

## Environmental Diesel

More than twenty years ago, the old house in Örebro has been a little known research-laboratory. With simple means and high goals, Carl-Johan Lindquist succeeded in producing a fuel for diesel engines from waste one gets from hamburger restaurants or vegetable oils from crops.

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R: What did that made you want to produce biodiesel?

CJL: It was the contact with farmers and their interest in being able to produce their own fuel. In particular minor farms, with shrinking margins, could do better if they pressed rapeseed oil itself and transesterified oil to their tractors instead.

R: Do you mean that it is so easy that almost anyone can make diesel?

CJL: Yes, that was the idea from the start. My three obsessions was that the process would be simple to manage, that it would work at normal atmospheric pressure and at ambient temperatures. It would not require any huge investments. For example, could a used milk tank good enough to convert canola oil into an environmentally friendly diesel fuel. High pressure and high temperature mean of course also a risk of fire and explosion, and that is to be avoided.

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Carl-Johan Lindquist calls his method the Cold Process and over the years has adapted it for different feedstocks. The initial mixture consisted of rapeseed oil, methanol and a catalyst which enables that transesterification occurs. Of one hectare of rapeseed becomes one cubic meter of canola oil, which ultimately yields about 1,000 liters of biodiesel (BIOL). In central Sweden, however, rapeseed cultivation only half as much ie 500 liters Biol. Next crop to refine with Cold Process became flax and the product BIOLIN can be used as an additive to fossil diesel, says Carl-Johan Lindquist. BIOLIN suppresses the formation of nitrogen oxides during combustion in diesel engines already at 5% blend in the fuel. The variant with flax protects against rust but is not as economically advantageous because of the price of flax. Other vegetable oils that can be converted into diesel with Cold Process are, cress, olive, palm, soybean, sunflower, etc. and they also go by the name Biol

It is not only the environment, economy and security that makes Cold Process appealing. Traditional transesterification involves heating the oil, and when the temperature is between 45 to 100 degrees Celsius so arises soap in the fuel depending on the choice of catalyst. As Carl-Johan Lindquist's method does not involve any heat so there is not soap in diesel fuel.

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R: How well tested are these products?

CJL: BIOL were sent for analysis to G. Vellguth Institut für Biosystemtechnik, Braunschweig in Germany, who helped to design the DIN standard 1985 and BIOLIN sent there too for analysis in 1992. Both BIOL and BIOLIN conforms to DIN norm. Together with the County Board of Örebro, Örebro County Council, I set up a prototype plant for BIOL-production in 1993 at Kvinnersta, (Natural Agro-secondary school in Örebro). The production plant was also approved by The Explosives Agency and Vocational Medicine at the University Hospital in Örebro. One of the school's tractors then went on 100% BIOL when the supply of raw materials were available, but otherwise MK1. Samples of both BIOL and BIOLIN were sent to AnalyCen AB in Lidköping for analysis.

1994-95 "Rapeseed Oil Engine - environmentally friendly public transport" a project in collaboration with the Municipality of Örebro County, County Council and Länstrafiken in Örebro. Länstrafiken ran two buses on the RME [1] and a control bus which operated with MK1. I have also developed a product (BIOIL) that do not follow the DIN norm, but that is an excellent environment product for cleaning and degreasing. It solves asphalt, tar, chewing gum and can be used to clean up oil tanks, particularly indoor tanks. BIOIL is biodegradable in about 21 days just like BIOL and BIOLIN, compared with up to 1000 days for regular diesel.

R: What has happened in recent years?

CJL: Well, there has been a lot about reusing cooking oil from hamburger restaurants and the like. I made my first try with cooking oil in the late eighties, but the industry has changed a lot since then. The quality of frying fat was much smoother before. Today, the density may vary from 0.89 up to 0.96 kg/l and frying fat from a restaurant can contain up to 1% water, while another contains additions of acids. There are things to do before you can start the transesterification.

R: How has it gone?

CJL: It has gone very well. 2002 I had my Cold Process analyzed and controlled by Mid Sweden University in Östersund. The usual transesterification process compared with the Cold Process in a degree thesis: "Product and business development, use of recycled cooking oil to produce biodiesel for marine use.". They noted that the usual process did not work on some frying oils and soaps was developed in the fuel, while warming the reaction mixture to 65 degrees Celsius for a long time. The Cold Process, however worked well and my "so-called" ESTROL also follows the DIN norm.

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Just over twenty years of research in a small basement laboratory has resulted in a smooth and efficient method for producing environmentally friendly diesel. The fuel is not a natural resource that runs out, but anything we can do by waste.