Vehicle Comfort at Minus 40 Degrees

New class of materials for shock absorber seals

With a new high-performance material, Freudenberg Sealing Technologies (FST) is ensuring that shock absorbers can reliably do their job even in extremely low temperatures, down to -40°C (-40°F). At the same time, the new material mixture, which is coming into use in damper seals for cars and commercial vehicles, is much more wear-resistant than conventional materials. The first-ever series production of the seals is already starting in the spring of 2016.

If you continue to cool a rubber component, it loses its elastic characteristics at a certain temperature. It is hard as glass beneath this threshold – which is why engineers talk about the “glass transition point.” Fluoro rubber mixtures are used in the seals incorporated into many shock absorbers today. These materials become very brittle at around -20°C (-4°F). The dampers maintain their leak tightness at even lower temperatures, but they are susceptible to damage, especially when high lateral loads are applied to the damper – for example, when a car runs over a high curb. A seal performs a central task in the shock absorber: It seals the oil-filled working space where the valve piston moves back and forth. The work carried out in this way transforms the mechanical energy, which is introduced when the car travels over an uneven surface, into heat and ensures that a car keeps its four wheels on the road. Thus it is clear that driving safety is no longer guaranteed when oil leaks occur.

The sealing of monotube shock absorbers, which are primarily used in sports cars and in the booming sports utility vehicle (SUV) segment, is especially demanding. In this design, the oil is placed under pressure by a gas (usually nitrogen). Here the two media are separated from one another by an additional damper seal. The pressures exerted on the seal can reach 100 bar or more.

Special low temperature polymers, which are cross-linked with peroxides, are used to extend the range of temperatures where fluoro rubber can be employed. But elastomers produced in this way normally show increased wear. “That is due to the chemical structure at the points where the molecules are bonded with one another during vulcanization,” explained Randolph Gaa, a materials expert at FST. He is taking advantage of the results of the company’s own basic research, which found a way to combine actually incompatible material characteristics with one another. Another advantage of the new material is that its frictional characteristics hardly fluctuate over the sequence of temperatures. This is important because drivers expect reproducible and thus identical driving behavior in every situation.

The first high-volume application of the new technology is imminent. A European automaker is using seals made of the new material mixture from FST on an ongoing
basis. It is being employed in monotube shock absorbers for SUVs. “Vehicles of this type are in use worldwide and have to prove themselves in both Siberia and the desert,” said Jürgen Emig, who heads product development for shock absorber seals at the company. Since the increased low-temperature resistance is solely due to the improved material characteristics, no design changes in the shock absorber are required. This also makes it possible to convert existing vehicle models to the new seals retroactively.

Shock absorbers in commercial vehicles are another application for the new sealing material. With current materials, commercial vehicle damping seals are strengthened with a steel ring in order to meet this requirement. If the new, reduced-wear material from FST is used, the design could be changed. That is the reason that a damper seal now being tested includes just one spring to ensure complete leak tightness. It is expected to go into series production in 2017.

Like all chassis components in today’s cars, future generations of shock absorbers must become lighter. That is why FST is now investigating the integration of plastics as a carrier part for damper seals, which would replace some of the currently incorporated steel or aluminum components. Among other options, the piston, including seal, could one day be produced with the two-component injection molding process. “If that is successful,” Emig said, “weight savings of 30 to 50 percent are possible.”

About Freudenberg Technologies
Freudenberg Sealing Technologies (FST) is a leading developer, supplier and service partner of advanced sealing technologies for a wide range of market segments, such as the automotive industry, civil aviation, mechanical engineering, shipbuilding, food and pharmaceuticals, and agricultural and construction machinery. In 2014, FST generated sales of more than € 2 billion in 2014 and employed some 15,000 people. The company is part of the Freudenberg Group which generated sales of more than € 7 billion in 2014 and employed approximately 40,000 associates in around 60 countries.

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