BOILERS

Walker Process Boilers produce hot water by burning the Digester Gas produced in an anaerobic digester. The hot water produced in the boiler is primarily used in a heat exchanger to heat digester sludge to maintain digester temperature. Any excess capacity for heating water may provide hot water for other uses such as building heat.

Boiler Construction:

Walker Process boilers are Scotch type with a cylindrical steel shell that has a cylindrical internal steel furnace located in the lower portion and with a bank (passes) of tubes attached to both end closures. These boilers are constructed according to ASME Boiler and Pressure Vessel Code, Section IV. All Walker Process boilers are inspected by a qualified inspector and the ASME "H" designator is stamped on the boiler nameplate. The boiler is a double pass, dry-back type that heats water to approximately 180 degrees F by burning either digester gas or an auxiliary fuel such as natural gas, LP gas or fuel oil.

The dry-back boiler uses a refractory lining to protect the boiler end plate where the heated gases are turned back and enter the boiler tubes. A major advantage of dry-back construction is that it allows for removal of the back plate without having to drain the water from the boiler. This feature permits routine inspection and cleaning of the boiler tubes to maintain peak boiler efficiency. It should be noted that dry-back boilers, due to their design and reliability, are favored by the commercial boiler industry as well.

Boiler construction also affects the ratings that manufacturers apply to their units. Walker Process boilers are equipped with a forced draft burner and a nominal rating guide of 10,000 input BTU/Hr./Ft^2. Output heat is based on 80% efficiency. The conservative nature of these ratings is proven by shop verification tests as well as by a long list of successful installations.

Some manufacturers attempt to directly relate boiler surface area with heat output. Surface area, however, is just one of many variables that influence heat transfer characteristics. Of equal importance are the firing rate of the boiler, the temperature differential between the combustion products and the water, the velocity of the gases through the fire tubes, and the recirculation rate of the water. A more practical approach to specify boiler capacity is to avoid the use of surface area requirements and simply specify shop verification of the manufacturer's rating instead.

BOILERS

Boiler in Assembly

Boiler being moved to test area

Burner:
There are two basic types of burners that are used to fire hot water boilers: 1) induced draft and 2) forced draft. Walker Process selected the forced draft burner as the preferred burner type due to the several design advantages that it offers:

1. **Combustion Control** – Mounted upstream of the furnace, the forced draft fan is in contact with only cool ambient air of constant density. The uniformity of the intake air ensures accurate control of the air-fuel mixture.

2. **Maintenance Requirements** – Blower reliability and long life are other features that explain why the forced draft fan is favored. Since the forced draft fan sees only cool, clean air, it is less prone to maintenance problems than induced draft fan. Also, because the forced draft fan is directly coupled to the blower, there are no V-belts to adjust or replace.

3. **Energy Savings –** The Walker Process burner system with a forced draft fan requires less power than a system with an induced draft fan. An induced draft system requires more air in the exhaust stream admitted to the breaching to keep the stack temperature sufficiently low.

Fuel

The burner is designed to use digester gas, natural gas, propane, or fuel oil. There are two methods to provide fuel to the burner; blend-in, and switch over.

The **Blend-In** System allows the burner to use digester gas if it is delivered with sufficient pressure. If the pressure of digester gas drops to a preset level, natural gas is allowed to blend into the fuel supply. If the digester gas drops below a second preset level the pressure regulator in the digester gas line will close and only natural gas will be used.

The **Switch-Over** System measures the pressure of the primary fuel, Digester Gas, and if it is at least at or above a preset point, the boiler burns only Digester Gas. If the pressure drops below the set point, the boiler closes the Digest Gas supply and switches over to burn only the alternate fuel.

Burner Control

If the boiler water temperature is below its set point, the burner starts and fuel is burned to raise the water temperature. If the water temperature is at/above set point, the control system turns off fuel supply and burner. When the water temperature drops below set point, the controls re-start the boiler burner.

Modulated Fuel Supply: A modulated fuel supply adds additional control to either the Blend-in or Switch Over fuel supply controls. Rather than the on/off temperature control mode of either system, a 3-mode PID (Proportional-Integral-Derivative) control loop modulates the fuel flow, to maintain water temperature. When the hot water temperature begins to drop below the set point, a gradual increase in fuel flow is provided. When the water temperature begins to increase over the set point, fuel flow is gradually reduced. The modulating control system provides two benefits to the boiler operation:

1. The 3-mode PID control loop provides more precise maintenance of the hot water temperature than a simple on/off control.

2. A modulated burner control system eliminates cold-start thermal shock to the boiler. Substantial thermal stress is imposed on a boiler's fire tubes and fire box every time a boiler is fired up from a non-burning state. Since the operating temperature of the boiler's firing components are about 500 dF, each time the control system turns the burner off, the safety features of a boiler control system purge the fuel system with ambient air. That purge quickly reduces the temperature of the firing chamber to about 180 dF. When the water temperature control calls for more heat, the boiler is re-fired, the components see the opposite thermal shock of quickly heating back to the operating temperature. These sudden thermal heating/cooling cycles stress the ceramic fire box and the fire tubes which, over time, will reduce the operating life of the components.

The addition of the modulated flow controller reduces the number of cycles of boiler shut down and start up; thus, extending the equipment's life.

Burner Safety Controls:

Walker Process Equipment boilers use the most current state-of-the-art burner control system to ensure safe operation. The controls utilize a microprocessor based burner management system that monitors the operation and performance of all electro-mechanical safety devices.

IN SUMMARY:
The Walker Process forced-draft type dry-back burner/boiler provides the most efficient means of combustion control that also provides the additional benefits of lower blower maintenance and less energy usage than induced draft type blowers.

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