

A Workshop On Reducing Emissions from Diesel Engines

March 28, 2008
Providence, RI



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Warwick Public School Department Alternative Fuels & Emissions Technology

- EPA Clean School Bus Assistance Grant
- B20/ULSD Blend with Exhaust Catalyst & Crankcase Filters
- Two Year Program Utilizing a 70 School Bus Fleet



Warwick Public School Department

Alternative Fuels & Emissions Technology

- August 2004 - Introduced ULSD/B20 Fuel Blend
- October to December – Data Logging of Bus Exhaust Gas Temperatures and Duty Cycle
- December 2004 – Determined Warwick Bus Fleet Did Not Data Log for the Use of Diesel Particulate Filters (DPF) Technology
- December 2004 - Utilized 36,000 Gallons Blended ULSD/B20
- May 2005 – Utilized 80,000 Gallons ULSD & 7600 Gallons of B-100
- May 2005 – Bid Specification to Purchase Diesel Oxidation Catalyst (DOC) Technology and Spiracle Crankcase Filters
- September 2005 – Completed Retro-Fit of 70 School Buses with DOC's and Spiracle Crankcase Filters.
- Annual - Fuel Consumption 180,000 gallons, miles 1.5 million
- Annual Fleet Fuel Efficiency Increased by 10%, 8.25MPG to 9.25MPG

Diesel Exhaust Data Logging



Cummins Diesel, Data Logging Technology



Clean Diesel Technologies, Data Logging Technology

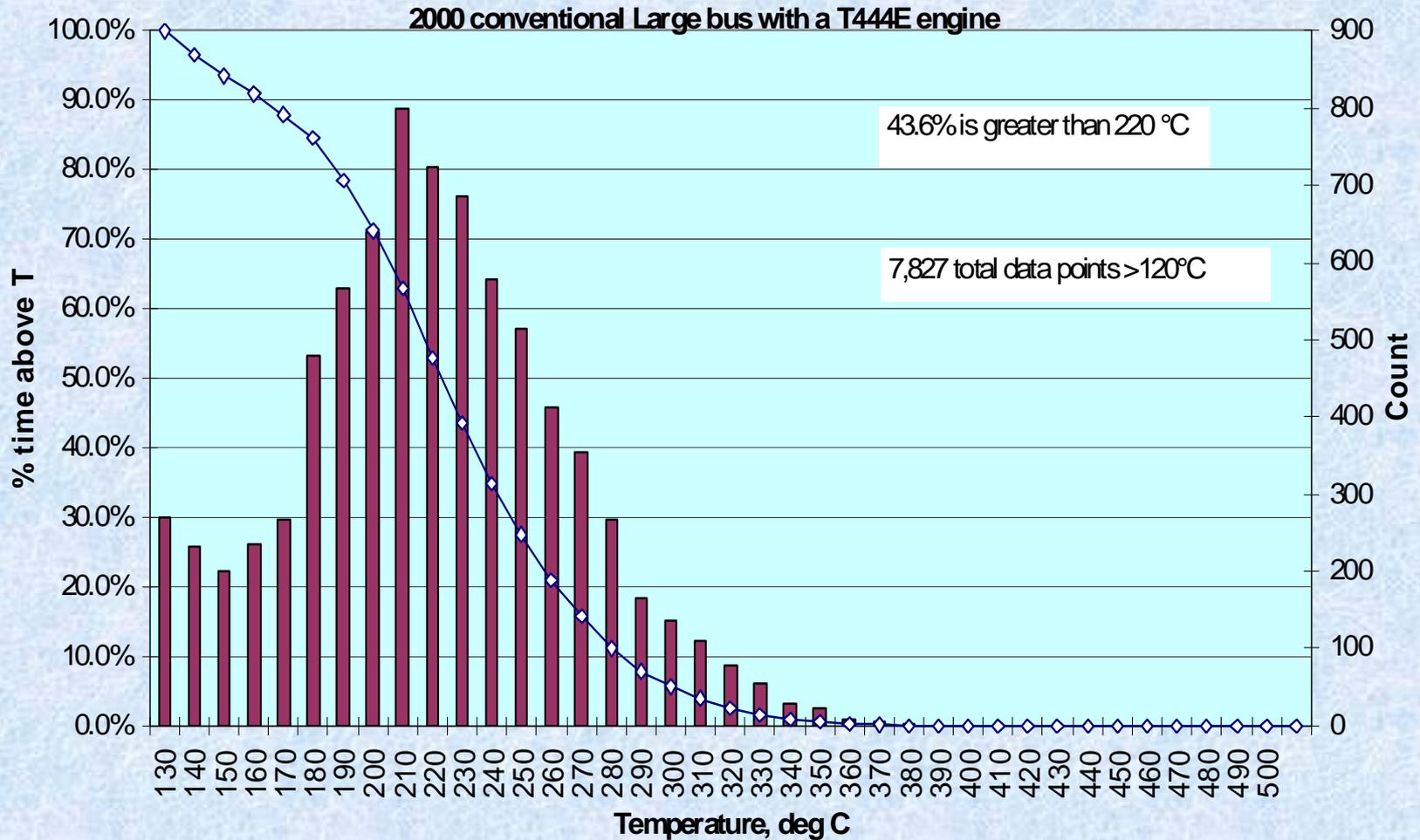
Diesel Exhaust Data Logging



Donaldson Company, Data Logging Technology

International T444E Histogram

Warwick Bus # 930987 9/23-9/30



Hudson Fleet Bio-Diesel/ULSD Blend Pilot

- 6/1/2007 Started Use Of – ULSD
- 6/29/2007 Started – B2/ULSD Blend
- 7/18/2007 Opacity Test – B-2/ULSD
- 7/30/2007 Started – B-5/ULSD Blend
- 9/15/2007 Started – B-10/ULSD Blend



Hudson Fleet Bio-Diesel/ULSD Blend Pilot

- Opacity Testing – 4 Vehicles

- Vehicles Tested –

Truck 0402 – 2004 Peterbuilt, Caterpillar, 108,030 miles

Truck 8809 – 1988 Mack, 300 Renault, 218,718 miles

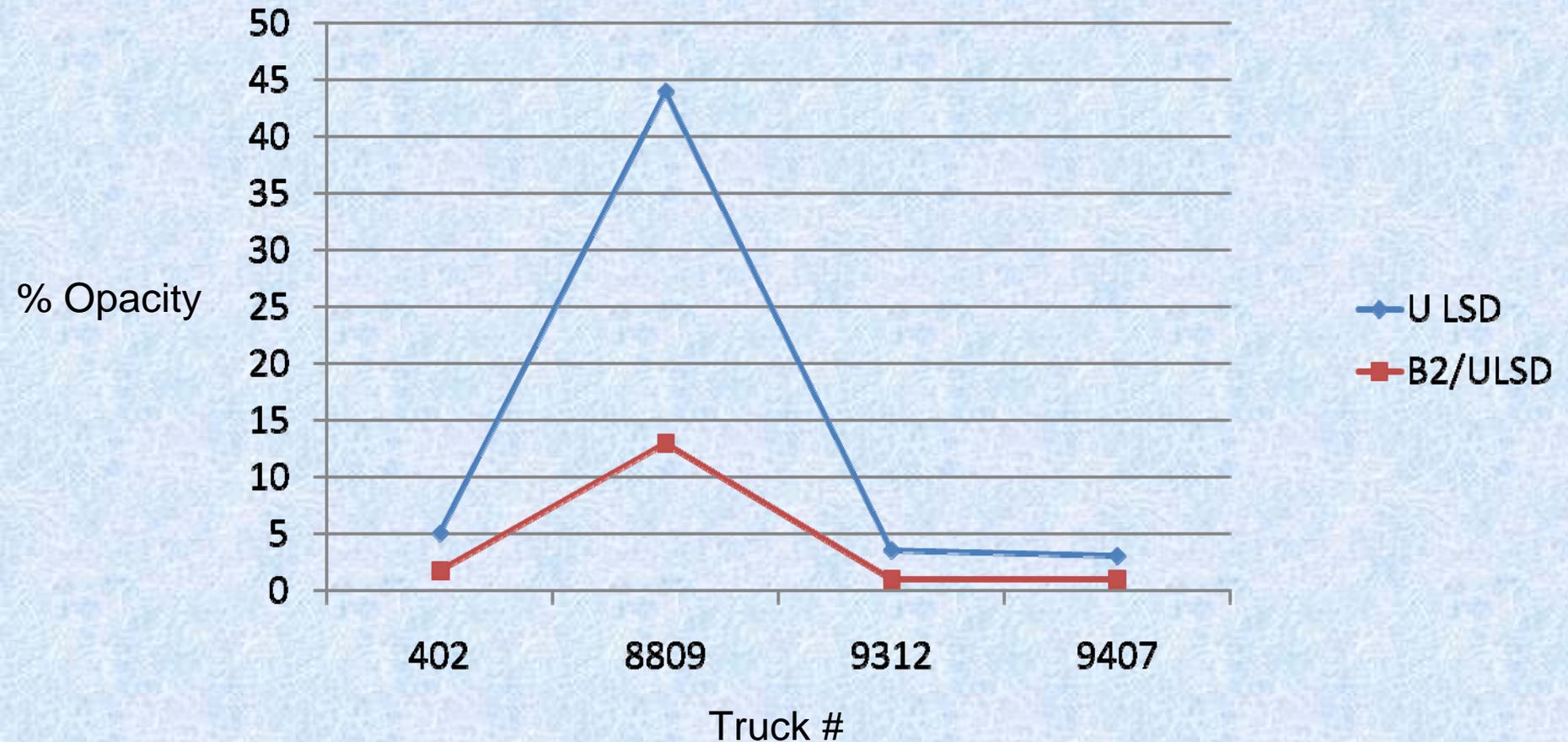
Truck 9312 – 1993 Mack, CH613 Mack, 470,893 miles

Truck 9407 – 1994 Mack, CH613 Mack, 151,277 miles



Exhaust Percent Opacity Test

ULSD vs. B-2 / ULSD Blend
30 % Reduction in Particulate Matter



Marine Bio-Diesel Pilot Project

- Old Port Marine & Save the Bay, End Users
- Rhode Island Office of Energy Resources, Grantor
- T.H. Malloy Oil & Drew Oil, Fuel Distributors
- West Central Soy, B100 Supplier
- hudson^{eco}fuel, Project Coordinator
- Total of 16 Vessels
- Blend B20/LSD, 20% Biodiesel w/ 80% Dyed Low Sulfur Diesel
- Phase I July - October 2006, Phase II July - October 2007
- Total Fuel Blend Consumed 15,000 gallons
- Engine Manufacturers, Cummings & Yanmar

Marine Pilot Vessels

- Save the Bay
- Old Port Marine



Alletta Morris



14 Launch Vessels



Amazing Grace



Bio-Fuel End Users

- The US Navy
- Port Edgewood Marina
- Save the Bay
- Old Port Marine
- REC Fuels (White Fuel Oil)
- T H Malloy Oil
- USDA Agricultural Research Center
- National Grid
- Warwick Public Schools
- The Hudson companies



EPA Fuel Mandate - ULSD

Date	Highway	Off Road	Marine	Rail	Heat
1993	500ppm	NA	NA	NA	NA
2006	15ppm	NA	NA	NA	NA
2007	15ppm	500ppm	NA	NA	NA
2010	15ppm	15ppm	NA	NA	NA
2012	15ppm	15ppm	15ppm	NA	NA
2014	15ppm	15ppm	15ppm	15ppm	NA

Biodiesel Emissions

Regulated

	B100	B20
Total Unburned Hydro Carbons	-93%	-30%
Carbon Monoxide	-50%	-20%
Particulate Matter	-30%	-22%
Nox (+ in vehicles, – reduction in burners!)	+13% (- 10%)	+ 2% - 2%)

Non Regulated

Sulfates	-100%	-20%
PAH (Polycyclic Aromatic Hydrocarbons)	-80%	-13%
nPAH (nitrated PAH)	-90%	-50%
Ozone Potential of speciated HC	-50%	-10%
Mutagenicity	-80%-90%	-20%

- **Biodiesel is the first and only fuel to have a complete evaluation of emissions results and potential health effects submitted to the US EPA under the Clean Air Act 211b).**
- **Both Tier I and Tier II have been completed.**

Bio-Fuel Benefits

Review

- Domestically Produced
- Reduces our dependency on foreign supply
- Renewable Biodegradable Energy Resource
- Added lubricity increases longevity of all moving parts
- Solvency properties aids System cleaning & reduced maintenance
- Reduced Petroleum Odor in stack emissions and fuel storage
- Reduced Emissions of greenhouse gases and Particulate Matter
- Works for on / off road applications and open combustion applications
- Requires no new refueling infrastructure
- Requires little or no equipment retrofit
- Easy to transition into or out of
- Cost Competitive.

The environment is critical... ...and the focus is shifting to health!



- Yale University Study
Children who ride diesel buses are exposed to far more particulates, PM
- CARB
Particulates “probable carcinogen”
- American Heart
Particulates can disrupt normal heart function
- American Lung
Diesel exhaust can exacerbate existing Asthma
- ARC & EPA — particulates, PM
No. 1, Asthma Trigger

They outlawed smoking in restaurants for the very same reasons!