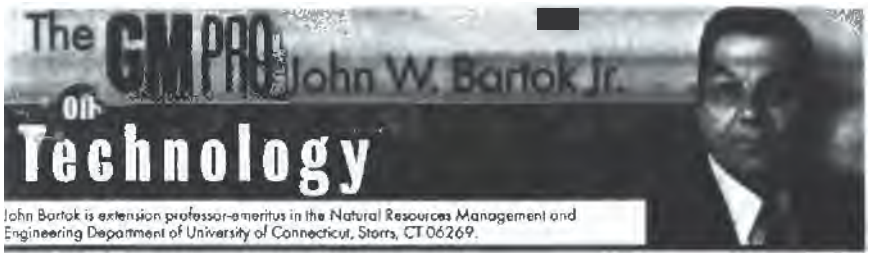

Coal provides heat alternative

Coal use in the United States reached a peak about 1910 when fossil fuels became plentiful. At the present time, its use is limited mostly to electricity generation and a few larger industrial plants. With more than 1,600 billion tons of known reserves, it has great energy potential for the foreseeable future. There are 1,400 mines in 23 states supplying more than 1.1 million tons per year. Coal is available within proximity to most greenhouse operations.

What is it?

Coal is a combustible rock with origin in the accumulation and partial decomposition of vegetation that dates back more than 300 million years. Peat is the first step in the transformation of vegetation to coal.

Over time and with greater pressure, soft coal (bituminous) is formed. It has a high heat value (12,000 Btu per pound), high ash content (10 percent) and medium ignition temperature (750°F-850°F). Bituminous coal is found in many areas of the United States. Add another 100 million years and you get hard coal (anthracite) with a slightly higher heat value (13,000 Btu per pound), lower ash content (6 percent) and higher ignition temperature (925°F). Most of the anthracite supply is in Pennsylvania.

Heat value

One ton of coal contains about 24 million Btu. It is equivalent to 175 gallons of No. 2 fuel oil, 240 therms of natural gas, 260 gallons of propane, 3 tons of green wood chips or 1.4 cords of hardwood. Most coal furnaces and boilers have a heating efficiency of 70-80 percent, which is slightly lower than fossil fuel burners.

After coal is removed from the ground, it is sent through a crusher and then graded for size. The stoker grade of bituminous and the buckwheat and pea size of anthracite are used for stoker-fed units.

Delivery is usually by trailer truck directly from the mine. Coal at the mine is relatively inexpensive. At present, costs are $35-$60 per ton depending on the heat output and mine location. Transportation costs vary with the distance the coal is hauled.

Although coal doesn't absorb moisture, it's best to store it under cover. This can be in bins or a bunker covered with a plastic hoop house. Outdoor storage may result in frozen lumps that don't feed well.

Burning coal

Combustion of coal is different from fossil fuels and wood. There are very little volatiles in coal, about 30

minimal number of volatiles, most of the combustion air needed to burn coal has to be supplied from underneath the fire. A coal fire has to be started with wood, oil or gas to bring it up to the ignition temperature. Once started, it will burn as long as fuel is supplied.

Furnaces and boilers

To provide the heat required in a greenhouse, consider a stoker-fired unit. These units are available as furnaces or boilers in sizes from 200,000 to several million Btu per hour. In addition, some existing heating units can be converted from fossil fuels to burn coal by adding a stoker unit to the firebox. Due to the complexities of the system, have it designed by a competent heating system professional.

Stokers are available to feed coal from a hopper or bin. The hopper should be large enough to supply the fuel needed for at least 24 hours. A 1 million Btu per hour burner will need about 130 pounds of coal per hour. The hopper for this unit would hold at least a ton of coal. Bin feed stokers are located at the bottom of the bin and draw the coal as needed.

Other components of the stoker are a steel feed auger, usually 4-6 inches in diameter, a gear motor and transmission to power the auger and a retort that holds the coal while it is burned. The retort is shaped like the bell on a horn and the coal is forced into the bottom by the auger. After burning, the ashes fall over the edge of the retort into an ash pit or removable metal container.

Primary air for combustion is supplied by a blower and an air feed tube. The air is supplied to the bottom of the retort. The speed of the auger and the blower are regulated to coincide with the rate of burn needed to provide the heat. Greenhouse temperature control is by thermostat or controller.

Other considerations

Solid fuel boilers usually have a larger water capacity to act as a heat buffer. Control is not as fast acting as it is with an oil- or gas-fired unit. An insulated hot water storage tank is sometimes used to store excess hot water. Using a mixing valve, this water can be lowered to 100°F temperature needed for root zone heating.

Coal-fired heating units require more labor input than comparable fossil fuel units as ashes have to be removed on a regular basis and the soot cleaned from fire tubes and heat-exchange surfaces. Coal may also have to be moved from storage to the feed bins.

Regulatory concerns

Environmental concerns and regulations are more rigid with solid fuels than fossil fuels. It is best to check with the local EPA before installing a coal unit. Generally, particulate matter cannot exceed 0.1 grains per cubic foot of exhaust gases. A sulfur analysis of the coal is needed and sulfur dioxide concentration should not exceed 500 parts per million, Opacity, the amount of carbon in the flue gases, needs to be at an acceptable level.

With the large difference between the million Btu prices for coal and fossil fuels, there is the potential for significant savings. Before committing to burning coal as your major fuel source, check to see that a long-term supply of coal is available and that a system can be designed to meet the regulations and your greenhouse heating needs.