Polymer Resistance to Alternative Fuels

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Alternative fuels are derived from resources other than petroleum. Some are produced domestically, reducing our dependence on imported oil, and some are derived from renewable sources. Often, they produce less pollution than gasoline or diesel. The increased global and domestic interest in alternative fuels created a need to study polymers and their resistance to these fuels.

Ethanol is produced domestically from corn and other crops and produces less greenhouse gas emissions than conventional fuels. E-85 is an alternative fuel consisting of 85% ethanol and 15% gasoline. Figure 1 shows the results of polymers that were tested at room temperature for Volume Swell after 70 hours in E-85 fuel.

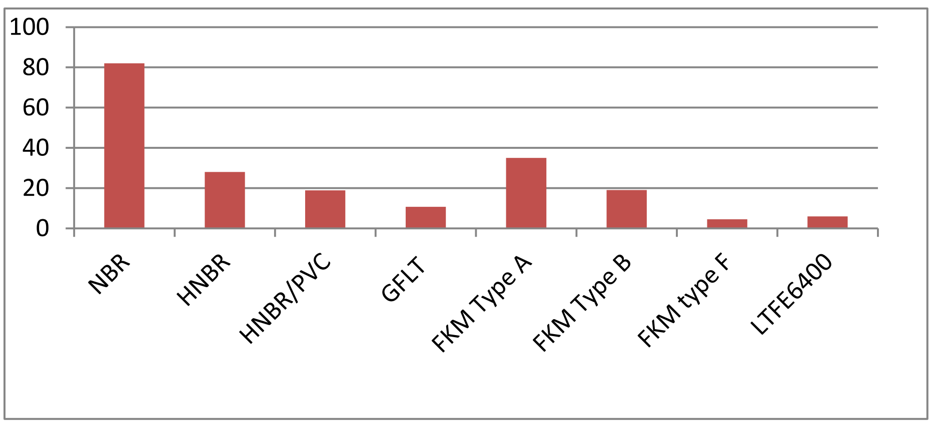

Figure 1. Volume Swells (%) of Various Polymers in E-85 (70 hrs. @ Room Temperature)

NBR, while relatively low in cost, exhibits greater swells in E85 due to the highly unsaturated backbone of the polymer. The FKM types A and B exhibit large swells because of the presence of metal oxides. HNBR provides moderate resistance to E85 while HNBR/PVC blends are slightly better. The peroxide cured FKM (type F, GFLT, and LTFE) are virtually unaffected by these fuels.

Biodiesel is derived from vegetable oils and animal fats. It usually produces less air pollutants than petroleum-based diesel. Biodiesels blended with rapeseed methyl esters are commonly used in Europe while the US blends biodiesel with soybean methyl esters.

When these biodiesels oxidize, they form aldehydes, alcohols, short chain carboxylic acids, and high molecular weight oligomers. The presence of these by-products causes many traditional polymers to degrade.

Figures 2 and 3 show the results of polymers that were tested at 80°C for Volume Swell after 70 hours.

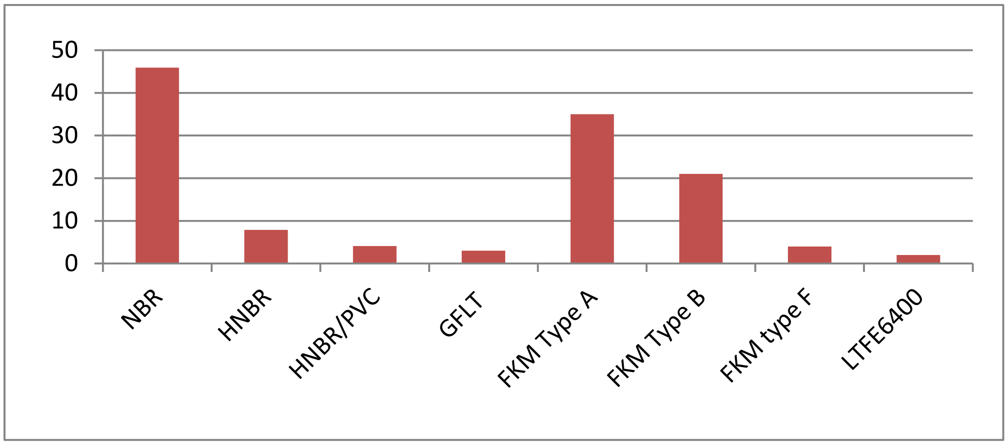

Figure 2. Volume Swells (%) in Biodiesel RME (Europe)

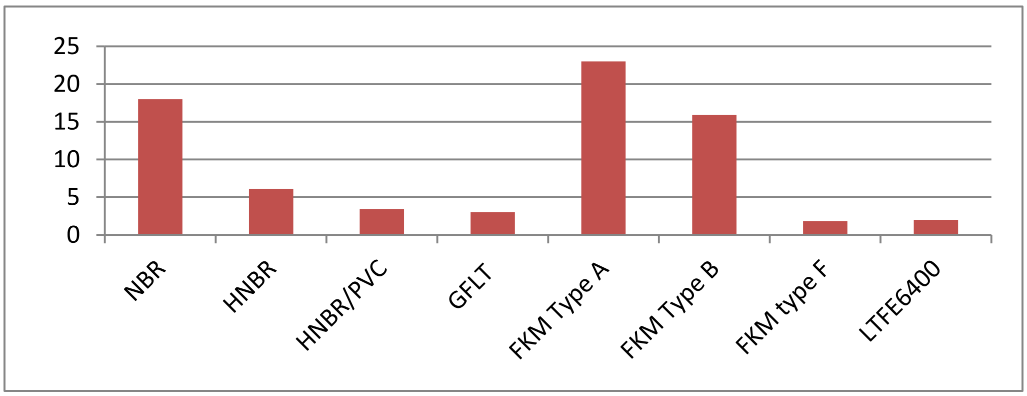

Figure 3. Volume Swells (%) in Biodiesel SME (US)

Once again, the NBR, FKM A, and FKM B showed relatively high volume change. Based on this volume change testing, HNBR performed better while LTFE, FKM F, GFLT and HNBR/PVC performed best.

The data presented here shows that the traditional polymers used in fuel-exposure applications are affected more than specialty polymers. In cases where this is a performance concern, new formulations will have to be considered. These formulations can be combined with an appropriate fabric substrate for diaphragm applications or provided in unsupported sheet for traditional gasketing use.

About the author: Charles Thrasher is Development Chemist for Trelleborg Coated Systems and has over thirty years in elastomeric compounding experience. He earned his degree in chemistry from McNeese State University.