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A Comparison of Wood Combustion with a Spreader Stoker And Horizontal Zoned Grate

There are many design flaws with spreader stoker combustion systems which lead to inefficient combustion, higher operating costs and potentially dangerous conditions. These problems are overcome by the design of the Horizontal Zoned Grate as described below:

1) The spreader stoker requires air to transport the fuel into the firebox. Some of this air is later used for combustion, but much of it is added only for fuel transport. This excess, or tramp, air cools the fire and reduces the firebox temperature and combustion efficiency. The impact of this tramp air is most severe when the fire is turned down and less fuel is being blown into the firebox because the percentage of transport air increases relative to required combustion air. The cooling effect of this air will lead to emissions from inefficient combustion at higher turndown levels. The Horizontal Zoned Grate uses no air for fuel transport. The only air entering the firebox is required for the combustion process. As a result, the firebox stays hotter for a given combustion level and combustion efficiency is increased. In general a spreader stoker can only be turned down about three to one while the Horizontal Zoned Grate can be turned down ten to one on dry fuel.

2) Since all wood fireboxes are under negative pressure from the induced draft fan, particles which are air borne can be sucked up the stack before they have time to fully combust. Once airborne, the amount of time a particle remains in the firebox is directly related to the air flow through the boiler. The spreader stoker requires more suction from the induced draft fan to overcome the positive pressure from the fuel delivery fan. The combination of particles in suspension and increased suction in a spreader stoker leads to a high percentage of unburned particles leaving the firebox. In contrast, the Horizontal Zoned Grate gasifies fuel on the grate and minimizes the required suction from the induced draft fan by minimizing combustion air flow into the burner. Less fly ash reduces maintenance on the boiler and increases the efficiency of the boiler.

3) Air for fuel transport also limits the ability to design a combustion air flow which uses all the firebox volume to efficiently blend the combustion air with the wood gas. In a spreader stoker, air and fuel are blown into the center of the front firebox wall. Although additional air is blown into the rear of the firebox, this single entry point for a relatively large proportion of the overfire combustion air has a significant impact on air flows inside the firebox. For instance, the firebox volume along the front wall to the left and right of the spreader stoker are dead spots and not fully used in blending the wood gas

with oxygen. In contrast, in the Horizontal Zoned Grate System, air is blown into the firebox from the front, rear and grate over the entire width and length of the firebox. In addition, the direction, nozzle size and "throw" of the overfire air has been carefully designed to maximize the use of firebox volume and turbulence.

4) The spreader stoker feeds material into the firebox above the fire. As it drops to the grate it can smother the material on the grate and create inefficient combustion. The Horizontal Zoned Grate brings fuel into the firebox at the back of the existing pile. This process minimizes the impact on the surface of the pile and prevents the pile from being smothered.

5) The spreader stoker also uses much more electricity than a grate burning system. Compare the fan size requirements of a spreader stoker to a Horizontal Zone Grate system and then calculate electric operating costs. The difference will probably surprise you.

6) The spreader stoker is designed to burn most material in suspension, as it is brought into the firebox. For this reason the system is very sensitive to large changes in moisture content, particle size and density. Take the extreme example to illustrate this point. If the system is set up to burn dry sawdust, and green chunks enter the firebox, the grate will be covered and the balance of the system will be altered. The Horizontal Zoned Grate is designed to have a large pile of fuel on the grate. This pile homogenizes the moisture content, particle size and density of the fuel and stabilizes it. If, in the example above, green fuel enters the mix it would be blended with fuel on the grate which would help reduce the fluctuation in fuel moisture content and minimize its impact. The fuel would combust further back in the firebox but the balance (ie: efficiency) of the system would be maintained.

7) The mass of fuel on the grate also increases the safety of the system by forming a barrier between the fire and fuel supply. A spark can travel back up the same duct that the spreader stoker uses to bring material into the firebox. In contrast, the pile of fuel in front of the auger in the Horizontal Zoned Grate "plugs" the system and helps prevent a spark from leaving the system.

8) BCS has replaced several spreader stokers because they were getting explosions from fine, dry dust in the system. These explosions occurred when this dust was blown into a firebox which was hot enough to gasify the fuel, but did not have enough heat or oxygen to complete the combustion process. This gas built up in the firebox until they were simultaneously ignited in an explosion.

BCS would be pleased to provide references of customers who have converted from the spreader stoker to the Horizontal Zoned Grate.