INTRODUCTION

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Schroeder Fuel Filtration Systems are designed and built to meet and exceed the biodiesel purification and filtration requirements of our customers. We are proud of our proven track record of providing quality purification products to the biodiesel industry. The designs of our products are a result of many hours of field testing, laboratory research, Schroeder's 65 years of manufacturing and filtration experience and partnerships with biodiesel producers, as well as a strong partnership with our friends and biodiesel experts in the UK, Filtertechnik.

Our purification systems have revolutionized biodiesel purification processes, allowing producers to increase production volumes and fuel quality, while our sensors and monitoring technology provide valuable insight into their current processes.

Our products enable producers to have in-house traceability and total quality control. We are committed to on-going research and development in order to keep ahead of this ever changing market. We work closely with our producers to allow them to **maximize their investment** in the form of regular training, extensive field support and comprehensive technical assistance.

Partnerships

Innovating products, solutions, processes and services to improve performance and efficiency in the industry.

Importance of Biodiesel Purification & Fuel Quality

Biodiesel has been produced for many years. In recent times it has become commercially viable for many producers and end-users alike, mostly due to spiralling fuel prices, government taxation and dwindling crude oil supplies. Numerous production facilities have sprung up to reap the benefits of producing environmentally friendly fuels.

End-user confidence in biodiesel, however, remains low. Some producers, who do not embrace fuel quality wholeheartedly, have tarnished the reputation of biofuels in the market. Others, who put fuel quality at the heart of their production agenda, will reap benefits in the long run.

Biodiesel production is a game of infinite variables. Base feedstocks, titrations, reaction efficiencies, viscosities, past experiences and temperature all influence the process in different ways.

Good upstream and in-house quality control procedures mark the difference between successful and unsuccessful producers.

In fact, many successful producers will tell you that the reaction process is the easy part of biodiesel production, and that purification process can be a little more challenging. Unfortunately, biodiesel purification is a subject that is far too frequently overlooked by many producers. In this catalog, we will walk you through the filtration and purification processes within biodiesel production.

Why Purify Biodiesel?

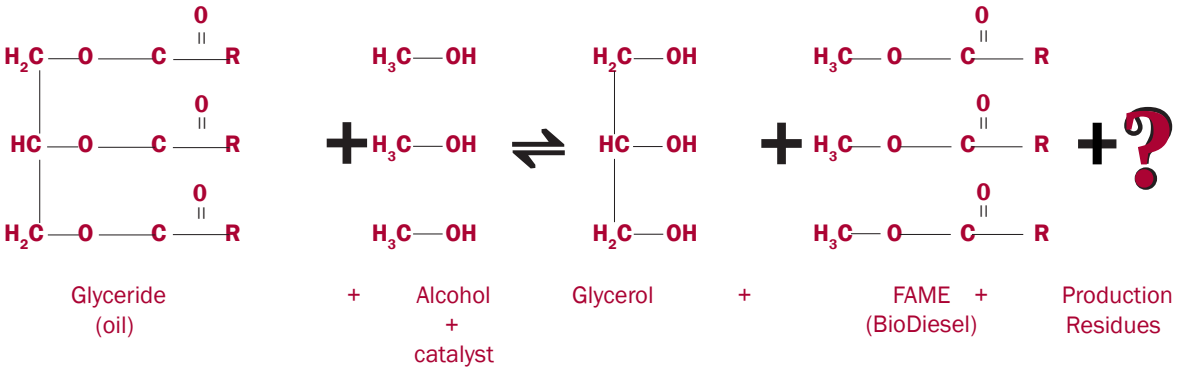
Biodiesel consists of three principle ingredients:

- Oils or Fats: vegetable oil, animal fat, algae oil, soy bean oil, etc.
- Alcohol
- Catalyst

The basic reaction (Transesterification)

- Vegetable oil + methanol react to produce biodiesel + glycerine (see below)
- A catalyst, temperature and agitation process drive the reaction.
- Sodium hydroxide (NaOH, caustic soda or lye) is usually the catalyst. Potassium hydroxide (KOH, caustic potash) can also be used.
- Most of the reaction occurs in the first few minutes. ~ 80% in 4min @ 55°C (131°F)
  (Ref Darnoko & Cheryan)

By neutralizing the free fatty acids with a catalyst, the methanol is able to break down the linking bond in the triglyceride, and the result is the formulation of methyl esters, glycerol and impurities. Once purified, methyl esters become biodiesel.



The schematic above shows the basic chemistry involved in biodiesel production. Once the methyl ester has been formulated, the following production residues are still present:

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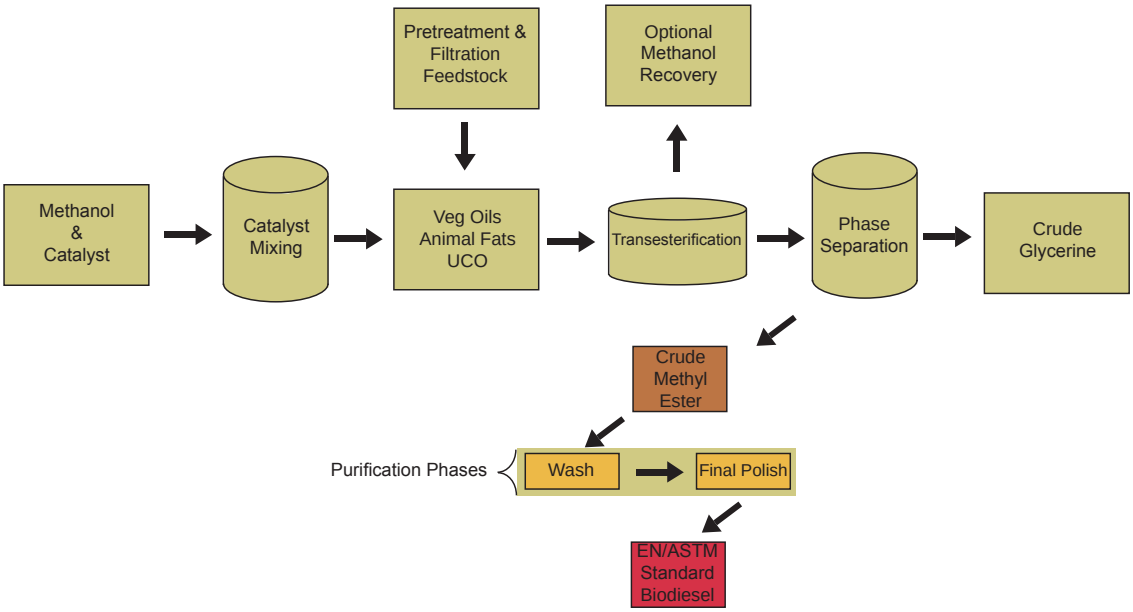
- Residual Methanol
- Glycerol
- Soap and Metals
- Residual Catalyst: Sodium or Potassium
- Moisture
- Free Fatty Acids

Why Purify Biodiesel?

All can have a potentially harmful impact on engine performance and component wear.

The previous schematic shows the individual biodiesel production phases of a typical production facility. Once the crude methyl ester has been produced following the transesterification, glycerol separation and methanol removal phase, it cannot be classified as biodiesel until the purification phase is complete.



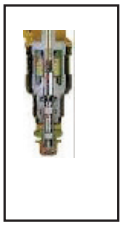
Once the purification phase has been completed, it is then and ONLY then, that industry standards EN14214 and ASTM D-6751 are achieved. This is explained in more detail in our quality control section of this catalog.

Some producers still hold that purifying crude biodiesel is not necessary. However, if you do not clean and dry biodiesel, the following may occur:

- Corrosion of fuel injectors (water, catalyst)
- Elastometric seal failures (methanol)
- Fuel injector blockages (glycerine, soaps, etc.)
- Increased degradation of engine oil
- Pump seizures due to high viscosity at low temperatures
- Corrosion of fuel tanks (excess water, catalyst)
- Bacterial growths and clogging of fuel lines/filters

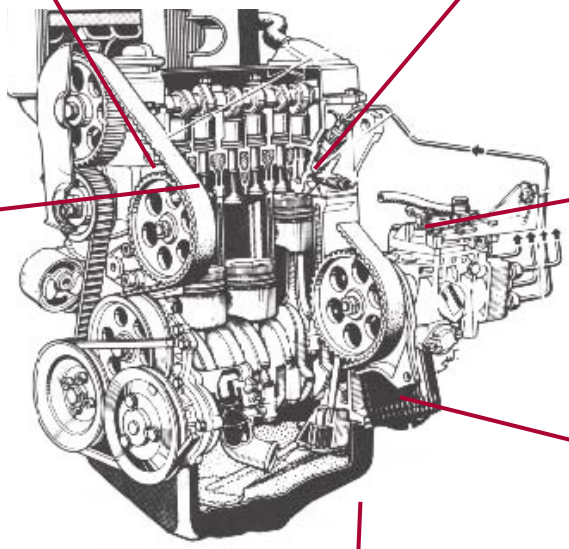
Diesel Engine Problems | Unpurified Biodiesel

Bacterial Growth



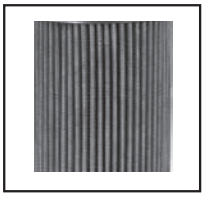
Clogged Fuel Injectors

Seal Failures

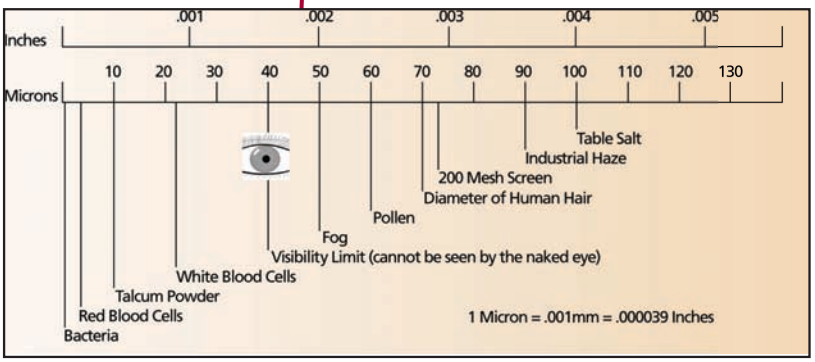


Damaged Fuel Pump

Oil Degradation / Leak-ages



Blocked Fuel Filter



Unseen particles can still cause damage.

Understanding EN14214 | ASTM Specifications

In recent times, the US BioDiesel Standard ASTMD6751, and the more stringent European standard EN14214, have been used to show the capabilities of biodiesel production equipment, which is impossible to achieve with just a biodiesel reactor 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 / ISO 3675	g/cm^3	0.86-0.90	
Viscosity 40°C	EN ISO 3104 / ASTM D445	mm^2/s	3.5-5.0	1.9-6.0
Distillation	ASTM 01160	% @ °C		90 %, 360°C
Flash Point	ASTM 093 / ISO CD 3679e	°C	101 min	130 min
Sulphur	ASTM D5453 / EN ISO 20846		10 mg/kg max	15 ppm max
Carbon Residue	EN ISO 10370	% mass	0.3 max	
Sulphated Ash	EN ISO 3987	% mass	0.02 max	0.02 max
Water	EN ISO 12937	mg/kg	500 max	*
Total Contamination	EN12662	mg/kg	24 max	*
Copper Strip Corrosion	EN ISO 2160 / ASTM D 4530		class 1	0.05 % max
Oxidation Stability (110°C)	EN14112	Hours	6 min	
Cetane Number	EN ISO 5165 / ASTM D613		51 min	47 min
Acid Value	EN1404 / ASTM D664	mg KOH/g	0.5 max	0.5 max
Methanol	EN 14110	% mass	0.2 max	
Ester Content	EN 14103	% mass	96.5 min	
Monoglyceride	EN 14105	% mass	0.8 max	
Diglyceride	EN 14105	% mass	0.2 max	
Triglyceride	EN 14105	% mass	0.2 max	
Free Glycerin	EN 14105 / ASTM D6584	% mass	0.02 max	0.02 max
Total Glycerin	EN 14105 / ASTM D6584	% mass	0.25 max	0.25 max
Iodine Value	EN 14111		120 max	
Linolenic Acid Methyl Ester	EN 14111	% mass	12 max	
Polyunsaturated Methyl Esters		% mass	1 max	
Phosphorous	EN 14107	ppm	10 max	10 max
Cold Filter Plugging Point	EN116			

* Combined water and contamination test under ASTM D2709
Reference Glossary for explanation on the specifications