Energy Management Success Story

Economizer Saves Money and Improves Environment

January 8th, 2004, was just another day of quality care-giving at Providence Continuing Care Centre (PCCC) Mental Health Services in Kingston, Ontario, except for what was going on in the boiler room where the commissioning of a new boiler feed water economizer was cause for celebration.

The economizer, designed to recover waste heat from the flue gases that normally flow up the chimney and out into the atmosphere, was about to have a major impact on energy savings for this 220-bed mental health facility on the shore of Lake Ontario.

PCCC has a power plant, staffed 24/7, equipped with three (gas or oil fired) water tube high-pressure steam boilers capable of generating 60,000 pounds of steam per hour. When the on-site laundry was operational, the power plant steam pressure was maintained at 125 PSI. When the laundry closed, the pressure was reduced to 90 PSI in winter and 75 PSI in summer. Closing the laundry resulted in immediate yearly savings of approximately $30,000. However, regardless of this change, generating steam from water is expensive and a facility this size uses a lot of steam to heat buildings and generate hot water used in bathing, washing, cooking and cleaning.

The majority of power plants, including PCCC's, are equipped with a heat recovery system where the condensate is recovered after the heat is extracted either directly from the steam or through a heat exchanger. Condensate recycling lowers the cost by re-using water that has been softened, chemically treated and is already in the 160-170 degree F. range. The portion that is lost is made up of raw water that must be softened, chemically treated and heated to the boiling point.

To further reduce steam-generating costs, most power plants are typically also equipped with a de-aerator that serves two purposes. First, live steam or exhaust steam is piped to the de-aerator's upper section where it mixes with the cooler boiler feed water. This raises the feed water temperature to 212 degrees F. or higher. PCCC's de-aerator uses steam turbine exhaust steam and raises the water to 228 degrees F. prior to pumping the water to the boiler steam drum where the water is evaporated into steam.

Corrosion abatement is the second purpose. At 220 degrees F., the boiler feed water temperature is higher than the boiling point of water, causing 90% of the trapped oxygen, and other inert gases present in the water, to be vented to the atmosphere. The remaining 10% is eliminated by pumping sulphite, an oxygen scavenger, directly in the boiler feed water thus reducing the risk of corrosion in the steam, condensate lines and the building heating systems.

Karin Carmichael,
Acting Administrator

An Energy Innovators Case Study

Canadian College of Health Service Executives
Collège canadien des directeurs de services de santé

Providence Continuing Care Centre
Sisters of Providence of St. Vincent de Paul

At 90 PSI, the steam temperature is 320 degrees Fahrenheit and requires 1,186 British Thermal Units (BTU) of heat to evaporate 1 pound of water to 1 pound of steam if the boiler feed water temperature is at 32 degrees Fahrenheit

Study Reveals Additional Potential Savings

Despite the existing cost reduction measures, an in-house study revealed that substantial additional savings could be achieved with a short payback period if an economizer were to be installed in the flue gas duct. Economizers have been around since the first boilers were fabricated, but they have typically been expensive and added significantly to the cost of a new boiler. Therefore, economizers were not installed when the PCCC power plant was constructed in 1957. Of course, back then, energy was "cheap" so energy saving was a non-issue. Today things are much different and every effort must be made to extract the maximum number of BTUs from the fuel and operate at the highest efficiency.

It was determined that an economizer could safely be installed without lowering the flue gas temperature below its dew point to where the minute amount of sulphur present in the fuel could damage the chimney and necessitate costly repairs in the future.

The Economizer

The unit had to be sized no larger than 48" in height and 48" in depth to fit inside the existing flue gas duct. Calculations indicated one economizer at least 60" wide would be needed to meet the criteria of increasing the boiler feed water tempera-

Providence Continuing Care Centre has been a member of Natural Resources Canada's Energy Innovators Initiative since 2001 and has demonstrated their commitment to reducing greenhouse gas emissions that contribute to climate change

ture from 220 to 260 degrees F. After due consideration, Bolger Steel & Fabrication, an authorized pressure vessel manufacturer in Cornwall, Ontario, was chosen to do the fabrication.

The problem was that a 60" wide economizer could not be lifted into place due to the limited open spaces between the boilers and auxiliary equipment. Therefore, it was decided to fabricate two 30" wide sections weighing 1,600 pounds each, with flanged headers, and lift them individually then bolt them together in the duct.

The economizers were fabricated from short lengths of finned tubes, even though they increased the economizer cost. Finned tubes were used to maximize heat transfer, welded to u-bends to form one 65' long finned tube from the inlet to the outlet headers. The 18 rows of finned tubes were then placed within a steel cage that not only protected them from damage during transportation, but also was used to lift them into place.

Two openings were cut in the existing steel flue gas duct and flanges welded in place to secure the economizers (henceforth economizer) to the main flue gas duct. A steel mezzanine floor was then constructed to allow the installation crew easy access to safely complete the installation of piping, etc. The unit is equipped with temperature gauges that allow operators to calculate the heat transferred to the boiler feed water and flue gas heat loss.

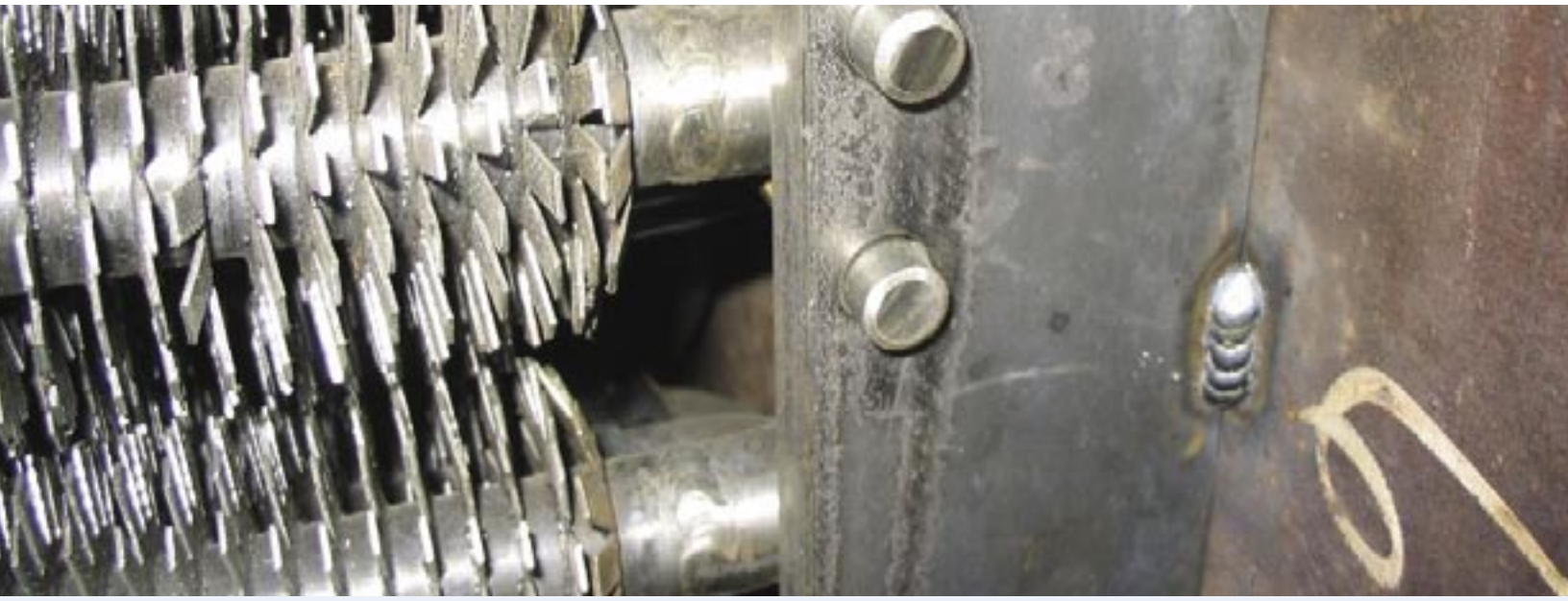
The Results

Since installation, the economizer has performed flawlessly and has, in the first 347 days, recovered in excess of 3.1 billion BTUs, reduced natural gas purchases by over $45.9K (88,600 cubic metres) and prevented over 166 tonnes of greenhouse gas emissions from escaping into the atmosphere. Project costs will be recovered in less than 15 months. The economizer has no moving parts and, providing the boiler feed water is properly softened and chemically treated, it should have a life expectancy in excess of 20 years.

To date, PCCC has recovered approximately 73% of the project costs. Full payback will come once a total of 116 million pounds of steam have been generated, based upon July 2004 natural gas prices. By that time PCCC will have recovered over 4.6 billion BTUs, avoided purchasing 132,434 cubic metres of natural gas, and reduced fuel costs by $63K and greenhouse gas emissions by 248 tonnes. Boiler efficiency will also have improved by 3%.

The project was easily completed without heavy reliance upon outside contractor assistance or expertise. While a qualified engineer was required to design the economizer, except for Bolger Steel & Fabrication, all design and installation was done by in-house personnel.

The success of the project illustrates what is possible with the dedication and commitment of enthusiastic and creative staff and support from senior management. PCCC has proven itself to be an organization with leadership committed to maximizing energy efficiency and making a significant contribution to the reduction of greenhouse gas emissions.



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