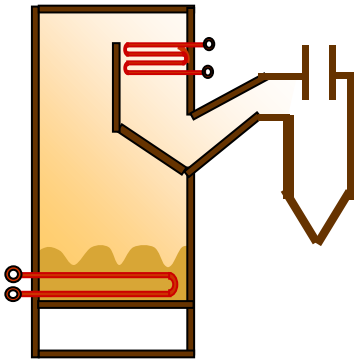
Kawasaki ICFB Boiler
(Internal Circulating Fluidized Bed Boiler)

Kawasaki
Powering your potential

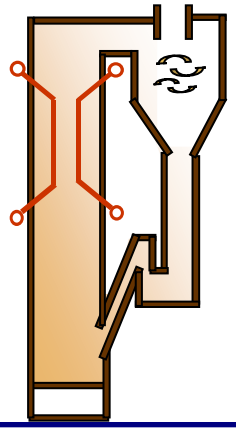
Standing Position of ICFB

BFB



- Small ～ Middle size
- Applicable for low heating value fuel (Paper sludge, wood chip etc.)
- Low height boiler

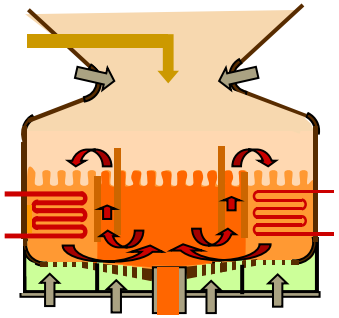
CFB



- Middle ～ Large size
- Co-firing of coal and other recycle fuel
- Bed temp. control by ash circulation
- Tower type boiler

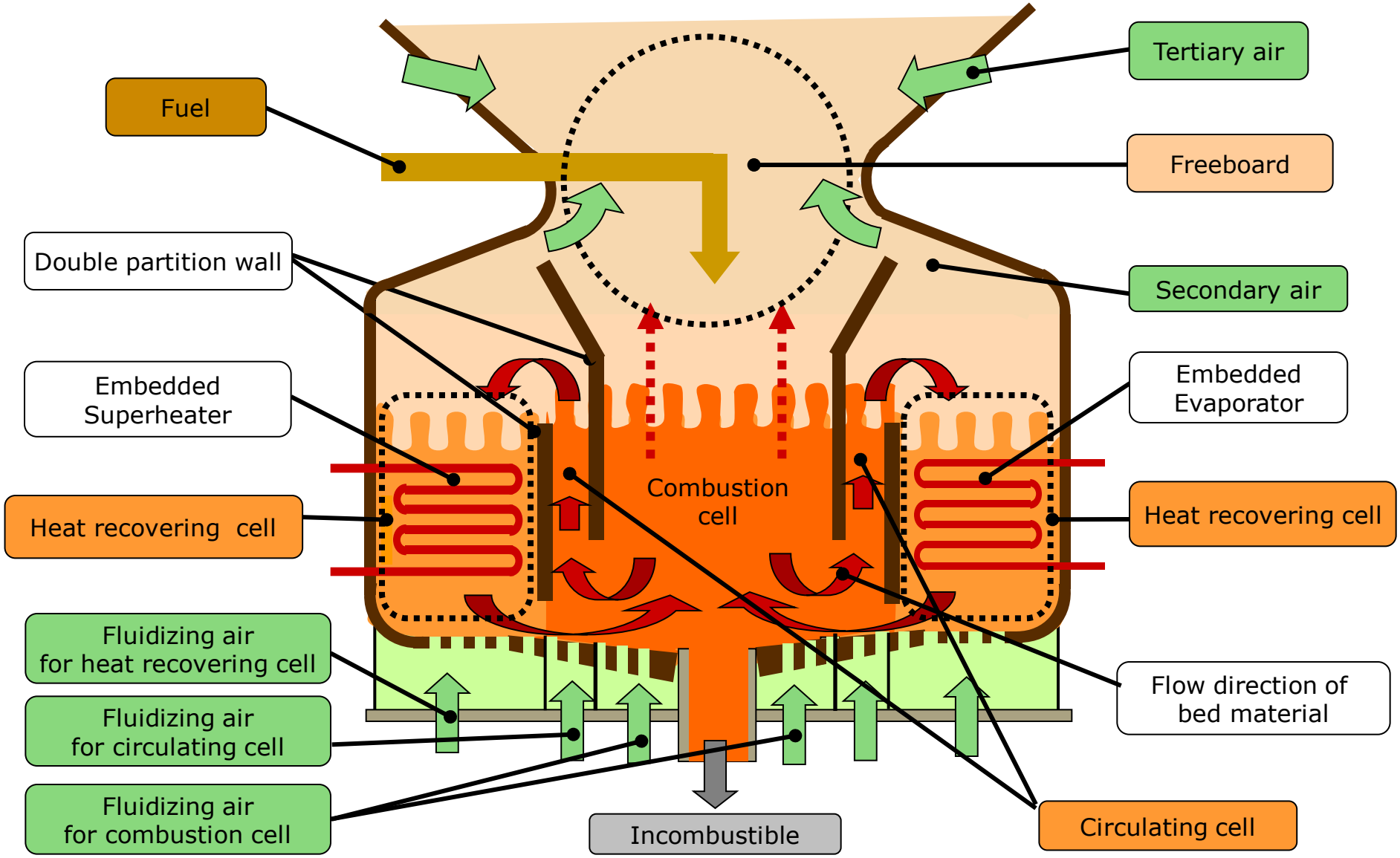
ICFB

Hybrid Type



- Small ～ Middle size (50～150t/h)
- Bed temp. control by BM circulation
- Applicable for low heating value fuel
- Applicable for high heating value fuel
- Applicable for corrosive fuel
- Same boiler height with BFB

Combustion System of ICFB

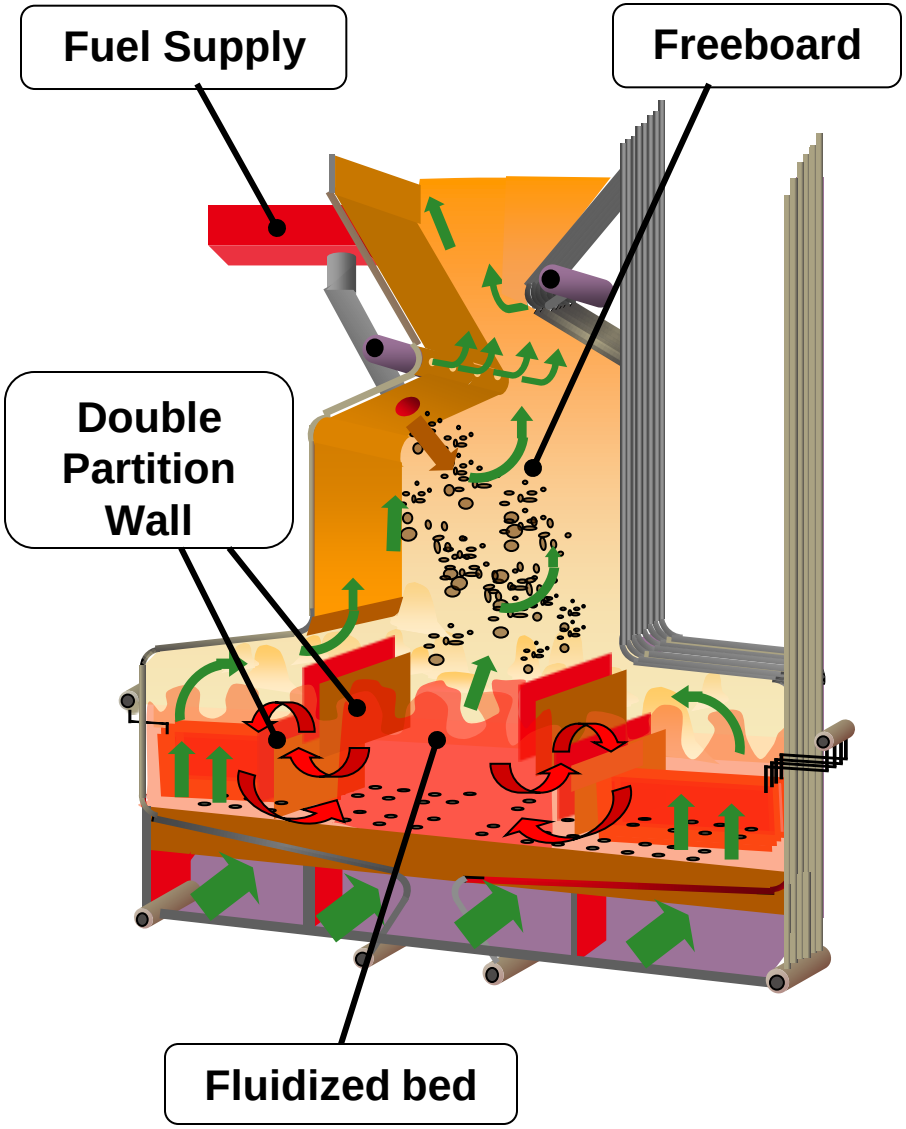


Fluidized bed and furnace

1.Large furnace
Three(3) "T"(retention Time, high Temp., Turbulence) is important for complete combustion without emission of dioxin. Furnace is designed to have large volume to keep long retention time.

2.Tertiary air nozzle and two-stage nose
Large two-stage nose is provided for turbulence and mixture of flue gas after blowing tertiary combustion air.

3.Heat recovering cell
Fluidizing air of heat recovering cell is heated through the bed and flowed out from the upside of partition wall to freeboard as secondary combustion air.



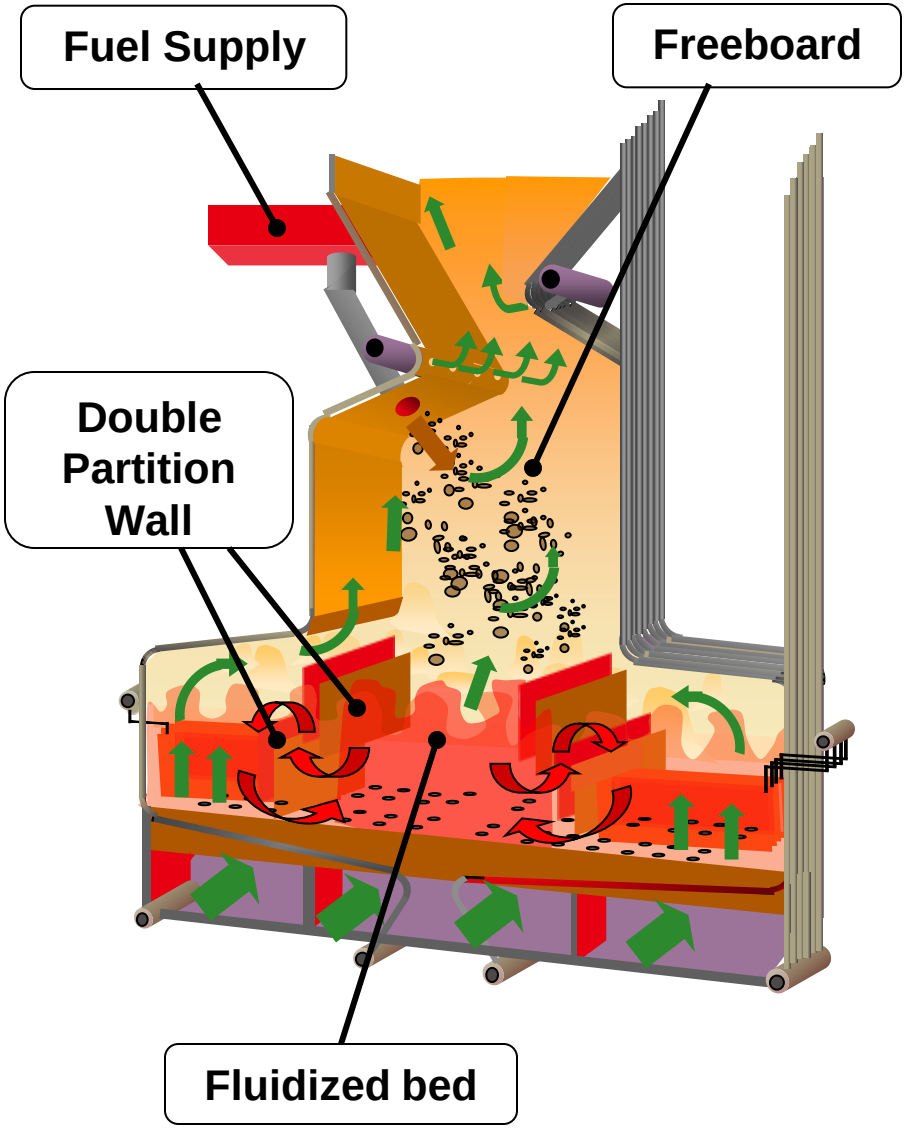
Fluidized bed and furnace

4.Double partition wall
Double partition walls are provided to prevent not only combustion in heat recovering cells but also influx of corrosive gas from combustion cell.

5.Fluidizing air nozzle
Fluidizing air nozzles are arranged uniformly and designed for 50-100% of boiler load.

6.Embedded heat exchanger
Approx. 35-45% of boiler heat recovery is absorbed by embedded heat exchanger (final superheater and embedded evaporator) which can be sized in small heating surface due to high heat transfer rate in fluidized bed.

7.Fuel chute
Fuel is supplied in combustion cell only, and is burned in the combustion cell with low temperature under poor air, and burned out completely in the freeboard with high temperature under rich air.

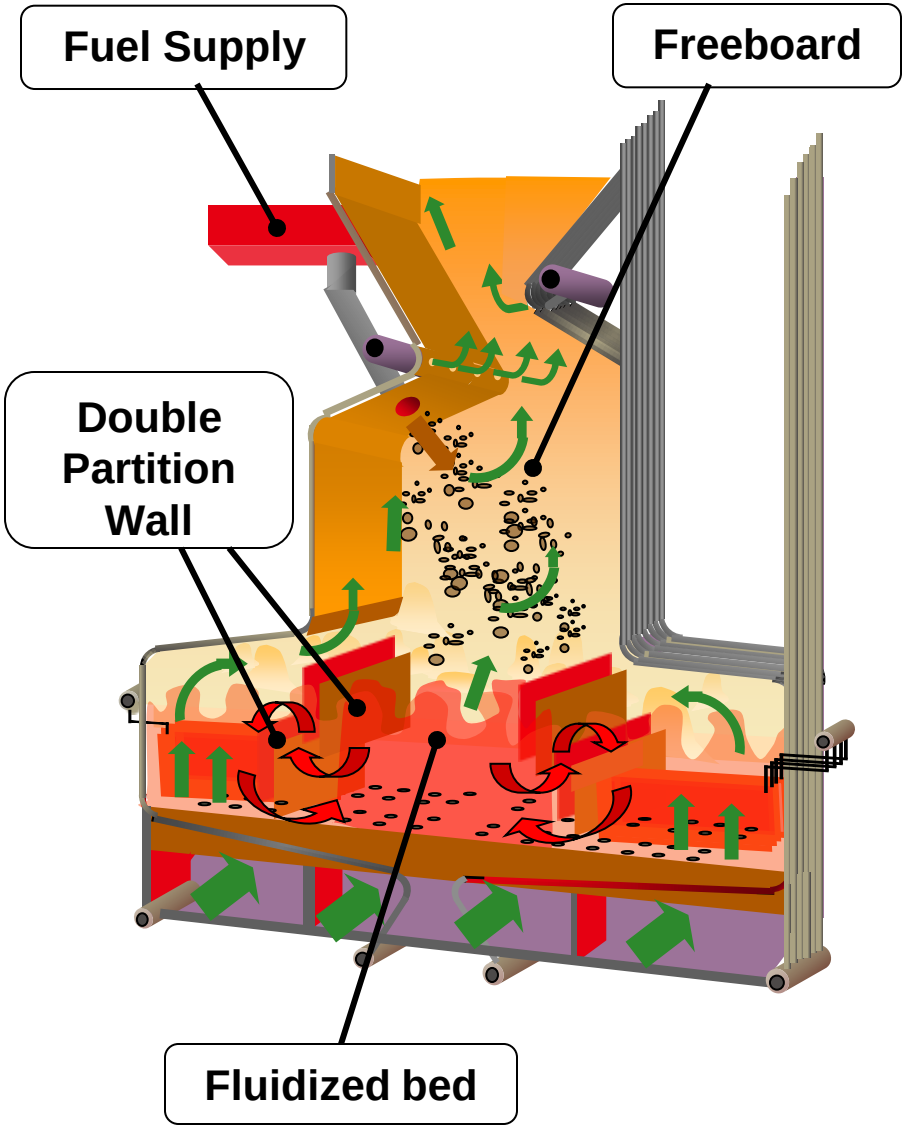


Fluidized bed and furnace

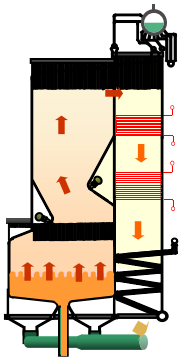
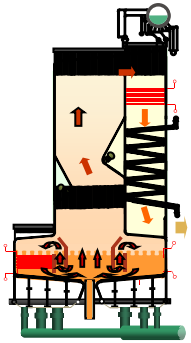
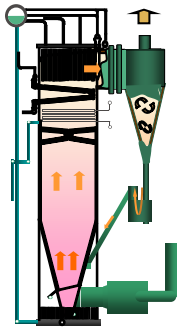
8.Refractory wall
Water walls of fluidized bed and freeboard on the bed are covered with refractory to keep suitable combustion atmosphere.

9.Operating condition
Relation of operating condition among combustion cell, heat recovering cells, and BM circulation cells, that is, bed temperature and fluidized air velocity for each cell, is important.

10.Water circulation
Large size downcomer is arranged for achieving suitable natural circulation of boiler water.
Forced circulation system of boiler water is applied to embedded evaporator and double partition walls with high heat transfer rate to keep suitable water circulation performance.



Fuel Application

Fuel application	 BFB	 ICFB	 CFB
Wood Chip mono-firing	◎	◎	▲
Wood Chip + RDF or RPF	○	◎	▲
RPF or RPF mono-firing	▲	◎	▲
Coal + Wood Chip	○	◎	◎
Coal + RDF or RPF	▲	◎	◎
Coal mono-firing	▲	◎	◎
Wood Chip + Paper Sludge	◎	◎	▲

◎ Good ○ Average ▲ Poor

Feature of ICFB

1. High combustion efficiency

- **Stable ignition & combustion** by Dense bed

  ⇒Low heating value fuel, High moisture fuel can be applied.

- **Constant combustion temperature** by BM circulating

- **Low NOx combustion** by multi air feeding and low air-ratio

Combustion cell air	⇒	Primary air
Circulation & Heat recovery cell air	⇒	Secondary air
Freeboard air	⇒	Tertiary air

- **High efficiency combustion** by sufficient retention time in the furnace

Feature of ICFB

2. Low level erosion / corrosion

●Separation of combustion zone and heat absorption zone by double partition wall

- Fuel can be completely fed into combustion cell
- Mild atmosphere of heat recovery cell

⇒ Arrangement of final SH is applicable!

●Low fluidizing velocity of heat recovery cell (1/2~1/3 of BFB)

⇒Prevention of erosion of embedded tube

●Heat transfer coefficient is very large (more than 5 times of convection heating area)

⇒ Compact design of embedded tube

Feature of ICFB

3. High Reliability

- Low erosion of upper furnace and convection heating area
  - ・No explosion of BM(Bed Material)
    - ⇒No need of countermeasure of erosion for furnace upper part
  - ・Low dust concentration at convection heating area
    - ⇒Low risk of erosion of convection heating tube
- Simple circulating system of Bed Material
  - ・Circulating area of BM is the bottom of furnace only
  - ・No cyclone ⇒ No maintenance of cyclone refractory

Feature of ICFB

4. Easy Operation & Easy Maintenance

●**Bed temperature control ⇒ Stable evaporation**

- Heat absorption can be controlled by air flow of circulating cell
- Heat absorption of embedded tube can be controlled by operating temperature of heat recovery cell

●**Limited maintenance area**

- Main maintenance area is “Bed area” and “Material handling system” only
- Low fouling of convection heating area
- Low erosion of furnace upper area and convection tube

Omuta Recycle Power

Boiler Type	ICFB
Evaporation	91 t/h
Steam Press. Steam Temp.	8.14MPa × 503 ℃
Fuel	RDF
Fuel Consumption	RDF：315 t/d
Emission	NOx：65ppm SOx： 3.0m^3N/h HCl： 32.5mg/m^3N Dust：20mg/m^3N DXN：0.1ngTEQ/m^3N CO：100ppm (O_2=12%,dry)
Plant site	Fukuoka prefecture
Delivery year	2003

Pellet type RDF

Tokushu Tokai Paper Co., Ltd. /Shimada mill

Wood chip

RPF

Boiler type	ICFB
Evaporation	75 t/h
Steam Press. Steam Temp.	9.81MPa×501 ℃
Fuel	Waste wood chip, RPF Waste plastic
Fuel Consumption	Wood chip：9.0t/h Waste Plastic：2.2t/h RPF：0.8t/h
Emission	NOx：50ppm (O_2=6%,dry) SOx： 10ppm (O_2=12%,dry) HCl： 100ppm Dust：0.04g/m^3N DXN：0.1ngTEQ/m^3N CO：100ppm
Delivery year	2006

Korea／Iksan city Commerce & Industry Energy Co., Ltd.

Boiler type	ICFB
Evaporation	75 t/h
Steam Press. Steam Temp.	6.37MPa×450 ℃
Fuel	RDF、Coal
Fuel Consumption	RDF：210 T/D Coal：65.5 T/D （RDF&Coal co-firing）
Emission	NOx：70ppm SOx： 30ppm HCl： 20ppm Dust：0.02g/m^3N DXN：0.1ngTEQ/m^3N CO ：50ppm （O_2=12%,dry）
Delivery year	2012

Pellet type RDF (& Coal)

Kawasaki, working as one for the good of the planet

“Global Kawasaki”

Kawasaki

Powering your potential