Two Superheater Upgrades in the Works for 2018

Jansen is well known throughout the pulp and paper, forest products, independent power producer, and energy-from-waste industries for combustion air system upgrades on power boilers and recovery boilers to increase firing capacity, reduce emissions, stabilize operations, mitigate erosion, and reduce fouling of flue gas passages. However, Jansen’s work in designing and supplying new superheaters is not as well recognized. Jansen has designed new superheaters for 12 boilers, including nine biomass-fired power boilers and three solid waste-fired units. Currently, Jansen engineers are adding to that total with two superheaters to be installed in spring 2018.

Boiler A is located at a biomass-fired power plant. Following commissioning, the boiler’s secondary superheater (SSH) experienced severe tube metal wastage, overheat failures, and tube distortions. Jansen participated in a thorough evaluation of the boiler which identified several design flaws related to total surface area sizing, tube wall thickness and metallurgy selection for stress and corrosion allowances, and support system and tie design. As a result, multiple and extensive repairs were

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A photo of superheater pendants awaiting installation.

Getting in Tune with Boiler MACT/GACT

With the passage of the final National Emission Standards for Hazardous Air Pollutants (NESHAP) rules for industrial, commercial and institutional boilers and process heaters at both Major Sources (Boiler MACT) and Area Sources (Boiler GACT), several years of wrangling over definitions, limits, and compliance requirements came to an end. The final Boiler MACT legislation mandated that emissions limits must be met by January 31, 2016, leading to a number of boiler upgrades across many industries. Since then, most boiler owners and operators have found that meeting the final emission limit requirements on a day to day basis has not been too difficult. However, another aspect of Boiler MACT/GACT compliance cannot be forgotten: boiler tune-up requirements to meet the work practice standards provisions of the rules.

The Boiler MACT/GACT rules require that industrial boiler owners conduct periodic tune-ups (every one or two years). For boilers with continuous oxygen trim systems, the frequency is extended to once every five years. Keeping track of the tune-up requirements and scheduling them well in advance of deadlines has been a challenge for some boiler owners/operators.

The tune-up procedure includes an inspection of combustion equipment during a shutdown, review of controls functionality, and operational tuning to reduce CO emissions. Although this might seem unnecessarily burdensome, the Boiler MACT/GACT tune-up has often led to improved operating practices and identification of equipment in need of repair or increased capacity. The result has been reduced overall CO emissions and boiler thermal efficiency improvements. Jansen engineers have carried out numerous Boiler MACT/GACT tune-ups, successfully reducing CO emissions for a wide variety of boilers. Two recent projects stand out for yielding good results while requiring different approaches.

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Stoker Grate Replacements to Increase Biomass Burning and Improve Operator Safety

Biomass firing in stoker grate fired boilers can be limited by one or more of the following:

- The size and/or type of the grate and its allowable fuel burning rate.
- Char and ash carryover that can lead to back end fires, fouling and blockage of heat transfer surfaces, and/or overloading of ash handling equipment.
- The presence of multiple rows of small ports on the front and rear air heater due to excessive flue gas velocities.
- Erosion in the generating bank, economizer, and/or air heater due to excessive flue gas velocities.
- ID or FD fan capacity.
- Fuel feed system capacity.
- A detailed Jansen boiler evaluation will identify the particular limitations, and define approaches to remove those limitations in order to increase biomass firing. Several recent evaluations were performed on biomass boilers limited by the grate size and/or type. Each grate type has a typical upper limit for cross-sectional heat input rate from biomass. Installing improved combustion air and fuel delivery systems can result in increased biomass burning rates, but only up to the heat input limit of the grate. Stationary pinhole, dump, and air-cooled vibrating grates have about 20% to 25% lower heat input limits than traveling and water-cooled vibrating grates. Therefore, a grate replacement can potentially allow a substantial increase in the biomass burning rate. An even larger increase can be achieved if the lower furnace cross-section is also expanded.

Stationary grates have the added disadvantage of requiring periodic manual ash removal. Grate cleaning reduces the overall biomass firing capacity and often requires increased fossil fuel firing. In addition, manual cleaning with rakes through open access doors continues to be an occupational health and safety issue. Potential for furnace blowbacks and repetitive strain injuries from handling heavy rakes put employees at greater risk of injury. Continuous ash removal by traveling and vibrating grates eliminates the need for periodic manual ash removal, thus increasing biomass firing availability and improving operating personnel safety.

Recently, Jansen was awarded with the design and supply of the grate replacement project on a biomass boiler. The boiler’s stationary grate will be replaced with an air-cooled vibrating grate supplied by Detroit Stoker Company. The project will achieve higher biomass firing rates and higher thermal efficiency due to improved fuel burn out, while reducing char and ash carryover and associated erosion.

For further information and specific inquiries, please contact Matt Henderson at 425.952.2844, or by e-mail at matt.henderson@jansenboiler.com.

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Boiler MACT/GACT

Boiler A has a design steaming rate of 200,000 lb/hr but typically operates at loads around 160,000 lb/hr. During tuning, the load averaged 150,000 lb/hr on biomass fuel. High excess air operation at the beginning of tuning resulted in flue gas oxygen of 10% with CO at 863 ppm (measured at the generating bank outlet). The high oxygen level was contributing to excessive char carryover and high CO emissions. By cutting overall air and by shifting air from undergrate air (UGA) to the boiler’s overfire air (OFA) ports, Jansen engineers dropped oxygen to 7.9% and cut CO by more than half to 372 ppm.

Boiler B was originally a recovery boiler, but was converted to biomass firing with a design steaming rate of 250,000 lb/hr. The steam load averaged 220,000 lb/hr during tuning on biomass firing plus a small amount of tire-derived fuel and natural gas through the burner igniters. Whereas Boiler A had high CO as a result of excessive air flow, Boiler B’s issue was too little air. Flue gas oxygen at the ID fan outlet was only 4.8%, with almost 1,100 ppm of CO. Following a rise in the FD fan setpoint to increase air flow, and a shift in air from UGA to OFA, oxygen increased to 6.3%, and CO dropped all the way to 243 ppm.

It’s worth noting that Boiler A’s OFA system consists of multiple rows of small ports on the front and rear walls, whereas Boiler B had been upgraded previously with a Jansen sidewall OFA system. Jansen’s experience is that these types of front/rear systems are often unable to generate low CO emissions at low oxygen levels. Boiler A showed substantially lower CO following tuning, but at oxygen levels near 8% at the generating bank outlet. In fact, tuning data from Boiler A showed a rapid increase in CO when oxygen dropped below 6%. Boiler B, with its upgraded combustion air system, was able to achieve reduced CO at oxygen levels near 6% at the ID fan outlet, which includes the effect of air in-leakage. Operating at lower flue gas oxygen resulted in higher thermal efficiency.

These cases illustrate how a fairly routine procedure can identify limitations in equipment and opportunities for improvement. At the same time, boiler tune-ups can lead to lower stack emissions and higher boiler efficiency. Jansen has repeatedly demonstrated the ability to not only fulfill the Boiler MACT/GACT tune-up requirements, but to help boilers achieve overall improved performance.

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required and the plant was forced to reduce the steam temperature from the 975°F design target.

Jansen’s design for the new SSH includes tube sizes and materials selected to increase the unit’s durability and service life. Jansen is also designing a support system for the SSH to replace the original “handcuff” hanger system which was prone to failure. A steam-cooled lateral spacer tube will be included to eliminate the current uncooled side-to-side ties.

Boiler B is located at a pulp & paper mill and fires a mixture of biomass fuel, mill sludge, and stoker coal. The unit has seen significant upgrades over the years, including a Jansen combustion air system upgrade several years ago that contributed to a significant increase in average steam generation. Unlike the Boiler A superheater, which was experiencing furnace-side tube failures, the challenges for Boiler B are related to the SSH hanger support system. The “J-hooks” in the hanger support system fail frequently, requiring costly maintenance to repair.

The mill contracted Jansen to design a new SSH, including a support system that would eliminate the J-hooks. Jansen’s design includes a parallel tube arrangement and a steam cooled lateral spacer tube for improved stability and maintenance. In addition, the number of tube material and wall thickness changes throughout the SSH have been reduced compared to the original design for easier material sourcing and maintenance. The new design supports the superheater pendants from within the penthouse, thus removing the support system from the harsh furnace environment. This design feature will provide a more reliable superheater and support system and ensure adjustability for installation.

Jansen’s superheater projects have addressed a wide range of superheater design and performance issues. As plants push to higher temperature and pressure steam conditions for increased power generation, Jansen has the experience and know-how to supply high quality and reliable superheaters to meet those demands.

For further information or specific inquiries, please contact John La Fond at 425.952.2832, or by e-mail at john.lafond@jansenboiler.com.

NEWS Briefs

Since our previous newsletter (Spring 2017), Jansen was contracted for the following new process and design engineering projects, many of which are still in progress:

- Chemical recovery and biomass boiler engineering evaluations.
- Combustion system upgrades for chemical recovery and biomass boilers.
- Boiler steam/water-side circulation studies.
- Boiler superheater evaluations and replacements for improved performance (increased steam temperature, improved steam temperature control, reduced erosion/corrosion, and improved maintenance).
- Design and supply of stoker-fired biomass capacity upgrades and grate replacement.
- CFD modeling of chemical recovery and biomass boilers.
- Boiler operational tuning and optimization support.
- Boiler MACT compliance review and operational tuning.
- CFB and BFB assessments and tuning.

A collection of boiler house cartoons can be viewed on our website: www.jansenboiler.com. Over 30 cartoons by Gordon Stevens shown previously in this newsletter are presented on the site. Each cartoon depicts a humorous situation with people and equipment in the boiler house.

A Big Welcome to Our New Co-Worker: Rene Lomeli

We are pleased to announce the addition of Rene Lomeli to our design team. Rene has been in the drafting profession for over 17 years and was most recently employed as a Technical Designer at The Boeing Company. His previous experience includes a stint as a Senior Drafting Specialist at Boise Cascade (now PCA), in Wallula, WA, and at a small fabrication shop, where he gained knowledge of machining processes and practices.

Rene attended ITT Technical Institute in Spokane, WA, and earned an A.A.S. in Computer Drafting. He brings to Jansen diversified drafting and design knowledge in many fields, including aerospace, food processing, and pulp and paper. Rene lives in Marysville, WA, and when away from the office enjoys tinkering on everything from his car to the family waffle maker.

Rene is working as a Senior Mechanical Drafter in Jansen’s Design Engineering Department.
Since 2000, these workshops have been attended by over 1,000 representatives of the pulp & paper, forest products, food, and energy-from-waste industries, and independent power producers.

The workshops consist of presentations about new technological developments and results to improve the operating performance, waste fuel burning capacity, efficiency, and fuel economy of biomass-fired boilers (mostly stoker-fired). In addition, the program will include troubleshooting and problem solving discussions of challenges that attendees bring to the workshop. Attendance to the workshop is free of charge, but space is limited.

Stay tuned at jansenboiler.com/biomass-boiler-workshops for information on 2018 workshops!

For sign-up and to receive a detailed program of the technical presentations, workshop location, and hotel, etc., please contact Cathy Thomas by phone at 425.952.2835 or by e-mail at cathy.thomas@jansenboiler.com.

ATTEND OUR SPRING 2018 BIOMASS BOILER WORKSHOP
Birmingham, Alabama, May 17-18, 2018

The workshops are presented and co-sponsored by:

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