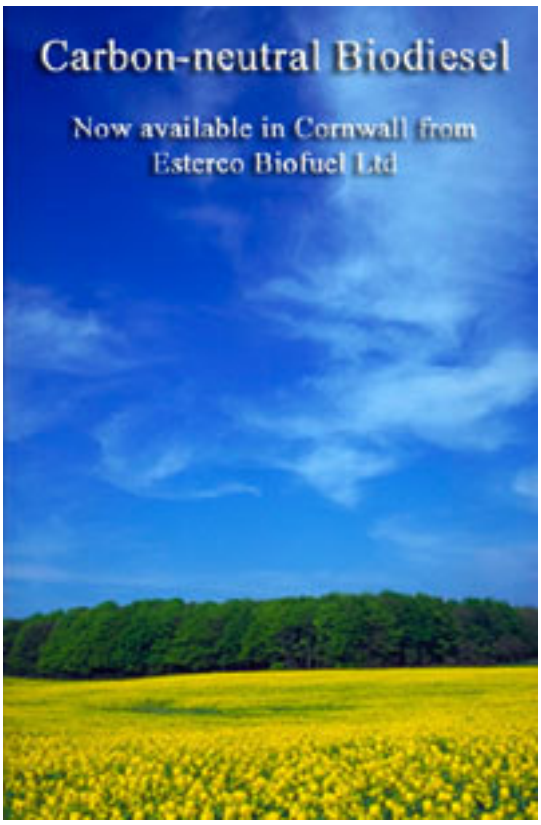
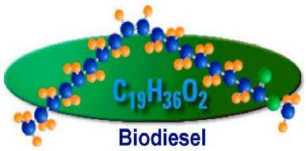


What is Biodiesel?



Biodiesel is a vegetable oil based fuel for diesel engines made by a chemical process known as transesterification; this converts the vegetable oil into a much thinner liquid called an ester.

Neat unmodified vegetable oil will run in a diesel engine. In fact, Herr Diesel's first engine was designed to run on unmodified peanut oil. Unfortunately, modern high speed, high injection pressure engines are unable to tolerate a viscous fuel such as vegetable oil. Also, some components of neat vegetable oil do not burn rapidly enough resulting in poor combustion.

For modern engine systems it has become necessary to change the nature of vegetable oil in order to achieve good injection and combustion characteristics. Until the motor industry builds their engines to handle neat vegetable oil fuel we are obliged to modify the fuel to suit the engines. Biodiesel is modified vegetable oil fuel.

Biodiesel has many benefits; emissions are reduced by around 90% in terms of poly aromatic hydrocarbons [PAHs] with similar reductions in particulates, sulphur and nitrogen oxides, SO_x and NO_x. It is also much kinder to the injection system and the engine in general than even the latest ultra low sulphur petroleum based fuels

Biodiesel can be manufactured from a number of renewable sources, but principally from used vegetable oils and virgin oils such as rapeseed oil. Germany already produces over a million tonnes of biodiesel per year. This shows there is a huge scope for British facilities and potentially an eager home market.

Esterco Biofuel Ltd has completed a feasibility study for the South West on the economics of a biodiesel manufacturing plant (or plants) taking in used vegetable oil much of which is currently poured down the drain or used for animal feed additives.

EU directives, currently being ratified for 2004 will make it illegal to feed used vegetable oil to farm animals. This will significantly increase the feedstock available for biodiesel production. This, coupled with the UK Government's tax reduction on biodiesel (that came into force in July 2002), should make it possible for biodiesel to compete with fossil fuel Derv.

Why Cornwall?

Initially Esterco was given a grant of £19,000 from Cornwall County Environmental Trust and the South West Investment Group.

The subjects researched were:

- Plant design and costing assessment
- Cropping and agricultural study
- Feedstock assessment study
- Business planning and site assessment study

The findings of this study indicated there would be a relatively slender profit margin versus high capital expenditure (around £5,000,000) for a 10,000,000 litres per annum facility. In addition, the feedstock assessment study was not sturdy enough to warrant this level of investment.

It was clear that to provide a secure business foundation, capital expenditure needed to be lowered considerably.

Cornwall is now a recognized 'Green' county in terms of the lead it has taken in the use of renewable energy sources.

The county also has considerable used vegetable oil resources: The large influx of visitors every year creates a huge demand for catering facilities which use vegetable cooking oils. The used oil could be converted locally into a clean, renewable diesel fuel.

In the longer term, the effects of the Foot & Mouth crisis may well encourage more farmers to consider the use of their land for industrial energy crops that can be used to produce biodiesel thus helping the county's already hard-pressed agricultural industry.

The Market

Esterco Biofuel Ltd has identified an opportunity to develop a micro plant capable of producing quality biodiesel from waste vegetable oils, animal fats and virgin oils.

In the past ten years Europe and the world has seen a massive increase in interest and implementation and usage of biofuels these being largely carbon neutral and low pollution.

There are internationally several producers of full scale commercial plant located in Germany, USA, Austria and France.

However in harmony with the exponential growth in the market there has been a parallel growth in the domestic/co-operative production of biodiesel. At present, there is no identifiable affordable turnkey facility for small-scale production of methyl esters.

The current price of Diesel fuel in the UK is around 80p per litre though this price will tend to both rise and fluctuate due to Middle East supply and political

instabilities. Biodiesel production is not subjected to this vulnerability. The cost of 'micro plant' produced biodiesel (after equipment expenditure) is around 15p per litre plus the 25p duty which has to be paid to HM Customs and Excise.

Esterco Biofuel Ltd

Martin Steele of Esterco Biofuel Ltd has had many years of experience in the field of methyl ester production to CEN [European Committee for Standardisation] 14-2-14 standard. He clearly understands the parameters to be achieved. In 2002/3 he designed and commissioned a small-scale production facility in north-eastern England with excellent results.

Martin's research began in 1997. The small plant he built and commissioned has so far produced enough biodiesel from waste cooking oils to travel twice round the earth's circumference!

His work gave a very solid foundation of knowledge. Later, he was given the opportunity to re-design & commission a small and very successful plant in the northeast. He says:

"To date I have covered the length and breadth of the UK running on fuels manufactured from materials as diverse as waste turkey grease to hemp oil, very often in a state of high rancidity."

"I understand the subtle differences in feedstock, and its potential qualities without expensive analytical methods."

"Working with waste vegetable oil [WVO] has proven challenging and rewarding. I am now able to deliver fuel with good Cold Filter Plugging Point (CFPP) characteristics even when utilising stearic acids, palmitics & other solid fatty acids which are generally considered unsuitable as road fuel feedstock."

The Concept

To produce and market a safe, durable, multi-feedstock, micro-production facility for application in niche markets.

The Facility

The stainless steel main body of the esterification reactor is constructed within Southwest UK.

The reactor contains many innovative design features. Its design and low cost makes a micro plant both affordable and safe for the small producer. A typical facility will generate 15,000MWh over the course of 1 year based on an 8 hours per day utilisation.

The EsterCo facility will handle, pre-treat and prepare waste vegetable oils and animal fats. It can also extract feedstock oil from rapeseed and other oil seed products.

Recycled Vegetable Oil [RVO] Refining

The feasibility study indicated there were certain weaknesses within the conventional approach to biodiesel production. These and our solutions are highlighted here.

Conventional European/US based technology has little in-house refining for crude bulk RVO. This leaves the industry at the mercy of the waste vegetable oil collection refining industry.

The biodiesel industry could easily find itself costed to minimum profitability by the RVO refiners. Another downside is that there are little or no refining facilities within the southwest. This adds carriage costs not to mention the environmental downsides of transporting bulk RVO hundreds of miles for conversion to biodiesel.

In-house crushing of oil seeds

Farmers located within the southwest region cultivate a significant amount of oil seed rape, as indicated by the Duchy Rose Warn study. Also, as this would be a non-food product, set-aside land might be used to cultivate still more feedstock for biodiesel manufacturing.

At this time, bulk crushing of oil seeds in UK is carried out at 3 locations, Liverpool, Kent and the Northeast. Clearly rapeseed produced in the southwest has a long way to go for refining into its two principle products:

- High protein cattle feed
- Crude virgin oil suitable for biofuels production.

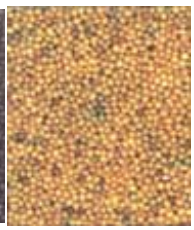
This situation reflects on the overall cost of animal feed and base feedstock for biodiesel production. Bulk first crushed crude virgin oil is prohibitively expensive. The business would also depend on a benevolent oil seed crushing industry; clearly not a good business scenario.

It was clear that all biodiesel plants must be able to operate as independently as possible. Therefore, all Esterco plants will be able to:

- refine and process RVO from multiple sources
- crush oil seed crops in-house and produce a high quality value animal feed product.

The knock-on effect for the end user is economic independence, maximum security and profitability.

Oil content of differing oil crops

PALM KERNEL	SESAME	RAPE SEED	MUSTARD	LINSEED	COTTON SEED	SOYA BEAN	PALM FRUIT
							
38 to 45%	50 to 56%	38 to 45%	38 to 45%	40 to 50%	18 to 22%	18 to 22%	20 to 22%

Typical extraction ratio per 100Kg of oil seeds

PALM KERNEL	36 kg	SOYA BEAN	14 kg
SESAME	50 kg	PALM FRUIT	20 kg
RAPE SEED	37 kg	GROUNDNUT KERNEL	42 kg
MUSTARD	35 kg	CASTOR SEED	36 kg
LINSEED	42 kg	SUNFLOWER	32 kg
COTTON SEED	13 kg	COPRA	62 kg

Martin Steele
June 2004

Biodiesel sales - Waste vegetable oil purchased
Biofuels consultancy - Plant design sales

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