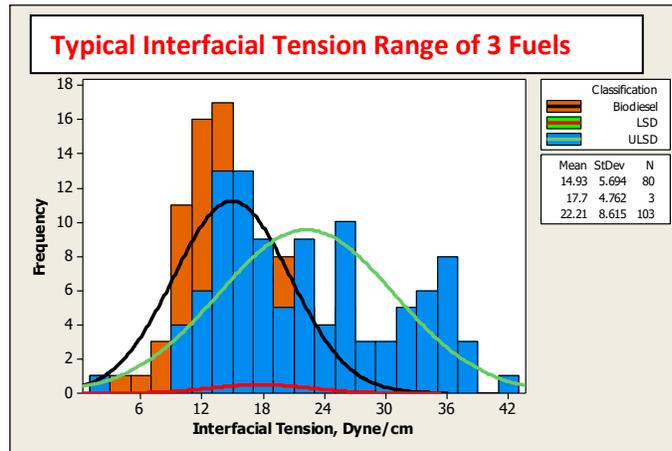


Water Contamination in Fuel: Cause and Effect

Water exists in three physical states and depending on the surrounding conditions it finds its way to the fuel systems like the high pressure common rail (HPCR) fuel systems on diesel engines. The important point thereafter is to provide the best possible on-engine protection by securing the fuel injector systems from severe damage. As the environmental challenges and emission regulations become more stringent, the fuel systems become even more efficient. All this indicates that the effective removal of water and solid contaminants from fuel is vital.

One of the most commonly thought of sources of water contamination is through condensation of atmospheric moisture to form liquid water. A research study shows that an empty 200 gallon fuel tank could contain a maximum amount of 22.8 grams of water vapor at 86°F, and 12.92 grams at 50°F^[1]. These values do not account for all of the water observed. Condensation is only one of the many ways in which water can contaminate fuel tanks. Fuel travels through several intermediate facilities prior to reaching the end user. It travels from refineries, is pumped through pipelines, is shipped via truck and is stored in tank farms before reaching the fuel stations.

What is the impact of the water contaminating the fuel? Microbial growth and bio-degradation of diesel fuel can cause filter plugging and more serious damages within the engine's fuel system. Problems like holes in the fuel tanks and fuel injector failures are observed if water removal is inadequate over long periods of time. A modern diesel engine consumes only a small portion of the fuel it draws, the rest of which circulates back to the tank. Fuel water separators help in reducing the water content by separating water from the fuel in every cycle. Depending on the size of the water droplets, it is characterized as free water, emulsified water, and/or dispersed water. The water droplet size, fuel type and engine operating conditions affect the performance of the fuel water separator and thus the amount of water retained in the fuel tanks. A fuel water coalescer and/or fuel water separator with tailored high efficiency composite filter media has the ability to remove free and emulsified water with >95% efficiency. Diesel fuel is more dense and less volatile than gasoline which allows air and moisture to infiltrate the diesel fuel. When comparing diesel fuel, biodiesel can hold more water than ULSD (Ultralow sulfur diesel). Due to the presence of ester bonds, biodiesel has a higher polarity than petroleum diesel which means higher affinity towards water. The nature of the fuel will also influence the amount of water contamination due to changes in thermodynamic properties like Interfacial tension. The thermal instability of fuel during recirculation, exposure to pumps and hot surfaces causes fuel breakdown, polymerization and formation of agglomerates and particulates in the fuel stream. A highly efficient particulate filter with 99% efficiency at >4 microns, will protect the engine's fuel system at all operating conditions, while proper filter system design will provide the needed water & particulate protection while balancing filter service life.



The above figure illustrates that IFT and fuel quality in general varies widely for commercially available fuels.

Reference:- [1] The Myth of Condensation in Fuel Tanks by David Pascoe

Author,

Dr. Saru Dawar has 7 years of experience in coalescence filtration research for air-liquid and liquid-liquid separation. She received her PhD in 2007 from the department of Chemical Engineering, The University of Akron. In her current role as a research engineer with Cummins Filtration, she is focusing on crankcase ventilation and fuel filtration research. She is a member of AFS and is also currently the chair of the AFS performance committee.

Keywords

Liquid-liquid filtration

Fuel filtration

Coalescing