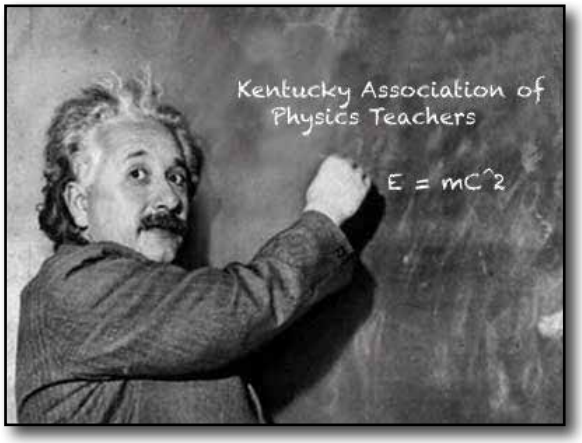
Today's Lesson in Physics:
The relationship between steam pressure and temperature



When water molecules heat up, they attain kinetic energy. The more they are heated, molecules eventually reach velocities great enough to break the surface of the water and become steam.

Steam is the heart of industry. It's powerful. It holds incredible amounts of energy; energy which has been harnessed by ancient civilizations and by the technologically advanced culture we live in today.

The relationship between steam pressure and steam temperature are critical in understanding the energy in the steam that a boiler produces. The relationship is quite simple in all reality, what is not simple is striking the perfect balance between pressure and temperature to provide the best steam solution for a customer. Don't panic, I know a guy, who knows a guy, who knows a boiler company that can help you! *Cough, Cough, WARE, Cough*

The higher the pressure of a boiler the more heat must be applied to make steam. With the increased pressure, you in turn get steam at higher temperatures. Higher temperature steam contains more energy per pound, which is known as Enthalpy. Enthalpy is defined as the thermodynamic potential made up of energy and pressure. In the US, its common unit of measurement is BTUs/Lb. So, if the pressure on a boiler is greater, the BTU/Lb of steam will also be greater.

To sum all of that up: higher boiler pressure = hotter steam = more energy per pound of steam

Now what does all of this mean in the real world? How do these relationships effect dollars and cents? Very little is free in this world, and the same is true here. Typically if a boilers pressure is higher, more material is needed to help the boiler withstand the heat necessary to generate the steam. More material means more dollars. Don't panic yet, there is some good news!

Let's break down a few real world examples:

Boiler A – 600 psig
–At 600 psig the temperature of your steam would be 486.38 F
–At 600 psig your enthalpy is 1203.68 btu/lb

Boiler B – 300psig
–At 300 psig the temperature of your steam would be 416.68 F
–At 300 psig your enthalpy is 1202.85 btu/lb

Continued on pg. 7

Wrap It Up!

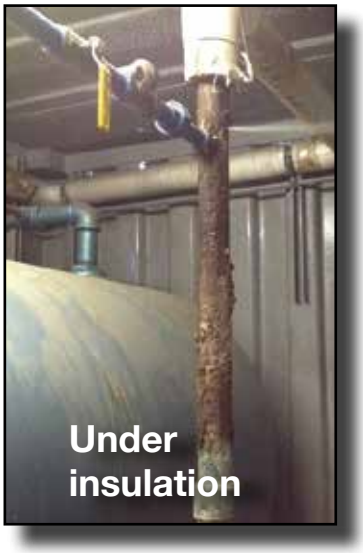
As fall spends the last of the heat that summer left behind, we enter that time of year so many facility maintenance personnel dread: the heating season. Losing heat in a building not only poses a problem for the occupants—it can also cause extensive damages to flowing water infrastructure, such as pipes, valves, storage tanks, and even boilers. It is common knowledge that water turns to ice when exposed to freezing temperature; the resulting expansion can delay bringing the system back online as water cannot flow through the ice. Alternatively, pipes, valves, etc. can break and require total replacement. When you consider water freezing inside a boiler, the damage could quickly become extremely expensive.

To avoid these unpleasant outcomes, it is important to protect your system by heat tracing and insulating any exposed lines. Insulation alone is often insufficient if there is not additional heat source for the lines, as a prolonged period of down-time (such as a power outage) could allow lines to cool off and freeze. In addition, insulating steam or hot water lines will prevent latent heat from being given up through the metal. This effectively lowers the delivered amount of output from the boiler; you are already paying for the fuel, water, and power to produce the heated fluid, so why shouldn't you be able to use as much of it as possible?

What type of insulation is right for you? As with most things, your selection will likely be tied to how much you are willing (and have available) to spend & what temperature you are dealing with, but there are several types of insulation most commonly employed. There is standard fiberglass insulation similar to the kind you would see used in most homes, and it is typically the most economical option. Foam and polystyrene insulation can offer greater efficiency, but they tend to be more expensive. Additionally, there is mineral wool insulation, other blanketed insulation of various types, and there are aluminum-jacketed insulation options for more aesthetic appeal and to better protect the material. Lastly, removable jacket insulation has become popular in many facilities for its effectiveness and ease of removal for inspection or maintenance and its ease of reuse thereafter, but it is much more expensive than other insulation methods since it is often custom-made to fit the shape of your facility's equipment.

Regardless of what type of insulation you are leaning toward, keep in mind that the piping beneath it should be periodically inspected for corrosion and leaks. If a leak goes unchecked, moisture can soak into certain kinds of insulation or just remain between the insulation and the metal, which can quickly cause "corrosion under insulation" (CUI), which can eat through the pipe and cause a serious leak or provide a damp, warm, dark place for mold to grow. See picture below.

For any of Ware's equipment, it is recommended that you consider the temperatures that the equipment will be exposed to during its time at your facility so that you can factor in the time and cost of properly protecting the lines from the changing weather. If your facility loses steam or hot water due to power loss in the middle of cold weather and it looks like it may not be quickly back online, it is important to secure your boiler as quickly as possible and to safely drain all water-bearing lines, valves, and equipment before they are allowed to freeze. Make sure that your operators are familiar with the proper procedure for securing your equipment. If, however, you find yourself with damaged equipment and need a boiler solution for your facility, Ware's rental fleet stands ready to help you get back online. If you would like to discuss preparing a contingency plan for your facility, feel free to call 1-800-228-8861 or view our video .



Boiler Tuning: Striking the Perfect Air/Fuel Mixture

You need three things to make a flame, fuel, oxygen and ignition. If you have ever made a potato cannon you understand this lesson well. Too much air in the combustion chamber and your spud doesn't launch with the pazzaz you expect, too much fuel, well, bad things can happen (boom). Side note: I've found that White Rain hairspray makes the best fuel source. To achieve the best launch you have to strike the perfect balance between fuel and air in the chamber. The same is also true with steam boilers. In order to achieve optimum efficiency, your boiler has to be tuned with the proper air/fuel mixture.

Too much O_2 in your boiler results in the boiler running inefficiently. Too much fuel in your boiler and catastrophic failure can occur.

Too often plant technicians look through the peep hole on their boiler, see a flame, and make the mistake of thinking their boiler is running "right". Most of time this is not the case at all. Not all flames are created equal. Just because you see a nice blue flame, doesn't mean you are getting the best production out of your boiler. Boilers must be sized to meet maximum potential demands, but did you know that the average boiler operates at 30-45% of its capacity?
When looking at boiler O_2 output you really want to keep it at or under 3%. When O_2 numbers climb above 3%, you have excess air and your boiler loses efficiencies. Excess air causes:

- Flame quenching
- Furnace cooling
- Reduced efficiency

To increase efficiency there are a few strategies one can employ to get the most out of their boiler.

Parallel positioning systems – with integrated flame management – This allows old technologies to be as efficient as they can be

Replacing linkage arms with servo motors on the fuel train and air systems

Utilizing a pre-mix technology achieves an 85% fuel air premix, making fuel air adjustments easier. Premix technologies also allow your boiler to achieve and maintain a 3% O_2 output which greatly improves turndown ratios – meaning you can make steam more immediately while realizing significant fuel savings.

WARE's team of boiler experts are highly skilled at evaluating the condition of a boiler and making sound recommendations on how to improve efficiencies and realize cost savings. WARE offers efficiency testing programs as well as controls and instrumentation evaluations to ensure that you are getting the most out of your boiler, day in and day out.

For a more detailed explanation of boiler tuning and how to get the most from your boiler, watch this video. WARE's experts discuss how to know if you are getting the most out of your combustion and measures to take to avoid flame quenching. They also discuss ways to look for better heat transfer and less maintenance. For more questions, call WARE today! (502)-968-2211

From left to right:
Jeff Coale, Ritchie Ware, Gerald Blain, Steven Taylor and John Viskup.

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NEW VIDEOS UPLOADED ALL THE TIME.

WARE new and used List

All equipment listed is for sale or lease and subject to availability

Unit	HP/PPH	Year	Manf.	Fuel	Type	PSI	Ctrl.
779	82,500	2013	Victory Energy Limpsfield	G/#2	Steam	350	IRI
767	75,000	2011	Victory Energy	G/#2	Steam/SH	750/750	IRI
747	75,000	2000	B&W (Low NOx)	G/#2	Steam/SH	750/750	IRI
750	70,000	1996	Nebraska (Low NOx)	G/#2	Steam/SH	750/750	IRI
709	60,000	1979	Zurn (Low NOx)	G/#2	Steam	500	IRI
741	60,000	1979	Zurn	G/#2	Steam	550	IRI
SB79	40,000	1986	Cleaver Brooks	Gas	Steam	260	IRI
496	800	1990	York-Shipley (Low NOx)	G/#2	Steam	200	IRI
634	800	1972	York-Shipley	G/#2	Steam	150	IRI
620	800	1975	York-Shipley	G/#2	Steam	250	IRI
SB139	500	2001	Cleaver Brooks		Steam	150	
SB200	400	2014	York-Shipley (Low NOx)	G/#2	Steam	150	UL/CSD1
SB138	350	1994	Cleaver Brooks		Steam	150	
SB137	250	1994	Cleaver Brooks		Steam	150	
415	250	1980	Eclipse	#2 Oil	HT/HW	954	IRI
SB148	200	1995	Kewanee	Gas	Steam	325	IRI
SB146	200	1995	Kewanee	Gas	Steam	325	IRI
SB216	250XID	2015	York-Shipley(Low NOx)	G/#2	Steam	150	UL/CSD1
SB213	175XID	2014	York-Shipley	G/#2	Steam	150	UL/CSD1
SB220	175XID	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB210	175XID	2014	York-Shipley	G/#2	Steam	150	UL/CSD1
SB217	150	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB214	150	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB224	150	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
RB769	150	1998	Precision	Electric	Steam	150	UL
SB225	100XID	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB219	100XID	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB221	100XID	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB222	50	2015	York-Shipley	G/#2	Steam	150	UL/CSD1
SB211	50	2014	York-Shipley	G/#2	Steam	150	UL/CSD1

One hour quote on-line at www.wareinc.com or call 800-228-8861

continued

WARE New and used List

All equipment listed is for sale or lease and subject to availability

Unit	HP/PPH	Year	Manf.	Fuel	Type	PSI	Ctrl.
SSB33	50 hp	2015	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB35	70 hp	2015	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB34	100XID	2014	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB32	150	2015	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB20	175XID	2012	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB25	250XID	2012	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB14	300XID	2011	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB15	500XID	2011	York Shipley	(Low NOx) G/#2	Steam	150	UL/CSD-1
SSB28	600XID	2012	York Shipley	(Low NOx) G/#2	Steam	250	UL/CSD-1
SSB30	800XID	2014	York Shipley	(Low NOx) G#2	Steam	250	UL/CSD-1
Unit	**Size**	**Manf.**	**Volt.**	**Type**	**Year**		
RC-24	30 ton	Mc Quay	480v	3 ph	2000		
RC-21	40 Ton	Mc Quay	480 v	3 ph	1999		
RC-1	60 Ton	Mc Quay	480 v	3 ph	1995		
RC-2	60 Ton	Mc Quay	480 v	3 ph	1995		
RC-13	60 Ton	Trane	200-230 v	3 ph	1989		
RC-5	95 Ton	Mc Quay	480 v	3 ph	1995		
RC-6	105 Ton	Mc Quay	480 v	3 ph	1995		
RC-8	155 Ton	Mc Quay	480 v	3 ph	1995		
RC-10	195 Ton	Mc Quay	480 v	3 ph	1995		
RC-11	195 Ton	Mc Quay	480 v	3 ph	1995		
RC-25	300 Ton	Mc Quay	480 v	3 ph	2003		
Two Water Cooled	200 Ton	Trane	480 v	3 ph	2015		

Chillers

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UNILUX

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Reimers

Wood Master Commercial Series

cbw

Today's Lesson in Physics: continued from pg. 1

The good news is that Boiler B, though it is half the pressure of Boiler A, still contains almost as much enthalpy or btu/lb. In a real world example Boiler B would typically be less cost to the customer without sacrificing much in the way of energy contained within each pound of steam produced.

If you are reading this, you probably have an interest in steam. You are also probably the kind of person who would be interested in the nH2O app. This app allows you to see firsthand, the relationship between steam pressure and steam temperature. Interested? **Click here** to download!

For even more information on the relationship between steam pressure and steam temperature and how that impacts your boiler application, contact WARE today! 800-228-8861.

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All net proceeds from the sale of SteamWARE T-shirts go to Kosair Charities, where health care is provided to Children when there is no one else to turn to.

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December 8 - 10

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