, application development is being strongly expanded.

Support from application development

EMS-GRIVORY provides intensive support for customers throughout the whole development process. Experienced engineers carry out first feasibility and profitability analyses and actively accompany the concept and design phases as well as manufacture of prototypes. Serial implementation is supported through optimisation of moulds or process technology. Specific component analyses can be carried out where and when required. Services are adjusted individually to suit customer requirements in each market segment. Where necessary, products are adapted to suit special requirements. In this way, our customers are provided with a complete solution and can differentiate themselves in their markets with cost savings, weight reduction or new designs.

Computer-Assisted Technical Service (CATS)

Component development is carried out increasingly using modern, digital computer-aided engineering (CAE) methods. The components are designed in a virtual environment and optimised using simulations. This enables short development times as well as lower risks and development cost savings to be achieved. EMS-GRIVORY’s Computer Assisted Technical Service (CATS) supports customers worldwide with their component development. This support is provided from Switzerland for the European and American markets and directly from China for the Asian market.

Realistic simulation

CATS is already used in the concept and design phase to help customers with realistic simulations. With the help of Finite Element Analysis, loads working in the components can be shown and deformation both calculated and optimised. Weak points in the design can be disclosed and suitable modifications checked. When the anisotropy of fibre-reinforced plastics or other nonlinear geometrical and material effects play a significant role for component behaviour, these can also be considered for calculation purposes. EMS-GRIVORY can take into account the injection-moulding process, including the resulting fibre-orientation of highly reinforced polyamides and the subsequent orientation-dependent material properties, during component layout design.

Simulation of the injection-moulding process

The injection moulding process by which the component is produced is often a decisive factor and is therefore, usually also simulated and optimised through use of CAE. The simulation allows the position of the gating and sprue to be evaluated as well as allowing filling problems such as weld lines or air inclusions to be identified before mould construction is completed and so that suitable measures can still be defined during the planning phase. Through complex optimisation of the rheological material data, EMS-GRIVORY is able to give a forecast of shrinkage and warpage before they occur and make use of this not only qualitatively, but also quantitatively for a first correction of the mould.

Computer tomography: Invisible becomes visible – and can be tested

At two of its production locations in the world, EMS-GRIVORY owns stand-alone CT (computer tomography) units with which, customer components can be scanned and analysed very quickly. The non-destructive analysis process is also able to suit customer requirements worldwide with the component development. This support is provided from Switzerland for the European and American markets and directly from China for the Asian market.

Anisotropic simulation of the lightweight design demonstrator which can be used to check deformation and failure behaviour.

The CMS lightweight design demonstrator serves to illustrate design principles and determine material-specific key values.

1. Principle strain

0% 5.0%

A deviation analysis on an EMS water meter generated using CT analysis.

Comparison of simulation and reality

The non-destructive analysis process is also especially suitable for precise component measurement, in particular for whole component assemblies or closed bodies, where conventional measuring methods cannot be used. In this way, a thread cover or the position of a seal in an unreachable position for example, can be accurately measured. This can also serve to make a comparison of the simulation and reality: All dimensions can be measured directly on the completed component and then be compared with the original 3D model or the simulation values. This often provides information about how precise the warpage forecasts obtained from the simulation can be and in which areas they can be further improved.

Lightweight construction: Successful with polymers and know-how from EMS-GRIVORY

EMS-GRIVORY is also the right contact with regard to lightweight construction – for two reasons. On the one hand, the high-performance polymers made by EMS-GRIVORY are excellently suited for lightweight design. They are five times lighter in weight than steel and only half as heavy as aluminium and, on the other hand, EMS-GRIVORY also offers comprehensive support during component development for this kind of application. Intelligent use of the materials, a sensible and good design and utilisation of all possibilities for simplification and integration of function are important for successful lightweight construction. EMS-GRIVORY has many years’ experience in many successfully implemented projects. Various demonstration components are also available in order to illustrate the advantages of lightweight design, including the EMS lightweight design demonstrator which allows design principles to be shown as well as the metrological determination of key values for simulation and layout.

All round good service

In future, EMS-GRIVORY will also remain a strong development partner and problem solver for its customers and will continue to support them at the highest technical levels. This starts with a structural/mechanical or injection-moulding suitable component layout, covers the definition and provision of material-specific key values and generation of innovative system solutions with customers throughout the world, up to new development of unique high-performance polymer materials.

RUEDI PORTMANN
Head of Computer Assisted Technical Services
Major Expansion of Process Technology Customer Service

New injection-moulding and extrusion equipment in the Application Development Centre

The demands made on a material supplier’s application development centre by customers include not only new polymers, but also innovative and economic processing methods. Process technology in the application development centre of EMS-GRIVORY is specialised on the processing of EMS polymers and is equipped with modern machinery including various injection-moulding and extrusion machines. In order to maintain the latest standard of the art at the production site at Domat/Ems (Switzerland) in future as well, over the past two years, focussed investments have been made in new equipment for the manufacture of multi-layer components.

Unit 1: Two-component injection-moulding machine

Integration of function and design plays an increasingly important role in product development of polymer components today. This often requires use of several materials. In addition, increasing cost pressure demands a reduction in assembly and jointing processes. Special processes in injection-moulding, such as multi-component processes provide an inexpensive component injection-moulding machine was taken into operation. The unit is technically so equipped, that customer moulds can also be sampled.

Unit 2: Multi-layer film machine

A multi-layer cast film line, installed at the end of 2017, makes it possible to test new material combinations for packaging films and in particular, to provide support to customers in the development and implementation of applications using technical films. The line is technically so equipped that it can be used for both the chill roll method for packaging films as well as the calender method for technical films. Thanks to the two extruders and a special distributor block technology before a wide slit die, along with mono-films, multi-layer films in the material combinations A/B or A/B/A with film thicknesses up to 1 mm can also be manufactured.

Major savings possible

Technical films are used in the back injection-moulding process for use in automotive interiors, telecom or sport and leisure time applications. This method, also known as film back injection-moulding or film insert moulding makes individual process steps or post-treatment such as decoration or functionalisation of components, coating or painting, unnecessary. This allows significant savings in manufacturing costs, time and plant investments to be achieved as well as increasing flexibility of production. When required, films can also be additionally thermo-formed in a deep-draw film unit for back injection moulding.

Unit 3: Multi-layer pipe machine

Automotive and truck manufacturers use EMS products worldwide for multi-layer media pipelines in their vehicles for transport of fuels such as petrol and diesel, AdBlue® for exhaust gas treatment in diesel engines, or compressed air. In electric vehicles, extruded multi-layer pipes are required as cooling and heating lines in the drive system. For the development of new applications and materials, the application development centre of EMS-GRIVORY has therefore taken into operation a new 5-layer pipe extrusion unit. Thanks to a new multilayer die head technology, cleaning of the unit has been made much simpler and the conversion times for the various layering as well as manufacture of mono pipes have been significantly reduced. Materials, which are challenging to process can be extruded without defects with this new technology for extruder and multi-layer head.

Leading position strengthened

The application development centre now has again a modern 5-layer pipe extrusion machine which can be used flexibly to provide a reliable and comprehensive customer service. As in particular, many new automotive customers are using extrusion machines from the same manufacturer, the development process for new applications is simpler and faster. Thanks to this investment, EMS-GRIVORY has further strengthened its leading position as development partner for multiple-layer pipes in the automotive and industry segments. With these new multi-component machines, the EMS-GRIVORY application development centre has expanded the range of advisory and other services it offers and can provide support for customers more quickly and competent in handling of projects from the idea right up to serial production.

STEPHAN WICK
Head of Process Development
EMS-GRIVORY worldwide
www.emsgrivory.com

EMS-GRIVORY – The leading manufacturer of high-performance polyamides
EMS-GRIVORY is the leading manufacturer of high-performance polyamides and the supplier with the widest range of polyamide materials. Our products are well-known throughout the world under the trademarks Grilamid, Grivory and Grilon.

We offer our customers a comprehensive package of high-capacity and high-quality products along with segment-specific advisory competence in distribution and application development. We maintain our market leadership through continual product and application development in all segments.

COMPETITION
LOTTERY DRAW AT THE EMS-GRIVORY STAND:
TAKE PART AND WIN A GIFT COUPON FOR THE PARKHOTEL MARGNA IN SILS
TO THE VALUE OF CHF 500.–!