Introduction

Fleet Services has developed a culture of responsible environmental management. The unit is constantly on the look out for ways to decrease the fleet's environmental footprint. Examples of some of the initiatives are the introduction of E10 fuel for all compatible vehicles, the purchase of hybrid vehicles for inclusion in the fleet and an investigation into initiatives whereby we can reduce the impact of greenhouse gasses being produced.

This philosophy will be continued into the future with continued vigilance for new technology and products which will assist us in this endeavour.

As part of this process Fleet Services were made aware of the product biodiesel which is reported to be an environmentally friendly fuel for diesel engines. The anticipated benefits were reported to Council in February 2004 and it was recommended that a biodiesel trial be started to ascertain if Council should use this environmentally friendly fuel.

The Aim

The aim of the trial was to carry out a practical assessment (as opposed to a scientific test) of the fuel in local North Queensland conditions.

The Trial

From research and extensive reading on the subject it was decided that the trial be conducted using a 20% biodiesel to 80% normal diesel blend (B20). The primary reason for this decision was the cost of the biodiesel fuel which has to be sourced from manufacturers in Northern NSW and road transported to Townsville in 205 litre drums.

Initial investigation also indicated that there would be clear benefits with minimal risks derived from using the B20 fuel although it is acknowledged that the gas emission of a B100 fuel would be of a better quality.

Initially it was necessary to establish a source which could guarantee quality and continuity of supply. We consulted with Mr Guy Lane from $SeaO_2$ Sustainable Development who helped us establish a supply relationship with Biodiesel Industries Australia Pty Ltd. This firm is currently supplying biodiesel at $1.56 per litre of which $0.60 per litre is freight and drum costs.

Equipment to deliver fuel to the truck tank at a 20% mix also needed to be sourced. After some research it was found that the industry didn't have anything available which could meet our needs. Consequently it was decided to develop our own dispensing unit which would automatically draw from bulk diesel tanks and biodiesel drums and mix it within the system as it is placed in the fuel tank of the truck. The efforts of Mr Col Jones have to be acknowledged for the development of this equipment.

Biodiesel dispensing facility

The vehicles used in the test were similar in their application, make and age. We used two water trucks (fleet numbers 6080 and 6107) and two service trucks (fleet numbers 2353 and 2354) one truck in each pair using standard diesel fuel and the other a B20 biodiesel blend (See truck specifications in appendix A). The fuel mix was also used in a smaller truck (used by the tyre fitter), without comparison to another, and the driver asked to comment on any change in performance.

The parameters which were tested were

1. Driveability of the trucks using B20 – subjective assessment by the drivers of the trucks.

2. Fuel pump wear – This was done by inspection. The fuel pump was removed and dismantled and examined for wear prior to and at the end of the trial.

3. Exhaust Emissions – Gas analysis of the exhaust gasses produced by all of the trucks was carried out. As one of the desired outcomes of this trial was to be able to operate the fleet in a more environmentally friendly and sustainable way, it was important to measure the impact the use of this fuel would have on air quality.

4. Fuel Consumption

   1. A fuel consumption check was carried out on the vehicles using bio-diesel. The consumption before and during the trial was compared.

   2. The fuel consumption of the vehicles solely using petro-diesel was also checked as a control.

The Results

1. All drivers of the /trucks using fuel with 20% biodiesel reported no adverse affects. As a matter of fact there is a general feeling that the trucks engines run smoother.

   All drivers expressed the view that they would have no hesitation in using the fuel on a permanent basis.

2. As mentioned previously the truck fuel pumps were dismantled and examined for wear before and after the trial.

   The report provided by the pump specialist indicates that there was no abnormal wear in the pump components as a result of using B20 at the end of the trial. (See appendix B)

3. The emissions from the trucks were measured by an independent business “Dynolink”, their report is attached in appendix C. It can be seen that all vehicles have shown no adverse effects on air quality using the B20 blend. In general there is a slight improvement in emissions at normal operating speed but a slight worsening at idle.

   Also there appeared to be varied results depending on the brand of truck being tested. This could be due to the different technology being used in each of the makes.

4. The comparison of the fuel consumption is shown in appendix D.

   Fuel consumption of the five vehicles was checked over three six month periods these being during the B20 trial, immediately before the trial and the same time as the B20 trial but twelve months earlier i.e. same time of year.

   The result of this test was variable. Two of the vehicles experienced and increase in consumption even though with the tyre fitter’s truck there was only a marginal increase. The third truck (6107) had a reduction in fuel consumption. A possible explanation of these results is as follows.

   1298: This vehicle is operated by the Fleet Services Tyre Fitter who has been closely involved with the trial. I have no doubt about the accuracy of the information collected in this instance and the type of work performed over the three periods would have been identical. This vehicle returned an increase in fuel consumption of 1.9% which was not unexpected due to the lower calorific value of the biodiesel.

   2353: As can be seen the result indicates that the fuel consumption of this vehicle also increased using B20 by 8.4%. Again this is consistent with the fuel characteristics.

Comparison of properties of diesel, canola oil and commercial US biodiesel. [4]

	Diesel	Canola Oil	Biodiesel
Density kgL^{-1} @ 15.5° C	0.84	0.92	0.88
Calorific value MJL^{-1}	38.3	36.9	33 – 40
Viscosity mm^2s^{-1} @ 20°C	4 - 5	70	4 – 6
Viscosity mm^2s^{-1} @ 40°C	4 - 5	37	4 – 6
Viscosity mm^2s^{-1} @ 70°C		10	
Cetane number	45	~ 40 - 50	45 – 65

6107: This vehicle showed a decrease in fuel consumption when converted to biodiesel. Further analysis of the data indicates that diesel usage immediately before the biodiesel trial (a period of one month) was 2% lower to that during the B20 trial. The assumption made in this instance is that this vehicle experienced a 2% increase in fuel usage and that the decrease when compared with earlier periods was due to operational reasons.

2354 and 6080: These were the control vehicles during the trial and only used pretrodiesel. As can be seen in appendix D, there is a "natural" fluctuation in the use of fuel which depends largely on the application and driver of the vehicle. However the general trend is for a slight increase in fuel consumption as for the "B20" trucks.

The costs

Council currently uses approximately 1.18M litres of diesel annually. If we assume an increase in fuel consumption of 4% when using B20 (average over the three trucks), Council's fuel usage would increase to approximately 1.227M litres.

The average price per litre of standard diesel to Council is $0.98 (August 2005) compared with the cost of biodiesel which is $1.56. This high cost is mainly due to transport and drum costs of the biodiesel which equates to $0.60 per litre. At a 20% blend biodiesel would add approximately11.6 cents per litre to the cost of fuel (on August prices).

Based on Council's annual diesel fuel usage rate the extra cost to Council could be in the vicinity of $188 000 ie an extra 11.6 cents per litre. It should be remembered however that this cost applies when supplied in 205 litre drums and would be reduced markedly if we are able to interest other parties in its use and purchase supplies in bulk. It is anticipated that the freight cost can be reduced to about 8 cents per litre if supplies are transported to Townsville in a bulk tanker. This in effect would reduce the extra cost of using biodiesel to about 1.2 cents per litre or $61 000 per year (depending on current diesel/biodiesel differential cost and actual increase in fuel consumption).

The present supplier has stated that he is willing to work with us to establish a local depot if Council decides to use the biodiesel for its fleet. The "commitment" of the supplier has not been verified but this has the potential to further reduce the cost to Council.

It has been stated that a manufacturing facility for bio-diesel may be established in Townsville sometime in the future. Costs could be reduced even further if plans to proceed with the bio-diesel manufacturing plant eventuate.

The advantages

Even though there is a cost associated with the introduction of biodiesel there are clear benefits achieved through its use.

Council's infrastructure will not need to be changed to be able to start the dispensing of the B20 blend. Further investigation will be necessary, but it is anticipated that a simple "splash mix" will be able to be used when stocking bulk tanks.

Some direct benefits of using biodiesel include

- A very positive impact for business units which are involved in triple bottom line reporting
- Improved emission standards (see appendix E)
- The fuel is a sustainable resource and could be an alternative crop for local farmers. It should be said that farmers don't seem to be aware of its potential at this stage.
- Pure biodiesel is biodegradable and consequently more environmentally friendly and easier to store and handle.
- It is non toxic and essentially free of sulphur and aromatics. [1]
- It is produced domestically, reducing dependence on foreign oil.
- It requires no engine modifications or changes in the fuel handling and delivery systems.
- Biodiesel is the only alternative fuel that runs in any conventional, unmodified diesel engine. It can be stored anywhere that petroleum diesel fuel is stored. [2]
- The lifecycle production and use of 100% biodiesel produces approximately 80% less carbon dioxide emissions, and almost 100% less sulphur dioxide. Combustion of biodiesel alone provides over a 90% reduction in total unburned hydrocarbons, and a 75-90% reduction in aromatic hydrocarbons. Biodiesel further provides significant reductions in particulates and carbon monoxide than petroleum diesel fuel. Biodiesel provides a slight increase or decrease in nitrogen oxides depending on engine family and testing procedures. Based on Ames Mutagenicity tests, biodiesel provides a 90% reduction in cancer risks. [2]
- 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. [2]
- Biodiesel is safe to handle and transport because it is as biodegradable as sugar, 10 times less toxic than table salt, and has a high flashpoint of about 300 F compared to petroleum diesel fuel, which has a flash point of 125 F. [2]

- Biodiesel is a proven fuel with over 30 million successful US road miles, and over 20 years of use in Europe. [2]
- When burned in a diesel engine, biodiesel replaces the exhaust odour of petroleum diesel with the pleasant smell of popcorn or chips oil. [2]

The Community

It is encouraging to note, that since Council has attracted media attention with its trial and investigation into the use of bio-diesel, that private individuals and other organisations have also shown interest. They have requested to share information and at one stage Queensland Nickel were contemplating trialling biodiesel in their plant fleet. James Cook university has also shown interest in using B20 in its motor vehicle fleet.

It is anticipated that further interest will be shown by other businesses as use starts to become more commonplace. This would bolster demand and facilitate the supply of the biodiesel in bulk quantities to a number of purchasers.

The future

At this stage there has been no testing of the fuel in earthmoving plant. We will start a trial with a selected item such as a backhoe using a similar procedure to the one used above.

Conclusion

There are no apparent adverse effects as a result of using bio-diesel in Council's trucks.

The evidence of the trial shows that there is a benefit through improved emissions at operating speeds. Our data on the overall "emission standard" performance isn't clear cut and it would need to be confirmed by more rigorous testing over a longer period. However there is no intention to do this at this stage as comprehensive data is available from a multitude of sources which supports the evidence that improvements in emissions will result as a consequence of using B20 (See appendix E).

Records show that the tyre fitter's truck displayed a very small increase in consumption, the water truck used 9.1% less and the service truck used 8.4% more indicating an overall average increase in fuel consumption. Again this is consistent with scientific evidence which suggests that a slightly higher fuel consumption can be expected due to the lower calorific value of the fuel.

The benefits of using a B20 blend fuel are many as highlighted in this report. As there is no evidence to indicate that there will be any adverse effect from its use of B20, serious consideration should be given to its introduction in the TCC fleet. Council's leadership will have the potential to increase the positive

impact of the fuel many fold through community uptake and its eventual acceptance by industry.

Recommendation

That Council support the use of B20 bio-diesel in its diesel powered vehicles and plant fleet subject to the resolution of supply issues.