Industrial Waste Heat Recovery Solutions

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Features

- Exhaust gas heat which is discarded from various plants into the atmosphere at 250°C-350°C is recovered by a boiler to generate electricity in a steam turbine.
- Power generation is possible without additional fuel contributing to factory energy saving. This is introduced in large cement plants and steel factories where energy consumption is particularly large.
- Joint Crediting Mechanism (bilateral credit system) can be used in cement waste heat power generation, contributing to the reduction of greenhouse gas emissions by JCM partner countries.

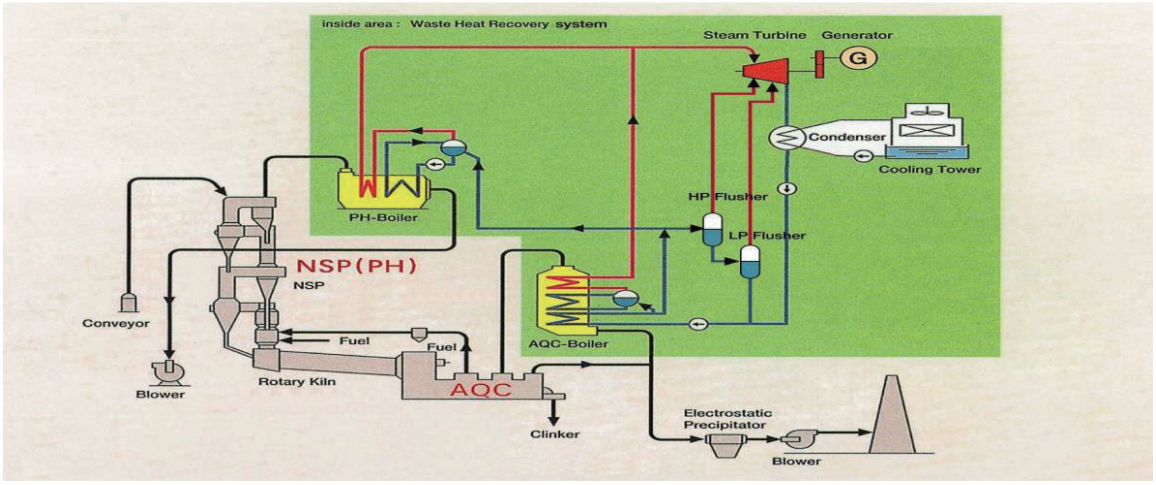
Waste heat recovery power plant for coke oven
(SOL CST in Brazil)

Waste heat recovery power plant for cement plant
(Conch Cement in China)

Sinter Cooler Waste Heat Recovery Equipment
(Wuhan Steel in China)

Basic Concept or Summary

- Explain the technical features of waste heat power generation equipment for cement plants.
- Heat is recovered from PH and/or AQC boilers on each cement plant line, and power is generated by a single steam turbine.
- Heat is recovered from the raw material pre-heater exhaust gas by PH boilers. (The boiler inlet gas temperature is 300°C-350°C) Because the exhaust gas contains a large amount of dust, a dust remover is installed to constantly remove dust.
- AQC boilers recover heat from exhaust gas from the Air Quenching Cooler. (The boiler inlet gas temperature is 250°C-350°C)



System diagram of waste heat recovery power plant for cement plant

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Effects or Remarks

- ◆ 9,000 kW of power generation output, that is about 30% of the electricity used throughout the cement plant of daily output 5,000 tons, was saved, contributing to an annual reduction of about 35,000 tons of CO_2.
- ◆ Application is possible for Japan's domestic J-credit system and for the JCM system in overseas JCM partner countries.

Installation in Practice or Schedule

Domestic

- ◆ 13 units of cement waste heat power generation equipment have been delivered since the first unit was delivered in 1980 (Sumitomo Osaka Cement Gifu Plant).
- ◆ Delivered 5 units of sinter cooler waste heat power generation equipment to JFE Steel and others.

Overseas

- ◆ To lead design, procurement, and construction for cement waste heat power generation equipment. Including this company's performance, more than 250 units have been delivered to China, India, Vietnam, and Germany, etc. Together with this joint venture we also developed a new PH boiler with the first machine delivered in 2017. This innovative boiler has a compact design that reduces initial investment and offers improved dust removal performance.

- ◆ In 2018, we delivered the world's largest 43,500kW output waste heat power generation plant at the Ssangyong Cement South Korea Tokai plant. This covered about 30% of factory power consumption, contributing to a reduction of about 170,000 tons of CO_2 per year.

Cement Waste Heat Power Generation Equipment
(Ssangyong Cement South Korea Donghae plant)

PH Boiler First Machine
(Huaibei Cement in China)

- ◆ We delivered a waste heat recovery power generation equipment for a coke oven, which was constructed in the ARCELOR－MITTAL－TUBARAO Ironworks in Brazil. This is one of the largest plants in the world as an waste heat power generation equipment for high-temperature exhaust gas exceeding 1000°C from coke oven and this is the first plant outside of the United States. There are two units of 98MW power output.

Waste heat recovery power generation equipment for coke oven
(SOL CST in Brazil)

Waste Heat Recovery Heat Exchangers :

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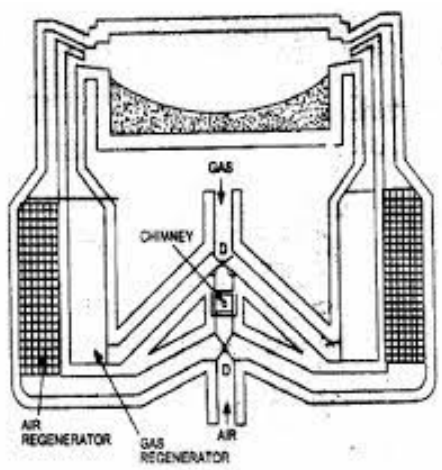
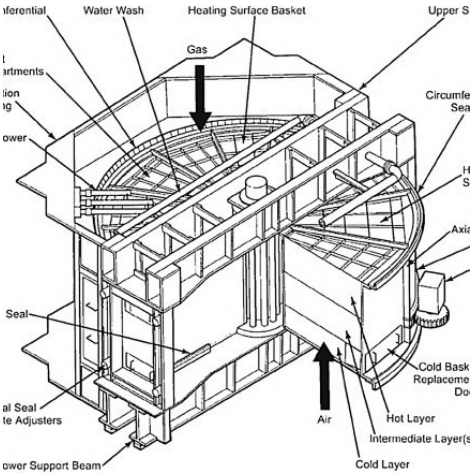
1. Recuperator
2. Regenerator
3. Rotary Regenerator / Heat Wheel
4. Passive Air Preheaters
5. Regenerative / Recuperative Burners
6. Finned Tube Heat Exchangers / Economizers
7. Waste Heat Boilers

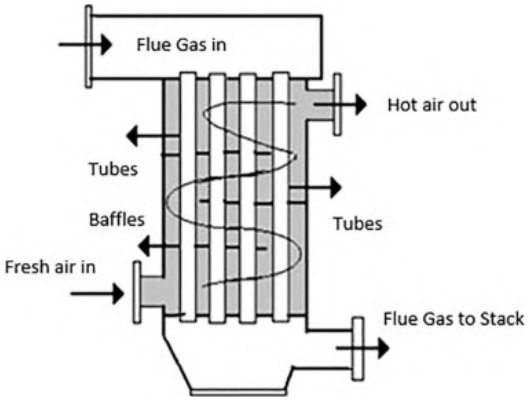
1. RECUPERATOR



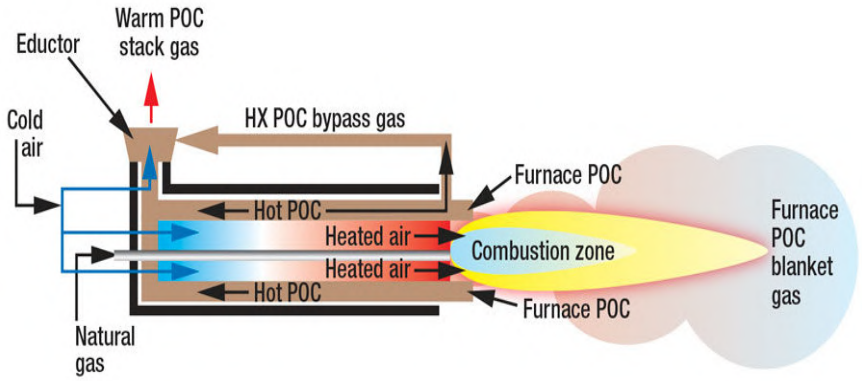
2. REGENERATOR



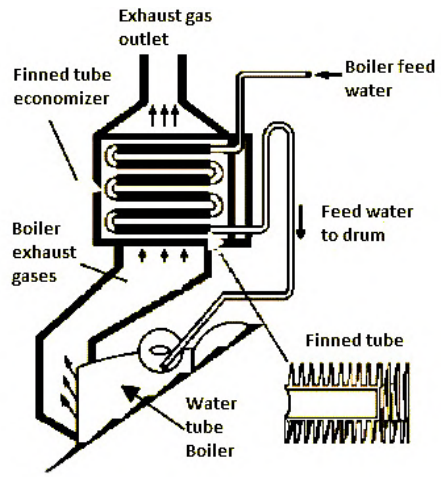
3. ROTARY REGENERATOR / HEAT WHEEL



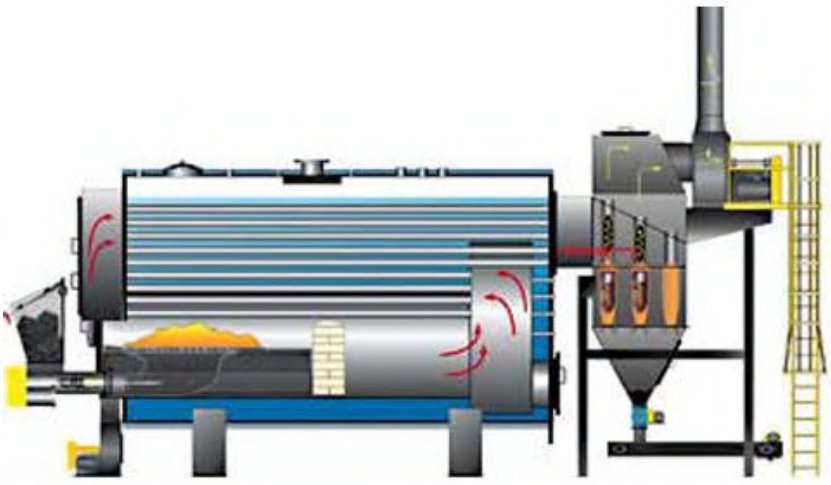
4. PASSIVE AIR PREHEATERS



5. REGENERATIVE / RECUPERATIVE BURNERS



6. FINNED TUBE HEAT EXCHANGER / ECONOMIZER



7. WASTE HEAT BOILERS

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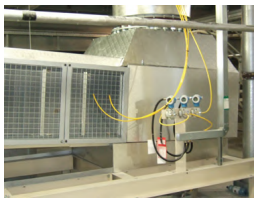
TYPE OF HEAT EXCHANGERS



GAS TO AIR

GAS TO LIQUID

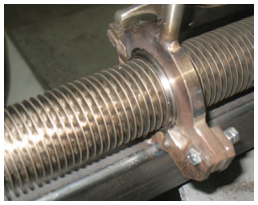
GAS TO OIL

STEAM CONDENSER

FLAT PANEL

HEAT PIPES / TUBES

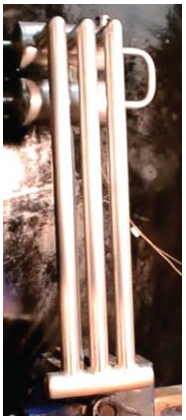
STANDARD TUBES



FINNED TUBES

HYBRID TUBES

S-SHAPE TUBE



LOOP TUBES

	Iron/Steel																		Glass Industry						Cement			Aluminum						Metal Casting			Cross-cutting		
	Coke Oven						Blast Furnace						BOF			EAF			Glass Melting																				
	Coke Oven Gas			Waste Gas			Blast Furnace Gas			Hot Blast Stove Exhaust			Basic Oxygen Furnace Gas			Electric Arc Furnace Offgas			Gas-fired Melting Furnace			Oxyfuel Melting Furnace			Cement Kiln			Hall-Heroult Cells			Melting Furnaces			Iron Cupola			Steam Boiler		
	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic	Commercial	Technical	Economic
Regenerator	-	-	-	+	+	+	-	-	-	n	n	-	x	x	x	x	x	x	+	+	o	-	o	-	n	n	n	-	-	-	+	+	o	n	n	n	-	+	-
Recuperator	-	-	-	n	-	-	-	-	-	n	n	-	x	x	x	x	x	x	+	+	+	-	o	-	n	n	n	-	-	-	+	+	o	+	+	+	+	+	+
Heat Wheel	-	-	-	n	m	-	n	n	n	+	+	+	x	x	x	x	x	x	o	o	-	n	o	-	n	n	n	-	-	-	o	+	o	n	n	n	+	+	+
Passive Air Preheater	-	-	-	-	o	o	n	n	n	+	+	+	x	x	x	x	x	x	n	n	n	-	o	-	n	n	n	-	-	-	n	n	n	n	n	n	+	+	+
Thermal Medium System	o	o	-	n	m	-	n	n	n	+	+	+	n	n	n	n	n	n	n	n	n	n	n	n	n	n	n	-	-	-	n	n	n	n	n	n	+	+	+
Waste Heat Boiler	-	-	-	-	-	-	n	-	n	n	-	-	o	+	o	n	-	n	o	+	-	o	+	-	+	+	+	-	-	-	n	n	n	n	n	n	x	x	x
Low T Power Cycle	-	-	-	n	m	-	-	n	n	-	m	n	x	x	x	x	x	x	x	x	x	x	x	x	o	+	o	-	-	-	x	x	x	n	n	n	-	m	n
Solid State Generation	-	-	-	-	m	-	-	-	-	-	m	-	-	-	-	-	-	-	-	m	-	-	m	-	-	m	-	-	m	-	-	m	-	-	m	-	-	m	-
Load preheat																+	+	o	n	m	n	o	o	o	+	+	+	n	n	n	+	+	o				+	+	+
Process Specific/Other2	o	o	-	o	o	-	o	+	-																+	+	+												

1. This table is reproduced in Appendix B with detailed notes
2. "Process-specific" includes coal moisture control for coke making, dry-type top pressure recovery turbines for blast furnaces, and recovery from cement clinker cooler.

Key:	Commercialization Status	Technical Feasibility	Economic Feasibility
	+ Frequently used in US o Limited commercialization - Not deployed	+ No technical barriers o Proven in limited applications m May be feasible, but not demonstrated - Not technically feasible	+ Cost-effective o Application-specific - Cost-prohibitive
	n Not addressed in available literature x Not applicable		

Waste Heat Recovery Technologies in Selected Applications

SECTORS & APPLICATIONS

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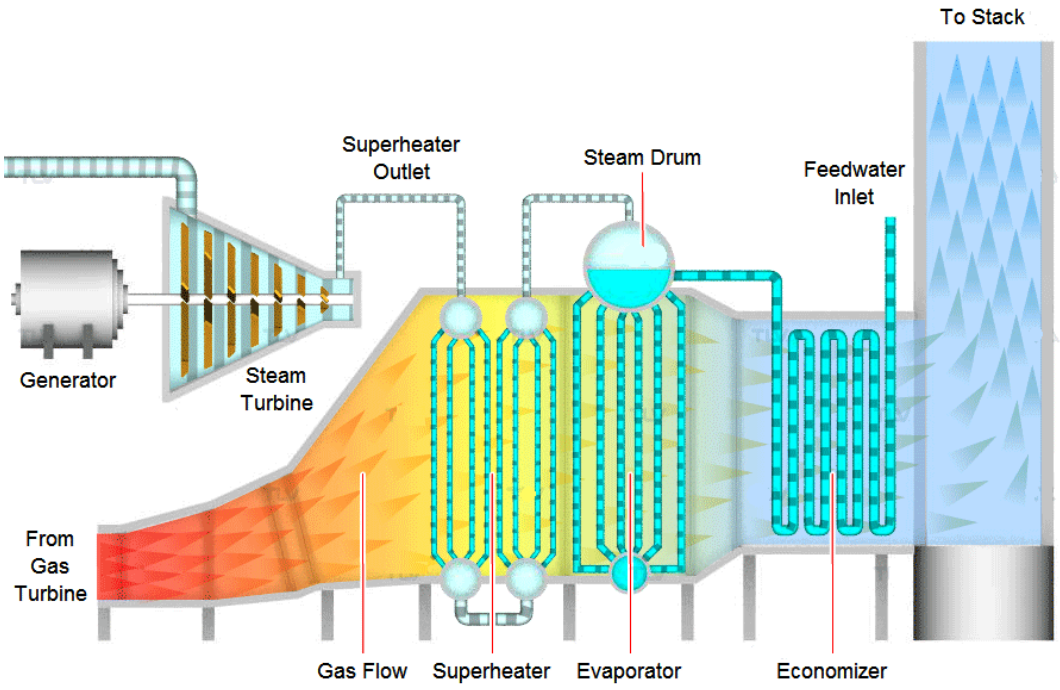
FITZER work across many sectors of business and can provide heat recovery systems for a diverse range of heat sources.
Our design team is available to discuss your particular requirements and tailor a system to suit you.

Sector	Heat Source	Application
Automotive	Furnace	Air Heating
Metals		Combustion Pre-heat
Construction	Kiln	Drying
Bricks		Building heating
Asphalt	Boiler	
Glass		Water
Ceramics	Oven	Process feed water
Food		ORC Power generation
Mining	Generator Set	
Oil & Gas		Thermal Oil
Exploration	Once Through Steam Generator	Thermal transmission
Processing		ORC Power generation
Generation	Thermal Oxidiser	
Pharmaceutical		Steam
Printing/Paper	Incinerator	Process
Waste to energy		



WASTE HEAT RECOVERY SYSTEM

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