Ultramizer Heat and Water Recovery System

Demonstration project shows potential of Ultramizer advanced heat recovery system

Most of the current industrial, commercial, and institutional boilers operate at 75% to 80% thermal efficiency, because the flue gas exhausted from the boiler stack has a high moisture content and is generally at about 450°F. In a boiler fired with natural gas at 15% excess air, the flue gas moisture content is 18% by volume. This represents a large amount of latent heat—about 10% of the total fuel higher heating value input to the boiler.

For this CARD project, Gas Technology Institute (GTI) and Cannon Boiler Works (CBW), in cooperation with CenterPoint Energy, demonstrated an advanced heat recovery system called the Ultramizer® on a 1,000 HP boiler at Michael Foods' Northern Star Potato plant in Chaska, Minn. This is the first demonstration of the Ultramizer technology in Minnesota. The Ultramizer technology simultaneously captures waste heat and water vapor from boiler exhaust gases. The goal of the project was to demonstrate and deploy the Ultramizer technology on commercial and industrial boilers in the 250 to 1,200 boiler HP (8,600 to 41,400 pounds of steam per hour) output range to assist Minnesota gas utilities in meeting their energy conservation goals.

The Ultramizer® employs an innovative method to capture this low-quality heat by using available low-temperature water to extract and condense water vapor from humid waste gas in GTI's patented Transport Membrane Condenser (TMC), thus recovering both sensible and latent heat to achieve fuel-to-steam efficiency as high as 92% to 94% (higher heating value basis).

Phase 1 of the project involved assessing the market potential for the Ultramizer technology in Minnesota and identifying three potential candidate sites for field demonstration. The results confirmed an excellent market potential for the technology in Minnesota, showing an overall market of 549 boilers within the target size range, with food processing plants identified as especially attractive because of the higher levels of make-up water used.

In Phase 2 of the project, a 1,000 HP boiler at the Northern Star Potato plant that was already equipped with a high temperature economizer was selected from the candidate sites based on space availability and savings potential. An Ultramizer heat recovery system, sized for a 300 HP boiler, was then designed, fabricated, installed and tested on a flue gas slip stream of the boiler to demonstrate its savings potential. Baseline testing, without the Ultramizer, showed efficiencies of 70% to 80% with an average efficiency of 76.05%. Longer term performance tests carried out over several months with the Ultramizer showed the Ultramizer recovered 33,900 to 40,700 gallons of water monthly for a projected yearly recovery of 436,000 gallons. The monthly energy recovery ranged between 455 and 545 MMBtus for a projected yearly recovery of 5,900 MMBtus.

The recovered water and energy translate into annual savings of $41,235 at $5/MMBtu natural gas and 80% boiler efficiency and $10 per 1,000 gallons of purchased and conditioned water. Based on these results, the estimated payback value is 11.8 years. When the project was first initiated, natural gas was priced at $10/MMBtu and the payback value at that higher cost would be 6.2 years. Through market acceptance of the technology the team envisions improved payback.

The demonstration test results confirm market potential for the technology for boilers that have 50% or higher makeup water demand, even those that are already equipped with non-condensing economizers like the installation demonstrated in this study.

Read the full report on "Advanced Heat Recovery System Field Deployment" (pdf). For more information on this project, contact CARD program administrator Mary Sue Lobenstein.