Coal Heat - Another Greenhouse Alternative

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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 over 1600 billion tons of know reserves it is a fuel that has great potential for energy for the foreseeable future. Presently there are 1400 mines in 23 states supplying over 1.1 million tons per year. Coal is available within proximity to most greenhouse operations.

Coal is a combustible rock which has its origin in the accumulation and partial decomposition of vegetation that dates back over 300 million years. Peat is the first step in the transformation of vegetation to coal. Over time and with greater pressure soft coal (bituminous) was formed. It has a high heat value (12,000 Btu/lb), high ash content (10%) and medium ignition temperature (750 - 850ºF). 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/lb), lower ash content (6%) and higher ignition temperature (925ºF). Most of the anthracite supply is in Pennsylvania.

Heat Value

One ton of coal contains about 24 million Btu's. It is equivalent to 175 gallons of #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% 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 the present time, costs from $35 to $60/ton depending on heat output and location of the mine. Transportation costs vary with the distance it 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 hoophouse. Outdoor storage may result in frozen lumps that don't feed well.

Combustion of coal is different than fossil fuels and wood. There are very little volatiles in coal, about 30% in bituminous and 5% in anthracite as compared to 50% in wood. Due to this, 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 automatic heat required in a greenhouse, a stoker fired unit should be considered. These units are available as furnaces or boilers in sizes from 200,000 to several million Btu/hr. 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 it is best to have it designed by a competent heating system professional.

Stokers are available that will feed coal from a hopper or bin. The hopper should be large enough to supply the fuel needed for at least 24 hours. A million Btu/hr 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 four to six inches in diameter, a gear motor and transmission to power the auger and a retort that holds the coal while it is being burned. The retort is shaped like the bell on a horn and the coal is forced in to 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.

Environmental concerns and regulations are more rigid with solid fuels than fossil fuels. It is best to check with the local department of environmental protection 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 ppm. Opacity, the amount of carbon in the flue gases, needs to be at an acceptable level.

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 the 100ºF 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 firetubes and heat exchange surfaces. Coal may also have to be moved from storage to the feed bins.

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

The following is a listing of some of the manufacturers that make stokers and heating units larger than 200,000 Btu/hr.

Industrial stokers are available from:

Messersmith Manufacturing, Inc. Bark River MI – www.burnchips.com
The Will-Burt Company, Orrville OH – www.willburt.com

Furnaces and boilers are available from:

Alternate Heating Systems, Inc., Harrisonville PA – www.alternateheatingsystems.com
Siebring Manufacturing, Inc., George IA – www.siebringmfg.com
Saskatoon Boiler Mfg. Co, Ltd. Saskatoon, Canada – www.saskatoonboiler.com
Decker Manufacturing, Decker, Manitoba, Canada – www.deckerbrand.com
McBurney Corporation, Norcross GA – www.mcburney.com
Hurst Boiler Welding Co.,Inc., Coolidge GA – www.hurstboiler.com
Weil McLain – Michigan City IN – www.weil.mclain.com