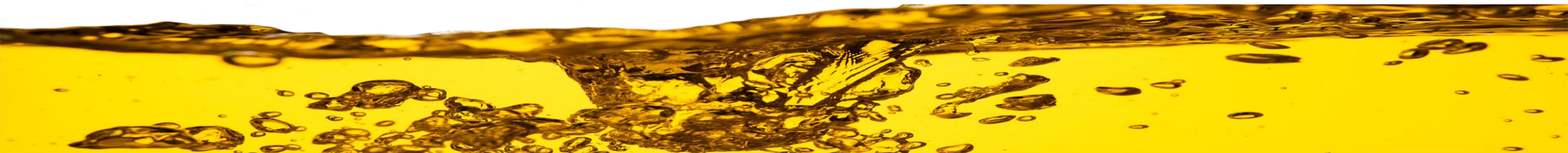




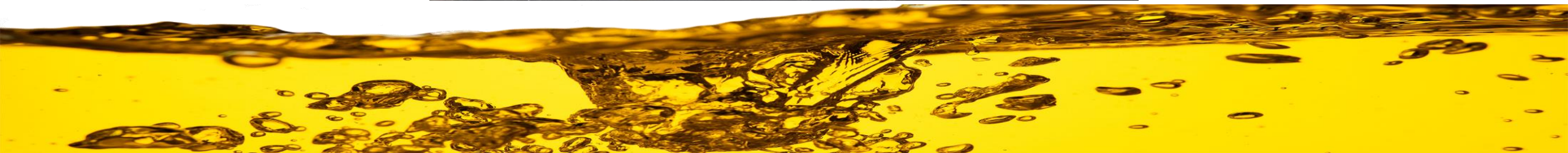
Diesel Fuel: A Proactive Approach to Proper Fuel Maintenance & Tank Integrity for Emergency Power Systems

Presented By: Michelle Hilger
Diesel Fuels Specialist & OnSite Power Advocate

** This is a follow up presentation to Protect Your Power Source: Ensuring Diesel Fuel Reliability & Operability in Emergency Power Systems **

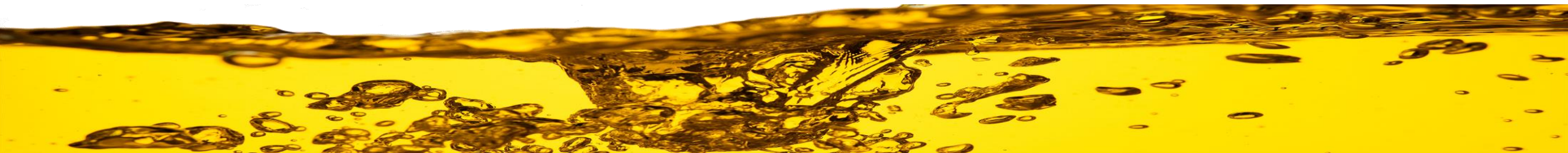


Where Does the Power Come From?



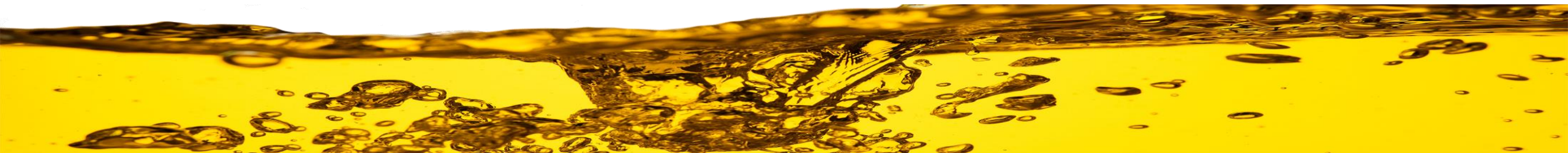
Today's Overview

- Review Types of Fuel Tanks for Generators
- Discuss Tank Integrity – Review of Standard Tank Fittings
- Recommended Monthly Inspections
- Chemical Treatments at Start Up
- Review & Questions



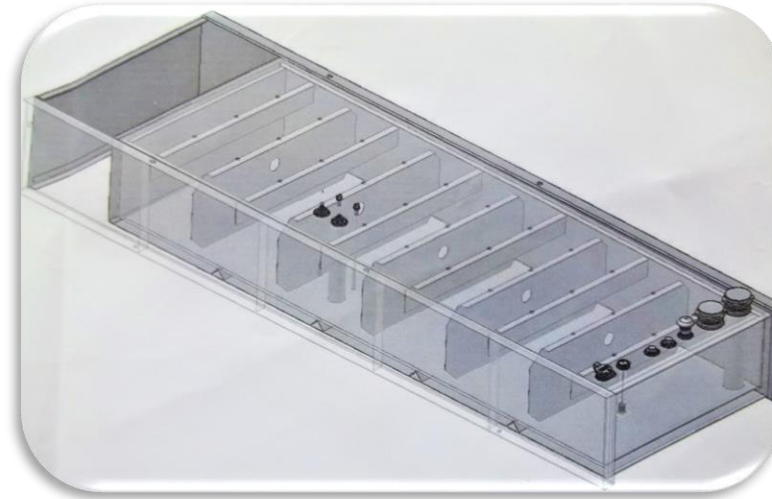
Type of Fuel Tank: Sub-Base (AST)

- Most common generator fuel tank
- Located directly under the generator
- Typically, the main fuel supply however for larger systems they may be considered a “day tank” as they can be fed from either an AST or UST.
- Vary in size (25 gallons to 15,000 gallons)

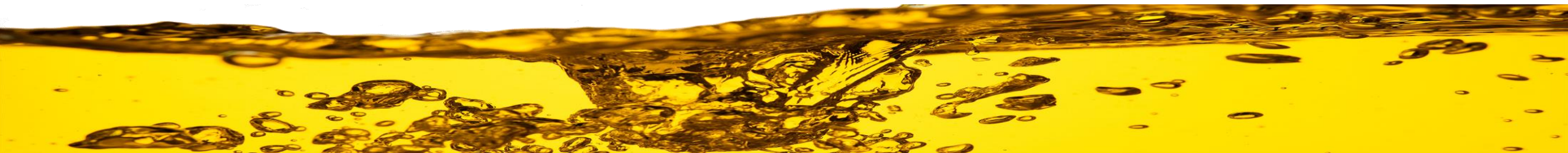


Type of Fuel Tank: Sub-Base Standard Design

- Baffles throughout the tank
- Very Limited Access – most access ports are in one or two baffles

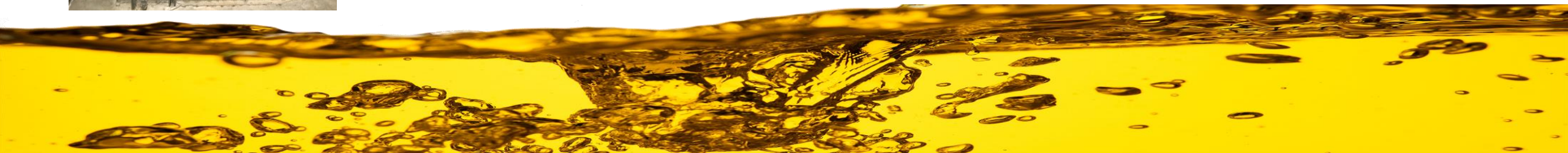


Standard Set Up: Sub-Base Tank & Challenges



Type of Fuel Tank: Day Tank (AST)

- Commonly found indoors
- Fed from main fuel supply (bulk UST or AST)
- Typically sized to provide a minimum of 2 hours of run time (based on code requirements for facility)
- Vary in size (15 gallons to 350 gallons)
- Can be single wall
- Limited access for cleaning – often the most neglected



Day Tank (AST) – What Happens Over Time



Original Fuel Sample



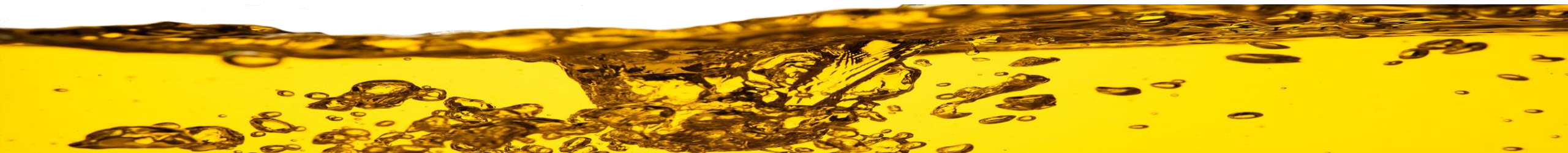
Inside Day after Removing Fuel



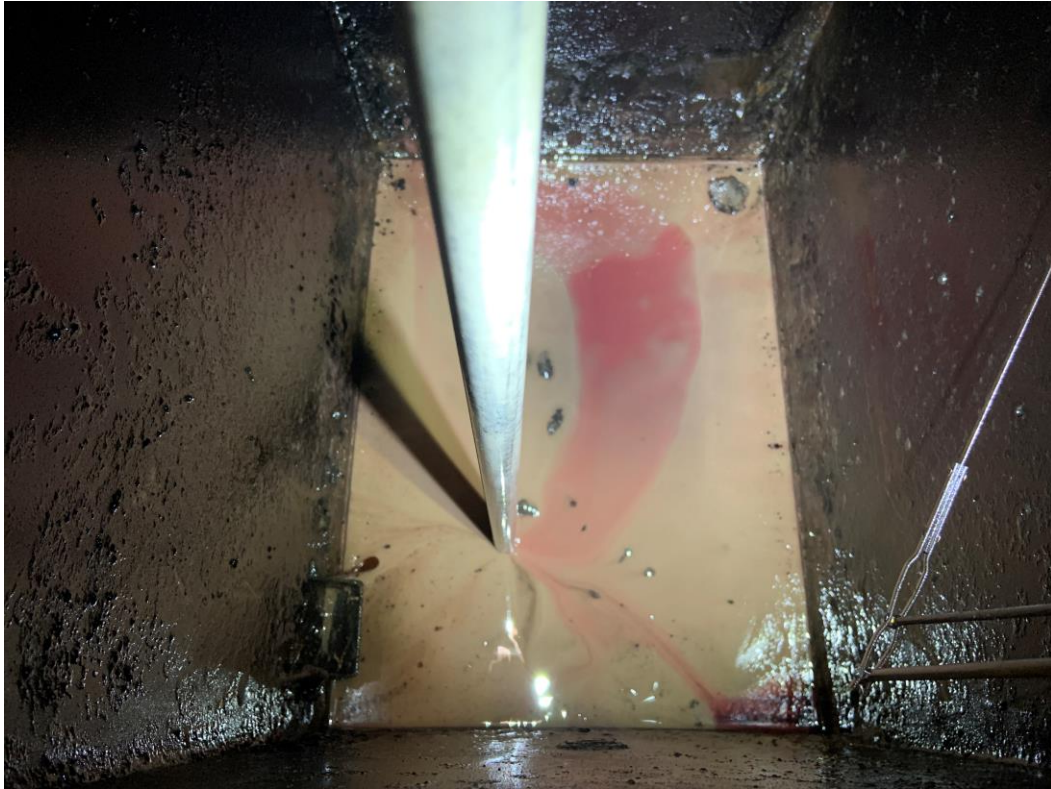
Tank after Power Washing



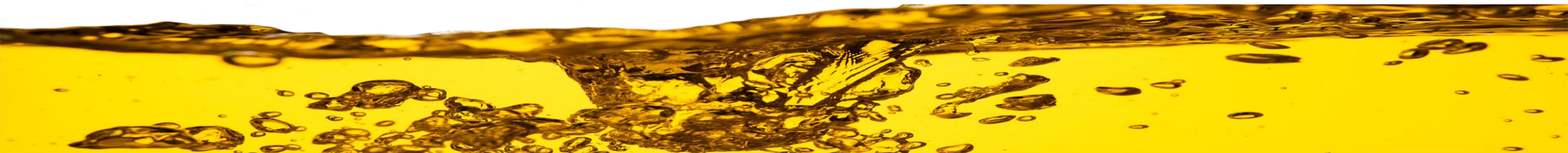
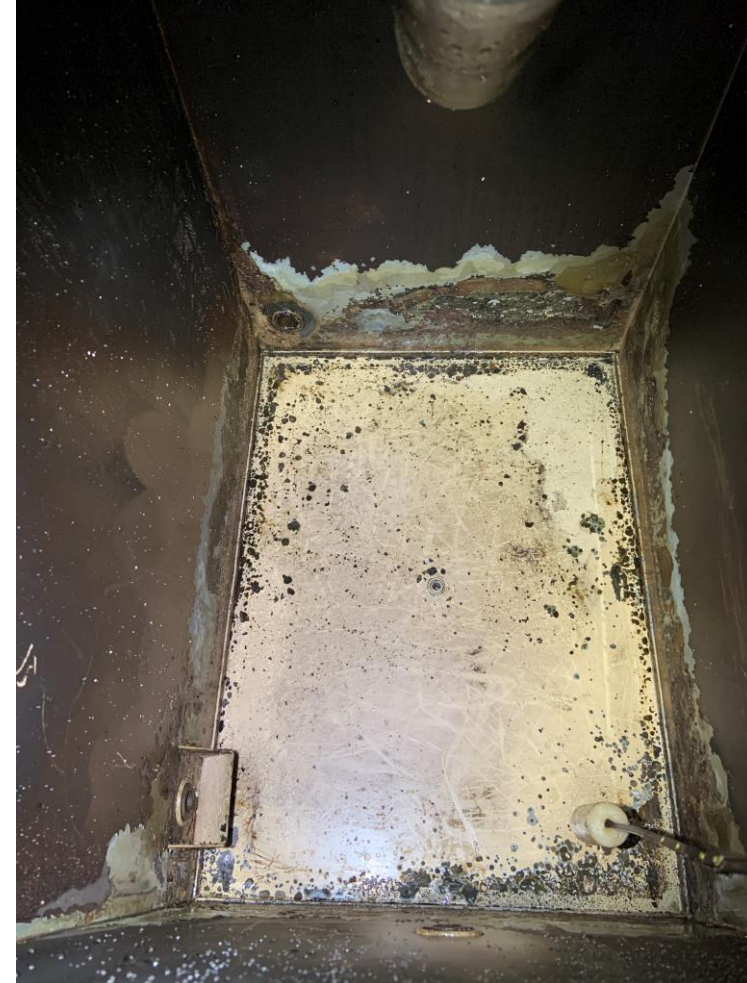
Sample after Refilling Cleaned Tank



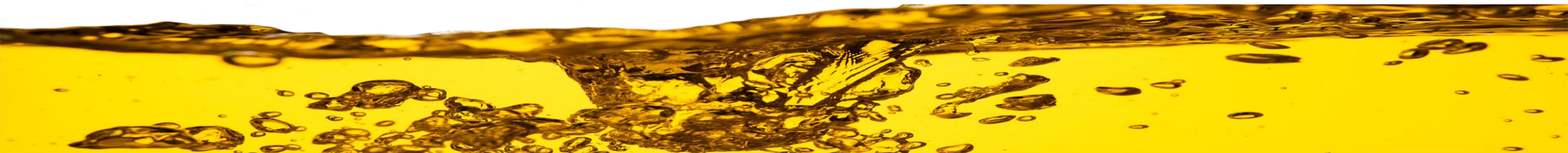
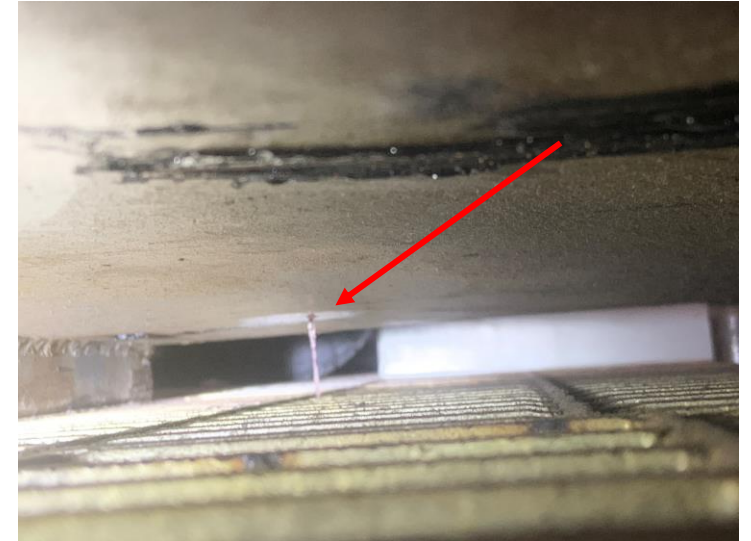
Day Tank (AST) – What Happens Over Time



*Drained tank due to significant amount of water
After power washing the tank clean
Notice the amount of corrosion from the water on the right...*

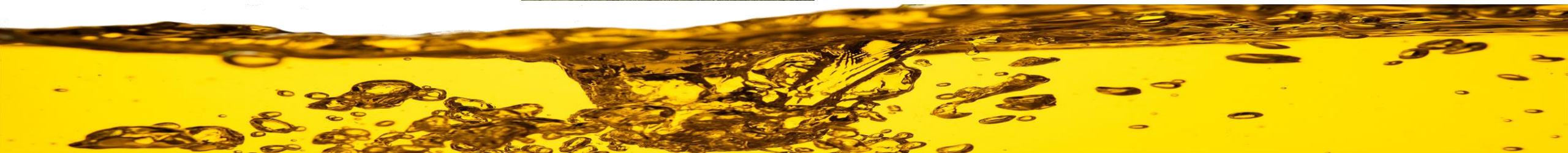


Day Tank (AST) – What Happens Over Time

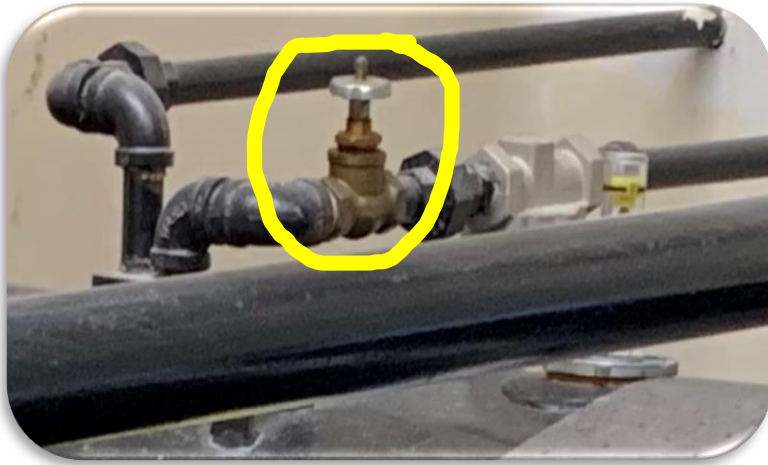


Type of Fuel Tank: Aboveground Bulk (AST)

- Often considered a main fuel supply
- Outside or Inside
 - Indoor AST's are commonly single wall heating oil tanks
- Could feed direct to a generator or a "day" tank
- Vary in size (110 gallons to 30,000+ gallons)



Notice – Tank Installation Materials



No low melting point materials for aboveground storage tanks per NFPA 30 – Flammable & Combustible Liquids Code

ie: Aluminum, Copper, Brass, Cast Iron...

Copper – not only is it against code, it accelerates the degradation of fuel overtime

No galvanized piping per ASTM D975, NFPA 110, & PEI RP1400

NFPA 31 DOES NOT APPLY TO FUEL TANKS WITH ENGINES / GENERATORS

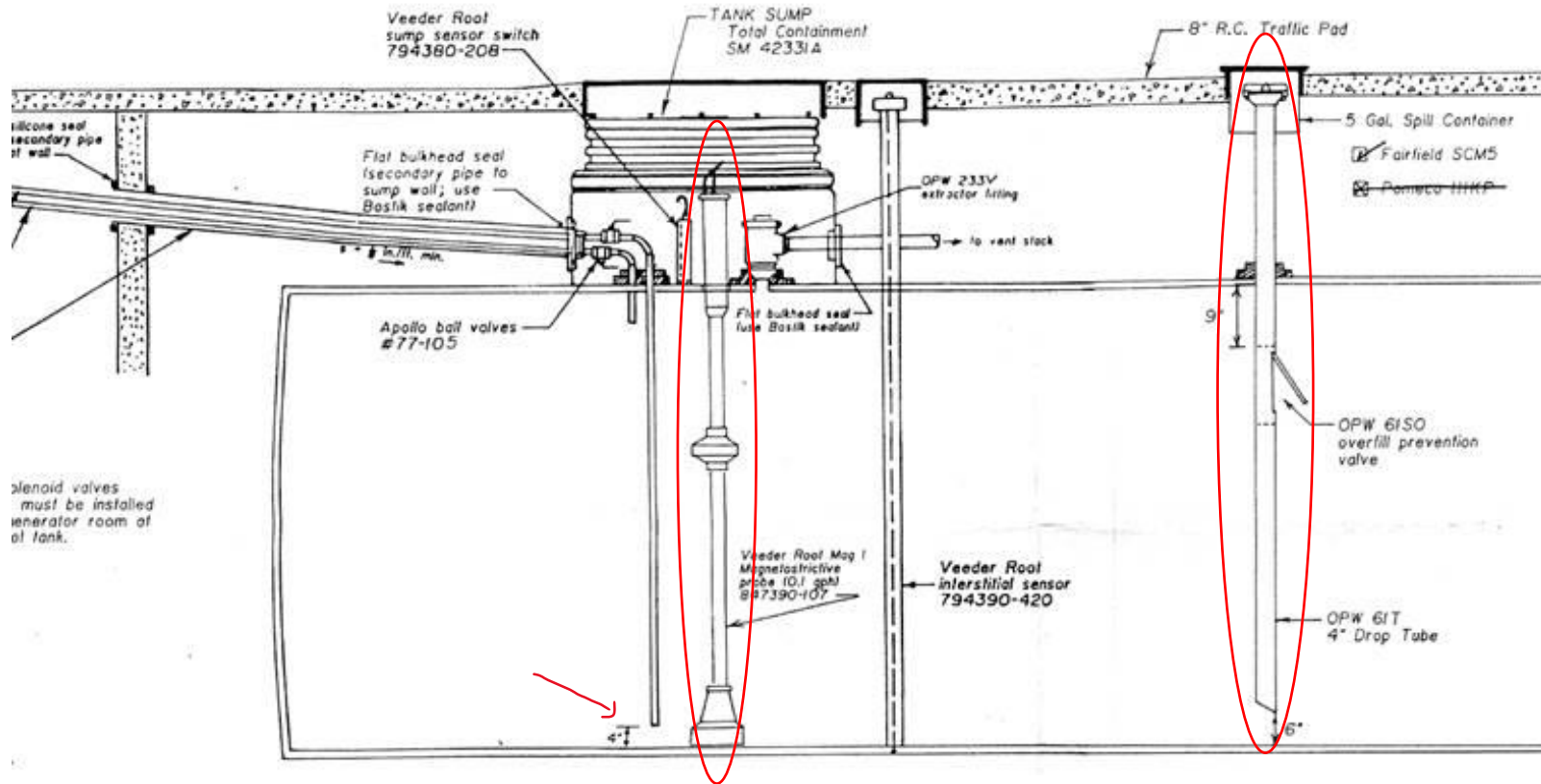


Type of Fuel Tank: Underground Bulk (UST)

- Considered a main fuel supply
- Commonly feed both the generator and boiler systems
- Could feed direct to a generator or a "day" tank
- Vary in size (500 gallons to 30,000 gallons)
- Limited access for cleaning (Fill Port & Veeder Root)



Type of Fuel Tank: UST Standard Design

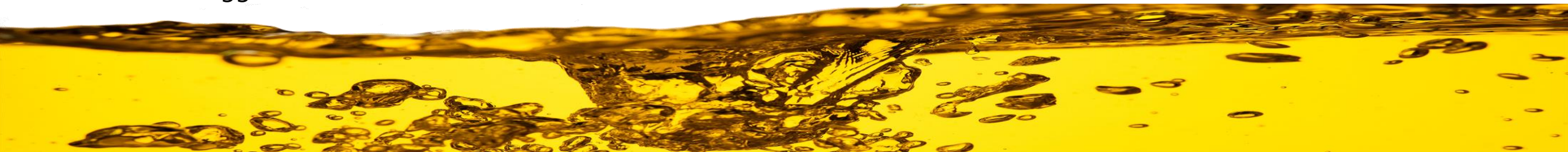
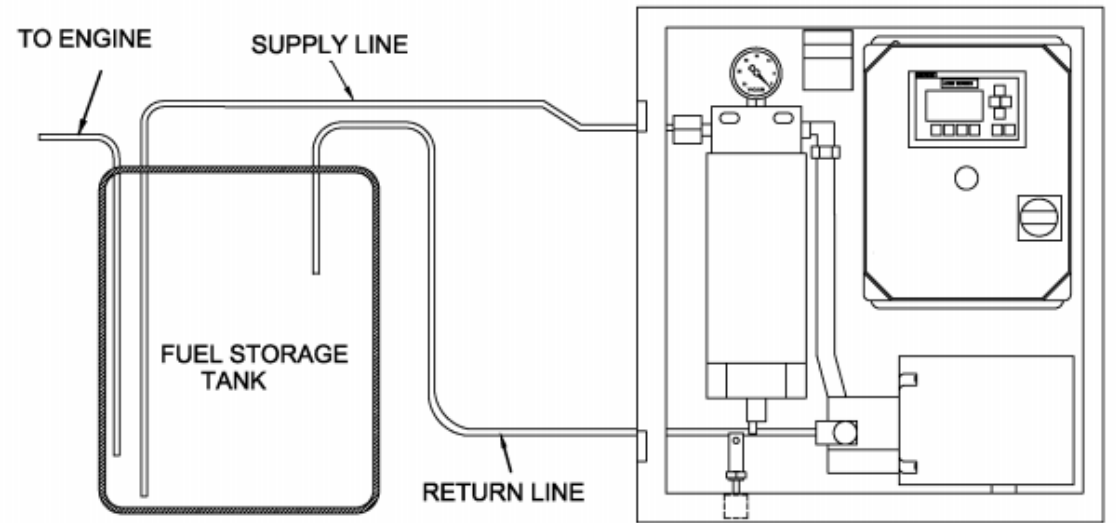


- Common installation practice was to "pitch" the UST's towards the FILL allowing water to collect and easily be removed
- In New England, we are finding the "pitch" is towards the SUMP
 - Fill port is not always accurate sample representation
 - Samples should be taken from both Fill and Veeder
- Suction line typically 4" to 6" from bottom
 - Permanent mounted fuel maintenance systems should be installed 1" from bottom to ensure it gets bottom water & sediment

Stationary Fuel Maintenance Systems

- Should be FM Approved & NFPA Compliant
- Operate on Time-Based Schedule
 - Should turn complete capacity of tank at least once a month
 - Do not turn off just because "it's loud"
- Sized based on the # of gallons of fuel tank
- If multiple tanks, you may need multiple systems
- Capable of removing both water and sediment
 - Two Stage Filtration
 - Particulate
 - Water
- Suction Line should be installed 1" from the bottom of the tank to ensure it filters out any bottom water & sediment. *** Biggest Installation Mistake ***

HOW IT WORKS



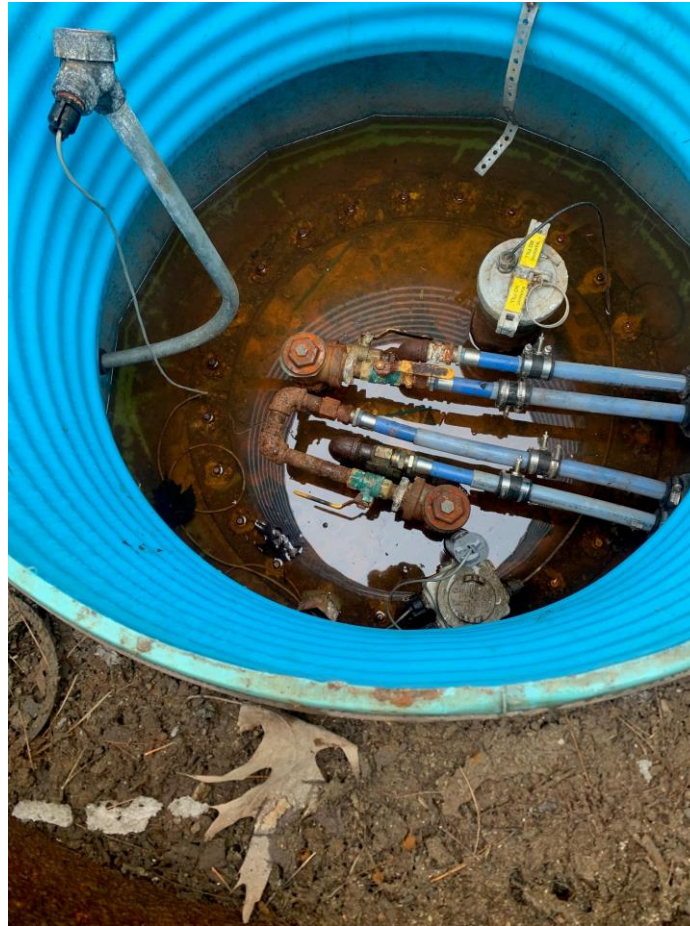
UST – Sample from Fill Port vs. Veeder Root



Sample taken from Fill Port of UST

Report indicated Bacteria & Mold but NO Water

Doesn't look like this tank needs much work



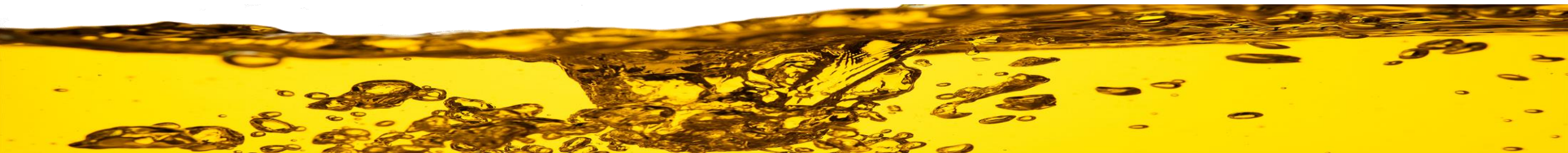
Veeder Root Access of UST
Filled with Water – Tank Components = Rusted



Sample taken from Veeder Root of UST

Significant Water, Rust & Sediment

This is a major clean up job



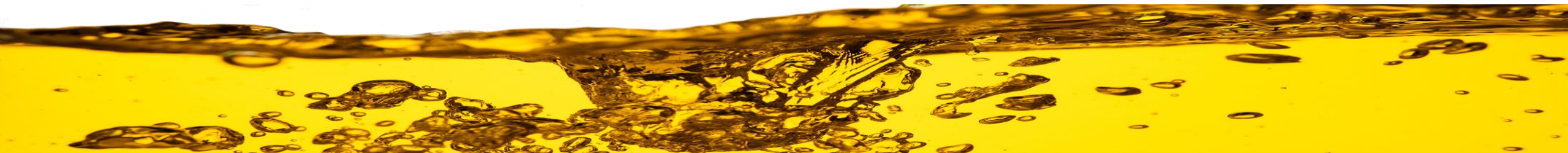
UST – Good Housekeeping is CRITICAL



- Water removal is KEY
- At least monthly open the covers and remove any water or dirt that may have collected.
- Check after any rain/snow storm



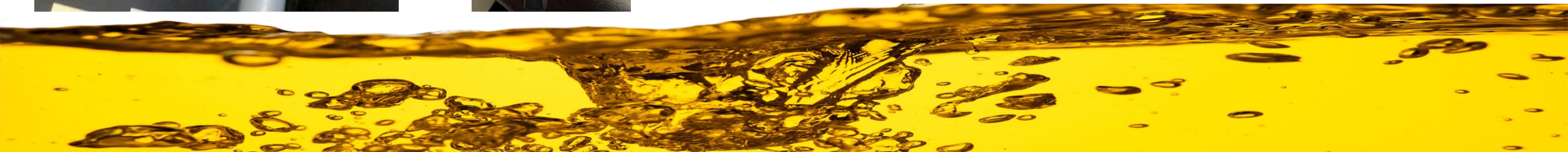
UST – Caption This...



Standard Fittings – Fill Cap / Port



- Turtle Cap
 - Most common
 - Standard Spec on Most Tanks
 - Not vapor tight
 - Allows for Moisture / Dirt Entry



Standard Fittings – Fill Cap / Port

- Should be Sealable & Lockable
 - Help prevent water entry
 - Help direct all vent air to standard vent pipe
 - Frequently inspect seal to ensure it is intact and functioning properly
 - Must be Black Iron – NO Brass or other low melting point materials
 - i.e.: Morrison 178 series (estimated \$60.00 parts upgrade)



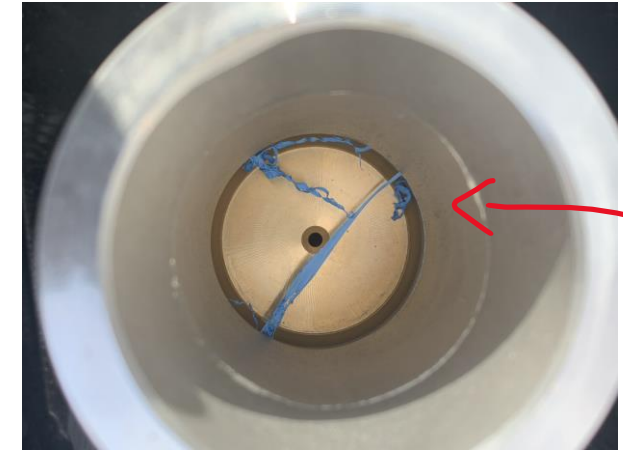
*Seal is damaged
Cap needed to be replaced*

*ALSO this is Brass which is
a low melting point
material*



*Not sealed. Standard truck
fill cap on rental generator.
Moisture caused microbial
growth*

Standard Fittings – Fill Cap / Port (Camlock)



Camlock Fill Caps provide excellent seal... However
If located inside Fill Containment Basin make sure they are
sized so that the spill basin lid can close.

Alternative is a LOW-PROFILE Camlock Cap (see below)

Additionally, NOT recommended to use Teflon Tape on fuel
fittings (see above)



Standard Fittings – Fuel Gauge

- Fuel Gauge

- Should be vapor tight and designed for the environment the tank is in
- Sized by tank depth and properly calibrated
- “Krueger” Heating Oil Tank style is incorrect for most generator fuel tanks
- i.e.: Morrison 718 Vapor Tight Gauge (estimated \$175.00 parts upgrade)

*Morrison 718
Installed on outdoor tank*

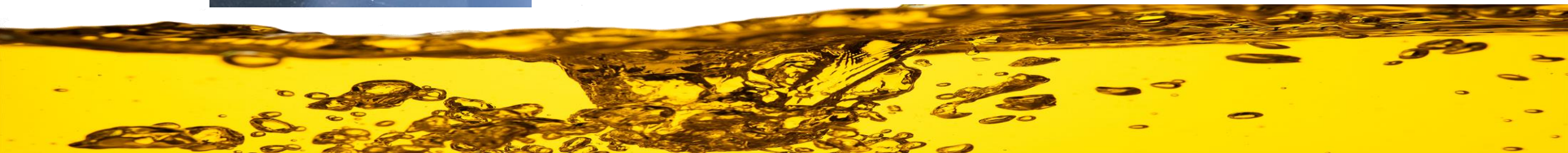


*Standard gauge within the
enclosure. These are okay,
just inspect and make sure
they are not cracked.*

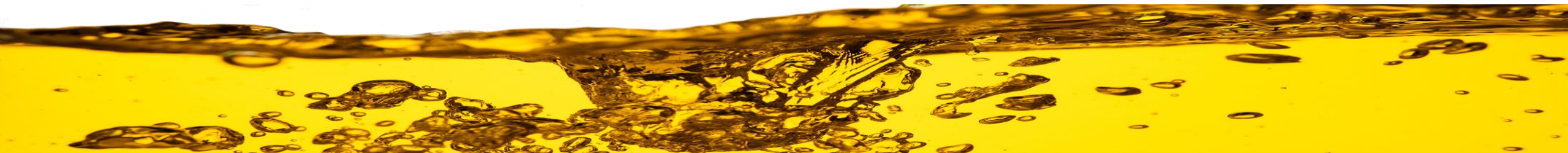


*Plastic is cracked in
multiple places.*

*Within tank, removed
several gallons of water
settled on the bottom just
below this gauge.*



Standard Fittings – Fuel Gauge (Broken)



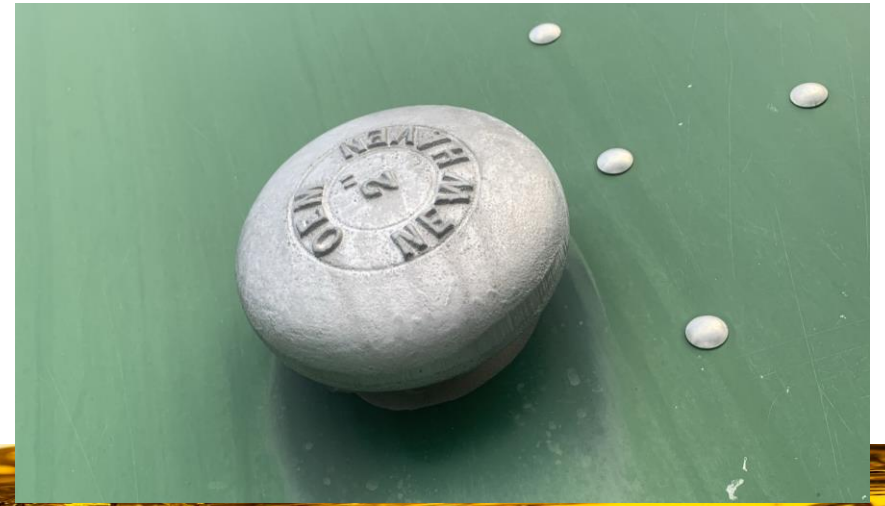
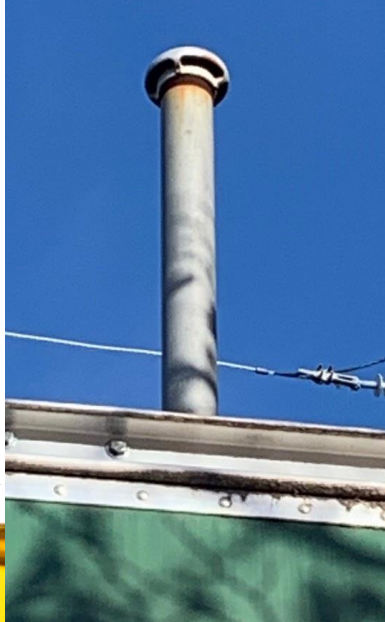
Standard Fittings – Normal Vent

- Normal Vent
 - Required on all aboveground tanks
 - Purpose is to allow air to move freely in and out of the tank
 - Height & Location dictated by codes, HOWEVER vents low and/or at same level of tank should be raised
 - Common Cap Styles – Updraft & Mushroom Caps
 - Allow water entry, condensation and dirt into the vent pipe
 - Strongly encourage a fully enclosed and filter cap for vents to help strip moisture & dirt contaminants
 - i.e.: Donaldson TRAP Breather Filters (estimated \$200.00 parts upgrade for filter alone)
 - Ideally changed once a year for standby applications

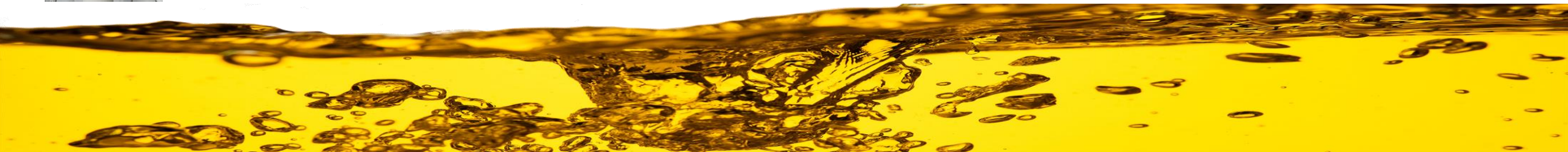


Smaller filters available for inside small generator enclosures.

Standard Fitting – Common Normal Vents

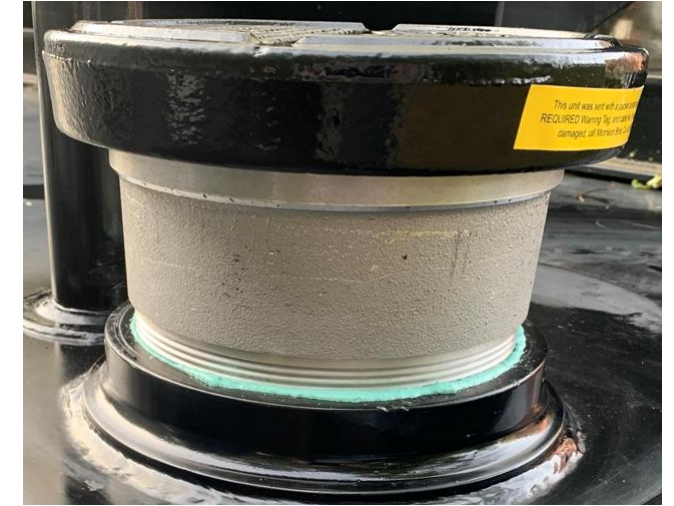


Standard Fitting – Common Normal Vents



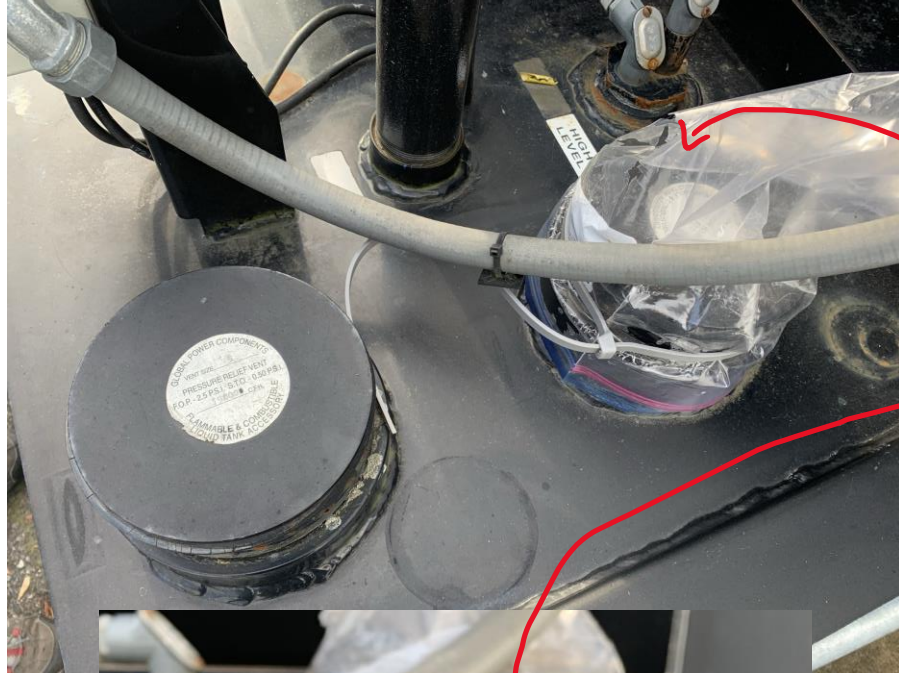
Standard Fittings – Emergency Vent

- Emergency Vent (estimated \$100-400 for parts upgrades, depends on size & location)
 - Required on all aboveground tanks
 - Size, Quantity and Location dictated by codes
 - Larger tanks often see a primary and secondary emergency vent
 - Choose the vent designed for the tank environment
 - Indoor vs. Outdoor
 - Frequently inspect O-rings and seals to ensure they are intact and functioning properly
 - Outdoor should have drip edges to prevent water intrusion



Example of Morrison 244M Emergency Vent with Drip Edge

Standard Fittings – Emergency Vent Challenges



Neither emergency vent designed for outdoor climate

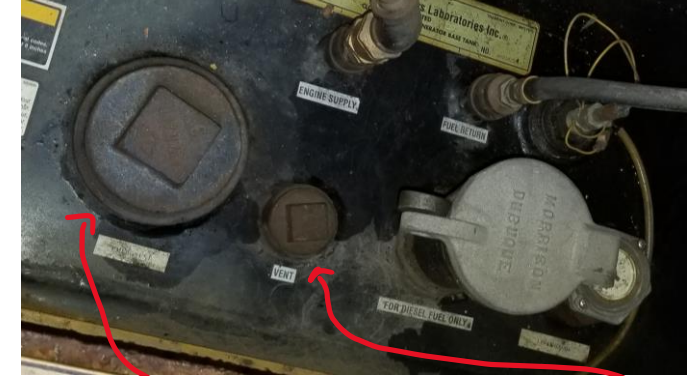
Ziploc Bag & Zip Tie covering broken primary emergency vent

Secondary emergency vent seals are cracked and vent is rusting

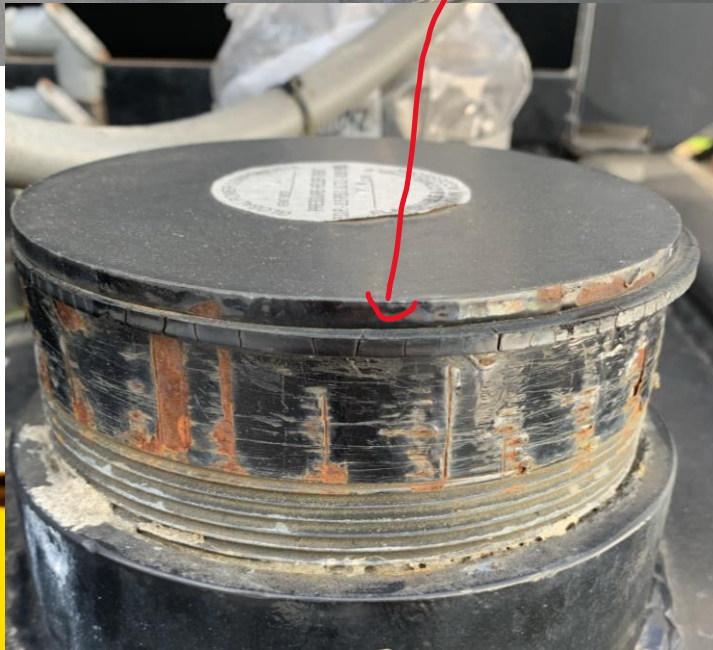
Both emergency vents should be replaced with Drip Edge Outdoor Rated Emergency Vents



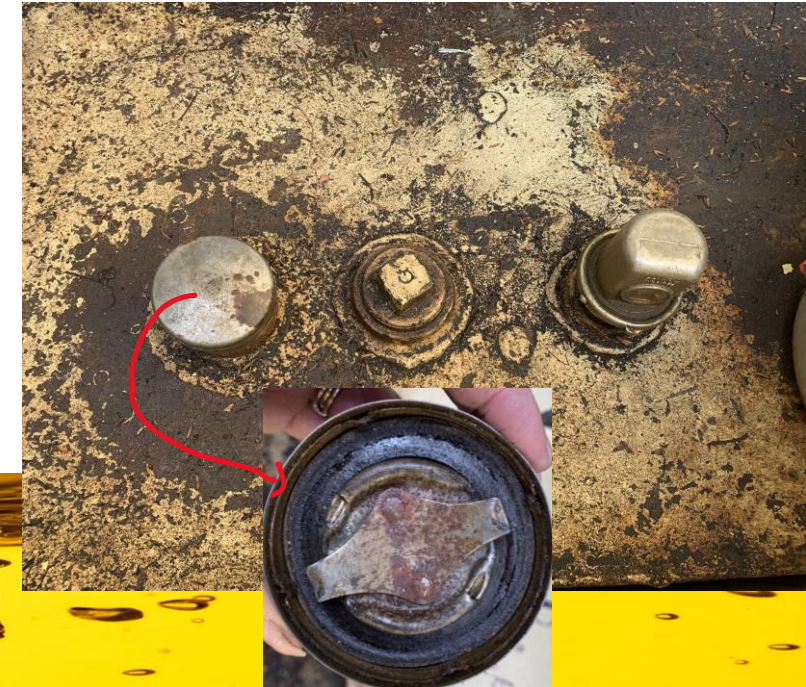
Plugs are NOT Vents



This tank is plugged and missing both emergency & normal vent



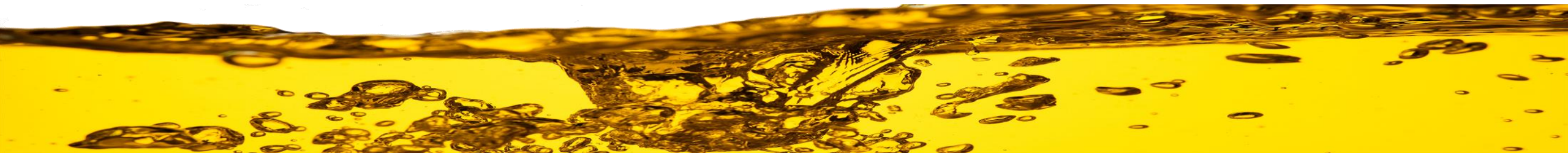
Tank missing both emergency & normal vent
Fill Cap is acting as combo fill/vent
Inside Fill shows moisture & rust



Choose Vents Designed for Environment

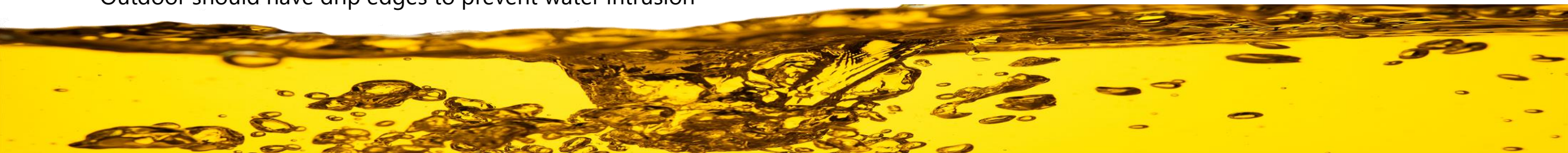


6 Month Old Generator & Fuel Tank
After 6 Months sample indicated about $\frac{1}{4}$ " of water as well as
microbial growth within tank – How did it get there?



Standard Tank Fittings Re-Cap

- Fill Port / Cap
 - Should be sealable & lockable to help prevent water entry & help direct all vent air to the standard vent pipe
- Fuel Gauge
 - Should be vapor tight and designed for the environment the tank is in
 - "Krueger" Heating Oil Tank style is incorrect for most generator fuel tanks
- Normal Vent
 - Required on all tanks
 - Purpose is to allow air to move freely in and out of the tank
 - Height & Location dictated by codes, HOWEVER vents low and/or at same level of tank should be raised
 - Common Cap Styles – Updraft & Mushroom Caps Updraft
 - Allow water entry, condensation and dirt into the vent pipe
 - Strongly encourage a fully enclosed and filter cap for vents to help strip moisture & dirt contaminants
- Emergency Vents – Primary & Secondary
 - Required on all aboveground tanks. Size & Quantity dictated by codes
 - Choose the vent designed for the tank environment
 - Indoor vs. Outdoor
 - Outdoor should have drip edges to prevent water intrusion

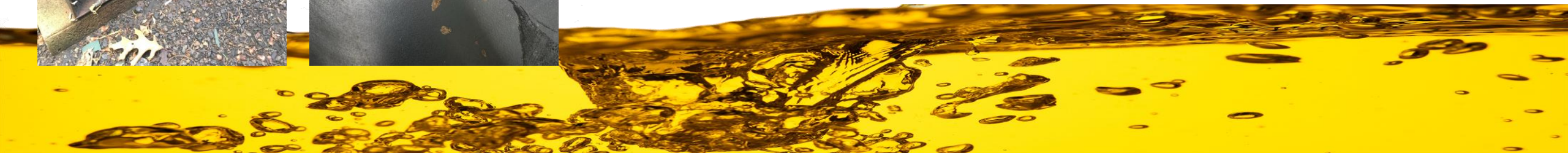


Frequently Inspect Your Fuel Systems



■ Recommended Monthly Inspections

- General Tank Condition
 - Any leaks on the ground?
 - Any water collecting on the top of the tank? If so, REMOVE
 - Rusty access ports?
 - Are all plugs & fittings sealed with proper thread sealant?
- Fuel Gauge
 - Is it reading at least 80%?
 - Keep tanks full and dry to avoid the majority of problems
 - Only need 7 degree temperature change for condensation to form
 - Any cracks? Condition of O-Rings / Seals / Gaskets
- Fill Cap / Port
 - Is it closed? Any water in spill basin?
 - Condition of O-Rings / Seals / Gaskets
- Normal Vent
 - Intact? Any rust? Condensation? Obstructions?
 - If TRAP Filter, how is the filter holding up? When was it last installed?
- Emergency Vents
 - Condition of O-Rings / Seals / Gaskets



Proactively Utilize Chemical Treatments

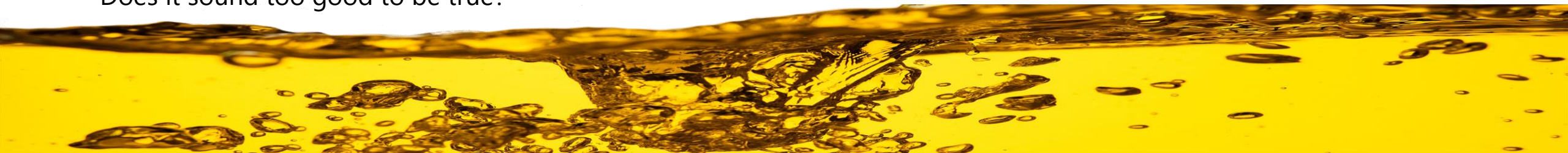
- Additives are necessary for today's diesel fuel and should be added at time of delivery
- Do not wait until fuel needs remediation for chemical treatment
- To protect for Long-Term Storage fuel should be treated with:
 - Stabilizers
 - Biocides
 - Cold Flow Enhancers
 - Particulate Dissolvers / Dispersants
 - Water Dissolvers / Corrosion Inhibitors
- EPA Registered?
 - [*Registered Fuels & Fuel Additives Under 40 CFR Part 79*](#)
 - [*Registered Pesticide Products*](#)
- No additive is created equal
 - Does it sound too good to be true?



X3.4 Fuel Additives

X3.4.1 Fuel additives can improve the suitability of marginal fuels for long-term storage and thermal stability, but can be unsuccessful for fuels with markedly poor stability properties. Most stability additives should be added at the refinery or as soon after manufacture as possible (no more than a few weeks) to obtain maximum benefits.

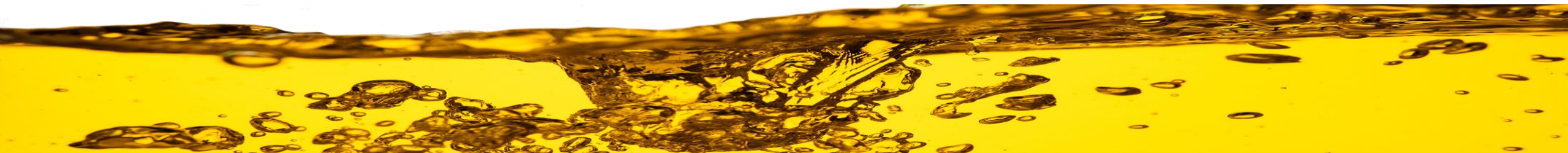
ASTM D975-20a Appendix



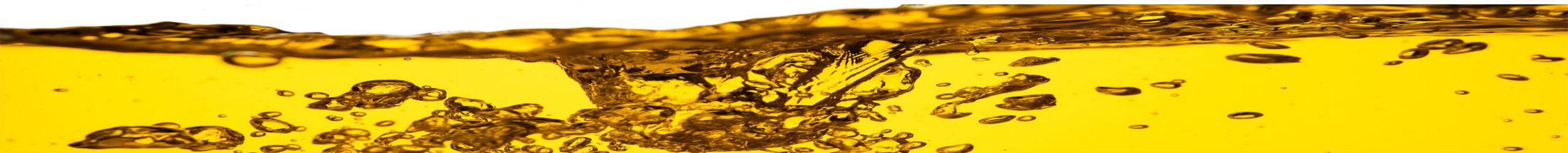
Properly Dispensing Chemical Treatments



- It's not as simple as dump and walk away
- Must mix in thoroughly throughout tank
- Best Method – Aeration Tool & Air Compressor
 - DIESEL FUEL ONLY!!!
 - Aeration not required on tanks less than 300 gallons
 - Aeration not required if dispensed at time of fuel delivery



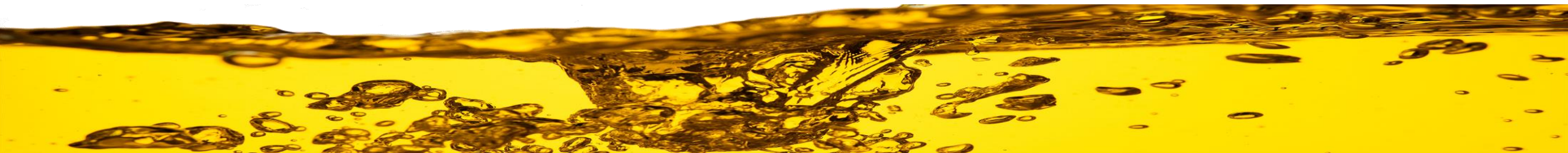
Real World Examples Fuel Tank Remediation



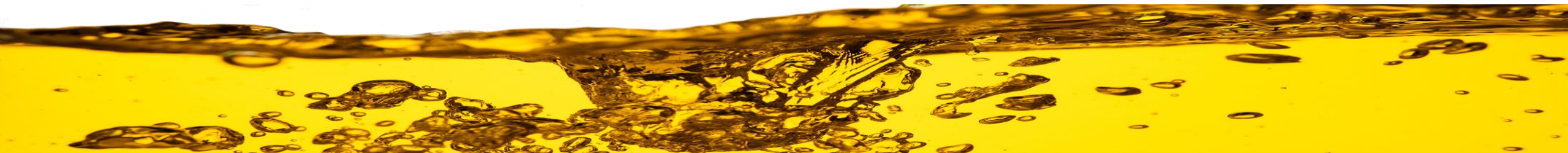
Expensive Remediation Job – How It Happened



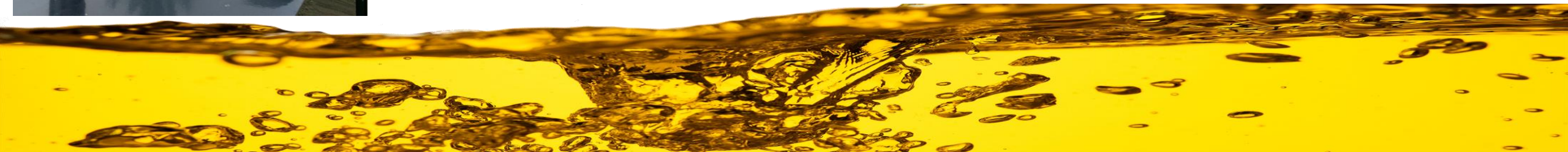
- Tank wasn't kept full
 - 3,920 gallon tank never filled above 25%
- Fuel Gauge
 - Not designed for outdoor use
 - Broken leaking water into tank
- Emergency Vents
 - Not designed for outdoor use
 - Seals were cracked allowing water in
- Normal Vent
 - Never installed
- Leaking Enclosure
 - Water building up on top of fuel tank



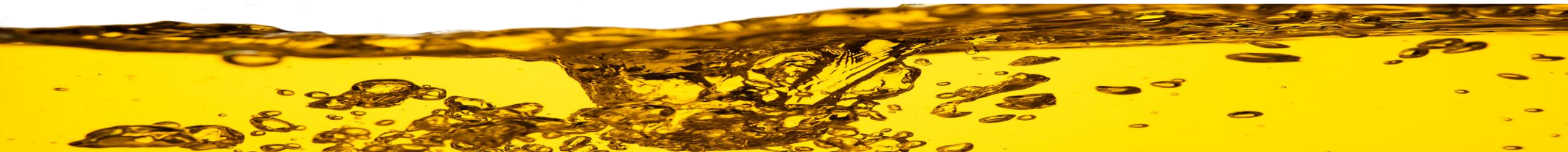
Tank Upfitting – Before & After



Tank Upfitting – Before & After



Tank Upfitting – Before & After



What Happened Here?



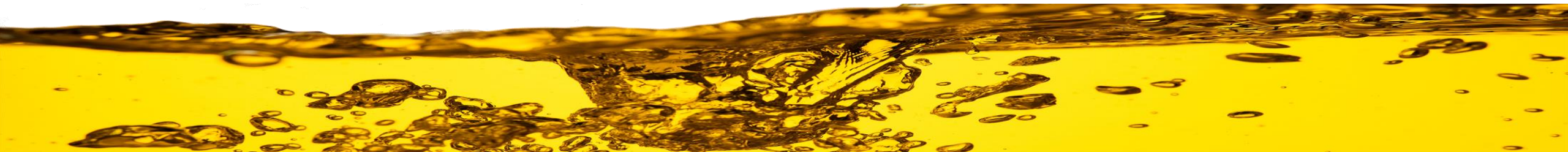
Do we have two jars of Coca-Cola

OR

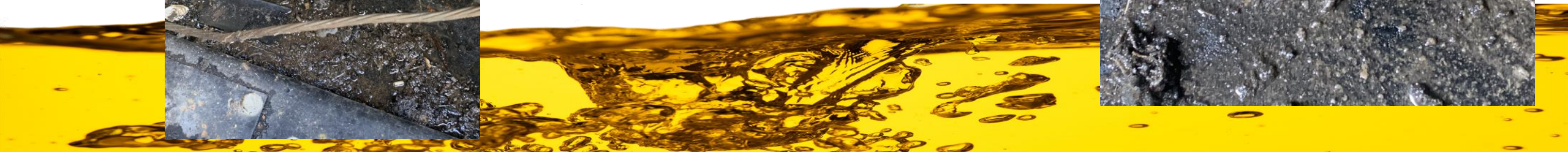
two jars of Diesel Fuel

OR

One bottle of Coca-Cola and
One Jar of Diesel Fuel?



Tank Housekeeping May Prevent Fuel Problems



QUESTIONS?

Michelle Hilger – Chief Connector
Mongoose Power Solutions

On-Site Power Generation Industry Advocate & Liaison
Diesel Fuels Specialist & STI Inspector # AST-6621

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ETPL & Sponsor of National Emergency Power Systems Technician Apprentice Program



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