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Renewable Diesel vs. Biodiesel

Over the last few years, renewable diesel has become an increasingly popular alternative fuel alongside biodiesel; but first, what's the difference between the two?

Production Process and Chemical Structure

Both renewable diesel and biodiesel are produced from the same vegetable oil or animal fat feedstocks (chemically known as triglycerides); but the major difference between renewable diesel and biodiesel starts with how these triglycerides are processed.

Renewable diesel is produced via **hydroprocessing** (also referred to as hydrotreating or hydrodeoxygenation), where the triglycerides are treated with hydrogen at high temperature and pressure to remove sulfur, oxygen and nitrogen and convert the triglycerides to hydrocarbons (i.e., chains of hydrogen and carbon atoms bonded together). The resulting renewable diesel product is chemically identical in structure to fossil diesel and has drop-in compatibility with traditional diesel engines.

Biodiesel is generated via a chemical process known as **transesterification**, where the triglycerides are reacted with an alcohol (e.g., methanol) to produce long-chain fatty acids. These molecules that make up biodiesel contain oxygen atoms, unlike traditional diesel, and require blending with conventional diesel fuel for use in traditional diesel engines.

Differing Chemical Properties

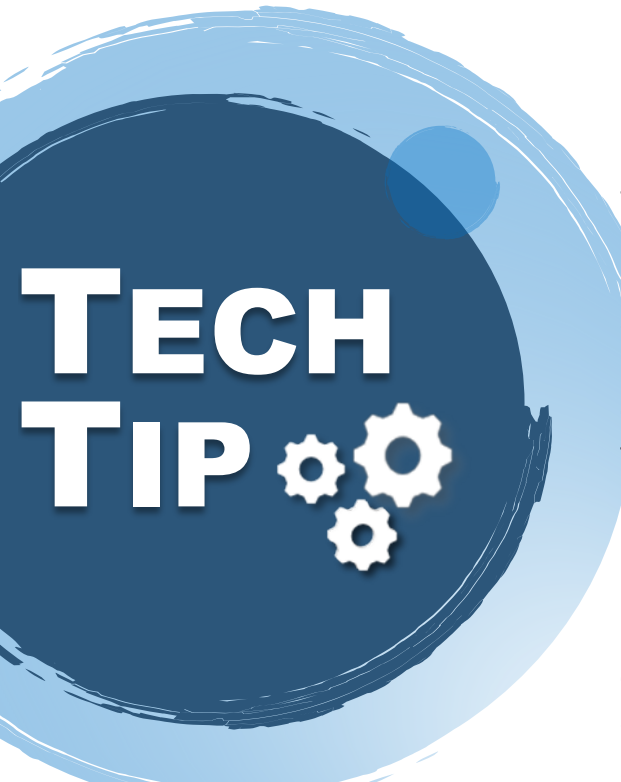
Due to differences in chemical structure, renewable diesel and biodiesel have varying chemical properties, as identified in **Table 1** below.

Properties	Petrodiesel	Biodiesel	Renewable Diesel
Cetane#	40-55	50-65	75-90
Energy Density, MJ/kg	43	38	44
Density, g/ml	0.83-0.85	0.88	0.78
Energy Content, BTU/gal	129 K	118 K	123 K
Sulfur	<10 ppm	<5 ppm	<10 ppm
NOx Emission	Baseline	+10	-10 to 0
Cloud Point, C	-5	20	-10
Oxidative Stability	Baseline	Poor	Excellent
Cold Flow Properties	Baseline	Poor	Excellent
Lubricity	Baseline	Excellent	Similar

Table 1: Diesel fuel properties [1].

Of note from Table 1 is the difference in energy content across each of the three fuels. While neither

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renewable diesel nor biodiesel has as high of an energy content as petroleum diesel, renewable diesel has a higher energy content than that of biodiesel. Additionally, renewable diesel has a notably lower cloud point than biodiesel, which means renewable diesel can withstand colder weather before fuel performance becomes a concern. In addition to its drop-in compatibility within existing petroleum diesel infrastructure, renewable diesel's relatively higher energy content and low cloud point support its use as a more favorable fossil fuel alternative.

Industry Shift to Renewable Diesel

Over the last few years, growth of renewable diesel production has outpaced that of earlier alternative fuel products such as biodiesel and fuel ethanol. In fact, domestic renewable diesel production has nearly tripled in the last two years alone [2]. In addition to new greenfield projects, petroleum refineries have converted existing processing units to be able to produce renewable diesel. These renewable diesel conversions have been economically feasible due to the additional feedstock flexibility, the fact that most petroleum refineries already utilize hydrotreating processes, and the implementation of various government incentives [3]. With this in mind, it makes sense why such renewable diesel conversion projects have been popular among numerous US refiners.

References

- [1] Jin Yoon, J. (2011). *What's the Difference between Biodiesel and Renewable (Green) Diesel?* Advanced Biofuels USA. Retrieved from https://advancedbiofuelsusa.info/wp-content/uploads/2011/03/11-0307-Biodiesel-vs-Renewable_Final-3_JJY-formatting-FINAL.pdf
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