Chapter 2

HEATING OIL & ITS PROPERTIES

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Chapter 2

Heating Oil and Its Properties

Introduction to petroleum

Petroleum Fuels Our Modern Life Style

More than six thousand products are made from petroleum. It is almost impossible to get through a day without using dozens of petroleum products.

Oilheat is reliable

Oilheat has a remarkable reliability record. Despite wars, embargoes, political unrest, and natural disasters, oilheat keeps its customers warm. This reliability is partly due to the variety of places where crude oil is found, the resourcefulness of everyone from the refiners to the local oil dealer, the flexibility of the delivery system, and the stability and safety inherent in heating oil.

Refining oil

Heating Oil is a fossil fuel, as are natural gas, propane, and coal. They are called fossil fuels because they are all made from the prehistoric plants and animals that form fossils.

Fossil fuels are hydrocarbons. Hydrocarbon molecules are the building blocks of life. Everything that is or was ever alive is made of molecules composed of hydrogen and carbon atoms. Carbon is normally a solid, which, if not totally burned, becomes smoke and soot. Bonded together, hydrocarbons can be a gas like propane, a liquid like heating oil or a solid like candle wax. The hydrocarbon gases contain more hydrogen; the liquids and solids contain more carbon.

Some Petroleum Products

Gasoline, jet fuel, kerosene, diesel fuel, heating oil, propane, butane, lubricating oils, greases, waxes, asphalt, nylon, plastics, fertilizers, washing, cleaning and polishing products, medicines and drugs, photographic film, pesticides, waxed paper, food preservatives, food flavorings, beauty products, Plexiglas®, vinyl, audio and video tape, synthetic rubber, synthetic fibers, textiles, explosives, solvents, wax for candles, candy, matches, and polishes, toiletries, crayons, roofing materials, floor coverings, carbon fiber, paints, lacquers, printing inks, DVDs and CDs. Five percent of our electricity generated is oil powered.

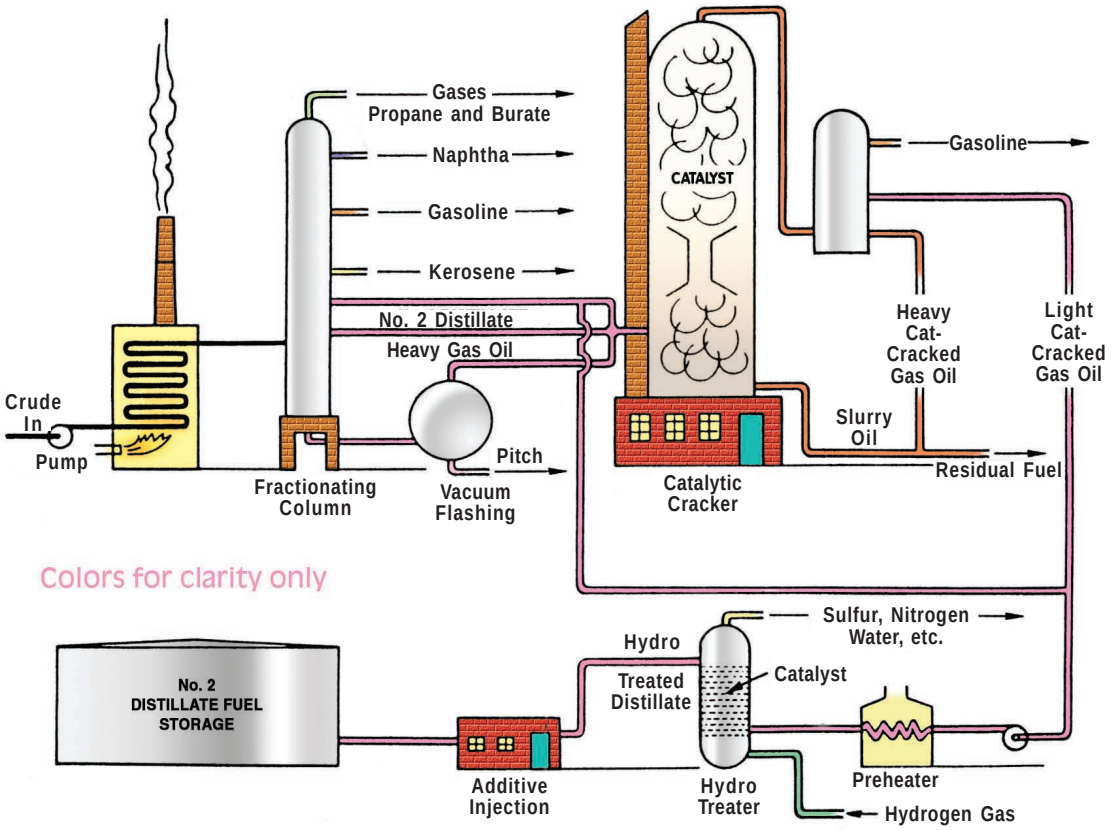


Figure 2-1: Refining oil

Petroleum comes out of the ground in the form of crude oil and wet gas. Both are a complex mix of compounds consisting mostly of the elements carbon and hydrogen. Sulfur and nitrogen are bound to some of these hydrocarbon compounds. This mixture of molecules is separated at the refinery by distillation into their various boiling ranges. Heating oil, diesel fuel, jet fuel, and kerosene are classified as middle distillates because their boiling range is in the middle of the sweep of petroleum products separated in the distillation process. Heating oil produced directly by the distillation process is called "straight run" product. Heating oil is also produced by catalytically and thermally cracking heavier, more complex molecules into the small heating oil hydrocarbon molecules. This is called "cracked" product. Blending a mixture of various middle distillate products together also creates heating oil. (Figure 2-1).

Properties of heating oil

American Society for Testing and Materials (ASTM)

ASTM publishes industry specifications for many different materials including petroleum products. The specification for Fuel Oils is ASTM D396. This standard sets the minimum specifications for the fuel.

Flash point

The *flash point* of fuel oil is the maximum temperature at which it can be safely stored and handled without serious fire hazard. The ASTM specified flash point

for No.1 and No.2 oil is 100°F minimum. When oil is heated to its flash point, some of the hydrogen flashes off but the fuel will not continue to burn.

Heating Oil's Physical Properties (No. 2 oil)

ASTM Specification:	D 396
Flashpoint:	100°F minimum (37.8°C)
Ignition Point:	>500°F (260°C)
Pour Point:	17°F (8.3°C)
Cloud Point:	Pour point temp. plus 10-20° (F)
Viscosity:	Varies: increases as temp. drops
Water/Sediment:	ASTM allowable amount of H_2O: 0.1% (Water content is usually much lower in practice)
Sulfur Content:	Ranges from 0.5% to 0.05% (5000 to 500 parts per million); ASTM maximum allowable amount is 0.5%.
Color:	Colorless, but heating oil is dyed red for tax compliance reasons. Color resembles cranberry juice.
BTU Content:	139,000 (approx.)

Ignition point

The *ignition* or *fire point* is lowest temperature at which rapid combustion of a fuel will take place in air. It is the temperature at which all the fuel has been sufficiently heated and vaporized to the point where it continues to burn for at least 5 seconds. For No. 2 oil, the ignition point is over 500°F.

Pour point

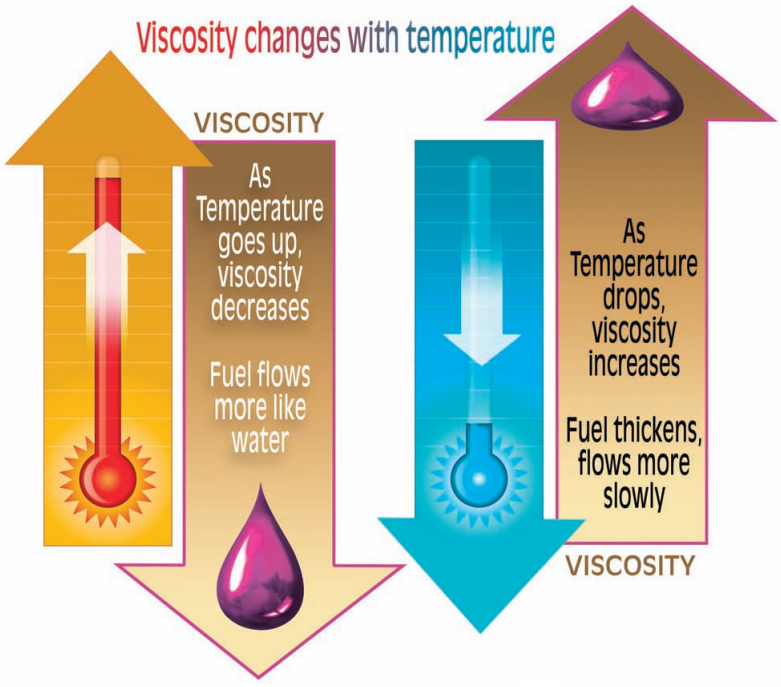
Pour point is the lowest temperature at which fuel will flow. Below this, it turns to waxy gel. The ASTM standard for untreated No. 2 oil is 17°F. Additives or kerosene are added to heating oil during the winter to ensure that it flows.

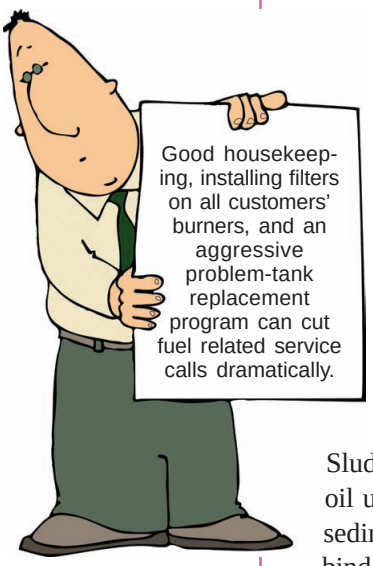
Cloud point

Cloud point is the temperature at which wax crystals begin to form in the fuel—typically 10 to 20 degrees above the pour point. These crystals can clog filters and strainers, restricting fuel flow. Raising the temperature causes the crystals to go back into solution. ASTM does not list a specification for cloud point for heating oil. Both pour point and cloud point affect winter performance, and could cause problems if the fuel is not properly treated.

Viscosity

Viscosity is the thickness of the fuel and its resistance to flow. Grease has a high viscosity. Gasoline has a low viscosity—it flows easily. Heating oil's viscosity changes dramatically with temperature. As the temperature decreases, viscosity increases. Normally the temperature of oil in a basement tank is 60°F. In the winter, you might get a delivery of 5°F oil. The colder oil will have a higher viscosity and burner





performance will be affected until the fuel warms. As stated in the Nozzle Chapter (Chapter 5), cold oil causes poor atomization, delayed ignition, noisy flames, pulsation, and possible sooting.

Water and sediment

Accumulation of water in tank bottoms is undesirable, since it leads to the formation of sludge and ice. Sludge is largely oil and water. Water and oil usually do not mix, but if organic sediment is present in the fuel, it acts as a binder to stabilize the mix of fuel and water. This forms a white milky substance that will not burn. The ASTM limit for water is 0.1%, but most fuel sold has much less water. Unfortunately, water can get into the system from condensation, leaks in lines, or missing vent and fill caps.

Sulfur content

Sulfur exists in varying degrees in all fossil fuels. The sulfur content of heating oil ranges from 0.5% to 0.05%; the ASTM maximum is 0.5%.

When the sulfur burns, it mixes with oxygen and forms sulfuric dioxide. It also creates a small amount of sulfur trioxide. The sulfur trioxide reacts with the water vapor in the combustion gases to create a sulfuric acid aerosol. If the acid condenses (at 150-200°) it adheres to the heat exchanger, flue pipe and the inside of the chimney. It creates a scaly yellow to red colored crust. Scale makes up 50% of deposits on the heat exchanger. It downgrades efficiency by 1% to 4% over the year. It also blocks flue passages, restricting air flow and increasing smoke and soot.

Using low sulfur fuel all but eliminates scale and soot formation on heat exchanger surfaces. The efficiency does not degrade over the heating season, saving energy. It also results in decreased appliance service.

Color

Heating oil is dyed red to differentiate it from on-road diesel fuel for tax compliance reasons. Problems with the fuel are not indicated by the darkness of the color. A murky appearance, however, may indicate a fuel quality problem.

Fuel related service calls

The oilheat industry's top two service priorities are improved reliability and reduced heating equipment service costs. A significant number of unscheduled no-heat service calls are caused by inconsistent fuel quality, fuel degradation, and contamination.

Heating oil varies during the season. Wholesalers get their product from around the world, from Malaysia to Texas. Each of these products is slightly different; as a result, the product in the customer's tank may be a mixture of a variety of fuels. A great deal of our product is created by blending various fuels together to meet the rather loose definition for #2 heating oil laid out in the ASTM D 396 specification. Additionally, over time, fuel degrades—water may enter the system and bacteria have an opportunity to grow. Good housekeeping, installing filters on all customers' burners, and an aggressive problem-tank replacement program can cut fuel related service calls dramatically.

Potential problems in the tank

The population of oil tanks in the field is aging. As the tanks age, rust and sediments build up in the tank. Secondly, oil has a finite shelf life and breaks down over time. The third problem is the size and speed of delivery. Filling a tank kicks-up all the sediments and rust in the bottom of the tank, and that leads to plugged lines, filters and nozzles. The solutions here are not to let the level of oil in the tank get too low, to slow down the pumping speed of

the truck, and to use diverters on the "blow or whistle pipes" (underground fill pipes) when filling underground tanks.

Major factors in fuel degradation

1. Chemistry of the fuel
   - *Heat causes the oxidation of organics*
   - *The presence of sulfur and nitrogen hasten degradation*
   - *Corrosion creates iron oxides (rust)*
   - *Presence of Gels caused by mercaptan sulfur*
   - *Incompatible fuels*
2. Microbiological effects
3. The tank and its environment—moisture, fuel circulation due to temperature differences
4. Lack of tank maintenance and poor design and installation that prevent adequate tank inspection, withdrawal of water and sediment, improper or no filtration, and lack of corrosion protection.

Fuel stability

Fuels degrade over time. If the fuels are contaminated, they will degrade even more quickly. The stability of heating oil depends a great deal on the crude oil sources from which it was made, the severity of the refinery process, the use of additives and any additional refinery treatment. Fuels that are stored for long periods of time and subjected to temperature extremes may form excessive amounts of sediments and gums that can plug filters, strainers, and nozzles.

Detecting "out of spec" oil

Occasionally, a bad batch of oil will be delivered. When that happens, there will be many service calls. If there is a spike in calls and they appear to be fuel related, you should alert your service manager. A fuel sample might show that the fuel can be fixed with additives, or the fuel may need to be replaced.

Water problems

The worst fuel problem is water in the oil tank. Water enters the tank in the following ways:

1. Condensation
2. Broken tank gauge (outside tank)
3. Loose fill or vent fittings and missing caps
4. Directly from delivery trucks
5. Leaking vent, fill pipes, or tank
6. Pumping old oil into a new tank

Sludge

Sludge is a combination of water, colonies of bacteria, degraded fuel, and other contaminates like sand, grit and rust. The ability of bacteria to grow almost anywhere and reproduce amazingly fast makes it an all too common problem. The bacteria live in the water and eat the fuel. They break the fuel down into hydrogen, CO_2, and carbon rich residue. The bacteria also create sticky slime or gum to protect themselves. Scientists call this slime "biofilm." This deterioration of fuel is a natural occurrence that will appear in all tanks unless proper maintenance is performed. The sludge grows at the oil-water line and when stirred up can to lead serious and recurring service problems—most notably plugged fuel lines, filters, strainers, and nozzles. Sludge is acidic and may eventually destroy the tank from the inside.

To reduce sludge formation:

• Never pump oil from one tank to another. You may be transferring tank killing sludge.

• Slow down delivery rates—high pressure filling can stir-up existing sludge causing it to be drawn into the oil line.

• Routinely check the tank for water—once you have removed the water, if possible, clean the sludge from the tank and treat the tank with a fuel conditioning additive.

• Draw the oil from the bottom of the tank—As water will condense and collect in all tanks, it is best to draw off the water as if forms. It will burn off in the combustion process. Allowing water to accumulate will create conditions favorable for the formation of sludge.

• The exception to this rule is outdoor above ground tanks. In cold weather, the water in the bottom suction line may freeze, causing a blockage and no heat. It appears that the best solution to this problem is to run the suction line into one of the top tappings on the above ground tank, use a floating suction line device, and regularly remove the water that condenses in the bottom of the tank.

Low temperature performance

As oil gets cold, several bad things happen. First, any water in the fuel freezes, plugging lines and filters. Second, the viscosity of the oil begins to increase, causing burner operation problems. Third, wax crystals begin to form in the oil. This wax or paraffin is a natural component of heating oil. Oil temperature is the main factor in changing oil viscosity. As the temperature of the oil goes down, the viscosity goes up. The oil gets thicker, which can cause a smoky fire.

How to deal with "frozen" tanks and oil lines

Cold-flow additives, called *Pour Point Depressants*, can help avoid frozen lines, but once the tank or lines have frozen or waxed, other solutions are needed.

The best solution is to top off the tank with kerosene. The agitation of the fuel in the tank caused by the kerosene delivery and the solvency of kerosene break up and dissolve the wax crystals. You may also have to remove the filter temporarily, convert to a one-pipe system and heat the suction line with a hair dryer or heat lamp.

If you are unable to arrange for a delivery, some technicians report that adding as little as five gallons of kerosene can help.

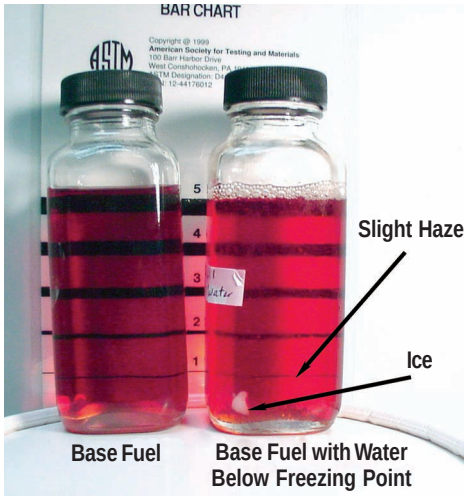
Others report having success "shocking" the tank with a pour point depressant. You may have to build a temporary shelter for the tank out of plywood or cardboard, whatever is at hand, and then use a heat lamp or hair dryer to warm up the lines enough to get the oil to flow. Be very careful with heat tape. If you wrap a heat tape over itself, it can burn through its own insulation causing a short that can result in a fire. The insulation on the wires can also crack with age and exposure to the elements creating potential for a fire.

Quick tests for fuel quality:

Clear and bright test

The purpose of this test is to detect possible water or solid contaminants in the fuel by visual inspection. Using a clean glass container, take the sample at the bleed port of the fuel unit. Be sure the fuel sample tap (the bleed valve) is clean and free of loose contaminates by flushing it out at maximum flow before drawing a sample.

Let the sample settle for a minute to remove the air bubbles. Observe the sample against a light background for a clear



bright condition. The sample should look more like cranberry juice than red wine. Swirl the container to create a whirlpool. Free water and solids tend to collect at the bottom of the whirlpool. The term "clear and bright" does not refer to color. "Clear and bright" fuel has no floating or suspended matter, and no free water. Bright fuel tends to sparkle.

White bucket test

This is a good quick test for drivers to be sure you are filling your truck with good fuel. The purpose of this test is to visually determine the possible presence of contaminants and water in the fuel.

Fill a clean white bucket half way with fuel and let the sample stand for a minute to remove the air bubbles. Place the bucket on a level surface with good light in the bucket. Inspect the fuel, it should be clear and bright with no water, or solids. It should not be hazy or cloudy, and there should be no brown or black slime. Drop a shiny coin into the bucket. If you can easily read the date, the fuel is probably OK. The fuel should also smell "normal." Strange odors can indicate problems. With either the 'clear and bright' or 'white bucket' test, a haze caused by wax crystals may appear in the fuel if it is too cold. A haze in fuel that is not too cold may be due to contamination with water.

Visual detection of bacterial contamination

The 'clear and bright' and 'white bucket' tests can also be used for testing tank bottoms, filter cans, and fuel pump drainings for the presence of microorganisms and sludge. There will be evidence that can be seen and smelled.

Put the fuel into a clean white bucket or clear glass jar. Allow the sample to settle for two minutes. Tip or swirl the container from side to side, looking for any evidence of dark colored solids, dark colored water, substances that cling to the side of the container, or a scummy mucus like material. Hold the sample in front of a light. Check to see if the solids are rust. Move a small magnet along the outside of the container. Rust particles will collect and follow the magnet. If the sample is a dark-colored, sludge-like material and it does not respond

to the magnet, then it is probably bacterial contamination.

Other indicators of these microorganisms are a matty, lumpy, or stringy consistency and a rank moldy odor.

Water detection paste

Water detection pastes determine the depth of water at the bottom of the storage tank. Apply the paste in a thin coating on a gauge stick from zero up to a couple inches above the suspected oil water interface. Carefully lower the stick into the tank until it lightly touches bottom. Hold it in this position for 30 seconds to a minute. Remove the stick— the water level will be clearly indicated by a definite color change where water contacts the paste. Water paste will not detect an oil-water emulsion. You should check customers' tanks for water once a year, and then drain off the water if detected.

Oil filtration

The installation of filters in burner fuel suction lines is strongly recommended. Filters protect the pump and nozzle by trapping contaminants before they reach these components. There are passages in the oilburner nozzle that are smaller than the diameter of a human hair. It takes very little contamination to plug up these passages in the nozzle. This is why it is critical to do everything to be sure clean oil is delivered to the burner.

There are a wide variety of filters available, but they all fall into one of two categories: spin-on filters and cartridge type filters. The spin on filter is similar to the oil filter on your car. The filter container, or can, and filter element (resin-coated filter paper with large surface area folded into a filter housing) are all one piece. The cartridge type has a replaceable filter element cartridge that you place into a filter can that attaches to the filter head. See Figure 2-2.

Filter elements are made from a variety of materials, including: wool felt, wound yarn, sintered plastic in a continuous micro-spun fiber, resin-coated paper, and stainless steel mesh. Filters are sized by flow rate gallons per hour (GPH) and pressure drop (*inches mercury Hg*). Each filter also has a micron, or mesh rating. These ratings represent the amount of pressure drop or filtration capability. The rating means the filter will remove 95% of the particles of that size or larger. A lower micron/mesh rating indicates a tighter filter construction, able to remove finer particles.

Filter elements made from sintered plastics with pore sizes in the range 30-75 microns and large surface area or spin on filters with resin-coated paper in the 10 micron range seem to work best. Most fuel units contain a 100 micron mesh strainer.

Nozzles also have a mesh or sintered bronze filter nominally rated for filtration to 40 microns. The tangential metering slots—the things that get plugged up in the nozzle—are typically 60 to 90 microns. Grease or dirt on your fingers can plug the nozzle, so they must be carefully handled. Felt and wound yarn filters may shed fine fibers that may clog low firing rate nozzles. See Figure 2-3.

To be fully effective, a modern filter must stop particles from reaching the

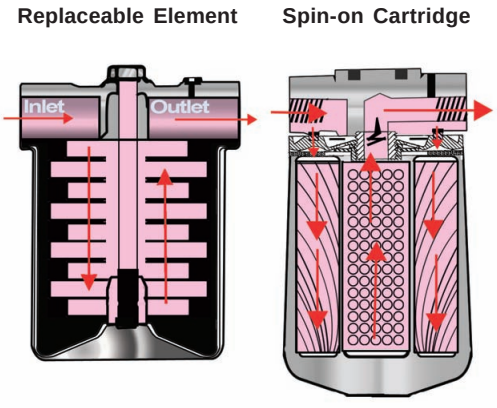


Figure 2-2: Filters: Cartridge type and spin-on

nozzle. There are two approaches to how a filter should react when it is full. Some filters allow oil to bypass the filter when the element is full; others are designed to stop the flow of oil when they are full.

While the filters that will not allow bypass will cause a no heat call when they are full, they ensure that no particles reach the nozzle. With the bypass type filter, once the filter is full, it will allow the contaminants to flow down stream and plug the pump strainer and nozzle. This will take longer to happen, but when it does, it will require work on the burner.

Many service managers are now advocating the installation of two filters on problem installations. They install a large standard cartridge bypass filter at the tank and a 10-micron no-bypass spin-on filter at the burner.

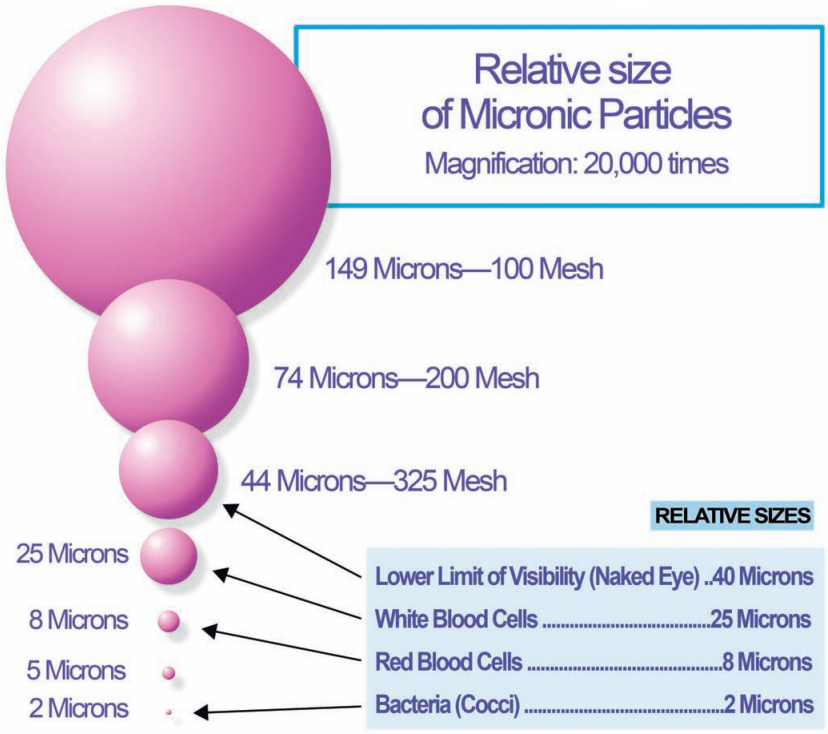


Figure 2-3: Relative size of micronic particles

Filters and sludge

Filters may fail because they have become blanketed with biologically active slime or sludge. The resulting black or gray "ball of grease" is a tough service problem. This sludge is not material that has been sucked from the tank; it is alive and actually growing in the filter.

When small particles of sludge in the oil tank are drawn into the oil line, the bacteria in these particles look for moist places to reproduce. If there is any water pocketed in the bottom of the filter canister or if there is water emulsified in the fuel, they can grow their biofilm. Contrary to popular belief, there does not have to be a layer of free water in order to support the growth of biologically active sludge. There is always some water dissolved in the fuel. This is why sludge can sometimes grow faster on filters and strainers than it can in the tank.

The rate at which sludge grows depends on the temperature and the availability of moisture and nutrients. Filters may plug, even with new tanks and lines. The "seed" sludge particles can arrive with the fuel from a contaminated tank upstream in the distribution system. They can be drawn directly into the suction line before they have a chance to settle to the bottom of the tank. If the conditions are right, a filter can plug within weeks of installation, even with

Steps to Better Fuel Performance

✔ Before removing the fill cap for a buried tank, the driver must be sure water, dirt, snow or ice cannot fall into the tank. After delivery, drivers should check gaskets and O-rings if needed on the fill cap to be sure they are in good shape, reinstall the fill cap, and make certain it is sealed tight.

✔ While making a delivery, the driver should check to be sure the vent cap is in place, there is no water around the fill, the vent pipe is solid, and there is no water in tank.

✔ On above ground outdoor tanks: are the tank legs stable on a solid foundation? Are there signs of rust, weeps, wet spots, deep scratches, or dents on the tank surface, oil leaks, or signs of spills, and does the tank need painting?

✔ Sampling of tank bottoms should be done routinely (during the tune-up) for cleanliness and lack of water.

✔ If excessive sludge and water are found, they should be removed as soon as possible.

✔ Hold up on deliveries to problem tanks until the sludge and water problem is solved.

✔ Once the sludge and water are removed from the tank: fill the tank with kerosene or specially treated fuel, tune-up the burner, hand-pump the oil lines thoroughly, then replace the filter, strainer, and nozzle. Schedule a follow-up call a month later to see to it that the tank and lines remain clean.

✔ The tank's fill boxes, fill pipes, vent caps and pipes and remote fills should be checked for cracks and leaks on every delivery and tune-up. Often the problem is a hole in the vent pipe just below ground level. Dig a few inches of soil away from the vent to check for rusting. If the fill box is in a driveway, it should be a "mushroom-type" fill box with a watertight gasket rather than a metal-to-metal fit.

✔ When additives are used, they should be added before filling the tank, if possible, to facilitate proper mixing.

an immaculately clean tank. Also, sludge is corrosive. Untreated sludge can attack the steel filter housing, causing pinhole leaks.

The answers to sludge fouling of filters is good housekeeping throughout the distribution system, keeping water out of tanks, and removing existing water. In problem jobs, the use of an effective sludge-control additive may be required. If you treat an already fouled system with an effective sludge dispersant, tiny dark particles are released from the biofilm as it breaks down. These particles are similar to those that result from fuel instability. Unstable fuel is usually dark in color—burgundy cherry to coffee colored. In both cases, the double filter system described above seems to the best answer.

Replacing the oil filter element

Cartridge type filter—shut off the oil then loosen the nut on the top of the filter head and lower the can from the head. (Use caution; the can is full of oil.) Remove the element and the gasket and clean inside the canister. Inspect the old element. Excessive sludge or evidence of water calls for action. Check the inside of the can for pitting and rust. Install the new element and new gaskets, reassemble, open the oil valve, and bleed the air out of the filter through the bleeder.

Spin-on type—shut off the oil and using a filter wrench, loosen and spin off the oil cartridge. Cut and remove the old center stud "O" ring and replace it with a new "O" ring. Remove the outside filter gasket on the new filter and apply a thin coat of petroleum jelly to both sides of the gasket. Carefully replace the filter gasket. Fill the cartridge with clean oil and spin it onto the filter head. Bleed the air from the filter.

Fuel additive treatment

Additives are designed to prevent or retard fuel deterioration. Numerous types of additives are available on the market. A successful fuel treatment program requires knowledge of the quality of the fuel in the tank and the specific service problems. Using an additive off the shelf without testing may be more harmful than doing nothing at all.

Selection of additives: The multifunctional aftermarket additives available for heating oil are proprietary products that offer a range of properties.

Guidelines:

- Define the problem and the additive that is needed.
- Make sure the fuel sample being tested represents the fuel being treated.
- Will the additive be used once, or is continuous treatment required?
- Does the additive perform more than one function?
- Does the additive supplier have technical support if there are questions or problems?
- Can the supplier provide a way to determine effectiveness in specific cases?
- Follow all safety and handling instructions on the labels and Material Safety Data Sheets that should accompany the package.
- Follow the recommended treatment rates.
- Properly dispose of the additive containers. Know and follow the local laws concerning disposal of sludge and water bottoms.

Types of additives:

Cold flow improvers: Flow improvers are designed to lower the cold temperature operability limit for the fuel, and to avoid wax plugging of the filters. Pour point reducers or anti-gels lower the temperature at which fuel gels or solidifies, and cold filter plug point reducers lowers the temperature at which wax plugs the filter. Once wax has formed in the fuel, an additive will not change the waxes present. To dissolve wax, a solvent such as kerosene, must be used.

Dispersants: Dispersants or detergents keep the little chunks of junk floating in fuel so they can slip through the fuel system and be burned, rather than letting them settle to the bottom of the tank. Initial use of dispersant may cause filter plugging as existing deposits, sludge, and dirt are broken up, suspended in the fuel and picked up by the pump.

Antioxidants and metal deactivators: Fuel degradation caused by oxidation or aging leads to gum deposits. Antioxidant additives can slow this process. Dissolved metals, such as copper, can speed aging and degradation, and produce mercaptide (sulfur containing) gels. To minimize these effects, metal deactivators combine with the metals and render them inactive. Periodic monitoring of fuel stability is recommended if these additives are being used.

Biocides: Serious problems can arise from microbial proliferation, including sludge formation, acid and surfactant formation leading to operational problems. (Translation: Critters can grow in the oil

Figure 2-4: Tank shed covering an outdoor, above ground tank

tank. They create a sludgy mess that will cause lots of no heat calls.) Biocides kill or prevent the growth of bacteria and other microorganisms. They must be fuel-soluble and must be able to sink to the water in the bottom of the tank where all the microbes live. Microbiological organisms in fuel are bacteria, molds, and yeast. Since biocides are poisons, you have to very careful. Read the label to determine product use, treatment rate, and human exposure hazards warnings.

Preventative maintenance

Good housekeeping means doing everything you can to minimize dirt and water from entering tanks. Water promotes the growth of microbes, which use the fuel as a food source, and accelerates the growth of sludge and internal corrosion of the tank. Water can enter the tank through cracked or leaking fill pipes and vents. They should be checked periodically and whenever water contamination is suspected. Varying air temperature and humidity can cause condensation within the tank. Dirt and debris are generally introduced into the fuel through careless handling.

Use of rags for cleaning components

The rags used for cleaning can be a source of trouble. Using a rag contaminated with sludge or microbes can introduce these contaminates to a clean system. Also, if they are of a loose weave or have frayed edges, strings or fibers, lint from these rags can get into the system and plug the nozzle.

Tank cleaning

With massive accumulations at the bottom and on the sides of the tank, mechanical cleaning, fuel filtration, the use of additives and a preventative maintenance program are the only way to effectively remove the sludge. Portable tank cleaning/filtration machines are available. Their effectiveness depends upon the condition of the tank, access to the interior, and the operator's skill. Before attempting to clean the tank, let the burner draw the oil down as low as possible to minimize the amount of fuel you will have to dispose. There are companies that offer tank-cleaning service. However, cleaning a residential heating oil tank is usually expensive and difficult, and a tank replacement may be more economical and effective.

Tank replacement

If the tank has gone too far, tank and fuel treatment remedies will only buy you some time. A tank's surface contains microscopic pits and craters where bacteria can 'hide." Once fresh fuel is added and a bit of water condenses, the bacteria can reproduce at an astounding rate and sludge formation begins. Often, the only solution is to replace the tank and oil lines. Never pump the oil from the old tank into the new one.

You will be transferring contaminates that caused the problem in the first place. It will take surprisingly little time to make the nice new tank as dirty as the old one.

If you are installing (or maintaining) an outdoor, above ground tank, it is recommended you paint it a light color to reflect the light. This will help keep the tank cooler and minimize moisture condensation inside the tank. Also, there are several types of tank sheds available, Figure 2-4. They minimize water build-up and frozen lines as the tank temperature is steadier.

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Keep the tank full

Topping off oil tanks, especially outdoor above ground tanks in the spring, helps prevent condensation—the less air in tank, the less condensation.

Bioheat fuel®

Biofuel is a renewable, biodegradable combustible liquid fuel. Biofuel is manufactured by processing vegetable oils such as soy and rapeseed (canola). It is also made from waste cooking oils and trap grease, tallow, and animal fats such as fish oil. Biofuel has an ASTM specification D6751 for pure biofuel (B100). It has 10-12% oxygen, so it will increase excess air to the flame. Its heating value is 125,000 Btu per gallon. It has a slightly higher density and higher cloud and pour points than #2 oil.

Bioheat fuel® is a blend of 95% or more #2 oil and 5% or less B100 biofuel. We call a 5% blend B5. Bioheat can be used in oilburners with little or no modifications to the equipment or operating practices. While flashpoint is higher, ignition with blends of 5% or less is no problem. The viscosity is higher, yet still within ASTM limits for heating oil; but flow rate and atomization are similar. Bioheat will create slightly less deposits on the heat exchanger thanks to the reduced sulfur levels.

Bioheat fuel® has strong public appeal as a renewable fuel. It has good lubricity that will help with low sulfur fuels. It increases our fuel source diversity, reducing dependence on foreign crude and is a potentially huge market for American agriculture.

Summary

Most of our fuel problems are created in the customer's tank and heating system long after delivery. Oilheat reliability is dependent on the technicians in the field, keeping customer's systems operating at peak safety, dependability, and efficiency.