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5 June 2003

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**EA Fuel Standards – Discussion Paper 6 - National Standard for Biodiesel:**

Ethyl Asia Pacific Company are pleased to make a submission in response to this Discussion Paper. We have a number of specific comments and also attach a general discussion paper on biodiesel developed by Ethyl Corporation.

We would also draw EA's attention to 2 papers by CONCAWE (CONCAWE is the oil companies' European organisation for environment, health and safety - the emphasis of its work lies on technical and economic studies relevant to oil refining, distribution and marketing in Europe) that consider various aspects of biodiesel in detail and biofuels in general:

- CONCAWE Report 2/95 – Alternative fuels in the Automotive Market
  http://www.concawe.be/Download/Reports/Rpt_95-2.pdf
- CONCAWE Report 2/02 - Energy and greenhouse gas balance of biofuels for Europe - an update
  http://www.concawe.be/Download/Reports/Rpt_02-2.pdf

I hope that this input will be of use to Environment Australia in your considerations and please don't hesitate to contact me should you require any clarification or futher information.

Yours Sincerely

Wayne Morris
Manager
Australia & New Zealand

## Specific comments on issues from Discussion Paper:

| Issue | Ethyl Asia Pacific Company Response |
|---|---|
| *Comment: What is your view on the need to develop a mandated national fuel quality standard for biodiesel?* | Ethyl support the introduction of a biodiesel standard to complement the existing Australian fuels standards framework developed by EA. |
| *Comment: What is your view on harmonisation of any Australian biodiesel standard with European and/or US biodiesel specifications?* | Given the harmonisation of other Australian fuels specifications with the "global" Euro specifications this would also make sense for biodiesel. |
| *Comment: Do you consider that an Australian standard for biodiesel should prescribe feedstocks or production technologies, or should the standard only address characteristics and composition of biodiesel?* | Do not consider the specification of feedstock or production technology to be a major concern. |
| *Comment: Do you wish to comment on any aspects of the impacts of biodiesel use raised in this chapter (Chapter 4)?* | Cold flow properties of pure biodiesel are usually not suitable for low temperature use. Blends of biodiesel can also have problems. Biodiesel does not usually respond well to common commercial Cold Flow Improver additives.<br><br>FAME containing fuels are more unstable than fossil fuels and we have conducted testing to show that phenolic antioxidants are effective in reducing sediment formation in these fuels at different percentages of FAME. Refer Attachment 1.<br><br>Odour can be a consumer perception issue, there can often be a characteristic "fish & chip" smell from exhausts.<br><br>The inclusion of FAME is very likely to cause the fuel to fail the IP387 filter blocking (FBT) limits required in Australia, experience shows any thing above 20% FAME mixed with fossil fuel tends to block filters at normal ambient temperatures. |

| | |
|---|---|
| *Comment: What are your views on biodiesel blends? Sections 6, 8, 9 and 10 should be referred to when commenting on this section.* | It appears there is wide consumer and OEM acceptance of blends of biodiesel in the 5-10% range. Use of 100% biodiesel does not appear well accepted. Refer comments above on FBT issues. |
| *Stakeholders are specifically requested to provide comment on:*<br>(a) *an appropriate Australian specification for the cetane number of biodiesel*<br><br>(b) *an appropriate test method for determining the cetane number of biodiesel.* | In line with the petroleum diesel fuel specification in Australia, an appropriate Cetane number for biodiesel is 45 minimum.<br><br>A Lower Cetane number could cause cold start /idle problems. Cetane index is not suitable for biodiesel<br><br>In line with European specifications, a suitable method to determine the cetane number of biodiesel is EN ISO 5165, using a cetane engine |
| *Stakeholders are requested to comment on the impacts of biodiesel on diesel engine oil. Section 8 – Technical Analysis of the Impacts of Blending Biodiesel with Diesel on blending and 10 – Vehicle Warranties and Labelling should be referred to when commenting on this section.* | In the past Biodiesel did not present any particular problems for lubricants, if the engines were running correctly. Normal lubes can be used for most applications. If the engines are running high loads and are smoking, the higher resultant lube oil soot levels will require more frequent oil drains.<br><br>If the engines have high fuel dilution, the lube oils may have oxidation or low temperature pumpability problems & this would also require more frequent drains. An issue with biodiesel use is that Lube oil fuel dilution is hard to measure, and may have to be estimated by oil viscosity. This is not accurate and can lead to durability problems.<br><br>Many OEMs have recommendations for either specific lube oil change intervals when biodiesel is used, or a differing regime of lube oil condition monitoring specific to biodiesel fuels. |

# ETHYL CORPORATION UPDATE ON GLOBAL USE OF BIODIESEL



## Introduction

Fuels derived from renewable biological resources for use in diesel engines are known as biodiesel fuels. Animal fats and virgin and recycled vegetable oils derived from crops such as soybeans, canola, corn and sunflowers can be used in the production of biodiesel fuel. Tall oil, produced from wood pulp waste, is another feedstock source. Biodiesel can either be used in its pure state or can be blended with conventional diesel fuel derived from petroleum.

Vegetable oil was used as a diesel fuel as early as 1900, when Rudolf Diesel demonstrated that a diesel engine could run on peanut oil.

However, its use as a fuel attracted little attention except in times of crisis such as during World War II and the energy shortages of the 1970s. Increasing environmental concerns, expensive overproduction in European agriculture and changes in government policies have resulted in expanded testing and usage of biodiesel.

Biodiesel is the name for a variety of ester-based oxygenated fuels from renewable biological sources. Chemically, biodiesel is referred to as the mono alkyl esters of long chain fatty acids derived from renewable lipid sources. It can be used in compression-ignition (diesel) engines with little or no modification. Pure biodiesel is biodegradable, nontoxic and essentially free of sulfur and aromatics.

Methyl or ethyl esters can be produced from vegetable and tree oils, animal fats, and/or used oils and fats. These oils are blended with an alcohol (usually methanol, although ethanol can be used as well) and a catalyst such as sodium hydroxide. The resulting chemical reaction (which occurs at moderate temperatures and pressures) produces an ester and glycerine. Glycerine is a valuable material used extensively in the manufacture of soaps and other consumer products.

Biodiesel's performance is similar to diesel. While biodiesel has slightly less energy per gallon than number 2 diesel, it has slightly more energy than number 1 diesel. Tests have shown its performance when used in vehicles to be virtually the same as diesel.

## Advantages of using Biodiesel

Biodiesel has a number of advantages when compared with both petroleum diesel and other alternative fuels.

1. Biodiesel can be produced domestically, which helps reduce a countries dependence on imported petroleum.

2. The development of the biodiesel industry could strengthen the domestic, and particularly the rural, agricultural economy of a country.

3. It is a renewable fuel that can be made from agricultural crops and/or other feedstocks that are considered waste, such as cooking oil and trap grease. This helps conserve resources and makes the best possible use of materials which may be perceived as having little or negative value.

4. The production of soy-based biodiesel has a positive energy balance (as much as 3:1), due to the high energy value of ester-based feedstocks, the low-energy requirements of the conversion process, and the nitrogen-fixing characteristic of soybeans, which reduces the need for fertilizer.

5. Biodiesel blends are competitive with other alternative fuels on a life-cycle cost basis, because of its lower associated infrastructure costs (no extensive engine or refueling modifications needed), the positive energy balance discussed above, and the efficiency of the fuel on a per-Btu basis. Used in conjunction with the compression-ignition engine (which is much more efficient than spark-ignition engines) biodiesel compares quite favorably with CNG, ethanol and methanol, the other leading alternative fuels in the marketplace today.

6. It is considered readily biodegradable and non-toxic. Continued testing indicates that biodiesel degrades as fast as and is as safe as sugar in the environment, and when blended with diesel accelerates the diesel's degradation in the environment. These characteristics may prove valuable in certain markets.

7. Biodiesel and biodiesel blends significantly reduce harmful tail pipe emissions as documented in tests using U.S. EFP protocols.

8. The emissions smell better and appear to help reduce nausea in those breathing the fumes.

9. Biodiesel at levels of as low as 5% blended with 95% conventional diesel have shown significant lubricity performance and pump wear protection. Biodiesel is 11% oxygen by weight and contains no sulphur. The use of biodiesel can extend the life of diesel engines because it is more lubricating than petroleum diesel fuel, while fuel consumption, auto ignition, power output, and engine torque are relatively unaffected by biodiesel.

<u>Disadvantages of using Biodiesel:</u>

1. The compression-ignition (diesel) engine normally has a higher oxides of nitrogen (NOx) emissions profile compared to engines fueled with other products and, for reasons that are not entirely understood, in certain engines use of biodiesel tends to slightly increase those emissions of oxides of nitrogen. Since NOx is an ozone precursor, there is some concern about this issue. However, this problem is not insurmountable and a number of techniques are being developed to ensure that NOx emissions with biodiesel will be lower than for diesel fuel. Recent research suggests that biodiesel used in new engines developed to meet 1998 emission standards will not increase NOx emissions.

2. The cost of biodiesel and its availability and the need to gain alternative fuel status for biodiesel blended with petrodiesel. Studies conducted when agricultural commodity prices were much lower than at present and petroleum prices were in the range of US$18 to $20 per barrel concluded that petroleum must rise to over US$40-$50 per barrel to make biodiesel production viable without a subsidy.

3. An additional concern is the environmental impacts of increased fertilizer and pesticide usage to increase oilseed production for use in manufacturing biodiesel.

4. Biodiesel has a higher viscosity than conventional diesel and therefore becomes less useful at lower temperatures. This limits its use in Canada, the northern U.S. and much of Europe. In these areas, biodiesel is marketed as an additive in a five to ten percent blend with conventional diesel fuel.

5. One of the concerns with conventional diesel is low temperature performance in terms of filter blockage as defined by CFPP & LTFT. These problems are mostly controlled by use of cold flow improver additives. It has been found that these additives are less effective in Biodiesel blends.

6. Tests have indicated that biodiesel is more likely to oxidise than conventional diesel leading to the formation of deposits than can block filters. Conventional Antioxidants have been found to be effective in these Biodiesel blends.

Biodiesel around the World

Biodiesel in Europe

Two factors have contributed to Europe's aggressive biodiesel industry expansion. First, in 1992, reform of the Common Agricultural Policy addressed European agricultural surpluses by idling some land used for food production through a set-aside policy. This policy, which provides a substantial subsidy to non-food crop production, stimulated the use of set-aside land for non-food purposes. In some instances the set-aside subsidy is topped up if the land is planted to raw material for biodiesel production.

In response to increased demand for industrial oilseeds for the manufacture of biodiesel, set-aside land planted to oilseeds for industrial purposes is estimated to have increased by 50 percent in 1995-96 to about 0.9 million hectares. If recent increases in industrial oilseed production are maintained, the Blair House Agreement limit of 1.0 million tonnes in soybean meal equivalent could be approached and/or exceeded within the next few years.

Secondly, high fuel taxes in European countries normally constitute 50 percent or more of the retail price of diesel fuel. The majority of European governments believe that the alternative use concept for cereal grains has little economic justification and will in fact merely add to, rather than relieve, pressures on agricultural budgets.

Despite strong political opposition, however, the European Parliament in February 1994 adopted a 90 percent tax exemption for biodiesel. The combination of legislation supporting the use of alternative fuels, differential tax incentives and oilseed production subsidies, resulted in bidiesel being priced competitively with diesel fuel in a number of European countries. Tax incentives take the form of significantly reduced assessments or exemption from taxes normally assessed on diesel fuel.

As of 1995, western European biodiesel production capacity was over 1.1 million tonnes per year largely produced through the transesterification process. This adds over 80,000 tonnes of glycerine by-product to the market annually. This has created a glut of glycerine on the market. In fact, Germany is limiting production of biodiesel using the transesterification process because of an excess supply of glycerine.

One method of disposal of the excess glycerine is incineration, however this wastes a manufactured product, creates an environmental risk and results in additional costs. Germany is now focusing on biodiesel production using the cold pressed rapeseed method to avoid the excess glycerine problem.

In some European countries marketing cooperatives have produced biodiesel in a small scale through the transesterification process for their own consumption.

However, disposition of the glycerine by-product remains a problem.

## Biodiesel in Japan

In early 1995 Japan decided to explore the feasibility of biodiesel by initiating a three year study. A new biodiesel plant was to be contructed with its feedstock being recycled vegetable oils collected in the Tokyo area, estimated at 0.2 Mt annually.

## Biodiesel in the United States

United States interest in biodiesel was stimulated by the Clean Air Act of 1990 combined with regulations requiring reduced sulphur content in diesel fuel and reduced diesel exhaust emissions. The Energy Policy Act of 1992 established a goal of replacing 10 percent of motor fuels with non-petroleum alternatives by the 2000 and increasing to 30 percent by the year 2010. By 1995, 10 percent of all federal vehicles were to be using alternative fuels to set an example for the private automotive and fuel industries.

Use of biodiesel in the U.S. is increasing, particularly in urban bus fleets. Extensive testing in the U.S. has concentrated on biodiesel produced from soybeans. A number of public transit fleets have been using biodiesel. Tests indicate production costs for biodiesel are 2.5 times that of petroleum diesel.

## Biodiesel in Canada

In the early 1990s, Canadian canola production increased in response to higher market prices relative to cereal grains and increasing grain handling and transportation costs. Canola production may have peaked in 1994 and 1995 given current yields, the suitable land base and crop rotational requirements. However, higher yields due to new Brassica Juncia varieties and improved chemical weed control may further increase production in the medium-term.

Most of Canada's exportable canola supplies are purchased by Japan. The remainder of the crop is crushed for domestic consumption or export, primarily to the United States. Biodiesel production in Canada would require displacement from higher priced food uses. There is potential for the use of lower quality canola oils from overheated or frost damaged seed without any ill affects on the quality of the biodiesel.

Canadian biodiesel technology has focused on the hydro-treating method using a conventional refining process similar to the petroleum industry. This method produces cetane (used as a booster for diesel fuel), naphtha (used as a gasoline supplement), and other products (usable as power burner fuels). The high cetane portion (super cetane), when blended about 5 to 10 percent by volume with diesel, enhances engine performance in diesel the way octane does in gasoline.

Hydro-treating production costs are not comparable to either the transesterification method or the cold pressing of rape oil as the products produced are different. It has been estimated that comparable processing costs will be considerably less than those for biodiesel. Currently there is no commercial use of biodiesel or green diesel in Canada but fleet tests of green diesel are underway.

<u>The future for biodiesel:</u>

There are two existing specifications for conventional diesel and Biodiesel fuels in Europe, these are the EN590 for conventional diesel and the DIN 51606 for biodiesel. There is also a proposed specification, which is the EN14214 for biodiesel. These specifications can be described as follows:

EN590 (actually EN590:2000) describes the physical properties that all diesel fuel must meet if it is to be sold in the EU, Czech Republic, Iceland, Norway or Switzerland. It allows the blending of up to 5% Biodiesel with 'normal' DERV - a 95/5 mix. In some countries such as France, all diesel sold routinely contains this 95/5 mix.

DIN 51606 is a German standard for Biodiesel, is considered to be the highest standard currently existing, and is regarded by almost all vehicle manufacturers as evidence of compliance with the strictest standards for diesel fuels. The vast majority of Biodiesel produced commercially meets or exceeds this standard.

EN14214 (currently prEN14214:2001) is a proposed standard for Biodiesel, currently being finalised by the European standards organisation. It is broadly based on DIN 51606.

In Europe most auto manufacturers are happy for 20% biodiesel to be used in their diesel vehicles and these fuels are readily available on the market. In the United States the EMA have recently put a cap of 5% on biodiesel blends. The EMA also states that neither pure biodiesel or biodiesel blends can be used to improve quality in ozone non-attainment areas due to the fact that these fuels increase Nox emissions. It also states that any biodiesel used in the blends has to meet the EN 14214 or

ASTM D6751 standards. The EMA are also concerned about the lack of oxidative stability seen with the biodiesel and also the cold flow limitations of these fuels.

The most relevant details of these specifications are shown on the following table

| Parameters | EN590 | DIN 51606 | EN 14214 |
|---|---|---|---|
| Density at 15 celsius | 0.82 - 0.86 | 0.875 - 0.90 | 0.86 - 0.9 |
| Viscosity at 40 celsius | 2.0 – 4.5 | 3.5 – 5.0 | 3.5 – 5.0 |
| Flash point , degrees Celsius | >55 | >110 | >101 |
| Suphur(% mass) | 0.350 | <0.01 | <0.01 |
| Sulphated ash(% mass) | <0.01 | <0.03 | <0.02 |
| Water(mg.kg) | <200 | <300 | <500 |
| Carbon residue(% mass) | <0.30 | <0.03 | <0.03 |
| Total contamination(mg/kg) | <24 | <20 | <24 |
| Copper corrosion | Class 1 | Class 1 | Class 1 |
| Cetane number | >51 | >49 | >51 |
| Methanol(mass %) | Not specified | <0.3 | <0.2 |
| Ester content(mass %) | Not specified | >96.5 | >96.5 |
| Monoglycerides | Not specified | <0.8 | <0.8 |
| Diglyceride | Not specified | <0.4 | <0.2 |
| Tridlycende | Not specified | <0.4 | <0.4 |
| Free glycerol | Not specified | 0.02 | 0.02 |
| Total glycerol | Not specified | 0.25 | 0.25 |
| Iodine number | Not specified | <115 | 120 |
| Phos(mg/kg) | Not specified | <10 | <10 |
| Alkaline metals | Not specified | <5 | <5 |

**Attachment 1:**