

Understanding EN14214 and ASTM specifications

In recent times, the European Biodiesel standard EN14214 has been used to show the capabilities of biodiesel production equipment which is impossible to achieve with just a biodiesel processor alone. So as to pass the 27 sub-tests, which make up EN14214, it is important to see biodiesel as having three main phases of production: • Pre-filtration • Reaction • Purification

	Test Method	Units	Europe	USA
Specification			EN 14214	ASTM D6751
Density @ 15°C	EN ISO 12185	g/cm ³	0.86-0.90	
Viscosity 40°C	EN ISO 3104	mm ² /s	3.5-5.0	1.9-6.0
Distillation		% @ °C		90%, 360°C
Flash Point	ISO 2719	°C	120 min	130 min
Sulphur	BS EN ISO 20846	mg/kg	10 max	15 max
Carbon Residue	IP13	% mass	0.03 max	
Sulphated Ash	EN ISO 3987	% mass	0.02 max	0.02 max
Water	EN ISO 12937	mg/kg	500 max	500 max
Total Contamination	EN12662	mg/kg	24 max	*
Copper Strip Corrosion	EN ISO 2160	3h/50°C	1	3
Oxidation Stability [110°C]	EN14112	Hours	6 min	
Cetane Number	EN ISO 5165		51 min	47 min
Acid Value	EN1404	mg KOH/g	0.5 max	0.8 max
Methanol	EN14110	% mass	0.2 max	
Ester Content	EN14103	% mass	96.5 min	
Monoglyceride	EN14105	% mass	0.8 max	
Diglyceride	EN14105	% mass	0.2 max	
Triglyceride	EN14105	% mass	0.2 max	
Free Glycerol	EN14105	% mass	0.2 max	0.2 max
Total Glycerol	EN14105	% mass	0.25 max	
Iodine Value	EN14111		120 max	
Linolenic Acid Methyl Ester	EN14111	% mass	12 max	
Polyunsaturated Methyl Esters		% mass	1 max	
Phosphorous	EN14107	mg/kg	10 max	10 max
Alkalinity	EN14108	mg/kg		
Group I Metals [Na, K]		mg/kg	5 max	
Group II Metals [Ca, Mg]		mg/kg	5 max	
Cold Filter Plugging Point	EN116			

* Combined water and contamination test under ASTM D6759

Density

Biodiesel has higher density than mineral diesel. The denser biodiesel will characteristically sink to the bottom of the tank and this can lower fuel consumption, which is determined volumetrically; so the denser the fuel, the higher the consumption will be. Under laboratory conditions, density is tested to EN ISO 12185, which is one of 27 separate tests which combine to meet EN14214. Density can be easily measured at the time of process, using a simple hydrometer method. Laboratory results and the EN14214 standards report density at 15°C so it is important that the result is corrected for temperature.

Viscosity

Viscosity of biodiesel is higher than mineral diesel, which can lead to problems in fuel delivery systems. High viscosity can lead to poor combustion, which leads to coking of injector tips and engine power loss. Viscosity decreases with unsaturation, but increases with the presence of mono, di or triglycerides. Lower viscosity can also indicate the presence of methanol in the biodiesel, which can be confirmed by measuring flash point (the lower the flash point, the more methanol is present). The removal of glycerides by effective purification means that purified biodiesel has increased flow capabilities which is beneficial during wintertime. Viscosity can be checked on-site, using a “falling ball” viscometer. This test consists of a precision tube, filled with the sample biodiesel and then a ball is timed as it falls a set distance through the fuel. The time taken is converted to viscosity. See quality control section.

Flash Point

Flash point is the lowest measure by which a liquid will ignite in air. The flash point with biodiesel should be low enough for it to be classified as “Non flammable” and tested to ISO 2719. Effective purification is key to residual methanol removal to ensure safer working and storage conditions to biofuel producers and users alike. Flash point can also be checked on site, using a portable flash point tester. A sample is heated to a given temperature, in a special enclosure. The lid is then opened and a pilot light is used to ignite any flammable vapour present. The ‘flash’ is automatically detected and provides a simple pass/fail to the EN14214 specification.

Sulphur Content

Sulphur emissions are harmful to human health and emissions make Sulphur Dioxide, which is indicative of acid rain. The sulphur content test BS EN ISO 20846 is difficult to pass using over used waste oils and without this part of the specification – your product will not meet EN14214.

Carbon Residue

The Carbon Residue is the material left over after combusting fuel. Residual carbon is responsible for coking fuel injectors so it is important to eliminate this. Effective purification removes residual soaps and metals which will lead to Carbon Residue.

Cetane Number

Cetane number is a measure of ignition quality. Fuels with low Cetane numbers show increased emissions due to incomplete combustion. Palm Oil and Tallow derived biodiesels have higher Cetane numbers. If you are using a feedstock which is not likely to pass EN ISO 5165 a Cetane boosting additive can be used.

Sulphated Ash

Similar to Carbon residue sulphated ash content is tested by taking a sample of biodiesel and combusting it and then weighing the residual non-combustible mineral ash under specifications to EN ISO 3987.

Water Content

EN ISO 12937 specifies a maximum of 500 ppm (parts per million) of water in biodiesel. As FAME is hygroscopic it can pick up water in storage and because of this there can be problems meeting the specification. At around 1500 ppm, the solubility limit is reached and the water becomes visible. Producers still using traditional “wet wash” systems may find this aspect of the EN Specification rather troublesome to achieve. Free water promotes biological growth and adverse reaction to transesterification which undoes biodiesel back into free fatty acids, which is disastrous in a fuel delivery system.

Digi water tests are available, which use a sample of biodiesel and two chemical reagents. After shaking together in an electronic cell for two minutes, the result is displayed in ppm water. See quality control section.

Total Contamination

Because production contaminants like residues and soaps may still be present in the purification stage of making biodiesel, effective purification and filtration is required to achieving total contamination to EN12662. This ensures the total removal of production residues, which means clean fuel and peace of mind!

Copper Strip Corrosion

This is defined as the likelihood to cause corrosion to copper, zinc and bronze parts of an engine such as injector tips and common rail systems. Clean biodiesel gives consistently good results in this area and is unlikely to fail EN ISO 2160 due to the low sulphur content.

Oxidation Stability

This property relates to the overall storage stability of the fuel; the higher the degree of unsaturation (double bonds) within the FAME molecules gives a decrease in oxidative stability which means that the longer it is stored the greater the reduction in quality will be. Tests have shown that effective purification can extend the product life of biodiesel via the removal of moisture, mono, di and triglycerides.

Acid Value

Acid value is a measure of mineral acids and free fatty acids contained in a fuel sample. The fewer residual compounds, the lower the acid value of the biodiesel. Effective purification will ensure that EN14104 is consistently achievable as is EN14214. Acid number will also increase over time if the biodiesel is stored incorrectly. Acid value can be determined rapidly using a TAN (Total Acid Number) drop test. A sample of biodiesel is added to a red coloured chemical reagent and then another chemical is added until the colour changes to green. The number of drops taken is easily converted to the Acid Number of the fuel. See quality control section.

Iodine Value

Higher Iodine values will have better cold properties whereas lower Iodine values have poorer Oxidative stability therefore affecting storage stability over time. Iodine value is determined by testing to EN14111.

Ester Content

To pass EN14103 there must be a minimum ester transformation of 96.5% FFA's into Methyl Esters. This test is determined by good practice in upstream processes and ensuring a good reaction driven by heat and effective agitation.

If there is not a sufficient reaction, then the levels of residuals of mono, di and triglycerides will be also out of specification, as they will remain untransformed and this will lead to missing EN14103 and EN14105 specifications.

Methanol Content

A high Methanol content means a lower flashpoint and dangerous storage instabilities. Effective methanol removal and purification ensures conformity to EN14110 which will lead to passing EN14214.

Glycerides

It is vitally important that a good transesterification reaction is achieved, as by achieving a transformation of more than 96.5% limits the amount of residual mono, di and triglycerides as per EN14105. Failing to meet the specification implies low conversion to ester and deposit formation on injectors and valves.

Group I Metals

Sodium and Potassium are limited to a combined 5ppm. Effective purification processes enables the effective removal of residual traces of Sodium and Potassium which can lead to levels exceeding the 5mg/kg upper limit required by EN14109.

Group II Metals

Production deposits like Calcium and Magnesium sulphate produce soaps which are harmful to a fuel delivery system and will fail the test IP377.

Phosphorous Content

This is to test for left over phosphor used in feedstock production and refining. Removal of production residues and chemicals to pass EN14107 and also across the specification of standards which combine to meet EN14214.

CFPP

Under BS EN 116, the test for Cold Filter Plugging Point requires biodiesel to pass through a filter until it can no longer do so. On average Rape Seed Oil has a CFPP of -5°C to -14°C whereas Palm Oil has a CFPP of around 10°C . This test shows that there is some sense in having shorter production chains in biodiesel production as local crops are more suitable to local weather conditions for more of the year.

Cloud point of biodiesel is also used as an indicator of cold temperature stability. The cloud point of the fuel is the temperature at which wax crystals first begin to form. Below this temperature, filters will start to become blocked and potentially starve the engine of fuel. Cloud point may be determined at the time of production using an electronic cloud point detector. A small sample (0.5ml) of biodiesel is added to the device and the test runs automatically and un-supervised. The cloud point is reported on screen as a temperature.