



# An Inside Look at The Technical Advances of Bioheat™ Plus



Answers you are looking for

# **Biodiesel and residential storage and heating equipment**

**Mario Bouchard, VP, Granby Industries**

# Responsibilities of the manufacturers of oilheating equipment and storage.

- Manufacturers are held to Agencies Equipment Certifications to be allowed to have their equipment installed and used in buildings for heating of the air and water and the oil storage.
- Equipment certification bodies haven't kept up to speed with the changes in the combustible liquids coming into the marketplace.
- This poses some challenges to the equipment manufacturers that want to follow the industry pressures towards the use of renewable combustible liquids such as biodiesel and renewable diesel.



## Requirements about residential storage and heating equipment with biodiesel?

- Certification or approvals of equipment for their intended use.
  - All heating appliance and storage equipment should hold a certification to be installed in buildings as per NFPA-31 installation code, here are some but not limited to;
    - UL726 for Oil-Fired Boilers
    - UL732 for oil-fired Storage Tanks Water Heaters
    - UL727 Oil-Fired Central Furnaces
    - UL296 Oil burners
    - UL80 Steel Tanks for oil burning equipment
    - UL142 Steel Above ground Tanks for flammable and combustible liquids
    - UL2258 Non-metallic Tanks for Oil Burner Fuels and Other Combustible Liquids
- All these certification standards must have in their scope the allowed use of biodiesel, in some level of blend.

# Heating Equipment

# Biodiesel and heating equipment I

- Heating equipment (furnaces and boilers)
  - Heat exchangers
    - Heat exchangers are steel or cast-iron assemblies
      - Built for the sole propose of extracting heat produced combustion products from burners
      - Exchange that heat to the air or water
  - In equal operating environments either be with fossil fuels or biodiesel, heat exchangers will not be subjected to any damages with either fuels considering that;
    - Same BTU/h input, same burner flame pattern, same draft requirements, adequate burner adjustments to allow proper combustion operation
      - Smoke trace, O<sub>2</sub>, CO, Excess Air, flue gas temperatures will be very similar

# Biodiesel and heating equipment II

- Heat exchangers are not subjected to any added stress with either of these combustible liquids
- Heat exchangers will provide very similar AFUE performance with either combustible liquids
- The expected life expectancy of a heat exchanger operated with either combustible liquids will remain unchanged.
- As with any combustible liquid heating appliance, annual maintenance is key in maintaining proper and reliable operation and maintaining product warranty.



New Generation Chamberless Heat Exchangers



Multiple Passes Cast Iron Heat Exchangers



Legacy Chambered Heat Exchangers

# Biodiesel and heating equipment II

# Does Biodiesel affect heating equipment

- Does converting a heating system currently using fossil fuel to biodiesel affect the heating equipment?
  - The short answer is No!
    - According to heating equipment manufacturers
      - Heat exchanges are not affected by switching between fossil fuel and biodiesel considering that;
      - Same BTU/hr. input, same burner flame pattern, same draft requirements, adequate burner adjustments to allow proper combustion operation
        - Smoke trace, O<sub>2</sub>, CO, Excess Air, flue gas temperatures will be very similar
    - Burner manufacturers are evaluating the specifics of switching between fossil fuel and biodiesel.
      - Components compatibility with both combustible liquids
      - Combustion adjustments



# Storage Tanks

- There are a few varieties of available combustible liquid storage tanks available on the market
  - Metallic (Steel)
  - Nonmetallic (High Density Polyethylene – HDPE or Fiberglass)
- The most common tanks found in the marketplace today are metallic tanks, made of carbon steel
  - The industry has been repeatedly informed, trained and understands well that fossil heating oil combined with water at the bottom of the tank will produce microbial corrosion which will lead to internal premature tank perforation.
    - NO WATER = NO CORROSION
  - THIS CONCEPT IS NO DIFFERENT WITH BIODIESEL
- A steel tank is at no greater risk of failing prematurely with the storage of Biodiesel compared to fossil fuel
- The key remains in good installation practices and annual maintenance of storage tanks
  - Verify for water presence annually and if water is found present, it should be removed
  - This is valid for all storage tanks, used with fossil or Biodiesel combustion liquid.



Steel Single Wall Tanks  
UL up to B20



Steel Double Bottom Tanks  
UL up to B20



2-in-1 HDPE Tanks  
UL up to B100

# Does biodiesel affect storage equipment

- Does converting an oil tank currently using fossil fuel to Biodiesel affect the storage tank?
  - It is a known fact that Biodiesel contains water in its molecule **as does** 100% LSD or ULSD fossil fuel contains water.
  - A tank in good overall condition, installed as per UL, NFPA codes and manufacturers instructions, annually serviced (as per UL, NFPA and manufacturers instructions) should not be more prone to internal corrosion by the simple addition of Biodiesel in the tank!!!
  - The key to a long-lasting steel oil tank **REMAINS** in preventing the constant presence of water at the bottom of the tank.

**NO WATER = NO CORROSION**



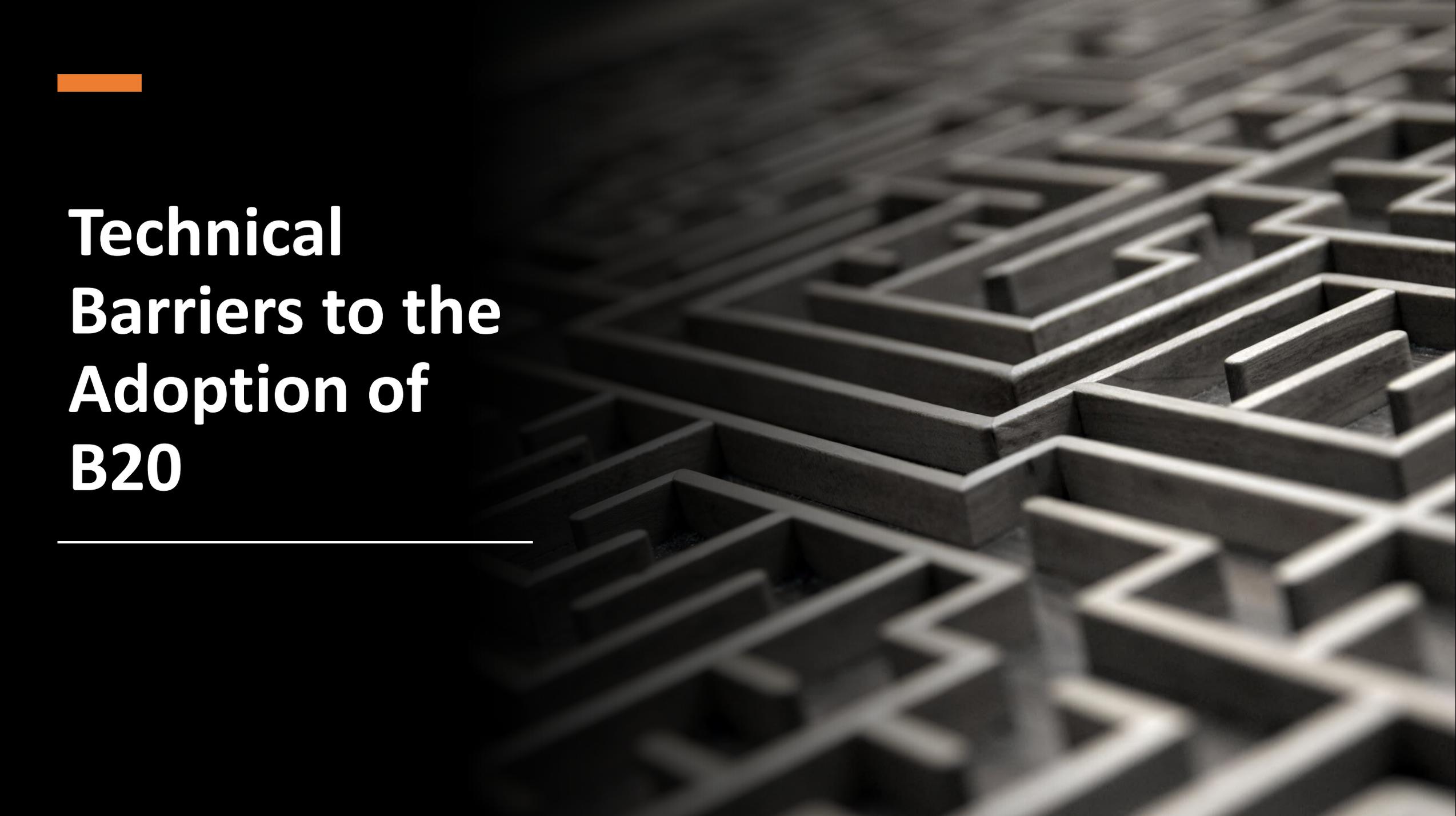
Fiberglass Tanks  
UL up to B100

# Does biodiesel affect storage equipment

- **Outdoor tanks**

- Outdoor tanks are exponentially more exposed to condensation formation inside the tank
- Outdoor tanks WILL accumulate more water from condensation at the bottom of the tank than indoor tanks
- Bottom feed outdoor steel tanks installed properly as per manufacturer's instructions UL and NFPA codes
  - With a slope towards the outlet and with a sloped oil line from the point of exit of the tank to the inside of the building
  - Should not accumulate any water at the bottom, should not fail prematurely, this is true if the tank is filled with Biodiesel AND Fossil Combustible liquids.





**Technical  
Barriers to the  
Adoption of  
B20**

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# There Aren't Any

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- A BNL compilation of studies done over the course of 25 years.
  - Industry Survey on the Use of Biodiesel Blends April 2014
  - Key Result: The results from the in-use fuel survey, which include over 13,000 buildings using at least B20, show that B20 and lower blends operate in the field in a similar manner as that of conventional heating oil. Thus based on this survey B6-B20 blends will operate as expected in the field.
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## *B20 to B100 Blends as Heating Fuels*

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submitted to the:  
**New York State Energy Research Development Authority  
National Biodiesel Board  
and  
National Oilheat Research Alliance**

# Pump Testing



**Legacy Pumps**



**Newer Model Pumps**

# Pump Seals & Elastomers

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- \*This recent testing shows common nitrile elastomers in typical heating oil burner pumps in the U.S. perform the same or better using B20 than those using conventional No. 2 heating oil.

\*NORA Technical Note March 2020

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# B20 Combustion Performance Conclusion

- \*The results in this section show that typical burners set up on No. 2 petroleum fuel oil can operate acceptably over the entire range of biodiesel blend levels without making changes in air/fuel ratio. However, as the blend level is increased, the operating excess air level will increase since biodiesel already contains some oxygen. The relatively small changes in B20 did not affect flame detector performance
- \*Section 5 BNL B20-B100 Blends as Heating Fuels

# How Much Difference?

## DC710

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Ref ID:	B0
Serial Number:	28037111586
Last Calibration Date:	2/12/2020
Calibration Due Date:	2/11/2021
Date/Time Taken:	6/9/2020 10:11:23 AM

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- Flue Gas Analysis Report -

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Fuel Type:	Light Oil
Carbon Monoxide (CO):	0 PPM
Carbon Dioxide (CO2):	11.7 %
CO Air Free:	Incalculable
Oxygen (O2):	5.2 %
Excess Air:	33 %
Temperature 1/Probe:	497.0 °F
Internal Temperature:	68.9 °F
Temperature Difference:	428.1 °F
Efficiency (Gross):	82.65 %

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## #2 Oil

## DC710

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Ref ID:	B20
Serial Number:	28037111586
Last Calibration Date:	2/12/2020
Calibration Due Date:	2/11/2021
Date/Time Taken:	6/9/2020 10:20:39 AM

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- Flue Gas Analysis Report -

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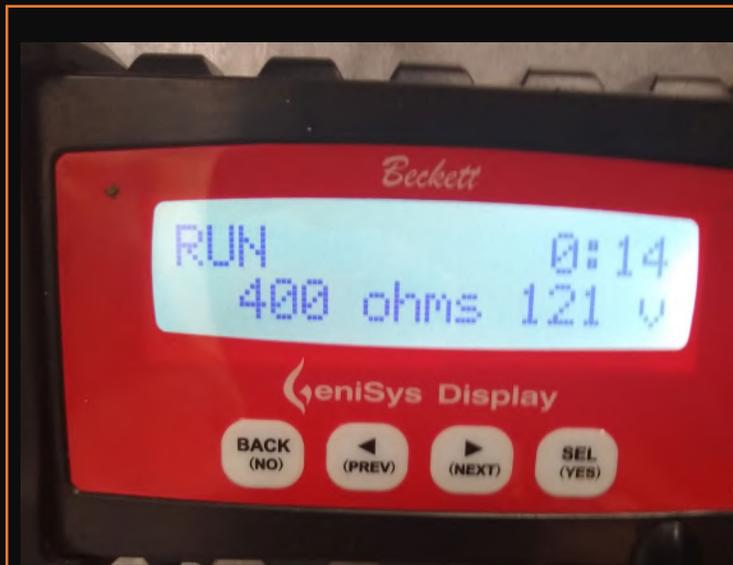
Fuel Type:	Light Oil
Carbon Monoxide (CO):	0 PPM
Carbon Dioxide (CO2):	11.5 %
CO Air Free:	Incalculable
Oxygen (O2):	5.4 %
Excess Air:	35 %
Temperature 1/Probe:	506.7 °F
Internal Temperature:	71.3 °F
Temperature Difference:	435.4 °F
Efficiency (Gross):	82.33 %

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## B20

# Flame Detector Performance

Cad Cell Resistance



#2 Oil



B20



# Final Observations

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- \*Overall, the results of this work have not identified a clear technical barrier which would limit the use of biodiesel in home heating systems. It should be emphasized that these results are only applicable to biodiesel which has been properly processed from its parent oil/fat into biodiesel and that meets the stringent ASTM D6751 specification for B100 prior to blending.
- \*BNL B20-B100 As a Heating Fuel



# Moving Forward

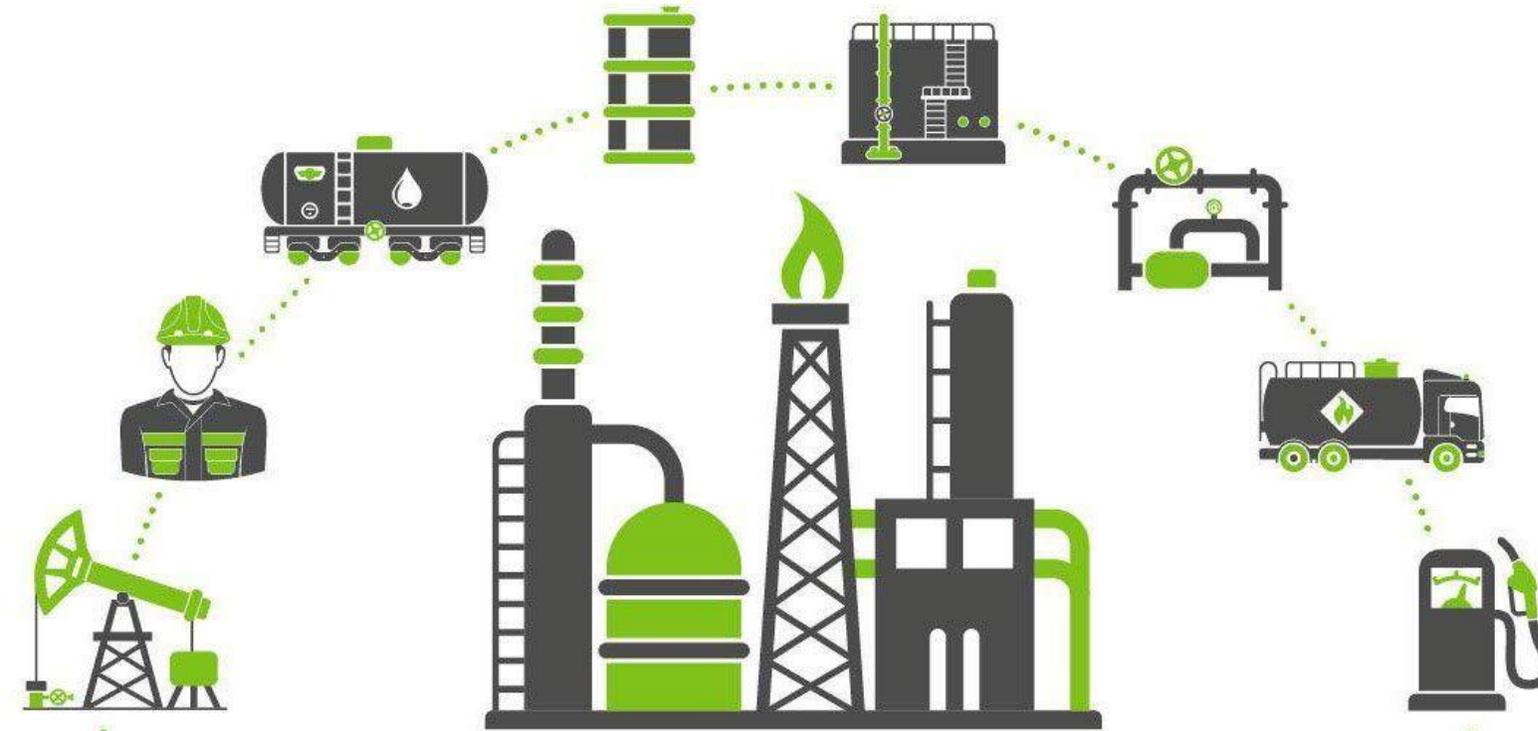
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- Extensive testing is ongoing by both manufacturers and NORA to be able to remove technical barriers to the adoption of higher blends and to meet the carbon reduction targets set forth by statute and the industry itself in the Providence Resolution





# OIL INDUSTRY



EXTRACTION



DELIVERY



PIPELINE



GAS STATION



**MANAGING FUEL  
QUALITY  
THROUGHOUT THE  
SUPPLY CHAIN**

- A Low Carbon Liquid Fuel Enabling Higher Efficiency Heater Technology
- Reduces Particulate and Greenhouse Gases
- Quicker Clean Outs / Heat Exchanger – Dealers
- Reduces Puff-Back Claims
- Better for Public Health
- Increased lubricity extending equipment life

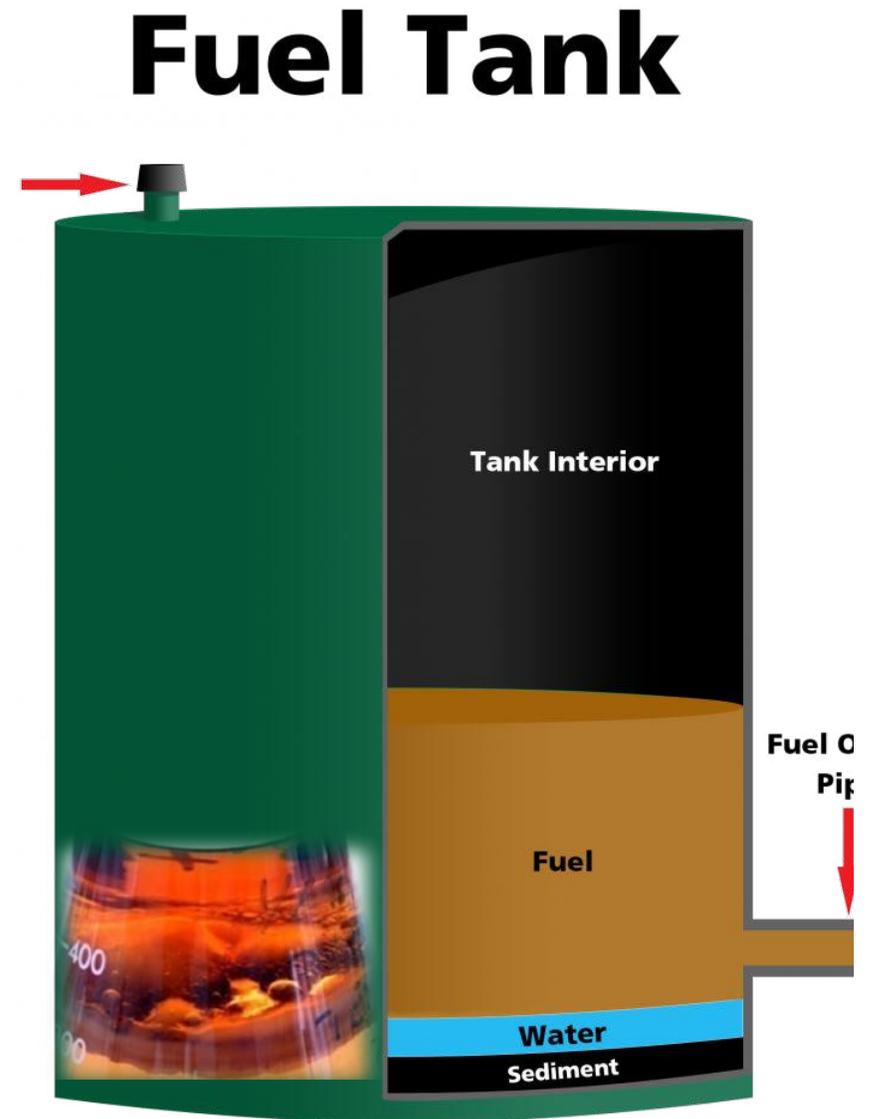


*Maximum Safety & Warmth  
Clean and Efficient*

**ULSHO AND BIODIESEL BLENDS CREATE A  
CLEANER, SAFER, BETTER FUEL**

## MANAGING THE FUEL WHICH YOU BUY AND SELL

- ✓ **Cold Flow** – Understand your cloud and pour points and treat for the lowest anticipated temperature - PPDs help.
- ✓ **Water** – Freezes at 32F. Water Accelerates fuel aging and greatly increases the likelihood of microbial contamination
- ✓ **Corrosion** – Pitting and pin hole leaks increase operational costs and environmental concerns
- ✓ **Stability** – Manage your ULSHO and biodiesel for long term seasonal storage
- ✓ **Oxidation** – Yellow metals copper , bronze , brass cause oxidation on fuel
- ✓ **Sludge** – Impacts fuel quality and instigates service calls from sediment and sludge clogging filters, strainers, and nozzles



# WHAT CAUSES DEGRADATION OF ULSHO AND BIODIESEL BLENDS ?

- ✓ Water
- ✓ Oxygen
- ✓ Microbial
- ✓ Temperature
- ✓ Peroxide Formation
- ✓ Acidic Degradation

✓ Yes

✓ Yes

✓ Yes

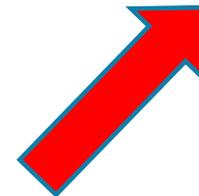
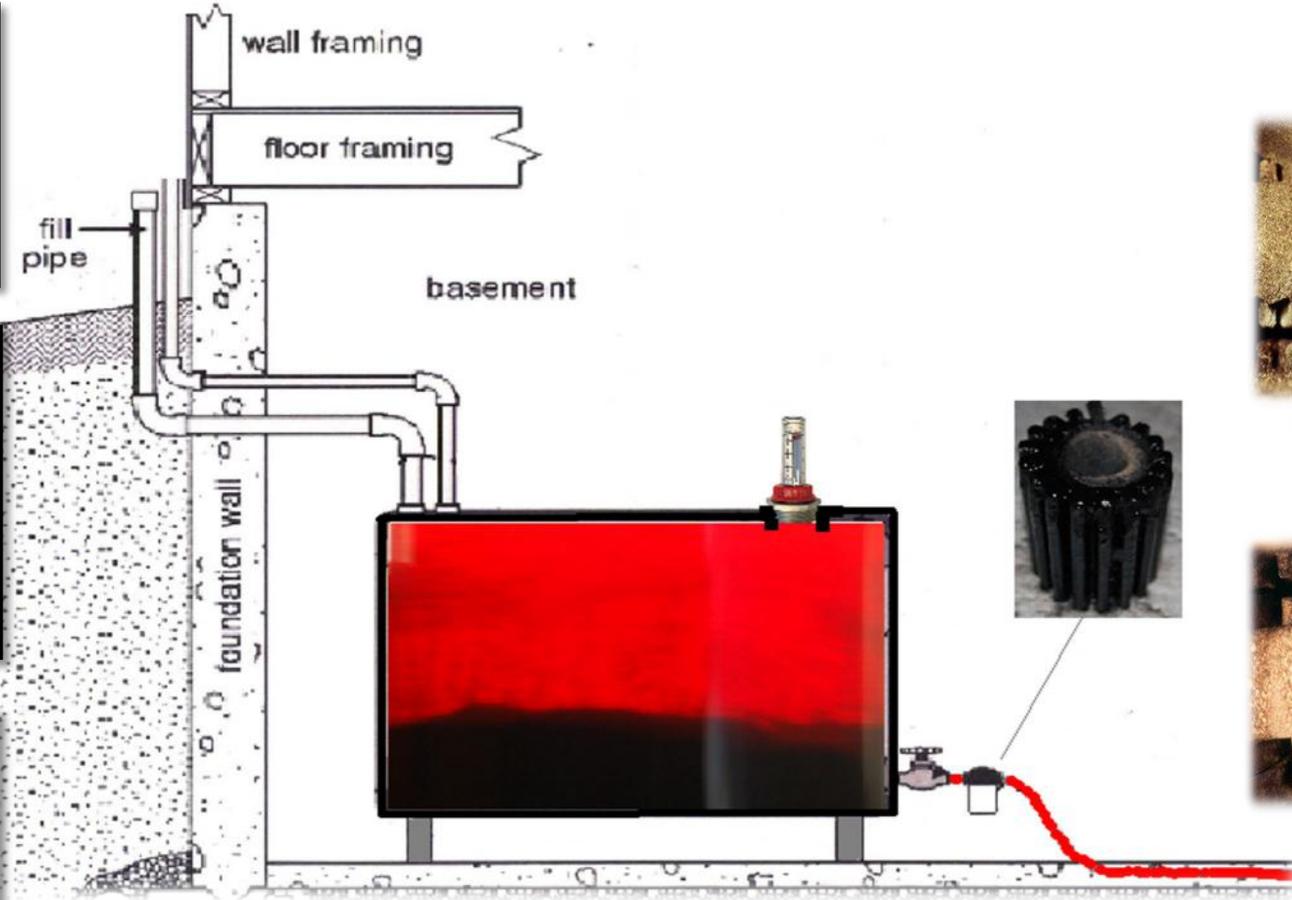
✓ Yes

✓ Yes

✓ Yes



# THE IMPACT ZONE



*Today there is a little less sludge generated but a greater tendency to form peroxides and acids. 75% of all contaminants are organic\* varnish & sludge also referred to as fuel degradation products. The wet side of the system was not a benefactor of the transition to ULSHO; however the heat exchanger was.*



## YOUR FUEL – YOUR RESPONSIBILITY

- ✓ **Tanks** – Plan for periodic access and inspection.
- ✓ **Lab Testing** – Designed to establish a prevent defense.
- ✓ **Fuel Degradation** – Helps extend the storage of ULSHO fuels.
- ✓ **Time, Temperature & Water** - Will accelerate oxidation of fuel.
- ✓ **Tanks** – Promote tank replacement with double wall tanks
- ✓ **Bottom Drain** - Valves can help remove water and sediment which accumulate during seasonal transitions.

## STICK & PASTE, VISUAL EXAMINATION



Sampled from Bottom of 20K Gallon Tank



Water detection paste can help reduce operational issues.

# HOUSEKEEPING AND FUEL TESTING

Sample #: \_\_\_\_\_  
 Customer Name: \_\_\_\_\_  
 Company Location: \_\_\_\_\_  
 Location-City, State: \_\_\_\_\_  
 Location-Contact Name: \_\_\_\_\_  
 Sample Drawn Date: 10/7/2016  
 Sample Received @ Lab Date: 10/10/2016  
 Fuel Labeled as: Heating Oil red with untreated  
 sample id 20,000gal tank  
 Sample Identification: \_\_\_\_\_  
 Report Date: 10/13/2016

Test Protocol	Treatment	Result	Targets	Cost/Test <sup>1</sup>
Water Content by Karl Fischer, ppm w/v (ASTM D6304C)	As Received		-	\$60.00
Bottom Sediment and Water, % vol (ASTM D2709 <sup>2</sup> )	As Received	11%	≤ 0.05%	\$75.00
Anaerobic Microorganisms (Easicult® S)	As Received	Negative	Negative	\$130.00
Aerobic Bacteria (Easicult® Combi)	As Received	Slight	Negative	
Aerobic Yeasts (Easicult® Combi)	As Received	Negative	Negative	
Aerobic Fungi (Easicult® Combi)	As Received	Negative	Negative	
Biodiesel Content, % vol (ASTM D7861)	As Received	0.7%	-	\$20.00

Cost Savings for Customer: **\$285.00**

**Recommendations/Alerts:**

*The bottom sediment and water content of this sample was determined to be greater than 0.05% v/v. This sample indicates the presence of viable microorganisms.*

*Biodiesel content was measured using an Infracpec™ VFA-IR Spectrometer according to ASTM D7861 test procedure.*



**Fuel Thief**

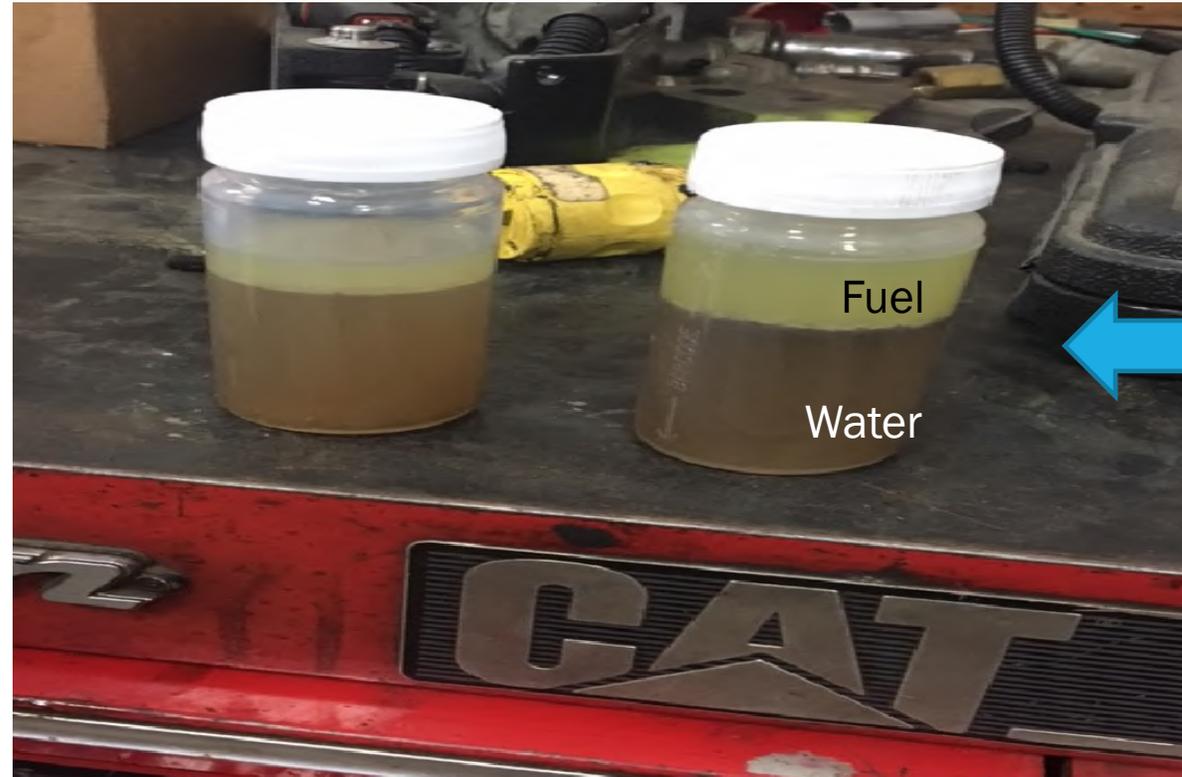
Establish a housekeeping plan to keep tank bottoms dry. Consider regular fuel testing that can mitigate exposure to performance issues and asset damage.

## UNDERSTAND YOUR FUEL

<b>Test</b>	<b>A 4000K Tank</b>	<b>B Tank 1</b>	<b>C Tank 2</b>	<b>D Tank 4</b>
Sediment (Sediment mL/Total mL)	0.1/100	1/100	15/100	0.25/100
KF (ppm)	459.1	2347.3	4484.7	364.4
% Bio	0.04	1.44	0.32	0.23
Microbes (Start: 9-25-19, End: 9-27-19) counts per mL	<1,000	100,000	10,000	100,000
Yeast (Start: 9-25-19, End: 9-27-19) counts per mL	<1,000	<1,000	100,000	10,000

Lab testing can help to manage exposure to contamination

## A CLOSER LOOK AT MICROBIAL CONTAMINATION ( BUGS )



Sample from Class 8 truck fuel filter water separator.  
Results indicated positive microbial activity.

**Pour Point Evaluation, B20 and Above**

**Pour Point ULHO 0 F**  
No additive

**Pour Point B100 +37 F**  
No additive

**Pour Point B20 +16 F**  
No Additive

Pour Point Evaluation		Managing Higher Percentage Blends of Bioheat®							
Degrees (F)	Neat Fuel & Blends	Base #2	Biodiesel	B5	B10	B20	B30	B40	B50
		Distillate	0						
	Biodiesel		37	0	10	16	16	21	27
Additive Blends									
1:xxxx	PPM								
2,000	500	-38		-33	-27	-27	-17	0	16
1,000	1,000	-44		-38	-60	-44	-22	-22	10
750	1,333	-54		-49	-49	-60	<-59	-27	-22
500	2,000	-54		-49	-49	-44	-60	-33	-33
250	4,000	<-59		-60	-54	-27	-17	-27	-27

\*Generic #2 ULS heating oil from Boston Harbor, Biodiesel is used cooking oil (UCO) feedstock, compliant with MA APS program.

\*\*Testing performed at Intertek, Chelsea, Massachusetts, September 2019

**Pour Point B0 -38 F**  
w. PPD

**Pour Point B20 - 27 F**  
w. PPD

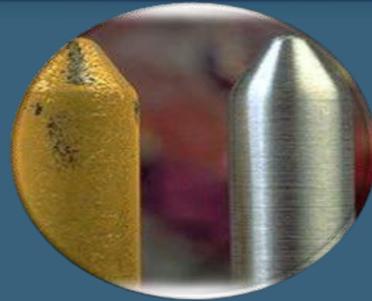
# Strategies Designed To Protect Your Fuel And Your P&L

Combined with proactive Housekeeping Protocols a contemporary fuel treatment program can help...



## Cold Weather Operation

Protects Fuel from Gelling in Tanks and lines



## Metal Deactivator

Protects Fuel From Yellow Metals/Copper Lines



## Corrosion Inhibitor

Protects Entire Fuel System, Truck, Tanks



## Tri-Stabilizer

Tri-Stabilizers To Protect ULSHO, biodiesel blends



## Dispersant

Cleans Tank, Fuel Line, Filter, Strainer and Nozzle



- **Contact**

- **Paul Nazzaro, 978-880-5338**