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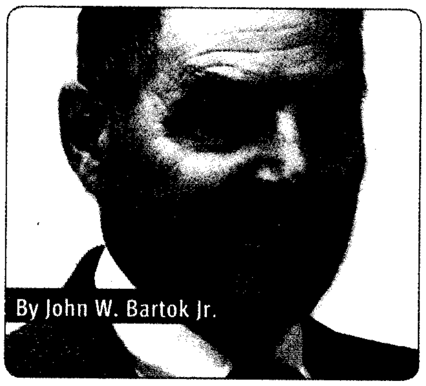
72. Upgrade your heating systems now. Bartok, J. W., Jr. Greenhouse Management and Production 28(8):66-67. 2008.



Upgrade your heating systems now

WITH FUEL PRICES INCREASING rapidly, growers need to evaluate heating system options available before making a decision on purchasing new or replacement equipment. A furnace or boiler should be replaced when it is no longer safe, when it has an efficiency of less than 75 percent or when its emissions are more than 10 percent above recommended U.S. EPA standards. Design and installation of a new system should be guided by a professional familiar with greenhouse conditions and environment control. You should also expect startup training and maintenance instructions.

When selecting equipment for gutter-connected or multiple freestanding greenhouses, consider installing a central-boiler system. This provides many options including easy heat distribution through unit heaters, sidewall fin piping or root-zone radiation. For hoop houses operated mainly during fall and spring growing seasons, hot-air furnaces or unit heaters are still the best choice as the heating system does not require draining for winter. Air circulation is needed with both systems to provide uniform temperature.

Condensing boilers

Water vapor is a byproduct of the combustion of gas or oil. This water vapor, which has a temperature of 400°F to 500°F, along with the other byproducts normally goes up the stack and is exhausted into the atmosphere. A condensing boiler incorporates an extra heat exchanger in the flue gas exhaust system so that the water vapor condenses back to a liquid. This process captures up to 8,000 Btu of heat per gallon of condensate, which is as much as 13 percent of the original fuel energy. The condensate heats the incoming air (if an air-to-air heat exchanger is used) or pre-heats the water (if an air-to-water heat exchanger is used). After the heat is removed, the low-temperature condensate water can be drained through a PVC pipe.

Condensing boilers work best where the return water is cool such as in a root-zone system where the water temperature is less than 100°F compared to a fin radiation system where the water temperature may be 140°F or higher. More of the heat can be transferred to the water. The efficiency is also affected by the humidity of the air. Under the right operating conditions, condensing boilers can achieve an efficiency of 95 percent or higher.

Condensing boilers tend to be more expensive than conventional boilers but with fuel prices escalating, the payback period continues to decrease.

Low-mass boilers

The amount of water storage in today's boilers continues to decrease. This results in a unit with smaller physical dimensions that takes up less space in the boiler room. It also means that there is less heat loss when it is on standby.

Although cast iron provides a longer life, many manufacturers now use steel for the firebox and heat exchanger to reduce the mass. Some also incorporate an extra pass for the flue gases to reduce the flue gas temperature more. With low mass boilers, there is more concern with thermal shock where the water returning from the piping system cools the firebox too much. This can put a stress on welded joints and castings.

Combustion technology

In a conventional burner, the fuel is injected continuously under pressure. It mixes with the air to the correct fuel-air ratio. Pulse units have been developed that operate similarly to a combustion engine.

The fuel-air mixture in a pulse burner is injected into the firebox at 60 to 70 times a second. An ignition spark starts the burning process. Once the unit heats up, it operates without the spark. Pulse burners tend to have a higher efficiency due to the greater uniformity of the fuel-air mixture and the finer atomization. Efficiencies of more than 90 percent are common.

Combustion of fuel requires air to provide the oxygen. About 10 cubic feet of air per minute is needed per boiler horsepower (33,475 Btu). In a conventional furnace or boiler, this air is generally supplied from cracks around the doors or vents or from a louver located in a sidewall near the heating unit. This cold air can create drafts that affect plant growth. The general recommendation is to provide 1 square inch of opening per 1,000 Btu per hour capacity of the heating unit.

Separated air burners receive all of the make-up air from outside the greenhouse through a wall vent and piping that is directly connected to the burner. This supplies dry air which is less corrosive than the nor-

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mal moist greenhouse air. It can also increase efficiency slightly.

Heat storage buffer tank

This technology has been around since the 1970s when it was part of many solar-collection systems. A large insulated water tank is part of the heating system. Hot water from the boiler is circulated through a heat exchanger to heat the water in the buffer tank. At night when heat is needed, the hot water from the tank is circulated through the heat pipes or unit heaters in the greenhouse.

This system allows a smaller boiler to be installed as it can be operated continuously day and night. Wood-fired boilers work particularly well with a buffer tank as they absorb the variable heat output from the combustion process that is not as easy to control as with fossil fuels.

Heating system controls

Solid-state controls are now part of most heating systems. Water temperature modulation should be incorporated into most boiler systems as it allows lower-temperature water to be circulated through the radiation as the heat needs decrease during the day.

Adjusting the water temperature based on the outdoor temperature and predicted weather conditions can save considerable fuel over the heating season. Purchase a boiler with a turn-down ratio of at least 5 to 1.

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