RECENT DEVELOPMENTS IN WOOD FIRED
SPREADER STOKER TECHNOLOGY

by
R. S. SADOWSKI
Industrial Sales Manager
and
R. A. CHILDS
District Sales Manager
Portland, Oregon
RILEY STOKER CORPORATION
WORCESTER, MASSACHUSETTS

ABSTRACT

This paper will briefly review the fundamental principles of burning wood and other cellulose fuels in a spreader stoker combustion system.

The application of recent developments in the design and operation of this system for stationary and traveling grates will be emphasized. The individual components of the system will also be discussed.

OBJECTIVES FOR WOOD BURNING ON A SPREADER STOKER

With the fossil fuel price escalation experienced over the last decade, there has been a corresponding shift toward the reliance on wood firing as a means of controlling energy costs. This shift has forced the designers and operators of power plants to treat wood as a primary fuel, rather than a waste product for disposal. Furthermore, attention has been focused on the reliable production of steam from wood using either with a mimimum amount or no auxiliary or supporting fossil fuel. Figure 1 tabulates the objectives pursued by the designer and operator in the firing of wood on a spreader stoker.

- PROVIDE EVEN HEATING PATTERN TO BOILER
- HIGH COMBUSTION EFFICIENCY
- HIGH AVAILABILITY AND RELIABILITY
- LOW AND PREDICTABLE MAINTENANCE
- COMPENSATE FOR WIDE FUEL RANGE
- COMPENSATE FOR WIDE VARIATIONS IN ASH CONTENT
- LOAD RESPONSE
- TURNDOWN
- MINIMIZE PARTICULATE CARRYOVER
- MINIMIZE OR ELIMINATE AUXILIARY FIRING ASH CONTENT

Figure 1 Objectives for Wood Burning on a Spreader Stoker

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REVIEW OF SPREADER STOKER FIRING

The basic principle of spreader stoker firing is the use of uniform distribution of fuel and air to each square foot of furnace or grate plan area producing an even heat release pattern to the boiler. (Figure 2)

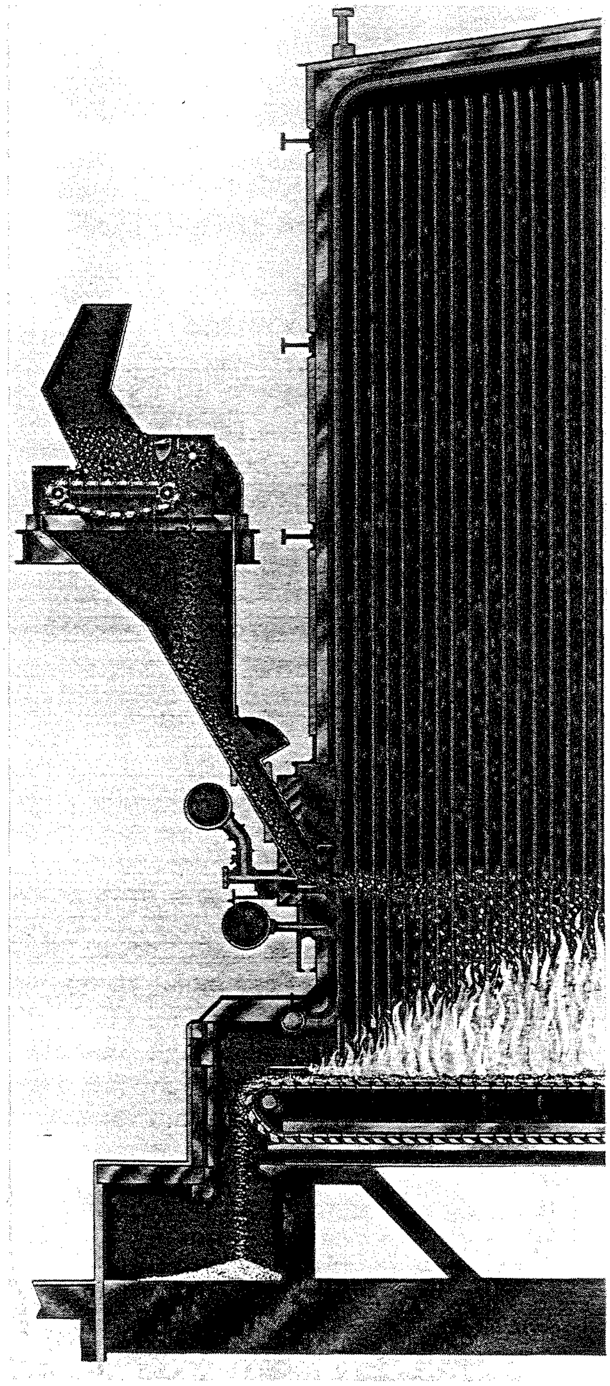


Figure 2 Riley Traveling Grate Spreader Stoker for Wood Burning

Uniform fuel feeding and distribution coupled with proper air distribution are required to accomplish and maintain this uniform heating pattern. The wide variation in fuel size, moisture, density and ash content mandate a system designed to compensate for these variations in addition to accomplishing the basic distribution task.

FUEL TRANSPORT

The supply system delivering fuel to the individual feeders across the width of the boiler should be designed to furnish a uniform fuel size distribution to each feeder. Some systems, such as non-partitioned vibrating conveyors, tend to deliver coarse fuel to one side of the boiler and fines to the other side. This leads to unbalanced firing, as the fines will tend to burn in suspension while the larger particles will burn on the grate. This may lead to one side of the unit operating with a bare grate. This grate becomes the path of least resistance for the air. The combustion process is unbalanced. The grate can overheat. Combustion is reduced.

An over-running conveyor system with a drag chain above each feeder opening will maintain each feeder with a full fuel supply at all times. The excess fuel is returned to the main storage pile or to a local surge bin. The openings to the feeders in the conveyor bottom should be staggered to minimize fuel segregation across the width of the unit.

An optimum size distribution for the fuel would be 100% less than 4", 98% less than 2" and not more than 50% less than ¼". This is not always achievable but it should be remembered that large pieces can jam the system and may not completely burn out. An excess of fines, however, can leave the grate bare, if dry, and mat over the grate if wet.

FUEL METERING

Once the fuel has been properly transported to the boiler firing aisle, it must be metered to the furnace in a controlled manner. The level of precision in the metering system is dependent upon whether wood is the primary fuel with load swing responsibility or a base loaded secondary fuel. In either case, it is imperative that certain minimum standards be met. Again, uniformity of distribution is the primary objective.

In addition, the feeders must be capable of compensating for any fuel variations that occur. Because most hogged wood fuels are a combination of the waste products from different points in the manufacturing process, the fuel composition can include several wood species, bark, sawdust, chips, planner shavings, sander dust and log yard waste in widely varying proportions. There will be changes in the bulk density of the aggregate fuel supply over time. Due to varying size and moisture content and less than adequate mixing, each feeder can see a different fuel supply.

Since feeders are volumetric devices, differing bulk densities can unbalance the firing rate. Where wood is the primary fuel, this potential unbalance must be compensated to maintain optimum firing conditions with each feeder having a separately controllable feed rate. The level of sophistication will vary depending upon the degree of reliance on wood as a fuel. On units with only partial base loaded wood firing, one or more feeders can each supply several fuel distributors through proportioning devices. A live-bottom bin with multiple drop-out points across the boiler front is also common. For units with full load wood firing, an individual fuel feeder is recommended for each fuel distributor. The fuel feeder (Figure 3) should provide a continuous stream of shredded fuel. Slug feeding should be avoided because it tends to promote piling on the grate. In addition, furnace puffs or pulsations can result as the degree of suspension burning rapidly varies in the furnace. Again, individual feeder biases are required to compensate for variations in fuel delivered across the unit width.

FUEL DISTRIBUTION ON THE GRATE

With a properly metered fuel supply equally distributed across the width of the furnace, we can now distribute the fuel uniformly over each square foot of the grate surface. A pneumatic distributor (Figure 4) is the preferred method of accomplishing this task. Although mechanical spreaders can and have been used, they have several disadvantages when compared to pneumatic devices. They are more complicated mechanically, can jam with stringy fuel, are susceptible to breakage with tramp materials and can hurl

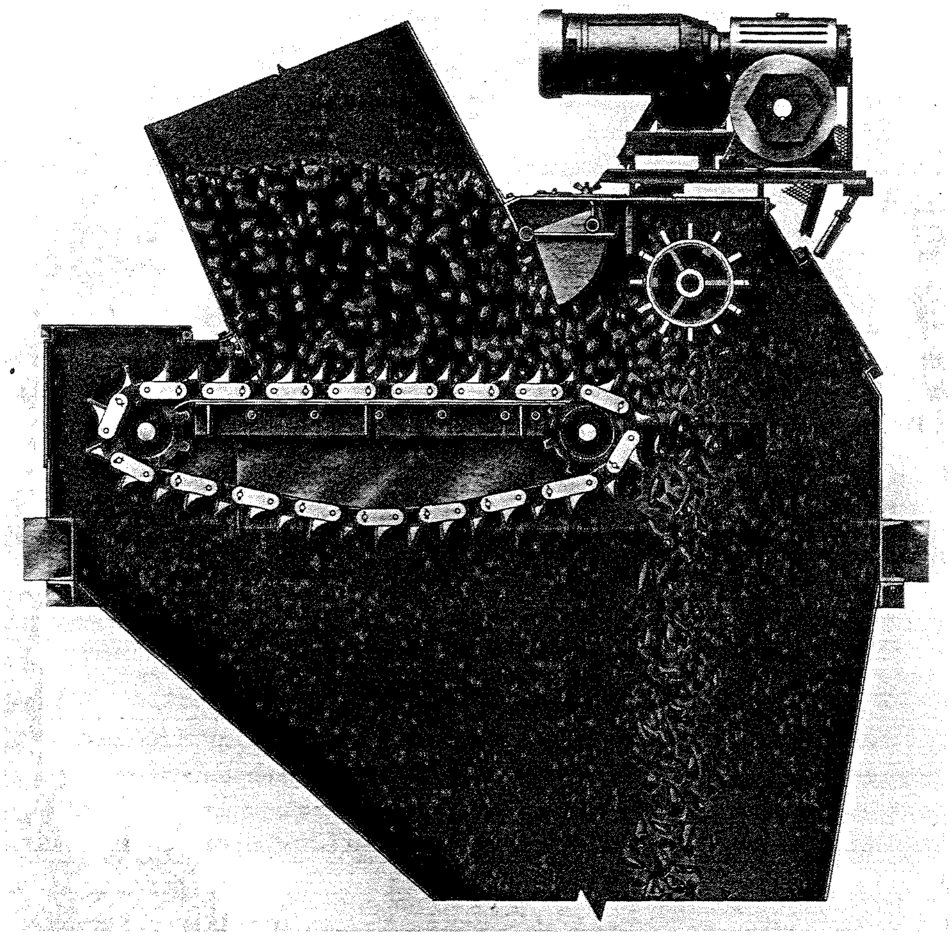


Figure 3 Riley Refuse Feeder

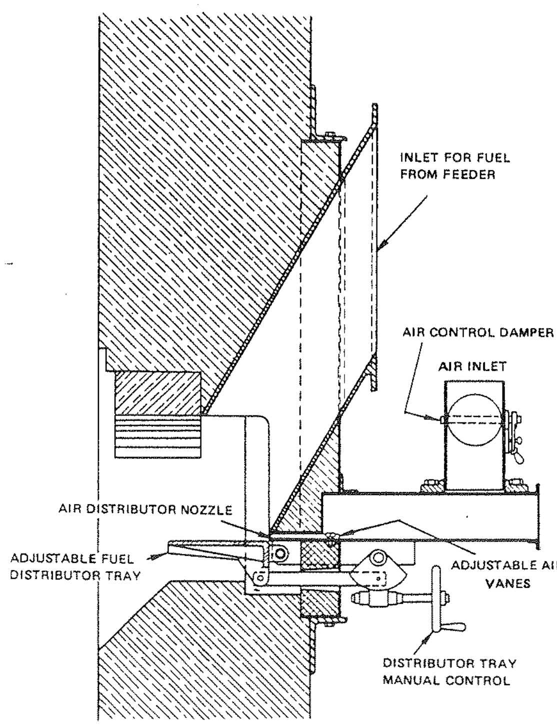


Figure 4 Riley Pneumatic Refuse Fuel Distributor

small, dense projectiles at very high velocities toward the rear wall where they can do considerable damage. Pneumatic distributors are simple, with no moving parts, offer an open path to the furnace, and dense tramp materials are transported only a short distance into the furnace.

Fuel slides down a chute from the feeder to a trajectory plate where it is blown into the furnace with a jet of high pressure air. The distributor should be located as low as practically possible in the furnace. At this point, the distributor must be capable of spreading a variety of fuels along both the width and depth of the grate surface. Adjustability is important here.

Two means of depth adjustment (Figure 5a) are recommended. The angle of trajectory of fuel into the furnace will roughly determine where most of the fuel will land along the depth of the grate. For a fixed distributor air pressure, the fuel can have tendency to pile at some point along the depth, depending on fuel conditions and tray angle. A slowly varying air pressure minimizes this phenomenon by sweeping the fuel over the grate. Rotating dampers with variable speed drives provide a reliable sweeping action. It is important to assure that the distributors are not synchronized in this sweeping action as furnace pulsations will result. This is avoided by staggering the position of the dampers on each distributor and then connecting them to a common jack shaft. An adjustable tray (see Figure 4) allows the operator to easily make corrections for long term, seasonal variations in the fuel without disturbing the air system.

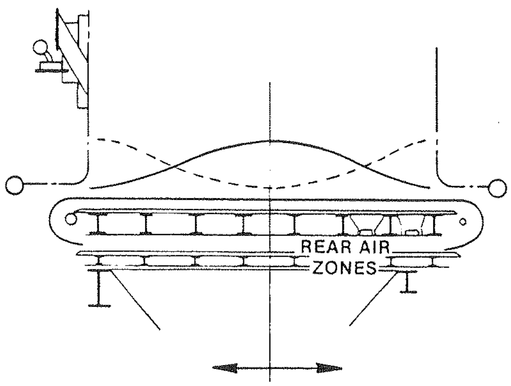


Figure 5a Depth Adjustment and Pulse Action

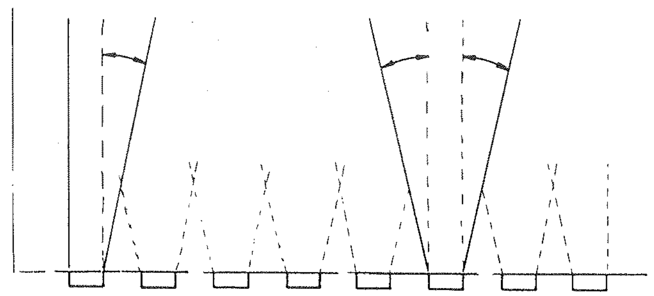


Figure 5b Pneumatic Distributor Adjustment Flexibility

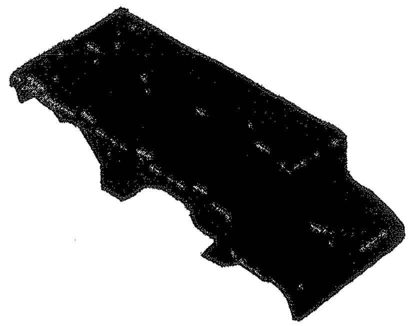
Lateral distribution over the grate is established in the design phase by assuring that several feed points are placed across the furnace. Approximately fifty percent of the firing wall should be devoted to feeder open area. It is important that the fuel distributor fan the fuel out from the center line of the distributor or gaps in coverage will result (Figure 5b). This fanning action is accomplished by adjustable air vanes in the nozzle (see Figure 4). Since most fuel feeders do not provide uniform fuel distribution across the width of the chute and trajectory tray, excessively wide distributors offer no advantage. A wide distributor presents a larger area exposed to radiant heat and tends to send the fuel straight into the furnace with little or no fanning action to cover the gaps between feeders. Complete lateral coverage over the grate surface, especially the front half, requires good fanning action.

GRATE SURFACE

All wood fired grates have four primary functions: to provide a platform for drying the fuel, to burn the fuel, to distribute the air for combustion, and to dispose of ashes. They must be capable of performing these functions in an environment with severe temperatures and minimum amounts of operator attention while withstanding mechanical abuse from falling tramp material.

Assuming that the fuel has been reasonably well distributed over the grate, we can expect an even heat release from the grate with uniform air distribution through its surface. Several closely spaced air openings promote uniform combustion over the entire surface and maximize the cooling area of the grate metal.

Normally, about 3% of the grate area is open area for air passage (Figure 6). With a properly designed plenum chamber delivering a disbursed air flow under the grate, a completely bare grate with 3% open area has about one inch w.c. pressure drop at full boiler load, and a very well balanced air distribution. This has been verified through several laboratory and field tests. Some designers feel that a much higher grate pressure drop is required to assure proper operation. We have found over the years that a one inch bare grate pressure drop with a properly designed grate surface, air plenum, and fuel system will perform with high reliability and utilize less horsepower.



- CLOSELY SPACED AIR OPENINGS FOR UNIFORM COMBUSTION, NO DEAD SPOTS
- MAXIMIZES COOLING SURFACE
- MINIMIZES DISTURBANCE OF PROTECTIVE ASH LAYER
- SELF CLEANING AIR PASSAGES
- MINIMIZES INDIVIDUAL CLIP WARPAGE
- HIGH TEMPERATURE CHROMIUM ALLOY STANDARD

Figure 6 NARRO-BAR® Grate Surface

Stationary and traveling grate spreader stokers fire in similar fashion. Their major differences are in the method of ash removal and cooling of the metal surface. Grate metallurgy is discussed in a later section of this presentation.

TRAVELING GRATE

The traveling grate, as shown in Figure 2, is a moving platform for the combustion of the fuel and the automatic, continuous removal of the ash. The rate of travel is determined by the ash quantity at the discharge end of the grate. Wood has a very low ash content and its ash can be very light, blowing off the grate if swept with only mild air stream.

This fundamental operating parameter is too often overlooked by plant personnel. Traveling grates are designed with two means of protection from the high furnace temperature. First and foremost, the ash covering the grate acts as an insulating layer between the fire and the metal and, secondly, air cools the metal as it passes from under the grate through the ash bed and into the combustion zone. When the grate is operated at too high a speed, no protective ash layer is established and high metal temperatures are the result.

The grate should be operated with a 2" to 4" ash bed at the discharge end. It may be necessary to operate the grate at its slowest speed or in an intermittent fashion to maintain these conditions. One unit in the Pacific Northwest operates the grate at minimum speed for 10 minutes every other hour at full boiler load and 5 minutes at the start of each shift at maximum firing rates. Most installations incorporate a variable timer control with the grate drive cycling on for 5 to 20 minutes and off for 5 to 55 minutes depending upon conditions at the time.

The grate surface should be made of a heat resistant cast material. Cast iron which is sometimes used in coal applications, is not suitable for the severe duty that wood firing presents. The characteristics of several materials will be described later.

A grate surface with several small grate clips or keys has a greater cooling area and is less prone to warping than are massive elements. Cored holes can plug during operation, so self-cleaning air passages are designed into the sides of each clip.

The grate support system and chain should be designed so that all drive and support members are isolated from the furnace (Figure 7). Support of the bottom return surface lowers bearing stresses and extends the life of the air seals. Graphite impregnated split-sleeve bronze bearings have had trouble free service for many years (Figure 8). A carbon-free lubricant is used as a vehicle to spread the graphite in the bearing. Carbon-based greases will solidify in the lube lines.

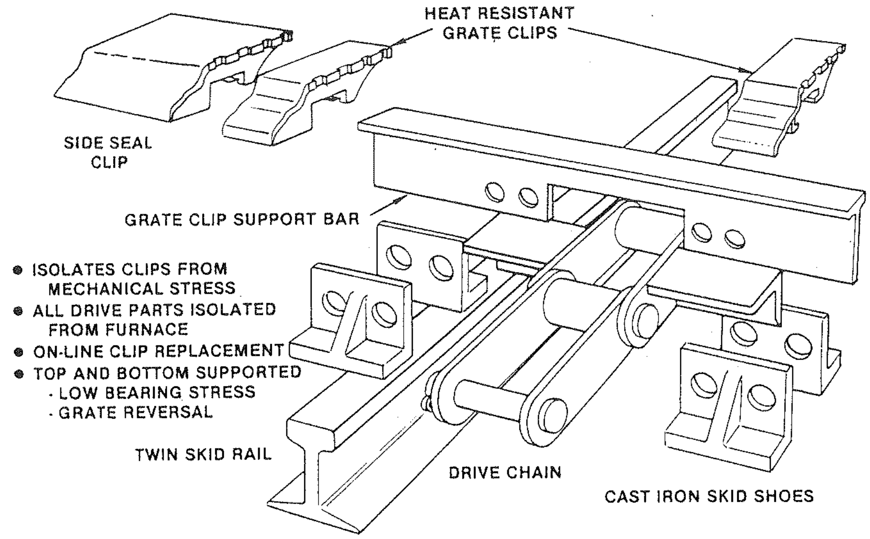


Figure 7 TEE-MOUNT® Grate Support for Traveling Grate Stoker

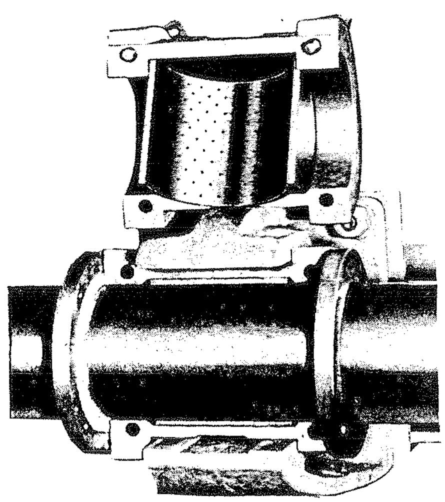


Figure 8 Heavy Duty Bearings

Air seals around the edges of the grate, at the front shaft, and at interface points with the boiler are necessary for the prevention of air leakage. Bottom-supported boilers require only simply fixed sealing techniques as there is little or no relative motion between the two pieces of equipment. Top supported boilers incorporate a flexible seal to compensate for the movement of the furnace relative to the grate surface.

WATER COOLED GRATE

Water cooled grates are attached directly to the floor tubes of the boiler (Figure 9a). Here, cooling is achieved by water flowing through the tubes. A high temperature cement is used to maximize the heat transfer from the grate block to the tubing.

Ash is removed by removing one feeder from service, allowing the fire on that section of grate to burn itself out, closing the air damper to that section of grate, and then by either manually raking it clean or by blowing the ash into the ashpit with steam jets. The feeder is then restarted, and the next section is cleaned in the same manner. There is usually some load reduction as well as a significant increase in ash carryover during grate cleaning associated with this method of firing.

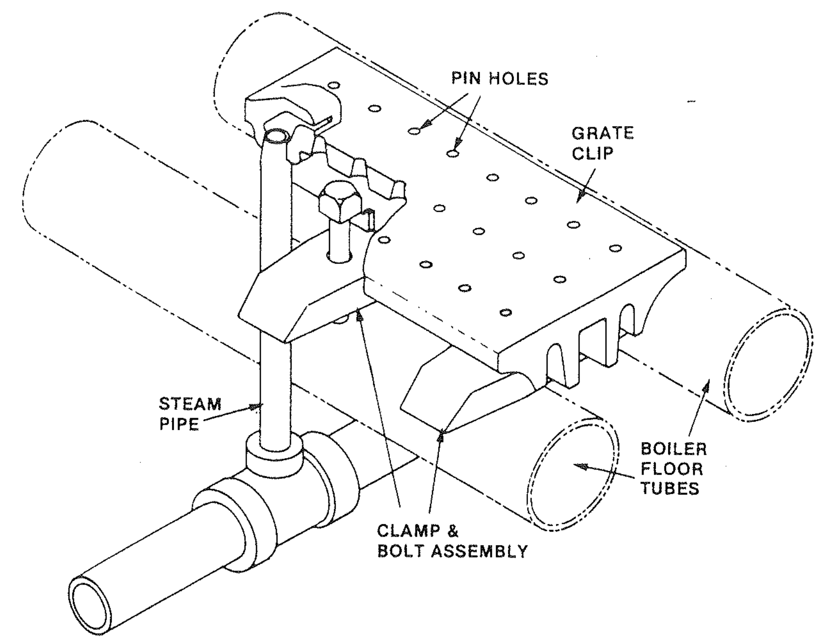


Figure 9a Water-Cooled Grate Clip with Integrally Cast Steam Jet Nozzle

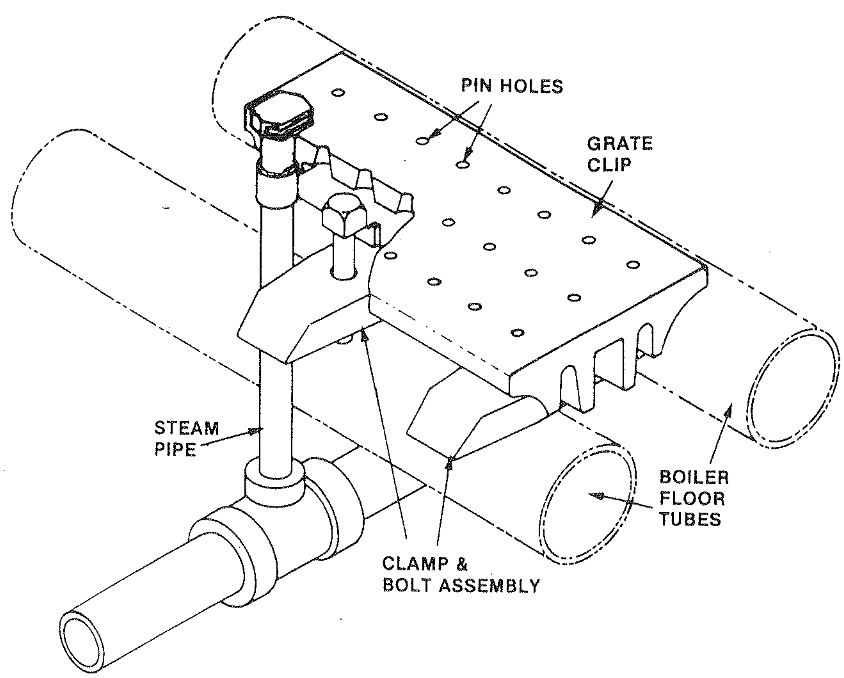


Figure 9b Water-Cooled Grate Clip with Stainless Steel Steam Jet Nozzle

HEAT RELEASE RATES

Spreader stokers operate at a higher heat release rate per square foot of live grate area than mass burning systems due to a combination of suspension burning and thin bed grate burning. The maximum heat release rate for spreader stokers firing wood with 45%–55% moisture is about 1,000,000 BTU/hr per square foot of active grate in a furnace designed with about 2½ to 3 seconds of residence time. This translates into a volumetric heat release rate of about 20,000 BTU/hr per cubic foot of furnace volume. The volumetric heat release rate will also be affected by other boiler design considerations so this number should only be used as a guide line.

Another consideration affecting the selection of grate heat release rate is the minimum load that the boiler is expected to carry on wood alone. Spreader stokers usually have a minimum firing rate of 250,000 to 300,000 BTU/hr/ft^2. A high heat release at full load extends the boiler turndown range. Another means of extended load range operation will be discussed later.

AIR SYSTEMS

While older units ran at 50% to 100% excess air, modern boilers routinely operate at 30% excess air.

Hot air improves the boiler's ability to burn wet wood. Air temperatures of 350° to 450°F are required for fuels with 40% to 50% moisture. Air temperature of 550°F is needed for 55% moisture fuels for sustained operation without auxiliary firing. Chromium alloy grates routinely run at these elevated temperatures.

The undergrate air should be delivered at a velocity near 2,000 feet per minute into a large plenum chamber to provide uniform air distribution to the grate.

The primary function of the overfire air system is to mix fuel and oxygen in the highest heat zone possible for effective burning (Figure 10). Properly designed systems also can reduce carbon carryover significantly.

- **High Volume in Lower Furnace for Complete Combustion**
- **Particulate Control**
- **Hot Air Temperature**
- **Full Penetration**
  - **Small High Pressure Nozzles**
  - **Large Low Pressure Nozzles**
- **No Interference with Fuel Distribution or Ash Protection**
- **Headers Independently Controllable**

Figure 10 Overfire Air System

Several systems have been tried over the years. These have evolved to a point where the industry standardized on 15% of the cold combustion air boosted to about 30 inches w.c. pressure and then introduced through several closely spaced nozzles along two rows in the rear wall and one under the distributors in the front wall. More recently, the advantages of higher quantities of hot overfire air have been recognized. Modern units now utilize 50% of the hot combustion air as overfire air (Figure 11). The advantages of this approach are discussed in the section on recent developments.

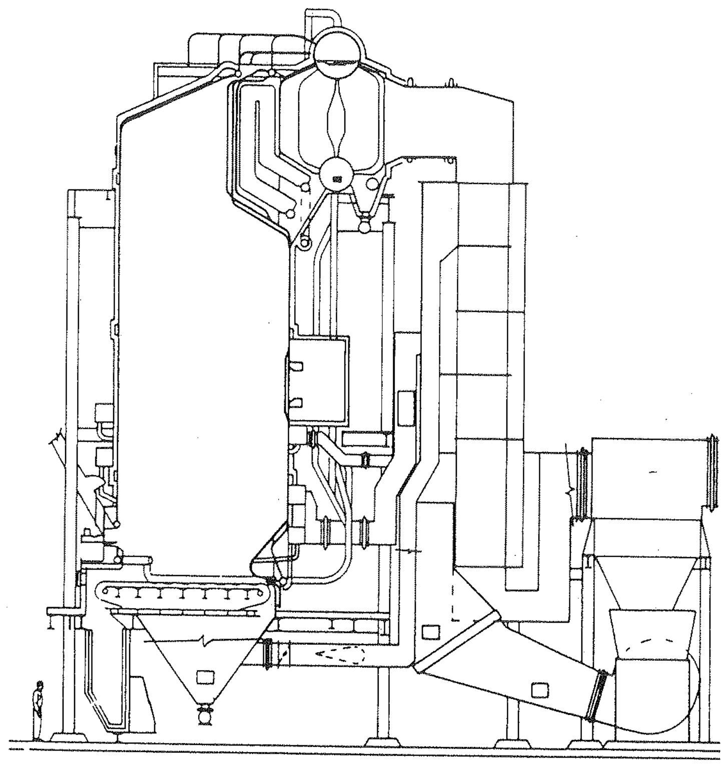


Figure 11 Boiler Fired by Hogged Wood, 140,000 pounds steam per hour at 400 psig and 725F Superheat. Fired by Hogged Wood with No. 5 Oil as Auxiliary Fuel and Equipped with 50% Hot Overfire Air System With Large, Low Pressure Nozzles

FLYCARBON REINJECTION

There is a significant carbon loss when unburned particles are carried out of the furnace. This loss can be greatly reduced by returning the carbon to the furnace from the boiler tank, air heater, and mechanical collector hoppers. A large portion of this carryover is fine sand which must be separated from the large carbon flakes prior to transport to the furnace (Figure 12). This minimizes erosion in the boiler and

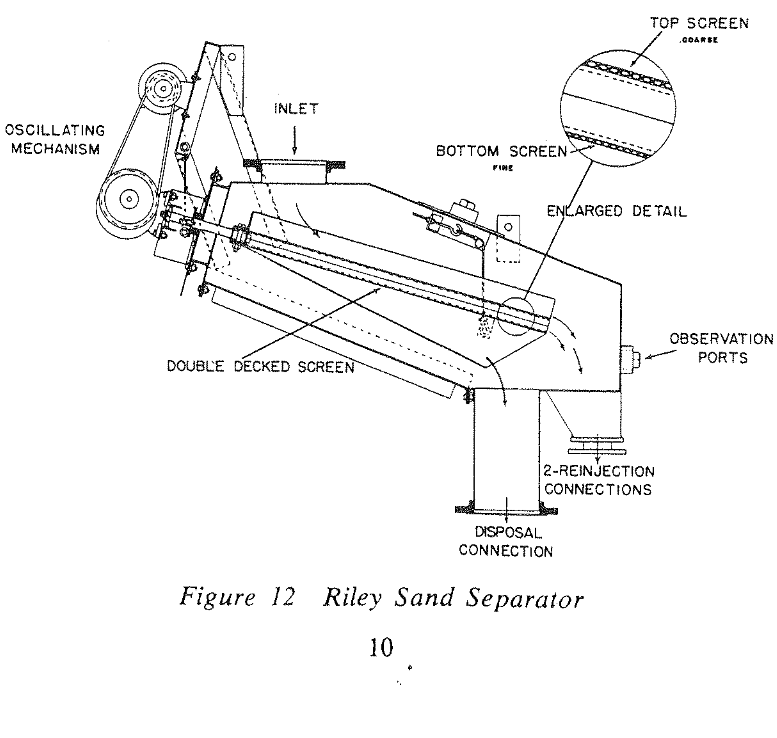


Figure 12 Riley Sand Separator

reinjection system. In some cases, it may be counterproductive to reinject from the mechanical collector due to the difficulty in separating sand and carbon after the flakes have been reduced to small particles in the collector.

AUXILIARY FUEL FIRING

Gas, oil or pulverized coal can be fired over the grate through burners located at least twelve feet above the grate. Radiant heat from the burners should be kept as far from the grate as the furnace and boiler designs will permit in order to minimize the potential for heat damage to the grate.

COAL AND WOOD FIRING ON A SPREADER STOKER

Coal and wood can be burned on a traveling grate in any proportion over the entire load range. Because of their density differences, the two fuels should be fired through separate feed and spreading systems. (Figure 13) Coal usually has much less moisture than the wood being fired so the efficiency of the boiler

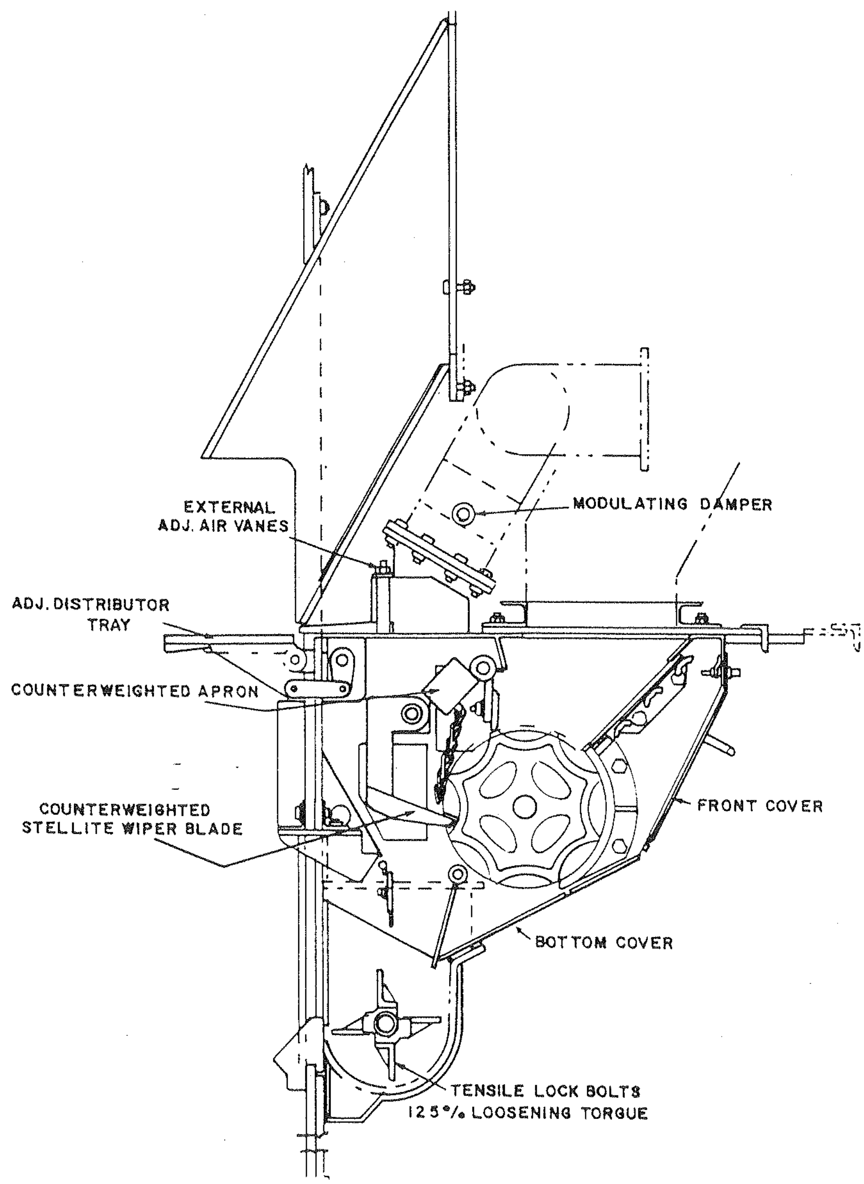


Figure 13 Riley Multi-Flex Combination Coal Feeder/Cellulose Distributor

increases with coal firing. Coal firing, therefore, usually requires a lower firing rate to produce a given steam load. (Figure 14)

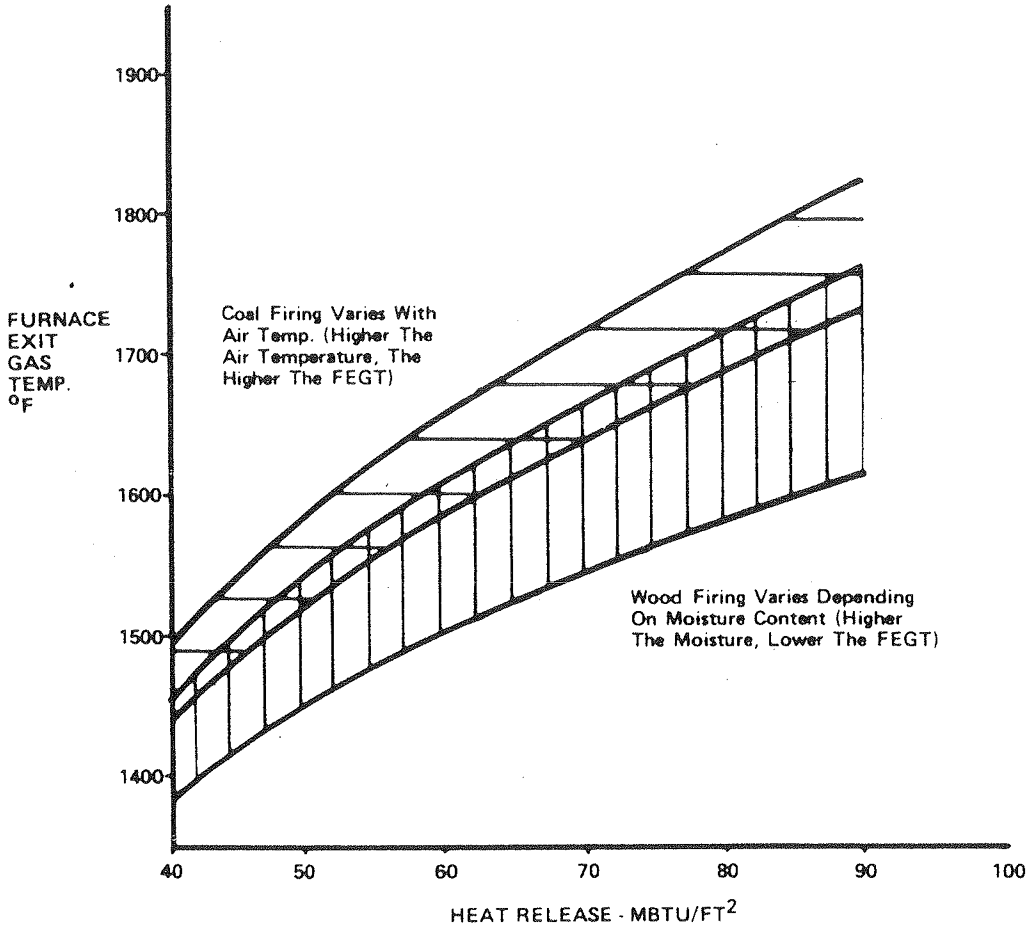


Figure 14 Furnace Exit Gas Temperatures

RECENT DEVELOPMENTS

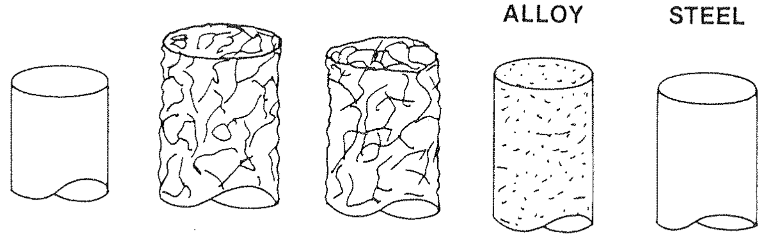
Several developments have been made in hardware design and operational techniques in recent years which improve system reliability and operating characteristics.

METALLURGY

When a cast material is exposed to a high temperature cycle in an oxygen rich atmosphere, the metal will oxidize, increasing in weight and physical dimensions while losing toughness. A traveling grate clip is in an oxidizing atmosphere with 300°F to 550°F on the underside of its travel and up to 1500°F when first introduced to the furnace prior to ash coverage. It is obvious that the effects of oxidation must be kept to a minimum if the surface is to have a long life with reasonable dimensional stability.

Several materials were heated in a test furnace to 1500°F for eight hours and cooled. The procedure was repeated 50 times, until there was no longer a great deal of change in the samples. The results are shown in Figure 15. The cast iron and ductile iron both exhibit scaling and dimensional distortion. The Riloy 3A chromium alloy did not scale and had much better dimensional stability. The 321 stainless steel was virtually unaffected. Production of a grate made of stainless steel would be prohibitively expensive, especially in light of cost and performance availability with the chromium alloy material.

Other matierals are now under study by our engineers to assure that the best performance is available at a reasonable cost.



	BASE CONDITION	CAST IRON	DUCTILE IRON	RILOY 3A CHROMIUM ALLOY	TYPE 321 STAINLESS STEEL
DIAMETER	1.000"	1.155"	1.097	1.041	1.000
% INCREASE		15.5%	9.7%	4.1%	0%
LENGTH	5.250	5.628"	5.332"	5.293	5.253
% INCREASE		7.2%	1.6%	0.8%	0.06%
% WEIGHT INCREASE	APPROX. 460 GRAMS	7.2%	3.4%	2.8%	0%
SURFACE	SMOOTH CAST SURFACE	PROGRESSIVE GROWTH LARGE BLISTERS START 20th	HEAVY SCALE FROM 6th CYCLE SHED SCALE AND RE-STARTED ON 18th CYCLE	VERY FINE BLISTERS ON 40th CYCLE	MINOR COLOR CHANGE

Figure 15 Effect of Temperature Cycles

MODULARIZATION

Recently, Riley Stoker began a program of modularizing its traveling grates to assure a high quality product through shop assembly and testing. (Figures 16 and 17) Shop labor efficiencies not available in the field offer increased reliability with a quicker schedule at a lower cost to the owner. The first modular traveling grate firing wood was put into service in 1979. There has not been one forced outage caused by the grate. Several other modular stokers have been placed in coal as well as wood fired service with excellent results.

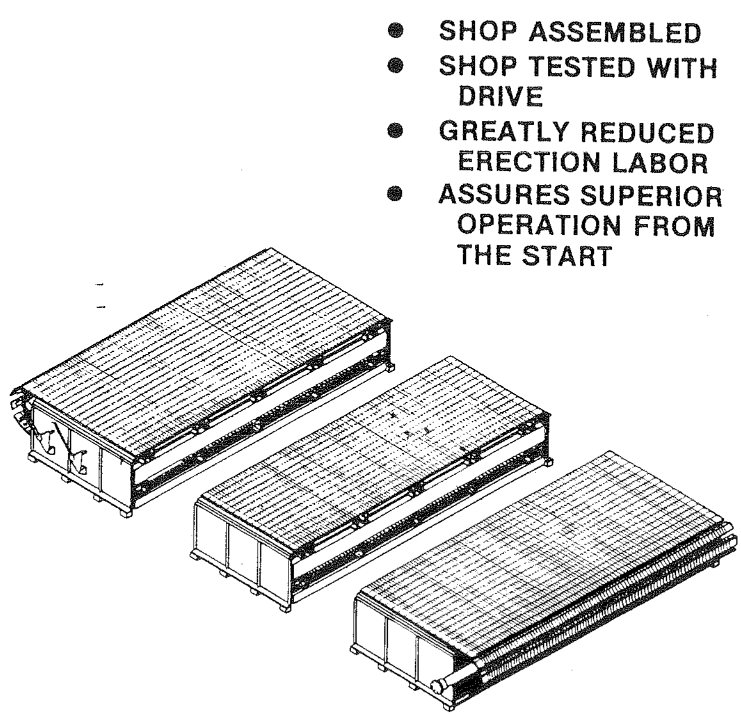


Figure 16 Riley Modular Construction

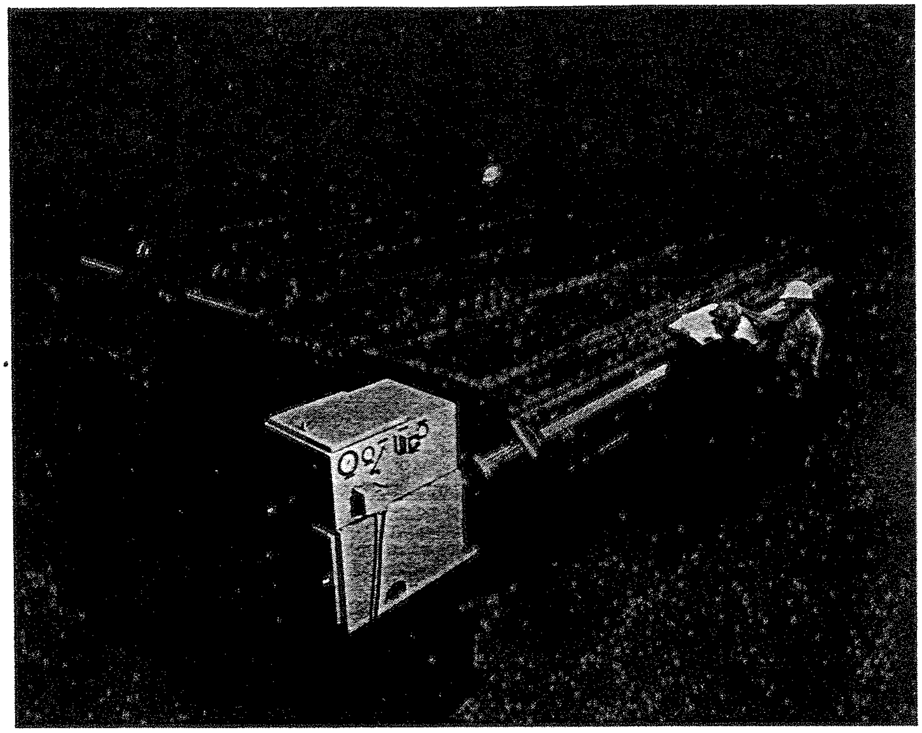


Figure 17 Riley Modular Traveling Grate

OVERFIRE AIR SYSTEMS

For years, stoker manufacturers limited their recommended grate heat release rates to 750,000 BTU/sq. ft./hr. in an effort to keep flyash, carbon loss and carryover under reasonable control. In so doing, grate residence time was increased while combustion temperatures were kept well below adiabatic. In recent years, however, grate heat releases in excess of 1,000,000 BTU/sq. ft./hr. have demonstrated the ability to successfully burn hogged wood at near complete combustion efficiencies. In order to control flyash carryover at such high heat release rates, several levels of overfire air nozzles in quantities approaching 50 percent have been employed. In so doing, undergrate air volume is considerably reduced and so are through-grate air velocities. This, in turn, reduces the tendency to lift the ash bed off the grate and hence reduces flyash carryover. (Figure 11 illustrates such a unit for 140,000 pph on hogged wood.)

To further illustrate this point, Figure 18a shows carryover conditions when 91% undergrate air is used, while Figure 18b shows the much reduced carryover quantities when only 5% undergrate is used. The theoretically predicted trend toward reductions in the char carryover have been demonstrated in the field. One Riley boiler in a papermill on the Washington Coast reduced its char carryover to one third of its previous level by increasing the overfire air to about 50% of the total air supply. Similar results have been reported at other installations. In addition, the furnace operated in a much more stable fashion. Fuel conditions had been producing a great deal of puffing in the furnace under the original operating setup. However, the new air distribution pattern has greatly reduced the puffing and stabilized the furnace.

As this paper is presented, we are starting up a wood fired retrofit project in the Northeast equipped with a high pressure hot overfire system designed to deliver 50% of the combustion air over a water cooled, steam cleaned grate.

BURNING PAPER MILL SLUDGE

As a result of cleaning up their effluent, paper mills are generating sizable quantities of sludge. Environmental restrictions preclude many landfill-type disposal methods for papermill sludge. The obvious alternative is to incinerate such sludges within the boiler furnace. To successfully incinerate sludges which

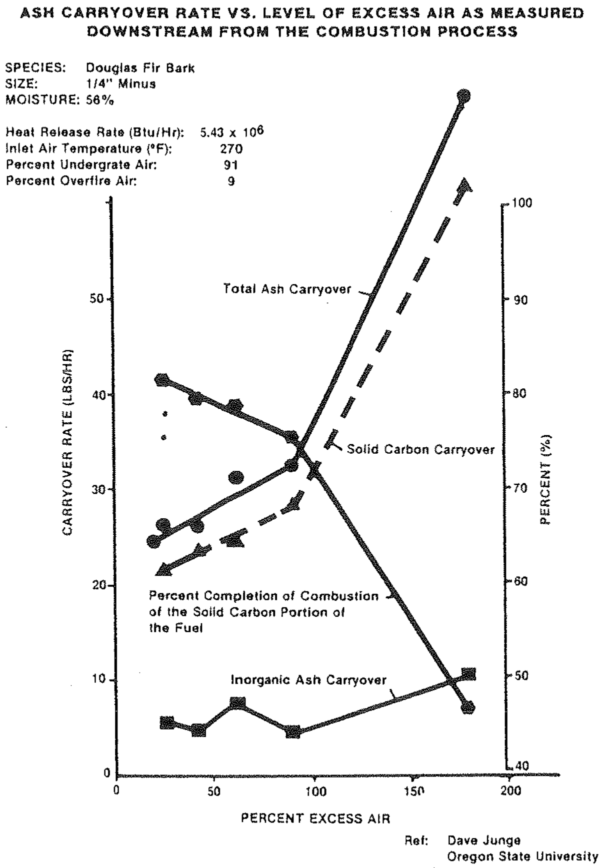


Figure 18a Carryover Conditions When 91% Undergrate Air is Used

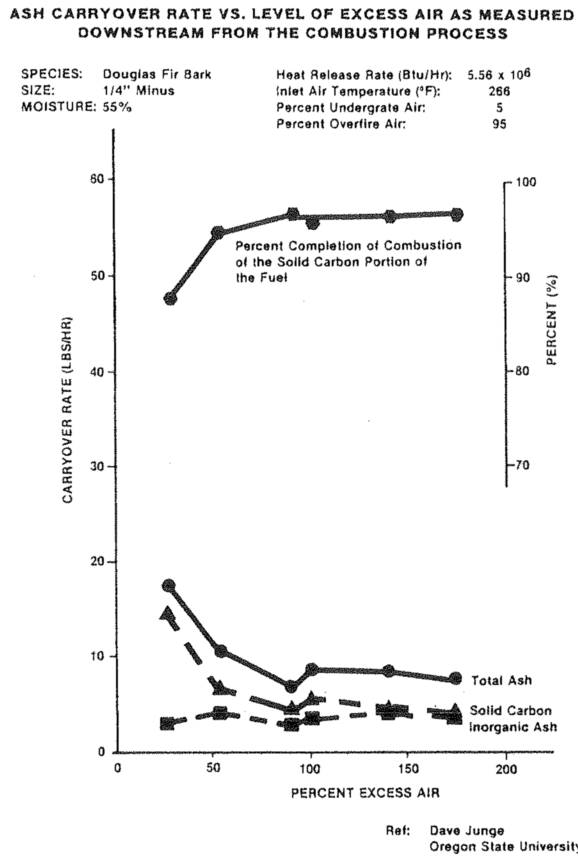


Figure 18b Carryover Conditions When 5% Undergrate Air is Used

contain high moisture levels requires prudent application of the three T's of combustion technology (Time, Temperature and Turbulence).

Most users would rather minimize the turbulence factor which inherently leads to high inorganic ash carryover. They justifiably express concern for accelerated convection tube fouling and erosion should this high ash-containing sludge exhibit such properties. They also share the belief that particulate collection systems are difficult enough to make, operate and maintain without additional loading on them.

The sludge incineration dilemma becomes obvious should high combustion intensity (temperature) be used to dry the sludge. This raises the question, "Would long furnace residence time be a better approach?"

Proponents of the high temperature approach favor a design providing for high stoker grate heat release rates. They argue that this enables the unit to turn down further before the combustion process is adversely affected by the sludge moisture and smoking results. For example, the 1,000,000 BTU/sq. ft./hr. full load grate heat release would allow turndown of 2 and 4 to 1 based on past operating experience burning high moisture cellulose fuels such as wet pine bark, and bagasse and high moisture lignite as shown in Figures 19a and 19b. To initially design for 750,000 BTU/sq. ft./hr. would limit turndown to only 1.5 to 1 on that basis for hogged wood and sludge firing.

The problem with high grate release rates is that the rates of sludge input often encountered result in rapid accumulation on the grate which quickly covers and insulates the sludge from exposure to the radiant drying effect of the furnace fire.

An alternative approach is to design for lower grate heat release rates in an effort to reduce rapid sludge piling. This requires a larger grate which, therefore, increases furnace residence time for sludge drying and then incineration.

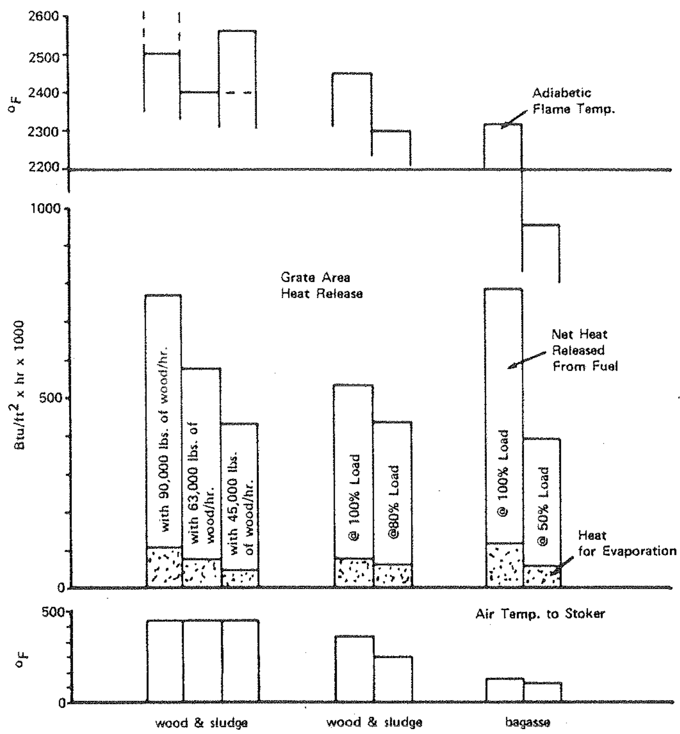


Figure 19a Comparison of Anticipated Combustion Conditions When Burning Wood and Sludge in Combination with Those Observed in Similar Installations

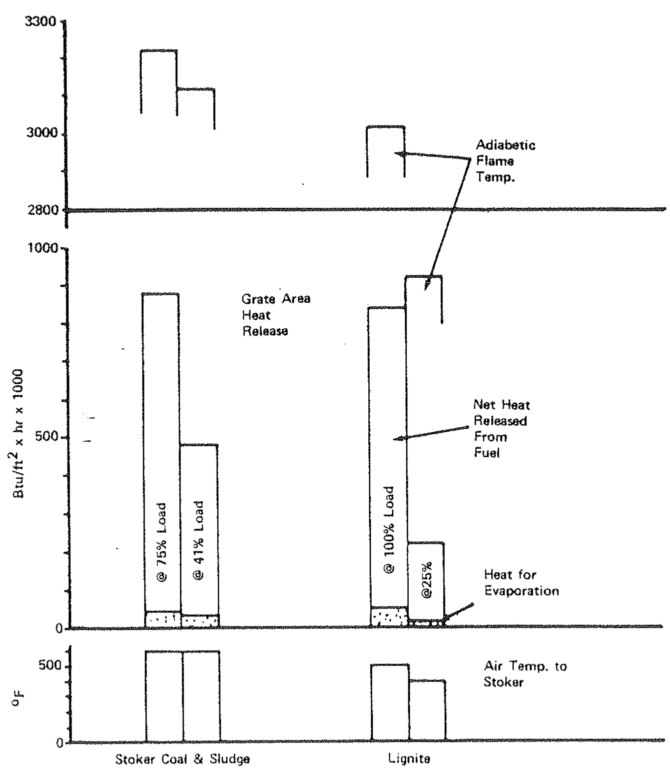


Figure 19b Comparison of Anticipated Combustion Conditions When Burning Stoker Coal and Sludge With That of Lignite Firing

Table I shows the results of laboratory testing of papermill white water clarifier sludge and reveals the following information with respect to sludge incineration:

1. When dried, sludge will incinerate well. Dried sludge readily ignited and exhibited self-supporting flame characteristics. As received (wet basis) sludge contained 11.8 percent volatile matter (54% on dry basis) by ASTM test. It could not be ignited.
2. After drying, rewetted sludge occupied only about ½ the volume of the original sample. This implies enhanced stability, and no free swelling problem potential.
3. The ash in this particular sample exhibited ash fusion properties in excess of 2700°F. Therefore, it is not likely to cause furnace slagging or convection bank fouling, and it is likely to form an excellent insulation for stoker grate thermal protection.

SAMPLE	LB MOISTURE / 100 LB AS REC'D SLUDGE
As received sludge	78.1
Dried (212°F) and rewetted	52.1
Dried (212°F) Pyrolized (1400°F) and rewetted	42.5
Dried (212°F) Pyrolized in Flame and rewetted	45.4

Table I Results of Laboratory Testing of Papermill White Water Clarifier Sludge

The extended load range firing technique described below offers a practical method of burning sludge as well as extending the turndown of wood fired units in general.

EXTENDED LOAD RANGE

In order to extend the boiler turndown range with a minimum or no smoke, or auxiliary fuel firing on wood fired and sludge burning units, designers have borrowed a page from hopper-fed coal stoker traveling grate technology. The use of lateral undergrate air zoning and variable trajectory pneumatic distributors permits the concentration of both fuel and undergrate air (Figures 20a and 20b). In doing so, local grate heat release rates can be increased to promote combustion and inhibit smoking and loss of ignition at low loads.

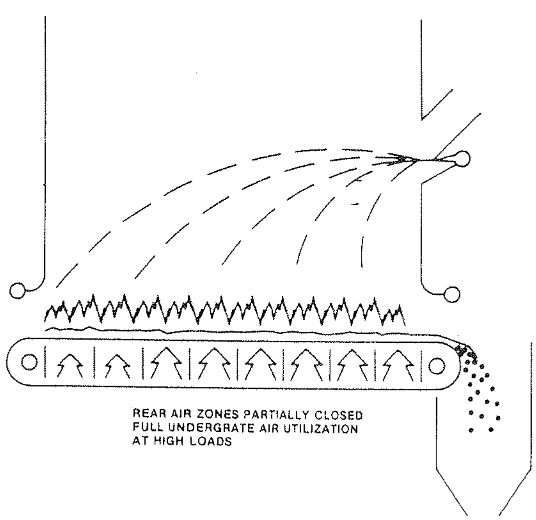


Figure 20 Typical Spreader Stoker Firing of Hogged Wood and Sludge

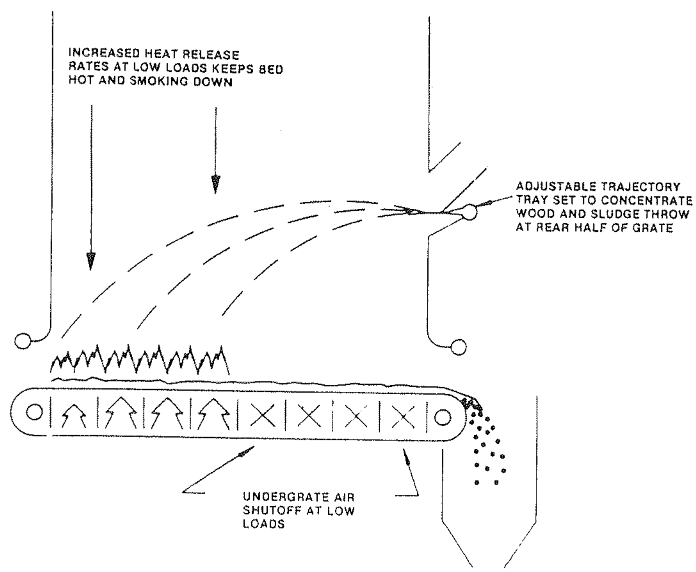


Figure 20b Spreader Stoker Firing of Hogged Wood and Sludge Using Lateral Undergrate Air Zoning and Variable Trajectory Distributors

IMPROVED STEAM CLEANING OF WATER-COOLED GRATES

A recently improved design for more efficient and reliable steam cleaning systems has been tested. The separate stainless steel cleaning nozzle (shown in Figure 9b) provides better control over the grate cleaning pattern and eliminates grate block failure due to thermal shock and steam pressure stresses associated with integrally cast steam nozzles.

CONCLUSION

Improved performance at a high level of reliability is achievable through state-of-the-art advances in the design of wood fired spreader stoker systems.

The burning of wood and wood "waste" requires widely flexible approaches to accommodate fuel variations. New developments in the design and operation of the spreader stoker combustion system can provide custom modification to existing grates. Application of this technology will result in energy and cost savings.

Boilers for the forest products and pulp and paper industries represent large capital investment. Reductions in the use of auxiliary fuels together with high boiler reliability and availability have never before been demanded so earnestly. Prudent users are understandably giving such approaches as those presented above very serious consideration in their efforts to protect their investments and assure the highest levels of equipment flexibility, reliability and economy.

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