

BioDiesel, Luber-finer, & You

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What is BioDiesel?

A renewable fuel for compression ignition, (Diesel), engines which contains modified animal fats and/or vegetable oils

A fuel blend component that meets the ASTM D 6751 *Standard Specification for Biodiesel Fuel Blend Stock for Middle Distillate Fuels* [1]

Chemical description: fuel containing mono-alkyl esters of long chain fatty acids

What is it made from?

Feedstocks include oil from soybean, rapeseed, and yellow grease for the bio portion of the fuel blend

- Yellow grease - Used fry oil, grease, animal tallow, etc
- Soybean - methyl soyate
- Rape seed - methyl ester (RME)- Predominantly found in Europe

How is it manufactured?

In the presence of a catalyst, long chain Bio-Oils are reacted with a short chain alcohol, such as methanol, to form the neat product known as B100. Glycerin is a sugar type by-product of this process that must only exist in a very small percentage in the resulting B100

What descriptions apply?

BioDiesel Blends are ratios of neat (straight) ASTM D 6751 BioDiesel, (B100) and petroleum (Dino) diesel fuels

In the term Bx, Bxx, or Bxxx, the percentage of BioDiesel in the fuel by volume measurement is reported as x. Therefore, B20 is 20% BioD and 80% Dino Diesel

You may see Syyy in addition to the B100 description, that is the Sulfur content in parts per million, (ppm)

What is the safest way to utilize it?

As a diesel fuel for compression ignition engines

In a Blend range from B2 - B20

As an injection system lubricity enhancement

By changing out dispensing and engine fuel filters at first fill

By having extra filters on hand for the transition

Working with your Luber-finer or PetroClear representative

What are the most problematic issues?

Cold weather operations - lower cloud and pour points. B20 blends have a 7°F [4°C] (typical) higher cloud point than # 2 Diesel. B100 can have very high cloud points, making even moderate climates an issue, reference B100 and Fuel Blending section

Storage Stability - B100 should be purchased in quantities that will be used in 30 days. Blends should be used in 90-120 days, shorter if in above ground tanks due to heat aging. Degradation products form and the fuel deteriorates in critical properties much faster than Dino diesel

Higher water saturation limits - causes fuel system corrosion and icing issues, supports microbiological growth, carries more water that condenses and drops out in storage tanks when the fuel temperature falls

Micro-biological growth - Bio-fuels are more susceptible to bugs that feed off the hydrocarbons and bio components and live off the oxygen in the fuel water interface as compared to Dino diesel. The growth by-products are acidic and drive the whole system acidic very quickly causing corrosion of all metal surfaces as well as an increased sediment load

Solvency & effects on dispensing and vehicle filtration systems - Varnishes, gums, sediments, and fuel degradation products are cut free and increase the load on the fuel filtration systems

Inadequate blending of B100 and Dino fuels - leaves a stratified fuel with the B100, or a high concentration of Bxx at the bottom of the vehicle tank/fuel pick-up, reference B100 section & Annex A for fast look summary of pro's and con's

What about running straight BioDiesel as in B100?

Few users can accomplish this for several reasons:

Cloud points can be as high as 65°F [18°C] depending on the basestock. Cloud point is the temperature where paraffin wax begins to precipitate. Wax as a solid will blind off the fuel filters, commonly called gelling. This occurs rapidly once the fuel temperature drops approximately 6° to 10°F [3° to 5°C] below the cloud point. Standard # 2 diesel cloud points are about 10°F [-12°C] in comparison

Solvent action is quite high, cutting loose and then transporting sediments, gums, varnish, and fuel degradation products from tanks and plumbing to the filters. Dispensing and vehicle fuel filters can plug in short order, and frequently, especially when using older storage and vehicle fuel tanks

Compatibility with fuel dispensing and fuel system components becomes an issue. Some metals are catalysts which form a high sediment load in the fuel

B100 supports microbiological growth quite easily

Storage stability of B100 is considerably lower than B20 blends when comparing the same basestock

Commercial transportation of B100 requires heated tankers and pipe lines for moderate temperatures such as 35° to 65°F [2° to 18°C]. This is dependent on the actual basestock in that load. The same applies to equipment fuel tanks and fuel lines, heaters may be required for even moderate climates

ASTM D 6751 B100 was never intended to be a motor fuel in its neat form

Can I get a bad or out of spec load of BioDiesel?

Certainly, as with most products there are fuels being sold as BioDiesel or BioDiesel Blends that do not meet the ASTM D 6751 specification. We have seen B100 fuel that had an out of spec glycerin content which plated off dispensing filters in a couple hundred gallons, and truck filters every two days. Dino fuel quality in general usually suffers when stocks are low & demand is high

What steps can be taken to improve chances for good quality BioDiesel?

You may already work with a supplier that has proven themselves. There is a voluntary quality control program known as BQ9000. The program Certifies Distributors and offers Accreditation for Producers.

Distributors/marketers/blenders are required to purchase their B100 blending stock from accredited producers and/or conduct ASTM 6751 fuel quality testing on B100

How about blending BioDiesel by topping partially full Dino diesel tanks?

In-tank and splash blending can be accomplished and success is directly proportional to fuel temperature and fluid turbulence. BioDiesel's specific gravity is higher than petroleum diesel; therefore it is heavier and should be added to a fuel tank after the Dino diesel to assist in blending. Never use a suspected aged, microbiological bug ridden, or problematic batch of B100 via dilution. It should be reprocessed by the manufacturer

Should the blending procedure be inadequate, a stratified mixture can occur in the bottom of the tanks where the fuel pick up resides. In these cases, the engine is running on 100% BioDiesel subjecting the vehicle to all problems associated with running B100. Blending yellow grease based (neat) B100 at fuel temperatures below 65°F [18°C] is likely to result in an incomplete blend. In any case, the temperature of B100 must be >10°F [5°C] above the cloud point of that particular batch of product

Information on blending is available in the US Dept. of Energy publication *2004 Biodiesel Handling and Use Guidelines* [2].

As a note of caution, the handling and transportation of middle distillates, such as Dino diesel fuel, generates static charges that must be dealt with properly to prevent unwanted and uncontrolled ignition

Are Luber-finer and PetroClear filters compatible with BioDiesel?

Yes, the elastomers, adhesives, metals, filtration media and media resin systems in our products are suitable for BioDiesel. Extensive laboratory and field testing has shown our filters to be compatible in BioDiesel Blends ranging from B2 to B20, and neat B100 from methyl soyate

Nevertheless, due to the wide variation in the basestock content of yellow grease derived blends, it cannot yet be proven without question, that some softening/swelling/degradation of elastomers, (sealing gaskets) at high concentrations (B35 - B100) will not occur. The users may not detect these conditions, even when examining the filter during changeout, because of the gasket fit into its retainer

It is important to note compatibility issues can also occur with Dino diesel fuels. Pipelines, storage tanks, transportation systems, and refineries inadvertently contribute to unusual chemistry situations. Diesel fuel is a highly engineered product, reference Annex B

We have research programs on-going to study the long term effects of high concentrations of BioDiesel. Our field staff is instructed to keep our Engineering team apprised of any unusual cases, either Dino or BioDiesel

What precautions should be taken regarding filters?

Use a superior quality filter such as Luber-Finer and PetroClear
Change dispensing and all vehicle filters upon loading BioDiesel into the tanks
Have extra filters available for dispensers and carry a few in the vehicle
Change filters on the dispensers as soon as any reductions in flow are noted
Change injection system fuel filters at each oil change interval, in the best of conditions, even if no filter clogging has occurred to date!

If you are running a BioDiesel blend higher than B5, you should be prepared to changeout filters at any length of service. This depends on degradation products resulting from previously used Dino diesel in the dispensing and vehicle tanks. This is somewhat dependent on the age of the systems

Does the solvency issue manifest itself only @ or above B35?

No. You will read on pro BioDiesel sites that B20 is a drop-in to existing systems and the problems begin around B30-35. We have fleets running B11 that are suffering through gross contamination being released and plugging dispensing and vehicle filters. Some fleets are doing fine with B20 after a short run of plugging. We have analyzed competitive filters from the same units. When the fuel system is in this kind of unbalanced condition there is virtually no difference in filter life regardless of the brand or media

It is important to remember the filters are doing their job by stopping the contaminant before it clogs the fuel injection system, or causes wear

What other options or recommendations for rapid plugging?

If you have open access to your dispensing pumps, such as an above ground tank, we recommend you add another filter in series to the system. Use a PetroClear 30 micron particulate filter as the primary followed by a 10 micron filter for the secondary. The 30 micron filter will keep some of the contaminant off of the 10 micron filter and may allow you to extend the service life of the secondary. The 10 micron filter is a good idea on the dispenser to take some of the load off of the vehicle fuel filters. Plugged dispensing filters are easier to deal with than plugged vehicle filters since they usually occur out on the job

It is possible that you simply won't be able to clean up certain tank loads in an efficient cost effective manner. In those cases it is best to have the fuel supplier involved in the solution. BioDiesel is just now becoming quite prevalent, all in the industry are still learning about the various effects and discovering new issues and opportunities upon implementation

Is Water Separation an Issue?

Biodiesel blends are a different system when it comes to water separation. The fuel behaves something like a strong detergent and emulsifying agent making water separation nearly impossible. The exception to the rule is highly specialized separators such as a Luber-finer 2000C Coalescer, for vehicle/equipment use. This unit is designed as a suction side primary particulate filter and capable of emulsified water removal in BioDiesel blends

What can be done for winter operations with BioDiesel blends?

B100 can be blended with # 1 diesel as well as # 2 diesel. In either case the cloud point temperatures of the blended fuel will be higher than Dino or winterized Dino fuels. Fuel distributors often modify the performance of Dino diesel for cold operations. Many of these additives can be used with the BioDiesel blends to enhance cold weather operations, reference Annex B

Isn't vegetable & cooking oil the same as BioDiesel?

Not in the form it exists in naturally or especially after thermal degradation from cooking. To use these oils as fuel causes the formation of gummy deposits due to thermal degradation and combustion which creates havoc within the cylinders and fuel delivery systems

Transesterification is a process neat BioDiesel goes through to reduce its viscosity and achieve properties required of a motor fuel by changing its molecular structure

These oils are Biologic, (plant) but not a legally registered fuel and for good reason

I've heard diesels will run on vegetable, peanut, or cooking oil?

Sure, compression ignition engines will run on a variety of liquids. Rudolph Diesel's first compression ignition engine ran on peanut oil. The question is for how long they will operate. Don't do it!

What about engine power?

Thermal BTU power output is lower by 10 % in B100

B20 blends are down a negligible 1-2 % on engine horsepower

Is BioDiesel compatible with the Engine's Fuel Injection System?

It is widely stated that 1993 and newer fuel system elastomers, seals, and metals are BioDiesel compatible. However, you should check with the equipment manufacturer before attempting to run >B20 blends

Some Lubricity Additives are Soy based, is that BioDiesel?

No, the percentage of the lubricity additive concentration is low, and they are not covered by ASTM D 6751. Soy based lubricity additives are quite effective, 0.5 - 1% provides adequate fuel injection system protection, even with Ultra Low Sulfur Diesel, (ULSD). Obviously, a BioDiesel blend fuel is more than adequate lubrication wise



References:

[1] ASTM D 6751 - 03A; Standard Specification for Biodiesel Fuel Blend Stock (B100) for Middle Distillate Fuels

[2] US Dept. of Energy publication; 2004 Biodiesel Handling and Use Guidelines

Annex A

Fast Look Summary

Pros

- Renewable resource- closed carbon chain
- Replaces petroleum volume extending supply
- Reduced HC, CO, CO₂, PM, NMHC emissions
- Provides waste stream for yellow grease
- Good public relations topic
- Marketing opportunities
- Distribution/dispensing opportunities
- Biodegradable, B100 4x greater than Dino diesel
- Recognized as an alternative fuel
- Government incentives

Cons

- Content of yellow grease uncontrolled
- B100 is tough on Nylon 6/6 - (next generation fuel filters)
- B35 - B100 has poor cold weather performance requiring supplemental additives or mechanical provisions
- 10-15 X Higher water solubility than petroleum diesel
- Supports Microbiological growth, "Bugs" love it - system goes acidic
- Increased fuel system corrosion issues due to water content
- Cavitation erosion of injector tips due to water content may increase
- Microbiological growth
- Poor storage stability
- Prematurely clogged filters initially above B5
- High Solvency action
- Increased Insolubles
- Not a petroleum product
- Slight increase in NoX emissions

Annex B

Diesel Fuel Additives & Contamination Control

Fuel Stability Additives

- Anti-Oxidants
- Thermal Stabilizers
- Metal Deactivators
- Dispersants
- Metal Deactivators
- Dispersants

Engine Perf. Additives

- Cetane Number Improvers
- Detergents
- Lubricity
- Smoke Suppressants

Fuel Handling Additives

- Anti-Foam
- Icing Inhibitors
- Pour Point Depressants
- Cloud Point Depressants
- Drag Reducers
- Static Dissipaters
- Sweetening Agents

Contamination Control

- Demulsifiers
- Dehazers
- Biocides
- Corrosion Inhibitors
- **Filtration !!**
 - **Particulate**
 - **Coalescers**
 - **Separators**

For each additive type there are multiple chemistries available and a tremendous number of possible combinations of additives in individual fuels. These are added at refineries, pipelines, storage, fuel distribution sites, and by the end users

Fuel is seldom the same from load to load. For these reasons it is impossible to test all combinations for compatibility