Penn Dot Fuel Maintenance Program

Surviving Winter and Changing Diesel Fuel Formulations

Penn Dot BY The Numbers

- 11 Districts Comprised of 67 Counties
- 96,000 Snow Lane Miles Maintained
- 5,400 Licensed Plow Operators
- 22,000 Numbered Pieces of Equipment
- 11,000 Major Motorized Pieces
- 2,255 Heavy Plow Trucks
- Fleet Value $900 Million
- Annual Equipment Budget $40 Million +$10 Million County Funds
- 725,000 Tons of Anti-Skid 5 Year Average
- 957,000 Tons of Salt 5 Year Average

Pennsylvania Winters?

Winter Entering Southern PA

Why Do We Stress Fuel Maintenance Year Round?

Major Fuel Related Events

- ***Act 78 Signed July 2008***–Statewide Bio-Diesel usage based on production thresholds
- ***D-8 Pilot***– 8 County pilot and study of B-5 usage from July of 2008 to June of 2009
- ***November 15, 2009***–Statewide implementation of B-5 in PENNDOT Fleet
- ***October 27, 2009***– Released Department policy related to fuel maintenance
- ***Act 78***– First threshold of production reached PA mandate of 2% in place May 1, 2010

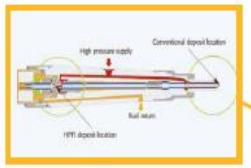
SPRING

Spring Helpful Hints: Drain all free water from storage tanks • Test tanks for entrained water and microbial contamination • Treat based on test results with Dri-Tek and Product 6000 biocide • Top off vehicle tanks nightly

SUMMER

Summer Helpful Hints: Continue to use Performance Plus HPFI Year Round • Use dispenser filters designed to absorb water • Submit a bottom sample to check for water, sediment and microbial contamination • Treat per test results recommendations

Corrosion Protection



Injector

Technical Support

Clean/Darkened Fuel

Storage Stabilizer

REDUCED MAINTENANCE COSTS & IMPROVED FUEL ECONOMY

Prevents formation of black soot and sludge
Provides thermal and oxidative stability
Improves and maintains optimal fuel economy

Effective in blends up to B20
Reduces harmful emissions
Improves & maintains horsepower

pennsylvania
DEPARTMENT OF TRANSPORTATION

Denver fleet trial

15,000 miles no additive

30,000 miles with Performance Plus HPFI

Extend Filter Life

Fuel Injector Valve Plungers

Baseline no additive

Fuel treated with ECDCLEAN® HPFI Antifoulant

Prevent Injector Fouling

lter Icing • Check Your Fuel's Operability on
Operature Operability • Deicer & Water Dispersant • W
FORMANCE PLUS HPFI ALL YEAR ROUND FOR MAXIMUM PROTECTION A

Water Control

WINTER

Winter Helpful Hints: Use EC-1 and Performance Plus HPFI for optimal protection and performance • Use larger micron size filters for winter operations per OEM • Check truck water separators often • RED ALERT STRATEGY

FALL

Fall Helpful Hints: Drain all free water from storage tanks • Test tanks for entrained water and microbial contamination • Treat based on test results with Dri-Tek and Product 6000 biocide • Top off vehicle tanks nightly

For technical information or support call 800-692-6016 or email your request to info@ppcterminals.com

Diesel Fuel Issues

- The main ULSD quality issues of concern are:
  - **Engine deposits/Engine optimal performance /Emissions**
  - **Winter Operability (Cold Flow Issues)**
  - **Thermal Oxidation of ULSD – Stability**
  - **Water Control**
  - **Microbial Contamination**
  - **Corrosion**
- Using the proper fuel additives is a necessity in ultra low sulfur diesel to optimize it for use in today's technologically advanced diesel engines.

Biodiesel

- Compared to regular diesel fuel, biodiesel;
  - Is more susceptible to degradation.
  - It can generate sediment in cold weather.
- House-keeping issues
  - It is hydroscopic in nature relative to diesel fuel.
    - There are more water issues when biodiesel present
  - It acts as a good solvent/cleaning agent
    - Can mobilize deposits and sediments from tank bottoms
    - Filter plugging issues common when Biodiesel is first introduced. Check your filters

Maintenance Activities

- Core Tank Maintenance Activities
  - Check storage tanks for contaminants
    - Drain water bottoms where possible
    - Use Water Dispersants to remove water (Per test results)
    - Check for Microbial contamination
    - Use a biocide product to treat for microbial contamination. (Per test results)
  - Check filters / screens for build up of deposits
    - Replace filters/screens where appropriate

Winter Nozzle Testing

- Winter Nozzle (October – March)
  - Cloud Point (ASTM D2500, D5772)
  - CFPP (ASTM D6371)
  - Pour Point (ASTM 97, D5950)
  - Water by Karl Fisher (ASTM D6304)

innospec fuel specialties

Customer Service Fuel Analysis Report

NOT AN INVOICE

Quality Assurance Program
Delaware Laboratory
200 Executive Drive, Newark, DE
TEL: (302) 454-8100
FAX: (302) 451-1380

Innospec Contact Representative:
Jodi Hilliard

Innospec Sample #:	P0702-1307
Customer Name:	
City, State:	
Contact Name:	
Contact Email:	
Contact Phone:	
Contact Fax:	
Company Location:	
Location-City, State:	
Location-Contact Name:	
Sample Drawn Date:	2/7/2007
Sample Received @ Lab Date:	2/12/2007
Testing Completion Date:	2/13/2007
Fuel Type:	#2 LSD 90/10 blend w/8500 HE LF @ 1:750
Sample Identification:	in ground

Test Protocol	Treatment	Results	Results, °C	Results, °F	Targets	Cost/Test
Cloud Point, °F, °C (ASTM D2500, D5772)	As Received		-13	8.6	None	$25.00
CFPP, °F, °C (ASTM D6371)	As Received		-28	-18.4	-15°F	$43.75
Pour Point, °F, °C (ASTM D97, D5950)	As Received		-36	-32.8	None	$25.00
Water by Karl Fisher, ppmv (ASTM D6304)	As Received	7			≤ 75 ppmv	$43.75
					Cost Savings for Customer:	**$137.50**

Recommendations/Alerts:

Spring Bottom Testing

- Bottom Testing (April through September)
  - BS & W % (ASTM D2709) or
  - Water by Karl Fischer ASTM D6304
  - Test kits used for microbial detection (no ASTM test method
    - Aerobic Bacteria
    - Anaerobic Bacteria
    - Yeast
    - Fungi

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200 Executive Drive, Newark, DE
TEL: (302) 454-8100
FAX: (302) 451-1380

Innospec Contact Representative:
Jodi Hilliard

Innospec Sample #:	P0708-4354
Customer Name:	
City, State:	
Contact Name:	
Contact Email:	
Contact Phone:	
Contact Fax:	
Company Location:	
Location-City, State:	
Location-Contact Name:	
Sample Drawn Date:	8/15/2007
Sample Received @ Lab Date:	8/17/2007
Testing Completion Date:	8/20/2007
Fuel Type Received:	#2 LSD Untreated
Sample Identification:	

Test Protocol	Treatment	Results	Targets	Cost/Test
Bottom Sediment & Water, % vol (ASTM D2709)	As Received	0.35%	≤ 0.05% volume	$37.50
Aerobic Bacteria	As Received	Negative	Negative	$37.50
Anaerobic Bacteria	As Received	Negative	Negative	
Yeast	As Received	Negative	Negative	
Fungi	As Received	Negative	Negative	
			Cost Savings for Customer:	**$75.00**

Recommendations/Alerts:

Pre Winter Helpful Hints

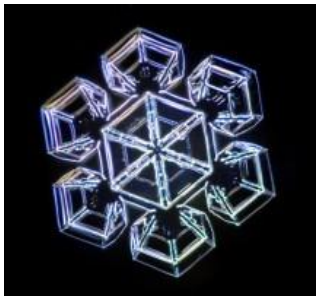
- Check water separators daily
- Use (Larger micron) fuel filters
- Check vehicle tank water levels often
- Make sure you have tested for water and microbiological contamination
- Stock-up on Treatments required to survive winter conditions
- Use Red Alert Strategy as necessary

Don’t forget your saddle tanks !

- Check saddle tanks for water with each PM and after large temperature swings
  - Remove the Water
  - Examine for indications of microbial mass and treat as necessary.
- Use of DRI TEK for added protection at a rate of 0ne quart per 250 gallons.

Fuel System Contaminants – Water

- Why is water such an issue? It can…..
  Freeze at 32 Degrees! And…..
  - Promote microbial growth
  - Induce corrosion
  - Interact with certain fuel additives
  - Degrade biodiesel
  - Form emulsions
  - Rapidly plug filters in cold weather



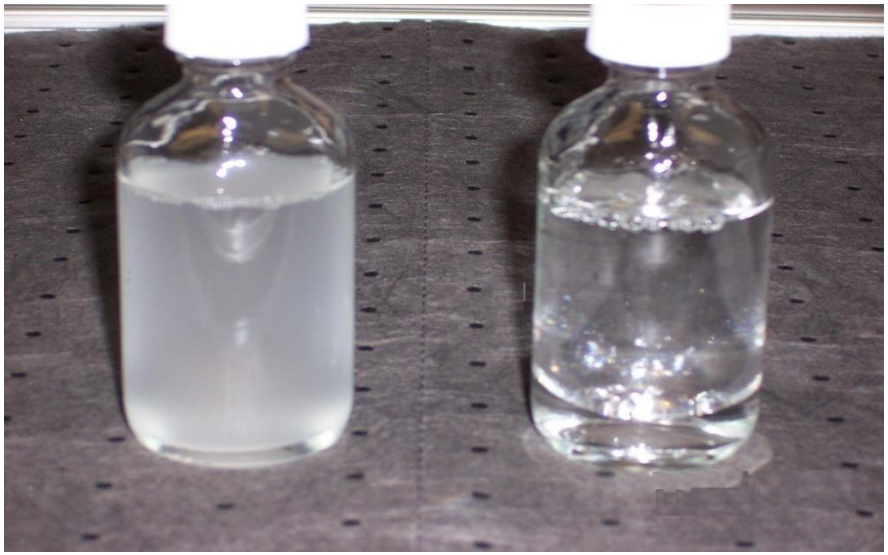
Majority of winter operability problems can be traced to water contamination. Get it pumped out of your systems and keep it out!

Water Removal & Management (Critical in Spring & Fall)

- First – Pump all free water from tank.
- Second – Pull a bottom sample from the tank & request a Karl Fisher water test along with a test for microbial contamination.
- Third – Treat based on lab report recommendation for both water and microbial contamination.

Water Dispersents

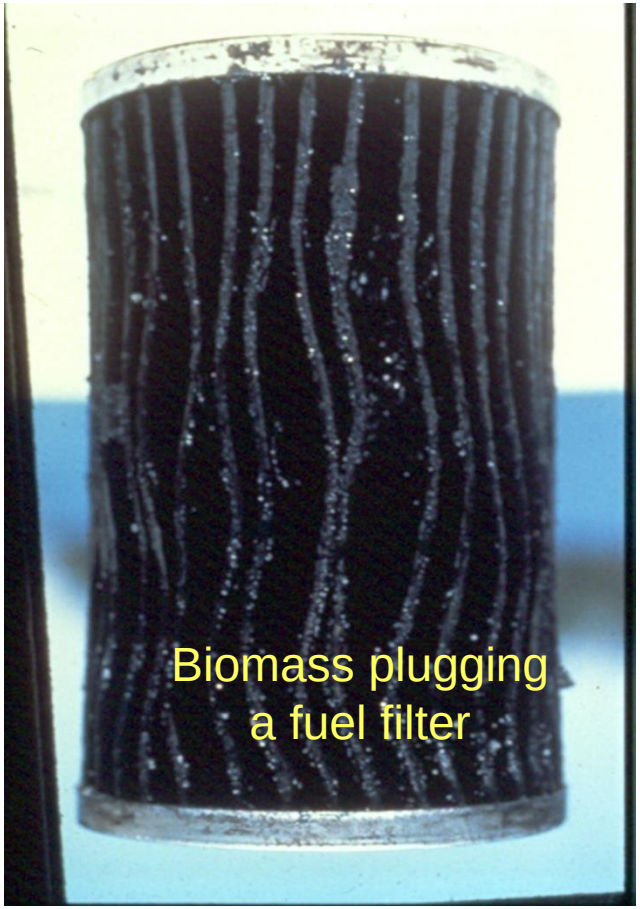
- Dual phase water control
  - Safely removes water via dispersancy action
  - Partitions into any water phase to depress freezing point



Test again

- To confirm that water is within acceptable levels, submit another sample to the lab to confirm treatment was effective.

Impact of Microbial Growth



Treatment for Microbial Contamination

- First – If microbial contamination is present treat with Product 6000 at a rate of 1 gallon per 2,000 gallons of fuel. The tank should be full and inactive for 24-48 hours after treatment to allow maximum kill.
- Second – After treating with Product 6000 make sure fuel is treated with Performance Plus HPFI to mobilize the dead microbial mass. Polish the fuel by filtering if possible. Monitor filters carefully until dead microbes clear the system.

Test again

- To confirm there is no microbial contamination left after treating please submit another sample to the lab to confirm treatment was effective.

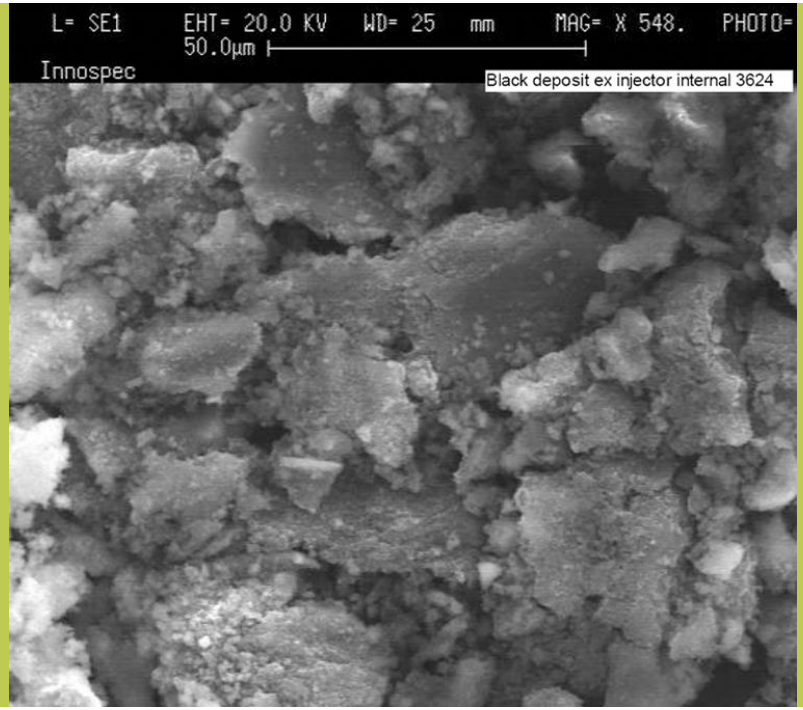
Premature Fuel Filter Plugging

Expected appearance

Appearance of fouled filter

Fuel filter blocking – illustration

- Particles appear to be agglomerates of smaller, hydrogen rich carbonaceous particles

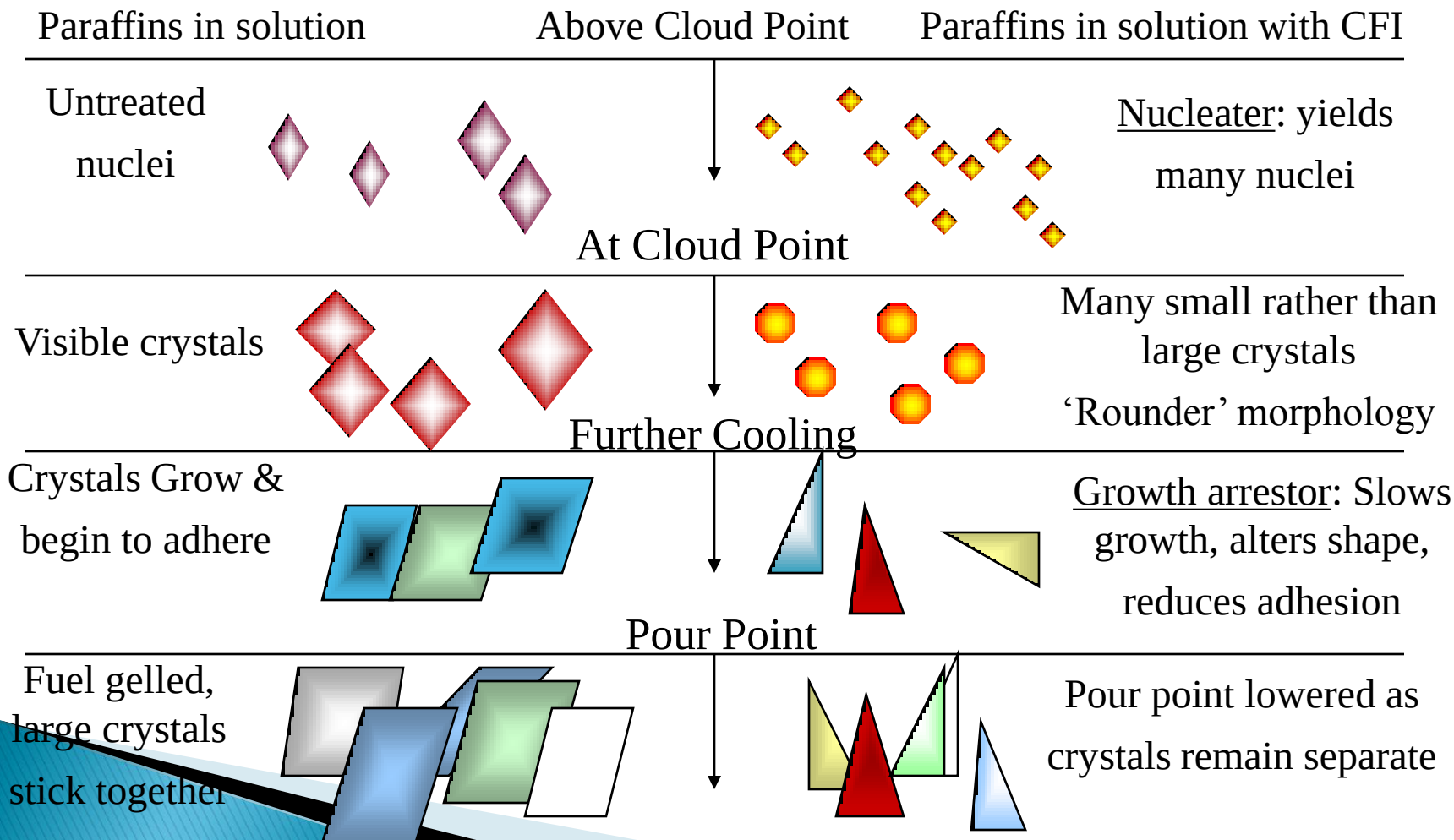


source – IOSP Dr. Ian Macmillan SAE 2008

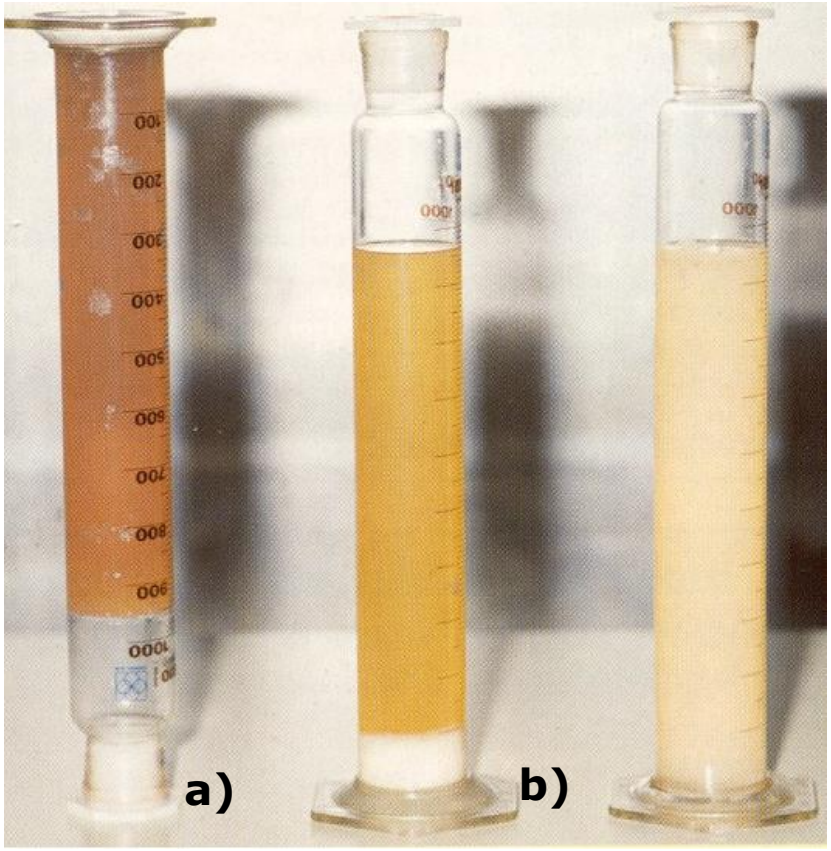
Common Rail Injection Systems

- Treatments have been developed to cope with black fuel, sooted filters and increased levels of injector failures in Post 2007 diesel engines. Engines with a High Pressure Common Rail injection system are particularly susceptible to these problems. The primary root cause is that these newer engines operate at very high temperatures and high pressures which thermally oxidizes the fuel at a very advanced rate.

How Wax Crystals Form



WASA – Effect



a) **Fuel without CFI and WASA**

⇒ **Solid, not pumpable**

b) **Fuel containing CFI only**

⇒ **Paraffin sedimentation**

c) **Fuel containing CFI and WASA**

⇒ **No paraffin sedimentation observed**

CFPP does not account for this

Red Alert Strategy

- Designed for Emergency use in extreme and prolonged low temperature conditions
- Anti-gel and de-icer combination dissolves gelled fuel which has already collected on fuel filter
- Follow appropriate procedures for use of Red ALERT
  - See PDS
  - See MSDS for safety and handling
  - Recommended treat rates and dosing procedures must be followed for effective use

Red Alert Strategy

- ## Proactive Treatment
- If extended period of cold temperatures is expected (below 0 °F), especially over an extended shut-down period, eg weekend or holiday period

  1. Add RED ALERT directly to the fuel tank at a treatment level of one 32 OZ. bottle to 50 gallons of diesel fuel
     - Overall RED ALERT treatment ratio should not exceed one 32oz. Bottle of RED ALERT per 50 gals. of diesel fuel.
  2. Idle or run engine for 10 to 15 minutes to ensure all fuel and the filter are treated

Red Alert Strategy

- ## Reactive Treatment
- If fuel appears to be gelled on morning of operation before equipment is started
  1. Spin fuel filter and saturate said filter with contents of one 32 oz. bottle of RED ALERT.
  2. Pour remaining contents of the bottle and one additional bottle into the fuel tank.
     - Overall RED ALERT treatment ratio should not exceed one 32oz. Bottle of RED ALERT per 50 gals. of diesel fuel.
  3. Wait 30 to 60 minutes before attempting to start the engine

PENNDOT Fuel Specifications

- ULSD Diesel Fuel with Biodiesel
- ULSD Diesel Fuel with Biodiesel and winter additive
- 80/20 blend of ULSD/Bio and ULSK
- 80/20 blend of ULSD/Bio and ULSK winter additive
- Biodiesel blends structured on contract up to 20% to allow for future legislative mandates

Contract Terms and Conditions

- "When additive is required, it shall be blended with the diesel fuel or heating oil prior to arrival"
- "For any ULSD fuel and Bio blend, the bio-fuel shall be injection blended with the diesel fuel"
- PCID 1056 "The blend of fuels shall be accomplished by the injection blending method"
- PCID 1056 still specifies Bio made from plant based feed stocks

Additional Contracts Needed to Support Fuel Maintenance

- **Tank Cleaning Contract–** Provides each County with easy access to tank cleaning that includes total evacuation of the tank and fuel filtration
- **Fuel Management Contract**–Offers each County Location additives in bulk or bottle
- Cold Flow Improvers
- Water Dispersants
- Microbial Treatments

Any Questions?????

Please contact Mike Connor, HEM III Section Manager for Fleet Operations at the Fleet Management Division phone 717-787-2790, E-Mail- miconnor@pa.gov

The End