

16th ANNUAL MDEC CONFERENCE

Biodiesel Test at Kinross Gold
Paracatu Mine - Brazil

KINROSS **MINING DIESEL mdec EMISSIONS COUNCIL** 2

KINROSS – WHO ARE WE?

- Growing senior pure-gold producer
 - 2.2 million gold equivalent ounces in 2010
- 8 operating mines
- 5,500 employees worldwide
- Strong culture built on “The Kinross Way”
- Suite of world-class development projects
- Highly prospective exploration portfolio
- Commitment to outstanding corporate citizenship

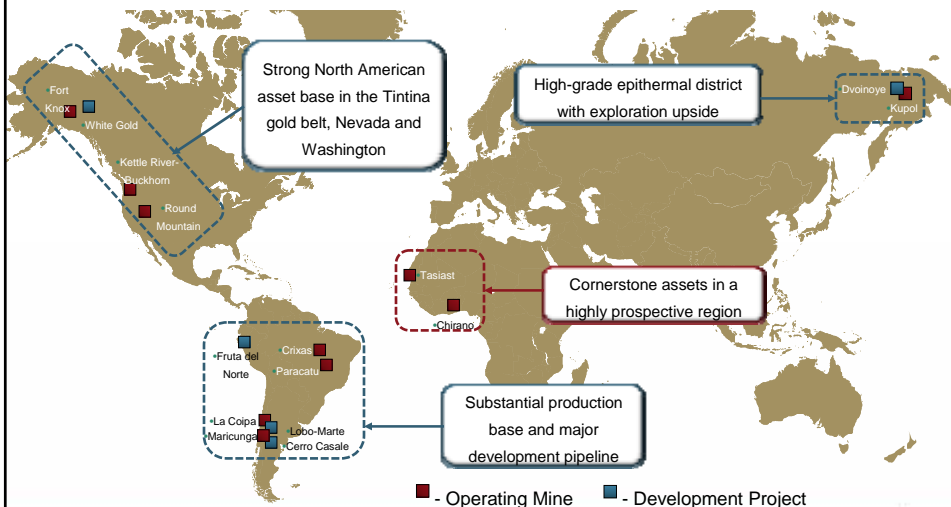
Our core purpose is to lead the world in generating value through responsible mining.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



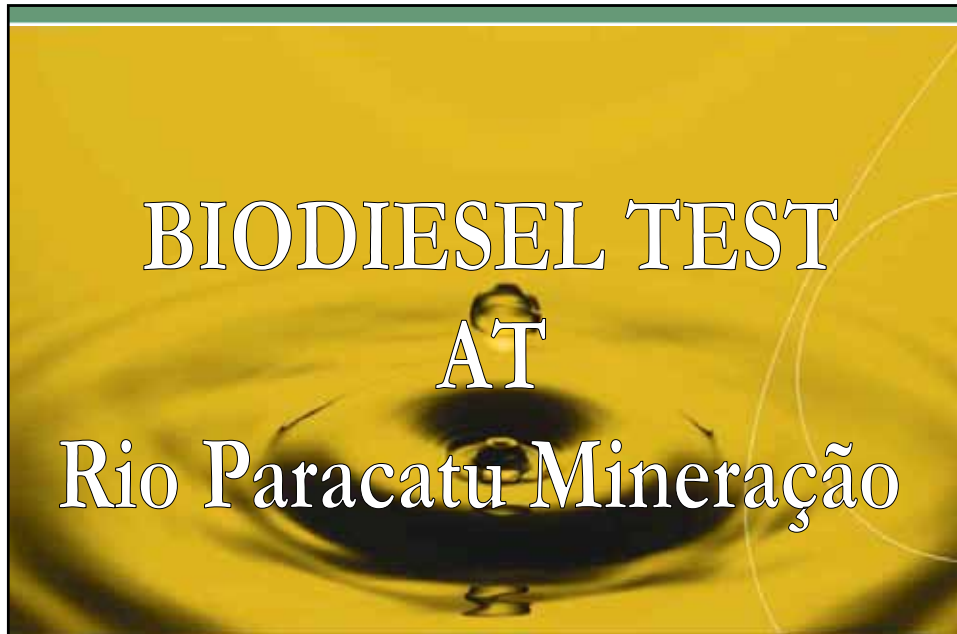
Operations & Development Projects



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test




BIODIESEL TEST AT Rio Paracatu Mineração



KINROSS 16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

MINING QUALITY **mdec**
EMISSIONS COUNCIL

5



KINROSS 16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

MINING QUALITY **mdec**
EMISSIONS COUNCIL

6

What is Biodiesel?

Biodiesel is basically a vegetable oil (or cooking oil) that has been processed to remove glycerin. Pure biodiesel can be burnt in the place of diesel, but presently it is significantly more expensive than diesel. The additional expense to produce and blend the biodiesel fuel is normally compensated by credits and or other government subsidies.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



7

Some Facts About Biodiesel



The use of the fuel biodiesel is a trend that is growing in some parts of the world. Biodiesel is more often used for transport trucks and in agriculture, however its popularity is growing. This is the result of three factors:

- ✓ Periodic diesel fuel shortages;
- ✓ Increases in the cost of the diesel fuel; and
- ✓ More stringent laws regarding emission from gas and diesel powered vehicles.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



8

More Biodiesel Facts (in Brazil)

- ✓ In Brazil service stations must carry biodiesel;
- ✓ Presently biodiesel is sold as a blend of 1% and this will soon increase to 2%;
- ✓ Currently biodiesel is more expensive than straight diesel due to rising soya bean prices;
- ✓ The government is encouraging the use of biodiesel through incentive programs;
- ✓ Biodiesel has been perceived as taking food away from the people;
- ✓ To remove this perception new crops of non food plants are being developed;
- ✓ Pinhão Manso and Mamona are non food crops being considered for biodiesel production; and
- ✓ Biodiesel is still in the development stage and the Brazilians believe they will eventually get it right.

Note: Ethanol fuels are sold every where in Brazil but there was a time when it did not perform so well. Over time it has been improved. They feel the same will become of biodiesel.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



9

Sources of Biodiesel

The most common they are:

- ✓ Oil from soya beans;
- ✓ Used cooking oil; and
- ✓ Oil of Palm, Canola, or Colza Seed

The concentrations of biodiesel mixes are:

- ✓ B5 - 5% biodiesel to 95% diesel
- ✓ B20 – 20% biodiesel to 80% diesel
- ✓ B100 – pure biodiesel / also known as clear biodiesel

Note: The sale of biodiesel, in some parts of the world, is being strongly promoted through incentives and benefits. Some of these benefits have merit whereas others are not totally proven. **These claims rarely show the potential problems that can occur by the use of biodiesel.**



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



10

Biodiesel Test at RPM

- RPM until recently consumed around 9 million liters of diesel per year.
- With the expansion RPM expects to consume approx. 20 million liters of diesel per year.
- Other mines within the region consume around 2.7 million liters of diesel per year.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



11

INFORMATION WAS COLLECTED BY CAT USING A DYNAMOMETER PRIOR TO FIELD TEST



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



12

Results From Dynamometer

Tests	Load		Torque		Gas Emissions	Combustion Temperature (°C)
	RPM	Theoretical (HP)	RPM	Load (lb/ft)		
Recondic.	1710	886	1290	3150	43.4	551/610
BIO 5%	1720	897	1300	3210	44.3	528/551
BIO 10%	1720	900	1290	3200	45.5	556/607
BIO 20%	1720	873	1300	3130	45.7	531/563
BIO 50%	1720	869	1310	3120	44.3	537/580
BIO 100%	1740	835	1320	2980	41.9	511/553



Conclusions From Dynamometer Test

Analyzing the performance of the CAT 3508 diesel engine, which is used in the 777C haul trucks, as per the dynamometer test, it was demonstrated that biodiesel did not significantly alter the power output for mixtures with percentages of 5 to 50%. For higher percentage mixtures, Caterpillar noted a reduction in the power. Caterpillar considers power losses below of 3% to be acceptable. However, for losses in the range of greater than 3% Caterpillar considers these to be problematic.



Tested Haul Truck CAT 777C – Capacity 86 tonnes

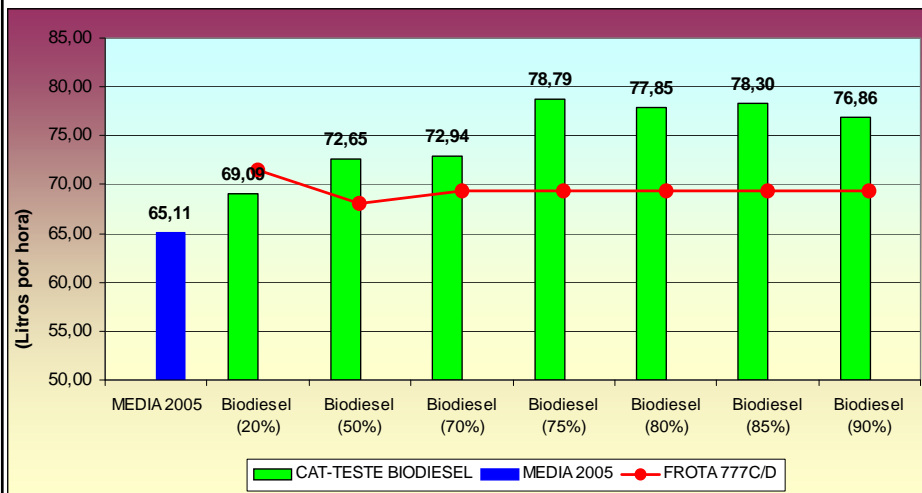


16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



15

Biodiesel Burn Rate (Lit/Hr Avg.) – CAT 777C



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



16

Volkswagon VW-17270 Test Fuel/Lube Truck



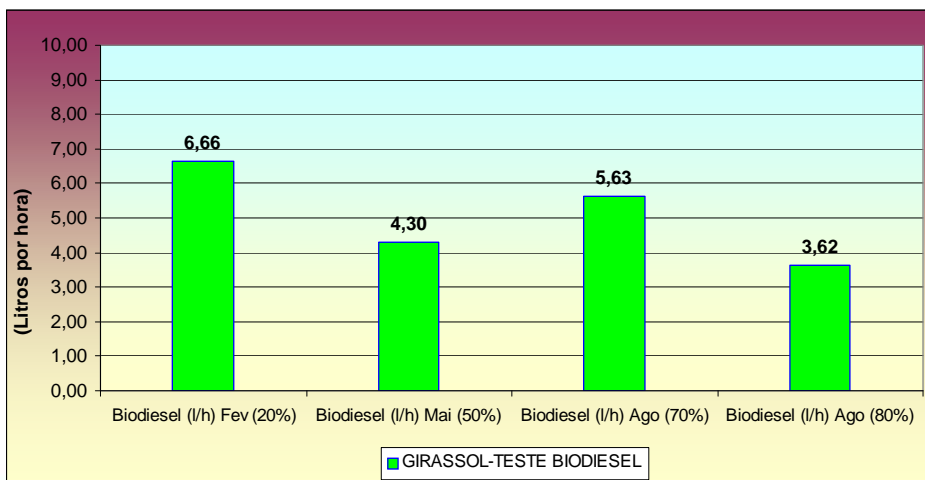
KINROSS

16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WINDYBUSH
mdec
EMISSIÖNS COUNCIL

17

Biodiesel Burn Rate (Lit/Hr Avg.) – VW-17270



KINROSS

16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WINDYBUSH
mdec
EMISSIÖNS COUNCIL

18

Tested Motor Grader – CAT140H



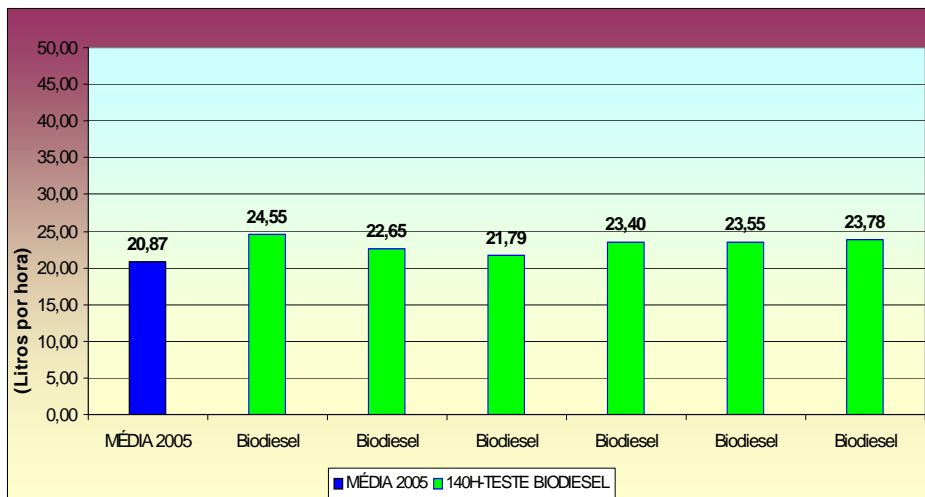
KINROSS

16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WINDY HAVEL
mdec
EMISSIONS COUNCIL

19

Biodiesel Burn Rate (Lit/Hr Avg.) – CAT140H



KINROSS

16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WINDY HAVEL
mdec
EMISSIONS COUNCIL

20

Tested Bulldozer – CAT D10T

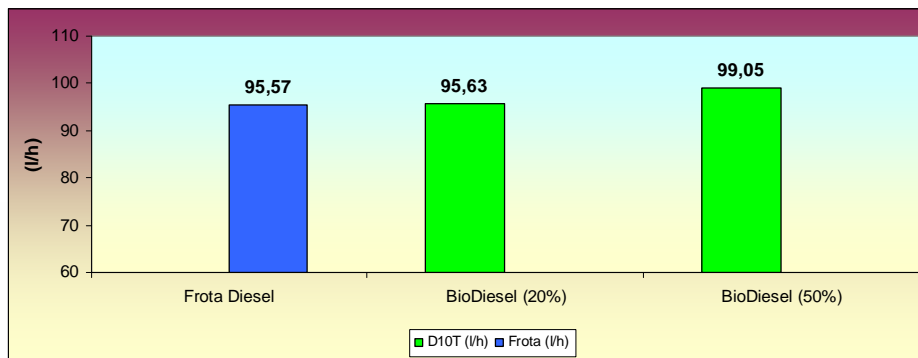


16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



21

Biodiesel Burn Rate (Lit/Hr Avg.) – CAT D10T



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



22

RPM Biodiesel Test Conclusions

- Equipment operators noted that the machines seem to have less power. They estimated 20%
- RPM determine that the only way to make Biodiesel viable would be to produce their own soya beans. Soya cake is still more valuable than soya oil.
- The test is no longer in progress.
- Vale is testing Biodiesel on their locomotives.



Pros and Cons of Biodiesel

PROS

✓ Reduction in gas emissions in diesel exhaust:

Unburnt hydro carbons.....14%

Carbon Monoxide..... 9%

Particulates 8%

- ✓ Increase of the fuel lubricating properties due to its low viscosity.
- ✓ Ability to degrade in cases of fuel spills.



Pros and Cons of Biodiesel

CONS

Biodiesel can cause deposits that build up on the membranes of the fuel filters resulting in a rapid clogging. The problem worsening when the concentration of biodiesel increases.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



25

Pros and Cons of Biodiesel

CONS

Increase in certain emissions in the exhaust gases

NOX2%

Fuel Economy

Pure biodiesel is 5 to 7% less efficient than regular fuel.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



26

Effect of Biodiesel on Fuel Filters

The fibers in the filter membrane are hygroscopic, and attract the water. The attraction between the filter and water is greater than the attraction between water and diesel. As the water continues being attracted by the filter, water drops form and increase of size until they cannot pass through the membrane and fall into the reservoir, where they are drained.

The ability of the fuel filter to work is based on the attraction between the filter membrane and the water being greater than the attraction of diesel and water. When the Biodiesel is added, it significantly increases the attraction with the water. Hence, the water will pass through the filter and will not be separate, rendering the filter effectively useless.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



27

Biodiesel Promotes the Growth Microbes in Fuel

- Biodiesel acts as a catalyst that increases the growth of microbes that already exist in fuels
- Biodiesel is hygroscopic which means it absorbs the water. Regular diesel can contain as much as 60 ppm of water. While biodiesel can contain 1200 the 1500 ppm of water (20 times more).
- Water increases the probability of microbiological growth and corrosion. The microbes only need a very small amount of water to establish its ecosystem and to proliferate.



16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test



28

Issues Related to the Storage of Biodiesel

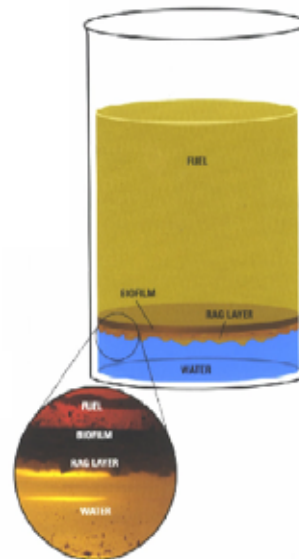
1. Biodiesel degrades two times faster than the conventional diesel fuel.
2. It cannot be stored for more than 3 months.
3. Biodiesel requires special storage and handling.

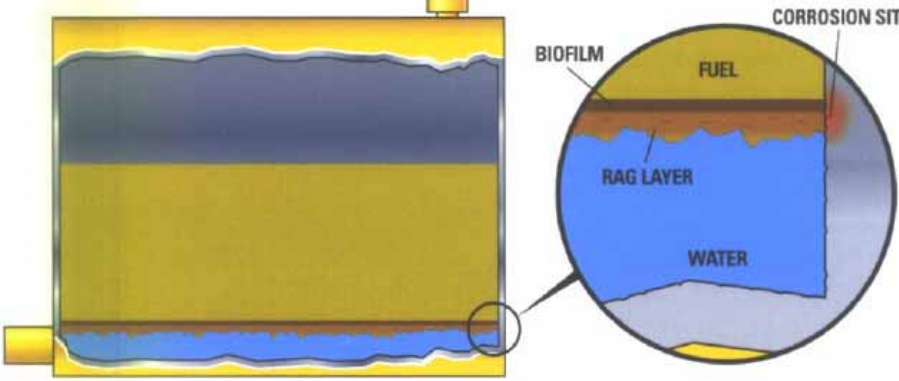
Biofilm

Biofilm is a complex colony of active microbiological organisms.

Rag Layer

Rag Layer is an active surface between biofilm and the water, where the microbiological growth occurs.





The diagram illustrates the layers of corrosion in a fuel tank. On the left, a vertical cross-section shows a fuel tank with a yellow top section, a blue middle section, and a yellow bottom section. A magnified circular view on the right shows the interface between the fuel and the metal tank wall. The layers from top to bottom are: FUEL (yellow), BIOFILM (orange), RAG LAYER (blue), and WATER (light blue). A CORROSION SITE is indicated by a red arrow pointing to the metal surface where the biofilm and rag layer meet.

Acid is a by-product of the microbiological growth, it can cause severe corrosion to fuel tanks.

It can also degrade various types of seals used in the fuel system, such as certain elastic polymers and seals made of natural rubber.

KINROSS 16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WIND DIESEL **mdec**
EMISSIONS COUNCIL

31

Note: Ethanol fuels are sold every where in Brazil but there was a time when it did not perform so well. Over time it has been improved. They feel the same will become of biodiesel.

KINROSS 16th ANNUAL MDEC CONFERENCE – October 5th 2010
RPM Biodiesel Test

WIND DIESEL **mdec**
EMISSIONS COUNCIL

32