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INFOSHEET

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Biodiesel quality

In this infosheet, the most important factors of biodiesel quality are shortly presented. Biodiesels are renewable fuels produced from several feedstocks. The cold flow properties, oxidation stability and the amount of certain trace elements are the bottleneck of biodiesel quality.

BIODIESEL

Biodiesel is a renewable, alternative fuel which can be used to substitute fossil diesel fuels. Biodiesels are produced from several kinds of vegetable oils or animal fats through transesterification process. The feedstock can be soybean, cottonseed, palm, peanut, rapeseed, sunflower, animal fat (tallow), used frying oils or oil from algae for instance. In transesterification, the triacylglycerols of oil or fat are mixed with alcohol and together with a catalyst they react to form alkyl ester and glycerol. Alkyl esters are fatty acid methyl esters, which give biodiesels their other well-known name, FAMEs.

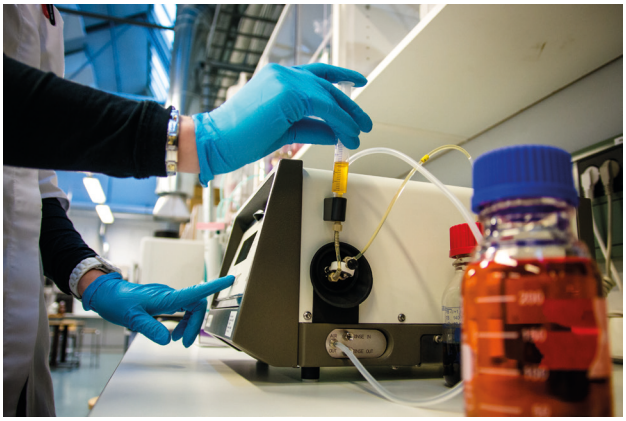
FUEL STANDARDIZATION

The quality of fuels is ensured by standardization. The standards describe the requirements and test methods for fuels. The purpose of retail fuel standardization is to protect the customer. There must be a correlation between the fuel that fulfils the requirements set in the standard and the operability and reliability of the power generation application concerned.

The requirements and test methods for FAMEs are described in Standard EN 14214. Fossil diesel fuel has its own standard; EN 590. FAME that fulfills the requirements set in EN 14214 can be used as fuel for diesel engines and for heating applications at 100 % concentration or as blend component in diesel fuel.

BIODIESEL PROPERTIES

The aim in biodiesel usage is to use it as substitute for fossil diesel. The most important property to show the suitability is cetane number which describes a fuel's igni- tion quality. Other important properties are heating value, pour point, cloud point, cold filter plugging point, kinema- tic viscosity, oxidation stability, lubricity, FAME –content and fatty acid profile and Na+K; Ca+Mg and P contents.
The mentioned elements are catalyst poisons.



Kinematic viscosity is one of the most important fuel properties.

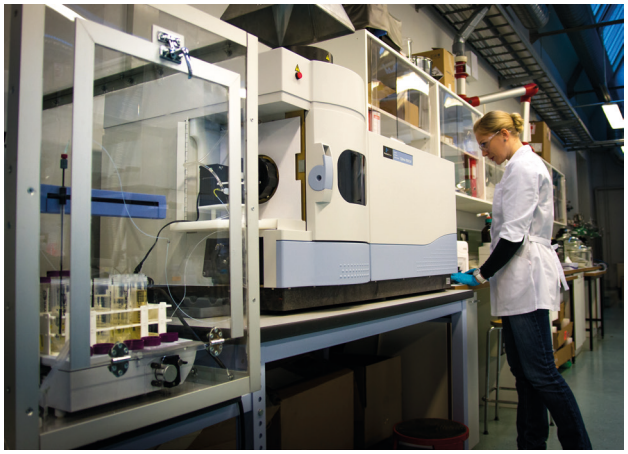
The bottlenecks of FAME quality are its cold properties and oxidation and storage stability. Also the amount of trace elements is recommended to be revised according to the engine manufacturers. According to some research results, even the accepted levels of above mentioned elements are deleterious for catalysts used in after treatment systems to diminish the engine emissions.
Basically, the raw material used for biodiesel production and the fatty acid composition determine the properties of biodiesel.

CETANE NUMBER AND COLD PROPERTIES

The cetane number of fuels is measured using some of the following methods: EN ISO 5165, EN 15195 or EN 16144. The result for all diesel fuels should be a minimum of 51.
Heating value is not a standardized value. Usually, for biodiesels it is approximately 37-38 MJ/kg and for fossil diesel 42-43 MJ/kg.
The cold properties of fuels are evaluated by analyzing pour point, cloud point and cold filter plugging point (CFPP). The limitation of cold properties is dependent on the climate regions. The CFPP is measured according to Standard EN116 and the limitations of it vary from -20 to +5°C and from -44 to -20°C but are the same for both biodiesel and fossil diesel. The cloud point (according to EN 23015, standard for biodiesel used as blend component) should stay within -3 to +16°C. The pour point is not a standardized property, but the pour point is at lower temperature than the CFPP or cloud point.

VISCOSITY, STABILITY AND LUBRICITY

The kinematic viscosity of fuels is measured at 40°C, according to Standard EN ISO 3104. The limitation for biodiesel is 3.50-5.00 mm²/s and 2.0-4.5 mm²/s for fossil diesel. The oxidation stability is measured according to Standard EN 14112 (or EN 15751 for blends) and the result should be at the minimum 8 h (or 20 h for fossil fuels or blends). Lubricity of FAMEs is usually at good level and it is not standardized for biodiesels.



ICP OES is used to measure the elements of the fuel, such as K, Na, Mg, Ca and P.

FAME-CONTENT AND ELEMENTS

The FAME-content and fatty acid profile of biodiesels is measured utilizing gas chromatography. The standard for FAME content is EN 14103 and the result should be at the minimum 96.5 m-%. Na+K; Ca+Mg and P contents are measured by ICP OES and according to Standards EN 14107, EN 14108, EN 14109 or EN 14538. The result of Na+K should not exceed 5.0 mg/kg, as well as should not Ca+Mg. The P content should not exceed 4.0 mg/kg.

ALGAE BIODIESEL

The quality of algae biodiesel is dependent on the fatty acid profile of algae oil. Most probably the restrictions of algae based biodiesel are the same as they are for all other biodiesel produced from different raw materials. Unsaturated fatty acids are the most reactive compounds in biodiesels and therefore prone to autoxidation. Oleic acid (18:1 cis), linoleic acid (18:2 n-6 cis), linolenic acid (18:3 n-3 cis) are the most common unsaturated acids present in oils or fats and consequently in biodiesel. Relative rates of oxidation are 1 for oleates, 41 for linoleates and 98 for linolenates. Even small amounts of highly unsaturated fatty acids have strong effect on oxidative stability of biodiesel. Some additives such as antioxidants and cold flow improvers may though be added to improve the fuel quality. Antioxidants need to be studied individually for each biodiesel raw material.

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