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Press Release

Expanded range of polyamide compounds

New cross-linkable polyamide compounds from DimeLika Plast replace costly high-performance plastics

DimeLika Plast GmbH, headquartered in Brühl, in the German region of Baden, are expanding their range of cross-linkable engineering plastics with the CompaMid® PA 6 and PA 6.6 product line.

With the cross-linkable CompaDur® PBT compounds, the company have already succeeded in implementing and commercialising a range of applications with several customers. The expansion of the product range with cross-linkable polyamides was thus a logical next step.
“By cross-linking plastics, plastic components, that is, we are able to improve the material properties of less costly plastics in the melt, so that they can replace metals, metal alloys and high-performance plastics, which are costly and often difficult to process. By replacing high-performance plastics such as LCP, PPS and PPA, we can generally save 5 euros per kg and more,” says Hans-Dieter Voss, Managing Director of DimeLika Plast.

The basic effect of beta irradiation can be explained as follows, using polyamide (PA) as an example:
Polyamides are linear polymers with amide bonds which repeat regularly along the main chain. Precisely metered beta irradiation breaks up the macromolecules in the polymer into radicals and cross-links them into new molecules.
The irradiation causes chemical changes to occur. Excitation of the molecules subjects the chemical bonds in the macromolecules to homolytic cleavage. Free radicals are formed when the bonds are broken. The key mechanisms of the change are chain cleavages occurring as random cleavages of bonds. Chain branches, the early stages of cross-linking, form a 3-D network in the subsequent cross-linkage. The precursor of every cross-linkage is an increase in molar mass due to this branching.
Moisture has a positive effect on cross-linking in the PA. Increases in moisture content in turn increase the motility of the amorphous areas, leading to a decrease in the glass transition temperature.

Irradiation improves mechanical properties in reinforced plastics (such as with glass fibres). This is not based on the cross-linkage of the matrix material, however. It can also be attributed to improved fibre/matrix adhesion.
The result of radiation cross-linking is a material with a significantly higher cross-linkage density which is comparable to thermosets or high-performance plastics in terms of its mechanical, thermal and chemical properties. Originally a thermoplastic polymer, the material can now withstand significantly higher temperatures of up to 350°C. It has an extremely high heat distortion temperature and excellent electrical and mechanical properties.

PA compounds must contain a special additive package in order to be cross-linked. CompaMid® PA 6 and PA 6.6 contain a specially developed cross-linking additive package which is incorporated during the compounding stage. The processor thus receives finished pellets which can be added directly to the shaping process. No mould changes or modifications are required, and the additive package does not affect the cooling and shrinkage behaviour of the compound.
“In the logistics chain (see Fig. 1), cross-linking is the last step after the shaping process (injection moulding, extrusion, blow-moulding), before the component is transported to the end user. Today, thousands of tonnes of finished and semi-finished plastic parts are upgraded by radiation cross-linking. The irradiation facilities existing today make it possible to perform the irradiation process in a matter of seconds. With short process times and professional logistics partners, this logistics chain will soon become a daily routine. Large international companies in the electrical and electronics industry have been using radiation cross-linking of plastics to their advantage for years,” explains Liborius Flöper, Managing Director of DimeLika Plast GmbH.

The following sectors provide promising prospects for radiation cross-linked polyamide compounds:

Automotive:
In the automotive industry, parts under the engine bonnet must continually withstand ever increasing temperatures and more aggressive environmental influences. For this reason, high-performance plastics have frequently been used in these applications – until now. Cross-linkable polymers are perfect as replacement materials for applications in the engine interior or exhaust system, where temperatures are high and parts come into contact with oil, grease, fuel and other corrosive media (such as salts).

And the trend toward weight reduction (think: metal replacement) is presenting more and more interesting possibilities for cross-linkable plastics.
Electrical/electronics industry. The excellent electrical and mechanical properties of cross-linkable polymers are ideal for many electrotechnical applications. These allow:
improved service life of components due to increased abrasion resistance maximum contact safety, since no halogens or red phosphorous are used improved chemical resistance (such as zinc chloride solution [ZnCl2]) use for 3D-MID components lead-free soldering technology up to approx. 280°C; high-temperature soldering (approx. 0.5 sec at approx.. 450°C) a significant increase in the RTI (Relative Thermal Index) according to UL 746 B (describes the improvement in long-term ageing behaviour) an improved rating per UL 746 A, Hot Wire Ignition; this means that UL 508 flame retardants can be dispensed with in many cases These materials meet the requirements for glow-wire resistance according to IEC 695-2 at 750°C, 850°C and 960°C.

The advantages of radiation cross-linking in summary:

Improved thermal properties:
The cross-linking reaction inhibits the flowability of the plastic, resulting in improved heat resistance. Thus a radiation cross-linked PA 6.6 exhibits adequate strength even at temperatures over 350°C. The thermal expansion coefficient is also reduced. The temperature index of a cross-linked PA 6.6 improves by 20°C (5000 h; 60% drop in breaking elongation).

Improved mechanical properties:
Radiation cross-linking improves the mechanical strength of reinforced plastics even at room temperature. This is due primarily to better coupling of filler materials with the polymer matrix, caused by activation of the interfaces. Radiation cross-linking also improves the disadvantageous tendency of plastics to creep in particular.

Improved tribological properties:
The amorphous material zones which form on the surface of plastic gears or journal bearings as a result of the manufacturing process

normally exhibit unfavourable wear behaviour. Yet these very amorphous areas are particularly conducive to radiation cross-linking, which dramatically improves their wear behaviour. With polyamides, radiation cross-linking can increase the continuous service temperature by up to +100°C, to give but one example.

Improved chemical properties:
The cross-linking of plastics substantially decreases solubility and swelling due to solvents. Radiation cross-linking likewise improves resistance to aggressive media such as brake fluid. This manifests itself in an improved stress crack resistance and a significantly reduced decline in strength due to the effects of solvents.

Cost-effectiveness
In addition to the previously mentioned financial savings, replacing high-performance plastics can also significantly reduce loss rates. In many cases, these materials are difficult to process. For instance, the processing of LCP causes bubbles form in the component. It also means that investments and new tools or modifications of existing tools can often be dispensed with.

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About DimeLika Plast

With their comprehensive know-how, high-end customised solutions, and new, innovative applications and products, DimeLika Plast GmbH, founded in early 2011, see themselves as a provider of services and ideas for their customers. Working together with suppliers of raw materials and plastics processors, the company, headquartered in Brühl, Germany, continually develops new and innovative product solutions that are specifically aimed to meet customers' needs and to help them improve their standing over the competition. An integral part of the company's approach to business is the close, professional support provided, from the consulting phase on to application engineering, raw materials selection, formulation development, production, and finally, on-site service.
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