



# Engineering Report

## Fuel Compatibility of Containment Solutions FRP Tanks and Biodiesel or Biodiesel/Diesel Blends

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### Background

Containment Solutions Inc. (CSI) single, double, and triple wall tanks are listed by Underwriters Laboratories Inc., under UL Standard 1316 - *Glass-Fiber-Reinforced Plastic Underground Storage Tanks for Petroleum Products, Alcohols, and Alcohol-Gasoline Mixtures*. This standard outlines the requirements for fiberglass reinforced tanks for the underground storage of petroleum-based flammable and combustible liquids, alcohols, and alcohol-blended fuels.

To obtain a UL 1316 listing, actual tank laminate was exposed to a number of environments and then tested for property retention to meet UL's minimum specified values. This testing was done by UL and included No. 2 Fuel Oil (Diesel Fuel) and No. 6 Fuel Oil as well as various other fuels including Ethanol and Methanol. However, at this time, there is no recognized representative biodiesel fuel for UL testing of underground tanks.

Currently, there are four ASTM standards that relate to Biodiesel:

1. ASTM D 975-08a Standard Specification for Diesel Fuel Oils. This specification covers seven grades of diesel fuel oils suitable for various types of diesel engines and includes an allowance for up to 5 percent biodiesel for the light middle (D-1) and middle (D-2) grade distillate fuels.
2. ASTM D 7467-08 Standard Specification for Diesel Fuel Oil, Biodiesel Blend (B6 to 20). This specification covers fuel blend grades of 6 to 20 volume percent (%) biodiesel with the remainder being a light middle or middle distillate diesel fuel, collectively designated as B6 to B20. These grades are suitable for various types of diesel engines.
3. ASTM D396-08(b) Standard Specification for Fuel Oils. This specification covers grades of fuel oil intended for use in various types of fuel-oil-burning equipment under various climatic and operating conditions and includes an allowance for up to 5 percent biodiesel for Grades No. 1 or 2 distillate fuels.
4. ASTM D 6751-08 Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels. This specification covers pure biodiesel (B100) for use as a blend component with middle distillate fuels and includes a new requirement that controls minor compounds using a new cold soak filterability test. The U.S. EPA requires that all biodiesel intended for use as a fuel meet D 6751.

Biodiesel is a fuel composed of mono-alkyl esters of long chain fatty acids (typically 16 to 18 carbons long) derived from vegetable oils and animal fats. Some sources of the oils and fats are soy beans, corn, cotton, sunflowers, rapeseeds, lard from pork, tallow from beef, etc.

Pure biodiesel meeting ASTM D 6751 is referred to as B100. When B100 biodiesel is then mixed with diesel, the resulting blended fuel is referred to as Bxx where xx is the percentage of biodiesel in the blend. For example, B20 means 20% of the blend is B100 and 80% of the blend is traditional diesel.

It is known from an understanding of the chemical composition of the biodiesel (long carbon chains) and its potential interaction with the materials used in a UL Standard 1316 listed tank, that biodiesel will have very little, if any, affect on the tank. This is further supported by resin manufacturers' field experience with fiberglass reinforced plastic (FRP) parts storing similar materials as well as CSI laboratory compatibility testing of biodiesel with CSI FRP underground tank laminate.

### **CSI Testing**

The UL Standard 1316 includes a protocol for testing various fuels. That protocol includes totally immersing representative tank laminate in the specified fuels at 100°F and determining their 270 day values as compared to their original properties. Because the UL testing is done at 100°F (a temperature higher than the normal fuel temperatures in underground fuel tanks) and with total immersion (an underground tank only is exposed on one surface to fuel), this test is much more severe than what actually happens to an FRP underground tank in actual service. Years of experience and application of this standard has shown that the UL test protocol is sufficient to determine the acceptability of a tank's construction for service with the UL tested fuels. In fact, this UL test protocol has not changed since the first edition of UL 1316 published July 1, 1983.

CSI has conducted testing of our laminate using the UL protocol of total immersion at 100°F with a soy based biodiesel fuel composed of 20% regular diesel and 80% biodiesel with the addition of a small amount of water and decanoic acid to simulate a slightly acidic fuel blend. At 270 days, the property retentions are greater than 96%. It is clear from these results that biodiesel has very little effect on CSI tank laminate and that the results far exceed the UL minimum retention requirements.

### **Summary**

Even though UL Standard 1316 does not currently include biodiesel and biodiesel blends, all Containment Solutions FRP underground single, double, and triple wall tanks manufactured since January 1, 1995 and listed by Underwriters Laboratories Inc. under UL Standard 1316 are capable of safely storing biodiesel and any biodiesel blend up to and including B100 meeting ASTM Standards D 6751, D 396, D 975, or D 7467, as well as petroleum-based flammable and combustible liquids, alcohols, alcohol-blended fuels at any alcohol level.