
Advanced
Fuel
Services Inc.
A Doctor's approach to Healthy Fuel

Why You Need Tank and Fuel Quality Management Service Programs ?

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(The Fuel Doctor)
Mechanical,
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Clean Tanks and Fuel Mean Reliable and Efficient Equipment

There are two areas we need to establish in order to understand the need for tank and fuel quality.

First we must understand "Protocol" which is the guidelines by which fuel is produced and the bench mark for maintenance.

Secondly we must understand the Methodology used to maintain tank and fuel quality.

➢ ***Who sets the Guideline by which it is important to have clean tanks and fuel?***

Fuel Guidelines, Standards and Specifications

- The most widely accepted fuel storage guidelines and standards are developed through a consensus of technical specialists and government agents representing different perspectives and interests on fire, environmental, health and other safety issues. The Environmental Protection Agency (EPA), National Fire Protection Association (NFPA), ASTM International, the Air Transport Association (ATA), and the American Petroleum Institute (API) are a few of the leading authorities. Each of these groups publish a series of standards and specifications that concern fuel quality and storage tank issues. A selection of the most appropriate and popular of these guidelines are as follows:

EPA CFR 40

Part 112 Oil Pollution Prevention requires the procedures for inspections and testing of above ground tanks

Part 280 Requirements for Owners and Operators of Underground Storage Tanks (UST) requires that USTs must be inspected every 60 days to ensure the equipment is running properly.

The EPA states that a new or upgraded storage system is a good start, but the system must be properly operated and continuously maintained. This includes water monitoring, removal and cleaning.

NFPA 20 Standard for the Installation of Stationary Pumps for Fire Protection,

8.6.4 Fuel Supply Maintenance states that "tanks shall always be filled by means that will ensure removal of all water and foreign material"

NFPA 25 Standard for the Inspection, Testing Maintenance of Water-Based Fire Protection Systems

Appendix B calls for a maintenance schedule to check to make sure diesel systems are free of water.

NFPA 30 Flammable and Combustible Liquids Code (2008)

21.8.8 Requires tank owners to establish a procedure for checking and removing remaining water from the bottom of the storage tanks.

NFPA 110 Standard for Emergency Power and Standby Power Systems (2010)

7.9.1.1 All fuel tanks and systems shall be installed and maintained in accordance with NFPA 30, Flammable and Combustible Liquids Code.

7.9.1.2 Fuel system design shall provide for a supply of clean fuel to the prime mover. (Annex A.7.9.1.2 provides further explanation of 7.9.1.2 Please see attached.)*

7.9.1.3 Tanks shall be sized so that the fuel is consumed within the storage life, or provision shall be made to replace stale fuel with clean fuel.

8.3.8 A fuel quality test shall be performed at least annually using tests approved by ASTM International Standards.

ASTM International D975, Section X2. Storage and Thermal Stability of Diesel Fuels

X2.6.1 A plan for monitoring the quality of bulk fuel during prolonged storage is an integral part of a successful program.

X2.6.2 Stored fuel should be periodically sampled and its quality assessed.

X2.7.1 Contamination levels in fuel can be reduced by storage in tanks kept free of water, and tankage should have provisions for water draining on a scheduled basis.

ASTM stands for the American Society for Testing and Materials. They have committees that review and establish the values, benchmark properties, and uniform standards by which petroleum products are evaluated — and products for a wide range of industries and endeavors. Understandably, their website is extensive and we recommend you refer to the website, if only to get an idea of the size and scope of ASTM activities.

ASTM International
100 Barr Harbor Drive
West Conshohocken, PA 19428-2959
Phone: 610-832-9585
www.astm.org

Provides the minimum requirements for maintaining the integrity of welded or riveted, non-refrigerated, atmospheric pressure, aboveground storage tanks.

ATA Specification 103 Standard for Jet Fuel Quality Control

2-4.2 Storage tank shall include the following equipment: (a) floating suction with means of verifying proper operation.

2-5.7.1 Storage tank interiors: (a) check fuel storage tank interiors for cleanliness and condition of coating (b) clean as required.

The Steel Tank Institute suggests that in order to safeguard your business, maintain good customer relations, ensure high-quality fuel, and leak-free operation of your storage systems, you must monitor for water in those systems and remove water whenever it is detected. This must be a routine part of your operations and maintenance procedures.

ANS: The Participating Industry Leaders just mentioned Set "Protocol" and House Keeping Procedures to Maintain Standards and Specifications.

ASTM Quality Testing Standards by which the fuel is produced

ExxonMobil

ConocoPhillips

Fuel Producers, The Refineries that adhere to the Standards and Specification

XERXES®
a ZCL company

Tank Manufactures, which produce the tanks we store the fuel our equipment runs on, Warranties!

FIREGUARD®

Engine Manufactures

Cummins Power Generation

CAT Diesel Power

Detroit Diesel

Volvo Penta

Kohler Power Systems

MTU

MAN

Northern Lights

John Deere

Perkins

FPT

EG Wilson

SDMO

Engine Manufactures and Equipment Packagers who use these Standards and Specification to produce the Systems we use.

- ***Each publish a fuels book for customer verification and reference of these standards and warranties that apply.***

Facts

- ***Fuels and tanks contaminate on their own.***
- ***Climate and weather adversely effect all Fuels and Tanks.***
- ***All Engine Manufactures adhere to ASTM Fuel Quality Standards.***

All Engine Manufactures design their equipment around ASTM Fuel Quality Standards for Performance, Efficiency, Ecology and Economy.

PEI™ The leading authority for fuel and fluid handling equipment.

Steel Plate Fabricators Association

STI® Steel Tank Institute

The Members of the Clean Diesel Fuel Alliance Formed a Committee to Investigate the Rapid Acceleration of Corrosion on Metal Tank Components and Surfaces from the use of Ultra Low Sulfur Diesel (ULSD).

CDFA hired the Battelle Institute to do an Independent Study and Published the following Hypothesis :

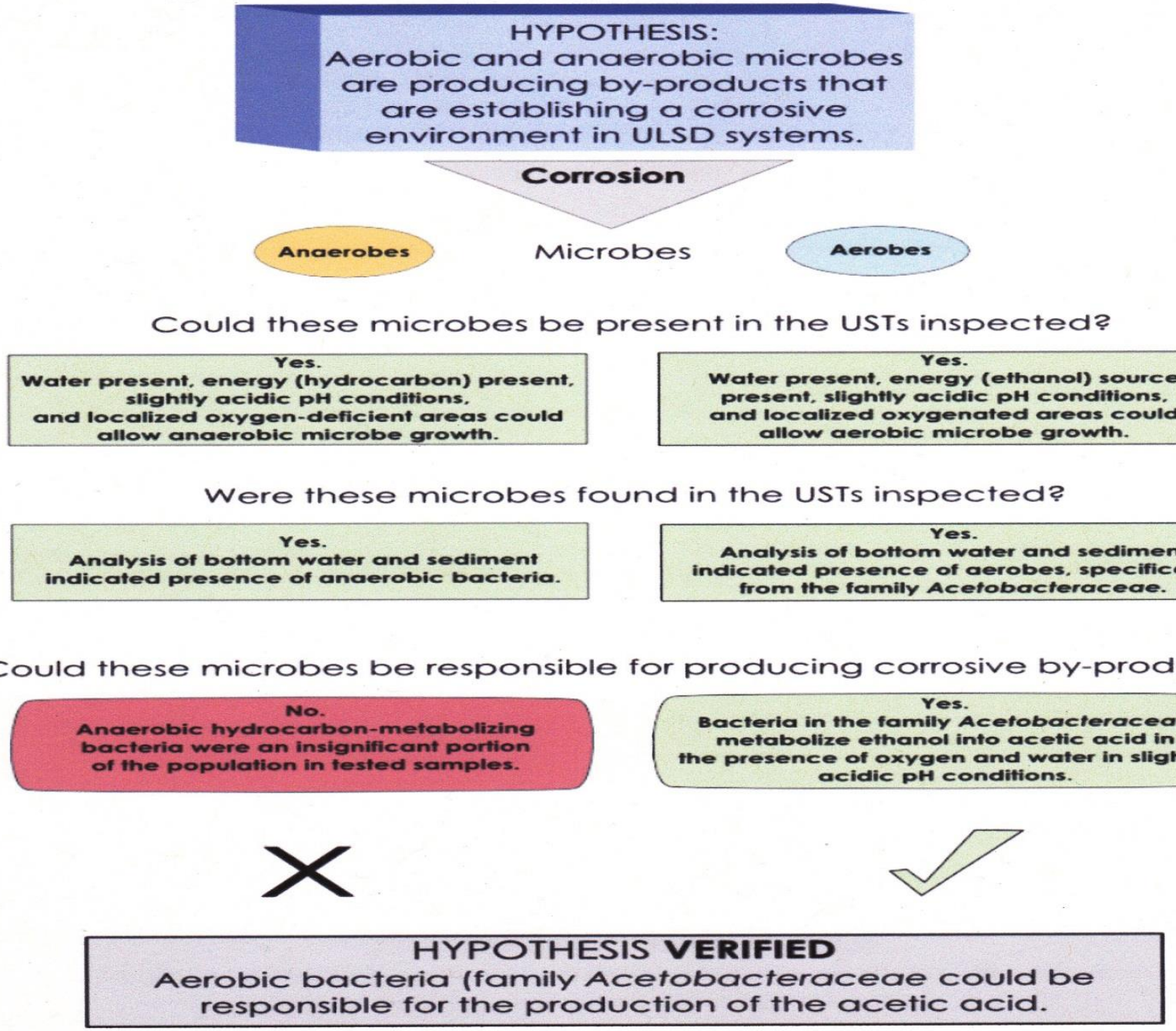


Figure 4. MIC Hypothesis Evaluation

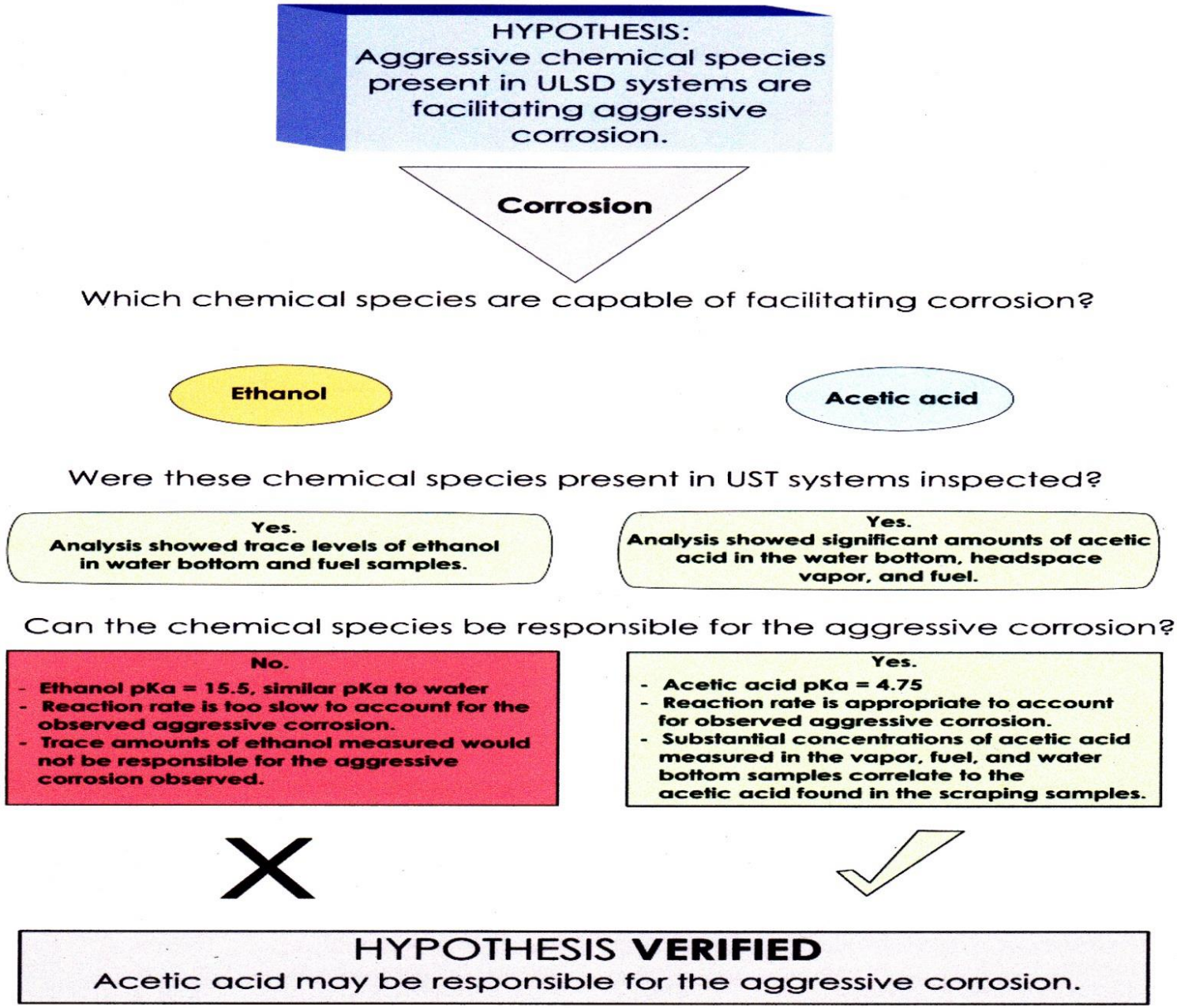


Figure 3. Aggressive Chemical Species Hypothesis Evaluation

FINAL HYPOTHESIS:

Aerobic microbes are producing acetic acid which is being dispersed into the humid vapor space coating and re-coating the UST equipment. This process concentrates the acetic acid on the equipment, resulting in severe and rapid corrosion.

Acetic acid is a corrosive species found in appreciable concentrations in vapor, fuel, and water bottom samples from the inspected USTs. Further, it was found in the chemical analysis of the corrosion scraping samples.

Did conditions exist for aerobic microbes that produce acetic acid?

Yes.
Oxygenated areas, water, and slightly acidic pH conditions were in all USTs inspected. Ethanol (energy source) was found in 5 of 6 USTs inspected.

Were these microbes found in the USTs inspected?

Yes.
Analysis of water bottoms with sufficient extractable DNA indicated presence of aerobes, specifically from the family *Acetobacteraceae*.

Could these microbes be responsible for the acetic acid and corrosion?

Yes.
Research conducted by Ghommidh, Navarro, and Durand indicates that with sufficient ethanol and oxygen, approximately 27 grams of Acetobacter can produce approximately 600 grams of acetic acid in one week. This quantity of acetic acid is sufficient to form approximately 920 grams of iron (III) acetate (corrosion).

Are USTs suitable environments for these microbes?

Yes.
The low diversity of microbes seen in the collected samples indicates the UST diesel environment is selective for the microbes given the energy source (ethanol), oxygen, and water.

- ***Ethanol* could enter the UST in diesel fuel that has come in contact with fuels containing ethanol. Shipping tankers commonly carry ethanol fuels, jet fuels, and diesel fuels, where cross-contamination of fuel and vapor is possible. Common manifolded ventilation systems could also force gasoline and ethanol vapors into ULSD tanks.**
- ***Oxygen* enters the UST environment during fuel deliveries and as ambient air displaces fuel during fuel dispensing. Solubility of oxygen in water at 20°C is approximately 9.0 mg/L and in diesel fuel is estimated to be 200-300 mg/L.**
- ***Water* can enter the UST environment via condensation from air displacing fuel removed during dispensing, dissolved in the fuel, or from surface water entering the UST.**

Is there a mechanism to disperse the acetic acid to the vapor phase?

Yes.
- **Turbulence in the UST liquids (fuel and water bottom) during fuel delivery can mix and splash water containing acetic acid to the vapor portion of the UST.**
- **Acetic acid produced in the water layer has a higher vapor pressure than diesel fuel and can migrate through the fuel into the vapor phase.**

Figure 5. Final Hypothesis

To visit the web sites of participating members of the Clean Diesel Fuel Alliance, click on the link of your choice below:

AAA, www.aaa.com
Alliance of Automobile Manufacturers, www.autoalliance.org
American Fuel & Petrochemical Manufacturers, www.afpm.org
American Petroleum Institute, www.api.org
American Trucking Associations, www.truckline.com
Association of American Railroads, www.aar.org
Association of International Automobile Manufacturers, www.aiam.org
Association of Oil Pipe Lines, www.aopl.org
Diesel Technology Forum, http://www.dieselforum.org/meet-clean-diesel
Engine Manufacturers Association, www.enginemanufacturers.org
Independent Liquid Terminals Association, www.ilta.org
Manufacturers of Emission Controls Association, www.meca.org
National Automobile Dealers Association, www.nada.org
National Association of Convenience Stores, www.nacsonline.com
National Association of Fleet Administrators, www.nafa.org
NATSO, Inc., representing Truck Stops & Travel Plazas, www.natso.com
National Tank Truck Carriers, Inc., www.tanktruck.org
Petroleum Equipment Institute, www.pei.org
Petroleum Marketers Association of America, www.pmaa.org
Society of Independent Gasoline Marketers of America, www.sigma.org
Steel Tank Institute, www.steeltank.com
Truck Renting and Leasing Association, www.trala.org
U.S. Environmental Protection Agency, www.epa.gov
U.S. Department of Energy, www.doe.gov
U.S. Energy Information Administration, www.eia.doe.gov
Western States Petroleum Association, www.wspa.org

The Methodology by which to Manage Your Tanks and Fuel
The Fuel Doctor's Philosophy

- Use a doctor's approach to the tank and fuel contamination problems.
- If you were sick the doctor would examine you, identify and classify your illness and prescribe a treatment program.
- After gaining control of the illness, he would prescribe some preventative measures to keep you healthy.

- Contamination in fuel is like an illness, it doesn't allow equipment to run at an optimal level. Fuel must be healthy and stored in a clean environment (the tank) to perform in the equipment.

- Tanks and fuel will stay healthy with the right programs, products and services in place.

Step 1 - Identification

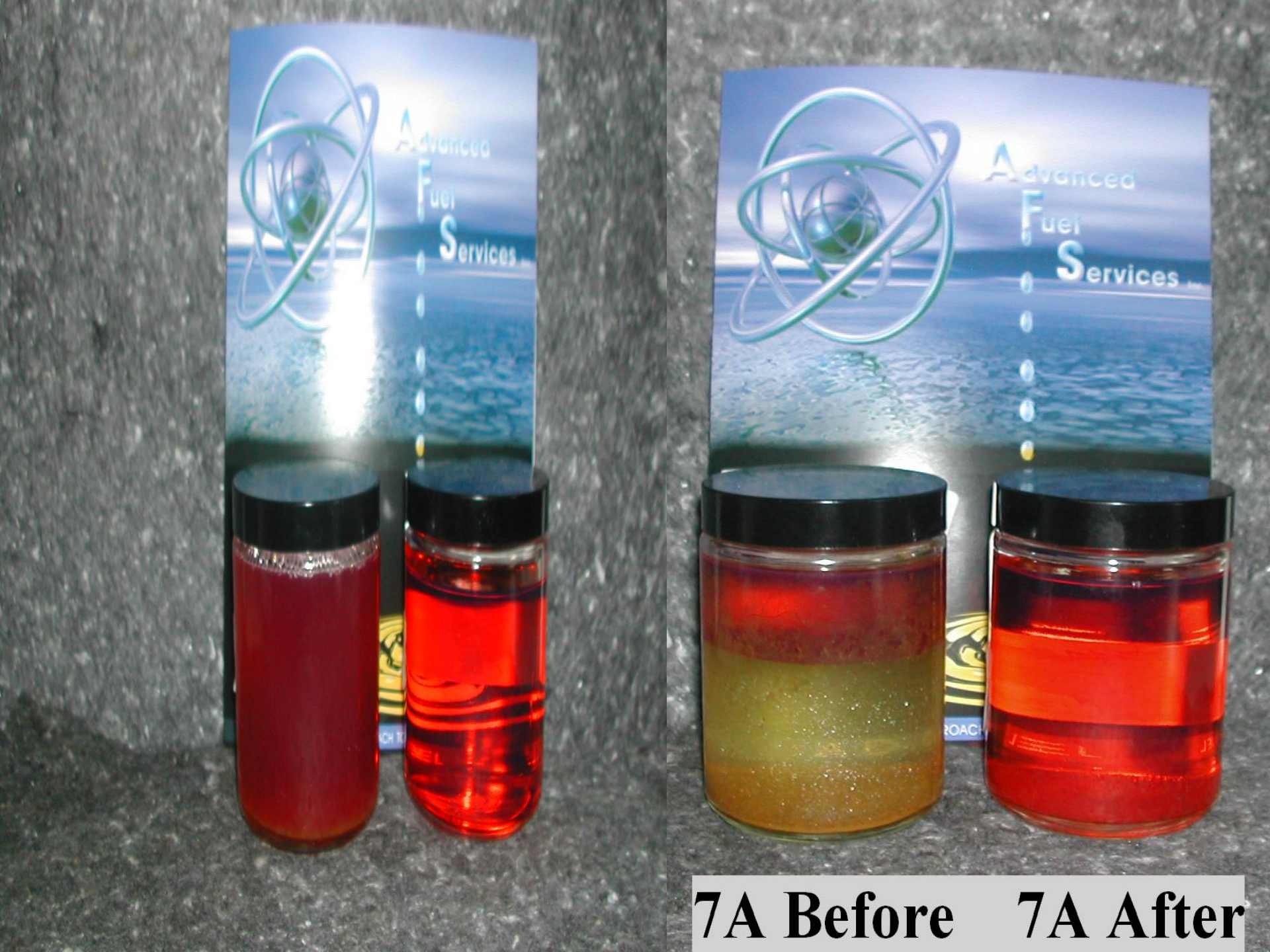
The Doctor would make an examination to identify the problems.

A sample of fuel is pulled from the tank with a portable sampling and on-site test kit. The sample is then examined to determine if contamination exists. Fuel deterioration is a natural effect with time and weather being the biggest factors. Water naturally builds up in the tank through condensation and transportation. This condensation promotes bacterial colonization and fungi growth along with clouding and gel formation. Dirt and rust, combined with water on metal surfaces, creating oxidation. The natural repolymerization process creates gums and resins, which interferes with pumpability and combustibility that lead to system shutdown. Fouled injectors begin slobbering and drooling causing more exhaust emissions and potential problems meeting EPA standards.

Step 2- Classification

The Doctor would analyze the symptoms and classify the illness.

The second step is to run an analytical test to determine the type and extent of organic and inorganic tank and fuel contamination. The results of organic and inorganic contamination are far-reaching. Your fuel becomes non-combustible and non-pumpable. Use of contaminated fuel can also lead to rapid abrasive wear and costly repairs because of clogged in-line filters and exploded injectors. Productivity is lost when your employees are forced to shift their focus from the work at hand to equipment failure and repairs.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BEVERLY HILLS
ENGINE 1


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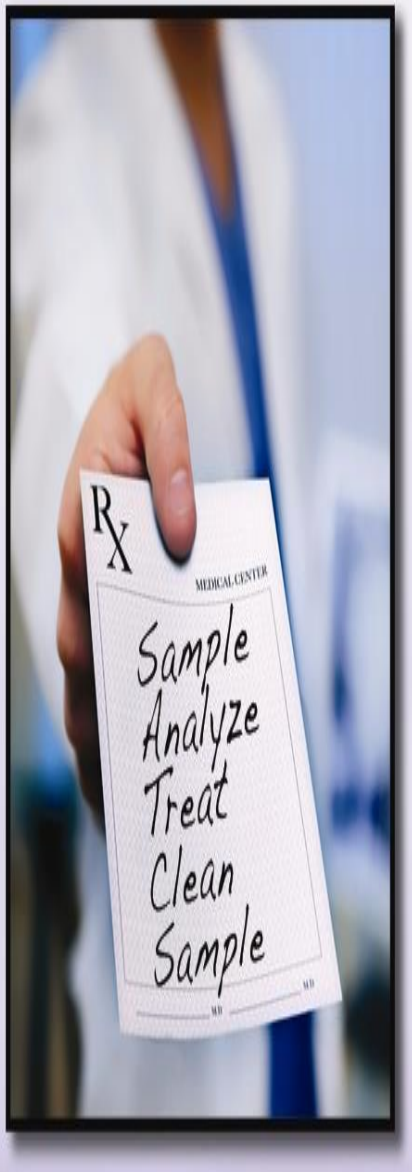
Related Components Effected by Fuel Quality

- Fuel Tank
- Fuel Transfer System
- Injection Pump
- Injectors
- Cylinder Walls
- Intake and Exhaust Valves
- Lubrication and Cooling

- Explodes Injectors
- Rapid Abrasive Wear
- Unrecoverable People Hours
- Time Bomb on Liability
- Equipment Replacement
- Down Time

Now that we have diagnosed the problem lets prescribe a program to combat the contamination.



Step 3 - Prescription of Care

The Doctor writes a Prescription of Care to gain control of the illness causing the discomfort.

After receiving the results of the analysis, AFS writes a prescription of care to correct the problems that are being experienced. Most commonly the prescription will consist of The AFS Tank and Fuel Quality Managemant Service Program. The correct dosages of AFS Treatment and a close looped multistage fuel monitoring and maintenance system, removes organic and inorganic contamination.

Most commonly the prescription will consist of:

- **Fuel Sampling**
- **Field Analysis**
- **Mobile Fuel and Tank Cleaning**
- **Fuel Stabilization and Treatment Chemistry**
- **Visual Fuel and Tank Survey**

AFS Proprietary Turbo Wash Technology

AFS Proprietary Portable Sampling and Analysis Turbo Wash , Snake, Vacuum and Video Technologies for Cleaning and Maintaining the Tank and Fuel Quality meeting

Standards and Specifications

AFS Rotary Impingement Jet Technology

Step 4 - Control

The Doctor has gained control of your illness.

If there is excessive water and bio-film build up in the tank, it must be removed. The use of AFS programs, products and services will bring your tank and fuel problems under control.

Step 5 - Prevention

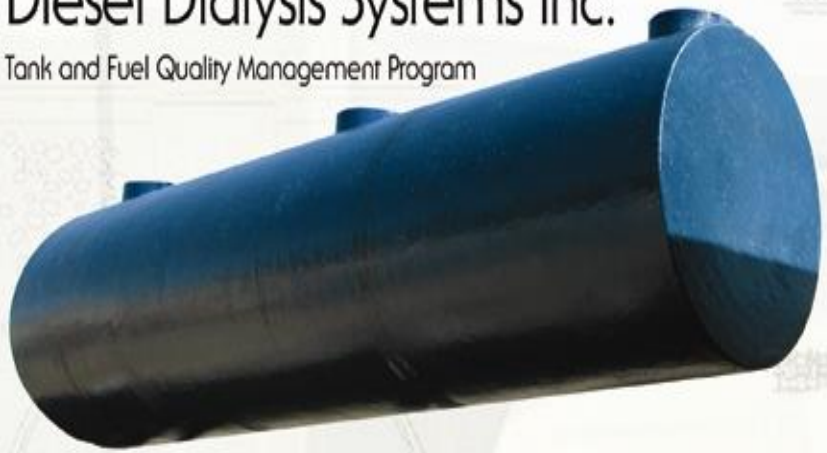
The Doctor puts you on a preventative maintenance schedule.

The final step is to provide your company with a well rounded Tank and Fuel Quality Management Program eliminating contamination before it can start.

What are you doing to insure your fuel quality meets ASTM Standards?

Diesel Dialysis Systems Inc.

Tank and Fuel Quality Management Program



- All engine manufactures adhere to ASTM fuel quality standards when designing their equipment for performance, efficiency, ecology and economy!
- Weather, geographic location, transport & storage adversely effect all fuels!
- It's been proven that fuel contaminates naturally as early as 28 days after leaving the refinery!

DDSI 4 System

- DDSI fuel monitoring & maintenance systems are fully automated.
- The system pulls the fuel from the bottom of the storage tank on a predetermined schedule or manually and runs it through a multiple stage decontamination process. Then the fuel is treated and returned to the storage tank meeting ASTM fuel quality standards.

Clean Tanks and Fuel = Reliable Power

Install a Diesel Dialysis System to regulate your tank and fuel quality standards and specifications.

Advanced Fuel Services Inc.

A Doctor's approach to Healthy Fuel

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Engineering, Sales & Service

Cell - 805.610.5234

National Service Center

www.advancedfuelservicesinc.com