A Unique Wood Burning Experience

A gasification boiler heats fluid like nothing I have ever previously experienced. Although I have heated my home with wood for over 30 years, very little of what I had learned about wood burning was applicable with a gasification boiler. I knew a little about woodgas as I have had a couple of stoves that capitalized on secondary air being introduced to the smoke from the fire. Most people are familiar with the term "flashback" and those who have had some experience with woodstoves know what I'm talking about. It happens quite often when you opening the door of a woodstove that has been damped down for a time, to see if it needs wood. When the oxygen hits the gasses coming off of the wood, the result is often a flare-up or "flashback". The same thing happens when firemen open up and allow air into a space that has been confined and smoldering. This is exactly what the gasification boiler capitalizes on, the gasses or woodgas given off by the heated smoldering wood.

The EKO LINE Gasification Boiler

The **EKO LINE BOILER** is divided into 4 basic sections. The top is the **FUEL CHAMBER**, not to be confused with a firebox that one finds as the heart of a standard wood stove. The bottom is the **GASIFICATION CHAMBER** where the ignited gasses reach temperatures of over 2,000 degrees. The **HEAT EXCHANGER TUBES** is where the burnt fuel gives up its heat to the hydrolic heating medium (normally, water). Finally, there is the **WATER JACKET**, which is the small storage for the medium which is used in the heat transfer through which the heat exchanger tubes travel.

The **FUEL CHAMBER** is exactly that as the wood is not meant to be wholly burned within it but only a little at a time. This can occur as described because of the nature of the draft system and the design of the chamber itself. The fuel chamber has two exits for the smoke (containing gasses). One is in the top of the rear wall of the chamber and is a standard 6" flue with a round flapper cover plate which is opened by pushing in a rod next to the top door at the front of the boiler. This is closed during normal operation but is opened to allow access to the fuel chamber. This is done to allow the smoke to exit the fuel chamber through this flue when either lighting the stove, checking the fuel supply in the chamber, or when opening the bottom gasification chamber door to remove the ashes. The other opening is located at the very bottom of the chamber and is referred to as the "nozzle". This nozzle is actually a slot which is 8" long, 1" wide and extends 4" down to the gasification chamber below. The size and number of nozzle(s) vary with the size of each boiler. There are air entry openings or holes in the middle of each side of this nozzle. When the boiler is operating, this is where the smoke or gasses exit the chamber. Mounted vertically in both front corners of the chamber (on each side of the door) is a square tube extending to near the top of the chamber. This allows outside air to be blown into the top of the chamber.

The **GASIFICATION CHAMBER** is where the high temperature gas burn takes place. Resting on the bottom of the chamber and located directly beneath the nozzle is a ceramic block with "U" opening in the top.

This is in place in order to accommodate temperatures in excess of 2,000 degrees when the boiler is operational. In the back of the chamber is an opening where the bottoms of the heat exchanger tubes begin. The **HEAT EXCHANGER TUBES** are three 2" tubes located vertically in the rear of the boiler extending from the gasification chamber to the level of the 6" flue in the back of the fuel chamber. These tubes are completely surrounded by the water jacket which receives heat from the gasses exiting the gasification chamber as they travel up the tubes to the boiler stack (chimney). Located inside of each of the tubes is a flat plate of steel turned into a spiral. This spiral steel serves to force the super-heated gasses to travel the length of the tubes in a spiral pattern, greatly enhancing the heat transfer from the gasses to the water as evidenced by stack temperatures of 325-375 degrees while the boiler is operational. Additionally, the top of these spiral plates are attached to a pivot rod that exits the boiler on the side. Attached to this rod is an arm that when moved back and forth allows the operator to scrape and clean the inside of the boiler tubes from the outside of the unit.

The **WATER JACKET** is located on the sides, back and top of the boiler and is the reservoir for the heated water being transferred to your heating system.

Boiler Operation

The EKO LINE Gasification boiler is a downdraft wood burning boiler that is controlled by a digital regulator and variable speed blower. It is very important to use DRY fuel. The boiler will burn a variety of material for fuel such as any kind of wood, dried corn (whole, dry, cob corn works well), pellets, and coal for example. However, care should be taken that the fuel be large enough not to be blown through the nozzle although smaller material can be placed on a bed of coals already present. The fire is started in the same manner as you would a woodstove or fire pit. Paper covered by ample kindling, a few pieces of dry wood topped by the desired fuel, placed in the bottom of the fuel chamber is sufficient to start the fire going. The fuel chamber door must be closed while the top damper is temporarily left open. The paper can then be lit with a long match or torch through the nozzle from the bottom gasification chamber. Once the paper is started on fire, the bottom door is left open approximately 1" and left to burn for about 15 minutes. At that time a small bed of coals should have formed. The bottom door is then closed and the fuel chamber door is slowly opened and the chamber is then filled with fuel to about the bottom of the flue. The upper door is then closed, the rod pulled to close the top flue, the regulator control is switched on, and you just watch the temperature of the water rise. The rest of the operation is automatic from this point on other than periodically checking the temperature and fuel in about 10 hours or so. (This is unless you have a **STORAGE TANK**! which is covered in the "storage tank" page of this site.) The boiler will climb from 50 degrees to a temperature of 180 degrees in about 45 minutes.

What happens within the boiler, while it is operational, is what sets it apart from other types of boilers. The blower forces outside air into the fuel chamber which forces all of the woodgas through the bottom nozzle where it is mixed with heated outside air within the nozzle which is also supplied by the blower via internal chamber and tubing in the refractory. The fuel chamber then becomes what can be thought of as a "charcoal making machine". As the air and gasses are blown downward through the fuel, only the bottom 3"-4" of the fuel is all that actually burns.

It is because of this burning process that as the fuel on the bottom is completely burned, the fuel cascades down through the fuel chamber to take its place. Filling the fuel chamber is literally filling a fuel magazine for the boiler.

As the gasses exit the nozzle in the gasification chamber, the flame that is produced most closely resembles that of a fuel oil burner, pointed straight down. It is here that temperatures are around 2,000 degrees, completely burning all the smoke and gasses that would be creating creosote as well as leaving ash in such small quantities that after a week of constant burning the amount of ash left would fill approximately half a 3 lb coffee can. Additionally, because of such high temperatures and complete combustion of the fuel, there is very little smoke rising from the chimney. As testament to the efficiency of the heat exchanger tubes is the temperature difference between the gasification chamber of 2,000 degrees and the stack temperature at around 350 degrees.

The regulator controls the actions of the blower and circulator pump. It allows you to select the desired temperature of your boiler water from 140-195 degrees, has an automatic set back of 5 degrees, as well as a programmable "idle" setting once the water has reached the desired temperature (this sets EKO LINE BOILERS apart from other gasification boilers).

When the boiler water reaches a temperature of 140 degrees, the circulator pump is automatically switched on, supplying heat to your heating system and an indicator is lit on the regulator indicating that the pump is operating. The blower will continue to operate until the desired temperature is reached then will automatically turn off and the regulator will then goes into "idle mode". During idle mode, the regulator periodically switches the blower on for a direct rise and fall cycle, the interval between each cycle having been programmed by the operator at between 1 and 9 minutes each. When the boiler falls 5 degrees below the desired temperature, the blower is switched "on" to bring the boiler back to the desired temperature. The boiler will continue to operate automatically in this manner until the fuel in exhausted. When the temperature drops to 140 degrees, the circulator pump automatically switches "off" but the blower will continue to operate. When the regulator has noted no rise in temperature for an hour, the blower is switched "off" as well and an indicator light is lit on the regulator indicating that the boiler is out of fuel. If continuous operation of the boiler is desired for heat, when it is noted that the temperature has dropped 10-15 degrees is a good indicator that the fuel chamber needs to be reloaded. If reloaded at that time, there should be no lapse in the heating cycle.

The circumstances surrounding your heat load, differing type of fuel used, as well as current outdoor temperatures, will affect the expected burn time for a load of fuel. Many conditions heating individual homes will differ and burn times will differ.
When heating with any boiler, safety is a prime concern. Caution should always be exercised regarding over-heating. The EKO LINE boiler taken care of that with its unique design and its digital regulator. When the boiler temperature reaches 200 degrees, the entire system shuts down. This effectively starves the fuel chamber for air and the fire goes out.