JANSEN

Boiler News

Number 55 | Spring 2024

OUR MISSION

Our Company provides combustion, boiler, and energy technologies, products, and services.

We are dedicated to working with our clients to help define and achieve their productivity, reliability, efficiency, safety, and environmental goals.

We accomplish this by:

- *Listening and understanding.*
- *Providing a flexible approach to problem solving.*
- *Developing creative and innovative solutions.*
- *Partnering with clients to implement these solutions.*

We commit ourselves to creating a challenging and supportive work environment that fosters opportunity for professional growth and fulfillment.

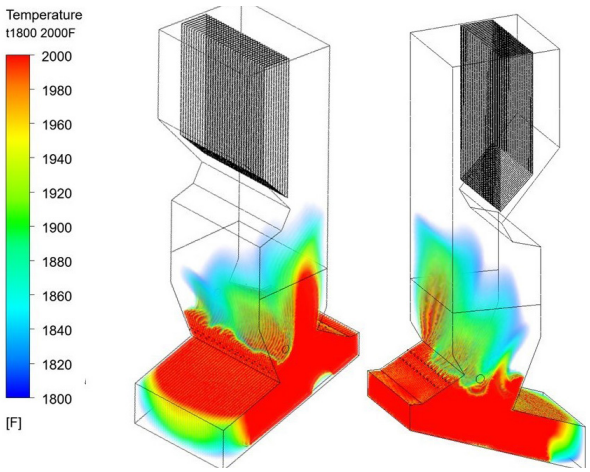
Our team is dedicated to the highest standards of professional ethics and integrity.

INSIDE THIS ISSUE:

SNCR Optimization through Furnace Temperature Modeling

Recently Jansen supported a municipal solid waste (MSW)-fired power plant with Computational Fluid Dynamic (CFD) modeling for one of their boilers. Jansen had conducted similar modeling for this client in the past, and they were happy with those results and the correlation between the predictions and actual performance. The scope of the recent modeling effort was similar, in that the client was looking for Jansen to evaluate and produce a temperature map for their furnace. The client would then use the map to optimize locations for additional urea injection ports for the boiler's selective non-catalytic reduction (SNCR) system.

Jansen initiated an evaluation of the boiler including a site visit to collect data with portable instruments as well as from plant instrumentation. Field measured data included a complete survey of the flue gas and combustion air systems. Temperature measurements were made at the furnace outlet using a specialized shielded suction pyrometer. Combustion air flow was measured by making pitot traverses at several locations around the boiler. These data served as inputs to a thermal model created for the boiler, with outputs serving as the inputs for the CFD model.



CFD Modeling Results of Furnace Temperature Contours

Jansen's CFD model generated a map of furnace temperatures for the site visit condition. Validation of the model's output was confirmed and correlated with the field measured data. A strong side-to-side temperature imbalance measured at the furnace outlet was closely predicted in the temperature map. This skewed temperature profile aligned with imbalanced air flows through the boiler's 15 undergrate air plenums.

Urea injection for NO_x control is most effective when the furnace temperature in the injection region is between about 1,800°F and 2,000°F. The figure illustrates a 3-D model of temperature contours in this range in the lower furnace. From these results, Jansen determined furnace elevations which would provide the most effective urea injection. The client then used the temperature map to locate additional injection ports.

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This project highlights how Jansen's capabilities can be used to support the Waste-to-Energy industry. It also demonstrates the importance of basing calculations and modeling on data collected from boiler instruments and field measurements. This approach allows Jansen to provide custom solutions to meet each client's needs.

Evaluating Options for a Recovery Boiler Air Heater Upgrade

Jansen is currently supporting a client experiencing significant performance and availability challenges with their recovery boiler. Originally, the unit used a Ljungström laminar air heater to heat the combustion air and a cascade evaporator to concentrate the black liquor fired in the boiler. Currently, the unit receives black liquor from a modern concentrator, leaving the old evaporator abandoned in place. The air heater continues to preheat combustion air, but operates with elevated leakage rates and requires constant maintenance and downtime.

Jansen was contracted to perform an evaluation focused on estimating costs for alternate options to replace the existing air heater. The current performance benchmarking found significant air leakage in the air heater even after the boiler came out of a major outage which represented a significant loss in performance and efficiency. Equipment limitations identified in the evaluation also included the combustion air system and induced draft fan deficiencies.

Following the current performance benchmarking, three heat recovery technologies were evaluated to quantify their benefits while documenting their disadvantages. 1) A conventional long-flow economizer and water coil air heater represented the recuperative option. 2) The regenerative option consisted of a review of modern laminar air heater design. 3) Lastly, a passive thermosyphon heat pipe heat exchanger was evaluated. Jansen's Design and Construction group then began developing equipment integration designs for each option and evaluated the loading impact to the building's current structural design.

Laminar Air Heater Wheel with Salt Cake Deposition

The results of the process and design efforts will provide the client with a thorough comparison of each option in terms of increased boiler availability and reduced operating costs, and each option's costs for equipment design, supply, and installation. To provide an unbiased comparison of the options, Jansen presented the evaluation results in a normalized format to illustrate increased gains in the steam from liquor throughput ratio.

Once the client has identified the preferred equipment upgrade option, Jansen will continue its design efforts to fully integrate the new equipment with the existing boiler and building structure. Jansen's experience with managing construction and installation projects can then be employed to ensure smooth and efficient installation.

This project required Jansen to think outside the box of typical recovery boiler evaluations and design to consider each potential solution for our client. We drew on our years of experience with recovery boilers to thoroughly explore multiple options for consideration. The next time you experience performance or availability challenges with your boilers, draw on Jansen's proven history and one-on-one support from beginning to end.

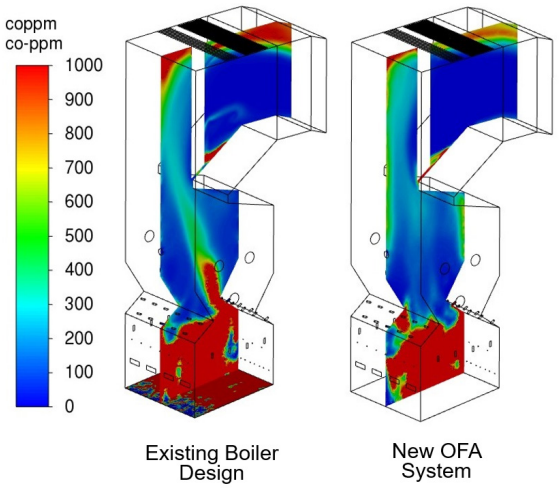
CFD Modeling of Boilers with Lower Furnace Arches

In examining deficiencies in boiler performance, problems can often be traced to factors outside the furnace, such as fuel quality. Sometimes, though, the issue is the furnace itself. Jansen's CFD modeling has demonstrated how performance improvements can be realized through air system upgrades, furnace modifications, or both.

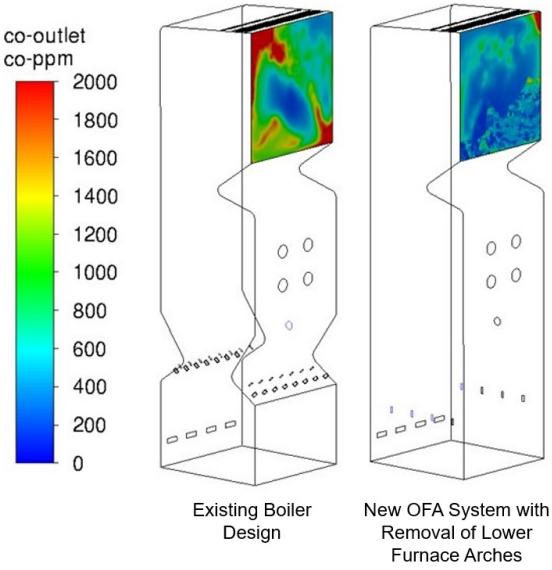
A furnace design concept that took hold in the second half of the 20th century was the addition of arches on the front and rear walls of the lower furnace (in addition to the nose arch). The intent of this design was that the lower furnace arches would separate the furnace into a lower gasification zone, in which fuel particles would dry and volatize, and an upper combustion zone, in which the volatile gases would then combust. Unfortunately, the arches also create a throat that greatly accelerates the flue gas flow. High flue gas velocities increase erosion within the furnace, particularly of the superheater tubes and the wall tubes that form the lower furnace arches. The accelerated flow also reduces the flue gas residence time in the upper furnace, which contributes to incomplete combustion of the volatile gases. The lower furnace arches can therefore lead to tube erosion and high maintenance costs, high carbon monoxide (CO) emissions, incomplete char burnout, and flue gas temperature and velocity stratification.

Two recent modeling projects involved biomass-fired power boilers with lower furnace arches. For Boiler A, the throat in the lower furnace produces a central channel of incompletely combusted volatiles, resulting in areas of high CO concentrations. The CFD model shows that replacing the existing overfire air (OFA) system with a modern sidewall interlaced OFA system located below the arches reduces flue gas CO by 14%. This modification also decreases unburned char carryover by 19%, representing an overall improvement in combustion performance.

CFD modeling results for Boiler B show that upgrading the OFA system and removing the lower arches reduces CO emissions by 54% and unburned char carryover by 71% compared to the existing design. These improvements in combustion efficiency for Boiler B compared to those of Boiler A show the relative improvement resulting from removal of the lower furnace arches.



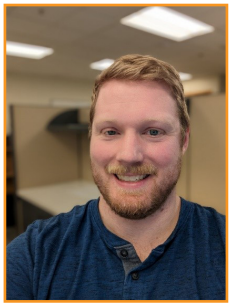
Furnace CO Profiles for Boiler A



Furnace Outlet CO Profiles for Boiler B

Power boiler performance deficiencies due to lower furnace arches can be reduced with the addition of an upgraded OFA system and removal of the arches. These results have provided Jansen's clients with a basis for developing boiler upgrade scopes. Jansen's CFD modeling is performed entirely in-house by our engineers. Please contact us for more information on how our modeling capabilities can help improve your plant's performance.

Jansen Welcomes...

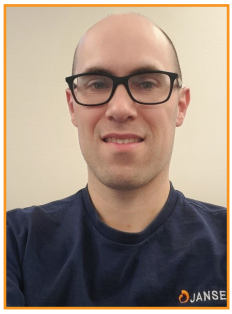


CORY EVANS

Process Engineer

Cory Evans joins Jansen with more than seven years in the pulp and paper Industry. His previous roles include Powerhouse Area Manager, Operations Maintenance Coordinator, Shift Supervisor, and Process Engineer. Cory graduated from the University of Washington with a degree in Bioresource Science & Engineering where he studied the conversion of lignocellulosic biomass into useful products, such as paper and biofuels.

Cory grew up and lives in the greater Seattle area. His hobbies include snowboarding and supporting Seattle sports.



PETER FINK

Project Engineer

Peter Fink brings 15 years of project engineering experience to Jansen. He received his bachelor's degree in mechanical engineering from Drexel University. Peter's career started at the Hanford Nuclear Site designing piping and pumping systems for the cleanup of nuclear waste. The last 10-plus years were spent in and around the pulp and paper industry designing and managing a variety of process projects from turpentine and soap recovery to NCG collection and incineration. Prior to starting with Jansen, he was the product manager of wet electrostatic precipitator technology and oversaw air pollution control projects in a wide range of industries (pulp & paper, wood products, fiberglass, semiconductors, mining, food production, etc.).

In his free time, Peter enjoys all the outdoor activities the Northwest has to offer. He is an avid skier and scuba diver. Additionally, you may catch him playing music in a variety of bands around the Northwest on the weekends.

ZHAOSHENG GAO

Senior CFD Combustion Engineer

Zhaosheng Gao brings over 20 years of CFD modeling and simulation experience to Jansen. Zhaosheng received his PhD degree in mechanical engineering from the University of Illinois at Chicago. His areas of expertise include CFD analyses of combustion, heat transfer, and flow problems in power plants, low NO_x burner design in the oil and gas industry, and industrial boilers and their auxiliaries. His work has specialized in computer simulation, turbulence and combustion theory, multiphase flow, mass and energy balances, and conjugate heat transfer (CHT), as well as analysis of combustion air, heat transfer in superheaters, and emissions performance in boilers.

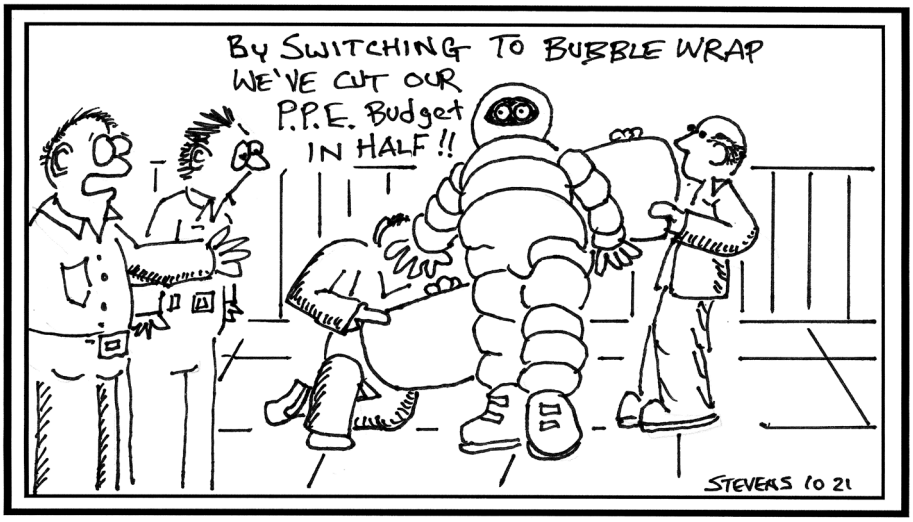
Zhaosheng and his wife have been residents of the Chicago area since 2016. He enjoys music and playing with his two kids in his spare time.

News Briefs

Jansen's experience in the pulp & paper, forest products, agricultural, and waste-to-energy industries and with independent power producers is extensive. Services recently provided to our customers include the following, many of which are in progress:

- Engineering evaluations of biomass, chemical recovery, waste-to-energy, and coal-fired boilers.
- Chemical recovery boiler capacity and condition assessments.
- Combustion air system upgrades.
- Economizer and superheater upgrades.
- Boiler steam/water-side circulation studies.
- CFD modeling of biomass, chemical recovery, and waste-to-energy boilers.
- Emissions control evaluations (CO, NO_x, TRS, and PM).
- Boiler operational tuning and optimization support.
- Boiler MACT compliance review and operational tuning.

For further information on Jansen's projects and capabilities, contact Mark McCabe at 425.736.9758 or by e-mail at mark.mccabe@jansenboiler.com. Additional information and specific project references can be found on our website at www.jansenboiler.com.



A collection of boiler house cartoons by Gordon Stevens shown previously in our newsletter can be viewed on our website: www.jansenboiler.com.

Boiler News is published regularly by Jansen Combustion and Boiler Technologies, Inc. to provide information to Owners and Operators of boilers.

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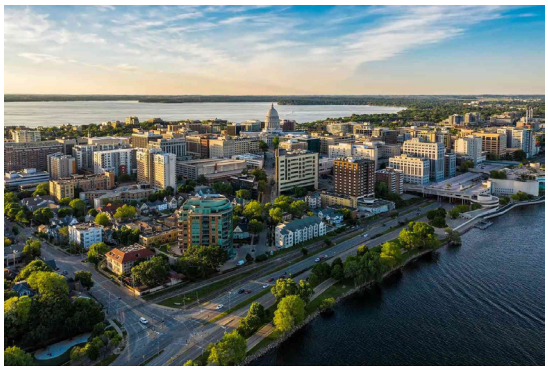
Spring 2024 Biomass Boiler Workshop

Madison, Wisconsin May 22-23, 2024

Since Jansen's workshops began in 2000, they have been attended by over 1,000 engineers, operators, and managers from numerous plants in the pulp & paper, forest products, energy-from-waste, independent power, and food processing industries.



The workshop consists of presentations about new technological developments and results of upgrades to improve the operating performance, burning capacity, thermal efficiency, and fuel economy of biomass- and other solid fuel-fired boilers. In addition, the program will include opportunities for troubleshooting and problem-solving discussions. Participants will benefit by:

- Learning from experts in the industry about current retrofit technology for biomass boilers and associated equipment.
- Seeing how other boiler owners solve their boiler problems.
- Discussing potential solutions for their specific issues.

Attendance to the workshop is free of charge, but space is limited.

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

The Biomass Boiler Workshop is presented and co-sponsored by:

FORNAX SERVICES

ProcessBarron

LDX SOLUTIONS

JANSEN Combustion & Boiler Technologies, Inc.

CleanAir

ENERO solutions

Heat Management