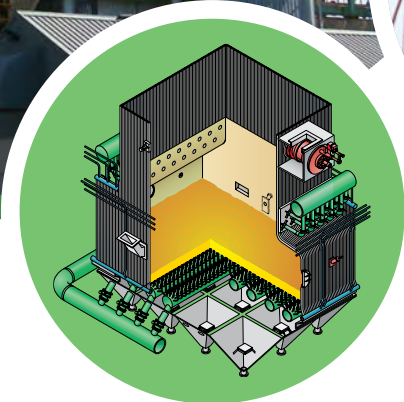


Bubbling Fluidized-Bed Boilers

Burning Biomass and Low-Cost Fuels

Clean, efficient, reliable and easy to operate





Since 1867, industries worldwide have benefited from The Babcock & Wilcox Company's (B&W) engineering expertise, manufacturing technology and operating experience as a major supplier of steam generating equipment. We continue this tradition as a leader in reliable steam generation with our bubbling fluidized-bed (BFB) boiler.

B&W's involvement with fluid-bed technology began in the 1950s with the first combustor at its state-of-the-art research center in Alliance, Ohio. Now, with an experience base of more than 30 BFB units, these facilities are helping the world realize the promise of clean energy from a wide variety of fuels.

Fuel Flexible

B&W's bubbling fluidized-bed boilers can burn a wide range of low-cost opportunity fuels.

The ability to utilize various fuel sources and types provides owners with the flexibility to take advantage of changing cost and availability.

B&W's BFB boiler is designed with a very large operating window to allow a wide range of fuels to be burned, separately or in combination.

This is necessary because fuel properties vary widely. For example, biomass fuels have a wide range of moisture and heating values depending upon their source and the time of year.

Our BFB boilers are designed with a high degree of flexibility to facilitate air movement between the bubbling bed and the overfire air system, to vary the gas recirculation volumes, and to adjust the fuel delivery to the bed. This operational flexibility allows owners to burn cheaper opportunity fuels and control fuel costs.

Viability fuels for a BFB:

- Wood waste
- Bark
- Paper mill sludge
- Recycled paper facility sludge
- Sewage sludge
- Tire-derived fuels (in combination)
- Oil
- Natural gas
- Coal (in combination)
- Peat
- Biomass
- Sugar cane waste
- Agricultural waste



Low Emissions

Significant environmental benefits are achieved with BFB technology.

NO_x

Due to the low temperature sub-stoichiometric combustion processes that occur in the bubbling bed, the generation of nitrogen oxides (NO_x) is inherently lower than that of a stoker-fired boiler.

Because of good carbon burnout, a selective catalytic reduction (SCR) system can cost-effectively be located before dust removal equipment to further reduce NO_x.

CO and VOCs

Due to the intimate contact between the bed material and the fuel, improved fuel burnout occurs. This results in very low carbon monoxide (CO) and volatile organic compound (VOC) emissions.

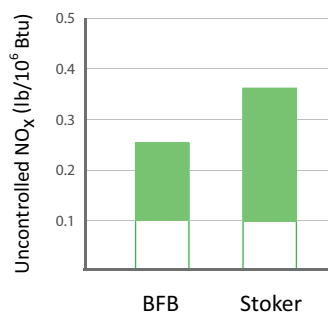
SO₂

The intimate contact between the fuel and bed material allows for in-bed capture of sulfur dioxide (SO₂). When burning biomass in combination with sulfur fuels, alkali normally present in the biomass will result in reduced SO₂. Limestone can also be added to the bed material for greater SO₂ capture.

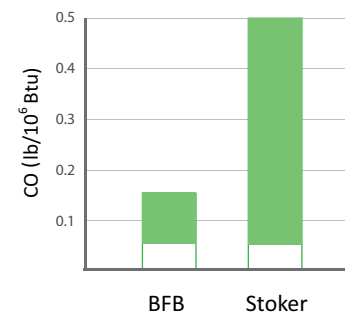
Particulate

Due to improved carbon burnout compared with a stoker boiler, the potential for fires in back-end environmental equipment is significantly reduced. This allows for the use of a baghouse to meet lower particulate requirements.

NO_x Comparison



CO Comparison



BFB boiler installations are proven to have lower NO_x, CO, VOC, SO₂, and particulate emissions than stoker-fired boilers with equivalent capacity.

Reliable

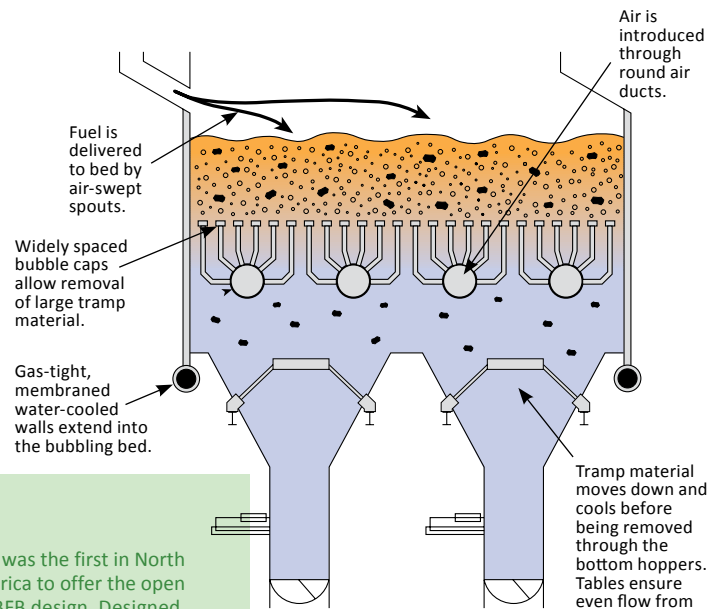
B&W's advantage

B&W's BFB boiler is designed with reliability in mind. Several features combine to provide low maintenance costs, high availability and long-term reliability:

- An open bottom design permits easy removal of oversized or foreign material.
- A water-cooled, gas-tight lower furnace eliminates the potential for gas leaks caused from refractory damage.
- Bottom-supported hoppers remove load from the boiler, reduce capital requirements, and reduce potential mechanical stresses between water-cooled and non-cooled components.

Incorporated in B&W PGG's design are these features to reduce maintenance costs:

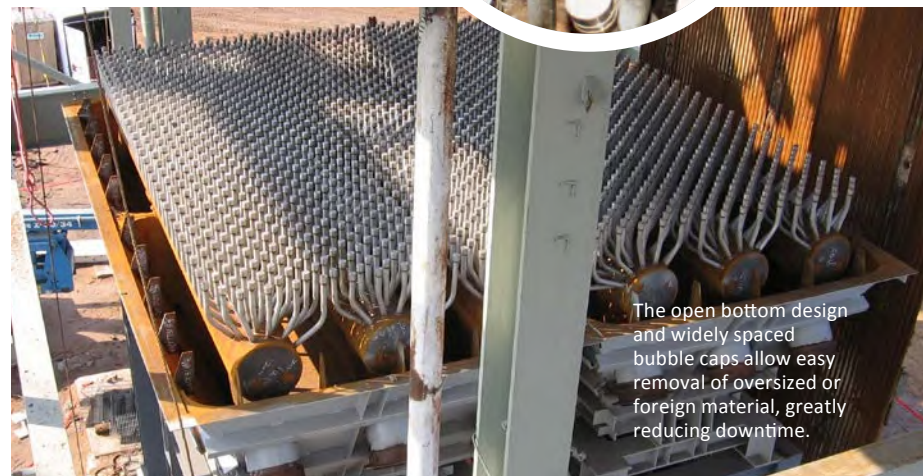
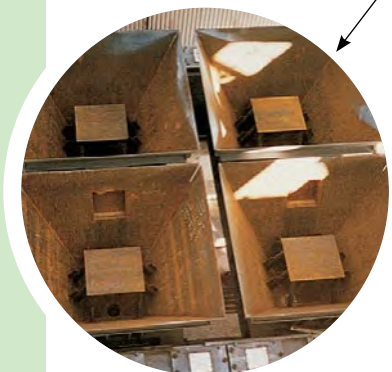
- No wear parts
- No moving parts
- No water-cooled screws or beams
- No cinder re-injection system
- Long-lasting bubble caps



B&W was the first in North America to offer the open bottom BFB design. Designed with no floor, the open bottom furnace results in complete debris removal with lower capital costs and maintenance expenses.

B&W's underbed ash removal system consists of bottom-supported hoppers which isolate the bubbling bed foundation and steel from the boiler steel. This design is considered an advantage, particularly when retrofitting an existing top-supported unit to a BFB.

B&W's bubble cap is durable and rarely requires replacement. In one installation, the original bubble caps are still in service 12 years after commissioning.



The open bottom design and widely spaced bubble caps allow easy removal of oversized or foreign material, greatly reducing downtime.

Easy to Operate



Advanced combustion controls automatically adjust to changes in operating conditions.

A B&W BFB boiler responds rapidly to sudden changes in fuel and steam demand. This feature is a critical requirement for easy operation of the steam generator.

Our advanced controls system automatically moves air from the bed to the overfire air system and modulates the volume of gas recirculation to adjust for changes in the fuel or sudden changes in steam demand.

The bubbling fluidized bed carries an inventory of hot bed material that will

rapidly convert the fuel's energy to steam. Automatically removing combustion air and fuel from the bubbling bed will accommodate rapid reductions in steam load.

The ability to adjust the throw distance of the fuel feed system allows fine tuning to accommodate variations in fuel moisture.

The B&W bubbling fluidized-bed boiler is the ideal biomass combustion system.



Efficient

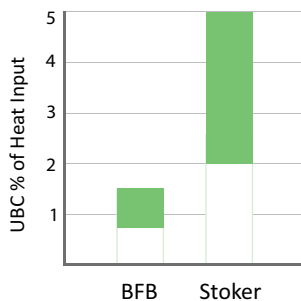
B&W's BFB boilers provide improved efficiency. Intimate contact between the bed materials in the fluidized bed and the fuel reduces the carbon remaining from incomplete combustion and greatly reduces the excess air required. This improved efficiency means lower fuel costs.



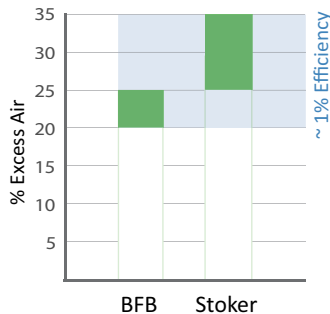
The thermal mass of the bubbling bed provides stability for fuel variations.

Lower fuel costs from better efficiency

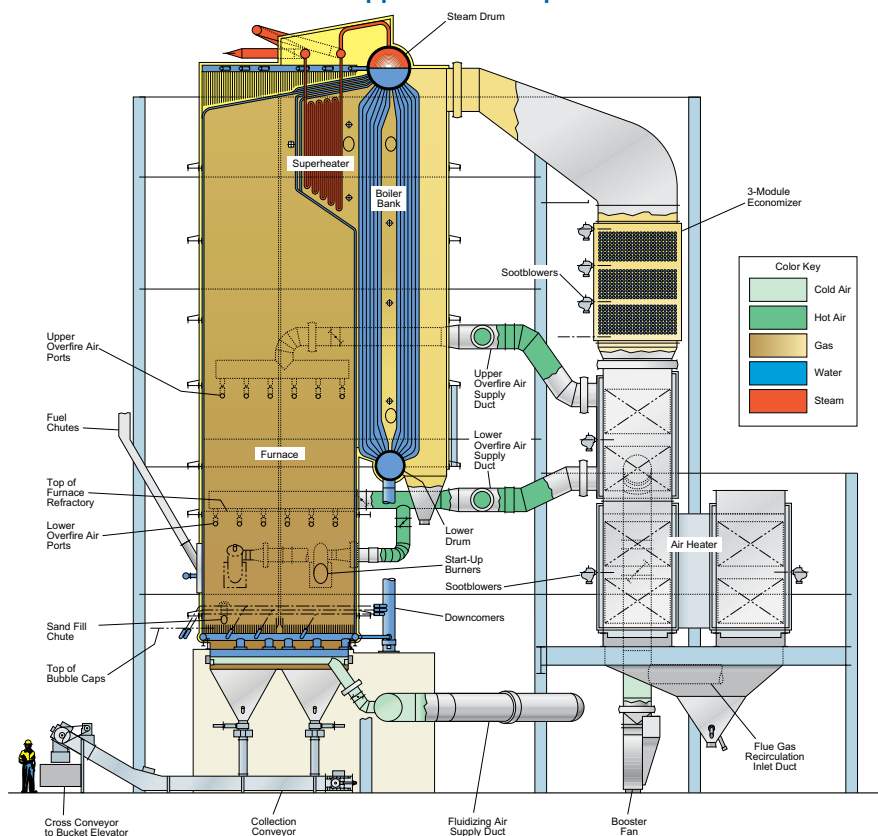
Efficiency improvement from improved carbon burnout



Efficiency improvement from lower O₂



B&W Bottom-Supported Towerpak® BFB Boiler



BFB boiler specifications for a variety of applications

Design features:

- Top- or bottom-supported
- One- or two-drum designs
- New or retrofit boiler applications
- Provides an option to reduce SO₂ and NO_x emissions
- Reduces paper mill sludge volume while producing steam
- Superior to other technologies for burning wet wood-based fuels – between approximately 2800 and 3500 Btu/lb HHV (6513 and 8141 kJ/kg) without support fuels

Capacity:

- Bottom-supported: up to 225,000 lb/h (28.4 kg/s)
- Top-supported: from 225,000 to 1,000,000 lb/h (28.4 to 126 kg/s)

Steam pressure:

To 2600 psig (17.9 MPa) throttle pressure

Superheater/reheater outlet temperatures:

As required, up to 1000F (538C)

Fuels:

Able to burn a wide range of conventional fuels and waste fuels with high moisture, including:

- Wood wastes and bark
- Paper mill sludges
- Recycled paper facility sludges
- Sewage sludge
- Tire-derived fuel, in combination
- Oil and natural gas
- Coal, in combination
- Peat
- Biomass
- Sugar cane waste
- Agricultural waste

Whether you're considering a new BFB boiler, or a conversion of your recovery, stoker-fired power or small utility boiler, fluidized-bed combustion offers significant operational advantages:

- Fuel flexibility
- High efficiency
- Low environmental emissions
- Reduced capital costs and operating expenses

Why B&W's fluidized-bed technology?

- The completely open bottom design has proven advantages
- Extensive research and development of fluid-bed combustion
- Operating experience with a wide range of unit sizes and high-moisture fuels

B&W offers quality and commitment to service

- Innovative design and technical expertise to increase production, optimize equipment and lower costs
- Capability, experience and track record to ensure your project will progress on schedule and reach performance targets
- A tradition of excellence since 1867

A comparison between BFB and stoker-fired technologies

	BFB	Stoker
Uses a baghouse and will meet particulate requirements	✓	
No furnace size limit	✓	
Lower NO _x emissions	✓	
Lower CO emissions	✓	
In-bed SO ₂ control	✓	
Higher efficiency from lower O ₂	✓	
Higher efficiency from low unburned carbon	✓	
Low potential for back-end fires caused by carryover	✓	
Stable steam generation with fuel variations	✓	
No moving parts	✓	
Burns high-moisture fuels and sludge	✓	
No cyclone dust collectors required	✓	
Small or no tubular air heater is ideal for recovery boiler retrofits	✓	
No submerged scraper conveyor	✓	
No high-maintenance cinder re-injection system	✓	
Can burn biomass and multiple fuels	✓	✓
Ability to remove oversized or foreign material in ash	✓	✓
No bed make-up material required	✓*	✓
Capital cost	✓	✓
Operating cost	✓	✓
High availability	✓	✓
High percentage coal		✓
High alkali fuels		✓
Refuse derived fuels		✓

*Not required on most BFBs

Established in 1867, Babcock & Wilcox is a global leader in advanced energy and environmental technologies and services for the power and industrial markets, with operations, subsidiaries and joint ventures worldwide.

For more information, or a complete listing of our sales and service offices, send an e-mail to info@babcock.com, or access our website at www.babcock.com.

www.babcock.com



From engineering and design through construction and startup, B&W provides total support for your BFB project.



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