Matching Elastomer Seals to Biofuel Applications

As the world attempts to reduce its dependence on fossil fuels, biofuels are now a reality. Brazil and the U.S. were early adopters of this alternative fuel for transportation but now its use is expanding in Europe, with Germany, France and Spain leading the way.

Biofuels are liquid fuels made from organic matter. Bioethanol is produced by the fermentation of plants containing sugar, such as sugarcane, sugar beet or corn, while biodiesel is produced by base-catalysed transesterification from oilseeds such as rapeseed, oil palm or others. Debate about "first generation" biofuels based on crops putting strain on global food production has, to an extent, hampered growth in fuelling of vehicles with biofuels. With the emergence of "advanced biofuels" sourced from seaweed and certain types of waste, use will undoubtedly increase.

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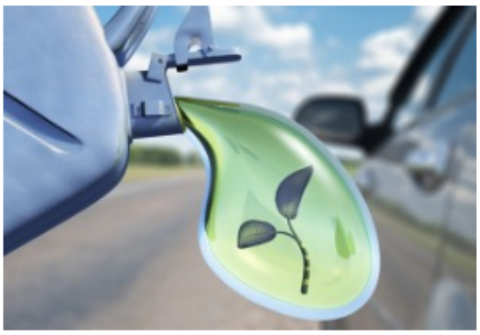
Component Compatibility

Trelleborg Sealing Solutions has worked with automotive manufacturers since biofuel technology was in its infancy and has conducted in-depth research on the suitability of sealing formulations in biofuel mixtures. It has evaluated the compatibility of typical automotive biofuels for both diesel and petrol engines with various fluorocarbon (FKM) and fluorosilicone (FVMQ) materials formulated for fuel systems.



Correctly matching elastomer seals to biofuel applications is imperative.

In addition to standard tests, Trelleborg undertook further testing to approximate the service conditions of water contamination in biodiesel and high-pressure in petrol systems.

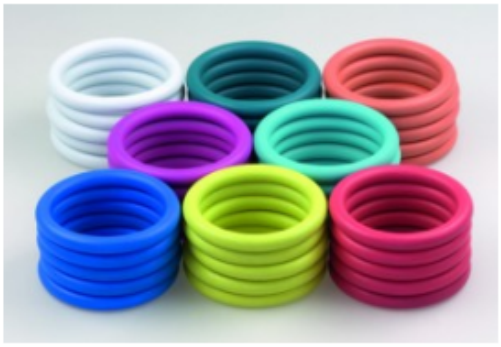
Water is a common contaminant of diesel and typically exists as a discrete phase at the bottom of storage tanks. As water is more soluble in biodiesel than in conventional diesel, it is more likely that dissolved water will be present in biodiesel blends.

In tests, bisphenol-cured FKMs showed a large deterioration in properties due to their metal oxide content. Water contaminant causes hydrolysis of the esters found in biodiesel and the subsequent formation of carboxylic acids, which deteriorates the polymer via dehydroflourination. Peroxide-cured FKMs performed best, as unlike bisphenol-cured FKMs, metal oxides are not used in their vulcanization.

Rapid Gas Decompression

In high-pressure petrol applications there is the risk of a sudden reduction of pressure in the system. In these situations, gas captured in a seal can cause the seal to split or crack sub-surface, dramatically reducing seal integrity.

Two compounds based on the same polymer, one specially formulated for rapid decompression environments and the other not, were assembled onto test equipment replicating a high-pressure fuel injector and tested in conventional petrol and biofuels.



Surface treatments can aid recognition and installation when using O-Rings of different material types

No failures were detected in O-Rings made from sealing compound not formulated for rapid decompression environments when tested with conventional petrol but in biofuel, they exhibited internal cracks. This was due to the higher polarity and smaller size of the ethanol in biofuel causing increased swell and a large enough reduction in mechanical properties to result in O-Ring damage during rapid decompression. In the compound specifically formulated to withstand rapid decompression, no failures were detected.

Correct Specification

Although standard laboratory tests suggest that typical automotive FKMs and FVMQs are compatible with biofuels, tests designed to replicate service conditions present a different picture. This indicates that when engineering fuelling systems, it is vital that the sealing compound used in biofuel applications is correctly specified for potential operational factors to ensure long and effective seal life.