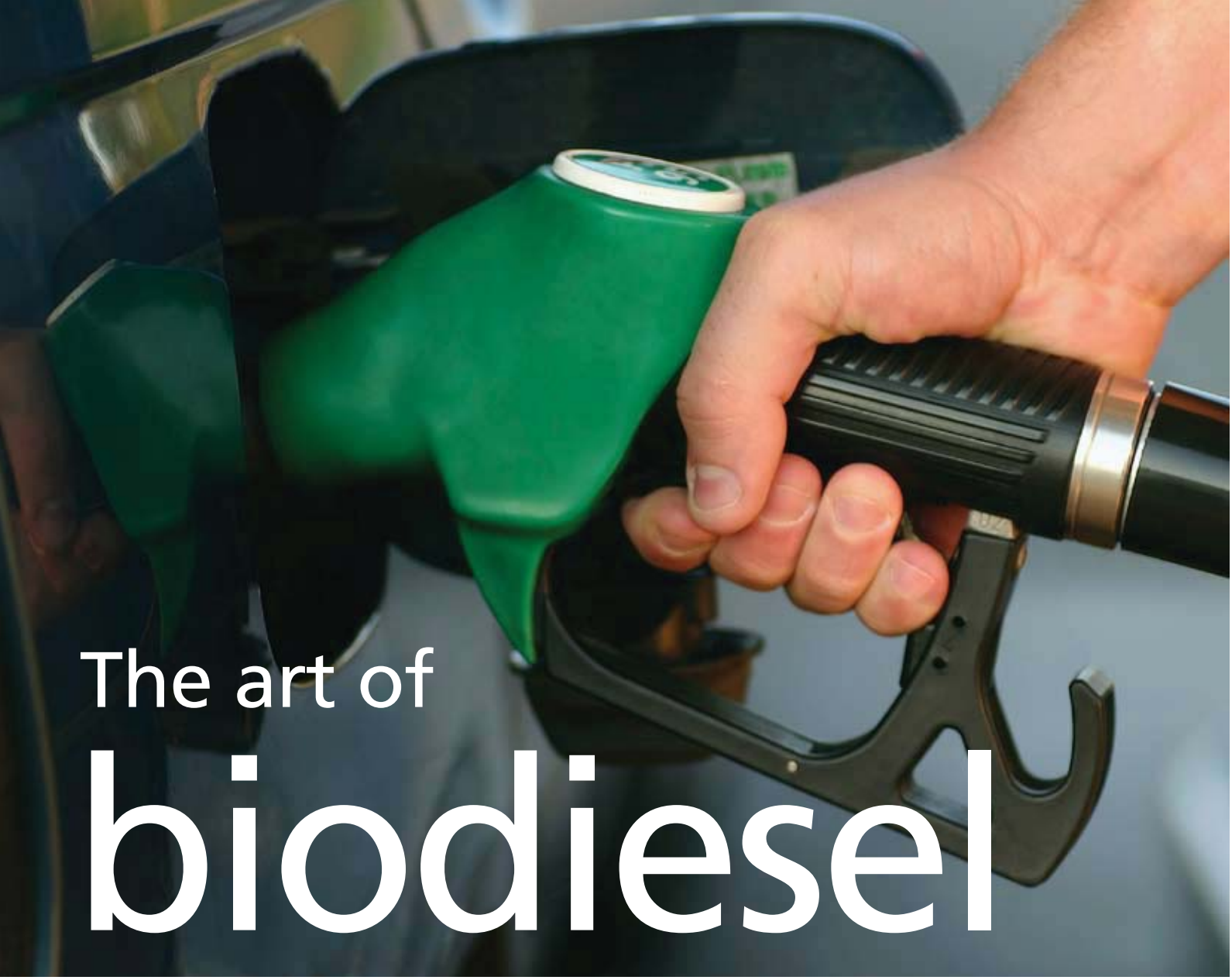

The art of biodiesel

The first biodiesel plant to start up in the Netherlands is using a FOSS XDS analyser to achieve its high quality standards. In Focus went to find out more about how routine analysis is contributing to success in the rapidly evolving biofuel sector.

Wilfred Hadders, General Manager of Sunoil Biodiesel has little doubt about the key to success in the biodiesel business. "Quality is the most important consideration," he says, holding a bottle of raw material in one hand and a bottle of finished biodiesel in the other to indicate how the quality principle applies throughout the process.

Biodiesel is an increasingly popular fuel with studies indicating rapid growth in consumption. Europe currently represents 90 per cent of consumption, with other countries catching up quickly. In the U.S. the number of retail outlets has risen from 300 in 2005 to more than 950 in 2006. One survey by Emerging Markets Online predicts that the fuel could represent as much as 20 per cent of all road diesel consumption in Brazil, Europe, China and India by 2020.

Add to this the European Union targets for biofuel consumption and biodiesel appears to be a good business to be in. But challenges remain, such as competition from bigger and more established plants in Germany. International standards must be met and cheaper imports from outside Europe are a constant threat. The quality that Hadders refers to is therefore essential to the future of Sunoil.

A young company

The company started just two years ago with production operating for about a year. The plant is neat, clean and efficient and to the unfamiliar eye surprisingly small for a plant currently producing around 80 million litres of biodiesel per year. If it were moved a few hundred kilometres further south it could easily be mistaken for a large winery.

There is an air of a successful start-up company and obvious pride in the whole undertaking of producing quality biodiesel. The laboratory manager Marc Arends describes how he used to make his own biodiesel at home until he discovered the Sunoil plant was starting up in his home town. He was quick to make a career move and his hobby became a full time job.

The process and need for analysis

Sunoil employ the most common method of making biodiesel. This involves taking raw oil and separating out the glycerin using a catalyst – a process called transesterification, see figure 1.

First the oil is put into a process tank and stirred. A catalyst consisting of potassium hydroxide and methanol is added. After a time the lighter diesel separates leaving a heavier residue of glycerine. The process is repeated to ensure that the conversion is as complete as possible, typically 99.5%. The diesel is cleaned to remove any leftover catalyst and methanol which is then re-used for subsequent processing. The glycerine is used for biogas production or for animal feed with the methanol removed. The biodiesel is used as is (B100) or mixed with regular diesel, for instance B10 or B20.

The XDS Rapid Liquid™ Analyzer is located in the plant laboratory and is used at different stages of the production process to check: 1. all incoming raw material, 2. the conversion process and 3. final product quality.

Hadders explains the importance of having a good laboratory to check incoming raw material. "Every batch is different and it is important to check everything to decide how best to process it," he says.

This flexibility is important. One day the plant could be using rapeseed oil, the next day soya oil or waste cooking fat. Sunoil is also investigating new potential sources including Jatropha, an inedible plant that grows well in arid conditions in countries such as Africa and India that could provide an effective non-food source for biodiesel.

Measurements throughout the process

Whatever the source, all incoming raw material is measured for moisture and free fatty acids.

A too high concentration of free fatty acids creates problems in production, for example with soap being produced – not exactly a desired biofuel. Generally, rape seed provides the best raw material source with a typical free fatty acid content of 0.7%. Refined soya oil is about 0.01 and used cooking oil is up to 5.0%. A high concentration of saturated fat makes it difficult to produce fuel that performs well at low temperatures, so waste cooking oil is exploited mostly for summer fuel.

Moisture content is important for usage of the fuel at low temperatures and is part of an international standard EN 14214 with an upper limit of 500mg/kg.

In addition to the raw material meas-

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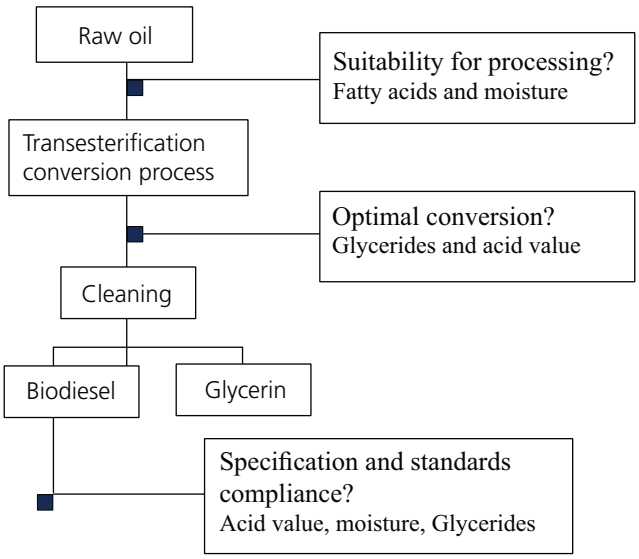
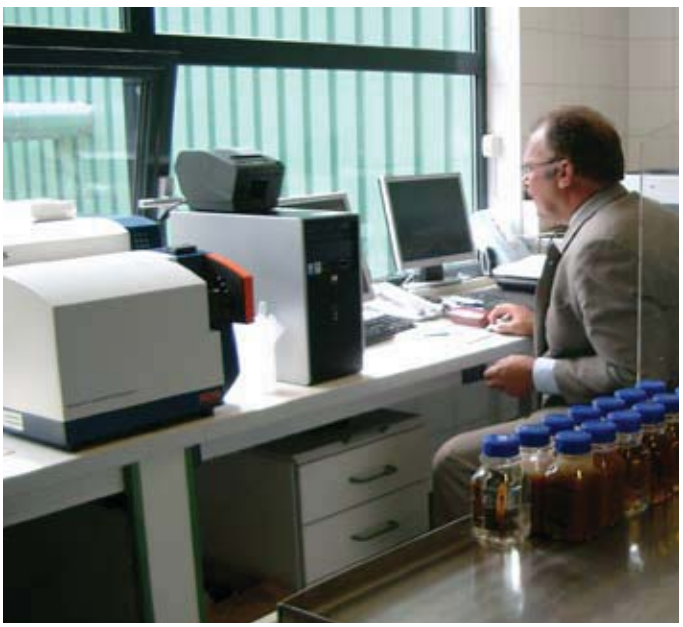


Fig.1 Schematic description of the biodiesel production process and control points. The transesterification method is a popular way to make biodiesel because it requires only low temperature and pressure, the conversion rate is high and there is a direct conversion with no intermediate compounds



The near infrared advantage: measurements with the XDS analyser shown here are fast, accurate and simple to perform by anyone

Sunoil Biodiesel currently produces 80 million litres of biodiesel per year

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urements, analysis is done right after the conversion process to check the effectiveness of the conversion process. The final biodiesel product is tested for compliance with standards including the EN 14214 standard.

The near infrared advantage

The plant originally used a Gas Chromatography instrument for analysing glycerides.

Measurements take about an hour with this method compared to about two minutes with the XDS near infrared (NIR) instrument. But for Marc Arends, the main advantage with the XDS is in its simplicity of use.

Anyone in the plant can now make a reliable measurement allowing more frequent analysis without the risk of human error that can occur with operators unfamiliar with Gas Chromatography technique. With the XDS, a liquid sample is simply placed in the XDS analyser and the results are displayed on a computer screen. "In the past there was some doubt about some of the results because obviously not everyone working in the plant is a trained laboratory technician," says Arends. "But now, with the XDS, it is so simple to make a measurement that the human error is removed and I can get on with other things instead of checking the validity of measurements."

The simplicity-of-use angle has similar advantages for checking the conversion process and spotting potential problems such as reduced yield due to poor conversion rate. "If there is a problem we can react more quickly," says Arends.

Besides the control parameters provided by XDS there are of course many more to be measured, "We dream of being able to measure everything as quickly and easily as with the XDS, remarks Hadders.

The specific parameters measured with the XDS NIR analyser during the production process are: Mono, Di and Triglycerides, Free Glycerin, water and Acid value.

NIR analysis is not just for big plants

While some may say that NIR analysis is only worthwhile for bigger companies performing a lot of tests every day, Sunoil have a different angle. This is to do with their special approach that involves knowledge, experience and a certain amount of instinct. "It helps that we are quite a small company," says Hadders. There is a feeling in the whole plant – a common goal to achieve the best quality- you loose that with a bigger plant."

The bottle of finished diesel that Hadders has used to explain the process may look ordinary to the untrained eye, but to everyone working at Sunoil it is proof of their success in achieving quality in a profitable way. The XDS is performing a vital role in achieving that success, providing a straightforward way for any of the staff to track production and maintain the company's competitive edge against bigger players. "We can do more analysis, we know what is going on, we know that what we are producing is of a high standard and that is everything for us," says Hadders. ■

by Richard Mills, FOSS (rim@foss.dk)

Biodiesel

Biodiesel is made by converting raw vegetable oil or animal fats into diesel with the use of a catalyst. It can be used directly in existing diesel motors as is or mixed with regular diesel.

The process creates glycerine mixed with methanol as a by-product. This can be used for biogas production or for animal feed with the methanol removed. It is also used in the pharmaceutical industry.

A variety of sources can be used according to price, availability and environmental conscious. Sources include rape seed oil, soya oil, palm oil, sunflower oil or even waste cooking oil. Potential new sources include Jatropha, an inedible plant that grows well in arid and poor soil conditions.

The oil to diesel conversion is efficient – one litre of rapeseed oil can make as much as one litre biodiesel.