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Use of Raw Vegetable Oil or Animal Fats in Diesel Engines

Recently, raw vegetable oils and animal fats have increasingly been substituted for "processed" biodiesel meeting established specifications.[1] The U.S. Department of Energy has stated that, "Raw or refined vegetable oil, or recycled greases that have not been processed into biodiesel, are not biodiesel and should be avoided."[2] The use of raw, unprocessed vegetable oils or animal fats in diesel engines – regardless of blend level – can have significant adverse effects and should not be used as fuel in diesel engines.

Raw or refined vegetable oil, or recycled greases have significantly different and widely varying properties that are not acceptable for use in modern diesel engines. For example, the higher viscosity and chemical composition of unprocessed oils and fats have been shown to cause problems in a number of areas: (i) piston ring sticking; (ii) injector and combustion chamber deposits; (iii) fuel system deposits; (iv) reduced power; (v) reduced fuel economy and (vi) increased exhaust emissions. Use of unprocessed oils or fats as neat fuels or blending stock will lead to excessive fuel condensation and corresponding dilution of the engine's lubricating oil that may result in sludge formation. Any or all of these conditions may result in reduced engine life, increased maintenance costs, or catastrophic engine failure. More over, the problems associated with the use of raw vegetable oil or animal fat may not become evident until a significant amount of damage has occurred over an extended period.

The significantly higher viscosity of raw vegetable oils (27 - 54 mm^2/s) compared to petroleum diesel fuel (2.6 mm^2/s) alters fuel injector spray patterns and spray duration, adds stress on fuel injection systems, and results in incomplete combustion and high dilution of the engine lubricating oil. In turn, fuel injector spray pattern, duration, etc. affect the combustion process and the resulting engine performance and emissions levels. This incomplete combustion increases fuel dilution of engine lubricating oil and leads to sludge development. In addition, the polymerization of glycerides in raw vegetable oils and animal fats during the combustion process results in undesirable deposits on pistons, piston rings, fuel injectors, valves, etc. It is important to note that such effects may not be immediate, but occur over a period of weeks or months depending on engine use and fuel system design.

Finally, raw or refined vegetable oils and animal fats experience significant degradation due to oxidation compared with petroleum diesel fuels. Such oxidation leads to sludge formation in the storage or vehicle fuel tank, which, in turn, can plug fuel filters and prevent fuel delivery to the engine's combustion chamber. This oxidation reaction is accelerated by exposure to heat which can be due to solar effects or fuel recirculation in the engine's fuel delivery system.

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[1] Biodiesel, or B100, is a term defined by the United States Department of Energy (DOE) as, "A biodegradable transportation fuel for use in diesel engines that is produced through the transesterfication of organically-derived oils or fats." ASTM International, a recognized standard-setting organization, has adopted "Standard Specification for Biodiesel Fuel (B100) Blend Stock for Distillate Fuels" (D6751), which defines the minimum performance parameters required for biodiesel to be considered acceptable as a blending stock for distillate fuels. Similarly, European Committee for Standards (CEN) has adopted "Automotive Fuels. Fatty Acid Methyl Esters (FAME). Requirements and Test Methods," EN 14214 which defines minimum performance parameters for biodiesel to be utilized as either a neat fuel or as a blending stock for distillate fuels.

[2] U.S. Department of Energy; Biodiesel Handling and Use Guidelines, revised November 2004