News Release

Tailored polyamide portfolio for the charge-air duct in modern combustion engines

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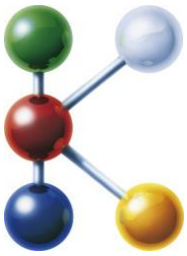
- **Ultramid® grades for various demands on pressure and resistance up to 220°C**
- **Selected polyamides available with globally consistent specifications, locally manufactured**

BASF at K 2016

Hall 5, booth C21/D21



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The reductions in fuel consumption and emissions which are prescribed by law in many countries are forcing the automotive industry to act. Besides developing alternative drives, the optimization of traditional combustion engines continues to play a key role. Downsizing results in higher pressures and temperatures, especially in components that carry air behind the turbocharger. BASF is responding to this development in engine designs with a consistent portfolio of PA6 and PA66 grades that meet the higher demands on the materials, their mechanical properties and temperature resistance. Depending on the base polymer and stabilization system, the materials are resistant to heat aging up to 220°C and show excellent burst pressure and weld strength. This means the part developer can be provided with the optimum material for each of the different components in the charge-air duct that offers the best value for money. Selected grades are based on global specifications: They are supplied worldwide from local manufacturing facilities, with uniform material properties and a consistently high level of quality.

More pressure, higher temperatures, lower costs

Turbochargers can be used to compensate for a loss of power in the engine while at the same time reducing the cubic capacity.

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Turbocharging produces higher pressures and temperatures in the engine compartment, especially in the charge-air duct. At the same time, car makers continue to develop the design of the charge-air duct to make the installation space more efficient and reduce emissions. This technological advancement in engine design is being accompanied by global processes of standardization and relocation of production facilities: Globally standardized engines and respective add-on parts are used in different vehicles that are produced locally. BASF is responding to this trend by offering a range of globally available products manufactured locally with globally valid specifications.

For use in the charge-air duct

BASF offers polyamides for the various temperature requirements of the charge-air duct. The range comprises PA6, PA66 and PA66/6 grades with a glass fiber content between 30 and 50 percent. Ultramid® B3WG6 GPX, a PA6 containing 30% glass fiber, has been newly added to the portfolio. It is resistant to temperatures up to 180°C and for a short time up to 200°C. Due to its excellent burst pressure and weld strength, it is suitable for air intake manifolds made from several parts. The upper end of the temperature range is covered by Ultramid® Endure, a specialty polyamide which can stand constant use temperatures of 220°C and peaks up to 240°C. The grades Ultramid® Endure D3G7 with 35% glass fiber reinforcement and D3G10 with 50% glass fiber reinforcement are suitable for injection molding. They are proven to work well in air intake manifolds of turbocharged diesel engines as well as in resonators and sensors. Well-known OEMs use Ultramid® Endure D5G3 BM (with 15% glass fiber), which is suitable for blow molding, in charge-air pipes. For temperatures between 180°C and 210°C, the portfolio contains PA66 plastics with enhanced heat stabilization. These include Ultramid® A3W2G6 to G10 (with glass fiber reinforcements from 30 to 50%) for temperatures up to 190°C, e.g. in charge air cooler endcaps, and the new Ultramid® A3W3G7 for temperatures up to 210°C.

Outstanding weld and burst pressure strength

In addition to the traditional storage of standard test specimens in a heating cabinet, which provides a good reference point for choosing materials, dynamic and close-to-component tests are playing an increasingly important role. These include tests of fatigue strength on tensile bars subjected to varying stresses, determining the burst pressure of welded hollow bodies and pressure alternation tests at different application temperatures.

Welded components are frequently used in the engine. If the material has a lower glass fiber content, the weldline can represent a weak point, particularly after aging. All of the grades in the portfolio display outstanding burst pressure and weld strength. They are particularly suitable for vibration and hot gas welding. The weld strength was measured on the Ultrasim® Weld Tester. BASF developed this complex test specimen in order to determine the fatigue strength of weldlines under various long-term loads. It also enables a more precise prediction of the part's service life using BASF's Ultrasim® simulation tool. The simulation helps customers to create an optimum design for their components at an early stage of development, to reduce development loops and the amount of prototypes.

Compared to the previous standard product, the newly developed Ultramid® B3WG6 GPX not only displays an initial burst pressure that is 25% higher. It also withstands four times as many alternating pressure load cycles at 100°C. Ultramid® A3W3G7, which is also new, fills in the gap between the Ultramid® A3W2 grades and Ultramid® Endure: The plastic shows very good mechanical properties even at constant use temperatures up to 210°C.

Global specification, local production

The demand for globally standardized materials will continue to rise. This is being driven by the desire of the globally operating OEMs to reduce their costs through modularization. Globally identical specifications make it possible to streamline approval and logistics processes if a material is only approved once centrally and can then

be procured globally from local sources. The obstacle is that a considerable amount of time and effort is required to establish uniform quality standards across different regions: For example, locally differing raw material sources, legal requirements, test standards and location-based differences have to be taken into account. BASF already offers several plastics which satisfy these requirements. The company is intensively working at expanding this global product portfolio. It also globally assists customers with component simulation and tailor-made support in application development and realistic component testing.

BASF at K 2016

Where your ideas become ideal solutions: BASF at K fair from October 19-26, 2016 in Dusseldorf, Germany, in hall 5, booth C21/D21. You can find all related press releases, photos and further information here: www.basf.com/k2016.

About BASF's Performance Materials Division

BASF's Performance Materials division encompasses the entire materials' know-how of BASF regarding innovative, customized plastics under one roof. Globally active in four major industry sectors - transportation, construction, industrial applications and consumer goods – the division has a strong portfolio of products and services combined with a deep understanding of application-oriented system solutions. Key drivers of profitability and growth are our close collaboration with customers and a clear focus on solutions. Strong capabilities in R&D provide the basis to develop innovative products and applications. In 2015, the Performance Materials division achieved global sales of € 6.7 bn. More information online: www.performance-materials.basf.com.

About BASF

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