

Identifying Energy Savings in a Foundry Operation

Industrial Energy Efficiency and
Competitiveness Workshop

October 2011

Prepared by:

Richard W. Loth

Energy Manager

Clow Water Systems

Coshocton, OH

Richard.Loth@clowwater.com

Topics

- Introduction to Clow Water Systems
- Energy Efficiency Projects
 - D.O.E. Audit; Anneal Oven---natural gas
 - D.O.E. Audit: Air Compressor system—electricity
 - Cupola Dehumidification--coke

Clow Water Systems, Coshocton, OH

- Clow has operated on the same 80-acre site in Coshocton, OH for over 100 years.
- The company produces ductile iron pipe and fittings.
- Pipe sizes range from 4-in to 36-in
- In 2010 the company produced over 100,000 tons of pipe and fittings
- Products are shipped domestically and internationally

Making Pipe

- Scrap steel is delivered on a just-in-time basis
- Materials are charged to a cupola to produce molten iron
- Pipe is centrifugally-cast in molds
- Fittings are produced in a green sand foundry
- Once cast, the pipe is annealed in a gas-fired oven
- After annealing the pipe is tested, lined and painted

Foundry is Energy Intensive

- Overall energy use in 2008 was 900 billion btu
- Energy Sources Used at Clow;
 - Coke
 - Natural Gas
 - Electricity

Identifying Opportunities to Reduce Energy

- As a result of working with Larry Boyd, Energy Industries of Ohio, three major energy initiatives have been realized at Clow Water.
 - Anneal Oven Reduction in Natural Gas
 - Compressed Air System Improvements---reducing the use of electricity
 - Dehumidification of Air Supplied to the Cupola----reducing coke use

Grant-Funded Energy Surveys

- Clow has benefitted from 2 D.O.E (Dept. of Energy) energy audits since 2009.
- Larry Boyd, Energy Industries of Ohio, was instrumental in arranging both audits and Larry conducted the audit on our anneal oven.
- Nearly \$750,000 in energy savings have been identified by these 2 surveys
 - 1. April 2009 audit performed on the anneal oven
 - 2. December 2010 audit performed on the compressed air system.

Anneal Oven Survey Background

- 3-day D.O.E. audit was performed by Larry Boyd in April 2009
- Anneal oven was targeted for an audit since it is the highest user of natural gas.
- The overall objective was to continue to lower our energy cost so we could remain competitive in the market.
- Savings objectives were grouped into short term, intermediate term and long term.

Anneal Oven Survey

Short Term Objectives---Completed

July 2009

- 1. Structural changes to the oven entrance
- 2. Improved oven zone separation using curtains
- 3. Increased use of ceramic fiber insulation
- 4. Operational modifications

Anneal Oven Survey

Intermediate Term Savings

Recommendations

- Retrofit the oven with high efficiency burners.
- Modify oven flues to help control oven pressure

An Oven Retrofit in July 2011 Incorporated the Intermediate Savings Recommendations

- The cornerstone of the retrofit was installation of four pair of regenerative burners in the high heat zone of the oven. (This portion of the oven consumes 90% of the fuel used in annealing our product.)
- Other important components of the retrofit included;
 - raising the oven roof in the high heat zone to help provide a more consistent heat for annealing.
 - Resize the flues and equip with automatic dampers

Anneal Oven Survey

Measuring the Improvement

- Due to large swings in gas pricing and changes in production schedules it was determined that the most effective metric for measuring reductions in the natural gas use would be in mcf/ton annealed.
- Benchmark gas usage was established prior to making the first short term improvements in 2009.

Gas Savings Measured Against our Baseline

- Short term improvements recommended by the DOE audit generated a 39% reduction in natural gas used for annealing pipe.
- Intermediate term improvements recommended by the DOE have generated a 56% reduction in natural gas used for annealing pipe in the first 6 weeks of operation.

Anneal Oven Survey

Long Term Savings Objectives

- Redirect waste heat from the oven to other processes in the foundry.
- Long term items may need to be reassessed due to the reduction in available waste heat as a result of the oven improvements.

Oven Entrance Mar 2011 After Intermediate Improvements



Oven Entrance July 2011 After Burner Retrofit



Air Compressor Survey

Background

- 3-Day survey was performed in Dec 2010 by Kelly Kissock, Ph.D, P.E., Director: Industrial Assessment Center, University of Dayton.
- The air compressor system was chosen for an audit since it consumes an estimated 20% of our electrical energy
- Clow has 9 compressors distributed throughout the factory. Total HP is 2300.
- \$250,000 of energy savings opportunities were identified in the survey.

Air Compressor Survey Recommendations

- Utilize controls for staging compressor operation
- Replace compressed air lances with localized blowers
- Institute a leak repair program
- Provide cooler outdoor air for compressors

Air Compressor Survey Results

- The survey provided a roadmap for us to improve the performance of our compressed air system and the quality of the air delivered.
- For improving air quality, 17 no-loss drains have been installed and all air dryers are being monitored for PM.
- Some piping changes have been made and more are planned to reduce line losses.
- Make-up air for 5 of the 9 compressors has been moved outside.
- A leak detection study was performed and corrective action is underway.
- Utilization of a master controller for staging compressor operation would yield significant savings. However after more detailed study, this recommendation is currently not feasible for our operation.

Dehumidification of Cupola Air

What is the Basis for Savings

- The carbon from coke combines with water vapor in the blast air to form CO and hydrogen, in an endothermic reaction. In a cupola the heat for this reaction is supplied by coke. To replace the carbon consumed and to make up for the loss of heat needed for melting, additional coke must be added to each charge. It is estimated that 1.19 lb of coke is needed to overcome each pound of water vapor that enters the cupola. Therefore dehumidifying the blast air reduces the amount of coke needed in each charge.*
- *taken from Modern Casting, April 1999, pg. 38.

Operational Date

- Dehumidifier was installed in Dec 2010
- Unit became fully operational April 15, 2011

Results

- The test results confirmed the savings estimates used in our request for funds.
- A 7.2% reduction in the use of coke/ton melt was realized during the test period.
- It is assumed that humidity will be high enough approximately 60% of the time in the Coshocton area to warrant the use of dehumidification for cupola combustion air.
- The 7.2% reduction for 60% of the time means that the dehumidifier will reduce coke use at Clow by 4.3% overall.

Conclusion

- The D.O.E. audits arranged through Energy Industries of Ohio have identified nearly \$750,000 in achievable savings on natural gas and electricity for Clow Water.
- Through our association with Energy Industries of Ohio, Clow became aware of the dehumidification system that made it possible to reduce our coke use by 4.3%