Generating Electricity from Biodiesel

the practicalities

by David Hatherill

Biodiesel is a subset of liquid biofuels and is specifically a non-petroleum based diesel fuel. The production of biodiesel involves reacting vegetable oils or animal fats catalytically with a short-chain aliphatic alcohol, typically methanol or ethanol. This reaction, known as transesterfication, produces an alcohol ester that possesses physical properties very similar to petrochemical based diesel fuel. Finning Power Systems has helped develop the UK's first significant high speed, biodiesel electrical power plant for Thames Water's Beckton Desalination Project. In this article David Hatherill, engineering manager for Finning Power Systems takes a closer look at what needs to be considered when using Biodiesel as a fuel for generator sets.

Rapeseed field *Courtesy of Finning Power Systems*

Biodiesel can be used in most standard diesel engines as the primary fuel source. To fuel an engine, biodiesel can either be used alone, as 100% biodiesel, or can be blended with conventional petroleum diesel. A 100% blend of biodiesel is known as B100. If biodiesel is blended with conventional petroleum diesel, this figure reduces. For example, a blend of 20% biodiesel with 80% petroleum diesel would be referred to as B20.

The current European standard describing the minimum requirements for biodiesel is EN14214. It is anticipated that this standard will be revised in the foreseeable future, due to the fact that EN14214 was originally an RME (biodiesel made from rapeseed) standard and has some deficiencies when applied to biodiesel from a broader range of feedstocks.

In principle, biodiesels conforming to EN14214 can be used at up to 100% in diesel engines. However, some third party fuel injection equipment (FIE) manufacturers have warned against using over 5% biodiesel blends, as their equipment was not designed to run on such fuels.

Some manufacturers do, however, provide biodiesel compatible components. Seeking expert advice from the manufacturer or dealer is therefore advised.

Fuel standards

Most engine manufacturers set their own standards for liquid fuels, and in general these are wider than the universal fuel standards within any given market: EN590, BS2869 etc. Manufacturers will be able to advise on the relevance of such standards and also interpret which are relevant to a specific project.

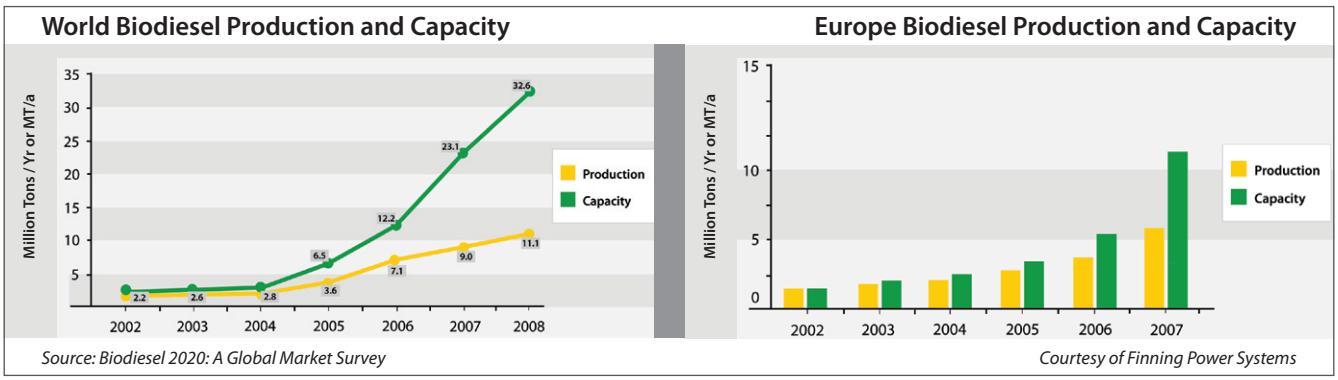
Fuel quality impacts far beyond its combustibility, so it is important to work closely with your service provider to develop a suitable maintenance regime.

Emissions

The major advantage of biodiesel fuel is that it can be produced from spent oils including by-products from other industries, such as used cooking oils, although careful control of feedstock is required to ensure consistent quality. The emissions from biodiesel engines can be significantly less polluting than standard diesel fuel as they contain little to no sulphur, but adjustment of the engine is required to meet these levels. A non-adjusted engine will generally produce more nitrogen oxide than the same engine on mineral diesel.

Density and calorific value

Whilst the density of biodiesel is slightly higher than conventional petroleum-based diesel, the calorific value is slightly less. This



Source: Biodiesel 2020: A Global Market Survey

Courtesy of Finning Power Systems

means that a greater volume of biodiesel must be injected to achieve the same power output as petroleum diesel.

If a particular unit is only going to be run on biodiesel, it may be acceptable to adjust the injection system to cater for any loss of power. However, if a unit is to be run on either fuel, such adjustments in the injection system may cause the engine to over fuel when run on petroleum diesel.

Cold weather performance

The properties of biodiesel are such that its waxing and cold filter plugging point (CFPP) occurs at much higher temperatures than petroleum diesel. The application and location in which the biodiesel is to be used, must therefore be taken into consideration. It may be necessary to use a fuel additive to prevent filter plugging, but these can be expensive.

Lubricating oil degradation

The use of biodiesel and raw vegetable oils has been linked to problems regarding the degradation of engine lubricating oils, with early oil changes often being required. As a result, most engine manufacturers recommend regular Scheduled Oil Sampling (SOS) until this factor is better understood and biofuel tolerant lubricating oils are available. Current lubricating oil blends are designed for mineral fuelled engines. As more biodiesel applications are installed, it is anticipated the oil industry will begin to provide specialist oils.

Storage

Since biodiesel is an effective solvent, there are a number of potential issues associated with its storage. Existing tanks should be thoroughly cleaned before storing biodiesel, as any existing sludge is likely to be dissolved, which may lead to blocked fuel filters.

Biodiesel is known to dissolve some of the paints used to coat the inside of fuel storage tanks. It is also known to react with copper, bronze, brass, lead, tin and zinc. Stainless steels and aluminium are unaffected. Fuel supply and storage systems should be built with this in mind. Plastic tanks should be avoided, unless known to be compatible. Some nitrile and natural rubbers are also known to be affected by the use of biodiesel.

Courtesy of Finning Power Systems

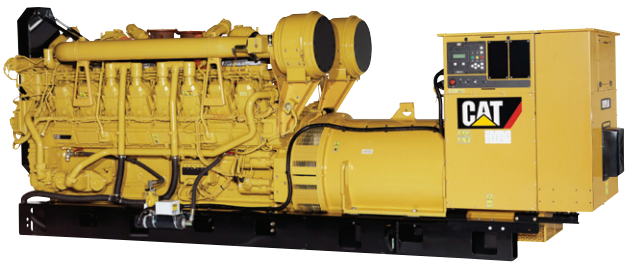
Further to this, it should be noted that biodiesel has a limited storage life. It is recommended that biodiesel is used within six months. After that period, the fuel should be reanalysed to ensure it still meets EN14214 specifications. Additives are available to extend the storage life of biodiesel.

Other vegetable oils

It is advisable to check with the engine manufacturer before considering other vegetable oils as potential fuel sources.

They are rarely recommended and on balance do not work in the long term unless additional fuel conditioning infrastructure is installed. If this is not used, engine performance and emissions will rapidly deteriorate. This is due to incomplete combustion and the build up of large amounts of soot in the combustion chamber.

A quick search of the Internet will produce a plethora of reports charting the demise of various test engines that have used a variety of crude vegetable oil fuels without fuel conditioning. It is possible to fuel larger, heavy fuel engines with untreated vegetable oils after some on site pre-treatment, but such systems are only economic from about 2-3MWe upwards.



Warranty

Finally one of the most frequently asked questions by an end user is how the use of biofuels affects their warranty. This is a question that needs to be answered by each individual manufacturer, but for illustration, I can outline the stance taken by Caterpillar®.

Caterpillar warrants the engine against defects in material and manufacture and will do so on any engine using biofuel. It follows, however, that any damage caused as a direct result of using biofuel could not have been caused by a defect in material. To this end you must check and agree the fuel specification in advance with the manufacturer.

The debate about using Biofuels will continue to rage. You should always seek professional advice and check reference sites from your proposed supplier if you are considering such an option; after all generator sets for standby power or as a prime mover are a big investment.

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