FUEL FLEXIBILITY

Foster Wheeler has experience with a wide range of fuel applications and is a recognized world leader in he technology of firing difficult fuels. The firing of low cost refuse fuels is particularly interesting in light of the current emphasis on wood and waste fuels including chicken litter, rice walls, and other agricultural waste products. The use of by-product fuels also provides a solution to waste disposal problems.





OIL & GAS APPLICATIONS

Series SD Generators

Process Description

The SD style steam generators is designed to fire single or multiple liquid and gaseous fuels, including by-product fuels such as blast furnace gas. This steam generator has proven itself over the years, reliably meeting the rigorous demands of industrial steam producers. Prominent users of this equipment are utilities and petroleum, chemical, paper and metal industries. Numerous applications have been made for power generation in a wide range of sizes with capacities up to and in excess of 75 MW.

Design Features

1. Bottom supported in order to use the structural advantage of steel tubing and the added benefits of low unit stresses and reduced steel weight.
2. Front fired with a deep furnace and a prominent nose -producing a uniformly distributed gas flow over all convection surfaces.
3. Fuel flexibility -the proportioning of the furnace and the arrangement of the heating surface make it well suited to burning low heat value fuels such as blast furnace gas, coke oven gas, CO gas, as well as conventional gas and oil fuels.
4. Superheat Control -equipped with superheaters exposed to furnace radiation or located totally within the convective section of the boiler. If closer superheat control is necessary a spray type desuperheater is installed in the intermediate temperature zone to insure uniform mixing and rapid, complete evaporation of the injected water.
6. Furnace Division Wall -permits compact proportioning in the larger sizes. This economical design employs well-established principles long used by Foster Wheeler and proven in large central station boilers.

Series SD design parameters:

Continuous capacity To 1,000,000 lb./hr
Maximum drum operating pressure 1600 psig.
Maximum final steam temperature 960˚ F
Operation Pressurized.

SOLID FUEL APPLICATIONS

Stoker Fired Steam Generators for Wood, Coal and Solid Waste Fuels

Process Description

Foster Wheeler offers a complete line of SF style grate fired boilers (hydrograte or flat pinhole grate, watercooled of aircooled vibrating grates, a flat pinhole grate, and a continuos ash discharge travelling grate). designed specifically for use with coal and solid waste fuels, with steam capacities of 25,000 lb./hr and higher.

Design Features

1. Fuel flexibility - is achieved as the stoker is adaptable to a wide range of fuel characteristics and it is only slightly affected by changes in fuel moisture. Fibrous fuels, such as wood waste, municipal refuse, agricultural waste, bagasse and other cellulose materials, alone or in combination with coal, can be easily burned on stokers.
2. Superheat control - a wide range of pressure and temperature conditions. The radiant/convective type superheaters provides a wide range of find superheat with minimal use of spray water.
3. Ease of operation
4. Low maintanance cost
5. Low auxiliary power
6. Smaller sizes can be bottom supported
7. MONO-WALL® - welded-wall furnace construction with a natural circulation of water.
8. Minimal refractory - the higher capacity, field erected units include a baffleless boiler bank design that minimizes the possibility of tube erosion while maintaining good heat transfer.
9. Two drum baffleless boiler bank - or Single Drum Designs.
10. Modularized






Pulverized Coal Generators

Process Description

Foster Wheeler offers a SF style steam generator firing pulverized coal, coke and lignites. These units can also be readily adapted to fire oil and gas as well. Pulverized coal burners are placed at the proper elevation to ensure even gas distribution over all convective tubes and the effective use of furnace surface.

Design Features

1. Single pass baffleless design - that eliminates gas firing, local concentrations of dry ash, and high gas velocities that can cause tube erosion.
2. Generous furnace proportions
3. Top supported
4. Superheat control - a wide range of pressure and temperature conditions.
5. MONO-WALL® - welded-wall furnace construction with a natural circulation of water.
6. Minimal refractory - the higher capacity, field-erected units include a baffleless boiler bank design that minimizes the possibility of tube erosion while maintaining good heat transfer.
7. Two drum baffleless boiler bank - or Single Drum Designs.
8. Modularized

SOLID FUEL APPLICATIONS

Bubbling Fluidized Bed Generators

Process Description

Foster Wheeler pioneered the commercial use of fluidized bed technol-ogy in the 1940 s and has maintained its leadership in the field. Together with our licensees, we have designed, engineered and erected over 100 fluidized bed boilers.

Fluidized bed reactors have been used for decades in industry applications where thorough mixing and intimate gas/solids contact are needed for high efficiency. In the 1950's, fluidized beds were first applied to combustion and steam generation. In particular bubbling fluidized bed (BFB) boilers are well suited for biomass fuels such as wood waste, and pulp and paper mill sludge. Further, the BFB technology has been effectively applied as a boiler retrofit for older stoker boilers and recovery boilers.

In fluidized bed firing, fuel is burned in a bed of hot incombustible particles suspended in an upward-flowing gas stream. The state of fluidization is determined by the gas velocity and bed particle size. The bubbling fluid bed combustor (BFBC) is characterized by relatively low velocity and coarse bed particle size Combustion temperature in the bed is in the range of 1380˚F - 1740˚F, to avoid softening of the bed material and to limit emissions. The turbulence and residence time in the bed and combustor provided good fuel burnout at these relatively low temperatures. Air staging is used to control bed heat release and temperature, eliminating the need for in-bed tubes and the erosion problems associated with them. This air staging also reduces NOx emissions Start-up burners, firing natural gas, are mounted just above the bed for pre-heating of the bed material prior to introduction of solid fuel. Load carrying burners, if supplied are located in the upper portion of the combustor These burners can carry full load operation while firing gas and / or oil.

Designed to optimize the firing of any Fuel

Design Features

1. High combustion efficiency - efficiencies up to 99%
2. Low maintanance cost
3. Enhanced emissions control - SOx and NOx stack emissions are controlled in the combustion process, reducing the need for flue gas treatment system. Dry ash residue produced by the unit is much easier to dispose of than wet sludge. Additionally, combustion temperatures and air staging provide for low NOx emissions.
4. Fuel flexibility - high sulfur and high ash coal, washery tailings, delayed petroleum coke, low-grade lignite, oil shale, tar sands, waste gas, wood waste, municipal refuse, rice nulls and other waste materials can all be utilized. Fluidized bed combustion is more tolerant of variations in fuel charac-teristics than other combustion systems.
5. Water cooled bed drains - located at the bottom of the fluidized grid to control bed inventory and remove any oversized trash materials such as rocks.
6. Minimal refractory - the higher capacity, field-erected units include a baffleless boiler bank design that minimizes the possibility of tube erosion while maintaining good heat transfer.
7. Two drum baffleless boiler bank - of Single Drum Designs.
8. Minimal fouling of boiler surfaces - slag formation is reduced by operating the fluidized bed at 1400-16000˚F, which is below normal ash softening temperatures. Therefore, soot-blowing requirements are minimized.

SOLID FUEL APPLICATIONS

Municipal Solid Waste Steam Generators

Process Description

Throughout much of the world, there is increasing awareness of the advantages of utilizing municipal waste as a low cost fuel to produce a valuable product such as steam. Communities facing the dual dilemma of increasing quantities of waste material and severe restrictions at sites available for landfill can solve both problems and conserve energy with the municipal solid waste fired steam generator.

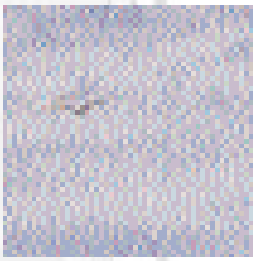
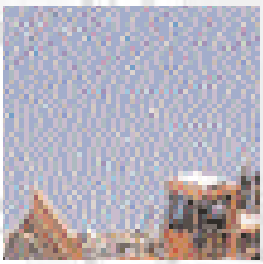
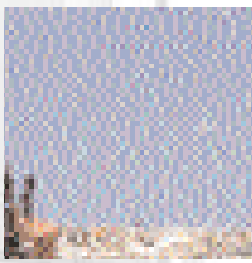
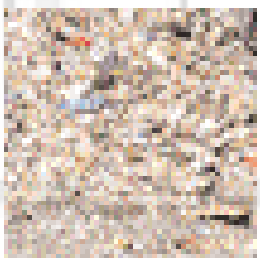
In selecting the company to design and supply a refuse to energy plant, it is important to choose a company with extensive experience in power plant engineering, power plant construction, combustion design and emissions control. This kind of experience is your best assurance of a long term, high quality solution to your solid waste problem.

An American pioneer in “refuse to energy plants”. Foster Wheeler is a pioneer in refuse to energy technology. We built the first waterwall mass-burning refuse boilers in the U.S. We built the boiler island for California’s first major resource recovery plant, in an area with some of the toughest air pollution laws in the country.

We’ve handled thousands of major projects in more than 127 countries. We’re also boiler island experts. The boiler island is the most critical part of the resource recovery plant. It burns the garbage, produces steam as energy and controls emissions. Foser Wheeler is a company with the technical and financial strength to guarantee the performance of your refuse to energy plant.

Design Features

1. Use of a rugged and proven stoker.
2. Completely water-cooled combustion chamber, therefore eliminating uncooled refractory walls and the associated large slag deposits.
3. Use of a dense studding pattern to secure a durable refractory material to the waterwall tubes, reducing maintenance costs.
4. Use of nickel alloys for overlaying the lower furnace and for tubes used in critical areas of the boiler.
5. Rappers are used to mechanically clean

the superheater by rapping the coils from the side with a series of tumbling hammers.
6. Low gas velocities and high corrosion allowances.
7. Vertical or Horizontal Designs
- The units can be configured vertically or horizontally to fit the space available to a client's facility.

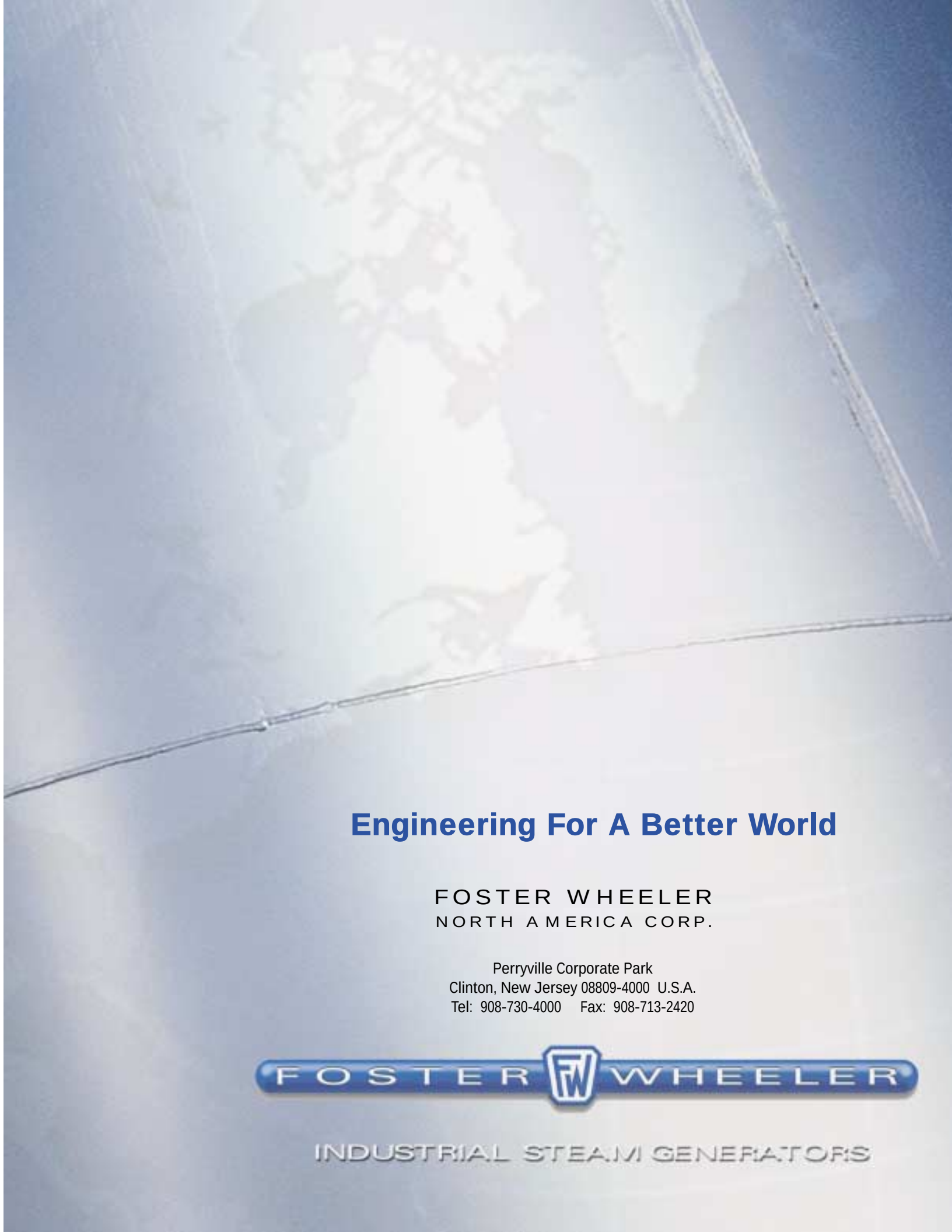
Foster Wheeler completed its first municipal waste fired steam generator in 1965 and offers all the experience necessary to produce reliable and efficient municipal waste burning units.

Advantages

Recovery of process heat for transformation and further use archives objectives of fuel economy and improved environ-mental hygiene dramatic savings are possible

Foster Wheeler has world-wide experience in this specialized field. Primarily, such systems cool hot gases and the heat removed is subsequently employed as additional energy In certain cases recovery of heat may be a secondary benefit to be derived from a requirement to cool exhaust gases prior to further process use or release to the atmosphere.

Waste Heat Recovery can be used to produce saturated or superheated steam, or to heat water, air, gas, glycol, oil or other fluids, and Foster Wheeler experience embraces. The petrochemical, utilities, gas processing, steel, copper, cement and pulp and paper industries.



Engineering For A Better World

FOSTER WHEELER
NORTH AMERICA CORP.

Perryville Corporate Park
Clinton, New Jersey 08809-4000 U.S.A.
Tel: 908-730-4000 Fax: 908-713-2420

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INDUSTRIAL STEAM GENERATORS