Fuel Economy with Significant Reduction in Unwanted Emissions

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Changing Combustion Characteristics for the Better

- Fuel Economy
- Significant Reductions in Unwanted Emissions
- Lower Noise Levels

Test Data Penn State University

- Data shows more air into cylinders as working fluid
- Results in enhanced hydrodynamic effects to reduce friction losses
- Accounts for lower noise levels

Test Data comparing coated vs. uncoated engines

- Comparing Air Flows in grams/min., under ISO 8178 Before and After D.E.T. coating

Mode	1	2	3	4
Before	803	1095	1313	1424
After	842	1136	1391	1514

Hydrodynamic Enhancements

- Typical Engine Friction Losses 2% to 4% of energy output
- Piston rings losses as both hydro-dynamic and dynamic friction losses
- Hydro-dynamic friction likened to car skidding on wet road
- Dynamic friction typical of a car traveling safely on a wet road

Additional air flows enhance hydrodynamic effects

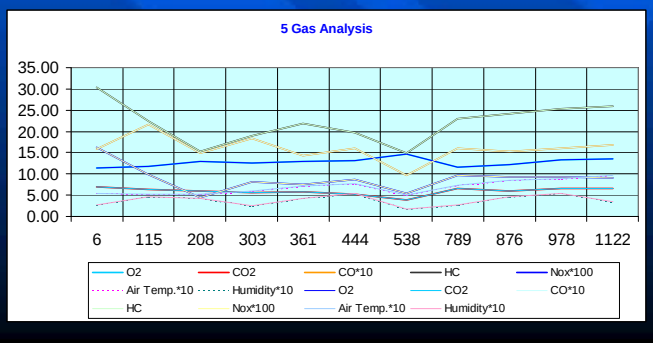
- A proposal has been made to Penn State University and US Dept Of Energy
  - » Quantify benefits as an extension of existing DOE tribology study at Penn State University
  - » Additional air flow benefits can only be realized with a turbo compressor

Significant Reductions in Unwanted Emissions

- Percentage reductions Measured at Penn State University using ultra low sulfur fuel.
  - Hydrocarbons 22.4%
  - Carbon Monoxide 22.1%
  - Particulates 28.1%
  - Nitrogen Dioxide 36.3%
  - However nitric oxide showed an increase of 39.3%

Need for catalyst sulfiding to reduce NOX Levels

- To achieve an overall decrease in both nitric oxide and nitrogen dioxide as NOX
  - Catalyst must be sulfided
- Tests on John Deere Diesel; at the D.E.T. test facilities showed a combined decrease in both CO and NOX levels at the catalyst was sulfided using 350 ppm sulfur in diesel fuel



DET Compressor 800 hour test shows

- Lower oxides of nitrogen both as NO and NO2
- Lower opacity levels as indication of unburnt particulates and smoke
- Lower carbon monoxide
- Slightly lower unburnt hydrocarbon levels

Testing the D.E.T. GreenCoat® with Nitrogen Enriched Air (NEA)

- Lister Petter Engine Driving a 25KW Generator
- Compact Membrane Systems, Inc., (CMS) offers a robust fully fluorinated fluorocarbon membrane with low pressure drop and an ability to sustain oxygen levels at 2% less than ambient at 21% total oxygen by weight.

Results of Testing with Nitrogen Enriched Air (NEA)

- Baseline uncoated head compared to operation with D.E.T. GreenCoat®

Engine Output	0%	25%	50%	75%	100%
NOX Benefit (as a reduction)	13.7%	37.3%	42.3%	43.7%	48.9%

Baseline D.E.T GreenCoat® NEA isolated compared to GreenCoat® with NEA

Engine Output	0%	25%	50%	75%	100%
NOX Benefit (as a reduction)	5.5%	35.5%	49.8%	40.5%	51.6%

Full NOX Benefits

- Total NOX Benefits from uncoated head to coated head plus NEA

Total NOX Reduction Benefits

Engine Loading	0%	25%	50%	75%	100%
BaseLine NOX ppm	115.9	263.34	400	485	605
GreenCoat® + NEAppm	71.2	158.16	176	229.4	239.5
Total NOX Benefit (as a reduction)	38.57%	39.94%	56.00%	52.70%	60.41%

Long Distance Hauling a 1999 Common Rail Cummins 330HP Engine

- Reduction in opacity as measured by the New Jersey DOT obtained from 4.1% to 2%
  - Representing over 50% reduction in particulates
  - Sustained fuel economy over 187,000 miles , 300,000 Km = 3.47% as measured from GPS data
  - Reduction in NOX emissions show sustained levels at over 50%

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