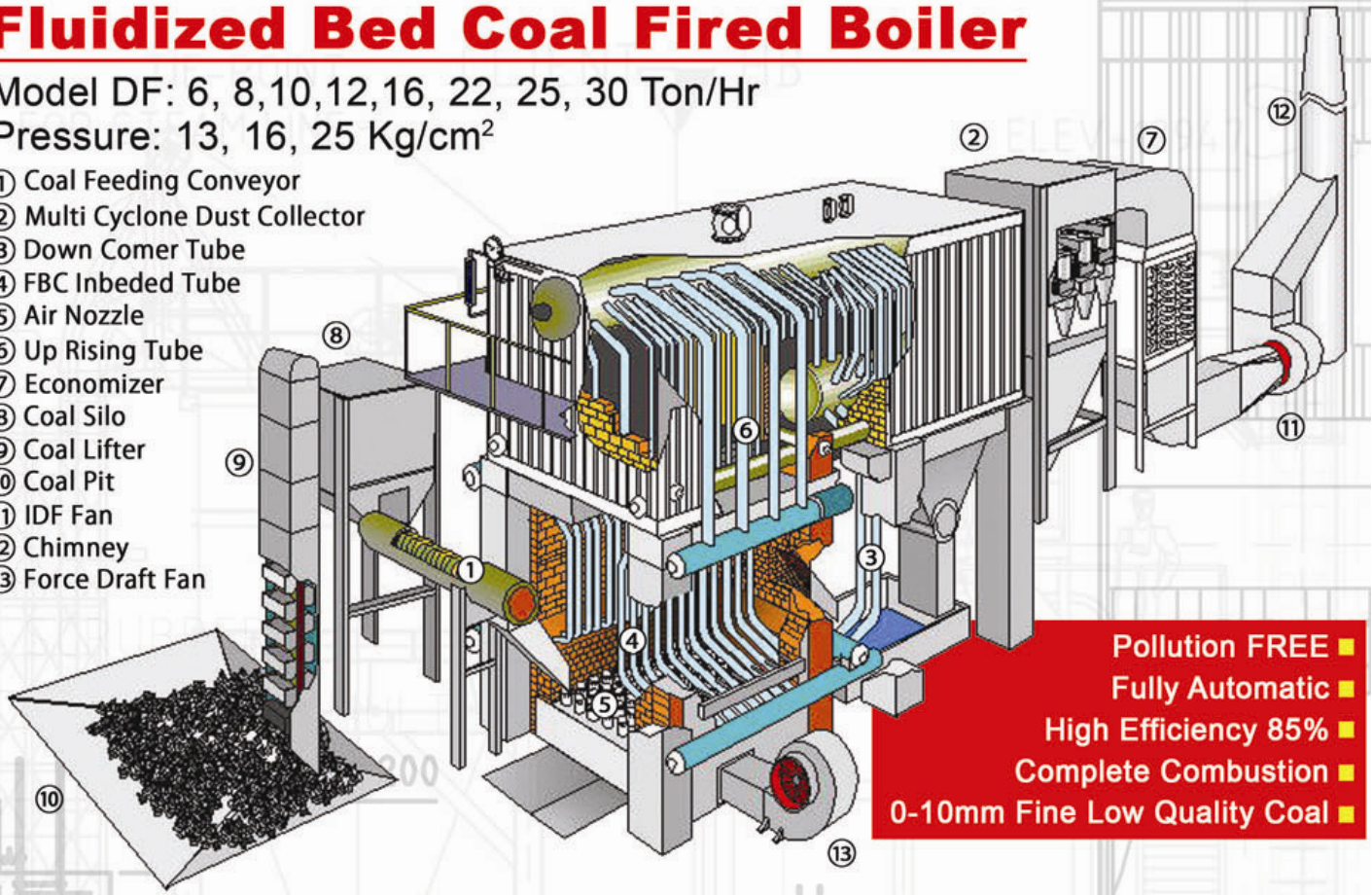
Fluidized Bed Coal Fired Boiler

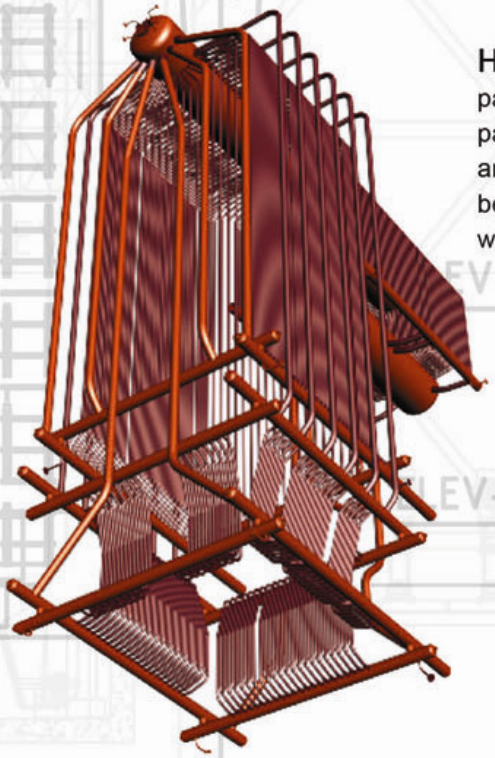
Model DF: 6, 8,10,12,16, 22, 25, 30 Ton/Hr
Pressure: 13, 16, 25 Kg/cm^2

① Coal Feeding Conveyor
② Multi Cyclone Dust Collector
③ Down Comer Tube
④ FBC Inbeded Tube
⑤ Air Nozzle
⑥ Up Rising Tube
⑦ Economizer
⑧ Coal Silo
⑨ Coal Lifter
⑩ Coal Pit
⑪ IDF Fan
⑫ Chimney
⑬ Force Draft Fan



- Pollution FREE
- Fully Automatic
- High Efficiency 85%
- Complete Combustion
- 0-10mm Fine Low Quality Coal

There are several methods adopted for firing solid fuels such as COAL, Palm Shell, Anthracite, chipped wood, Paddy Husks, Coconut Shell, Bagasse, etc. The fuel could be fired on Chain Stoker, Traveling Grate, Reciprocating Grate, Dumping Grate, etc. But today's cutting edge technology is the "FLUIDIZED BED COMBUSTION". This phenomenon of fluidized bed has been used in chemical engineering for half a century, but it has been used for combustion of solid fuel in only about three decades old. Solid particles could be moved by fast stream of air. The movement depends upon the velocity of air in the medium. If the velocity is too slow, air will percolate through the bed solids. On the other hand, if the velocity is too strong, the solids will be pneumatically transported. If the velocity of the air stream passing through the bed is gradually increased, a point is reached where individual particles are forced upwards with the rising bubbles. As the bubbles comes out of the bed and burst, these particles are returned back to the bed causing rapid mixing of particles. The surface is no longer defined and the bed in this state is called bubbling bed or 'FLUIDIZED BED".



HOW IT OPERATES: When air is passed through an inert bed of solid particles such as silica sand, the air will seek a path of least resistance and pass upward through the sand. With increase in velocity, the air starts bubbling and the particles attain a state of high turbulence. Under such condition, the bed assumed the appearance of fluid and exhibits the properties associated with fluid, hence the name 'FLUIDIZED BED".

FBC Air Distributor & Circulating Sand Bed system

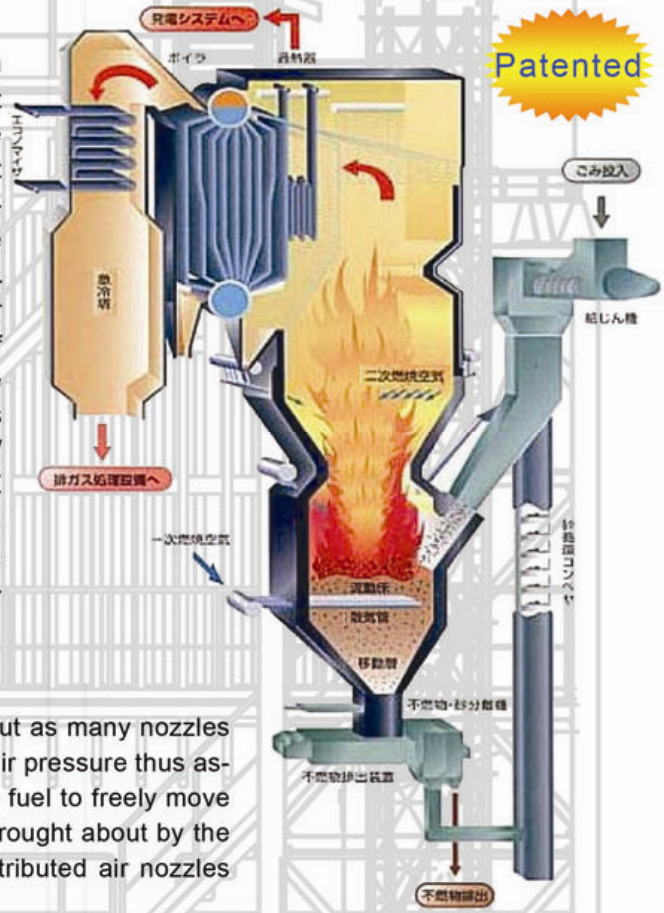

FBC Nozzle and Cooling Tubes Arrangement

FBC COOLING TUBES

The main function of FBC tubes is to regulate and / or maintain the bed temperature so as not to reach the adiabatic temperature. Another function is to generate more steam because it has 5 - 6 times better co-efficient of heat transfer, thus enable to maintain the temperature of combustion zone below 1000 °C which is below the ash coagulation / melting point of most of the biomass and fossil fuels. About 40% of steam generation emanates from the FBC tubes, which was installed on both side of the furnace and directly in the line of fire. It has protective fins to prevent from abrasion due to constant movement of the sand surrounding the furnace sand bed.

CIRCULATING SAND BED CLEANER:

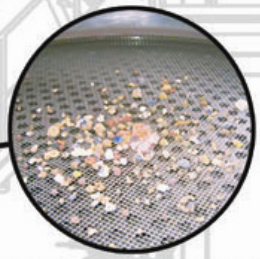
This system was primarily designed in order to burn fossil fuels with lots of inherent impurities like soil, sand stone, etc., which could not be burned. With its system, the impurities can be removed from the furnace WITHOUT SHUTTING DOWN THE BOILER and thus, it could be operated ON-LINE. When the sand bed have already substantial amount of impurities on it, it can be noticed from the furnace pressure indicator from the control panel. It has a HIGH, NORMAL and LOW level. When the indicator shows HIGH level, the operator will open the shutter below the sand belly and the sand with lots of impurities was drained to the oscillating sand screen cleaner where the impurities goes down to the dirt bin, while the clean sand goes back again to the furnace by means of a pneumatic conveyor / blower. This could be done WITHOUT SHUTTING DOWN THE BOILER. It only takes about 10 - 15 minutes every cleaning time, and the sequence depends on the purity and/or dirtiness of the coal. Based on experience, 2 - 3 times cleaning of the sand has been observed every 24 hours of operation.

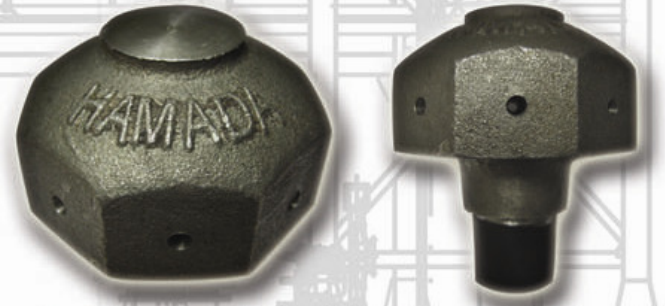


FURNACE AIR DISTRIBUTION AND NOZZLE:

The air distribution design is of zig-zag configuration allowing to put as many nozzles as possible. In doing so, the sand bed has an even distribution of air pressure thus assuring uniform sand movement through the bed. It also assure the fuel to freely move from one place to another due to constant turbulence of the bed brought about by the rapid pulsation of the sand velocity from multiple and evenly distributed air nozzles throughout the furnace bed area.


Silica Sand Screen Cleaner


Foreign particles inherent in the coal could be removed efficiently by the sand screen cleaner



Carbonized Cast Steel High Pressure Nozzle

FBC NOZZLE: The FBC nozzle are made from Carbonized Cast Steel designed for power plant boilers and can withstand temperature up to 1300 °C and designed to last for 3 years. It is located about 400 mm below the sand bed where the temperature is only 600 °C. Replacing the nozzle is so easy because it has a thread for easy removal and replacement.

Conveyor Sytem


Single Bucket Coal Lifter

There are several methods of fuel handling and conveying system that we use. First is the simple bucket lifter. It consists of a 300 - 400 Kg single bucket per lift, driven by a motorized cable winch with gearbox. It also consists of a vertical rail and guide. It is the most practical conveying system though looks quite primitive. But the most important in any operation is its sturdy design, simple of operation, less maintenance and practically trouble-free. Its significance is very noticeable on rainy season where coals are generally wet and sticky.

RUBBER BOX CONVEYOR:

It is designed for bigger boiler capacities (22 - 30 tph) and could be installed up to 70 degrees inclination with low speed movement. It is made from vulcanized rubber with flexible sidings. It continuously rotates with evenly distributed load and driven by a motorized gearbox.

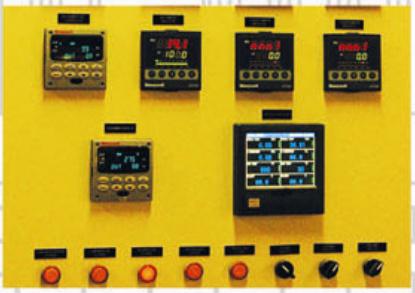

Rubber Box Conveyor

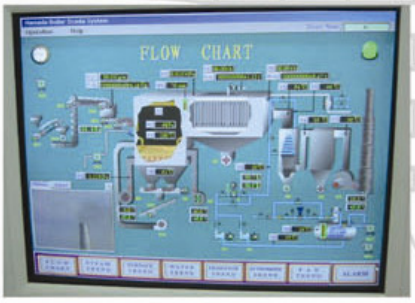
Control

The control system consists of two main components: the Main Control Panel and the Power Box. The main control panel consists of UDC controllers, inverters, gauges, switches etc. While the Power Box are mainly contractors, circuit breakers, overload relays, voltage and ampere meters, etc. It controls and manages the operation of the boiler on an automatic or semi-automatic operation. Standard supply is the individual UDC controller set-up (bottom center). It individually controls the functions of ID fan, FD fan, secondary FD fan, feed water pumps, etc. We also provide our control system with PLC with SCADA (bottom right).

PLC with SCADA


UDC Controller Set-Up





Fuel

Only Fluidized Bed can Mix Various Biomas Fuel

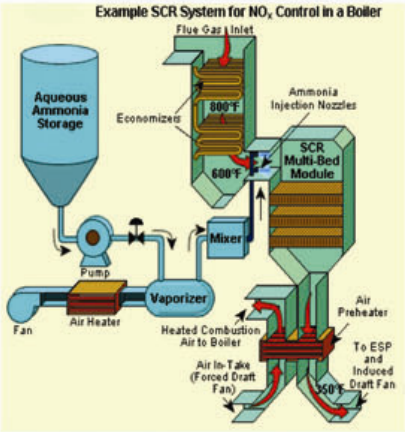
Coal | Corn Cob | Coconut Shell | Rice Husk | Bamboo | Palm Kernel
Wood Chip | Wood Bark | RDF/RPF | Pulper Reject (Cleaner Reject) | Rag
Rope | Screen Reject | Sludge Cake | City Waste | Water Treatment Waste

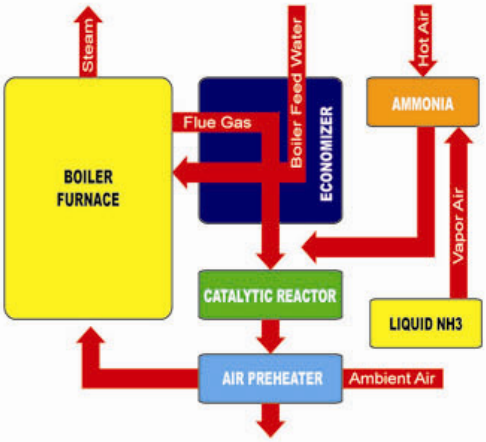
Environment

NOx Solution (How to reduce NOx)

Combustion Modifications:

Reducing the flame temperature at the peak combustion area will mean reduction of NOx formation. This is the most effective method to control NOx and Fluidized Bed Combustion which maintains low temperature (850 - 950 °C) combustion area is proven to be the best method to combat NOx problem.





Flue gas treatment:

Flue gas treatment to remove NOx is useful in cases in which higher removal efficiencies are required that could not be achieved with combustion control. Selective Catalytic Reduction (SCR) is the most advanced and effective method for reducing NOx emmissions. In selective catalytic reduction, the NOx species are reduced by NH3, ultimately to N2 gas. The predominant reactions are Ammonia being vaporized and injected down steam from the boiler feed water preheater as shown in the illustration at right.

$$4NO + 4NH_3 + O_2 \text{ -- } 4N_2 + 6H_2O$$
$$2NO_2 + 4NH_3 + O_2 \text{ -- } 3N_2 + 6H_2O$$

SOx Solution

Option I : Desulfurization at FBC furnace By injection of CaCO3

$$CaCO3 \Rightarrow CaO + CO_2$$
$$2CaO + 2SO_2 + O_2 \Rightarrow 2CaSO_4$$

CaCO3 Needed to inject into FBC bed

$$Bs = \frac{Bj \times Sy \times K}{CaCO3 \times N} x100 = 86.8Kg/Hr$$

CaCO3 consumption (Bs)
Coal Consumption (Bj) = 1000Kg/Hr
Sulfur Content (Sy) = 1%
Ratio (K) = 2.5
Calcium Carbonate (CaCo3) = 32
Efficiency (N)= 90%

Option II : Desulfurization at the Venturi Scrubber by mixing NaOH

Na Solution

$$2NaOH + SO_2 = Na_2SO_3 + H_2O$$
$$Na_2SO_3 + SO_2 + H_2O = 2NaHSO_3$$
$$2NaHSO_3 + O_2 = 2Na_2SO_4$$

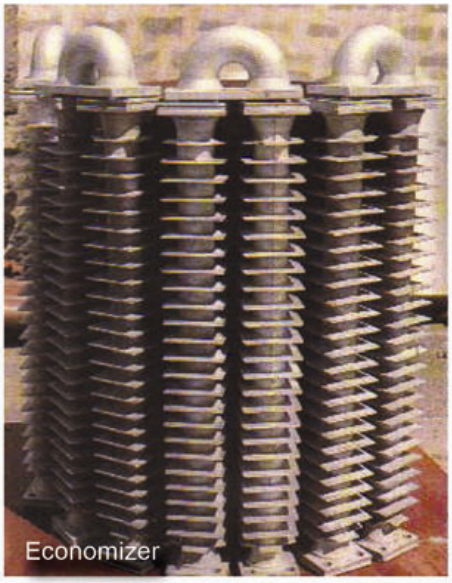
For DF Series, most of the case, we use Multi Cyclone and Venturi Wet Scrubber only, without employment of expensive DeSOx tower. Specially if you use Indonesian coal of below 1% sulfur content, SO2 level is lower than the government set value. You have two (2) options to remove SO2 according to the content. First OPTION is to inject CaCO3 into the Furnace. Second OPTION is NaOH solution to be injected to the Venturi Water Scrubber for reaction as indicated in this paper. In anyway, FBC boiler does not require expensive DeSOx tower at the exhaust gas area. This is a remarkable advantage of FBC system.

Emission Regulation - ASIA & U.S.A

PARAMETERS	UNIT	INDONESIA		PHILIPPINES	TAIWAN	VIETNAM	THAILAND	CHINA	U.S.A.
		BOILER	P-PLANT						
Particulate Emmission	mg/M3	230	150	150	50	200	320	80	50
Sulphur Dioxide (SO2)	mg/M3	750	750	500	200	1000	400	400	250
Nitrogen Oxide (NO2)	mg/M3	825	850	1000	210	500	700	260	250
Opacity	%	20	20	20	18	20	20	18	18
CO	PPM	-	-	500	100	500	690	150	400
HCL	mg/M3	5	-	-	-	200	75	75	-
HG	mg/M3	-	-	-	-	0.5	0.2	-	-

Environmental Equipment


Ash Storage Silo


Economizer


Multicyclone


Ash Disposal Truck


Cast Iron Mini Clone


Settling Pool


concrete scrubber tower


Venturi scrubber

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