Sustainability in the market is dependent on engaging oneself intensively with the wishes, problems, expectations and requirements of customers. For this reason, our market development has been organised successfully for some years now according to customer segment. We concentrate our strengths on niche applications in selected strategic market segments.

By means of segment teams active throughout the world, we develop complete system solutions together with our customers. This means not only material recommendations, but also innovative proposals for cost and weight optimisation, as well as part design and new design concepts.

We have specialists from research through to sales, providing founded knowledge of market trends, applications and their specification profiles for all our strategic market sub-segments such as automotive, electro/electronics, industry and optic or packaging. Our goal is your market success.

This is the case, for example, with our metal replacement products Grivory GV and Grivory HT, which have been used with great success for some time now for the substitution of cost-intensive die-cast metal parts. Our latest product families have also grown. Our products with long-glass fibre reinforcement have been supplemented with long carbon-fibre reinforced materials which are characterised by maximum stiffness, even at low component density. We have strengthened our Grivory product assortment with new flame retardant materials and products approved for use in contact with drinking water and have introduced new transparent Grilamid TR grades. In addition, we also have at our disposal a wealth of experience with simulation calculations and application-related test results which are integrated daily into our customer project work.

We focus on innovation and help you gain greater competitive advantage.

Success proves us right. This is emphasised by the fact that along with the introduction of new products, we will already start operation of our new PPA production plant in October 2010, six months earlier than planned, and in this way, increase our production capacity by 40%. We look forward to sharing qualitative growth with you.
Polyamide 6 and Polyamide 66 are the materials which we usually have in mind when talking about polyamides. These polyamides are used in very large quantities, mainly for fibre production, but also for other extrusion applications and in injection moulding. Although these two polymers account for the largest fraction of synthetically produced polyamides today, they cover only a very small part of all the variations offered by this enormously versatile class of polymers.

Considering that all proteins are polyamides, one perhaps realises how broad the spectrum can be covered with polyamides really is. The naturally occurring polyamides, however, are not thermoplastic, which limits their use as engineering polymers.

The class of thermoplastic polyamides alone already allows for numerous possible variants. Regarding thermoplastic polyamides EMS-GRIVORY is the company with the most comprehensive polyamide range – worldwide!

Polyamides are polymers whose polymer chains contain amide groups at more or less regular intervals. The monomers from which polyamides are produced have acid groups and amino groups. Depending on the type and combination of these monomers, the properties of the resulting polymers can be changed in a targeted manner. The monomers influence inter alia chemical stability, barrier behaviour, toughness, shape retention under heat and dimensional stability.

The products from EMS-GRIVORY are based on a very broad palette of base polymers which no other polyamide producer can offer today.

The versatility of the polyamide range of EMS-GRIVORY is not by any means exhausted by the varieties mentioned. By enhancing them with additives, the good material properties of the polyamides can be improved further. One example of this is Grivory GVX, which by addition of reinforcement fibres attains a tensile E modulus of 28'000 MPa, combined with low warpage and improved shear strength. It goes without saying that coloured, flame retardant or specially stabilised polyamides are available. There are practically no limits to the imagination here.

Apart from the physical aspects, the polyamide range of EMS-GRIVORY has numerous other advantages. Among these are the comprehensive approvals which have been granted for the products. Many products have worldwide approvals for contact with drinking water and foodstuffs, recognisable by the FWA (Food and Water Approved) designation. Further examples are the flame-retardant, halogen-free V0 products, which are classified V0 as per the standard UL 94.

The resulting polymers can be changed in one of these monomers, the properties of which have acid groups and amino groups. From which polyamides are produced or less regular intervals. The monomers chains contain amide groups at more...
Polyamides with long carbon-fibre reinforcement

LFT portfolio with significant additions

EMS-GRIVORY is expanding its range of long fibre reinforced products, which are already very well established in the market, with long carbon-fibre reinforced (C-LFT) high-performance materials based on Grivory GV and Grilamid L. These new material grades show the advantages of long fibre reinforcement very clearly. Compared to conventional carbon-fibre reinforced polyamides, the stiffness values are increased by nearly 60%, leading to exceptional properties.

These C-LFT materials show outstanding notched impact resistance which is unusual for such stiff products. It was possible to improve the tensile strength values of C-LFT products by more than 70% with the same density. These values reach well above the 250 MPa limit for Grilamid 2S products (with 40% carbon-fibre content). Notched impact strength values in this case were around 30 kJ/m².

The partially aromatic Grivory, reinforced with carbon fibres, exceeds even these values: Grivory GCL-3, for example, achieves tensile strength values above 300 MPa and a tensile modulus of 23 GPa with a density of only 1.28 g/cm³.

The effect of long carbon fibre reinforcement on the tensile modulus with 30% fibre content in Grilamid L: Compared to conventional carbon-fibre reinforcement, the modulus is increased by 60% with a simultaneous doubling of the notched impact strength. Also shown are the key material figures for Grilamid LCL-4 with 40% long fibre content.

The C-LFT products based on Grilamid L or Grivory GV contain a standard quantity of long carbon fibres of 30% or 40%. Modified products to suit individual customer requirements are also available from EMS-GRIVORY on request.

New Grilamid variants reinforce the team

Top class for the engine compartment

Grilamid L, a polyamide 12, has for years been the leader in connector applications in fuel and cooling systems as well as for oil, air and vacuum tubes in automobiles.

The continuous enhancement of power train systems causes higher temperature peaks and materials in use in the engine compartment must keep up with this evolution. For such applications, EMS-GRIVORY offers two new glass-fibre reinforced Grilamid variants made of alternative polymers with an improved thermal stability and superior mechanical strength when exposed to high temperatures.

Grilamid 2S (PA 610) and Grilamid 2D (PA 612) are available with 30, 40 or 50% glass-fibre reinforcement. All types are stabilised against heat and UV radiation, and are available in the standard colours natural and black. Special custom made colours and laser-printable types are available too upon request.

The twelve new grades may be easily combined directly in subassemblies composed of injection moulded quick connectors and fluid tubes made of extruded, non-reinforced Grilamid 2D or Grilamid 2S compounds.

Grilamid 25 was initially developed for air and oil applications, whereas Grilamid 2D, thanks to its excellent hydrolysis resistance, is predestined for use in cooling systems containing water/glycol media.

GK-DEPESCHE 2010

Andre Sturzel
Product Manager Grilamid

Lightweight construction without compromises
Carbon-reinforced long-fibre polyamides

The new carbon-reinforced long-fibre polyamides from EMS-GRIVORY enable weight reduction without compromises. In comparison to conventional carbon-reinforced polyamides, achieved stress and stiffness values allow an impressive 20% increase in performance. Superior performance without added weight!

Visit us at the K 2010 in Düsseldorf
October 27th – November 3rd, Hall 6 / E61

Your innovative development partner
EMS-GRIVORY
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phone +41 81 632 78 88, fax +41 81 632 76 65
www.emsgrivory.com/k2010

A report on Grilamid 2S for brake servo systems is to be found on page 6
The Grilamid TR success story continues

High heat modification and excellent surface quality

Already the first generation of Grilon TSG W injection-moulding and Grilon EBGM extrusion grades, has now been supplemented. The second generation of Grilon TS has improved heat stabilisation allowing the material to be used at even higher operating temperatures.

Weather resistance and fatigue strength, as well as even better stress crack resistance.

Grilon TR 30 is a new addition, and its properties are outstanding, especially the unique combination of high strength and good impact strength. Compared with the previously stiffest type, Grilon TR 55, the modulus is increased by 30% and the V-notch impact strength by 50%.

High surface hardness is combined with this exceptional stiffness, which means better scratch and wear resistance, approaching that of PMMA - depending on the conditions of use.

Chemical resistance as a matter of course

Like all Grilon TR types, Grilon TR 30 also exhibits excellent stress crack resistance when in contact with a wide variety of media. It has a very high resistance - especially against non-polar media such as fuels, oils and fats - that other transparent polymers such as PMMA or PC do not have.

Grilon TR 30 is therefore highly suited to applications in contact with automotive and industrial fluids, such as, for example, filter housings, flow meters and viewing ports. Other applications are dimensionally stable housings or covers with exacting requirements concerning surface gloss and transparency in the industrial, household and electrical fields. In addition, a significantly improved oxygen barrier enables numerous new applications in the packaging industry to be realised.

Grilon TR 30 has a further interesting detail: this material is compatible with Grilon TS and Grivory GV. This enables low-cost, multi-material components to be realised in the design process for injection moulding or by various subsequent processes such as the welding together of different components.

Glass substitute - rich in detail

With Grilon TR 30 the range of transparent polyamides from EMS-GRIVORY is expanded by a material with a completely new spectrum of properties. On the subject of glass replacement, Grilon TR 30 solves numerous problems that can occur with other transparent polymers. Starting with the basic Grilon TR types, many further product modifications are available.

The second generation for even higher application temperatures

Grilon TS never feels the heat

The product series Grilon TS, which includes an assortment of Grilon TSG W injection-moulding and Grilon EBGM extrusion grades, has now been supplemented. The second generation of Grilon TS has improved heat stabilisation allowing the material to be used at even higher operating temperatures.

High heat modification and excellent surface quality

Already the first generation of Grilon TSG W has proved its value with excellent resistance to heat ageing. This material withstands permanent temperatures of up to 150°C and short-term temperature peaks of up to 210°C. With the new grades, short-term peak temperatures of up to 230°C are possible.

The high strength and stiffness values of this material are maintained over the complete temperature range. The new Grilon TSG W is characterised by excellent surface quality with very little roughness and is suitable, for example, for Henn connectors in charge air cooler housings.

Grilon TS production is simple to process and, compared to PA 66, has a significantly larger processing window. The high crystallinity and excellent flowability of the melt make short cycle times and therefore, high productivity, possible. Outstanding mechanical properties are high weld line strength, very good dimensional stability and creep strength as well as high impact strength.

Exceptional weld line strength

Previously, charge air pipes made of Grilon EBGM could be used under permanent temperatures of up to 200°C. With an increased filling material content, use is now possible at permanent temperatures up to 210°C.

The second generation of Grilon EBGM products with optimised heat stabilisation, can now be used for charge air pipes under permanent temperatures of 210°C, combined with more stable tearing strength and elongation at break after heat ageing at 220°C (on test bars). Furthermore, highly filled products (up to 50% filler content), can be processed using injection-moulding methods, to obtain products which can be used under permanent operating temperatures of up to 220°C. These products have excellent dimensional stability without negative effects on the elongation at break.

Due to its excellent resistance to established automotive media (including oil, hot oil, cooling water and fuel), Grilon TS is the ideal material for highly stressed components in under-bonnet applications. Typical application examples are oil sumps as well as components in air-intake and charge air systems. Grilon TS is available in all the mentioned types with 15, 30, 35, 50 and 60% glass fibre reinforcement.

Torsten Mehler
Product Manager Grilon

The correct balance in every case Grilon TS 55, TR 90, TR 30

<table>
<thead>
<tr>
<th>Breakable (N/)m</th>
<th>V-notch impact strength (\text{kJ/m}^2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>TR 55</td>
<td>12</td>
</tr>
<tr>
<td>TR 90</td>
<td>14</td>
</tr>
<tr>
<td>TR 30</td>
<td>14</td>
</tr>
</tbody>
</table>

The correct balance in every case Grilon TS 55, TR 90, TR 30

Distinguishing points: Grilon TR 30, within the Grilon TR family, is a very high-modulus E-modulus with high V-notch impact strength
**Art comes from Ability**

**Grilamid TR – the design polymer**

EMS-GRIVORY proves its competence in the manufacture and development of new materials with a comprehensive range of services for its customers. These include choice of material, feasibility studies, design and processing optimization or initial sampling.

Now, spiderweb is defining the competence of EMS-GRIVORY in a new dimension: spiderweb combines function and shape in a unique way, synergetic in respect of processing capability and structural components. The structures are captivating in their elegant uniqueness and optical and physical lightness as well as stiffness and toughness. Spiderweb demonstrates in an impressive manner the unique optical and mechanical properties of Grilamid TR 90, which strikingly emphasise the exclusivity of the sculpture.

One remarkable advantage can be seen during production of spiderweb. Just to what extent, is shown in a thought experiment. How many tons of clamping force are required to manufacture a living room sofa using injection moulding? 1,000 tons, 2,000 tons or more like 5,000? Probably many, many more and the right machine would probably have to be developed first as well. Thanks to spiderweb, manufacturing can take place – depending on the number of cavities – already using a 50-ton machine. The injection mould required is small and inexpensive. Production of furniture and structures of any size are as unlimited as your fantasy.

With spiderweb, the ‘same part system’ is interpreted in an impressive way. Numerous identical parts create a complex, polyvalent and individual component simply by fitting and fixing the single parts. The modules provide net structures with a very high performance-to-weight ratio. In his designs, Forakis took inspiration from nature and the integral philosophy of famous architect and designer Richard Buckminster Fuller.

The exceptional design, the so-called “Dual Mode Structure” is flexible in one direction while it reacts rigidly in another direction. Making use of these properties, the spiderweb chair is especially comfortable. While the seat gives slightly, the backrest provides stable support. Following the same principle, the spiderweb table stabilises objects which are placed on it. This principle can be continued as wished and leads to an infinite number of possible functional and decorative objects, but can be applied just as well to supporting walls and columns in construction applications.

Jozeph Forakis’ magnificent concept ideas were optimised by EMS-GRIVORY to gain a design optimally suited for the material used. Strength and stiffness simulations were made in an initial feasibility study. EMS-GRIVORY developed a special latch device for simple and safe connection of the elements to each other. In addition, the manufacturing process was optimised using rheology simulations.

Spiderweb will be presented to the general public for the first time at the K2010. Visitors at our stand can catch a breathtaking insight into the new world of design. The properties of Grilamid TR 90 can be experienced firsthand, sitting on a comfortable spiderweb chair.

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**Dream candidate for a fine appearance**

**A case for Grilamid TRV**

Housings and structural components are becoming increasingly sophisticated and thin-walled. This presents great challenges for the material used in respect of processing capability and quality. Here, apart from the balance between stiffness and toughness, a perfect surface quality is also of great importance. Semicrystalline polymers typically exhibit warping and local sinking, and because of the fibre reinforcement, achieve only a limited surface quality.

To avoid these phenomena and solve the quality problems, Grilamid TRV is the first choice. The molecular structure enables injection mouldings to be produced with almost no warping and with smooth, uniform surfaces. Best of all: Grilamid TRV achieves all this even when the highest component strength is required and very high degrees of reinforcement with glass fibres are essential.

---

Robert Meyer zu Westram
Product Manager Grilamid TR
Since the 1970s, vehicle brake boosters have become standard. The additional braking power results from vacuum supplied by the motor or generated by a pump; a line transfers the vacuum to the brake booster unit. This requires high vacuum resistance, also at high temperatures, from the line material. At the same time, the material must be dimensionally stable at high temperature and flexible at low temperature.

A material that fulfills these requirements perfectly is the newly developed Grilamid 2S from EMS-GRIVORY. Grilamid 2S is based on regenerative raw materials and belongs to the current GreenLine product line.

**Excellent performance spectrum**

In vacuum tests both variants of Grilamid 2S showed a very good temperature performance. At a vacuum of 200 mbar, the tube made of the more flexible material collapsed only at 180°C, and that of the stiffer material remained stable even up to over 200°C.

Tubes to be used in the engine compartment, however, must not only be thermally stable. Resistance to media is also an important requirement of the material. Good chemical resistance complements the list of material properties and makes the newly developed products the material of choice for automotive tubings.

Grilamid 2S sets new standards with regard to a constant stiffness as possible over the entire temperature range. Not only the brake booster lines benefit from the increased performance; this range of properties could also be interesting for other tubes or injection moulding parts.

**Comparison of the properties of the two Grilamid 2S types**

<table>
<thead>
<tr>
<th>Properties</th>
<th>Standard</th>
<th>Unit</th>
<th>Grilamid 2S stiff</th>
<th>Grilamid 2S flexible</th>
<th>PA 612 Elastomer</th>
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<tr>
<td>Tensile E-Modulus at 23°C</td>
<td>ISO 527</td>
<td>MPa</td>
<td>1550</td>
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<td>600</td>
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<tr>
<td>Tensile E-Modulus at 180°C</td>
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<td>MPa</td>
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<td>55</td>
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<tr>
<td>Tensile strength</td>
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<td>Elongation to Break</td>
<td>%</td>
<td></td>
<td>200</td>
<td>175</td>
<td>200</td>
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<tr>
<td>Charpy impact test, 30°C</td>
<td>ISO 179/1eU</td>
<td>J/m²</td>
<td>without break</td>
<td>without break</td>
<td>without break</td>
</tr>
<tr>
<td>Charpy notch impact test, 30°C</td>
<td>ISO 1193</td>
<td>J/m²</td>
<td>20</td>
<td>15</td>
<td>8</td>
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<tr>
<td>Density</td>
<td>ISO 1183</td>
<td>g/cm³</td>
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</tr>
<tr>
<td>Melting point</td>
<td>ISO 11357</td>
<td>°C</td>
<td>220</td>
<td>220</td>
<td>194</td>
</tr>
</tbody>
</table>

**Mobile phones are environmentally compatible using GreenLine**

Communication technology has developed rapidly over the last years and will continue to show strong growth. For 2010, experts are forecasting sales of 1.4 billion mobile phones. In light of these quantities and the very short life expectancy of these products, the selection of sustainable materials is gaining enormous importance in this sector.

Along with the latest technology, a fresh and modern design is an important market strength, or even the main purchasing incentive. Mobile phones are advancing to become lifestyle products, which are replaced as soon as newer models are available. If it is taken into consideration that the purchasing power in China and India – it is not surprising that from a statistical point of view, the leading manufacturers in the mobile phone market introduce a new model onto the market each week.

Faced with the correspondingly high demand for plastic materials, sustainability is also playing an increasingly important role. Put even more clearly, it is a key requirement specifically for mobile phones throughout the world. Based on high oil prices and an increasing awareness of environmental protection, a fundamental rethinking is occurring with both consumers and manufacturers. And the necessity of protecting non-renewable energy sources is now widely recognised. EMS-GRIVORY has reacted to this trend with the development and expansion of a completely new product series: *GreenLine!*

**Polyamides from renewable raw materials**

Greeline incorporates bio-based polyamides which are excellently suited for the manufacture of mobile phones. GS1 products in the Greenline product family are manufactured partially or completely from renewable raw materials. EMS-GRIVORY has developed a “green alternative” which can immediately replace 1:1 conventional high-performance plastics used in the manufacture of mobile phones.

Today’s mobile phones must provide numerous functions, be ready stylish, robust and as thin as possible – a requirement catalogue which cannot be satisfied using conventional plastic materials. This is where the high-performance plastics from EMS-GRIVORY step up to the plate. They provide not only resistance to chemicals but also thermal stability and the necessary impact strength while allowing the desired freedom of design – the Greenline product line handles these requirements just as easy as petroleum-based polyamides made by EMS-GRIVORY.

Polyamides from EMS-GRIVORY are the first choice with engineers and designers of mobile phones as they enable them to make a selection from a wide portfolio of high-performance materials which are continually being improved. Also available throughout the world is quick and flexible customer service. EMS-GRIVORY has adapted its offer to perfectly suit the requirements of a lively market segment where trends usually change faster than the weather.

**The GreenLine portfolio**

Reinforced Grilamid 15 is exceptionally well suited for the manufacture of stiff covers. Non-reinforced, amorphous grades can be used in injection-moulding processes for overmoulding metal sheets, as they have extremely high resistance to stress cracking and very good flowability. Grilamid BTR is a special amorphous, transparent polyamide which can be used to make windows, while a partially bio-based PPA – Grivory HT3 – can be used for connectors.

GreenLine polyamides are based on renewable raw materials which cannot be used for food.

Stay in touch – naturally

Sabine Bertram
Application Development
Industry and Electro
New materials expand range of applications

Comprehensive portfolio for electronic connector applications

EMS-GRIVORY offers suitable materials for all varieties of electronic connectors, such as PCB- connectors, D-Sub or I/O connectors. EMS-GRIVORY is now expanding the range for this area with Grivory HT3, a high-temperature-resistant polyamide.

The new Grivory HT3 types feature extremely low moisture absorption. Compared to other PPA types, they absorb approximately 50% less moisture. This spares expensive, moisture-proof packaging. Even after very long storage times under a wide range of climatic conditions, components made of Grivory HT3 are very well suited for reliable soldering. Another feature of the low moisture absorption is the excellent dimensional stability.

Thin-walled products

Because of its very good flow behaviour and excellent strength, very thin-walled components may be produced in all colours with Grivory HT3. Short-term thermal loading up to 260°C is possible. Compared to LCP, Grivory HT3 is convincing because of its excellent weld-line strength.

All Grivory HT3 products for plugged connectors are UL-listed and free from halogens and red phosphorus. Compared to other halogen-free, flame-retardant high-temperature polyamides, Grivory HT3 exhibits a significantly lower corrosiveness with regard to injection-moulding equipment.

EMS-GRIVORY’s entire product portfolio of electrical plugged connectors comprises, apart from Grivory HT3, the products Grivory HT2 V0 and Grilon TS V0.

Grivory HT3 is 45% based on renewable raw material and belongs to EMS-GRIVORY’s family of GreenLine products.

As with all other applications, it goes without saying, also in the field of plugged connectors, that the Application Development Centre of EMS-GRIVORY supports its customers from the idea right up to series maturity.

Albert Flepp
Product Manager Grivory HT

For environmentally-friendly diesel engines

Mobile with low emissions

What for a long time has been state-of-the-art in commercial vehicles is now also being implemented in diesel cars; follow-up treatment of the exhaust gases with SCR (Selective Catalytic Reduction) to reduce the concentration of nitrogen oxides. The quality of the materials used is of decisive importance here, to avoid contaminating the aqueous urea solution and hence damaging the catalyst.

EMS-GRIVORY supplies various high performance polyamides that easily fulfill the strict requirements of the automotive manufacturers.

PA can do it

To avoid degradation of the urea solution, no metallic washout from the material used in the SCR system can be allowed. Hence the unirradiated and glass-fibre reinforced polyamides must prove their suitability among the alternative materials.

The following products from EMS-GRIVORY’s portfolio fulfill the strict limits of ion washout, i.e. six weeks storage in the aqueous urea solution AdBlue® at 80°C:

- Grivory HT3 XE 4101 (PPA-GF30)
- Grivory HTV-4X1 (PPA-GF40)
- Grilamid XE 3976 (PA610-GF30)
- Grilamid V-SH (PA12-GF50)
- Grilamid L 25A NZ (PA12-HI)
- Grilamid XE 3974 (PA610-HI)

At the same time, these high performance materials also fulfill the requirements for mechanical properties – both before and after storage in the urea solution.

Many products, numerous applications

EMS-GRIVORY has a large selection of reinforced injection moulding types suitable for components in urea systems. These include housings, pipes, connectors, filters, valves and other structural components. Furthermore, the extrusion materials Grilamid L 25A NZ and XE 3974 are recommended for lines, pipes, and hoses or also profiles in the SCR system. With the aid of EMS-GRIVORY materials, a large contribution to low-pollutant mobility can be made while also complying with future emission limits for diesel engines.

How SCR works

In commercial vehicles, the SCR process for nitrogen oxides in the exhaust gases has been standard for a long time. Controlled by the engine electronics, the aqueous urea solution is metered into the hot engine exhaust from a separate tank, as required, where it is converted to the reducing agent ammonia. The harmful nitrogen oxides are converted by this ammonia via a catalyst into harmless nitrogen (N2) and water vapour (H2O). Urea is a non-toxic, colourless, odourless, water-soluble substance which is also used in the agriculture, textile, cosmetic and pharmaceutical industries. AdBlue® is the trademark of the VDA (German Automobile Association) for the aqueous urea solution.

Ralph Kettl
Manager Application Development
Automotive

Renewable.

Same performance - less CO2-emissions

Grilamid 1S PA1010 / Grilamid 2S PA610
Grilamid BTR transparent PA
Grivory HT3 Polyphthalamide

Visit us at the K 2010 in Düsseldorf
October 27th – November 3rd, Hall 6 / E61

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Cost-saving potential from metal replacement have not yet been fully exploited

High-performance polyamides for direct contact with drinking water

Cost saving potential from metal replacement has not yet been fully exploited in drinking water systems. Equipment or system suppliers looking to be market leaders, must venture into challenging fields where high temperatures and in some cases, very long warranty periods must be overcome. The choice of plastic material with a good performance profile and the opportunity of benefiting from intensive and efficient technical support provided by the plastics supplier are decisive for success.

Comprehensive approvals

Lead is often added to brass to allow it to be more easily machined. The permissible lead content in drinking water, as per a EU guideline which will become valid in December 2013, is 0.010 mg/l (current limit: 0.025 mg/l). In the meantime, practically all suppliers are working on the development of partial or complete plastic solutions.

All materials which come into contact with drinking water must be certified according to the corresponding national approvals. All materials made by EMS-GRIVORY with the abbreviated designated FWA (food and water approvals) are approved for direct contact with drinking water and food.

Cost savings and integrated function

Special polyamides have a very high performance profile and enable clear cost advantages to be achieved. As a rule of thumb, replacement of metal in sanitary applications can provide potential cost savings of 35 – 50%. In individual cases, well thought out concepts can even achieve significantly higher savings. For a water distributor in a shower fitting only two plastic parts, elegantly joined by a rapid connector, are needed instead of the 10 threaded brass parts previously required. The resulting reduction in weight also allows transport costs to be saved as the plastic component weighs only 110 g compared to the 1200 g brass component.

Cold-water applications

Tapping saddles serve to connect domestic pipes to the underground community water supply at a later date. In Germany, this kind of assembly is usually modified for use at operating pressures between 10 and 16 bar and water temperatures of up to 30°C. Warranty periods can be up to 50 years. Recently, after an extensive testing period, tapping saddles and sealing package frames made of Grilamid LV FWA (PA12) became available for use for the first time.

Together with a partner company, EMS-GRIVORY already realised the first plastic water meter in 1995. Water meters and filters are components subject to dynamic high stress which must undergo stringent testing. According to the German technical regulation for water meters, DVGW Arbeitsblatt W 421 (May 2000), the water pressures of three times the operating pressure of 10 to 16 bar must be withstood for a minimum of 10 minutes. In addition, dynamic tests with 200 000 load cycles between 150 kPa and 1.3 times the permissible operating pressure, must also be passed. Both the partially polyamides Grivory GV FWA and Grivory HT1V FWA respectively provide the necessary mechanical strength for this kind of specification profile. Due to their high strength Grivory HT1V FWA grades are particularly in focus in current development work for water meter housings and pressure plates. This also applies to Grilamid LV FWA grades due to their simple processing and durability.

Reversible flow water filters are an ideal example for the targeted combination of two high-performance polyamides, which are both optimally adjusted to suit the application requirements. The water filter housings are made of Grivory GV FWA, the transparent filter bowls of Grilamid TR 90 LS.

Grilamid TR 90 LS provides one important prerequisite in case of damage. For safety reasons and to limit damage as far as possible, filter bowls must exhibit ductile fracture behaviour with crack formation. Most transparent plastic materials however, are brittle and form splinters when they burst. Grilamid TR 90 LS has a very high burst pressure and exactly the required fracture behaviour. In addition, Grilamid TR 90 LS shows a very good stress crack resistance when exposed to chemicals and cleaning agents.

Contact with hot and warm water

Operating temperatures of up to 60°C and high water system pressures are normal for shower fixtures, mixing taps and hot and cold water distributors. Furthermore, the rapid opening and closing of single lever taps causes high temperature surges. For this reason, the materials used must have good strength values at high temperatures – a requirement which is satisfied exceptionally well by Grivory HT1V FWA. This high-performance polyamide is characterised by sufficient resistance to chlorine in the water and has extremely good creep resistance even when in contact with water at fluctuating temperatures. This property profile has made Grivory HT1V FWA a preferred material for shower heads, water volume valves and diverter buttons for both hot and kitchen fittings with threaded connections. The performance capabilities of this material are also exhibited in jet nozzle covers for whirlpools, pressure reducing valves or pump housings in secondary flow circuits, for example.

Factors for success

EMS-GRIVORY offers a wide range of materials for use in direct contact with drinking water. The degree of component stressing has a significant influence on the life-expectancy of the component. EMS-GRIVORY also has a wealth of experience, gained from simulation calculations and application-oriented test results, which is invested daily into the customer's project work and contributes towards increasing the life expectancy of installations components and assemblies in a sustainable way.

Volker Eichhorn
Head of Application Development Industry and Electro

Healthy feeding - feeding bottles made from Grilamid TR

For some time now, bisphenol A has been in the centre of attention, since it is contained in materials used for making feeding bottles. In the meantime, such bottles have been banned by law in Canada, Australia, France and Denmark.

The transparent polyamide Grilamid TR is available as an alternative. This glossy material is the perfect replacement for the materials previously used for feeding bottles, owing to its glass-like appearance. Grilamid TR is free from phthalates and contains no bisphenol.

Very clear advantages

Grilamid TR has excellent organoleptic properties. This means that the plastic gives no odour or taste to the liquid inside, nor does it absorb aromas from the container which could cause odours in the empty bottle. Grilamid TR fulfils the criterion of being taste-neutral with respect to a number of aromas and substances.

Grilamid TR is even better than its predecessor as regards enduring dishwash and cleaning product resistance as well as scratch resistance to handling.

For safety reasons and to limit damage as far as possible, plastic parts, elegantly joined by a rapid connector, are needed instead of the 10 threaded brass parts previously required. The resulting reduction in weight also allows transport costs to be saved as the plastic component weighs only 110 g compared to the 1200 g brass component.

Cold-water applications

Tapping saddles serve to connect domestic pipes to the underground community water supply at a later date. In Germany, this kind of assembly is usually modified for use at operating pressures between 10 and 16 bar and water temperatures of up to 30°C. Warranty periods can be up to 50 years. Recently, after an extensive testing period, tapping saddles and sealing package frames made of Grilamid LV FWA (PA12) became available for use for the first time.

Together with a partner company, EMS-GRIVORY already realised the first plastic water meter in 1995. Water meters and filters are components subject to dynamic high stress which must undergo stringent testing. According to the German technical regulation for water meters, DVGW Arbeitsblatt W 421 (May 2000), the water pressures of three times the operating pressure of 10 to 16 bar must be withstood for a minimum of 10 minutes. In addition, dynamic tests with 200 000 load cycles between 150 kPa and 1.3 times the permissible operating pressure, must also be passed. Both the partially polyamides Grivory GV FWA and Grivory HT1V FWA respectively provide the necessary mechanical strength for this kind of specification profile. Due to their high strength Grivory HT1V FWA grades are particularly in focus in current development work for water meter housings and pressure plates. This also applies to Grilamid LV FWA grades due to their simple processing and durability.

Reversible flow water filters are an ideal example for the targeted combination of two high-performance polyamides, which are both optimally adjusted to suit the application requirements. The water filter housings are made of Grivory GV FWA, the transparent filter bowls of Grilamid TR 90 LS.

Grilamid TR 90 LS provides one important prerequisite in case of damage. For safety reasons and to limit damage as far as possible, filter bowls must exhibit ductile fracture behaviour with crack formation. Most transparent plastic materials however, are brittle and form splinters when they burst. Grilamid TR 90 LS has a very high burst pressure and exactly the required fracture behaviour. In addition, Grilamid TR 90 LS shows a very good stress crack resistance when exposed to chemicals and cleaning agents.

Contact with hot and warm water

Operating temperatures of up to 60°C and high water system pressures are normal for shower fixtures, mixing taps and hot and cold water distributors. Furthermore, the rapid opening and closing of single lever taps causes high temperature surges. For this reason, the materials used must have good strength values at high temperatures – a requirement which is satisfied exceptionally well by Grivory HT1V FWA. This high-performance polyamide is characterised by sufficient resistance to chlorine in the water and has extremely good creep resistance even when in contact with water at fluctuating temperatures. This property profile has made Grivory HT1V FWA a preferred material for shower heads, water volume valves and diverter buttons for both hot and kitchen fittings with threaded connections. The performance capabilities of this material are also exhibited in jet nozzle covers for whirlpools, pressure reducing valves or pump housings in secondary flow circuits, for example.

Factors for success

EMS-GRIVORY offers a wide range of materials for use in direct contact with drinking water. The degree of component stressing has a significant influence on the life-expectancy of the component. EMS-GRIVORY also has a wealth of experience, gained from simulation calculations and application-oriented test results, which is invested daily into the customer’s project work and contributes towards increasing the life expectancy of installations components and assemblies in a sustainable way.

Volker Eichhorn
Head of Application Development Industry and Electro

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The high-performance polyamide Grilamid TR sets the standard with its long service life. Feeding bottles made from this material are boiling-water-proof, and can be used in commonly used conventional electric and home steam sterilisers for feeding bottles.

The favourable mechanical properties remain stable over a wide temperature range. For instance, it passes the drop test even at low temperatures: cold-induced brittleness or stiffening does not exist with Grilamid TR. Furthermore an unusually high surface tension, enables excellent printing.

Worldwide approvals for food-stuffs

Grilamid TR has the approval of the FDA (Food and Drug Administration) for food contact and conforms to the guideline lines of the European authorities, as well as the relevant EU directives for feeding bottles. Grilamid TR fulfils the Japanese food contact requirements and conforms to the medical requirements of the United States Pharmacopoeia (USP) Class VI, further emphasising the broad application area of Grilamid TR.

Grilamid TR processes extremely well with the single-stage injection stretch blow moulding process used for the production of feeding bottles. These machines, which fabricate the finished hollow body in a single step, are at present mainly supplied by the manufacturers AOKI and NSSEI. The wide processing window and the unproblematic processing assure a stable production process with a minimum of rejects.

However, feeding bottles are just the beginning. Grilamid TR is also the perfect material for other baby articles, containers, tableware and toys. Here further advantages come into play, such as the almost unlimited colour possibilities and excellent adhesion to elastomers such as silicone.

Gabriel Garcia
Application Development Industry and Electro
Materials in direct contact with foodstuffs
High-performance polyamides for kitchen appliances

According to investigations by the journal *Ökotest*, a temperature of 270°C may easily occur in frying pans, areas covered with oil being hotter than dry areas. Of the twenty spatulas tested by the editors, only the product made from Grivory HT1V FWA was given the rating ‘very good’.

Materials that come into direct contact with foodstuffs must have the corresponding regional approval. In the case of foodstuff contact, for example, the American FDA/NSF or European EU guidelines apply. All materials from EMS-GRIVORY with the abbreviation FWA (food and water approval) have approval for foodstuff contact.

Grivory HT1V FWA has proved itself on account of its good hydrolysis resistance for many years in hot-water containing components in kitchen appliances. This polyamide is found in the hose connectors, valves, brewing chamber housings, boilers or steam nozzles of many coffee machines made by well-known international manufacturers. These components have proved themselves in over 10,000 brewing cycles and in cleaning cycles with aggressive decalcifying agents.

For transparent applications in coffee machines, e.g. milk tanks and coffee bean containers, EMS-GRIVORY supplies Grilamid TR. It contains no bisphenol A, and in contrast to many other transparent plastics, it is dishwasher-proof. Further applications for Grilamid TR are feeding bottles for babies, window dowls in cooking pot lids and covers for vacuum food-storage containers.

Grivory HT1V FWA has a very high melting point of 325°C and is therefore eminently suitable for what are considered to be simple cooking aids: spatulas, tongs or ladles. These are preferably made of plastic in order not to damage the sensitive Teflon coatings of pans.

Betty Bossi – What is meant by heat-resistant? (Betty Bossi Number 7/10)

Many spatulas or skimmers made of plastic are marked as heat-resistant. But up to which temperature this really applies varies considerably, depending on the material type. Betty Bossi tested a wide variety of materials. For this, they measured the temperature of heated fats and oils with IR cameras. Betty Bossi thus has the best basis for defining the most suitable material. Betty Bossi chose a material from EMS-GRIVORY for their frying and braising covers, but also for kitchen cutlery for frying or deep-frying.

Volker Eichhorn
Head of Application Development

In dairy farming, glass was the dominant material for a long time. Meanwhile, transparent plastics have established themselves in this demanding application area. Apart from PSU and PPSU, it is above all transparent polyamides that enjoy the largest market growth at present.

Grilamid TR, from EMS-GRIVORY’s portfolio, is highly suited for this application area: an amorphous transparent polyamide that has a series of advantages over sulfone polymers. The most important of these is the bright, clear intrinsic colour, whereas sulfone polymers typically exhibit a yellowish-brown appearance that is unattractive for milk processing. Moreover, with Grilamid TR the fabrication of the parts is simplified since it is processed at significantly lower mass and mould temperatures.

Milk flow meters are an excellent example of the use of Grilamid TR. These are approved by the International Committee for Animal Recording (ICAR) and the Herd Improvement Association (DHIA). Grilamid TR has all the necessary approvals worldwide for direct foodstuff contact. Furthermore, Grilamid TR 55 also satisfies the requirements of the American 3-A Sanitary Standards for Multiple-Use Plastic Materials.

Michael Pabst
Application Development
Transparent Polyamides

EMS • Metal Replacement.
Weight reduction = CO2 reduction

EMS-GRIVORY is a pioneer in metal replacement with the high-performance polyamides Grivory and Grilon, and has already contributed towards reducing CO2 emissions from traffic for many years now. The CO2 balance sheet is further improved by biopolymers based on renewable raw materials and use of process steam from a biomass power station.

Visit us at the K 2010 in Düsseldorf
October 27th – November 3rd, Hall 6 / E61

Your Innovative development partner
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www.emsgrivory.com/k2010

Michael Pabst
Application Development
Transparent Polyamides
Polyamides from EMS-GRIVORY offer great performance and high utility, on condition that they are used and processed correctly. From the initial idea up to series production, EMS-GRIVORY customers receive support from Application Development Centre specialists in order to obtain the optimum from the respective products and the associated production. If requested by the customer, the Application Development Centre (ADC) undertakes parts of the project. In this way, each customer can concentrate on his strengths and achieve his goal more quickly thanks to cooperation. Also, should things become critical, the ADC is always there for its customers and quickly finds a suitable solution.

The ADC specialists are well acquainted with your area of work, whether it is a market segment, a process or a product. Specialists and customers speak the same language – and the communication is good right from the beginning. Synergies develop across market segments and ideas connect to give completely new solutions.

With the Application Development Centre in Switzerland and further sites in the USA and Asia, EMS-GRIVORY guarantees a comprehensive service. Thus intensive care at the highest level is assured for customers who are active worldwide.

Implementing customers’ ideas
For their customers and partners, the applications engineers of EMS-GRIVORY perform a feasibility study, examine the economic aspect and find the right material. Supported by CAE, they demonstrate how the component and the tool must be optimally designed. And, if it is impossible, the ADC explains why.

Getting the maximum out of the components – with support from CAE.

For the production of prototypes, the comprehensively equipped technical laboratory is always available with numerous process technologies and, if desired, the ADC team will take care of the tooling. If the customer is in a hurry, the first samples are made in Rapid Prototyping. If all runs smoothly, the customer starts series production. This is how the ADC of EMS-GRIVORY works: one is only satisfied when the customers are also satisfied.

Eyes open for innovation
In the Application Development Centre new manufacturing processes and special processes are continuously being examined. The comprehensive machine park is always up to date and ready for the polyamide processing of the future. Follow-up processes are also examined by the ADC and refined. During this, application or processing patents often arise, which may be freely used by customers and development partners.

The scope of the ADC’s work also includes the evaluation of future market requirements, which EMS-GRIVORY’s research and development division implements in new products. Through accompanying processing and application tests, EMS-GRIVORY makes sure that all products fulfill their promises in practice. If needed, EMS-GRIVORY supports its customers and their partners with training by highly-qualified specialists who are very familiar with the relevant application area. The scope of the ADC’s services is rounded off with application-specific component testing for all conventional material properties.

Christian Kruse
Head of Application Development Centre

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Today’s spectacle frames set two trends, on the one hand correction lenses are becoming increasingly lighter and more filigree, and on the other hand even higher safety requirements apply for sport and leisure glasses. EMS-GRIVORY has the best product for both trends with the two ‘new’ types Grilamid TR 90 TL and Grilamid TR 90 NZZ.

Filigree frames for correction lenses that are as light as possible require even higher-strength polyamides. Grilamid TR 90 TL was developed precisely for these requirements. This new amorphous polyamide, apart from having the well-known features above all increased material strengths of the Grilamid TR products, is as light as possible require even higher-strength polyamides. Grilamid TR 90 TL was developed precisely for these requirements. This new amorphous polyamide, apart from having the well-known features above all increased material strengths of the Grilamid TR products, is

The marking or inscription of plastic parts with laser radiation is being employed increasingly to exploit its various advantages. By writing with a laser, additional work steps such as sticking on labels or printing, often with solvent-containing inks, are avoided. In addition, a laser may be flexibly integrated inline in an assembly line or operated separately as a workstation.

A prerequisite for laser writing is that the plastic absorbs the laser beam. It can either foam, which results in a bright inscription on a dark background, or it can carbonise, which gives a dark inscription on a light background. Certain absorber additives in the plastic can also cause a colour change in the material. An inscription like this penetrates more or less deeply into the plastic part, but under certain circumstances can be scratched off or felt as a rough surface.

Especially aesthetical and untouchable, on the other hand, is the inscription of a component beneath the surface. This process is possible with multilayer components that, for example, have been fabricated by means of monosandwich injection moulding, barrier injection moulding, multilayer injection blow moulding or by overspraying a part with a second component. Here the outer component must consist of a plastic that is transparent to both light and laser beams, e.g. Grilamid TR 90, and the component behind it must be laser-absorbent. An ‘under the skin’ inscription can neither be scratched off nor form a rough surface. For this reason, this type of inscription is not only secure but also fulfils the requirements for components with high aesthetical demands. A marking that is optically so attractive can even be used for pure decoration.

**Two worlds united: Grilamid TR combines fashion with safety**

Brilliant performance on the nose - Grilamid TR

**Best protection all around**

With sport and leisure glasses, apart from the wish for a trendy design, important safety aspects arise. Functionality combined with safety is demanding for the materials employed, for it is no longer merely a question of UV protection. Modern sports glasses also offer mechanical protection against physical injury. EMS-GRIVORY has developed the new Grilamid TR 90 NZZ especially for this combination of requirements. Thanks to its extreme impact resistance, it gives protection without detracting from the standard requirements such as design freedom and wearer comfort. The mechanical improvements in the product thus lie mainly in the impact resistance, but are also noticeable in improved levels of stress crack resistance. These are features that are not only interesting for spectacles.

With their design freedom, as well as their excellent mechanical properties, these two new products follow in the footsteps of the already established Grilamid TR products. EMS-GRIVORY now has an even broader spectrum of high-performance amorphous thermoplastics. EMS-GRIVORY thus proves once again that with Grilamid TR, it is, for good reason, the unchallenged world market leader for the plastic spectacle industry as far as quality is concerned.

Robert Meyer zu Westram
Product Manager Grilamid TR

Werner Züst
Process Development Manager Injection Moulding and Extrusion
Cosmetic bottles with an intelligent barrier

Beauty begins with multilayer packaging

With beauty products the packaging must of course be designed to be specially attractive. EMS-GRIVORY supplies different polyamides that make something special out of cosmetics and pharmaceutical packaging.

The extremely clear material grades distinguish themselves when used as a replacement for glass. Since the density of plastic is considerably lower than that of glass, a reduction in weight of 60% can be achieved. This means lower transport costs and reduced vehicle emissions. Furthermore, plastic is unbeatable and malfunctions of the bottling plant due to glass breakage can be avoided.

First class appearance included

For high-quality cosmetic and pharmaceutical products, protection from external influences is especially important, as well as the suppression of absorption or permeation. To this end, packaging materials are needed that incorporate barrier characteristics against various media. Since a single type of plastic cannot accomplish this, multilayer containers are manufactured, in which Grivory G is almost always present as a barrier against oxygen or solvents. It is in special demand for small, handy flasks of up to 100 ml in volume, where the use of substitute glass is increasing at the moment.

An especially interesting option in the design of such packaging is the use of laser-absorbing master batches for the outer layer. The latter can then be written on or decorated by laser without solvents, is scratch-resistant and cannot be felt.

For the support of customer projects, a multilayer injection blow moulding machine is available in the EMS-GRIVORY technical centre on which suitability tests can be performed, and customers’ tools can also be adapted.

New material – many benefits

Depending on the application, EMS-GRIVORY can provide a suitable metal-substitution material. The highly reinforced polymer materials Grivory GV, Grivory HT and Grilamid LV have already proved to be excellent alternatives to die-casting materials such as zinc, aluminium and magnesium alloys.

A further benefit of metal substitution using these types of polyamide is that antitrust treatment is unnecessary, which regularly costs time and money with metal components. Thanks to functional integration, bearings or mating elements can be integrated into the design of a single plastic component and it is often possible to replace several metal parts with a single plastic component – which saves numerous fabrication steps. Last but not least, because of the two to fourfold lower density of plastics, transport costs for the parts decrease, and with applications in the automotive area, increased use of plastics helps to lower fuel consumption and hence the CO₂ emissions.

Fabrication of PA prototypes rapidly and at low cost

In many application areas, metal replacement now plays a significant role, cost savings of up to 50% are possible, as moulds for plastics processing have longer service lives and numerous post-processing steps can be spared, such as deburring, painting, milling, turning, threadcutting...

Support right from the beginning

If a metal component is to be replaced by a high performance polyamide, EMS-GRIVORY supports the customer right from the beginning. In a first step, the stresses and strains that the component must withstand are determined; in a second step, an adapted component design is modelled by computer simulation, so that the effects of the stressing and strains can be determined – these steps ensure that the desired plastic component performs just as well in practice as its metallic equivalent.

The exact forces and temperatures to which a metal component is subjected, however, are often unknown. It is here that many empirical values gleaned through experience and from the test bench play an important role. Whether or not a plastic component can perform in the same way must therefore be tested on a prototype. The usual methods are, however, limited. If they are milled from an expensive semi-finished product, the prototypes only have limited utility, and suitable semi-finished products are often not available in the first place. The alternative of fabricating a prototype mould is time-consuming and very costly.

EMS-GRIVORY has developed a rapid, low-cost solution: the prototype is fabricated directly with the customer’s die-casting mould, for this purpose usually only slight, reversible tool adaptions are necessary. Moulds which are no longer usable for die-casting can also be used. Thanks to this simple approach, prototypes made out of several different EMS-GRIVORY polyamides are also available quickly. Admittedly, remachining is still necessary in this adaptation phase, but the components can be set up immediately and subjected to trials and practical tests. This service has been successful for a long time and impresses interested parties by showing them in which application areas high-performance materials from EMS-GRIVORY can be used.
The simulated plastic

The ideal component comes out of the computer

Because of present day requirements, the development of new products can be very complex and costly. Newly developed products must be enduring, light and cost effective. In order to be able to implement these conditions, simulation software from component development has been indispensable for some time.

A mould for manufacture of plastic components using injection-moulding processes can cost up to several hundred thousand Euros. Here it is obvious that solid planning of both the component and the mould pays off without a doubt. For this purpose, various computer programmes are available which, for example, simulate the manufacturing process (injection moulding simulation) or by means of FEM (Finite Elements Method) calculate the component strength. Results from computer simulations today supply the fundamentals for the designer and the construction of the mould, and help in the choice of materials. With an FEM calculation, for example, area of the component subjected to especially high stress can be shown. One of the greatest challenges remaining to this day is the simulation of glass-fibre reinforced polyamides.

Forces and fibres

High-stiffness composite materials made of glass or carbon fibres and polyamides are being increasingly used to replace metals. In the injection moulding process, the fibres in the outer layer are strongly aligned to the flow direction of the melt. Predominantly in the fibre direction, they reinforce the polyamide with respect to tensile strength and stiffness. Perpendicular to the fibres and especially in weld lines, however, the reinforcement is less. This deficit may be partially compensated for by targeted optimisation of the component.

Today it is possible to take into account in the FEM calculation the fibre orientation calculated in the injection moulding simulation. In order to calculate the anisotropic mechanical properties according to the fibre direction, micromechanical models are used. With their help, stress-strain curves of fibre-reinforced plastics can be determined in dependence on fibre orientation, length and quantity. But micromechanical models serve not only to describe the materials for FEM calculations or injection moulding simulations, EMS-GRIVORY also uses them for the validation of material data and in the development of new materials.

Linked simulations

For the preparation of micromechanical models, measurements on samples with known fibre orientation, length and fraction are required. By considering the fibre orientation in the FEM simulation, the precision of the prediction can be increased, especially for deformation of a component under loading or with natural vibration modes. Knowledge of the main stress direction relative to the fibre orientation is also an advantage for the assessment of failure. Furthermore, the residual stresses calculated in the injection moulding simulation can be superimposed on a stress situation caused by external loading.

Long-fibre reinforced materials, compared to short-fibre reinforced materials, have a greater energy absorption capability and are therefore predestined for use in components that are subjected to high dynamic loading, e.g. in crashes. In the simulation of crash events, apart from the anisotropic mechanical characteristics, the failure process itself is of great importance. For this, different failure models are available.

Despite this progress in linked simulations, the behaviour of fibre-reinforced components may be predicted only as ‘an approximation to reality’, as the actual behaviour is highly complex. The multitude of different influences makes model building more difficult. These include time, temperature and moisture dependant material behaviour of polyamides and the influence of processing on the properties. Nevertheless, use of the existing approaches considerably increases both the knowledge of the material and the quality of the calculations. Such current knowledge enables EMS-GRIVORY, who has supported customers for over 20 years with component simulation, to offer improved advice and assistance in the dimensioning of components, to take account of the properties of the plastics and in the new development of innovative products.

Perfection starts with the design

Topological optimisation in component design

On the subject of component optimisation, EMS-GRIVORY has supported their customers for many years already. The goal in this is the optimum dimensioning of components to take account of the properties of the plastics.

For example, how does one determine which cross-sectional shape a beam must have so that it remains as stiff as possible and shows only a minimal bending when loaded on one side? Special software is of assistance for answering this and similar questions. The Application Development Centre (ADC) augmented its wide-ranging computation portfolio in this area with the optimisation software TOSCA®.

The optimisation software selected calculates a design draft in several loops. This procedure is called topology optimisation.

Step by step to the component

The starting point is a so-called installation space model, which is the maximum available space. With a computational model derived from it, the expected component loading is simulated and the result then led to the optimisation program. This computer, in steps, the optimum design form by reducing the local stiffness, described by the E modulus, for regions with low loading and maintaining it for regions of high loading.

The software enables a selection from among various objective functions on which the optimisation is to be orientated, the most frequent goal is the minimalisation of the component volume or weight at constant component stiffness. Other possible objective functions are the maximisation of the overall stiffness at constant component weight or also the maximisation of the 1st resonant frequency at the system. At the end of the optimisation process there is a preliminary design with optimal component properties. This preliminary design can be further processed in the next step in a CAD program.

Apart from the actual component loading, additional conditions can be defined that are relevant for the design shape. For injection moulding castings this is above all the ejection direction that also determines a possible shape. TOSCA® even enables the consideration of several local, different ejection directions, as can often occur with complex components.

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Ralf Beck
CAE Engineer

Maximum performance with minimum weight

It may be that the computed design suggestions assume a surprising shape, who

se advantages, however, are obvious on closer examination. Such a surprise was supplied, for example, by the development of a beam that is fixed at one end and loaded at the free end (Fig. 1) – as described in the problem description of the input question. The result is surprising as it deviates significantly from a classical structure.

With the aid of topology optimisation with TOSCA®, the ADC can design structural components considering the material properties, installation space and loadings at minimum weight or volume. Especially weight minimisation usually means favourable manufacturing costs at maximum component performance for the customers.
EMS-GRIVORY manufactures at the heart of China’s automotive and electronics market

EMS-GRIVORY grows with its customers and, at the start of 2010, started-up a new production plant with application development at Suzhou. Following the production plant in Taiwan, this is the second plant to start operations in Asia.

The new application and development centre as well as the production line are located at the Suzhou Industrial Park (SIP), the hi-tech park in Suzhou, to the west of Shanghai and at the centre of the automotive and electronics market in China.

The production plant is equipped with the latest, state-of-the-art process technology – developed in-house by EMS – and can be readily described as the most modern plant in China. The unique technology allows tailor-made, customer-oriented manufacturing of high-performance polyamides for high-quality applications in the rapidly growing automotive and electronics markets.

With this production plant in China, EMS-GRIVORY is following the European OEM’s and tier suppliers and can react more quickly to local requirements. In addition, EMS-GRIVORY is expanding its team: In future, more experts will be available locally, who can carry out CAD analyses, have excellent knowledge of the local markets and can provide the comprehensive technical customer service which is valued by customers of EMS-GRIVORY throughout the world. Expert competence, market knowledge and processing know-how – for years now this has made EMS-GRIVORY market leader in the field of high-performance polyamides and the ideal development partner in all market segments.

Non-warping cover for undisturbed reading pleasure

Obtaining a minimum of deformation in components is no longer just a question of appearance. Highly automated production lines in the electrical and electronic industries rely on the perfect fit of all components. An example is the cover of an E-book reader: the circuit boards did not fit properly into the cover so the components regularly got stuck in the assembly line. Furthermore, this poor fit caused recurring problems in the reader’s function. The remedy was changing to material from EMS-GRIVORY: the choice fell on Grivory GVX-5H, providing a very high stiffness and toughness. This semi-crystalline high-performance polyamide is 50% reinforced with glass fibres being easily processable in thin walled applications. Great dimensional stability, combined with a very high surface quality, enable the manufacture of a most attractive cover that also passes the required fall tests. The designer of this E-book reader also has the option of lacquering the cover with effect paints, e.g. pearlescent decoration or soft-touch effects or applying IMD technology. Laptop covers and mobile telephones also benefit from the numerous advantages of the Grivory GVX product family.
Metal substitution on a new level

EMS has on the one hand invested in local production and at the same time established specialists for the automobile market in Asia. Automobile experts with well-founded specialist knowledge in all fields are available to the customers and guarantee a complete service. This is all in order to be able to offer locally in China the same high service as in Europe.

Success did not take long to arrive. Local automobile makes such as Chery or Brilliance already use materials from EMS-GRIVORY.

The Chinese car maker Chery uses Grivory HTV-5H1 for individual clutch components. Since each market has its own peculiarities, the key to successful co-operation with customers is a strong, competent local presence. In Asia, three development centres in Taiwan, Japan and China permanently take care of customers’ interests. The on-site specialists know the different markets and their requirements, and can hence apply their technical knowhow to individual customer requirements more rapidly and in a targeted manner. In this way EMS-GRIVORY supports its customers continually with many additional benefits for their competitiveness and a decisive competitive lead.

On familiar terms with progress

EMS-GRIVORY Asia plays a pioneering role in metal substitution. In order to enable personnel at significant opportunities in this area, EMS-CHEMI (Taiwan) Ltd. has NSF Certification since August 2010. NSF International is a non-profit, non-governmental organisation that sets standards and product certifications for public health and safety. These standards are relevant for the fulfilment of North American market requirements. Grivory FWA and Grilamid FWA (food and drinking water approved), which are approved for contact with foodstuffs and drinking water, can now be distributed locally from the production site in Taiwan. Production for the certified materials started in September. The materials with FWA designation are mainly used in coffee machines, fittings for hot and cold water systems, valves, flow meters, filters and mountings, but also in medical applications. NSF Certification further broadens the application spectrum of FWA materials, which have comprehensive worldwide approval at their disposal. FWA materials play an important role in metal substitution in that they make a significant contribution to reducing the lead content in drinking water by replacing brass.

In the substitution of metals, the long glass fibre products from EMS-GRIVORY are gaining in importance. The LFT polymides, based on the trade names Grivory, Grilamid and Grilon, were introduced to the Asian market in 2008. Especially in the area of pressure casting, conversion and clutch components made of Grivory HTV-SH1 have already been successfully implemented. As everywhere, cost advantages, weight saving, quality and service are what count in China. Companies such as BMW, Audi or Mercedes-Benz, which also produce in China, rely on the materials and broad specialist knowledge of EMS-GRIVORY in order to attain the same quality standard as in Germany for the components produced in China.

Experts expect a sustained growth of the Chinese automobile market. But not only will the demand in general increase; especially the demand for quality and comfort will rise. EMS-GRIVORY materials are clear leaders in this area.

EMS-GRIVORY

Right in the middle instead of only on the sidelines

EMS-GRIVORY Asia plays a pioneering role in metal substitution. In order to enable personnel at significant opportunities in this area, EMS-CHEMI (Taiwan) Ltd. has NSF Certification since August 2010. NSF International is a non-profit, non-governmental organisation that sets standards and product certifications for public health and safety. These standards are relevant for the fulfilment of North American market requirements. Grivory FWA and Grilamid FWA (food and drinking water approved), which are approved for contact with foodstuffs and drinking water, can now be distributed locally from the production site in Taiwan. Production for the certified materials started in September. The materials with FWA designation are mainly used in coffee machines, fittings for hot and cold water systems, valves, flow meters, filters and mountings, but also in medical applications. NSF Certification further broadens the application spectrum of FWA materials, which have comprehensive worldwide approval at their disposal. FWA materials play an important role in metal substitution in that they make a significant contribution to reducing the lead content in drinking water by replacing brass.

In the substitution of metals, the long glass fibre products from EMS-GRIVORY are gaining in importance. The LFT polymides, based on the trade names Grivory, Grilamid and Grilon, were introduced to the Asian market in 2008. Especially in the area of pressure casting, conversion and clutch components made of Grivory HTV-SH1 have already been successfully implemented. As everywhere, cost advantages, weight saving, quality and service are what count in China. Companies such as BMW, Audi or Mercedes-Benz, which also produce in China, rely on the materials and broad specialist knowledge of EMS-GRIVORY in order to attain the same quality standard as in Germany for the components produced in China.

Experts expect a sustained growth of the Chinese automobile market. But not only will the demand in general increase; especially the demand for quality and comfort will rise. EMS-GRIVORY materials are clear leaders in this area.

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More than 300 products can now be compared on the EMS-GRIVORY website at www.emsgrivory.com. Along with technical and safety datasheets, various search functions make it easy to find the right material.

Right on schedule for K2010, the Business Unit EMS-GRIVORY has launched a new and comprehensive database called “EMS Material Database”, which encompasses the most important products from the product families Grivory, Grilamid, Grilon and Grilflex.

This database has been integrated in the EMS-GRIVORY website - www.emsgrivory.com – and can be accessed in German and English without any login or password. The database contains extensive technical data on more than 300 specialty polyamide products used in a variety of applications and market segments.

This new web tool allows not only rapid downloading of technical and safety datasheets but also comparisons between products or the definition of specific data tables for selected grades. Other features are simple searches by product family, designation or polymer groups as well as advanced searches for specific properties, product attributes, application or material approvals or certifications. With only a few mouse clicks, users can create a search profile, compare key material data of EMS products and save the results on their own computer.

Andre Sturzel
Product Manager Grilamid
EMS-GRIVORY worldwide
www.emsgrivory.com

Access and compare more than 300 products online

New online material database

Ride like the wind!

Flevobike «GreenMachine»

The wheel rims of this trendy ride are made of Grivory GC-4H and GV-6H. The rims are subject to high loads so the strength and stiffness requirements on the materials used are correspondingly high.

Along with good processability, weight reduction of the component as well as corrosion resistance of the plastic wheel rims in salt spray tests as per DIN EN ISO 9227 were of great importance.

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