

Hi-Low bed ICFB

BEST SELECTION FOR BIOMASS AND LOW CALORIE COAL

Merits of High-low Internal Circulating Fluidized Bed (ICFB):

Burning biomass with ICFB has the following key advantages:

1. By using the heating surface of dense zone, it is easy to control the temperature of dense zone in a range of 700-800 oC which will resolve the coking problem of the bed fuel.
2. Controlling the furnace temperature in a range of 750-800 oC by adopting large furnace section, much bigger than the normal CFBC.
3. Large furnace section, low gas velocity will result less consumption of bed materials. For normal 75t/h CFB, the amount of bed material sand should be compensated about 2 ton per hour, while ICFB fluidized bed only needs about 30kg per hour. (Silica sand)
4. The pressure head of air blower is lower than normal CFB, so its power consumption is much less. The separator will be installed in the system, however, with this low factor circulating, the separator resistance is far below than normal CFB. This will reduce the resistance of boiler proper and reduce the power consumption of IDF.
5. ICFB will have less ash built up in the furnace which will lower the corrosion factor which means longer lifespan of boiler and less maintenance workmanship.
6. Air is supplied ICFB with grade controller. This will control the discharge of NOx.

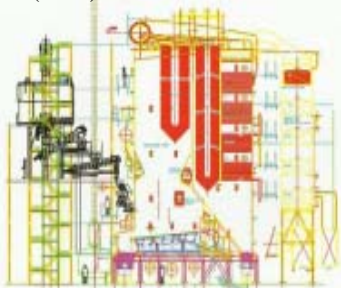
Various type of Biomass Boiler

Kind of combustion:

1. Stationary Fixed Grate
2. Water-cooled vibrating grate
3. Combined Chain grate

Fluidized bed:

1. Bubbling Fluidized bed (BFB)
2. Normal Fluidized bed (CFB)
3. High-low internal circulating fluidized bed (ICFB)



Watercooled Vibrating Grate System



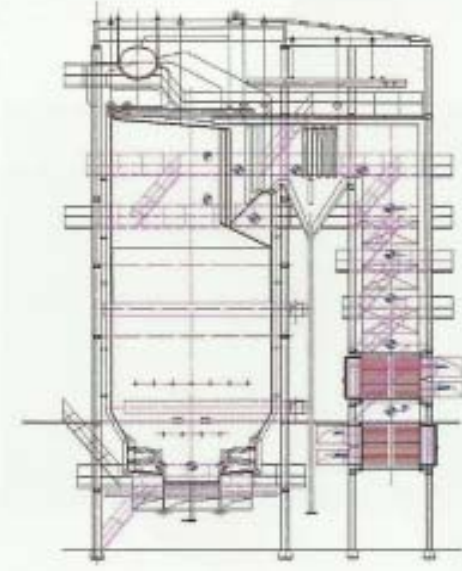
Combined Chain Grate System



Stationary Fixed Grate System



Circulating Fluidized Bed (CFB)



Internal Circulating Fluidized Bed (ICFB)

Adopting the technology of ICFB.

Its main point is to change the single fluidized bed of normal FBC by using multi-layer bed and the so called differential velocity fluidized bed structure with different fluidized air velocity. Comparing with FBC boiler of single fluidized bed, it has characteristics as follows:

1. Fuels can be separated by different grain sizes, the coarse particles are concentrated on the lower layer of main bed, and fine particles are on upper layer of auxiliary bed. Since the separated average grain size of fuels on auxiliary bed is smaller than the main bed, the fluidized air velocity of auxiliary bed is 1-1.5 times lower than main bed's. Fine fuels and low fluidized air velocity can significantly reduce the wear of heating surface of submerged pipe (the pipe lifespan can increase to 30,000 hours from the general 5,000 hours), which solves the problem of safe reliability of CFB boiler.
2. Internal circulation of fuels that formed by different fluidized air velocity between high and low bed which strengthens the horizontal intense mix of the fuels extends the staying time of fuels and desulfurizing agent in the bed this enhances the combustion efficiency and desulfurizing rate of boiler. This technology is especially suitable for burning mixed fuel.

3. ICFB boiler will have better load regulating performance with multi-layer bed structure. Particularly, it has improved the phenomenon of coking and lowers the surplus in the flow gas. With this technology, the boiler can also operate economically and reliably under load of about 30%
4. Since fuels are mainly fed to the main bed and the air volume is blown into the main and auxiliary bed respectively, the formed NOx is highly reduced.
5. With the function of different air velocity for main and auxiliary bed, we can realize a kind of convenient combustion with mixing coal and biomass which are different in density. ICFB boiler can burn fuel in the main and auxiliary bed respectively which is different from normal CFB boiler.

Four Important Elements that Affect Deposit

K (Na)

Oxide, chloride and sulfate are formed by the vaporization and decomposition of potassium (K). All these compounds have low fusion points. When the K and its compound congealed on the flying ash particles, the surface of flying ash particle will contains K. Thus, the particles will be stickier and have low fusion point.

Cl

Cl has a kind of transmission function during the biomass combustion. This will help the alkali metal elements move to the particle surface from the inner part of fuel particle to have chemical reaction with other substances. At the same time, it will facilitate the vaporization of alkali metal elements.

S

After vaporization, S has chemical reaction with alkali metal of gaseous phase and generates alkali metal sulphide. Moreover, they congeal with each other on the ash particles or deposit of water wall to form a white thin layer for facilitating the gathering and bond of deposit.

Ca

When biomass is rich in K, Ca and S, the soot deposit and slag-bonding will be serious. The clinking in fluidized bed mainly occurs during the sulphating process of CaO and among the particles of CaSO4. Fusion phase appears obviously among the clinking particles. CaSO4 is regarded as binding agent of ash particles on the surface of superheater tube, which can make the soot deposit and slag-bonding more serious.

Characteristics of biomass fuel

Physical and Chemical characteristics of Biomass:

1. Low ash content.

The ash content of wooden raw materials is extremely low, which is only 1-3%. While the straw is higher, which is 5-10%.

2. Looseness of texture, low density.

The nature bulk density of biomass fuel is generally around 50-200kg/m3.

3. Alkalis metal content, such as K and Na is high. Meanwhile, it contents certain amount of Cl-. Therefore, the ash melting point is low and it is corrosive.

	Maize	Wheat	Cotton	Branches of fruit tree
K(%)	13.88	25.25	31.78	13.23
Na(%)	2.3	2.35	5.78	1.01

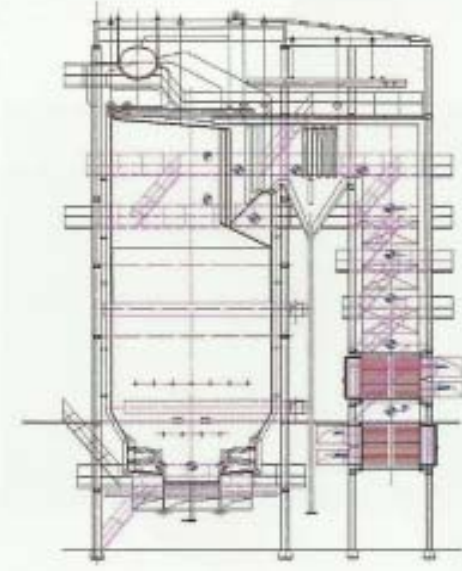
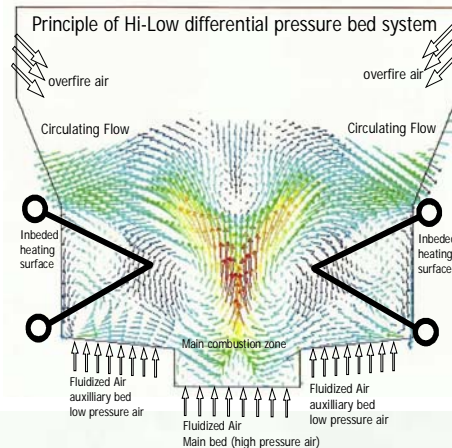
4. Low Sulfur content, generally less than 0.3%.

5. High volatile. Volatile of dry ash-free basis is generally more than 60%.

Merits of ICFB in terms of biomass fuels:

ICFB can resolve the existing problem of biomass fuels combustion. The following table is a comparison for the type and performance between ICFB and CFB:

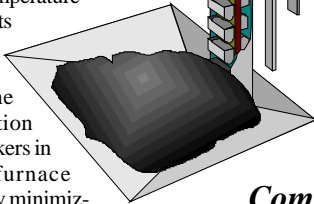
No.		Grate Furnace	ICFB	CFB
1	Fuel Pretreatment	Simple Treatment (Hard straw <100)	Pre-crushing is required (<100mm)	Pre-crushing is required (<100mm)
2	Yellow Straw	Suitable	Suitable	Unsuitable
3	Fuel with high moisture	Unsuitable	Suitable	Suitable
4	Boiler electricity rate	Low	Low	High
5	Continuous and stable operating time	Long	Long	Short
6	Regulating Load	Common	30-110%	30-110%
7	Investment	High	Low	Quite high
8	Cost of overhaul	High	Low	High
9	Emission of Nos.	High	Low	Low



COAL-FIRED BOILER

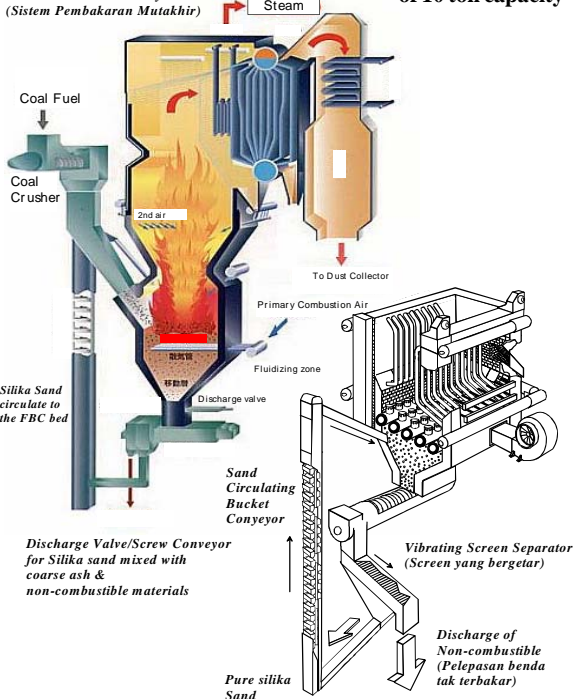
Fluidized Bed Combustion (FBC) technology has seen rapid expansion in the last 10 years and now represents a significant sector of the market for coal fired boilers. Reasons for this success include low acid gas emissions and greatly enhanced fuel flexibility. Principles of Fluidized Beds are when solid particles can be moved by a fast stream of air or other gas, for example when pressurized air or other gas is admitted below a column of solid particles the particles are lifted and separated by the passage of the gas until, as the rate of gas flow is increased, they behave as a liquid with vigorous movement and mixing. Compare to conventional boiler design, FBC boiler allows fuel to stay longer in the combustion chamber thus providing sufficient time to have enough contact with air. Also, due to the in-bed turbulence and the scouring action of the bed materials on the heat transfer surface, the fireside heat transfer coefficient can be about 3 times

than that of boilers using conventional firing system. Its combustion efficiency is such that it can burn virtually every last scrap of energy in the fuel. The very low content of unburned carbon in the disposed ash further attests to its high combustion efficiency as high as 99%. The temperature in the FBC area is kept below the ash melting point at 850 - 950 oC. This low combustion temperature prevents fusion of ash and the formation of clinkers in the furnace thereby minimizing the bad effects of fouling and erosion of heat surface. This is especially important for fuels with very high ash content like low-grade coal and low ash fusion point.



Hamada Fluidized Bed Combustion Circulating Sand Bed

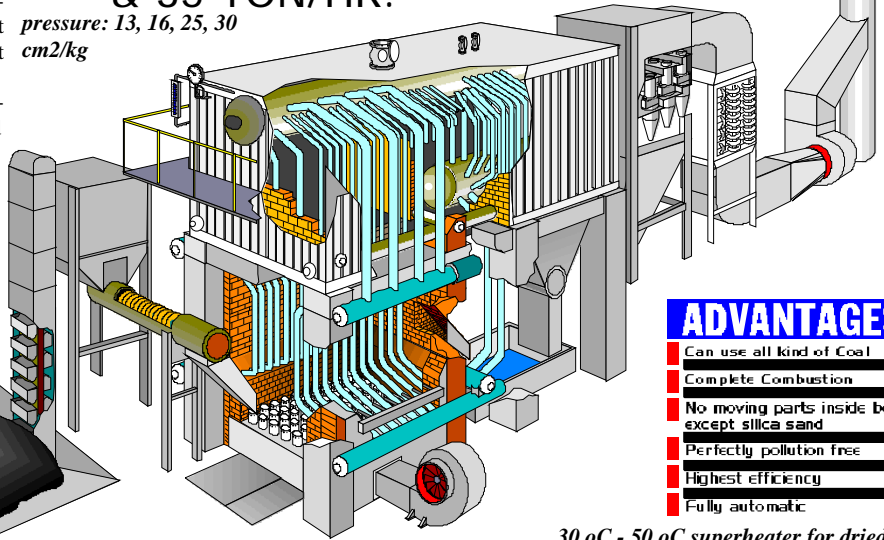
Advanced Combustion System (Sistem Pembakaran Mutakhir)



Right picture Suspension Firing of rice husk of 10 ton capacity

DF MODEL For process steam below 25 bar 6, 8, 10, 12, 16, 22, 25, 30 & 35 TON/HR.

pressure: 13, 16, 25, 30 cm2/kg



ADVANTAGES

- Can use all kind of Coal
- Complete Combustion
- No moving parts inside boiler except silica sand
- Perfectly pollution free
- Highest efficiency
- Fully automatic

30 oC - 50 oC superheater for dried steam by option

Compact Fluidized Bed System

Rice Husk Boiler

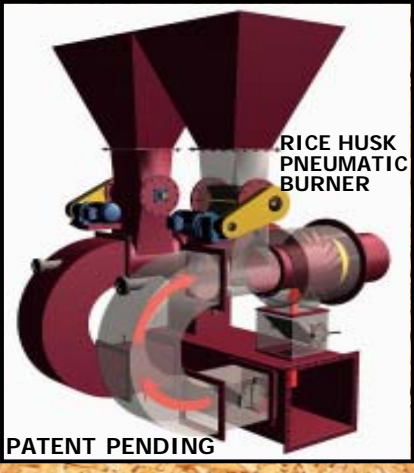
HOCHIMIN CITY/VIETNAM: Cai Lan Oils & Fats Industries Company Ltd of Malaysia has several vegetable oil refineries in Vietnam. Hamada Boiler made its remarkable success to install first in the history, 100% rice husk firing boiler. What is remarkable is in the design of combustion system, that uses specially designed rice husk burner to spray the rice husk into the furnace of about 800 oC and almost 80% of rice husk burns in the air in suspension, then the rest of 20% will fall onto the heavy duty chain stoker running slowly at the bottom of the furnace. This is a very unique system of rice husk combustion without necessity to make briquet of rice husk like in the picture. For Chain stoker system if burner is not used shall have to use briquetted rice husk. In Vietnam, rice husk will cost about Dong 500 per KG (price delivered by boat along the river bank if your factory has access to the river) that is about US\$0.0277 per KG (\$27 per ton). But this price is a raw rice husk without compressed or made into briquet. If compressed, cost will become almost double although transport cost will be reduced.



SUSPENSION FIRING



10 ton/H capacity (Near Hochimin City)



RICE HUSK PNEUMATIC BURNER

PATENT PENDING

Top and 2nd largest papermill in Taiwan are using Hamada FBC Coal Boiler

TAIPEI: Taiwan has almost 36 Boiler Manufacturing companies locally. But no one until now manufactures fluidized bed boiler. Due to the Taiwan government strict control on environment which set the limit of NOx as low as Japan level, chain grate boiler can not meet the requirement any more. This is the main reason that the top and 2nd largest papermill of Taiwan selected Hamada FBC Boiler. FBC boiler can easily pass the government rule on NOx because of low combustion temperature. Cheng Loong Paper Mill (Zhupei Factory and Tayuan Factory) and Yong Fong Yi (YFY-Yangmei Factory, YFY-Chingsui factory, and Union paper-Douryu factory) are using Hamada Boilers.

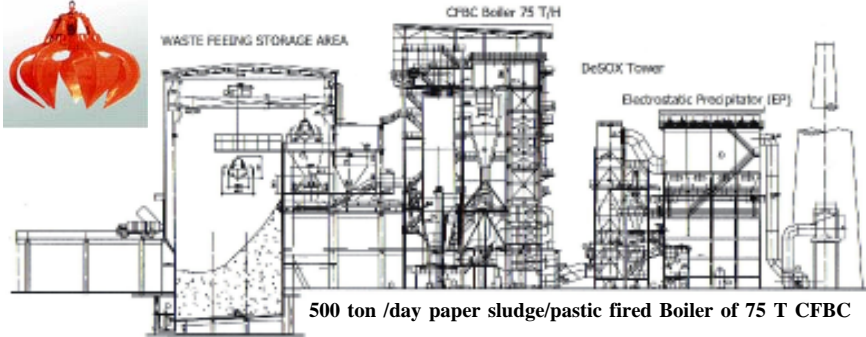
Hamada Boiler in Bangladesh Energy Independence from now and beyond

Dhaka: Hamada Boiler, which is known to be the Fluidized Bed Boiler Specialist, has set its eyes into supporting the Bangladesh in its quest for energy independence. The opening of its Bangladesh operation is in response to the Bangladesh Government request, as stated in the Bangladesh Energy Plan 2012 Update, which called for the development of the country indigenous energy resources and promotion of clean technologies to sustain efficient energy supply and demand chains that will eventually lead to increase self-reliance and provide the much-needed boost to the country's economic front. The more than 70% savings on energy/power cost from the use of coal, as opposed to the traditional

energy/power sources, is expected to trigger an exodus of factories and small power plants shifting to coal in no time. Such trend is predicted to persist and stay over the long run as the price of oil is expected to continually increase in the world market and as gas and power shortages, as well, is expected to perennially negatively impact the domestic affairs. With Hamada Boiler's state-of-the-art Coal-Fired Fluidized Bed Boiler Technology using locally produced high-grade coal, the Bangladesh Government's goal of 60 percent self-sufficiency level in 2020 will definitely be within reach-permanently changing the energy/power landscape of Bangladesh from now on and beyond.

PAPER SLUDGE/PLASTIC WASTE FIRING CFBC BOILER

We have successfully installed boiler using paper sludge/plastic waste 500 ton a day at Tianjin City of China in 2008. This papermill has 500 tons of waste materials from their process. 200 ton of paper sludge with almost 74% water content, and 300 tons of waste plastic of mixture of screen reject, pulper reject and rag rope which has a content of steel wired that must be removed first and water content is about 59%. In order to reach required heating value and water average water content, coal of about 154 ton/day is mixed to have the average water content of 51.36%. With this water content, heating value will become 2,113 Kcal/Kg.



500 ton /day paper sludge/pastic fired Boiler of 75 T CFBC



Plastic Sludge/Waste + coal firing CFBC boiler

	COAL	PAPER SLUDGE	PLASTIC WASTE	AVERAGE
ANALYSIS	99.97	99.8	99.75	99.82
Car (C)	58.15	7.49	25.62	27.76
Har (H)	3.94	1	2.28	2.28
Oar (O)	4.87	8.89	10.52	8.69
Nar (N)	0.71	0.35	0.6	0.55
Sar (S)	0.64	0.18	0.15	0.27
Mar (H ₂ O)	7.2	74	59	51.36
Aar (Ash)	24.46	7.89	1.58	8.91
Qar _{net,p}	20850	1170	7760	8836.25
Qar _{net,p}	4988	280	1856	2113.94
	23.6%	30.6%	45.8%	100%
FUEL INPUT (T/H)	154.5	200	300	654.5

Paper Sludge Analysis

ITEM	UNIT	BEFORE DRY	AFTER DRY
Weight	ton/day	205	84
Moisture	% (wt)	65	15
Dried conter	ton/day	71.75	71.4
Ash	% (wt)	15.09	35.67
Combustible	% (wt)	20.87	49.33
C	% (wt)	8.4	19.86
H	% (wt)	1.29	3.05
N	% (wt)	0.46	1.09
O	% (wt)	10.7	25.29
S	% (wt)	0.022	0.05
Cl	% (wt)	0.003	0.01
H.H.V/Dry	Kcal/kg	2294	2294
L.H.V/Dry	Kcal/kg	2101	2101
H.H.V/Wet	Kcal/kg	825	1950
L.H.V/Wet	Kcal/kg	374	1697



This paper factory produces paper sludge of almost 200 ton/day with 65-74% water content and directly used to the boiler without drying but with coal mixture. If this sludge will be dried, coal consumption will be reduced accordingly.

500 T per day waste firing capacity/ 75 ton CFBC 39 bar 450 oC 15 MW turbine power plant x 2 Tianjin, near Beijing China
China do not have the restriction of transport of plastic waste and this plant uses raw and wet plastic waste as fuel.

Hamada Boiler eyes on Biomass fuel Boiler in 2012 .

BANGKOK: In the year 2012, Hamada Boiler will continue its research into more widely for various biomass Fuels. Water-cooled Vibrating grate which has successful record in burning rice straw in the northern part of China is one of the great achievement since 2005. New technology of High-Low differential pressure bed Fluidized Bed (ICFB) will solve a lot of problems of Biomass fuel's low melting ash point as explained in the front page of this news paper. Large furnace with low velocity flue gas speed and low furnace temperature are the key point for the solution for many problematic biomass fuels. In Honduras, Central America, we have installed 35 ton capacity Biomass Boiler burning Arundo Donax fibrous fuel which ash melting point is as low as 800-900 oC. In Central American countries, demand of Biomass fuel boilers is high and Hamada Boiler will expand its activity together with its sole agent, G.A. EXPERTISE of Miami, USA, who is representing Hamada in the whole Central American countries.

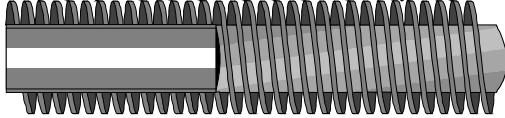


specially designed FBC combuster for Various Biomass Fuels

The Latest Heat Pipe Technology

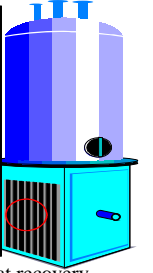
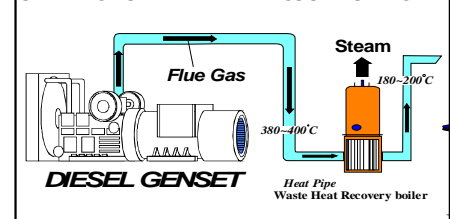
THERMAL VACUUM TUBE WASTE HEAT

Low Temperature Waste heat Recovery Boiler



This technology is really a revolutionary for the low temperature flue gas of 300-500 oC. Before, waste heat recovery boiler uses ordinary boiler tube and low temperature flue gas passes through the boiler, thus needing huge area of heating surface for the low temperature gas and causing a serious problem of carbon accumulation inside the boiler that will automatically increase the air resistance which might cause damage to the diesel generator engine. Now, with this new technology, flue gas of low temperature do not go into the boiler, instead, gas will get in touch with only completely sealed straight tubes (finned) with total vacuum inside and filled with special chemical. Under the vacuum condition, water (H₂O) will evaporate at much lower temperature than the evaporation temperature of 100 oC below atmospheric pressure of 1 kg./cm² (absolute pressure)

GENERATOR SET + THERMAL VACUUM TUBE BOILER



Application of Heat Pipe Technology for waste heat recovery of Diesel Powered Generators.
PT. ASAHI CHEMICAL
Indonesia



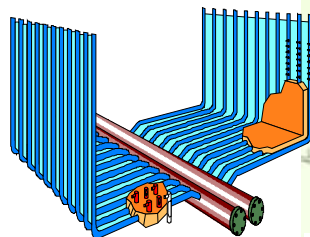
75 ton 60 bar 450 oC HIGH PRESSURE CFBC FOR POWER PLANT BOILER

INDONESIA TORAY SYNTHETIC (75 TON X 2 UNITS, 15 MW x 2 CONDENSING TURBINE)

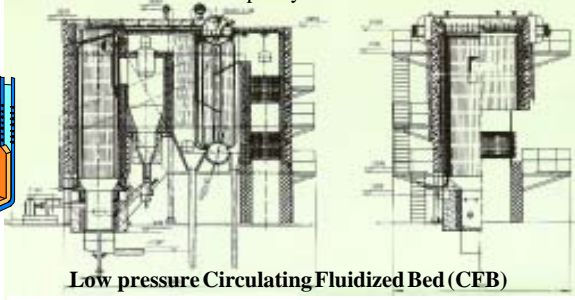


HAMADA CFBC BOILER OF 75 TON Membrane wall design, which permits standard insulation and lagging greatly reducing radiation losses as compared to the conventional tube arrangement with thick refractory

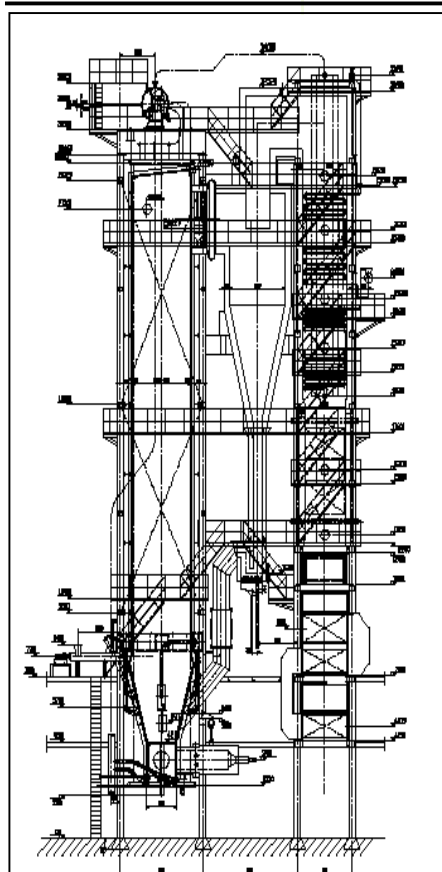
CO-GENERATION PROJECT:
Utmost saving can be obtained when you generate electricity by high pressure steam and use extraction steam or exhaust steam for your processing need.



LOW PRESSURE/ BI-DRUM CFBC BOILER
For lower pressure requirement below 25 bar, Bi-Drum design will be used instead of single drum. Hamada Boiler expanded its range of product to the lower pressure CFBC with this design to answer to the need of below 35 ton capacity.



Low pressure Circulating Fluidized Bed (CFB)



CIRCULATING FLUIDIZED BED (CFBC) 75 TON/H 60 BAR 450 oC for POWER PLANT SPECIFICATION

Co-Generation Project by Hamada Boiler ASIA KRAFT PAPER (AKPC) OF BANGKOK INSTALL 9MW COAL FIRED POWER PLANT

Most effective and ultimate saving project by Back Pressured Turbine of 9 MW with 75 ton/H process steam

BANGKOK; 6 years ago AKPC started to use Hamada FBC coal boiler for their process steam requirements and in 2011, signed a contract with Hamada for building a co-generation coal power plant with 75 ton/H CFBC high pressure boiler of 9.8 MPa pressure with 540 oC superheated steam with 100% back pressure turbine of 9 MW. Back pressure steam of 10 bar will be fully utilized for the process of their papermill.



This is the sample of the most ultimate saving way of steam and power generation by coal. Among many factories not many company can adopt this similar style because they may not have this much of huge steam requirement of low pressure steam with the balanced and stable load of electric power.

Dole Philippines goes to Biomass Multi-Fuel Boiler for General Santos Plant

GENERAL SANTOS; Pilippines One of the biggest Pineapple plantation and cannery DOLE PHILIPPINES has started Biomsdd project for their process steam requirement by using Hamada Biomass Boiler of rice husk / cocoshell multi fuel system. It consist of two units of 18 ton capacity equipped with the specially designed rice husk burner with the travelling grate for cocoshell firing. Installation work will start in April and will be completed by August this year.



Ginebra San Miguel Bacolod Distillery uses coal fired FBC boiler

Bacolod, Philippines: San Miguel Corp., Southeast Asia's largest food and drink group, is diversifying further in the utility sector. First trial was done with its group, Bacolod DBI (Distilleria Bago Inc.) with 16 ton/H Hamada Fluidized bed Boiler to take care of its process steam requirement. Now that the substantial saving has been realized since one year of operation, it is possible to expand to other group factories and brewery this year. Ginebra is using the local coal of Semirara and PNO. Philippine have several coal mining and quality of coal is very much accepted by Fluidized bed boiler and sulfur content of the coal is comparatively low as same level of that of Indonesian coal that no additional DeSOx tower is required to meet the local SO2 emission standard.



Steam cooled cyclone (above 100 T/H capacity) Power Plant use Automatic ASH BIN pneumatic pump to collect ash to the fluidizing Ash silo for automatic discharge to the truck. (Totally closed system)



PLEASE VISIT OUR WEB SITE: <http://www.hamadaboiler.com>
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