Grower 101:

Heating Systems — Maintenance Pays

How to keep winter heating costs from skyrocketing.

By John w. Bartok, Jr.

According to the U.S. Department of Energy, natural gas prices will triple this winter. (For more information see Headlines in the August 2003 issue of *GPN*.) With the continuing unrest in the Middle East, propane and fuel oil will probably follow suit. Now is the time to get your heating system tuned up for the long, cold winter ahead.

Heating systems are complex compared to materials handling systems or watering equipment. Everything, including the burner, controls, fuel supply, heat distribution system and chimney has to be clean and in proper adjustment to get maximum heat output. An increase in efficiency of only 2 percent in the heating system for a 30- x 100-foot greenhouse can save 285 therms of natural gas, 330 gal. of propane or 200 gal. of fuel oil this winter. This will more than pay for a tune-up.

A competent service person should clean and adjust all furnaces and boilers at least once each year, preferably before the heating season begins. The following are the most important things that should be checked.

COMPONENTS TO SERVICE

Gas Burners. The combustion process is similar for natural gas and propane. Due to the differences in heat output of the fuels, different burners are needed. Ideally, the flame should burn as blue as possible for maximum heat. Yellow tipping of the flame is caused by insufficient primary air and indicates incomplete combustion that causes soot formation. A dirty orifice or one that is out of line can reduce the primary air.

Unstable flames from the burner ports are an indication of air drafts from leaks in the firebox or a cracked heat exchanger. This can lead to incomplete combustion and smoke if the flames impinge on cool surfaces. The leaks or cracks can be a source of flue gases that get into the greenhouse and injure plants.

Gas Supply. Inlet pressure and manifold pressure should be checked to be sure they are properly set. Low pressure may occur when several heating units are supplied from a single source.

Supply pipe size needs to be adequate for the Btu-per-hour output of each unit. After visual inspection of the supply piping, turn on the gas and check for leaks at all fittings using a water/soap solution. During the winter, maintain adequate gas in propane tanks, as low pressure can lead to an inadequate supply to burners on cold nights.

Gas valve, overheat control and standing pilot or spark ignition should be checked for proper operation and safety. The burner manifold and nozzles should be brushed off with a bristle brush and cleaned with compressed air. Electrical connections should be tight and clean.

Oil Burners. Only a few parts typically need maintenance on oil burners. The firebox is designed for a limited range of heat capacity; therefore, the nozzle should be replaced with one that has the manufacturer's recommended type, capacity and spray pattern.

The filter removes particulate matter, mold and slime before the oil reaches the nozzle. It needs to be replaced once or twice per year. Filters can usually be purchased locally from a heating supply store or a home center.

The fuel pump provides the pressure to force the oil through the nozzle. There are very few problems unless the pump is worn. The pressure that the pump develops should be between 100 and 120 psi. It can be checked with a pressure gauge in the bleeder plug. Pressure that is too low will produce a large droplet size that may cause smoke.

The new 14,000-volt electronic igniter is better than the older style 10,000-volt transformer for providing a spark source. Both should produce a 1-inch spark jump between the two contacts. Use an insulated screwdriver ➧

Top to bottom: Multiple boilers or furnaces increase efficiency and provide back-up insurance but increase yearly maintenance costs; Placing fuel oil tanks inside reduces midnight alarm calls due to cold oil flow problems; Extend the chimney above the peak of the greenhouse to improve draft. Add a cap to prevent back drafts; Tight greenhouses require a source of make-up air to the burner or a separate combustion air system. (Photos courtesy of John Bartok)

Top: If you have more than five heating units, a $300 combustion test kit will pay for itself in improved fuel efficiency; Right: Locate thermostats and sensors in an aspirated box in the plant zone.

for safety. A gap of less than ½ inch usually indicates ignition problems.

Electrodes provide the spark for igniting the fuel in the firebox. They need to be cleaned and checked for cracks and should be adjusted to the position specified in the maintenance manual. The distance from the nozzle tip and spark gap are critical for smooth ignition.

Flame monitoring devices in the firebox can be either light or heat sensors. Smaller heating units usually use a cadmium phototube (cad cell) that sends a signal when activated by light from the flame. Larger units employ sensors that detect the heat in the fire. Both types need to be positioned accurately and cleaned to remove soot.

Safety devices are an important part of all heating systems. Fan and limit switches, aquastat, combustion relay and safety timing relay should be checked for positive operation using a test light or multimeter.

Fuel Oil Supply. Twenty percent of service calls are a result of dirty fuel. A combination of old oil, condensation and bacteria fill the filter quickly with a black slime. Biocides, filtration or water stripping (drawing off the water from the bottom of the tank) are effective ways to reduce the problem.

Low oil temperature from outside tanks is another problem causer. As oil cools below 20º F, its viscosity (resistance to flow) increases. Water droplets in the oil freeze and paraffin precipitates out clogging the filter. Moving the tanks inside, adding a fuel treatment (kerosene), applying heat tape (check building codes to see if this is allowed) and raising pump pressure slightly will reduce the problem.

Chimneys. To get an adequate draft, the chimney or stack should be at least 2 feet above the peak of the greenhouse or headhouse. A rule of thumb is that for each 1 foot of horizontal run of the connector, you need 2 feet of vertical connector. The top of the chimney should be at least 8

feet above the top of the furnace. Add a chimney cap to prevent backdrafts.

Chimney size should be the same size as the furnace or boiler connection. Connections should be airtight and held in place with three sheet metal screws.

Make-up Air. For each gallon of fuel oil burned, 800 cu.ft. of air is needed. With modern, airtight greenhouses, a separate source of make-up air should be provided, otherwise incomplete combustion can occur with reduced heat output. Unless you have a separate combustion furnace or boiler, provide a make-up air vent or air intake pipe near the heating unit. It should be sized to 1 sq. inch per 2,000-Btu-per-hour capacity. The inlet should be above the snow line and screened to keep out rodents.

COMBUSTION EFFICIENCY TESTS

To help in making final adjustments, an efficiency test should be made. This 10-minute procedure can help to save considerable fuel over a heating season.

For atmospheric injection gas burners, carbon dioxide level, flue gas temperature and draft diverter measurements are taken, and gas pressure and secondary air adjustments are made to get peak efficiency. For large system power gas burners with forced draft, adjustments are made at the blower. Testing to meet state statutes, Occupational Safety & Health Administration standards and insurance company requirements is also required.

On oil burners, measurements of draft intensity, smoke level, flue gas temperature and carbon dioxide content are usually taken. Draft intensity varies with outside temperature, wind speed, chimney height and temperature. For smaller size units, a draft of 0.04-0.06 inches of water column in the first section of the flue pipe is desirable. Too little draft increases smoke levels, too much draft reduced efficiency.

A barometric damper in the flue pipe is used to reduce fluctuations in the draft. Smoke is an indication of incomplete combustion. A smoke scale reading of one or two is desirable. Higher levels result in deposits of soot on heat absorbing surfaces.

A flue gas carbon dioxide reading of 10 percent or higher and a temperature of 600º F or lower will give an efficiency of about 80 percent. Adjustments to the burner motor and air gate opening will help to obtain the highest efficiency.

FINAL THOUGHTS

Two other system components should also be checked. Clean the sensing element and any exposed contacts in thermostats several times per year. Locate all thermostats together in the plant zone to give the best temperature response.

Insulate hot water distribution pipes in unheated areas. Each uninsulated linear foot of a 2-inch supply pipe will loose about $4 worth of heat this winter.

Maintenance is an ongoing process with all heating units. Use a log sheet to record all important operating data, procedures for testing and corrective measures that were taken. GPN

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