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Mining Diesel Emissions Conference - 2009

## *Evaluation of the Impact of Using Biodiesel Fuel in Mine Production Equipment*

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## Introduction

- Like all industries in Canada, mining is actively looking to reduce GHG emissions from all sources.
- In addition, providing good air quality in the underground mine environment can be a challenge – especially with larger engines and vehicles.
- As a renewable fuel, biodiesel has the potential to reduce GHG emissions, but can reduce some toxic emissions as well.



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## Biodiesel Fuel

- Renewable – carbon neutral.
- Reduction in CO and DPM emissions.
- Some increase in NOx possible.
- Operability/handling similar to diesel.
- Most common use in blends.

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## Project Objectives

- Help mine plan for effective biodiesel implementation underground.
- Baseline air quality assessment (DPM).
- Training of personnel.
- Two vehicle pilot study of B20 fuel.
- Real-time underground emissions test.
  - Determine the reductions of DPM.
  - Observe NOx penalty.
- Projection of benefits for mine-wide implementation of biodiesel.


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## Research Methodology


- In-mine pilot study using two vehicles.
  - Caterpillar 769D truck
  - Caterpillar 988F loader
- Portable emissions measurement system.
  - SEMTECH-DS
  - CANMET-MMSL DPM sampler
- Vehicle emissions sampling over actual production duty cycles during regular shift operation.
- Biodiesel fuel station – (segregated).


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## Pilot Test Vehicles






- Caterpillar 769D
- Caterpillar 988F

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## Biodiesel Refuelling Station






- B20 premixed by supplier and delivered in 1000L cubes.

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## Portable Emissions Measurement System




- SEMTECH-DS

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## Vehicle Shift Operation



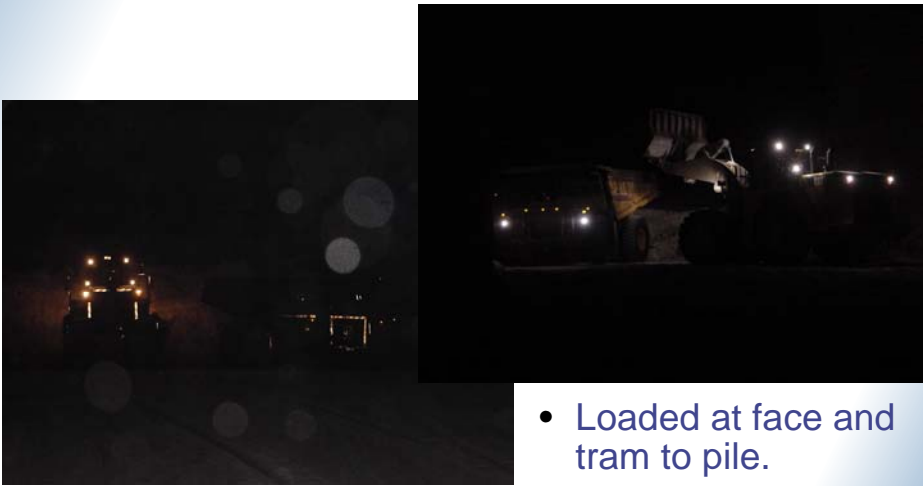
- Loader cycle

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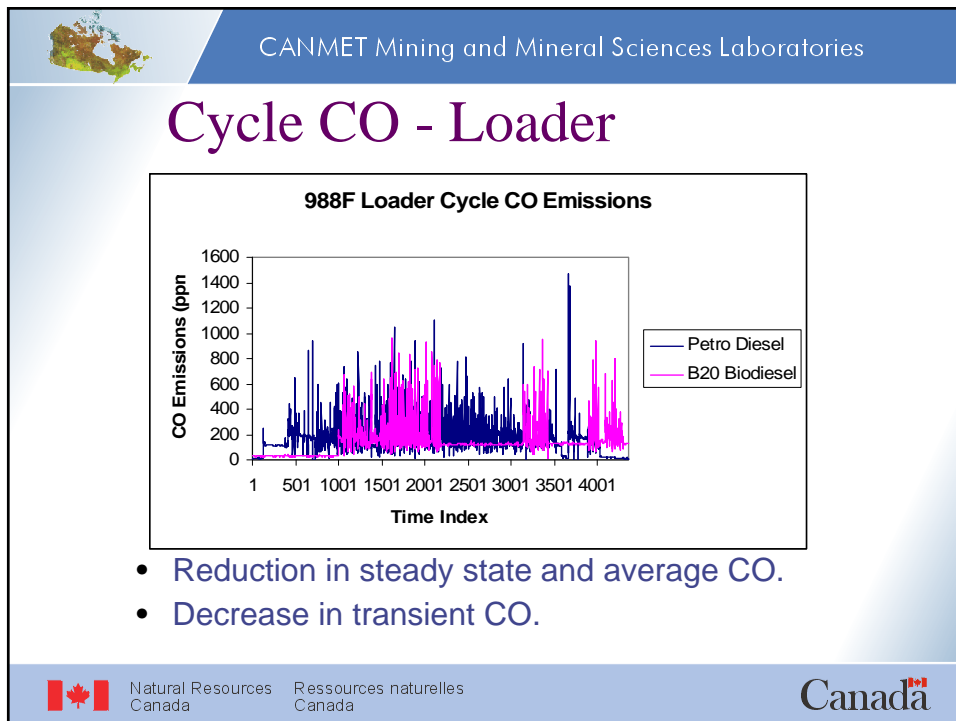
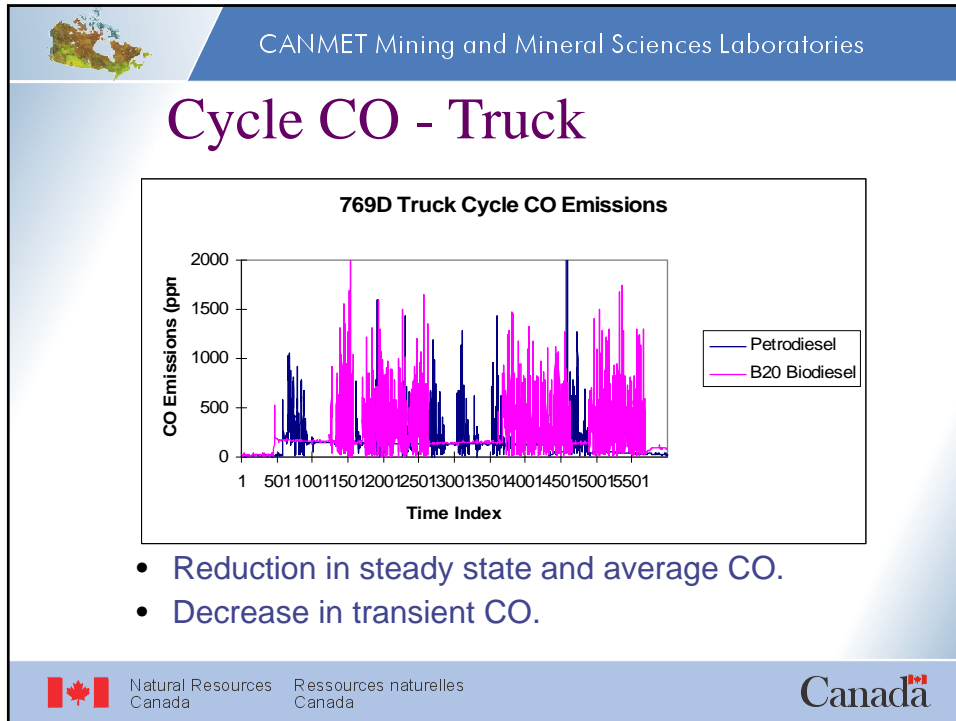
## Truck / Loader Cycle

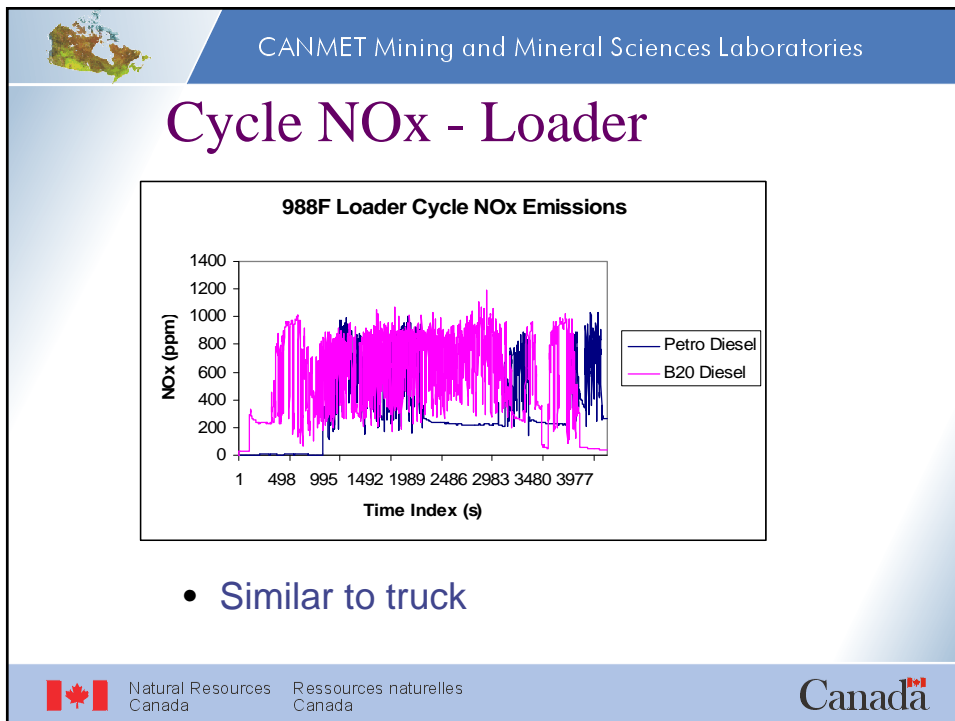
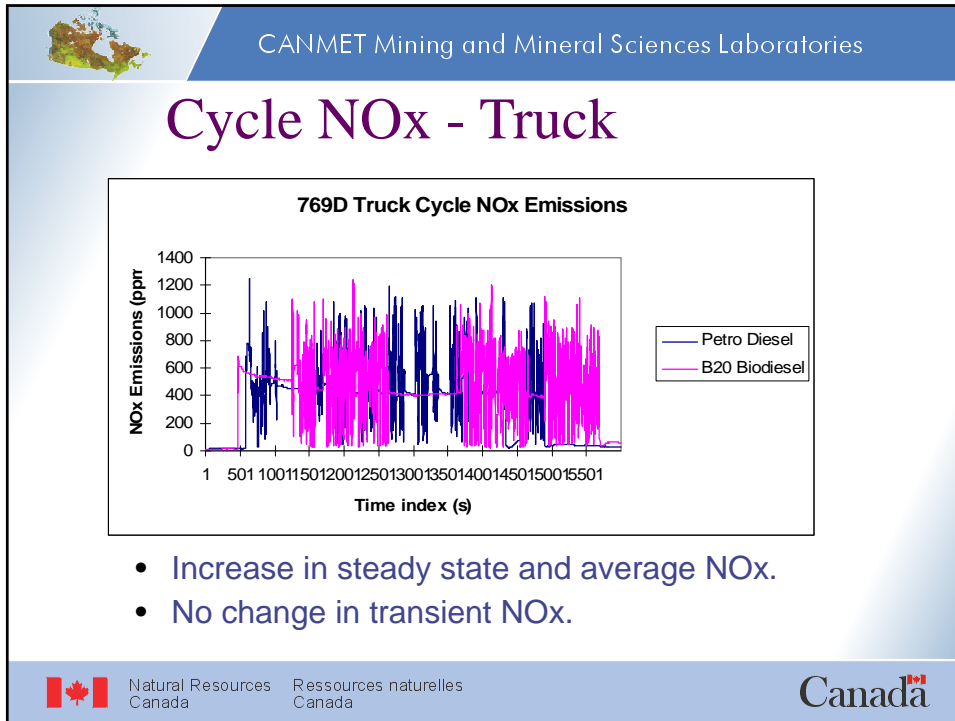



- Loaded at face and tram to pile.

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## Results Summary - Truck


	CO	NO	NO <sub>2</sub>	NOx	DPM	THC
	ppm	ppm	ppm	ppm	g/hr	ppm
<b>Petro Diesel Fuel</b>	230	258	64	322	36	122
<b>Biodiesel Fuel</b>	136	350	73	424	24	89
<b>% Change</b>	-41	36	15	32	-33	-27

- Cycle averaged emissions.
- (-) sign means reduction in emissions.
- Significant decrease in CO, DPM, HC
- NOx penalty



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## Results Summary - Loader

	CO	NO	NO <sub>2</sub>	NOx	DPM	THC
	ppm	ppm	ppm	ppm	g/hr	ppm
<b>Petro Diesel Fuel</b>	175	394	40	434	43	215
<b>Biodiesel Fuel</b>	171	486	75	561	38	210
<b>% Change</b>	-2	23	86	29	-12	-2

- Reductions not as significant as truck but similar .
- Highly transient cycle may limit PM reductions on Tier 2 engine.
- NOx penalty.




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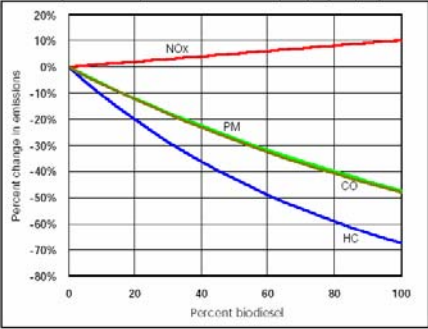




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## Discussion






Percent biodiesel	NOx (%)	PM (%)	CO (%)	HC (%)
0	0	0	0	0
20	~2	~-10	~-15	~-25
40	~4	~-20	~-30	~-40
60	~6	~-30	~-40	~-55
80	~8	~-40	~-50	~-65
100	~10	~-50	~-60	~-75

- CANMET Laboratory B50 Tests


	Diesel	B50	Change
CO (g/hr)	48	27	-44
NO2 (g/hr)	37	44	19
NO (g/hr)	103	98	-5
NOx (g/hr)	140	142	1
DPM (g/hr)	3	4	31

- EPA Biodiesel review.



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## Conclusions/Recommendations


- Some NOx/NO<sub>2</sub> penalty which may affect ability to meet provincial regulation.
- Benefits for CO, HC and DPM reduction.
- Using a higher blend (B50 or B100) may be warranted.



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## Next Steps

- Model projected effects for mine-wide implementation.
- Ambient DPM study to confirm effects.
- Investigation of NO<sub>x</sub> reduction technologies for NO<sub>2</sub> control.
  - SCR (selective catalytic reduction)
  - EGR (exhaust gas recirculation)




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## Acknowledgements

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*Questions?*



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