

PROJECT CAPABILITIES



BOILER CONVERSION TO BIOMASS BURNING



Scope of Service

Boiler owner/operators in recent years have been motivated to convert existing fossil fuel-fired boilers to burn some, or exclusively biomass fuels. Biomass fuels often provide lower fuel costs and lower flue gas emissions as well as being considered a “green” renewable resource. Whether the boiler currently burns exclusively fossil fuels or burns a combination of fossil and biomass fuels, JANSEN has the experience and capabilities to provide the necessary services to enhance biomass firing in most all boiler configurations.

A recommended phased approach to fuel conversion projects is listed below:

- Initial assessment of feasibility and required modifications to generate early budgetary costs.
- Engineering evaluation of existing boiler to determine the unit’s capabilities when operating with the new fuel (pressure parts, auxiliary and air pollution control equipment).
- Definition engineering to develop +/- 10% accuracy cost estimate.
- Engineering design, fabrication, and materials supply.
- Installation.
- Operator training and start-up assistance.

JANSEN has the capability and experience to carry out any or all of these steps.

Selected References (see next page)



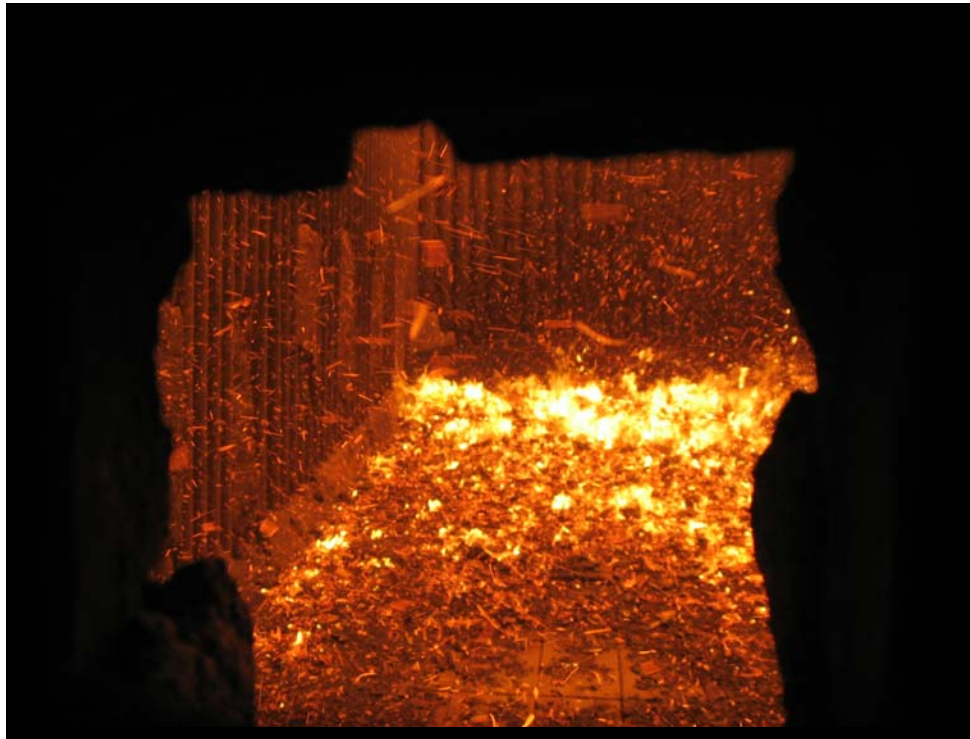
Selected References

AES Corporation - Lufkin, TX
EPCOR Canada - Squamish, BC
Great River Energy - Elk River, MN
Hu Honua Bioenergy LLC - Hilo, HI
New Ulm Public Utility - New Ulm, MN
Packaging Corporation of America - Valdosta, GA
Sonoco Products Co. - Hartsville, SC
Springs Global US, Inc. - Lancaster, SC
Turbine Diagnostics Services, Inc. - Forest City, NC
Weyerhaeuser Paper Company - New Bern, NC

PROJECT CAPABILITIES



BIOMASS BOILER EVALUATIONS



Capacity, Operational Performance, Fuel Economy, and Emissions

Fuel economy, maximum availability, steam generating capacity, optimized emissions performance, and operating flexibility at the lowest cost are the key goals of biomass-fueled power boiler operation. JANSEN has assisted numerous mills with implementing operational and hardware changes to improve the performance and thermal efficiency, minimize fossil fuel co-firing, reduce landfill costs, and reduce air pollution emissions from their biomass boiler operations.

Scope of Services

- Waste fuels combustion problem solving (waste wood, TDF, NCG, sludge, etc.).
- Improved performance and steam generating capacity from biomass.
- Application of advanced combustion technology.
- Reduced CO, VOC, NO_x, SO₂, and particulate emissions.
- Computational Fluid Dynamics (CFD) modeling and analysis.
- Measurement and analysis of boiler circulation.
- Incineration of concentrated and dilute non-condensable gases (CNCG & DNCG), and sludges.

Selected References (see next page)



Selected References

Alabama River Pulp Company - Perdue Hill, AL
Alliance Forest Products - Coosa Pines, AL
Appleton Papers, Inc. - Roaring Spring, PA
Avista Corporation - Kettle Falls, WA
Boise Cascade Corporation - DeRidder, LA (2 units)
Boise Cascade Corporation - Steilacoom, WA
Boise Cascade Corporation - Rumford, ME
Boise Cascade Corporation - Int'l Falls, MN (2 units)
Boise Cascade Corporation - Wallula, WA
Burney Forest Products - Burney, CA
Canfor Intercon - Prince George, BC
Canfor Northwood - Prince George, BC
Canfor PGP&P - Prince George, BC
Cariboo Pulp & Paper - Quesnel, BC
Caracol Knits - San Pedro Sula, Honduras
Catalyst-Hudson - Anderson, CA
Catalyst Paper - Crofton, BC
Catalyst Paper - Port Alberni, BC
Consolidated Papers, Inc. - Wisconsin Rapids, WI
Corn Products International - Winston-Salem, NC (2 units)
Corner Brook Pulp & Paper - Corner Brook, NF
Daishowa America - Port Angeles, WA
Daishowa Marubeni - Peace River, AB
Delta Natural Kraft - Pine Bluff, AR
Domtar Inc. - Ashdown, AR (2 units)
Domtar Inc. - Espanola, ON
Domtar Inc. - Kingsport, TN
Domtar Inc. - Nekoosa, WI
Eurocan Pulp & Paper Company - Kitimat, BC
Evergreen Packaging - Canton, NC
Flambeau Paper - Park Falls, WI
Fletcher Challenge - Crofton, BC
FMC Corporation - Green River, WY
Fortistar Biomass - Hillman, MI
Fraser Papers, Inc. - Park Falls, WI
Fraser Papers, Inc. - Plaster Rock, NB
Georgia-Pacific Corporation - Cedar Springs, GA
Georgia-Pacific Corporation - Crossett, AR
Georgia-Pacific Corporation - Palatka, FL
Hercules Pinova - Brunswick, GA
Inland Paperboard and Packaging - Rome, GA
International Paper Company - Augusta, GA
International Paper Company - Bastrop, LA
International Paper Company - Corrigan, TX
International Paper Company - Courtland, AL
International Paper Company - Franklin, VA
International Paper Company - Georgetown, GA (2 units)
International Paper Company - Mansfield, LA (2 units)
International Paper Company - Pensacola, FL
International Paper Company - Pine Bluff, AR
International Paper Company - Pine Hill, AL
International Paper Company - Pineville, LA
International Paper Company - Prattville, AL
International Paper Company - Riegelwood, NC
International Paper Company - Saillat, France
International Paper Company - Selma, AL
International Paper Company - Terre Haute, IN
International Paper Company - Ticonderoga, NY
International Paper Company - Vicksburg, MS
KapStone Papers - Charleston, SC
KapStone Papers - Roanoke Rapids, NC
Ketchikan Pulp Company - Ketchikan, AK
Kimberly-Clark Corporation - Everett, WA
Kimberly-Clark Corporation - Loudon, TN
Koch Cellulose - Brunswick, GA
Longview Fibre - Longview, WA
Louisiana-Pacific - Chetwynd, BC
Louisiana-Pacific - Roaring River, NC (2 units)
MacMillan Bloedel Ltd. - Port Alberni, BC
Mead Paper - Chillicothe, OH
Mead Paper - Escanaba, MI
Mead Paper - Stevenson, AL
MeadWestvaco Corporation - Covington, VA
MeadWestvaco Corporation - Luke, MD
MeadWestvaco Corporation - Phenix City, AL (2 units)
Minnesota Power - Duluth, MN (2 units)
Minnesota Power - Grand Rapids, MN (2 units)
Mondi SCP - Ružomberok, Slovakia
Neucel Specialty Cellulose - Port Alice, BC
NewPage Corporation - Escanaba, MI (2 units)
NewPage Corporation - Wickliffe, KY
NewPage Corporation - Wisconsin Rapids, WI
Orange County Container Group - Forney, TX
Ohio Edison Company - Akron, OH
Packaging Corporation of America - Counce, TN
Packaging Corporation of America - Valdosta, GA (2 units)
Packaging Corporation of America - Tomahawk, WI
Port Townsend Paper - Port Townsend, WA
Portucel - Cacia, Portugal
Primary Power - Flint, MI
Riverwood International - Macon, GA
Riverwood International - West Monroe, LA
Rock-Tenn Company - Demopolis, AL (2 units)
Roseburg Forest Products - Dillard, OR
Roseburg Forest Products - Weed, CA
SAPPI North America - Cloquet, MN
SAPPI North America - Skowhegan, ME (2 units)
SAPPI North America - Muskegon, MI
Simpson Paper Company - Gilman, VT
Simpson Tacoma Kraft - Tacoma, WA
Smurfit-Stone Container Corporation - Fernandina Beach, FL
Smurfit-Stone Container Corporation - Florence, SC
Smurfit-Stone Container Corporation - Hodge, LA
Smurfit-Stone Container Corporation - Missoula, MT
Smurfit-Stone Container Corporation - Stevenson, AL
Smurfit-Stone Container Corporation - West Point, VA
SP Newsprint - Newberg, OR
Spruce Falls, Inc. - Kapuskasing, ON
Stone Container (Canada) Inc. - Portage du Fort, PQ
Stora Enso North America - Biron, WI
Tacoma Public Utilities - Tacoma, WA
Temple-Inland - Bogalusa, LA (2 units)
Thilmany Papers - Kaukauna, WI
Tolko Manitoba - The Pas, MB
Verso Paper - Sartell, MN
Weldwood - Hinton, AB
Westvaco - Evadale, TX
Weyerhaeuser Company - Columbus, MS
Weyerhaeuser Company - Cosmopolis, WA
Weyerhaeuser Company - Everett, WA
Weyerhaeuser Company - Kamloops, BC
Weyerhaeuser Company - Longview, WA
Weyerhaeuser Company - New Bern, NC
Weyerhaeuser Company - Oglethorpe, GA
Weyerhaeuser Company - Plymouth, NC
Weyerhaeuser Company - Port Wentworth, GA
Weyerhaeuser Company - Rothschild, WI
Weyerhaeuser Company - Springfield, OR
Weyerhaeuser Company - Valliant, OK
Wheelabrator-Spokane - Spokane, WA
Willamette Industries - Bennettsville, SC
Willamette Industries - Campti, LA
Willamette Industries - Hawesville, KY

PROJECT CAPABILITIES

BIOMASS BOILER COMBUSTION SYSTEM UPGRADES



Many biomass fuel-fired boilers experience challenges that prevent higher biomass (i.e., wood waste or sludge) fuel burning rates at significant lower operating cost. For example, the unit may experience high CO and VOC emissions and excessive carryover of fly ash, and/or may experience combustion instabilities with the need for continuous co-firing of auxiliary fossil fuel to sustain combustion.

All these problems are symptoms of poor combustion that is caused by ineffective overfire air (OFA) delivery. JANSEN's modern, sidewall, high capacity OFA system has proven that these problems can be solved. Our sidewall OFA system creates a zone of turbulent mixing across the full furnace cross section in which fines and volatiles are rapidly burned.

A limited number of relatively large OFA nozzles are used. Because the patented JANSEN air nozzles have very low internal pressure losses, our OFA system can typically be installed without the need for new or modified forced draft (FD) fan(s). Installation time is during a five day outage.

Operational benefits (and associated economic impact) that are normally achieved are:

- Reduced reliance on auxiliary fuel to maintain combustion (lower auxiliary fuel cost).
- Ability to burn additional biomass fuel (lower auxiliary fuel cost).
- Reduced carryover of fly ash (lower landfill cost).
- Reduced carbon content in fly ash (improved thermal efficiency).
- Reduced excess air usage (improved thermal efficiency).
- Reduced CO, NO_x, and VOC emissions (higher efficiency and better emissions compliance).
- Reduced flue gas temperature into the superheater (less erosion/tube wastage).
- Improved combustion stability and reduced furnace puffing (this may be a safety issue).
- Efficient incineration of HVLC NCG.

Selected References (see next page)

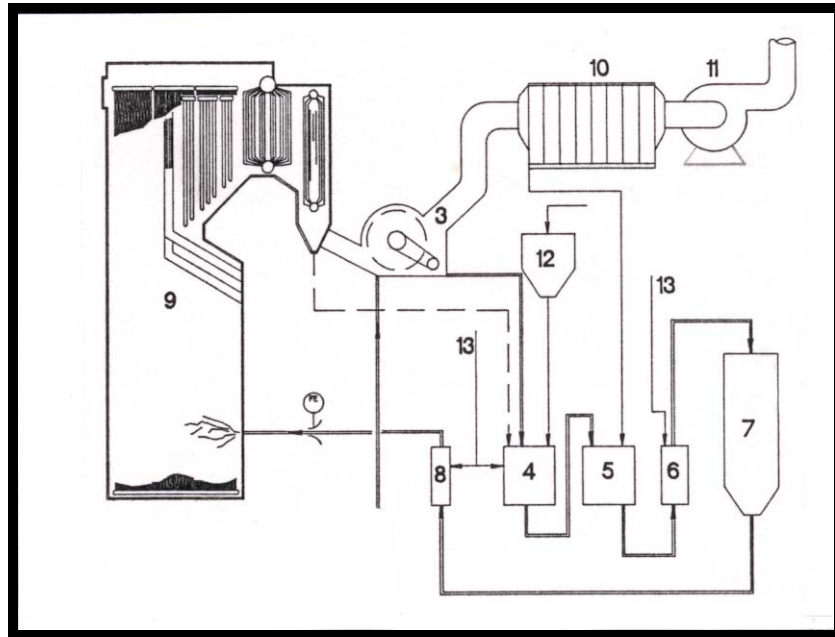


Selected References

Alabama River Pulp Company - Perdue Hill, AL
Appleton Papers, Inc. - Roaring Spring, PA
Boise Cascade Corporation - Steilacoom, WA
Boise Paper - Wallula, WA
BTG Slovensko - Chemes, Slovakia
Cariboo Pulp & Paper - Quesnel, BC
Catalyst Papers - Port Alberni, BC
Consolidated Papers, Inc. - Wisconsin Rapids, WI (2 units)
Daishowa America - Port Angeles, WA
Domtar Industries - Ashdown, AR
Domtar Industries - Kamloops, BC
Domtar Industries - Rothschild, WI
Domtar Industries - Windsor, PQ
Great River Energy - Elk River, MN
International Paper Company - Augusta, GA
International Paper Company - Bastrop, LA
International Paper Company - Courtland, AL
International Paper Company - Franklin, VA
International Paper Company - Georgetown, SC (2 units)
International Paper Company - Jay, ME
International Paper Company - Mansfield, LA (2 units)
International Paper Company - Pensacola, FL
International Paper Company - Pine Bluff, AR
International Paper Company - Pineville, LA
International Paper Company - Prattville, AL
International Paper Company - Riegelwood, NC
International Paper Company - Saillat, France
International Paper Company - Selma, AL
International Paper Company - Texarkana, TX
International Paper Company - Ticonderoga, NY
Koch Cellulose - Brunswick, GA
Longview Fibre - Longview, WA
Mead Coated Board Inc. - Phenix City, AL (2 units)
Mead Paper - Chillicothe, OH
MeadWestvaco Corporation - Covington, VA (2 units)
Minnesota Power - Duluth, MN (2 units)
NewPage Corporation - Escanaba, MI (in progress)
NewPage Corporation - Wickliffe, KY
Packaging Corporation of America - Counce, TN
Packaging Corporation of America - Valdosta, GA (2 units)
Rayonier, Inc. - Jesup, GA
Riverside/Tolko - Armstrong, BC
SAPPI Fine Paper North America - Cloquet, MN
SAPPI Fine Paper North America - Skowhegan, ME (2 units)
Simpson Tacoma Kraft - Tacoma, WA
Smurfit-Stone Container Corporation - Hodge, LA
Smurfit-Stone Container Corporation - Missoula, MT
Smurfit-Stone Container Corporation - Portage du Fort, PQ
Smurfit-Stone Container Corporation - West Point, VA
Tolko Manitoba - The Pas, MB
Westvaco Corporation - Silsbee, TX
Willamette Industries, Inc. - Campti, LA
Weyerhaeuser Company - Bennettsville, SC
Weyerhaeuser Company - Columbus, MS
Weyerhaeuser Company - Longview, WA
Weyerhaeuser Company - Valliant, OK

PROJECT CAPABILITIES

RECOVERY BOILER PERFORMANCE AND ENGINEERING EVALUATIONS



Purpose

All recovery boilers are designed individually and operated differently. In order to determine the feasibility of modernizing existing units for increased capacity, improved efficiency, extended service life, reduction in emissions of air pollutants, or other specific purposes, detailed knowledge is required about their specific arrangement and operational limitations. The performance evaluation, which includes a boiler field test, determines baseline conditions and provides a prediction of the expected results of an upgrade. JANSEN has carried out performance evaluations for over 90 kraft recovery boilers, many of which have led to actual upgrades.

Scope of Services

The JANSEN performance and engineering evaluation is adapted to local conditions and the specific requirements of each assignment, and will normally include the following scope of services:

- Field test to collect current data and establish present performance and baseline conditions.
- Performance calculations under test conditions and projected future operation.
- Engineering evaluation of critical design and operating parameters affecting the proposed changes.
- Computational Fluid Dynamics (CFD) modeling and analysis.
- Steam/water circulation study.
- Determination of necessary boiler modifications to accomplish the desired objective.
- Budget cost and project time schedule estimates.

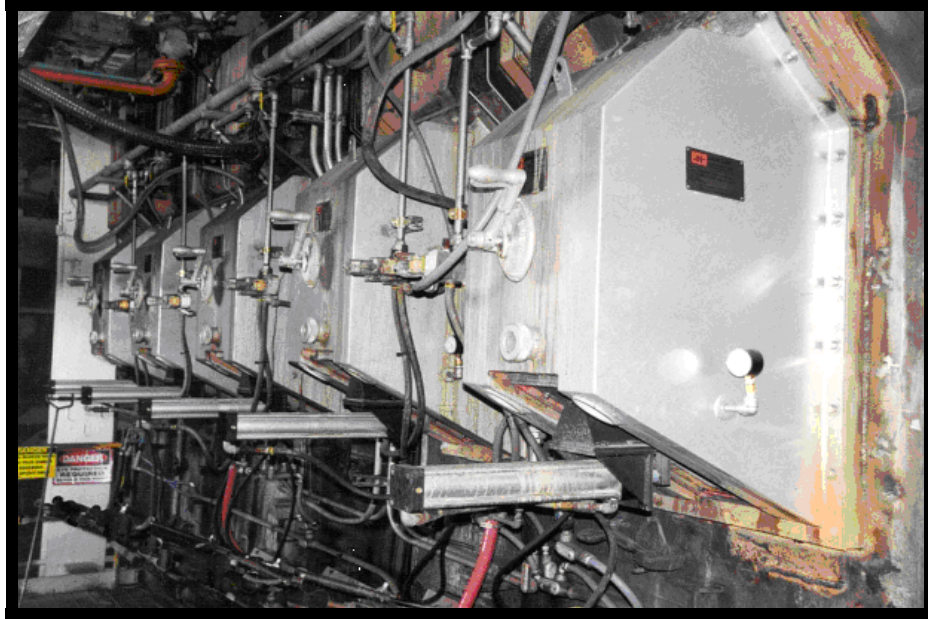
Selected References (see next page)

Selected References

APRIL Group - Rizhao, China
 Alabama River & Pine Pulp Companies - Perdue Hill, AL
 AssiDomän Sepap, Štetí - Czech Republic
 Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
 Blue Ridge Paper - Canton, NC
 Boise Cascade Canada Ltd. - Fort Frances, ON
 Boise Cascade Corporation - DeRidder, LA
 Boise Cascade Corporation - International Falls, MN
 Boise Cascade Corporation - Jackson, AL
 Boise Cascade Corporation - Rumford, ME
 Boise Cascade Corporation - Wallula, WA
 Boise Paper - St. Helens, OR (2 units)
 Bowater Carolina - Catawba, SC
 Bukocel - Hencovce, Slovakia
 Carter Holt Harvey Pulp & Paper Ltd. - Tokoroa, NZ
 Champion International Corporation - Quinnesec, MI
 Champion International Corporation - Roanoke Rapids, NC
 Champion Papel e Celulose Ltda. - Mogi Guaçu, S.P., Brazil
 Clearwater Paper - McGehee, AR
 Domtar Inc. - Lebel-sur-Quevillon, PQ
 Domtar Papers - Cornwall, ON
 E.B. Eddy Forest Products Ltd. - Espanola, ON
 Eurocan Pulp & Paper Company - Kitimat, BC
 Federal Paper Board Company, Inc. - Riegelwood, NC
 Fletcher Challenge Canada Ltd. - Mackenzie, BC
 Georgia-Pacific Cellulose - Crossett, AR
 Georgia-Pacific Cellulose - New Augusta, MS
 Georgia-Pacific Corporation - Ashdown, AR
 Georgia-Pacific Corporation - Big Island, VA
 Georgia-Pacific Corporation - Brunswick, GA
 Georgia-Pacific Corporation - Camas, WA (2 units)
 Georgia-Pacific Corporation - Cedar Springs, GA
 Georgia-Pacific Corporation - Clatskanie, OR
 Georgia-Pacific Corporation - Monticello, MS
 Georgia-Pacific Corporation - Palatka, FL
 Georgia-Pacific Corporation - Zachary, LA (2 units)
 Gulf States Paper Corporation - Demopolis, AL
 Inland Paperboard and Packaging - Orange, TX
 International Paper Company - Mansfield, LA (2 units)
 International Paper Company - Pine Hill, AL
 International Paper Company - Riegelwood, NC
 International Paper Company - Svetogorsk, Russia (2 units)
 Irving Pulp & Paper, Limited - Saint John, NB
 Kimberly-Clark Corporation - Coosa Pines, AL
 Kimberly-Clark Corporation - Terrace Bay, ON
 Koch Cellulose - Brunswick, GA
 Kruger Wayagamack Inc. - Trois Rivieres, PQ
 Longview Fibre - Longview, WA
 MacMillan Bloedel Limited - Port Alberni, BC
 Mead Corporation - Chillicothe, OH
 Mead Corporation - Escanaba, MI
 Mead Corporation - Kingsport, TN
 MeadWestvaco - Covington, VA (2 units)
 Northwood Pulp & Timber Ltd. - Prince George, BC
 Packaging Corporation of America - Counce, TN
 Packaging Corporation of America - Valdosta, GA
 Port Townsend Paper - Port Townsend, WA
 Rayonier, Inc. - Jesup, GA (2 units)
 Repap Manitoba - The Pas, MB
 Riverwood International - West Monroe, LA
 SAPPi Fine Paper North America - Cloquet, MN
 SAPPi Fine Paper North America - Muskegon, MI
 SAPPi Fine Paper North America - Skowhegan, ME
 Scott Maritimes Limited - New Glasgow, NS
 SCP - Ružomberok, Slovakia
 Simpson Paper Company - Eureka, CA
 Simpson Paper Company - Pasadena, TX
 Skeena Cellulose, Inc. - Prince Rupert, BC
 Smurfit-Stone Container Corporation - Brewton, AL
 Stone-Consolidated Inc. - Portage du Fort, PQ
 Stone Container (Canada) Inc. - New Richmond, PQ
 Tasman Pulp and Paper Co. Ltd - Kawerau, NZ
 Union Camp Corporation - Eastover, SC
 Visy Pulp and Paper - Tumut, Australia
 Western Pulp Limited Partnership - Squamish, BC
 Western Pulp Limited Partnership - Port Alice, BC
 Westvaco Corporation - Wickliffe, KY
 Weyerhaeuser Paper Company - Kamloops, BC
 Weyerhaeuser Paper Company - New Bern, NC
 Weyerhaeuser Paper Company - Valliant, OK

PROJECT CAPABILITIES

RECOVERY BOILER CAPACITY UPGRADES (KRAFT)



Increased Capacity

Existing recovery boilers often have a potential for increased throughput, while meeting stringent air emission limitations, provided these units are upgraded with modern air and liquor delivery systems. Using the patented Jansen High Energy Combustion Air Nozzle™, JANSEN has retrofitted over 25 recovery boilers for this purpose. The capacity gains over previous operation have been in the range of 20% to 50% with TRS release well below 5 ppm. Additionally, both boiler pluggage and air emissions have decreased as a result of the improved combustion conditions.

Scope of Services

Typical upgrade engineering services from JANSEN include:

- CFD modeling to optimize design features of the modifications.
- Redesign of the air delivery and distribution system, including multi-level air supply, fans (if needed), ducting, ports, and air nozzles.
- Redesign of the liquor delivery and firing systems, including piping, liquor heaters, gun ports, and liquor nozzles.
- Redesign of boiler pressure parts (JANSEN has ASME S-stamp certification) and auxiliaries for improved operation, reduced pluggage, additional capacity, or other purposes.
- Implementation of HVLC NCG incineration.

Selected References (see next page)



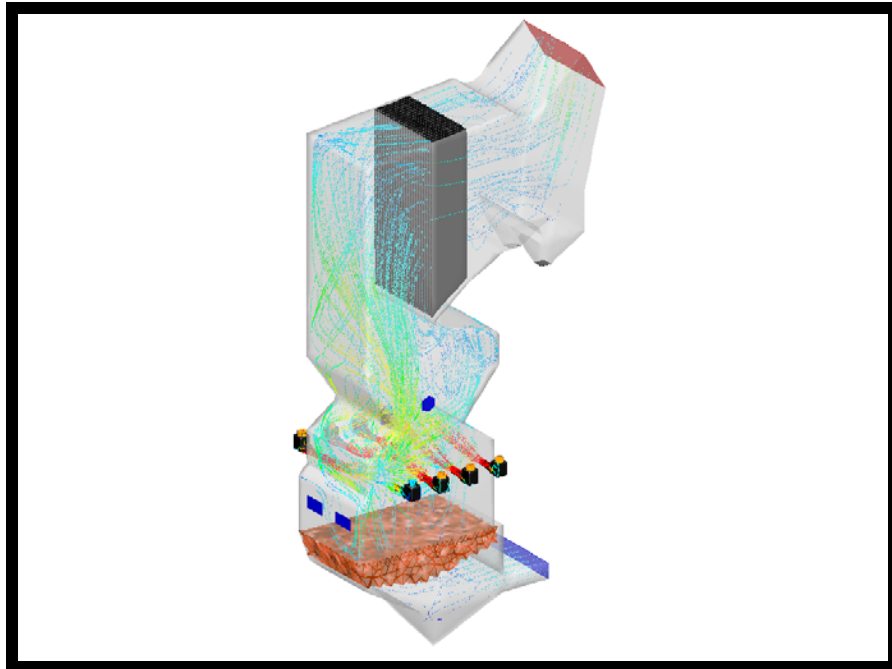
Selected References

Boise Cascade Corporation - International Falls, MN
Bowater Carolina - Catawba, SC
Clearwater Paper - McGehee, AR
Domtar Papers - Cornwall, ON
Fletcher Challenge Canada Ltd. - Mackenzie, BC
Georgia-Pacific Corporation - Big Island, VA (2 units)
Georgia-Pacific Corporation - Camas, WA
Georgia-Pacific Corporation - Clatskanie, OR
Georgia-Pacific Corporation - Monticello, MS (2 units)
Georgia-Pacific Corporation - Palatka, FL (1987)
Georgia-Pacific Corporation - Palatka, FL (2007)
Georgia-Pacific Corporation - Zachary, LA
MacMillan Bloedel Limited - Port Alberni, BC
Mead Paper - Chillicothe, OH
Mead Paper - Escanaba, MI (multiple phases)
NewPage Corporation - Wickliffe, KY
Packaging Corporation of America - Valdosta, GA
Rayonier, Inc. - Jesup, GA (in progress)
SAPPI North America - Skowhegan, ME (partial)
Simpson Tacoma Kraft Company - Tacoma, WA
Skeena Cellulose, Inc. - Prince Rupert, BC
Smurfit Cartón de Colombia - Cali, Colombia (2 units)
Smurfit Mocarpe - San Felipe, Venezuela
Smurfit-Stone Container Corporation - Brewton, AL (2 units)
Weyerhaeuser Paper Company - New Bern, NC

PROJECT CAPABILITIES

COMPUTATIONAL FLUID DYNAMICS (CFD) MODELING

- **Chemical Recovery Boilers**
- **Biomass Boilers**
- **Waste-to-Energy Boilers (MSW & RDF)**



JANSEN uses Computational Fluid Dynamics (CFD) modeling software to analyze fluid flow patterns, fuel combustion processes, fuel capacity, emissions performance, and heat transfer profiles in various boiler-related equipment. The scope of services typically includes boiler data collection, set-up of a model to evaluate current performance, and the use of this model to evaluate conceptual improvements. CFD modeling by JANSEN is conducted in-house by JANSEN engineers.

Applications

Typical areas where JANSEN applies CFD modeling to predict, evaluate, and/or optimize performance of boiler equipment include:

- Modifications to the combustion air delivery system.
- Evaluation of temperature and oxygen distribution in combustion furnaces.
- Optimization of the liquor distribution in recovery boilers.
- Heat transfer analysis in superheaters, generating banks, and economizers.
- Analysis of flow pattern and particulate distribution in inlet ducting to precipitators.
- Evaluation of combustion conditions in waste fuel- and fossil fuel-fired boilers.
- Evaluation of boiler emissions performance (TRS, CO, VOC, SO₂, NO_x, particulates).
- Spray cooler, scrubber, and cascade/cyclone evaporator performance predictions.
- Evaluation of HVLC and LVHC NCG incineration.

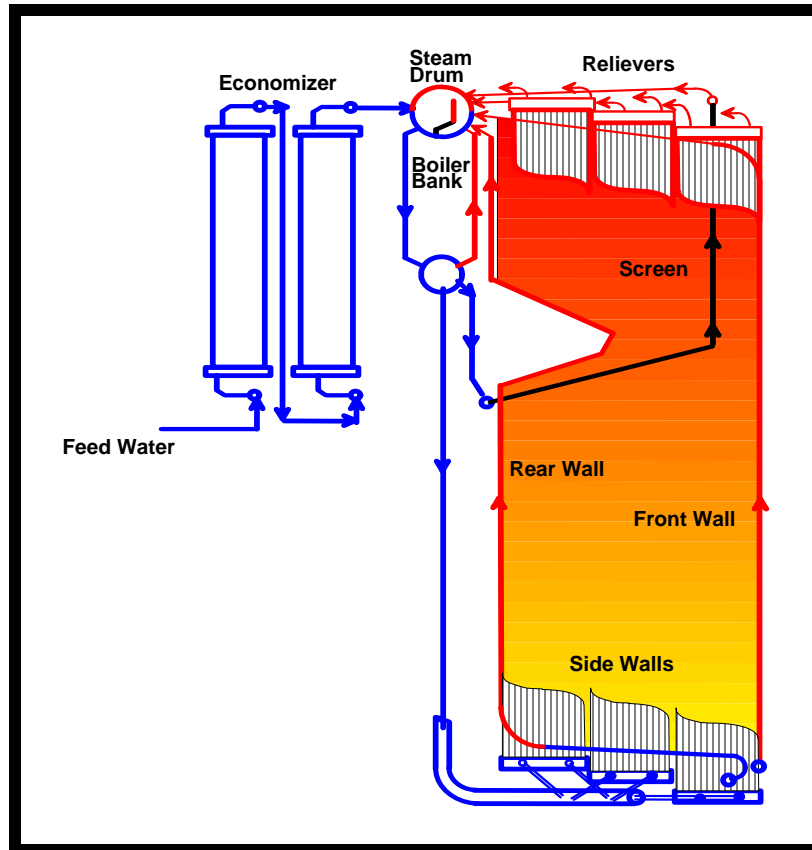
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 APRIL Group - Rizhao, China
 AssiDomän Sepap - Štetí, Czech Republic
 Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
 Boise Cascade Corp. – Int'l Falls, MN (2 units)
 Boise - DeRidder, LA (2 units)
 Boise - Wallula, WA
 Bukocel - Hencovce, Slovakia
 Clearwater Paper - McGehee, AR
 Confidential Customer - Canada
 Corn Products International - Winston-Salem, NC (2 units)
 Covanta Energy - Hartford, CT
 Daishowa America - Pt. Angeles, WA
 Daishowa Marubeni - Peace River, AB
 Domtar Industries - Ashdown, AR
 Domtar Inc. - Nekoosa, WI
 Domtar Inc. - Rothschild, WI
 Domtar Inc. - Windsor, PQ
 Domtar Papers - Cornwall, ON
 Eurocan Pulp & Paper - Kitimat, BC
 Evergreen Packaging - Canton, NC
 FMC Corporation - Green River, WY
 Georgia-Pacific Corporation - Brunswick, GA
 Georgia-Pacific Corporation - Camas, WA (2 units)
 Georgia-Pacific Corporation - Clatskanie, OR
 Georgia-Pacific Corporation - Crossett, AR
 Georgia-Pacific Corporation - Monticello, MS
 Georgia-Pacific Corporation - New Augusta, MS
 Georgia-Pacific Corporation - Old Town, ME
 Georgia-Pacific Corporation - Palatka, FL (2 units)
 Georgia-Pacific Corporation - Port Hudson, LA
 Graphic Packaging International - West Monroe, LA
 Great River Energy - Elk River, MN
 Harmac Pacific Inc. - Nanaimo, BC
 Inland Paperboard and Packaging - Orange, TX
 International Paper Company - Augusta, GA
 International Paper Company - Bastrop, LA
 International Paper Company - Cantonment, FL
 International Paper Company - Corrigan, TX
 International Paper Company - Courtland, AL
 International Paper Company - Franklin, VA
 International Paper Company - Georgetown, SC (2 units)
 International Paper Company - Jay, ME
 International Paper Company - Mansfield, LA (2 units)
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 International Paper Company - Pineville, LA
 International Paper Company - Prattville, AL
 International Paper Company - Saillat, France
 International Paper Company - Selma, AL
 International Paper Company - Texarkana, TX
 International Paper Company - Ticonderoga, NY
 International Paper Company - Vicksburg, MS
 KapStone Papers - Charleston, SC
 Ketchikan Pulp Company - Ketchikan, AK
 Kimberly-Clark Corporation - Everett, WA
 Koch Cellulose - Brunswick, GA (2 units)
 Kruger-Wayagamack, Inc. - Trois Rivieres, QC
 Longview Fibre - Longview, WA (2 units)
 Louisiana-Pacific - Roaring River, NC
 Maine Energy - Biddeford, ME
 Mead Paper - Chillicothe, OH
 Mead Paper - Escanaba, MI
 Mead Paper - Stevenson, AL
 MeadWestvaco - Covington, VA (2 units)
 MeadWestvaco - Phenix City, AL (2 units)
 Minnesota Power - Duluth, MN (2 units)
 Neucel Specialty Cellulose - Port Alice, BC (2 units)
 NewPage Corporation - Escanaba, MI (3 units)
 NewPage Corporation - Wickliffe, KY (2 units)
 Packaging Corporation of America - Counce, TN
 Packaging Corporation of America - Tomahawk, WI
 Packaging Corporation of America - Valdosta, GA (2 units)
 Plum Creek - Columbia Falls, MT
 Process Equipment/Barron Industries - Pelham, AL
 Rayonier, Inc. - Jesup, GA (3 units)
 Riverside Forest Products - Armstrong, BC
 Rock-Tenn Company - Demopolis, AL (2 units)
 SAPPi North America - Cloquet, MN
 SAPPi North America - Muskegon, MI (2 units)
 SAPPi North America - Skowhegan, ME (3 units)
 Simpson Tacoma Kraft Co. - Tacoma, WA (2 units)
 Smurfit-Stone - Brewton, AL (2 units)
 Smurfit-Stone - Hodge, LA
 Smurfit-Stone - Missoula, MT
 Smurfit-Stone - West Point, VA
 SP Newsprint - Newberg, OR
 Stora Enso North America - Biron, WI
 Tembec - Chetwynd, BC
 Thilmany Paper - Kaukauna, WI
 Veolia Dade County - Miami, FL
 Veolia Waste-to-Energy - Burnaby, BC
 Visy Pulp and Paper - Tumut, Australia
 Westvaco Corporation - Silsbee, TX
 Westvaco Corporation - Wickliffe, KY
 Weyerhaeuser Canada Ltd. - Prince Albert, SK
 Weyerhaeuser Company - Columbus, MS
 Weyerhaeuser Company - Kamloops, BC
 Weyerhaeuser Company - Longview, WA
 Weyerhaeuser Company - Springfield, OR
 Weyerhaeuser Company - Valliant, OK
 Wheelabrator Energy - Baltimore, MD
 Wheelabrator Energy - Portsmouth, VA
 Wheelabrator Inc. - Spokane, WA
 Willamette Industries - Bennettsville, SC
 Willamette Industries - Campti, LA

CAPABILITIES

BOILER CIRCULATION STUDIES



Boiler Circulation

Circulation of water through boiler tubes is necessary to prevent tube overheating and potential failure. The need to conduct a circulation study on a boiler is typically dictated because of any one, or combination of, the following reasons:

- To establish the maximum steaming rate at which circulation remains adequate.
- To determine pressure part modifications needed to support a significant increase in fuel burning rate.
- To evaluate the effect of changing boiler operating conditions (such as type of fuel or operating pressure) on circulation.
- To evaluate the effect of changing heating surfaces on circulation.
- To uncover factors causing repeat pressure part failures and/or tube overheating.
- To investigate the cause of excessive scale depositions inside tubing.

A valuable technique used by JANSEN during its analyses of circulation conditions is the application of Ultrasonic Flow Monitoring (UFM).

Selected References (see next page)

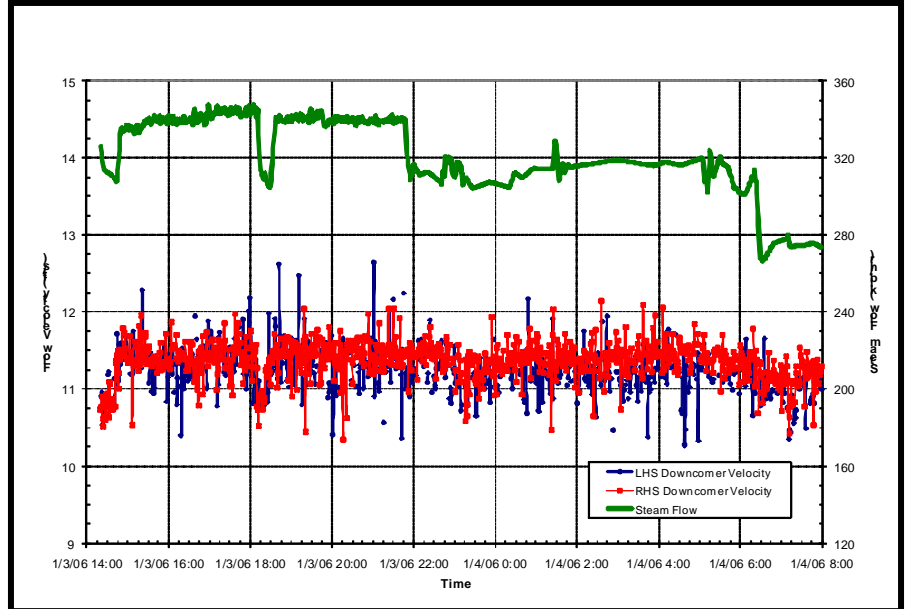


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APRIL Group - Rizhao, China
AssiDomän Sepap - Steti, Czech Republic
Australian Paper - Morwell, Australia
Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
Blue Ridge Paper Company - Canton, NC
Boise Cascade Corp. - DeRidder, LA
Boise Cascade Corp. - International Falls, MN (2 units)
Boise Cascade Corp. - Jackson, AL
Boise Cascade Corp. - Rumford, ME
Boise Cascade Corp. - Wallula, WA (2 units)
Bowater Incorporated - Catawba, SC
Bukoza - Hencovce, Slovakia
Cariboo Pulp & Paper Co. - Quesnel, BC
Carter Holt Harvey Pulp & Paper Ltd. - Tokoroa, NZ
Champion International Corp. - Quinnesec, MI
Champion International Corp. - Roanoke Rapids, NC
Champion Papel e Celulose Ltda. - Mogi Guaçu, Brazil
Covanta Energy - Hartford, CT
Domtar Papers - Cornwall, ON
Domtar Inc. - Ashdown, AR
Domtar Inc. - Bennettsville, SC
Domtar Inc. - Kingsport, TN
Domtar Inc. - Lebel-sur-Quevillon, PQ
Donohue Forest Products Inc. - St. Félicien, PQ
E.B. Eddy Forest Products Ltd. - Espanola, ON
Federal Paper Board Company, Inc. - Riegelwood, NC
Fletcher Challenge Canada - Mackenzie, BC
Fort James Corporation - Clatskanie, OR
Fraser Papers Inc. - Edmundston, NB
Fraser Papers Inc. - Park Falls, WI
Georgia-Pacific Corporation - Big Island, VA
Georgia-Pacific Corporation - Camas, WA
Georgia-Pacific Corporation - Cedar Springs, GA
Georgia-Pacific Corporation - New Augusta, MS
Georgia-Pacific Corporation - Palatka, FL
Georgia-Pacific Corporation - Wauna, OR
Graphic Packaging - Macon, GA
Harmac Pacific Inc. - Nanaimo, BC
Hercules Pinova - Brunswick, GA
Howe Sound Pulp & Paper - Port Mellon, BC
Inland Paperboard & Packaging, Inc. - Orange, TX
International Paper Company - Mansfield, LA (2 units)
International Paper Company - Pine Bluff, AR
International Paper Company - Pine Hill, AL (3 units)
International Paper Company - Pineville, LA
International Paper Company - Riegelwood, NC
International Paper Company - Svetogorsk, Russia (2 units)
Interstate Paper Company - Riceboro, GA
Irving Pulp & Paper, Limited - Saint John, NB
KapStone Paper - Roanoke Rapids, NC
Kimberly-Clark Corporation - Coosa Pines, AL
Kimberly-Clark Forest Products Inc. - Terrace Bay, ON
Kimberly-Clark Nova Scotia Inc. - New Glasgow, NS
MacMillan Bloedel Limited - Port Alberni, BC
Mead Corporation - Chillicothe, OH
Mead Corporation - Escanaba, MI (2 units)
Mead Corporation - Kingsport, TN
MeadWestvaco - Phenix City, AL (2 units)
Minnesota Power - Grand Rapids, MN
Montenay Onyx - Burnaby, BC
New Ulm Public Utilities - New Ulm, MN
Northwood Pulp & Timber, Inc. - Prince George, BC
Packaging Corporation of America - Counce, TN
Packaging Corporation of America - Valdosta, GA
Plainwell Paper Company - Anderson, CA
Pope & Talbot, Inc. - Halsey, OR
Rayonier, Inc. - Jesup, GA
Repap British Columbia Inc. - Prince Rupert, BC
Repap Manitoba - The Pas, Manitoba
Riverwood International Corporation - West Monroe, LA
SAPPI Fine Papers North America - Muskegon, MI
SAPPI Fine Papers North America - Skowhegan, ME
SCP - Ruzomberok, Slovakia
Simpson Paper Co. - Eureka, CA
Simpson Tacoma Kraft - Tacoma, WA
Smurfit Cartón de Colombia - Cali, Colombia (2 units)
Smurfit Mocarpe - San Felipe, Venezuela
SP Newsprint - Newberg, OR
Stone-Consolidated Corp. - Fort Frances, ON
Stone-Consolidated Corp. - Portage du Fort, PQ
Stora Enso North America - Wisconsin Rapids, WI
Tasman Pulp and Paper Company Ltd. - Kawerau, NZ
Western Pulp Limited Partnership - Squamish, BC
Westvaco Corporation - Covington, VA
Westvaco Corporation - Wickliffe, KY
Weyerhaeuser Canada Ltd. - Kamloops, BC
Weyerhaeuser Paper Company - Longview, WA
Weyerhaeuser Paper Company - New Bern, NC
Weyerhaeuser Paper Company - Oglethorpe, GA
Weyerhaeuser Paper Company - Port Wentworth, GA
Weyerhaeuser Paper Company - Springfield, OR (3 units)

PROJECT CAPABILITIES

ULTRASONIC FLOW MONITORING (UFM) OF BOILER CIRCULATION



Scope of Service

A valuable technique used by JANSEN during its analyses of circulation conditions is the application of Ultrasonic Flow Monitoring (UFM). UFM allows for direct water velocity measurements in selected downcomers and boiler furnace tubes without penetrating the pressure part boundary (as this is needed when using Pitot tubes). Therefore, UFM measurements require no boiler downtime.

UFM data provide invaluable input in the evaluation of boiler circulation conditions. The technique has been used successfully for making flow measurements on tubes and pipes with diameters from 2½ inch to 22 inch and water velocities from less than 0.1 ft/sec to over 14 ft/sec at temperatures up to 600°F.

For many applications, the UFM technique offers the following benefits and advantages:

- UFM instrumentation is clamped onto the outside of a tube rather than drilling and welding Pitot tubes.
- UFM instrumentation is mounted while the boiler is on-line.
- UFM instrumentation can be easily moved to different locations.
- UFM instrumentation makes a line-scan measurement across the pipe rather than a single point.
- UFM instrumentation can detect reversal of flow direction.
- UFM instrumentation can be calibrated mid-way during testing.
- UFM instrumentation can accurately measure flows as low as 0.1 ft/sec.

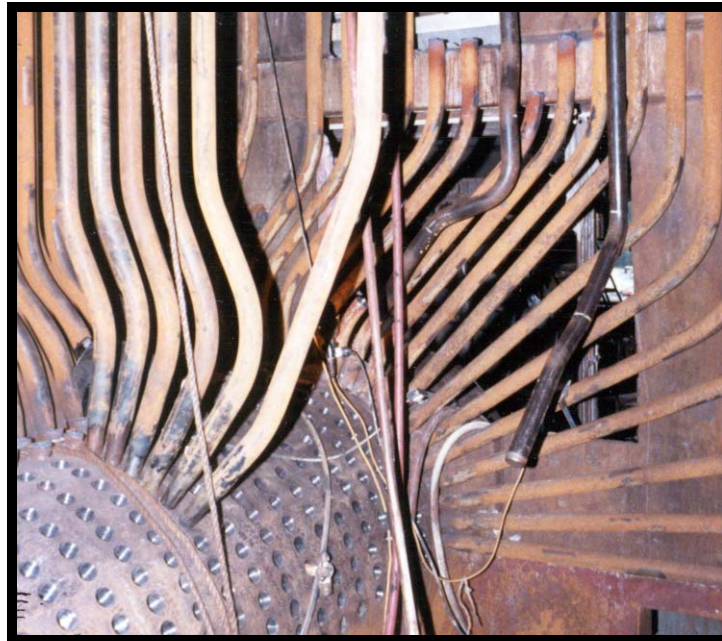
Selected References (see next page)

Selected References

APRIL Group - Rizhao, China
 Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
 Boise - Jackson, AL
 Boise - International Falls, MN
 Boise Paper - Wallula, WA (2 units)
 Bukoza - Hencovce, Slovakia
 Carter Holt Harvey Pulp & Paper Ltd. - Tokoroa, NZ
 Champion International - Quinnesec, MI
 Confidential Client - North America
 Covanta Energy - Hartford, CT
 Domtar Inc. - Ashdown, AR
 Domtar Inc. - Bennettsville, SC
 Donohue Inc. - St.-Félicien, PQ
 Fraser Papers Inc. - Park Falls, WI
 Georgia-Pacific - Camas, WA
 Georgia-Pacific - New Augusta, MS
 Georgia-Pacific - Wauna, OR
 Graphic Packaging - Macon, GA
 Howe Sound Pulp & Paper - Port Mellon, BC
 International Paper Company - Courtland, AL
 International Paper Company - Mansfield, LA (2 units)
 International Paper Company - Pine Bluff, AR
 International Paper Company - Pine Hill, AL (3 units)
 International Paper Company - Pineville, LA
 International Paper Company - Riegelwood, NC
 International Paper Company - Svetogorsk, Russia (2 units)
 KapStone Paper - Roanoke Rapids, NC
 Louisiana Pacific - Samoa, CA
 Mead Paper - Chillicothe, OH
 Mead Paper - Escanaba, MI
 MeadWestvaco - Phenix City, AL (2 units)
 Minnesota Power - Grand Rapids, MN
 Montenay Onyx - Burnaby, BC
 New Ulm Public Utilities - New Ulm, MN
 Northwood Pulp & Timber Ltd. - Prince George, BC
 Plainwell Paper - Anderson, CA
 Pope & Talbot - Halsey, OR
 Rayonier Inc. - Jesup, GA
 Rentech Energy Midwest Corporation - East Dubuque, IL
 SAPPi Fine Papers - Muskegon, MI
 SAPPi Fine Papers - Skowhegan, ME
 Simpson Tacoma Kraft - Tacoma, WA
 SP Newsprint - Newberg, OR
 Stora Enso North America - Wisconsin Rapids, WI
 Weldwood of Canada - Hinton, AT
 Westvaco - Covington, VA
 Westvaco - Wickliffe, KY
 Weyerhaeuser Corporation - Longview, WA
 Weyerhaeuser Corporation - Oglethorpe, GA
 Weyerhaeuser Corporation - Port Wentworth, GA

PROJECT CAPABILITIES

BOILER PRESSURE PART DESIGN



JANSEN is a fully qualified engineering firm specializing in the design and specification of boiler pressure parts. Projects include redesign of heat transfer components using improved technology. These boiler components have included new generating banks, superheaters, water wall furnaces, and economizers. JANSEN holds an ASME Boiler and Pressure Vessel Code Section I "S" stamp for the design of power and recovery boilers and the NBIC "R" stamp.

Scope of Service

- Performance testing
- Analysis of heating surface requirements
- Process design engineering
- Detail drawings and specifications for fabrication and construction
- Engineering, Procurement, and Construction (EPC) scope of supply.
- Startup services

Selected References (see next page)



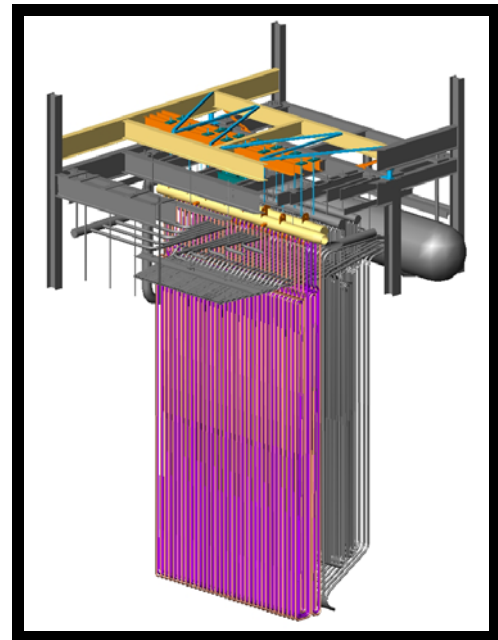
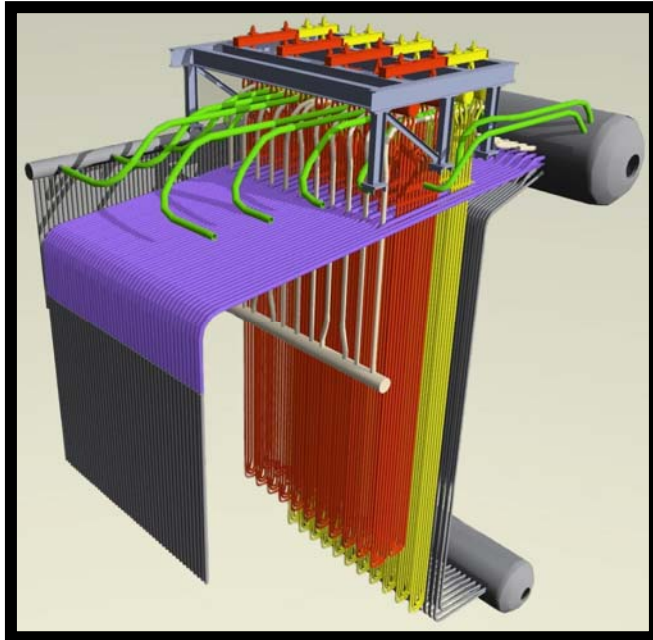
Selected References

Bowater Inc. - Catawba, NC
Cariboo Pulp & Paper - Quesnel, BC
Domtar Industries - Kamloops, BC
Fletcher Challenge Canada Ltd. - Mackenzie, BC
International Paper Company - Ticonderoga, NY
International Paper Company - Vicksburg, MS
Kimberly-Clark Forest Products, Inc. - Everett, WA
Kimberly-Clark Forest Products, Inc. - Terrace Bay, ON
Mead Paper - Escanaba, MI
Minnesota Power - Duluth, MN (2 units)
Montenay Inc. - Burnaby, BC
Packaging Corporation of America - Valdosta, GA (2 units)
Simpson Tacoma Kraft - Tacoma, WA
Skeena Cellulose Inc. - Prince Rupert, BC
Smurfit Cartón de Colombia - Cali, Colombia
Western Pulp Limited Partnership - Port Alice, BC
Weyerhaeuser Paper Company - Campti, LA
Weyerhaeuser Paper Company - New Bern, NC

PROJECT CAPABILITIES

SUPERHEATER CAPACITY & PERFORMANCE UPGRADES

- Chemical Recovery Boilers
- Biomass Boilers
- Waste Fueled Boilers (MSW and RDF)



Scope of Services

The performance and reliability of superheaters plays a critical role in overall plant efficiency and in-house power generation. With increased fuel and power costs, more emphasis is placed on maximizing in-house power generation. In recent years, Jansen has completed projects of the following nature to improve the operating performance, capacity, and reliability of superheaters in existing waste fueled boilers:

- Corrosion analyses (see Capabilities Reference Sheet C-14).
- Metallurgical upgrades to improve corrosion resistance.
- Design and supply of additional heating surface to increase final steam temperature.
- Modify steam flow pattern to minimize pressure loss across the superheater.

Selected References (see next page)



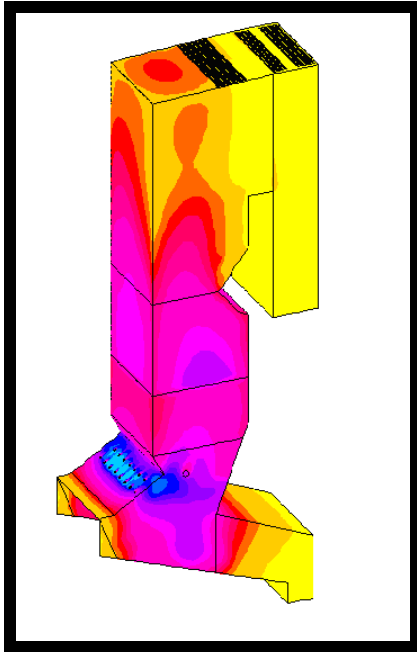
Selected References

Cariboo Pulp & Paper - Quesnel, BC
International Paper Company - Ticonderoga, NY
International Paper Company - Vicksburg, MS
Kimberly-Clark - Everett, WA
Montenay Inc. - Burnaby, BC (3 units)
Packaging Corporation of America - Valdosta, GA
Simpson Tacoma Kraft - Tacoma, WA
Western Pulp Limited - Port Alice, BC
Weyerhaeuser Company - Campti, LA

PROJECT CAPABILITIES

BOILERS IN ENERGY-FROM-WASTE INDUSTRY

- Municipal Solid Waste (MSW)
- Refuse Derived Fuel (RDF)
- Tire Derived Fuel (TDF)



Scope of Services

Typical waste fuels in this industry are municipal solid waste (MSW), refuse derived fuel (RDF), and tire derived fuel (TDF). Jansen has completed the following projects for customers in the Energy-from-Waste (E-f-W) industry.

- General troubleshooting and problem root cause analyses.
- Superheater corrosion analyses.
- Feasibility studies for boiler fuel conversion (from prior fuel to MSW/RDF/TDF).
- Review of process design factors, pressure part evaluations, and circulation studies.
- Computational Fluid Dynamics (CFD) modeling of combustion performance and heat transfer characteristics.
- ASME Code “S” pressure part design (furnace, superheater, generating bank, and/or economizer).
- Pressure parts supply, fabrication, and installation.
- Efficient combustion air delivery systems, i.e., overfire air (OFA) upgrades.

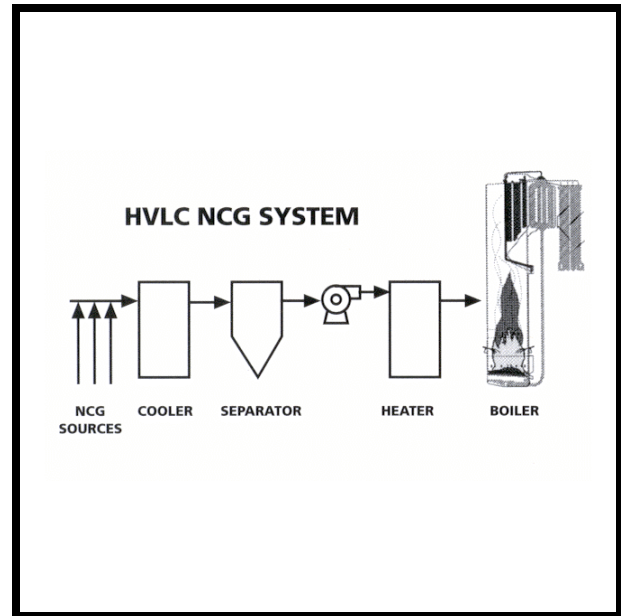
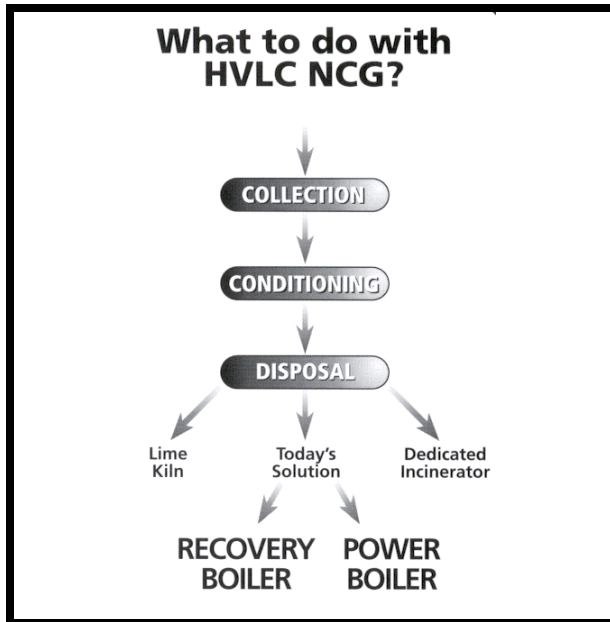
Selected References (see next page)

Selected References

Consumat Recomp - Bellingham, WA
Covanta Energy - Harrisburg, PA
Covanta Energy - Hartford, CT (2 units upgraded)
EnergyAnswers Corporation - Albany, NY
EnergyAnswers Corporation - Agawan, MA
Exeter Energy - Sterling, CT
Great River Energy - Elk River, MN
Green Island Energy Limited - Vancouver, BC
Maine Energy Recovery Company - Biddeford, ME
Montenay Power - Miami Dade County, FL
Montenay Power - Burnaby, BC
Montenay Power - York, PA
ReEnergy Holdings - Albany, NY (several plants)
The Barlow Group - Harrisburg, PA
Veolia Dade County - Miami, FL
Veolia Waste-to-Energy - Burnaby, BC
Von Roll America, Inc. - East Liverpool, OH
Wheelabrator Energy - Baltimore, MD
Wheelabrator Energy - Hampton, NH
Wheelabrator Energy - Portsmouth, VA (4 units upgraded)
Wheelabrator Energy - Spokane, WA

PROJECT CAPABILITIES

EVALUATION DISPOSAL OF DNCG AND CNCG IN RECOVERY/POWER BOILERS



Because of Cluster Rule legislation, many kraft mills in North America collect and incinerate high volume low concentration (HVLC) non-condensable gas (NCG).

These dilute non-condensable gases (also called DNCG) are collected from various sources such as washers, deckers, chip bins, liquor tanks, sewers, and many others. They contain small amounts of TRS and volatile organics, with moist air making up over 95% of the DNCG. As a less expensive alternative to purchasing a dedicated incinerator, this stream can be conveniently combined with balance of combustion air in a power boiler (at the level of overfire air) or recovery boiler (secondary/tertiary air levels). More and more mills are disposing of concentrated NCG (CNCG) in boilers as well.

Mills are faced with making informed decisions where and how to inject the NCG stream safely in an existing boiler and in a manner that will not detrimentally affect normal boiler operation.

Scope of Services

- Help select boiler(s) best suited for disposal of DNCG and/or CNCG stream (i.e., specific power or recovery boiler).
- Evaluate impact of NCG injection on boiler efficiency, normal fuel burning capacity, air emissions, corrosion factors, safety, and potential odor problems.
- Determine best location and method of injection of the NCG stream into the furnace in order to assure rapid and complete thermal oxidation.
- Define NCG injection conditions consistent with BLRBAC Recommended Good Practices.
- Define potential secondary (pay-back) benefits of HVLC NCG injection (i.e. combustion air delivery upgrade).
- Develop budgetary estimate or Class 10 cost to design, supply, and install boiler modifications for the injection of the NCG stream.

Selected References (see next page)

Selected References

Appleton Papers - Roaring Spring, PA
Bowater, Inc. - Calhoun, TN
Bowater, Inc. - Catawba, SC
Canfor PGP&P - Prince George, BC
Domtar, Inc. - Windsor, PQ
Eddy Specialty Papers - Espanola, ON
Georgia-Pacific Corporation - Camas, WA
Georgia-Pacific Corporation - Clatskanie, OR
Georgia-Pacific Corporation - Monticello, MS
Georgia-Pacific Corporation - Old Town, ME
International Paper Company - Franklin, VA
International Paper Company - Pensacola, FL
International Paper Company - Texarkana, TX
MeadWestvaco Corporation - Covington, VA
MeadWestvaco Corporation - Luke, MD
MeadWestvaco Corporation - Phenix City, AL
Roseburg Forest Products - Dillard, OR
Roseburg Forest Products - Weed, CA
Simpson Tacoma Kraft - Tacoma, WA
Westvaco - Evadale, TX
Weyerhaeuser Company - Oglethorpe, GA
Weyerhaeuser Company - Plymouth, NC
Willamette Industries - Hawesville, KY

PROJECT CAPABILITIES



DISPOSAL OF HVLC DNCG IN RECOVERY/POWER BOILERS USING JANSEN HIGH ENERGY COMBUSTION AIR NOZZLES™



Injection of High Volume Low Concentration (HVLC) dilute non-condensable gases (DNCG) in the boiler using the Jansen High Energy Combustion Air Nozzles™ can be practiced in different ways:

- In a recovery boiler, global mixing of the DNCG stream with all secondary and/or tertiary air through all new nozzles. On a power boiler, global mixing with all overfire air (OFA).
- Local mixing of the DNCG stream with air to selected new nozzles on the secondary and/or tertiary air levels, or OFA.
- Separate injection (using blower), without air mixing, through a selected number of new nozzles.

The benefits of installing Jansen air nozzles for DNCG disposal in the recovery/power boiler are many:

- Work includes initial process evaluation to determine best location and method of injection.
- Injection method, system, and nozzles are custom designed for each application.
- Nozzle has clean, open discharge with high jet velocity, and no back flows or tube impingement.
- Nozzle tips are corrosion resistant.
- Rapid combustion of DNCG components; no emissions excursions.
- Boiler stability is not affected.
- Nozzles have shown no/low maintenance.
- System has easy shut-off capability.

Selected References (see next page)



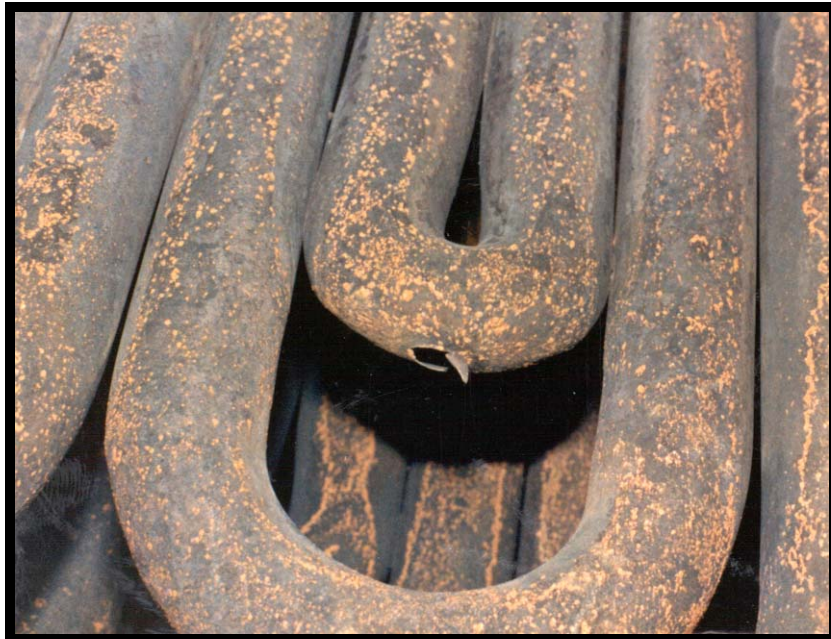
Selected References

Appleton Papers - Roaring Spring, PA
Bowater, Inc. - Calhoun, TN
Bowater, Inc. - Catawba, SC (2 units)
Canfor PGP&P - Prince George, BC
Georgia-Pacific Corporation - Camas, WA
Georgia-Pacific Corporation - Clatskanie, OR
Georgia-Pacific Corporation - Old Town, ME
International Paper Company - Texarkana, TX (2 units)
Mead Paper - Escanaba, MI
Mead Paper - Chillicothe, OH
Stone Container - Portage-du-Fort, PQ
Westvaco Corporation - Silsbee, TX
Weyerhaeuser Company - Campti, LA

PROJECT CAPABILITIES



SUPERHEATER CORROSION PREVENTION



Excessive tube metal wastage in recovery and other waste fuel boiler superheaters due to fireside corrosion has often become troublesome as mills attempt to increase boiler firing capacity. Firing boilers at higher rates has, in some cases, led to higher final steam temperature and excessive superheater metal temperatures, which can accelerate corrosive metal loss. JANSEN has developed an engineering analysis approach that helps to predict where corrosion problems may occur and provides the means to design solutions to overcome these problems. The analysis includes collecting boiler operating data, obtaining process samples for chemical analysis, reviewing superheater geometry and metallurgy, and a comprehensive heat transfer analysis.

Scope of Service

- Prediction of tube metal temperatures to identify areas most vulnerable to corrosive attack.
- Identification of process parameters to maintain tube metal temperatures at safe levels, i.e., final steam temperature and pressure, attemperator water flow rates, firing capacity, flue gas conditions, deposit characteristics, etc.
- Allow redesign of superheater tube layout and metallurgy to avoid exposure of tube metal to excessive temperatures and heat fluxes.

Selected References (see next page)

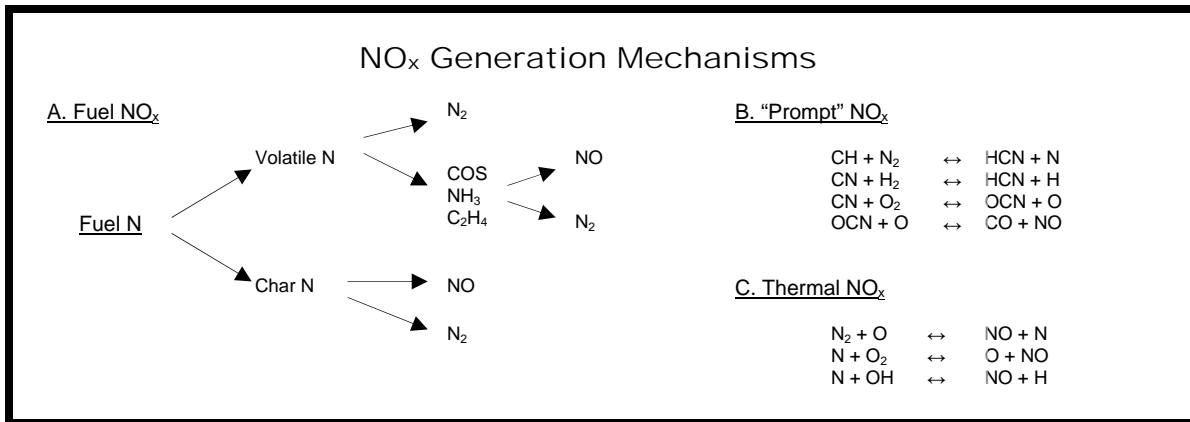
Selected References

Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
Boise Cascade Corporation - Rumford, ME
Georgia-Pacific Corporation - Zachary, LA
Great River Energy - Elk River, MN
Ketchikan Pulp Company - Ketchikan, AK
Kimberly-Clark Forest Products Inc. - Everett, WA
Kimberly-Clark Forest Products Inc. - Terrace Bay, ON
Maine Energy - Biddeford, ME
Mead Paper Corporation - Chillicothe, OH
Montenay Power - Miami, FL
Montenay Power - York, PA
Montenay Inc. - Burnaby, BC
Scott Maritimes Limited - New Glasgow, NS
Visy Pulp & Paper - Tumut, Australia
Westvaco Corporation - Covington, VA
Western Pulp Limited Partnership - Port Alice, BC
Western Pulp Limited Partnership - Squamish, BC
Wheelabrator Energy - Spokane, WA
Willamette Industries - Hawesville, KY

PROJECT CAPABILITIES



NO_x EMISSIONS REDUCTION



Background

Many plants are facing stricter NO_x emission limitations from boiler stack gases in the near future. Often, NO_x emissions must be reduced by more than 50% from current levels.

Jansen's Approach to Solving NO_x Issues

1. Understanding the customer's goals
2. Understanding the local environmental permitting constraints.
3. Evaluating the current boiler operation to:
 - a. Determine current NO_x creation mechanism
 - b. Analyze the physical arrangement of the combustion system; size of furnace, location of existing burners and air supply
 - c. Determine operating strategy/control, fuel splits, load variability
 - d. Establish fuel properties
4. Perform Computational Fluid Dynamics (CFD) modeling to predict effectiveness of types of solutions.
5. Evaluating types or combination of NO_x reduction solutions for most viable and cost effective solutions. Determine capital cost and operating costs as well as "side effects" of proposed solutions.
6. Providing operating recommendations and hardware alterations that best meet the customers' goals. Where appropriate, possible solutions may include:
 - Staged combustion/overfire air
 - Low excess air
 - Fuel rich secondary combustion (reburning)
 - Urea/ammonia injection (SNCR)
 - Flue gas recirculation (FGR)
 - Low NO_x burners
 - Automatic combustion controls
7. Design and supply specific NO_x reduction technology and equipment.

Selected References (see next page)



Selected References

Boise - International Falls, MN
Boise - Wallula, WA
Georgia-Pacific Corporation - Crossett, AR
International Paper Company - Roanoke Rapids, NC
International Paper Company - Texarkana, TX
International Paper Company - Ticonderoga, NY
MeadWestvaco Corporation - Covington, VA
MeadWestvaco Corporation - Phenix City, AL
Rayonier, Inc. - Jesup, GA
Simpson Tacoma Kraft - Tacoma, WA
Smurfit-Stone Container Corporation - Hodge, LA
Smurfit-Stone Container Corporation - Missoula, MT
Smurfit-Stone Container Corporation - Stevenson, AL
Stora Enso North America - Wisconsin Rapids, WI
Veolia Waste-to-Energy - Burnaby, BC
Weyerhaeuser Company - Valliant, OK

PROJECT CAPABILITIES



SINGLE COMBUSTOR BIOMASS GASIFICATION TECHNOLOGY

Advanced Combustion Technology

JANSEN's single combustor biomass gasification technology is based on the application of two elements of advanced combustion technology, namely:

1. **The use of our patented High Energy Combustion Air Nozzle™ for the second stage of combustion.** The unique nozzles provide efficient conversion of static pressure into high velocity jets that provide exceptional penetration and mixing for the complete combustion of the gases driven off in the gasification stage.
2. **The use of Computational Fluid Dynamics (CFD) modeling.** JANSEN has developed sophisticated CFD modeling capability of solid waste fuel combustion. CFD modeling for each installation allows variation of combustion parameters and selection of certain design features and operating characteristics of fuel and air supply that optimizes the gasification and combustion processes in the single combustor.

Features of Single Combustor Biomass Gasification

- **Two or more stages of oxidation**
 - Gasification stage – pyrolyzation and volatiles release
 - Second stage – burnout of combustible gases
- **Complete combustion**
 - Lower carbon monoxide (CO) and volatile organic compounds (VOC) than conventional biomass combustion
- **Reduced nitrogen oxides (NO_x) emissions**
 - Staged combustion – reduced local temperatures
 - Lower excess air requirements
- **Reduced particulate emissions**
 - 30% to 50% reduction in fly ash carryover out of the furnace
 - Essentially complete burnout of soot
- **Low auxiliary equipment horsepower required**
 - No high powered forced draft fan required as for fluidized bed
 - Better overall plant efficiency – more power per pound of fuel



- **Reduced landfill costs**
 - No spent bed material as in fluidized bed technology
 - Superior carbon burnout compared to conventional technology
- **Lower operating and initial capital costs**
 - More attractive to power systems developers
 - Lower capital costs for either OEM or retrofit/upgrades
 - Shorter shutdowns for retrofits c/w FBC and others
 - Less ash system related maintenance costs
- **Higher equipment availability/reliability to produce power**
 - More bottom ash generation/less fly ash to cause downstream wear and tear, pluggages, load reductions
 - More even grate metal temperatures due to more even fuel and ash coverage
 - less alarms and load reductions to stabilize
 - Equally flexible to fire a wide range of solid fuels c/w FBC
- **Summary: This is not conventional Stoker Firing Technology**
 - Traveling grate is retained for continuous ash removal
 - Lower UFA/OFA ratios for lower particulate carryover
 - Lower fly/bottom ash splits for lower M&O costs
 - Increased lower furnace heat release rates for lower UCL
 - Lower CO, NO_x, VOC, and particulate emissions
 - Higher net power generation and availability & reliability

PROJECT CAPABILITIES

SULFITE (SSL) AND SODA LIQUOR RECOVERY BOILERS



Scope of Service

In addition to the kraft process, JANSEN possesses extensive experience with design and operation of sulfite (ammonia and MgO) and soda based recovery boilers. Our services include the following activities:

- Field testing to collect operating data and establish performance and baseline conditions.
- Performance calculations for ammonia and MgO sulfite liquor boilers.
- Performance calculations for soda liquor boilers.
- Engineering evaluation of critical design and operating parameters.
- Steam/water circulation study.
- Determination of conceptual boiler modifications.
- Budget cost and project time schedule estimates.
- Design/supply SSL burning capacity upgrade.
- Operator training seminars.

Selected References (see next page)



Selected References

AV Cell - Atholville, NB
Fraser Papers, Inc. - Edmundston, NB
Georgia-Pacific Corporation - Big Island, VA
Ketchikan Pulp Company - Ketchikan, AK
Kimberly-Clark Corporation - Everett, WA
Mead Corporation - Kingsport, TN
Neucel Specialty Cellulose - Port Alice, BC
Tartas S.A. - Tartas, France
Tembec Inc. - Temiscaming, PQ
Western Pulp Limited Partnership - Port Alice, BC
Weyerhaeuser Paper Company - Cosmopolis, WA

PROJECT CAPABILITIES

FLUIDIZED BED BOILERS BUBBLING / CIRCULATING (BFB / CFB)



Scope of Service

In addition to the stoker fired waste fuel boilers, JANSEN conducts evaluations on Bubbling Fluidized Bed (BFB) and Circulating Fluidized Bed (CFB) boilers. Our services include the following:

- Field testing to collect operating data and establish performance and baseline conditions.
- Engineering evaluation of critical design and operating parameters.
- Analysis of erosion factors.
- CFD modeling.
- Steam/water circulation analysis.
- Determination of conceptual boiler modifications.
- Budgetary cost estimates.
- Addition of in-bed heating surfaces
- Over-bed combustion air delivery
- Incineration of HVLC and LVHC NCG.

Selected References (see next page)



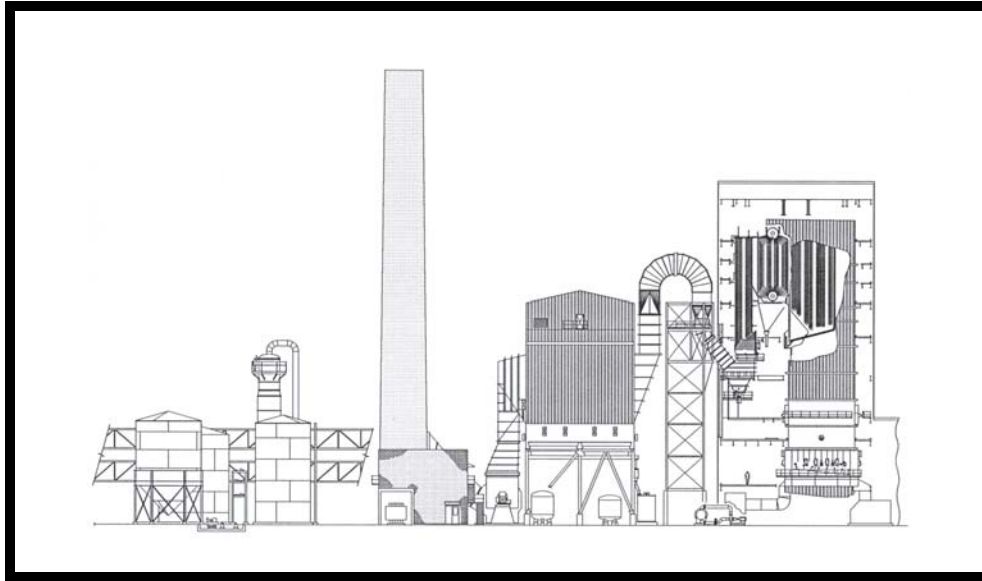
Selected References

Boise Cascade - Rumford, ME
Bowater, Inc. - Calhoun, TN
Catalyst Papers - Port Alberni, BC
Domtar, Inc. - Hawesville, KY
Domtar, Inc. - Kingsport, TN
Georgia-Pacific - Clatskanie, OR
International Paper Company - Courtland, AL
Mondi SCP - Ružomberok, Slovakia
Sonoco Products Co. - Hartsville, SC
Tacoma Public Utilities - Tacoma, WA
Thailand Biomass Boilers - Thailand

PROJECT CAPABILITIES



RECOVERY BOILER LOW ODOR CONVERSION



Conversion of a conventional recovery boiler (equipped with a cyclone or cascade evaporator) to the direct fired, low odor configuration consists of the following major aspects:

- Removal/demolishing of the cascade or cyclone evaporator.
- Installation of a liquor concentrator.
- Installation of additional economizer surface, either by complete replacement with a large vertical flow economizer, or adding a small second economizer unit.
- Replacement of the ID fan to handle higher gas temperatures.
- Modification of the wet bottom precipitator to dry bottom configuration to eliminate direct contact between liquor and flue gases.
- Installation of associated ductwork and liquor piping.

Scope of Service

JANSEN is capable of performing all engineering functions related to converting a conventional recovery boiler to a low odor configuration, including equipment specification, design of the economizer, and all ducting and piping design.

Selected References (see next page)

Selected References

Kimberly-Clark Forest Products Inc. - Terrace Bay, ON (partial)
Skeena Cellulose, Inc. - Prince Rupert, BC

PROJECT CAPABILITIES



PROJECTS IN CANADA



Services in Canada

Since our inception in 1976, JANSEN has completed numerous projects in all Canadian Provinces where pulp mills are located. The type of project and scope of work included:

- Boiler Conversion to Biomass Burning (see Capabilities C-01)
- Biomass Boiler Evaluations (see Capabilities C-02)
- Biomass Boiler Combustion System Upgrades (see Capabilities C-03)
- Recovery Boiler Performance and Engineering Evaluations (see Capabilities C-04)
- Recovery Boiler Capacity Upgrades (see Capabilities C-05)
- Computational Fluid Dynamics (CFD) Modeling (see Capabilities C-06)
- Boiler Circulation Studies (see Capabilities C-07)
- Ultrasonic Flow Monitoring (UFM) of Boiler Circulation (see Capabilities C-08)
- Boiler Pressure Part Design (see Capabilities C-09)
- Superheater Capacity & Performance Upgrades (see Capabilities C-10)
- Boilers in Energy-from-Waste Industry (see Capabilities C-11)
- Evaluation Disposal of DNCG and CNCG in Existing Boilers (see Capabilities C-12)
- Superheater Corrosion Prevention (see Capabilities C-14)
- NO_x Emissions Reduction (see Capabilities C-15)
- Sulfite (SSL) and Soda Liquor Recovery Boilers (see Capabilities C-17)
- Fluidized Bed Boilers Bubbling/Circulating (BFB/CFB) (see Capabilities C-18)
- Recovery Boiler Low Odor Conversion (see Capabilities C-19)

Selected References (see next page)

Selected References

Alberta Pacific Forest Industries, Inc. - Boyle, AB
AV Cell - Atholville, NB
Boise Cascade Canada - Fort Frances, ON
Canfor Intercon - Prince George, BC
Canfor Northwood - Prince George, BC
Canfor PGP - Prince George, BC
Carriboo Pulp & Paper - Quesnel, BC
Catalyst Paper - Crofton, BC
Catalyst Paper - Port Alberni, BC
Corner Brook Pulp & Paper - Corner Brook, NF
Daishowa Marubeni - Peace River, AB
Domtar Papers - Cornwall, ON
Domtar, Inc. - Kamloops, BC
Domtar, Inc. - Lebel-sur-Quevilon, PQ
Domtar, Inc. - Windsor, PQ
Donahue Forest Products Inc. - St. Félicien, PQ
E.B. Eddy Forest Products - Espanola, ON
EPCOR Canada - Squamish, BC
Eurocan Pulp & Paper Company - Kitimat, BC
Fletcher Challenge - Crofton, BC
Fletcher Challenge - Mackenzie, BC
Fraser Papers Inc. - Edmundston, PQ
Fraser Papers, Inc. - Plaster Rock, NB
Harmac Pacific Inc. - Nanaimo, BC
Howe Sound Pulp & Paper - Port Mellon, BC
Irving Pulp & Paper Ltd. - Saint John, NB
Kimberly-Clark Forest Products, Inc. - Terrace Bay, ON
Kimberly-Clark Nova Scotia, Inc. - New Glasgow, NS
Kruger Wayagamack Inc. - Trois Rivières, PQ
Louisiana Pacific - Chetwynd, BC
MacMillan Bloedel Ltd. - Port Alberni, BC
Montenay Power - Burnaby, BC
Neucel Specialty Cellulose - Port Alice, BC
Northwood Pulp & Timber Ltd. - Prince George, BC
Repap Manitoba - The Pas, MB
Scott Maritimes Ltd. - New Glasgow, NS
Skeena Cellulose Inc. - Prince Rupert, BC
Spruce Falls Inc. - Kapuskasing, ON
Stone Consolidated Corp. - Fort Frances, ON
Stone Container Canada Inc. - New Richmond, PQ
Stone Container Canada Inc. - Portage du Fort, PQ
Tembec, Inc. - Chetwynd, BC
Tembec, Inc. - Temiscaming, PQ
Tolko Manitoba - The Pas, MB
Tolko/Riverside FP - Armstrong, BC
Veolia Waste-to-Energy - Burnaby, BC
Weldwood of Canada - Hinton, AB
Western Pulp Limited Partnership - Port Alice BC
Western Pulp Limited Partnership - Woodfibre, BC
Weyerhaeuser Canada Ltd. - Kamloops, BC
Weyerhaeuser Canada Ltd. - Price Albert, SK

PROJECT CAPABILITIES



PROJECTS OVERSEAS



Overseas Projects

Since our inception in 1976, JANSEN has completed a variety of projects overseas in Europe, South America, Asia, and the South Pacific. The type of project and scope of work included:

- Biomass Boiler Evaluations (see Capabilities C-02)
- Biomass Boiler Combustion System Upgrades (see Capabilities C-03)
- Recovery Boiler Performance and Engineering Evaluations (see Capabilities C-04)
- Recovery Boiler Capacity Upgrades (see Capabilities C-05)
- Computational Fluid Dynamics (CFD) Modeling (see Capabilities C-06)
- Boiler Circulation Studies (see Capabilities C-07)
- Ultrasonic Flow Monitoring (UFM) of Boiler Circulation (see Capabilities C-08)
- Superheater Corrosion Prevention (see Capabilities C-14)
- Sulfite (SSL) and Soda Liquor Recovery Boilers (see Capabilities C-17)
- Fluidized Bed Boilers Bubbling/Circulating (BFB/CFB) (see Capabilities C-18)
- Recovery Boiler Audits
- Recovery Boiler Operations Training Seminars

Selected References (see next page)

Selected References

APRIL Group - Rizhao, China
Asia Pulp & Paper - Perawang and Lontar, Indonesia
AssiDomän Sepap - Štetí, Czech Republic
Australian Paper Maryvale Mill - Morwell, Australia
Bahia Specialty Cellulose S.A. - Camaçari, BA, Brazil
BTG Slovensko (Chemes) - Hummene, Slovakia
Bukocel - Hencovce, Slovakia
Carter Holt Harvey Pulp & Paper Ltd. - Tokoroa, New Zealand
Champion Papel e Celulose Ltda. - Mogi Guaçu, S.P., Brazil
Cofely - GDF Suez - Saillat, France
Hyne Timber - Queensland, Australia (2 plants evaluated)
International Paper Company - Saillat, France
International Paper Company - Svetogorsk, Russia (2 units evaluated)
Mondi SCP - Ružomberok, Slovakia (2 units)
Portucel - Cacia, Portugal
Smurfit Cartón de Colombia - Cali, Colombia (2 units upgraded)
Smurfit Mocarpel - San Felipe, Venezuela
Tartas S.A. - Tartas, France
Tasman Pulp and Paper Co. Ltd - Kawerau, New Zealand
Thailand Biomass Boilers - Thailand
Visy Pulp and Paper - Tumut, Australia

PROJECT CAPABILITIES



BOILER MACT AND CISWI COMPLIANCE REVIEW AND IMPLEMENTATION



Approach in Addressing Boiler MACT and CISWI Compliance

Step 1 - Problem Definition

- a. Determine classification of facility and boiler(s).
- b. Establish emissions limits that pertain to the boiler(s) classification.
- c. Review current and historical emissions data relating to MACT and CISWI regulations.
- d. Provide recommendations to obtain missing information.
- e. Provide operational tuning of the unit.
- f. Identify boiler emissions that will require remediation.
- g. Provide potential solutions/options based on available information.

Step 2 - Solution Creation

- a. Determine feasibility of changing the boiler's classification to avoid or alleviate modifications required to meet MACT or CISWI.
- b. Further develop potential solutions/modifications needed to meet emissions limits.
- c. Identify the most cost effective solution ($\pm 30\%$ cost estimate).
- d. Assist customer in preparing submittal to permitting agency.

Step 3 - Solution Implementation

- a. Develop appropriations grade cost estimate ($\pm 10\%$), if necessary.
- b. If requested, implement the solution design/supply or design/supply/construct project.
Work with "teaming partners" to offer complete solution.

Selected References (see next page)

Selected References



Alabama River Cellulose LLC - Perdue Hill, AL
Avista Corporation - Kettle Falls, WA
Brunswick Cellulose, Inc. - Brunswick, GA
Evergreen Packaging - Canton, NC
Georgia-Pacific - Big Island, VA
Georgia-Pacific - Crossett, AR
Georgia-Pacific Wood Products LLC - Dudley, NC
Georgia-Pacific Wood Products LLC - Duluth, MN
Georgia-Pacific Wood Products LLC - Emporia, VA
Georgia-Pacific Wood Products LLC - Hawthorne, FL
Georgia-Pacific Wood Products LLC - Jarratt, VA
Georgia-Pacific Wood Products LLC - Roxboro, NC
Kimberly-Clark - Chester, PA (4 units)
Kimberly-Clark - Everett, WA (4 units)
Kimberly-Clark - Loudon, TN
Longview Fibre - Longview, WA
Louisiana-Pacific - Roaring River, NC
NewPage Corporation - Wisconsin Rapids, WI (2 units)
Packaging Corporation of America - Tomahawk, WI
Packaging Corporation of America - Valdosta, GA
Rayonier - Jesup, GA (3 units)
Smurfit-Stone Container Corp. - Fernandina Beach, FL
Weyerhaeuser - Oglethorpe, GA