



GREENS
POWER EQUIPMENT



WASTE HEAT BOILERS

ENERGY CONSERVATION SOLUTIONS
for a better planet





ENERGY CONSERVATION SOLUTIONS

For a better planet



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THE GREENS GROUP

A subsidiary of TEi Limited (UK), we are a global one-stop thermodynamic solutions provider for land and marine applications, empowering a large number of main stream industrial sectors such as oil and gas, petrochemicals, power generation, iron and steel, construction and more.

Be it operations on land or at sea, our products and solutions have helped scores of industries conserve energy and resources and preserve the environment around them.

The Greens name has been synonymous with Waste Heat Recovery since the invention of the Fuel Economiser by Edward Green in 1845.

Our range of energy conservation products include:

- Marine Boilers and Economisers
- Industrial Boilers
- HRSG
- Exhaust Gas Boilers
- Waste Heat Recovery Boilers
- Power Plant Economisers
- Gas Heat Exchangers
- Retrofits, Spares and Services.

WASTE HEAT RECOVERY

Greens has played a pioneering role in waste heat recovery since the 19th century. We design, manufacture and supply customised or bespoke waste heat recovery boilers (WHRB) for a host of industries such as Power, Cement, Fertilizers, Refineries, Chemicals, Glass, Metal and many more.

These boilers help to recover waste heat from exhaust, process or lean gases, which can either be re-applied in the industrial process, or used to produce hot water or high temperature-high pressure steam for power generation.

Greens is committed to help industries to make the most of waste heat, and thereby enhance plant efficiencies, save on fuel and energy costs, reduce GHG emissions and conserve the environment around them.

WASTE HEAT BOILERS



GREENS WHRB OPERATIONS

INDUSTRY	SOURCE OF WASTE HEAT
PETROCHEMICALS	
Fertiliser	H2504 Plant, NH3
Refinery	FCCU
	SRU
	H2
Chemicals	HNO3, Process Gas
MINERALS	
Cement	PH
	AQC
Glass	Furnace
Ceramic	Kiln
METALS	
Ferrous	
Steel	Furnace
DRI	Kilns
Coke	Oven
Non Ferrous	
Copper	Smelter
Zinc	Smelter
Lead	Smelter
INCINERATOR	
Hazardous	Furnace/Kiln
MSW	Furnace/Kiln
POWER GENERATOR	
Diesel Engine	Exhaust Gas
Gas Turbine	Exhaust Gas
LEAN GAS	
Carbon Black	Co
Blast Furnace	BFG
Caustic	H2



CEMENT

Most Portland cement is made in a rotary kiln. In modern works, the blended raw material enters the kiln via the pre-heater tower. An integral part of the process is a heat exchanger called a 'suspension preheater'. This is a tower with a series of cyclones in which fast-moving hot gases keep the meal powder suspended in air.

Throughout the process, the meal gets hotter and the gas gets cooler until the meal is at almost the same temperature as the gas. When the gas exits the kiln, it is still at a high temperature and is made to pass through the WHRB.

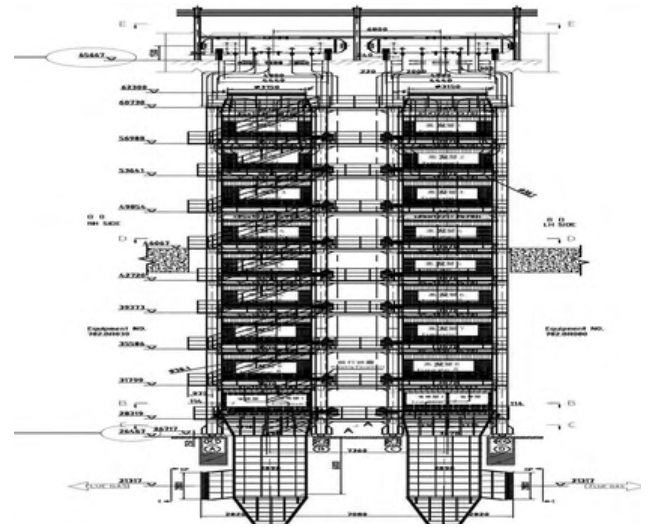
Such gases are highly dust laden and Greens developed not only the WHRB but also an effective hammering device and mechanism to ensure continuous cleaning and maximum heat recovery.



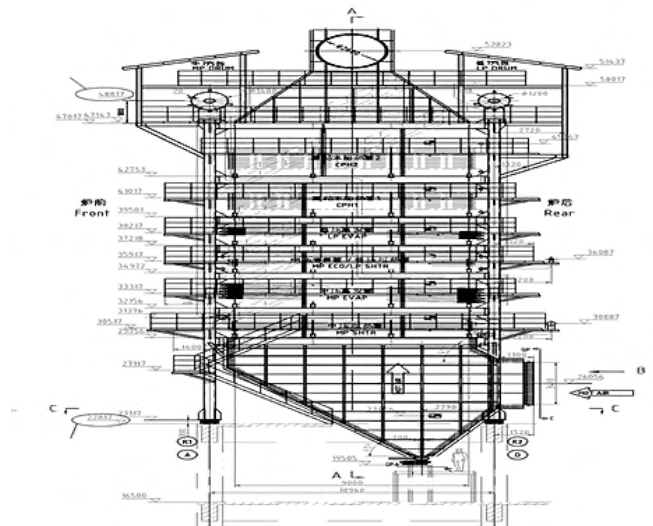
**2 X 14.5 TPH PH Boilers and 1 X 11.9
TPH AQC Boiler
to generate power of 8.4 MW**

On the other side, when the clinker is out, to bring down its temperature inert gas or generally air is used to quench it. The hot air after the quenching needs to be cooled and Greens WHRB are very apt to handle such gases with abrasive particles.

GENERAL ARRANGEMENT PH BOILER



GENERAL ARRANGEMENT AQC BOILER



TYPICAL CEMENT WHRS PARAMETERS

Description	Units	2000 TPD	4000 TPD	5000 TPD	6000 TPD	8000 TPD
Gas Flow - PH	Nm ³ /hr	120,000 to 145,000	240,000 to 300,000	320,000 to 360,000	365,000 to 420,000	380,000 to 500,000
Gas Flow - AQC		75,000 to 100,000	160,000 to 200,000	180,000 to 260,000	270,000 to 300,000	300,000 to 350,000
Gas Inl temp- PH	Deg C	280 - 350	280 - 350	280 - 350	280 - 350	280 - 350
Gas Inl temp- AQC		350 - 500	350 - 500	350 - 500	350 - 500	350 - 500
Gas Out Temp- PH	Deg C	150 - 200	150 - 200	150 - 200	150 - 200	150 - 200
Gas Out Temp- AQC		90 - 130	90 - 130	90 - 130	90 - 130	90 - 130
Steam Generation	TPH	8 - 15	30 - 40	35 - 45	40 - 50	45 - 65
Steam Pressure	Kg/cm ²	7 - 19	7 - 19	7 - 19	14 - 19	14 - 19
Steam Temperature	Deg C	300 - 440	350 - 440	350 - 440	350 - 440	350 - 440
Power Generated (Avg) AQC + PH	MW	2 - 3.5	6 - 8	7 - 9	8 - 12	9 - 15



COKE OVEN

The production of coking coal involves the burning of coal at high temperature in an oven with reduced oxygen. Carbonisation starts and produces volatile matter, which burns and produces heat, as by-products are recovered. The exhaust gases, which are at a higher temperature, are allowed to escape to the atmosphere.

Greens supplies specially designed WHRB to capture heat energy from the exhaust gases to generate power. The WHRB for Coke Dry Quenching process is supplied in modules for quick and easy site installations.

- **Coke Oven Capacity : 0.6 Million TPA; 4 batteries of 34 ovens each, and 5th battery of 40 ovens.**
- **Power Plant Capacity : 30 MW**
- **No of Boilers : 5 Nos**
- **Boiler Steam Output : 4 X 25 TPH and 1 X 35 TPH**
- **Boiler Pressure : 3.8 Mpa**
- **Steam Temperature : 450 Deg C**

A turnkey Power Project wherein Greens designed, manufactured and supplied all the boilers for the project and sourced the steam turbines and balance of plant from consortium partners





- Plant Capacity : 100,000 MTPA
- 4 X 800 TPD Batteries
- Power Plant Capacity : 12 MW
- Nof of Boilers : 4 Nos
- Boiler Steam Output : 18TPH each
- Boiler Pressure : 25 Kg/cm2
- Steam Temperature : 405 Deg C

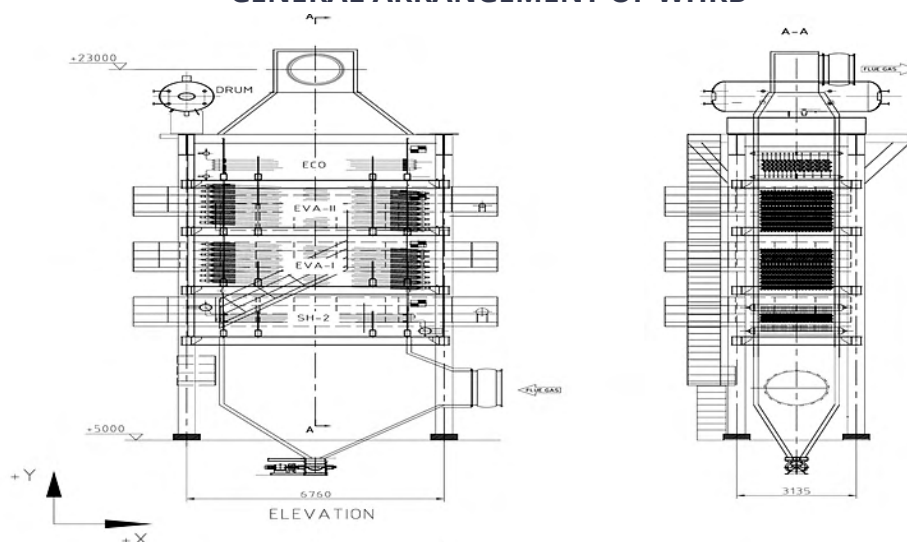
GLASS FURNACE

Modern glass formulations are often complex and varied, combining powders with raw materials to achieve very specific glass properties. Producing these specialty glasses requires a glass furnace with accurate temperature capability above 1500oC. This process results in exhausting the gases at high temperature, carrying abrasive particles.

Greens has the expertise to handle this type

of gas in the WHRB to produce saturated steam which in turn is used for Tank Farm Heating, Line Tracing etc. To boost capacities, the WHRB incorporates a superheater for combined heat and power. Greens did a bespoke design on a 100,000 MT/A Glass plant, where a 12 MW Waste Heat Recovery Power Plant was built, which could supply 20% power consumption of the Glass Melting Furnace.

GENERAL ARRANGEMENT OF WHRB





TURBINE CAPACITY

**No of Turbogenerators : 8 X GE-Fr5
and 5 x GE Fr9**

Total Turbine Rating : 700MWe

WASTE HEAT RECOVERY PLANT

No of Boilers : 13 Nos.

Total Boiler Steam Output 1390 TPH

HRSR FOR ALUMINIUM SMELTER

The power required by the Aluminium Smelter is provided by the turbine. The waste heat recovery plant from the turbine exhaust gas provides 1,390 tonnes of steam per hour to the sea water desalination plant in the complex, which caters to the fresh water needs of the city. Greens produced the designs and manufactured the units, including all associated plant, for the contract which was worth £30 million.

Because the plant is erected upon consolidated sand without piles, design for considerable differential settlement was essential.

The company had specific involvement in the power station operating philosophy together with the commissioning of TEG ducting – including re-design of gas turbine exhausts to improve flow distribution – blast stacks and dampers. The waste heat boilers were complete with all piperacks and pipework including steam main to desalination plant, water treatment plant, boiler feed water pumps, auxiliary boilers and all associated electrics, instrumentation and controls.





HRSG FOR CCPP

Heat Recovery Steam Generators behind a Gas Turbine can be operated either in the cogeneration mode or combined cycle mode. Cogeneration mode is predominantly used in the process industries and supplies steam for various process applications. For Combined Cycle Power Plant (CCPP), Greens supply HRSG's of Single and Dual Pressure for various frame sizes of gas turbines ranging from 1MW to 75MW. The units are supplied in harps as well as in modules



Greens designed, manufactured, supplied and installed HRSGs on Turnkey basis for a CCPP with a configuration of 2GT + 2HSRG + 1STG
Each HRSG was designed in 4 modules.

- Module 1 – HP HTSH, HP LTSH & HP Evaporator
- Module 2 – HP Economiser 2, LP SHTR & HP Economiser 1
- Module 3 – LP Evaporator
- Module 4 – Condensate Preheater

Boiler specifications

- Phase I – 2 X 125 TPH Boiler; 110 TPH at HP Section, 15 TPH at LP Section.
- Phase II – 2 X 126 TPH Boiler; 113 TPH at HP Section, 13 TPH at LP Section.
- Design pressure - 10.74 MPA (109.5 KGF/CM²) at HP Section and 0.87 MPA (8.87 KGF/CM²) at LP Section.
- Super heated steam temperature - 5380C +/- 50C at HP & 2750C +/- 50C at LP
- Total heat surface area - 76790.00 M²
- HP Steam Generation : 113 TPH at 98 bar(a) at 538 +/- 5 Deg.C
- LP Steam Generation : 13.6 TPH at 9 bar(a) at 275 +/- 5 Deg.C
- Steam to Deaerator : 1.08 TPH
- CPH Water Flow : 130 TPH at 12 bar(g) at 51 Deg.C



HAZARDOUS WASTE INCINERATOR

Some industrial processes produce waste, which can be hazardous and it is important for companies to reduce or recycle hazardous wastes from their processes through incinerators.

Incineration converts waste into ash and fuel gas. Greens, with their WHRB technology, have gained expertise in handling high temperature gases exhausted from incinerators. Steam generated thus finds usage in process or power generation.

The WHRB is designed to extract required heat from the exhaust gas of Hazardous Waste Incinerator. For this purpose flue gas from Incinerator is arranged in a direction counter to

water / steam circuit of Water Wall Panel and parallel to circuit of Evaporator. The exhaust gas from SCC to GCT duct is tapped to enter into WHRB inlet.

The gas travels through the first pass of Water Wall Panel, then through evaporator modules, post which it is allowed to enter to the existing GCT. The steam drum is connected to Water Wall Panel Header and Evaporator bottom Header through down comer and Risers. It receives the mixture of steam and water from the evaporator modules as well as water wall panel by heat transfer. After separating water from the steam / water mixture at drum, the saturated steam is supplied through MSSV to the heating process.

WHY CHOOSE US ?

➤ LONG RANGE VISION

- High Investments in people, skills and expertise.
- Focus on developing advanced technology for continuous product improvement.
- Care for customer satisfaction and product reliability.

➤ CREDIBILITY, INTEGRITY AND RELIABILITY

- Several decades of experience as Thermodynamic Applications experts.
- Worldwide sales and service network.
- Greens patented machines and first class production facilities.
- Greens high standard products at high production volumes.
- Facilities located for easy access to main shipping ports.
- Supply to international standards, codes of practice and marine classification societies.
- Experienced technical team to ensure efficient solutions for land and marine applications.





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