BOILER & STEAM SYSTEMS

Boiler Facts

VOLUME 1, ISSUE 1

MARCH 2003

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ABOUT BOILER FACTS

Boiler Facts will be a semi-annual newsletter written for Steam Plant Personnel, Engineers, and Plant Operators. We intend this to be informative and factual. The goal is to help you to more clearly understand boiler room equipment and the physics and chemistry that make steam an effective way of transporting heat. We will also cover combustion, boiler safety, and economics, as they are equally important to the boiler room. This newsletter is also intended to familiarize you with **Boiler & Steam Systems** and its services.

To make this a more valuable and informative newsletter, we need your participation. Please send us your questions concerning boilers, combustion, or steam systems. We will answer any questions you send in either directly to the sender or they may appear in the next **Boiler Facts**.

We are also interested in having you let us know if you need more than one copy of **Boiler Facts**, and if you prefer an e-mail newsletter format in the future. We also plan to make it available at our web site (in the future).

Please fill out the attached reader service card and mail your comments to us.

Thank you and enjoy the reading!

Dave Sharpe

Dave Sharpe
Boiler & Steam Systems, LLC

SPECIAL POINTS OF INTEREST:

- *Low Water cut off control.*
- *Historical look at Marine boiler rooms in the early 1900's*
- *Fuel Cost comparisons made easy.*
- *Closer look at **Boiler & Steam Systems***

Steam 1602 Times the Volume?

When water is at 212°F and heat is added it will turn to steam. As it turns to steam it expands in volume. At sea level this water will expand to 1602.8 times its original liquid volume @ 212°F.

If you started with water at 50°F and created steam at 212°F your expansion would be 1671.8 times the original volume. 50ºF water would convert to 12# steam and would be 949.8 times its original volume, 50º water converted to 100# steam would be 242.3 times its original volume, and 50º water converted to 250# steam would be 108.7 times its original volume.

Low Water Cut Off Control

By Dwight Briski , Field Service Manager, Cole Industrial Inc.

On a steam boiler the low water cut-off is the most frequently mentioned item when talking about safety controls. The main low water cut-off control and the auxiliary low water cut-off control are the first lines of defense in keeping water in the boiler. Yet the low water cut-off device is often ignored or overlooked.

On most modern boilers, the low water cut-off is responsible for three main functions. It visually displays the water level by use of a sight glass. It signals the feedwater pump or the modulating feedwater valve to add water to the boiler. The low water cut-off also shuts the burner down if the water gets too low. To do these functions reliably, the low water cut-off needs to be checked and maintained.

Here are some of the answers I get in the field when I ask the boiler operator, "What is the normal water level?" "Give it plenty, that will be good." "Ah, it is always up and down in the sight glass, so don't worry." " I can't see the water level because the glass is dirty, but the burner is still running so it's okay, I guess." All of these answers lead me to give an on the spot review of some of the important operation and maintenance items needed to insure safe and reliable operation. No matter if you have a float type, probe type, mercury bulb type, or snap action type low water cut-off, the following are the things you should expect out of these controls:

SAFETY: That the control is sound and it will shut down the burner when activated and the gauge glass is functional.

DURABILITY: The float will last when it operates at its rated pressure and tested regularly. Years of reliable service should be expected of this control.

REPEATABILITY: The switching action should be accurate. The moving parts should not have a tendency to hang up and the burner cut-off happens at the same point in the gauge glass every time.

EASE OF MAINTENANCE: The control head assemblies are easy to remove. The terminal's wiring and wire insulation is easy to inspect for brittleness or worn spots. The float and bellows, mercury bulbs and snap action switch assemblies are accessible.

As competent boiler operators we have an obligation to maintain, test and operate these low water cut-off devices properly. The best procedure is to perform and low water cut-off test, and visual inspection every day.

Remember these operational and maintenance tips when blowing down a low water cut-off device on a steam boiler:

The blowdown action cleans the mud, crud and sludge out of the housing.
Lengthy blowdown should shut off the burner.
The mercury bulb should be inspected to make sure it is not oxidized and stringy.
Visually check that there are no shorted wires, cracked insulation, terminals bridged, or jumpered out.
Make sure water column piping is vertical.

Being mindful of how these low water cut-off devices work. Testing and maintaining them is the only way to insure reliable operation.
Note: McDonnell & Miller now recommends replacing the float heat assembly every five years. This is a recent change undoubtedly based on field experience.

BOILER ROOM JARGON

Continuous blowdown: referred to as top blowdown. This is boiler water removed continuously from the surface of the boiler water to remove scum, oil, foam and light solids from the boiler and control the total solids level in the boiler.
Intermittent blowdown: referred to as bottom blowdown. This is water taken from the bottom of the boiler to remove heavy sludge, scum and heavy solids from the boiler. This is done every 8 hours or daily depending on the make up water usage and chemistry.
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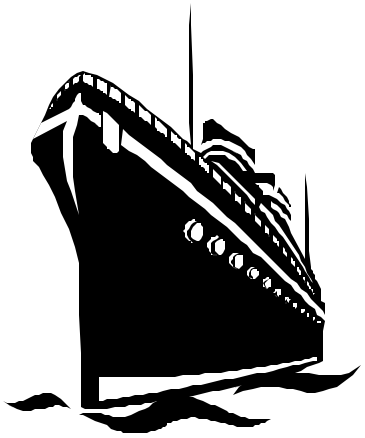
100 Years Ago

Excerpts from “Maxims and Instructions for the Boiler Room.”
By N. Hawkins
Published by: Prentise Hall,Date of Publication: 1902



Umbria employed 104 steam operators.

Firing on an Ocean Steamer like the “Umbria,” the men come on in gangs of eighteen stokers or firemen and twelve coal passers, and the watch lasts four hours. The “Umbria” has 72 furnaces, which require nearly 350 tons of coal a day, at a cost of almost $20,000 per voyage. One hundred and four men are employed to man the furnaces, and they have enough to do. They include the chief engineer, his three assistants, and ninety stokers and coal passers.

The stoker comes to work wearing only a thin undershirt, light trousers, and wooden shoes. On the “Umbria” each stoker tends four furnaces. He first rakes open the furnaces, tosses in the coals, and then cleans the fire, that is, pries the coal apart with a heavy iron bar, in order that the fire may burn freely. He dashes from one furnace to another, spending perhaps two or three minutes at each. Then he dashes to the air pipe, takes his turn at cooling off, and waits for another call to his furnace, which comes speedily. When the “watch" is over, the men shuffle off, dripping with sweat from head to foot, through long, cold galleries to the forecastle, where they turn in for eight hours. Four hours of scorching and eight hours sleep make up the routines of a fireman’s life on a voyage.

The temperature is ordinarily 120°, but sometimes reaches 160°; and the work then is terribly hard. The space between the furnaces is so narrow that when the men throw in coal they must take care when they swing back their shovels, lest they throw their arms on the furnace back of them.

In a recent trial of a government steamer the men worked willingly in a temperature of 175°, which, however, rose to 212° or the heat of boiling water. The shifts of four hours were reduced to two hours each, but after sixteen men had been prostrated, the whole force of thirty-six men refused to submit to the heat any longer and the trial was abandoned.

BOILER ROOM JARGON

Commonly misused terms can create confusion and miscommunications with plant and maintance personnel. Here are the correct definitions for some commonly misused terms.

Condensate: any condensed steam from heat transfer surface, through the trap, until it reaches the boiler room surge tank, feed tank or DA tank.
Pumped condensate: condensate after it has collected in a vessel and pumped (via steam or electric) back to the boiler room.
Make up water: Raw water or softened water that is being added to the boiler system to maintain water level in the system. This can be done at a feed tank, surge tank or deaerator tank to replace lost condensate steam or blowdown.
Softened water: water that has been processed through a water softener or water conditioner (typically zeolite resin softener).
Feed water: water after it has been collected in a tank in the boiler area. This can be a blend of condensate and make up water. It will be pumped to the boiler sometimes via the deaerator tank.
Treated water: water that has had chemicals added to make it suitable for the boiler.
Deaerated water: water that has passed through a deaerator tank. (This is also used as boiler feed water).
Boiler feed water: water that is being stored or pumped directly to the boiler (or to the economizer and then to the boiler).
Boiler water: water circulating in the boiler after generating steam, containing dispersed boiler treatment chemicals.

Energy Cost Comparison

This chart is a quick way to estimate and compare your relative fuel costs.
The relative efficiencies of each fuel and boiler system have been factored in.

Directions to compare your present energy cost:

1. Find the vertical column that lists your boiler fuel.
2. Move down that column until you find a cost that is closest to your fuel cost.
3. Move horizontally across to see the fuel costs equivalent to your current fuel cost.

Natural Gas Cost/therm $/therm	#2 Oil Equivalent Price/$/gal	10% Moisture Equivalent Energy Value$/Ton	50% Moisture Wood Energy Energy Value $/ton	Fuel cost 1,000,000 BTU Output
.30	.424	48.07	23.29	3.75
.35	.495	56.08	27.17	4.37
.40	.566	64.10	31.05	5.00
.45	.637	72.11	34.93	5.62
.50	.707	80.12	38.82	6.25
.55	.778	88.14	42.70	6.87
.60	.849	96.15	46.58	7.50
.65	.920	104.16	50.46	8.12
.70	.990	112.17	54.34	8.75
.75	1.061	120.19	58.22	9.37
.80	1.132	128.20	62.11	10.00
.85	1.203	136.21	65.99	10.62
.90	1.274	144.23	69.87	11.25
.95	1.344	152.24	73.75	11.87
1.00	1.415	160.25	77.63	12.50
1.10	1.557	176.28	85.40	13.75
1.20	1.698	192.30	93.16	15.00

EXAMPLE: If you currently pay $0.50/therm for natural gas, this is equivalent to #2 oil @ $0.707/gallon or dry wood @ $80.12/ton or 50% moisture wood waste at $38.82/ton. If you currently sell green wood at $10/ton, then you could save ($38.82 - $10.00)$28.82/ton by burning wood and not using natural gas.

If you have any questions, please call us at (425) 614-0784.

Cost of 1 Horse Power Motor Running 8760 Hours (1 year)

Electrical Rate per kw/hour	Electrical Costs
@3.0¢	1 HP / Year = $196
@3.5¢	1 HP / Year = $229
@4.0¢	1 HP / Year = $261
@4.5¢	1 HP / Year = $294
@5.0¢	1 HP / Year = $327
@5.5¢	1 HP / Year = $359
@6.0¢	1 HP / Year = $392
@8.0¢	1 HP / Year = $522

BOILER & STEAM SYSTEMS

Boiler & Steam Systems was started in 2001 by Dave Sharpe to assist companies in reducing their use of fossil fuels and to design and install innovative systems to burn wood waste. We assist the plant in designing efficient steam distribution and condensate recovery systems. We also work on existing distribution systems to increase efficiency, improve heat transfer and minimize steam flash losses.

One of our goals is to install modern wood burning systems that are much more efficient, more reliable, and take far less maintenance than previous wood burning systems. With current fuel prices (March 2003) companies can save a large amount of their energy cost by burning wood waste for their thermal energy needs.

We believe it is important for companies to reduce there operating costs to be more profitable in today's competitive marketplace. Reducing energy cost is one way to get a competitive advantage. **Boiler & Steam Systems** can assist your company to use energy efficiently, and reduce your operating costs. There are many steam systems that waste large amounts of energy, in most cases, the fixes are quite inexpensive. Below is a list of some of the services and systems we supply.

Wood Fired Boilers
Steam Distribution Systems
Blowdown Heat Recovery
Boiler Controls
Fuel Studies
Installed Systems
Blowdown Evaporators
Steam Silencers
Boiler Audits
Sander Dust Boilers
Condensate Recovery Systems
Air Heaters
Boiler Stack Emissions
System Design
Environmental Control Equipment
Gas and Oil Boilers
Breeching and Boiler Stacks
Boiler Trouble Shooting

Our focus is from the boiler room through the steam distribution and condensate recovery system. This is the area of our expertise and experience; we can provide your company excellent value in this area. If you have any questions please call us at (425) 614- 0784.

About Dave Sharpe

He started Boiler & Steam Systems in April of 2001 to develop and install wood waste energy systems. His interest in wood fired boilers started 25 years ago when Dave worked on suspension fired wood waste boilers. He found it amazing that a little over two pounds of sander dust would deliver the same energy as one pound of oil! He continued his work on suspension-fired boilers, development of hog fuel grinding equipment and fire proof air filtration systems on wood fired boilers.

Dave developed a strong belief that the northwest had its own unique advantage. It had it own " Oil Wells" in the form of hog fuel and wood waste. We grow the trees and what we don't use for lumber or pulp can supply our thermal energy. After enduring the oil crisis of 1973 – 1980 this seemed like a great advantage for this part of the country. When trees can grow two feet per year and we have many billions of trees in the northwest, we have a huge energy source that grows every year!

His keen interest in using wood to reduce the cost of energy was a key motivator in starting Boiler & Steam Systems. Dave believes industry needs wood energy systems that have higher on line reliability, with lower maintenance and operating costs. After working on this premise for a number of years, he has defined a number of superior components and designed unique systems to deliver more reliable performance with lower maintenance cost.

When not at work, Dave and his wife Jane, spend their time with their two sons. Dave enjoys wood working, and buying tools. On the weekends Dave can be found skiing at Crystal Mountain, or in the summers windsurfing at the Columbia River Gorge.

Boiler & Steam Systems

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Burning Wood Waste To Save Energy

Ask about our blow down evaporator to meet your zero liquid discharge requirements

Reader Response Card

Name_____

Phone Number_____

Company_____

City/ State_____

Please take me off your mailing list
Please send ____copies of **Boiler Facts** to our location
I am interested in receiving future **Boiler Facts** via e-mail
Please contact me. I am having problems with:

- Steam Distribution
- Boiler Performance
- High Maintence cost
- High Fuel Cost
- Water Treatment
- Boiler Flue emissions
- Other

I have a question regarding our boiler room

_____
_____
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