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Alberta Institute Of Power Engineers

STEAM LINES

The Publication for Power Engineers of Alberta

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Edmonton Branch

The Edmonton Branch meets on the third Tuesday of the month unless notified otherwise. The venue is Room R.0120 of the NAIT campus and the time is 6:30 PM.

The March 15 meeting will be a speaker meeting with Brown & Marshall Electric giving a presentation on Electroflow – A Process of Power Factor and Power Conditioning.

The April meeting will be a tour and is being finalized. Please watch for upcoming information.

There will be two more Executive Committee meetings, April 11 and May 16, before the summer break. They will be held at the NAIT venue, R.0120. Thomas Schmidt, Secretary, Edmonton Branch, AIPE

Calgary Branch

The Calgary Branch meets on the third Wednesday of the month unless notified otherwise. The venue is Room T247 in the Thomas Riley building of the SAIT campus. Meeting time is 7 pm.

The March meeting will be off campus in the form of a tour of Enerflex in southeast Calgary. The planned date was March 19 but this may have to be rescheduled to a bit later, April 2 or 9. Please watch for an email accordingly.

The April meeting will be a speaker meeting with Tom Leming of ABSA being the speaker. His topic will be centered around the latest Power Engineering Regulation changes and he will respond to any and all concerns he is presented with at the meeting. In an effort to help with time scheduling it would be helpful if you would pass on any topics or concerns you have for him by emailing them to shupac.ray@shaw.ca.

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Notes

The Calgary Branch was presented with a booth at the National Pressure Equipment Conference in Banff. It was very informative and there was much discussion by some of those present about the status and future of Power Engineering. There were also many who asked questions about the Institute of Power Engineers – we must improve on this aspect of our organization. In addtion, there was discussion on having a day added to the conference for the benefit of Power Engineers since we are generally the overseers of these pressure vessels. Comments would be helpful and greatly appreciated.

In This Issue…

Ask someone you'd like to know better to list five people he/she would most like to meet. It will tell you a lot about him/her.

Advertisers: If your ad appears to be incorrect or out of date, please contact Tania Shupac at steamlines.production@ipecalgary.com

If you would like to see your add in this newsletter please contact Jim Hyrve at steamlines.advertising@ipecalgary.com for more information.

From the Director's Chair

The AIPE has put a lot of focus lately on student membership, which may not be visible to some of you. We have long recognized that students represent not only our future Members, but also the future of our profession, and Student Members have always been welcomed into our Branches. However, we have not usually been very successful at retaining Student Members after they graduate, and I hope that our recent initiatives will help to change that. The National IPE policies state that Student Members must be full-time Power Engineering students or part-time Power Engineering students who are not otherwise employed for pay. Student Members are Members at the Branch level only, and the terms of their membership are determined by the individual Branches, including the amount of their dues. The intent of this provision is to enable non-working students to have most of the benefits of membership (such as tours and networking) while avoiding the full cost of the dues.

In Alberta, the Area Executive Council recently approved a policy that standardizes Student dues in our Branches at $10 per year, and makes a provision for Branches to form Student Chapters. The concept of a Student Chapter was born in 2002 at SAIT, and much credit goes to Calgary Branch President Ray Shupac PE, Doug Macaulay PE, Harry Maekelburger PE, (all SAIT staff), and students Dan Iverson, Dustin Moore, Curtis Lunseth, and Howard Barstead for re-implementing the idea. The Chapter is called the "Power Club," a term devised by students and staff a number of years ago and which became defunct with the advent of "common coring" at SAIT. It provides a formal, visible presence for the AIPE on the SAIT campus, under the auspices of a Faculty Advisor. The Chapter is organized as a "club" according to the rules of the SAIT Students' Association (SAITSA). Students have their own meetings and social activities, their own Executive and awards, and their own financial accountability and record keeping. Funding is managed partly through the Branch and partly through SAITSA. Power Club BBQ's on campus are a major success, and the Power Club's President represents Student Member interests by sitting in at Branch Executive Committee meetings. Of course, Student Members are also always welcome to partake of all regular Branch activities.

In 2004, Student Members at Medicine Hat College organized their own Power Club, facilitated by Burke Bechtel PE. Burke is a Calgary Branch Member and MHC instructor who also sits on our Area Executive Council. Like Ray, he gave very generously of his time and energy to start up the Power Club, and also oversaw and contributed to its initial

fundraising. The Club has had four supper meetings, and has partly financed a plant tour and two safety training programs for its Members. They will be issuing their first scholarship this semester.

Very special thanks go out to Ray and Burke for their vision, effort, and generosity, and also to all of the SAIT and MHC students who are taking advantage of the Power Club opportunity. My hope is that other colleges in Alberta will also establish Power Clubs, tailored according to the policies and circumstances of their host colleges. In 2003 and 2004 the Edmonton Branch provided an evening of interview training for NAIT Student Members who will soon be seeking summer or permanent employment, and the Branch will be administering two scholarships for NAIT students this year. There has also been recent interest in increasing the AIPE presence at Portage College in Lac La Biche.

For our Student Members, I suggest that one of the biggest benefits that you will get from Power Club membership is an intangible benefit that you may not be aware of. Employers today are looking for staff who can demonstrate strong interpersonal, teamwork, communications, and leadership skills, and these are often as important as the technical knowledge and competence that you acquire in classrooms, labs, and practicums. Students without a lot of work experience are often hard pressed to show that they have these additional skills. Volunteering to assist with your Power Club will serve both to help you learn the “soft” skills, but also to document how you have applied them in a professional organization.

Finally, my thought for the day: What I've learned is that I still have a lot to learn.

Lorne Shewfelt, PE, Alberta Area Director.

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Part 1 of this 2 part article appeared in our Jan. Feb. 05 issue.

BOILER EFFICIENCY FACTS – PART II

DEFINING BOILER EFFICIENCY

Combustion Efficiency

Combustion efficiency is an indication of the burner's ability to burn fuel. The amount of unburned fuel and excess air in the exhaust are used to assess a burner's combustion efficiency. Burners resulting in low levels of unburned fuel while operating at low excess air levels are considered efficient. Well designed burners firing gaseous and liquid fuels operate at excess air levels of 15% and result in negligible unburned fuel. By operating at only 15% excess air, less heat from the combustion process is being used to heat excess air, which increases the available heat for the load. Combustion efficiency is not the same for all fuels and, generally, gaseous and liquid fuels burn more efficiently than

solid fuels.

Thermal Efficiency

Thermal efficiency is a measure of the effectiveness of the heat exchanger of the boiler. It measures the ability of the exchanger to transfer heat from the combustion process to the water or steam in the boiler. Because thermal efficiency is solely a measurement of the effectiveness of the heat exchanger of the boiler, it does not account for radiation and convection losses due to the boiler's shell, water column, or other components. Since thermal efficiency does not account for radiation and convection losses, it is not a true indication of the boilers fuel usage and should not be used in economic evaluations.

Boiler Efficiency

The term "boiler efficiency" is often substituted for thermal efficiency or fuel-to-steam efficiency. When the term "boiler efficiency" is used, it is important to know which type of efficiency is being represented. Why? Because thermal efficiency, which does not account for radiation and convection losses, is not an indication of the true boiler efficiency. Fuel-to-steam efficiency, which does account for radiation and convection losses, is a true indication of overall boiler efficiency. The term "boiler efficiency" should be defined by the boiler manufacturer before it is used in any economic evaluation.

Fuel-To-Steam Efficiency

Fuel-to-steam efficiency is a measure of the overall efficiency of the boiler. It accounts for the effectiveness of the heat exchanger as well as the radiation and convection losses. It is an indication of the true boiler efficiency and should be the efficiency used in economic evaluations.

As prescribed by the ASME Power Test Code, PTC 4.1, the fuel-to-steam efficiency of a boiler can be determined by two methods; the "Input-Output Method" and the "Heat Loss Method".

Input-Output Method

The Input-Output efficiency measurement method is based on the ratio of the output-to-input of the boiler. It is calculated by dividing the boiler output (in BTUs or other suitable units) by the boiler input (in the same units used for the input) and multiplying by 100. The actual input and output of the boiler are determined though instrumentation and the data is used in calculations that result in the fuel-to-steam efficiency.

Heat Loss Method

The Heat Balance efficiency measurement method is based on accounting for all the heat losses of the boiler. The actual measurement method consists of subtracting from 100 percent the total percent stack, radiation, and convection losses. The resulting value is the boiler's fuel-to-steam efficiency. The heat balance method accounts for stack

losses and radiation and convection losses.

Stack Losses

Stack temperature is a measure of the heat carried away by dry flue gases and the moisture loss. It is a good indicator of boiler efficiency. The stack temperature is the temperature of the combustion gases (dry and water vapor) leaving the boiler and reflects the energy that did not transfer from the fuel to the steam or hot water. The lower the stack temperature, the more effective the heat exchanger design, and the higher the fuel-to-steam efficiency.

Radiation and Convection Losses

All boilers have radiation and convection losses. The losses represent heat radiating from the boiler (radiation losses) and heat lost due to air flowing across the boiler (convection losses). Radiation and convection losses, expressed in Btu/hr, are essentially constant throughout the firing range of a particular boiler, but vary between different boiler types, sizes, and operating pressures.

Components of Efficiency (impact and sensitivity)

Boiler efficiency, when calculated by the ASME heat balance method, includes stack losses and radiation and convection losses. But what factors have the most effect or "sensitivity" on boiler efficiency? As discussed earlier, the basic boiler design is the major factor. However, there is room for interpretation when calculating efficiency. Indeed if desired, you can make a boiler appear more efficient than it really is by using a little creativity in the efficiency calculation. The following are the key factors to understanding efficiency calculations.

1. Flue gas temperature (Stack temperature)
2. Fuel specification
3. Excess air
4. Ambient air temperature
5. Radiation and convection losses.

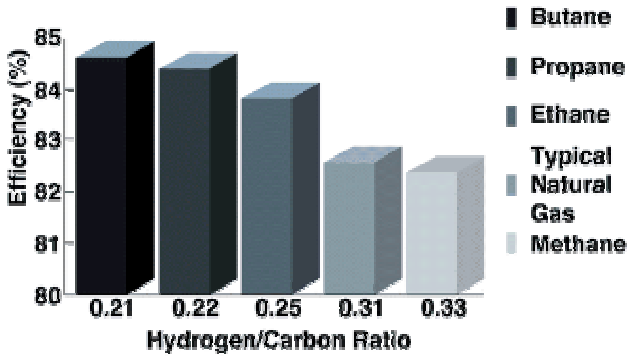
Flue Gas Temperature

Flue gas temperature or "stack temperature" is the temperature of the combustion gases as they exit the boiler. The flue gas temperature must be a proven value for the efficiency calculation to be reflective of the true fuel usage of the boiler. A potential way to manipulate an efficiency value is to utilize a lower-than-actual flue gas temperature in the calculation. When reviewing an efficiency guarantee or calculation, check the flue gas temperature. Is it realistic? Is it near or less than the saturation temperature of the fluid in the boiler? And can the vendor of the equipment refer you to an existing jobsite where these levels of flue gas temperatures exist? Jobsite conditions will vary and have an effect on flue gas temperature. However, if the efficiency value is accurate, the flue gas temperatures should be confirmable in existing applications. Don't be fooled by estimated stack temperatures. Make sure the stack temperature is proven.

Don't work for recognition, but do work worthy of recognition.

Fuel Specification

The fuel specification can also have a dramatic effect on efficiency. In the case of gaseous fuels, the higher the hydrogen content, the more water vapor is formed during combustion. This water vapor uses energy as it changes phase in the combustion process. Higher water vapor losses when firing the fuel result in lower efficiency. This is one reason why fuel oil fires at higher efficiency levels than natural gas. To get an accurate efficiency calculation, a fuel specification that represents the jobsite fuel to be fired must be used. When reviewing an efficiency guarantee or calculation, check the fuel specification. Is it representative of the fuel you will use in the boiler? The representation of efficiency using fuel with low hydrogen content will not provide an accurate evaluation of your actual fuel usage.



The Efficiency vs. H/C Ratio bar graph shows the degree to which efficiency can be affected by fuel specification. The graph indicates the effect of the hydrogen-to-carbon ratio on efficiency for five different gaseous fuels. At identical operating conditions, efficiencies can vary as much as 2.5-3.0%, based solely on the hydrogen-to-carbon ratio of the fuel. When evaluating boiler efficiency, knowing the actual fuel specification is a must.

Excess Air

Excess air is the extra air supplied to the burner beyond the air required for complete combustion. Excess air is supplied to the burner because a boiler firing without sufficient air or "fuel rich" is operating in a potentially dangerous condition. Therefore, excess air is supplied to the burner to provide a safety factor above the actual air required for combustion. However, excess air is heated during combustion of the fuel, thus taking away potential energy for transfer to water in the boiler. In this way, excess air reduces boiler efficiency. A quality burner design will allow firing at minimum excess air levels of 15% (3% as O_2). O_2 represents percent oxygen in the flue gas. Excess air is measured by sampling the O_2 in the flue gas. If 15% excess air exists, the oxygen analyzer would measure the O_2 in the excess air and show a 3% measurement.

Seasonal changes in temperature and barometric pressure can cause the excess air in a boiler to fluctuate 5% - 10%. Furthermore, firing at low excess air levels can result

in high CO and boiler sooting, specifically if the burner has complex linkage and lacks proper fan design. The fact is, even burners theoretically capable of running at less than 15% excess air levels rarely are left at these settings in actual practice. A realistic excess air level for a boiler in operation is 15% if an appropriate safety factor is to be maintained.

When reviewing an efficiency guarantee or calculation, check the excess air levels. If 15% excess air is being used to calculate the efficiency, the burner should be of a very high quality design with repeatable damper and linkage features. Without these features, your boiler will not be operating at the low excess air values being used for the calculation, at least not for long. If less than 15% excess air is being used for the calculation you are probably basing your fuel usage on a higher efficiency than will be achieved in your day to day operation. You should ask the vendor to recalculate the efficiency at realistic excess air values.

Ambient Temperature

Ambient temperature can have a dramatic effect on boiler efficiency. A 40°F variation in ambient temperature can affect efficiency by 1% or more. Most boiler rooms are relatively warm. Therefore, most efficiency calculations are based on 80°F ambient temperatures. When reviewing an efficiency guarantee or calculation, check the ambient air conditions utilized. If a higher than 80°F value was utilized, it is not consistent with standard engineering practice. And, if the boiler is going to be outside, the actual efficiency will be lower due to lower ambient air temperatures regardless of the boiler design. To determine your actual fuel usage, ask for the efficiency to be calculated at the lower ambient conditions.

Radiation and Convection losses

Radiation and convection losses represent the heat losses radiating from the boiler vessel. Boilers are insulated to minimize these losses. However, every boiler has radiation and convection losses. Some times efficiency is represented without any radiation and convection losses.

This is not a true reflection of fuel usage of the boiler. The boiler design also can have an effect on radiation and convection losses. For example, a wetback design boiler tends to have much higher rear skin temperatures than a dryback design. This is easy to prove. Just go to the back of a quality dryback boiler and touch the rear door. Cool rear temperatures are the result of low radiation and convection losses in the rear of the boiler. Boilers operating with high rear temperatures are wasting energy every time the unit is fired.

Radiation and convection losses also are a function of air velocity across the boiler. A typical boiler room does not have high wind velocities. Boilers operating outside, however, will have higher radiation and convection losses.

Summary

Selection of a boiler with "designed-in" low maintenance costs and high efficiency can really pay off by providing ongoing savings and maximizing your boiler investment. Remember, first cost is a relatively small portion of your boiler investment.

High boiler efficiency is the result of specific design criteria, including:

- Number of boiler passes
- Burner / boiler compatibility
- Repeatable air/fuel control
- Heating surface
- Pressure vessel design

Boiler efficiency calculations that are accurate and representative of actual boiler fuel usage require the use of proven and verified data, including:

- Proven stack temperature
- Accurate fuel specification
- Actual operating excess air levels
- Proper ambient air temperature
- Proper radiation & convection losses

When evaluating your boiler purchase, ask your boiler vendor to go through the efficiency calculation to verify it is realistic and proven. Also review the type of boiler/burner being utilized to check if the unit's performance will be consistent and repeatable. You will pay for the fuel actually used, not the estimated fuel based on the efficiency calculation. Once the boiler is installed, you can't go back and change the design efficiency of the unit.

The facts regarding boiler efficiency are clear: optimal high efficiency boiler designs are available. You will get superior performance with these premium designs. And efficiency calculations can be verified and proven. Make sure the efficiency data you are using for your boiler evaluation is guaranteed and is accurate and repeatable over the life of the equipment. Make sure your actual fuel usage requirements of the boiler are understood before you buy.

In the end, the time spent evaluating efficiency will be well worth the effort. Insisting on a high efficiency, repeatable design firetube boiler will pay off every time your new boiler is fired, for the entire life of the equipment.

Special thanks to Cleaver Brooks.

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An interesting bit of information for those of us who take an extended vacation when we are able to.

Beware of Exploding Dishwasher!

From the Chief Inspector:

Normally articles about boiler explosions arrive on my desk, but recently an article on an exploding dishwasher arrived, which I thought would interest everybody.

A person was checking vacant housing units and started the dishwasher as part of the inspection. A few minutes later the dishwasher exploded, doing considerable damage to the housing unit. Nobody was hurt in this incident but the

potential was there.
At first it was assumed that sewer gas had entered via the drain connection but no evidence of sewer gas could be found in other similar vacant housing units. The dishwasher owner's manual provided the answer: "...under certain conditions, hydrogen gas may be produced in a hot water system that has not been used for two weeks or more. If the hot-water system has not been used for such a period, before using the dishwaser, turn on all hot-water faucets and let the water flow."
Tests were carried out on the water lines and extremely high hydrogen readings were found.
Just as operators would not assume that other abandoned piping was safe to work on without checking for explosive contents, even non-flowing hot water lines can be seen to pose a significant hazard potentially.
This article originally appeared in "The Pressure News", Volume 6, Issue 3, September 2001.

MEDICINE HAT COLLEGE POWER CLUB

The MHC AIPE Student Chapter Power Club is in its second successful semester.
The following people were elected last semester to the executive of the AIPE Student Chapter Power Club and will continue in their respective positions to the end of this year.
President- Colby Kivol (ph 403.)
Vice-President - Cam Drescher (ph 403.)
Treasurer- Thomas Bahng (ph 403.)
Secretary- Kurtis Bergian (ph 403.)
Co-secretary- Regan Jackson (Ph 403.)
Activities/Membership Director- Owen Meadows (Ph 403.)
Co-Activities/Membership Director - Chris Haskell (ph 403.)

We had our first meeting of the winter semester on Thursday, January 13, 2005 (meetings are every **second** Thursday of the month except December, June, July and August). There were 19 attendees including myself, Burke Bechtel, as student advisor.
Everyone attending contributed $5.00 to the pot; $4.00 towards the pizza and pop to start the meeting and $1.00 towards the Looney draw at the end of the meeting (the club picked up the difference in costs).
The first order of business was to agree to the awarding of the first $300.00 IPE Power Club Annual Scholarship this semester to one of our two year members. A committee was struck to determine the parameters for the scholarship.

The members elected to set aside funds to subsidize IPE student member training for two outside courses-H2S Alive as well as Confined Space Entry, to the tune of $10.00 per member per course.

As well, the membership agreed to subsidize one IPE Student tour this semester up to a maximum of $10.00 per attendee.

The Looney draw was won by Colby Kivol.

Burke Bechtel, PE

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CALGARY BRANCH

The January meeting was a tour of the SAIT Power Plant and was a success. Special thanks to Chief Engineer Bruce Robertson and tour guide Jim Nelson, PE. A framed Certificate of Appreciation was presented and now appears on the control room display wall.

The February speaker meeting was interesting with feedback emails to that effect. Lee Edgar, CGA, was the speaker and discussed tax preparation as well as small business book keeping and other related topics. It is hoped this topic becomes an annual event at this time of year – tax time! Lee Edgar's complimentary advertisement appears in this issue. Feel free to contact him at any time. A framed Speaker Appreciation Certificate was presented to Lee.

Communications are ongoing regarding a spring meeting with the Vancouver and Victoria Branches. It is hoped the applicable executives can meet on the BCIT campus, discuss ways of enhancing IPE membership growth, membership involvement with branch operations, and other topics which will bring our Institute forward. Hopefully, a tour of the BCIT campus facilities will close the visit. Also, those attending will bring spouses along for what we hope will be a pleasant and enjoyable break for them. This could become an annual spring-break event if things go as desired.

Steam Lines staff continues to work hard at making our periodical a respectable one and the positive feedback is very well received. Much time has been spent on advertising and it is hoped the results will be positive. Two Edmonton Branch members, Tedd Wagil PE and Jim Hyrve PE have become part of the SL staff and have been a tremendous help. They continue to work hard with the Calgary group and we certainly wish them to know of our appreciation. They are excellent examples of "volunteerism", a necessity for our existence.

I attended a retirement party for member Henry Englehart PE at the University of Calgary Power Plant and expressed wishes for an enjoyable time henceforth for him and Nadine on behalf of the Branch. During my congratulatory chat I pointed out how he was very instrumental in getting the Calgary Branch active again during the fall of 2001. Henry and Nadine – congratulations and always enjoy!

On behalf of the Calgary Branch – spring is on the way, let's all enjoy. It is a time of renewal and good time to stand in the middle of the backyard and take a ”walk” around ourselves" a few times! The "360° self-view" can be interesting.