Transparent and Safe

Material for Applications in Cell Phones, Cars, Toys, and Beverage Bottles

Grilamid TR 50 is the latest addition to Ems-Grivory's amorphous polyamide product range. The new material combines properties such as high stiffness, optical quality, and chemical resistance with high ductility and toughness.

The development of transparent polyamides by Ems-Grivory started in the 1980s. The first commercialized product, Grilamid TR 55, paved the way for acceptance of amorphous polyamides in numerous applications, such as baby feeding bottles and fuel sight glasses. A crucial factor in the success of amorphous polyamides was their outstanding chemical resistance in comparison with other transparent materials. Further advantages of transparent polyamides such as stress crack resistance, durability, and low density were also important at that time.

In the 1990s, Ems-Grivory became a leader in flexible sunglass frames and flexible lenses with Grilamid TR 90. This polyamide's flexural fatigue strength coupled with optical quality, wide colorability, and UV resistance make it the most important product so far in the Grilamid TR portfolio. In the 2000s, Grilamid TR 30 was developed with emphasis on stiffness, scratch resistance, and surface hardness, as well as cost effectiveness. In automotive interiors, the deep black, glossy effect of "piano black" has become well »

In transparent, colored or opaque piano black formulations, Grilamid TR 50 offers high ductility and design freedom (© Ems-Grivory)

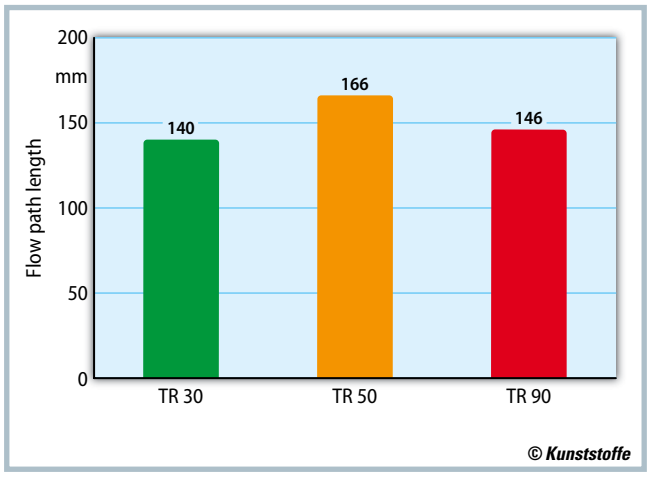

Fig. 1. Comparison between the flow path lengths of three products in the Grilamid family (source: Ems-Grivory)

known. The amorphous polyamide, Grilamid TR60, with a high glass transition temperature of 190 °C was developed during the same period for use in large kitchen articles.

Grilamid TR50, which has been available since the start of 2018, combines the high stiffness of Grilamid TR30 with the optical quality, ductility, and toughness of Grilamid TR90. Despite a 44 % higher elastic modulus (**Table 1**) than Grilamid TR90, it achieves the same transparency and clarity; its optical values of 0.2 % haze and a Yellowness Index YI of 1.5, are at a very high level.

Ductility Ensures Safety

The development of Grilamid TR50 took two years, including pilot production and application development. The prime focus was on the safety aspects of the end products, particularly toys, cars, and beverage bottles. Thanks to the high ductility of the new material, fracture does not give rise to sharp edges or dangerous splinters. High strength and good processability (high flowability) permit wide freedom in the design of new toys, irrespective of whether they are transparent or colored. Grilamid TR50 can be tailored and compounded to supply grades ranging from colorless and transparent through intense shades all the way to piano black. In addition, the material – like all Grilamid TR products – is free from bisphenol A, which is a requirement of toy manufacturers.

For interior automotive applications, behavior in the event of a crash is important. Here, once again, the high ductility of Grilamid TR50 enables it to be used in close proximity to passengers, while the excellent chemical resistance of the new material to skin contact is also an important requirement. Unlike other amorphous polymers, the Grilamid TR family also has better stress crack resistance. This makes it suitable for applications such as bezels for screens, air vents, control panels, and dashboards or functional components on the steering wheel, which are only possible to a limited degree with polycarbonate. Due to this material's high surface quality, components can be produced cost effectively in different colors without additional coating. In addition, parts made from Grilamid TR50 have good dimensional stability on account of its low moisture absorption. A grade of Grilamid TR 50 containing UV and heat stabilizers has also been specially developed for use in automotive interiors.

For use in beverage bottles, a material must satisfy strict safety requirements (no bisphenol A, formulation compliant with EU Regulation 10/2011, harmless fracture behavior) and permit light weight through low density. Grilamid TR50 meets these requirements and is very suitable for beverage bottles on account of its neutral intrinsic color and high transparency. In addition, thanks to its high flowability (**Fig. 1**), it can be used to produce very thin-walled components with high strength and toughness, such as sight glasses for fuel and lubricants. A variant with additionally improved flowability and demoldability is also available.

Conclusion

Grilamid TR 50 increases safety and cost effectiveness in many critical plastics applications. It is an addition to the existing Grilamid TR range of transparent amorphous polyamides and a bisphenol A-free replacement for polycarbonate. With its excellent property combination, various specially tailored grades, and wide color options, the new material ensures safe, transparent applications. ■

Property	TR 30	TR 50	TR 90
Tensile modulus, cond. [MPa]	2800	2300	1600
Tensile strength, cond. [MPa]	90	80	60
Notched impact strength, cond., 23 °C [kJ/m²]	12	10	13
Ball indentation hardness, cond. [MPa]	160	130	90
Glass transition temperature, dry [°C]	160	145	155
HDT/A dry (1.80 MPa) [°C]	125	110	115
Water absorption, 23 °C/saturated [%]	9	6.5	3.0
Moisture absorption, 23 °C/50 % RH [%]	3.5	2.5	1.5
Density dry [g/cm³]	1.15	1.09	1.00
Flammability UL 94, 0.8 mm [-]	V2	HB	HB

Table 1. Comparison between the properties of different Grilamid materials (source: Ems-Grivory)

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