Küttner Energy GmbH

Dipl.-Ing. Joachim Praeger

Engineering and Contracting worldwide

KÜTTNER

Content

1. Company

Küttner GmbH & Co. KG
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Managing directors:

Dr.-Ing. Christian Bartels-von Varnbüler
Dr. Karl Isken
Dr.-Ing. Christian Malek
Dipl.-Ing. H.-Jaan Rachner (deputy)

Company – head quarter – managing board of directors

- **KÜTTNER** was founded in 1949 by Dr. Küttner and has ever since developed into a group of mid-sized companies mainly acting in international plant engineering and construction.
  - 1949 starting with handling and conveyor technique
  - from 1960 followed by construction of large charging systems for blast furnaces
  - and 1970 Introduction in furnace construction
  - From 1980 starting the internationalization
  - from 1990 followed by development of the Non-Ferrous Technology
  - and 2000 development of the Energy and Environmental Technology
- In the **KÜTTNER Group** more than 550 specialists are employed (about 250 in Germany)
- The annual sales is approx. 150 - 200 Mio.-Euro

INDUSTRIES

- **Steel Mills**
- **Foundries**
- **Non-Ferrous**
- **Environmental**
- **Energy Generation**

TECHNOLOGIES

- **Material Handling**
- **Industrial Furnaces**
- **Heat Recovery Systems**
- **Flue Gas Cleaning Systems**
- **Automation**

SERVICES

- **Planning**
- **Design**
- **Delivery**
- **Construction**
- **Commissioning**

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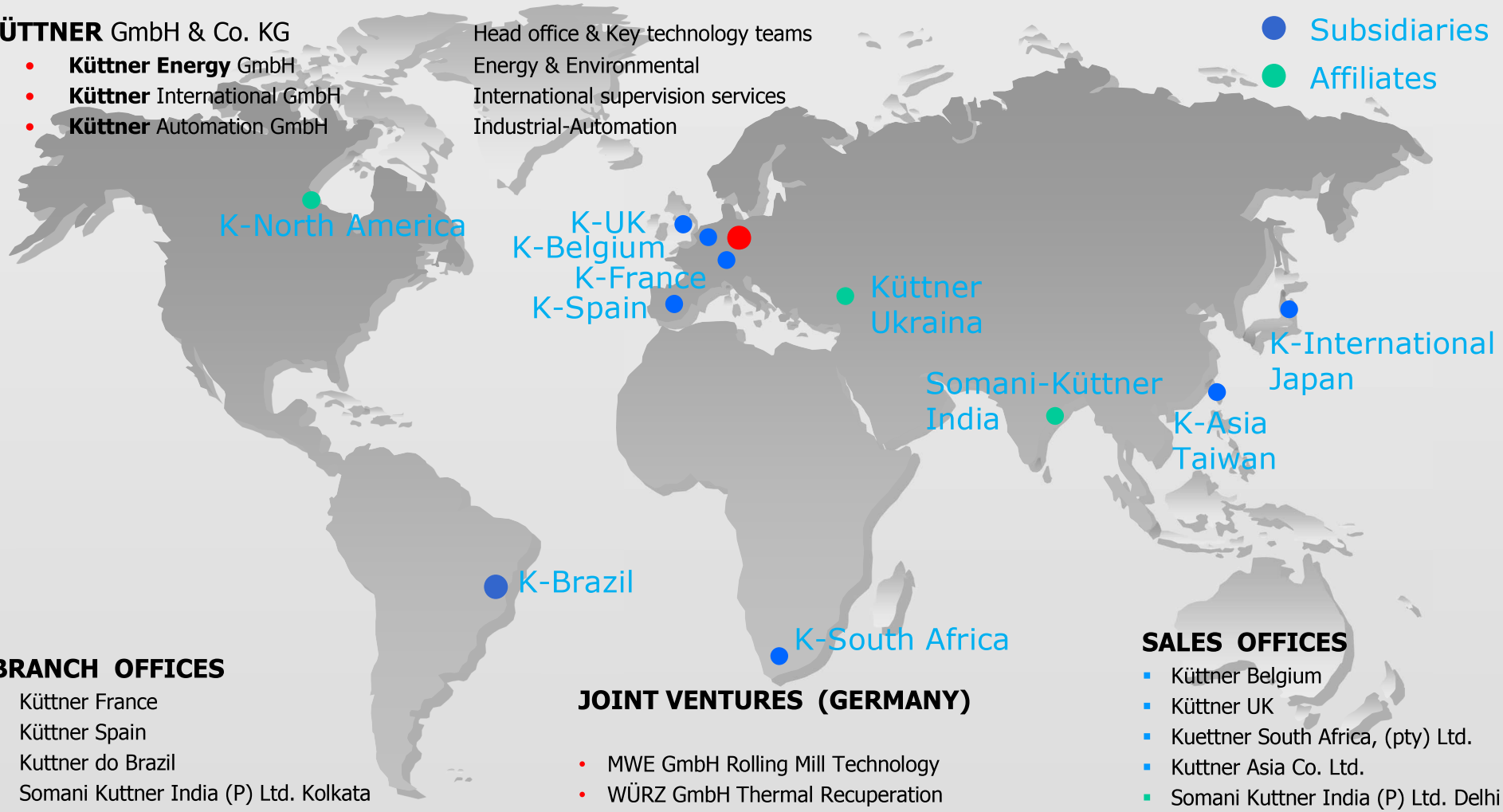
KÜTTNER GmbH & Co. KG

- **Küttner Energy** GmbH — Head office & Key technology teams
- **Küttner** International GmbH — Energy & Environmental
- **Küttner** Automation GmbH — International supervision services
  Industrial-Automation



BRANCH OFFICES

- Küttner France
- Küttner Spain
- Kuttner do Brazil
- Somani Kuttner India (P) Ltd. Kolkata
- Kuttner North America

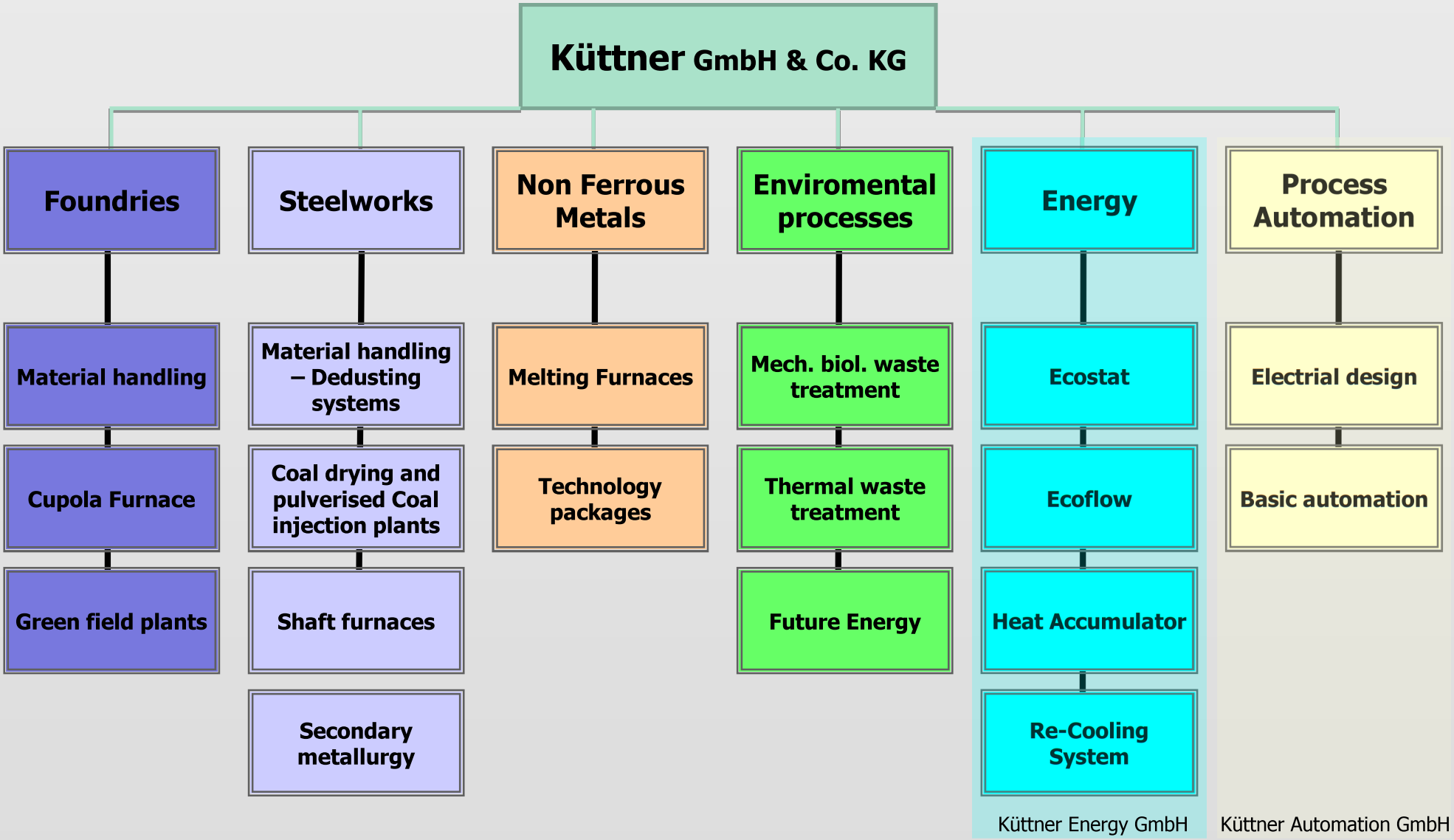
JOINT VENTURES (GERMANY)

- MWE GmbH Rolling Mill Technology
- WÜRZ GmbH Thermal Recuperation Engineering

SALES OFFICES

- Küttner Belgium
- Küttner UK
- Kuettner South Africa, (pty) Ltd.
- Kuttner Asia Co. Ltd.
- Somani Kuttner India (P) Ltd. Delhi
- Representation Küttner Ukraine

Branch offices acting as full local supplier with access to the Group´s German technology. Know-how transfer and close relation to the customers from domestic offices. The overseas workforce is about 250 employees and about 50 representatives

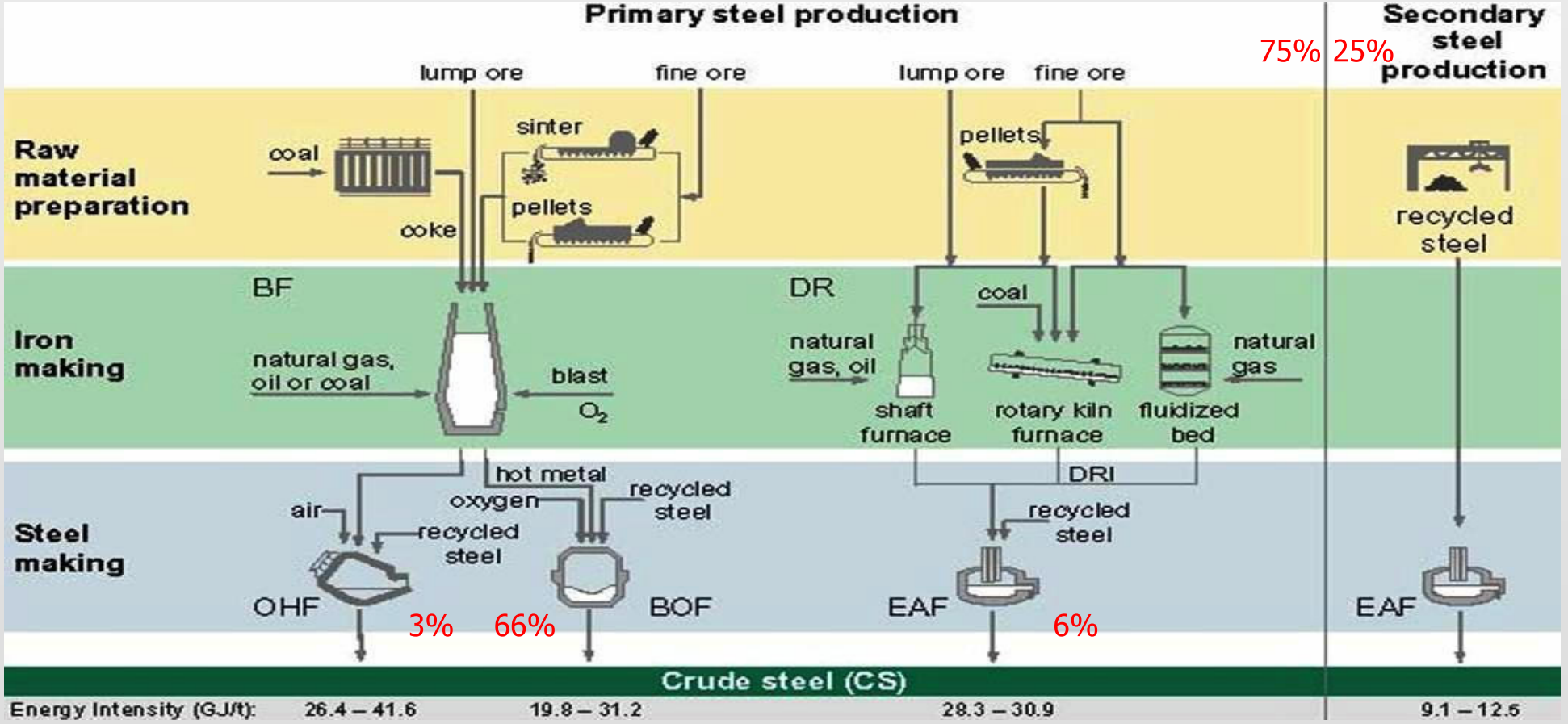


Company – departements and products

- **Küttner Energy** was on the market for more than **25 years** as **GEA** (GWA Wärme- und Anlagentechnik)
- A new strategy and restructuring of GEA Group in **2001** gives **Küttner** Group a first class opportunity to acquire GWA which fits perfectly into the heat recovery strategy of the Küttner products for steel and other applications.
- **Küttner Energy** holds
    - the same experienced experts,
    - the design **software**,
    - the availability of GEA **workshops** (including all essential certificates, e.g. TÜV, Druckbehälterverordnung, AD2000 DGRL 97/23/EG etc.)
    - the access to GEA **Research and Devolpment Department.**
- Today**, Küttner Energy** enacts more than **30 years experience** for plants in **waste heat recovery systems** for steelworks, power plants, cement industry, glass industry, chemical industry, etc.

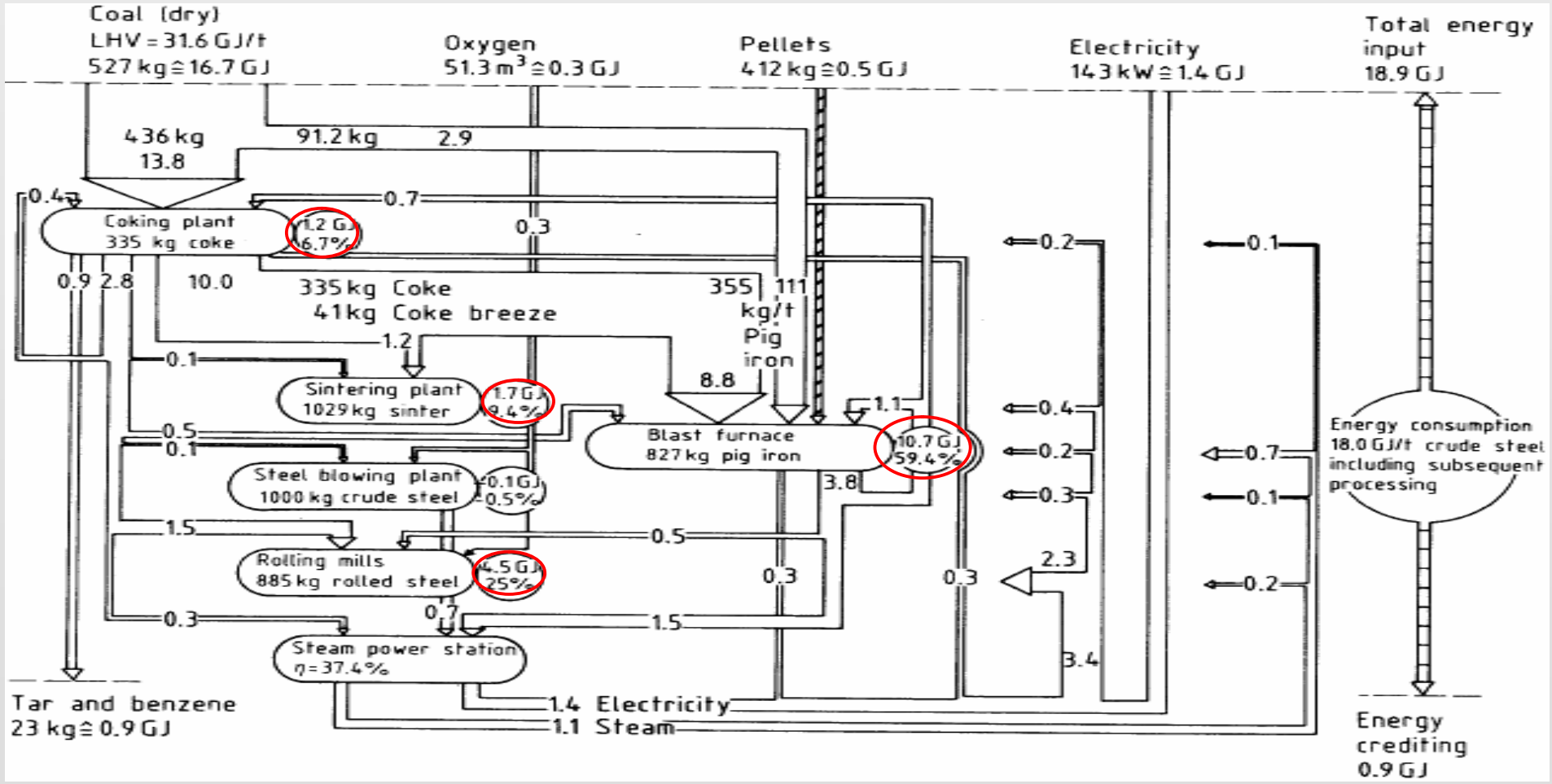
Content

Integrated steel mills - crude steel production methods



Source: World Steel Association, Fact sheet "Energy" October 2008
Steel production routes and energy intensity per route (in units of GJ per tonne of crude steel produced). This figure is for illustrative purposes only, as the steelmaking process can vary from one facility to another. Energy intensity is shown as a range because it varies depending on steel grade produced and technology used. Energy intensity values are based on CO2 intensity values from worldsteel 2007 data. The CO2 intensity values include direct and indirect emissions from coke making, sintering, iron making, casting and rolling. Mining is not included.

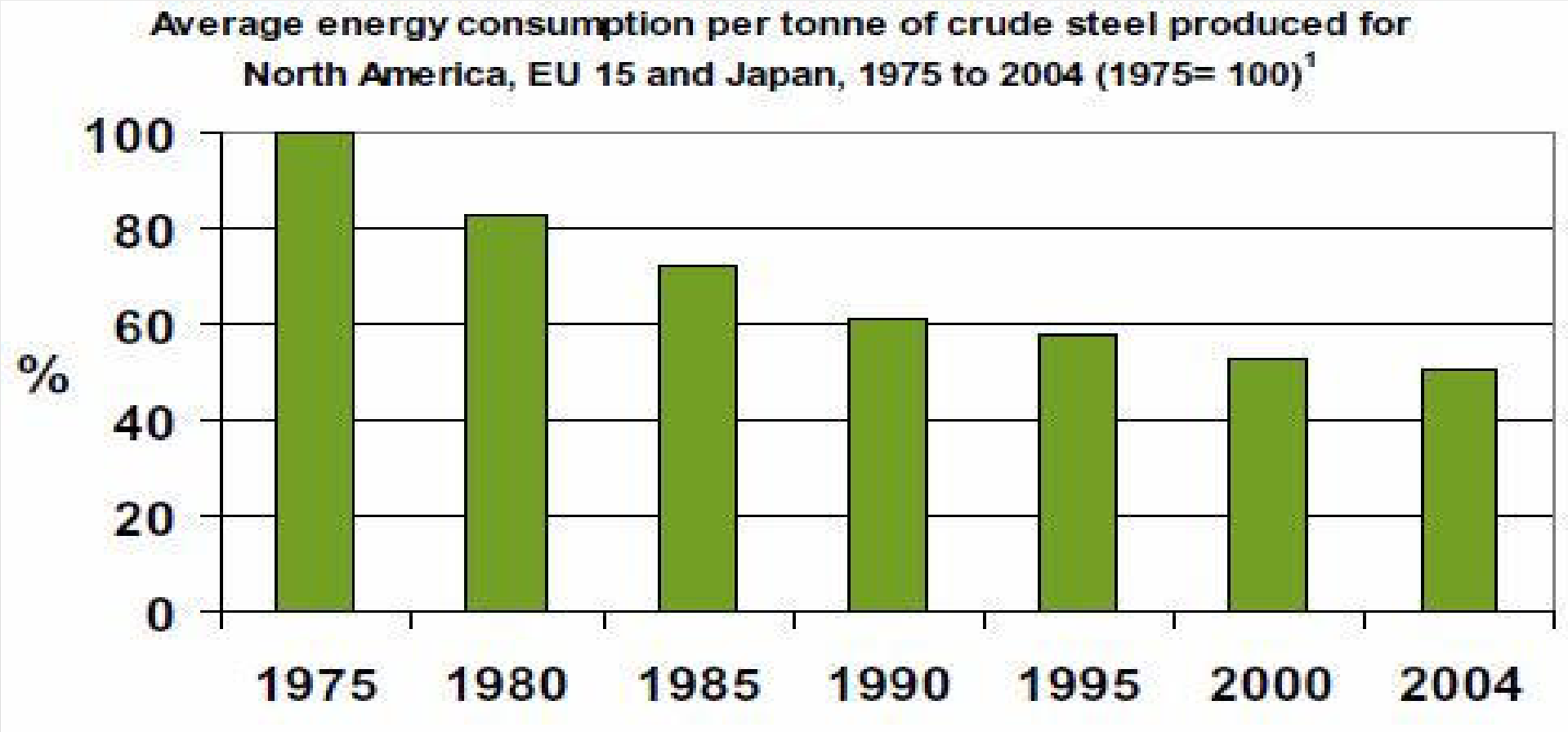
Integrated steel mills - energy streams



Source: European Commission, Integrated Pollution and Prevention Control, Reference Document on BAT for the Production of Iron and Steel, December 2001

Integrated steel mills – Typical energy demand distribution in an integrated steelworks per ton of crude steel - [Ullmann's, 1989].

Integrated steel mills - Improvements in energy efficiency



Improvements in energy efficiency have led to reductions of about 50% in energy required to produce a ton of crude steel since 1975 in most of the top steel producing countries

Source: World Steel Association, Fact sheet "Energy" October 2008

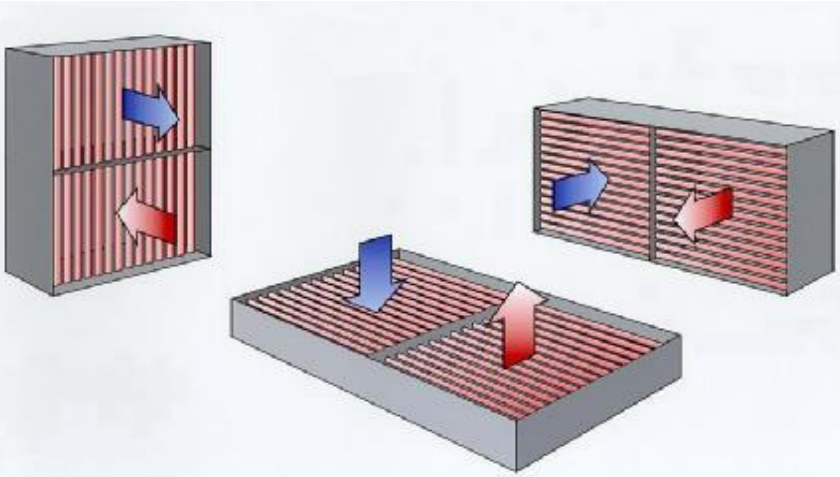
Content

2a. Ecostat Heat Pipe System

- The Ecostat Heat Pipe System is used as heat exchanger between two gas streams using a working medium inside by taking advantage of combine the principles of both thermal conductivity and phase transition.

- **Characteristics**
- Simple plant geometry, compact design
- Arrangement horizontal or vertical
- Gas-tight, no leakage between the fluids (gases)
- Large number of independent pipes
- Minor pressure drops (fan power consumption)
- No control and safety elements necessary
- No moving parts, no propulsion energy
- Ease of erection (modular); ease of inspection
- High reliability and availability

- Working fluid evaporates by absorbing heat of hot gas
- Vapor migrates along cavity to lower temperature end
- Vapor condenses to liquid by releasing the heat to cold gas
- Working fluid returns to higher temperature end



Ecostat-Heat-Pipe-System - principle

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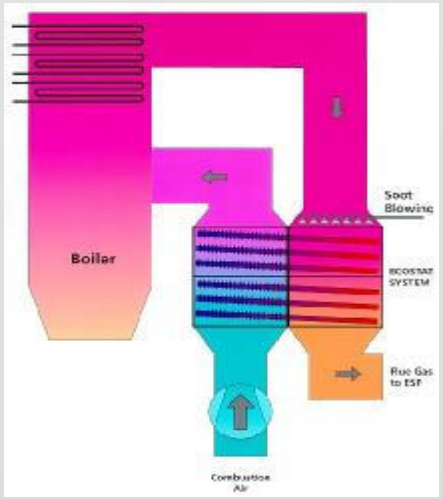
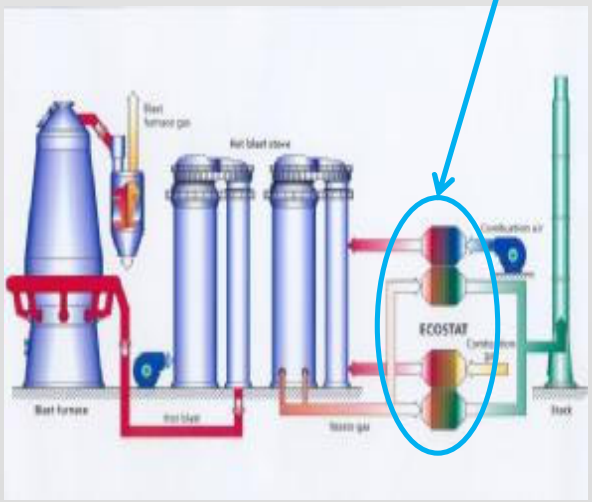
Ecostat-Heat Pipe System

- **Applications**
- Boiler Air Pre-Heating (APH)
- Air and Gas Preheating in Steel Industry (COWPER)
- Around Catalytic Converter (DENOx)
- Around Flue Gas Desulfurisation (FGD)

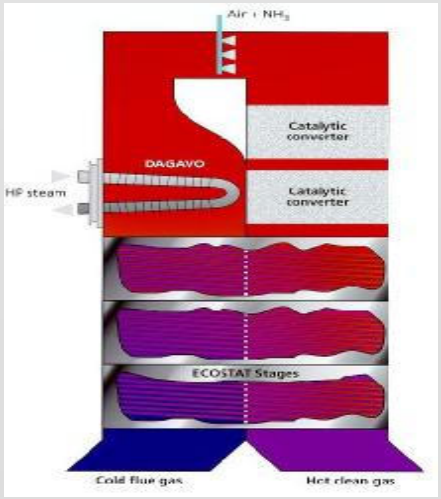
- **APH**



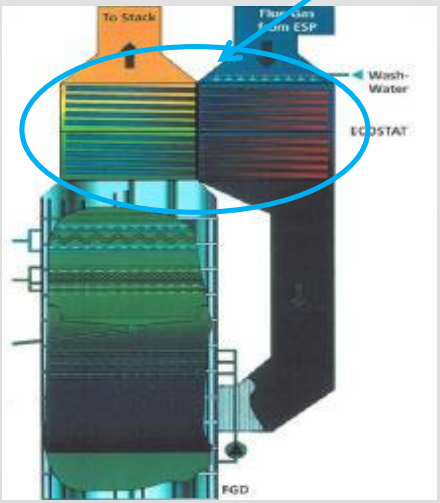
- **COWPER**

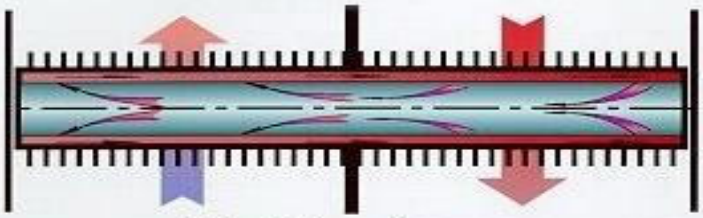


- **DENOx**

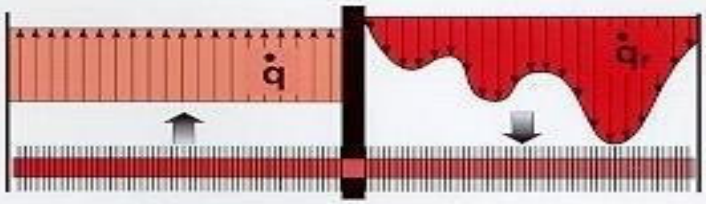


- **FGD**

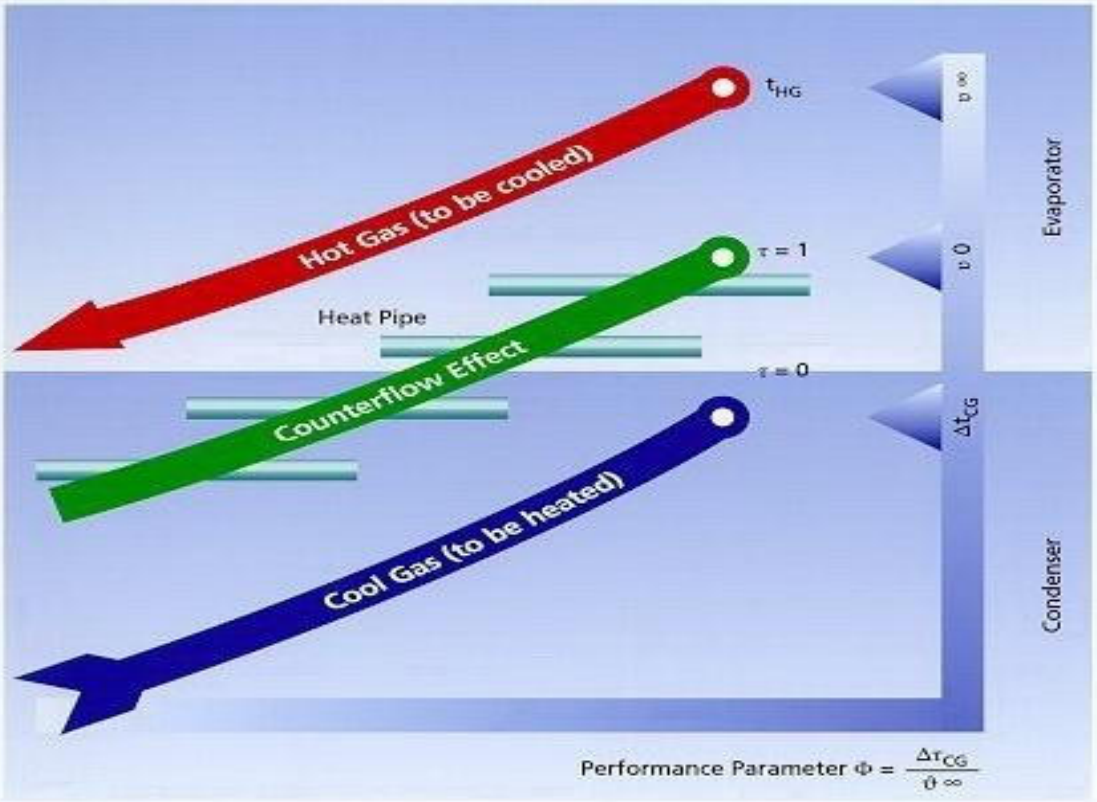


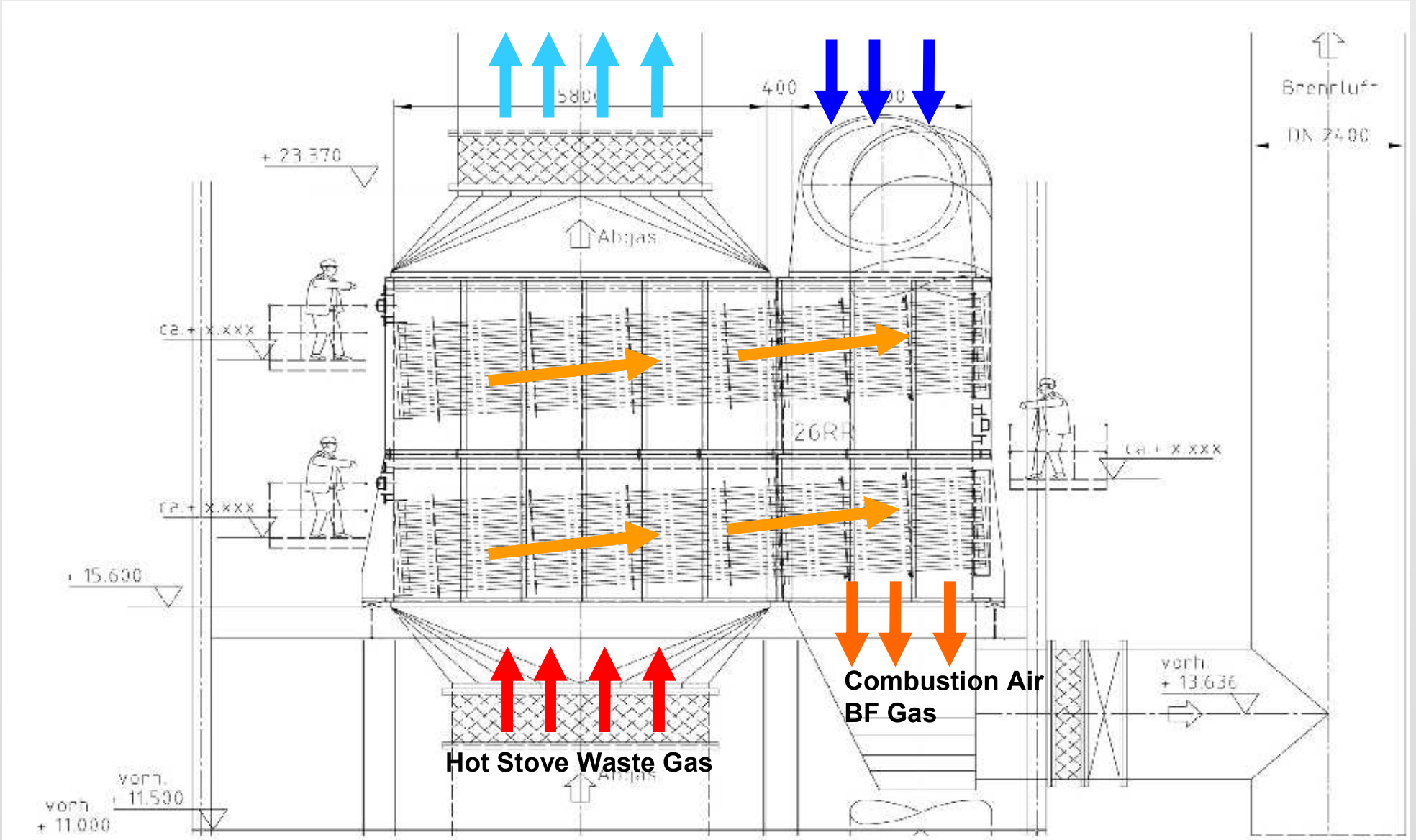


Working diagram of a heat pipe



Heat pipe working as temperature-profile rectifier





Ecostat-Heat-Pipe-System – principle flow directions

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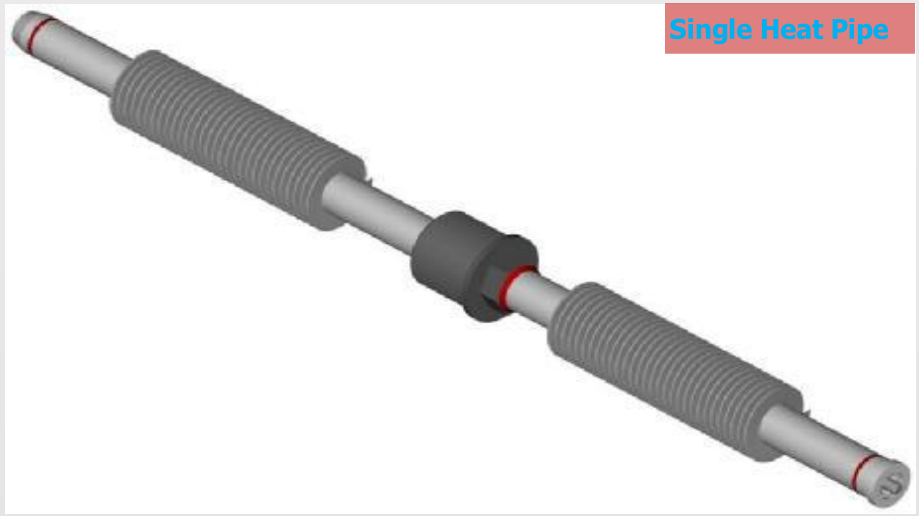
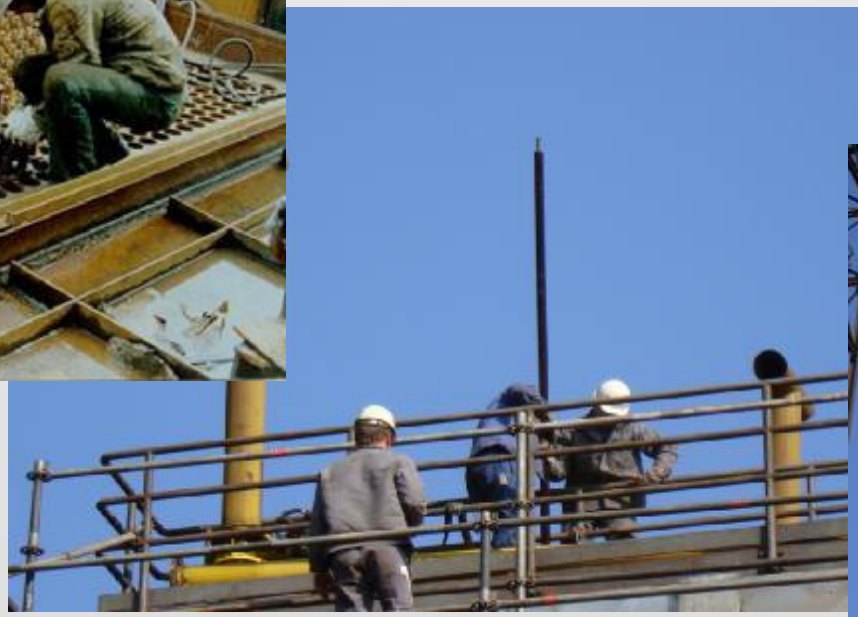
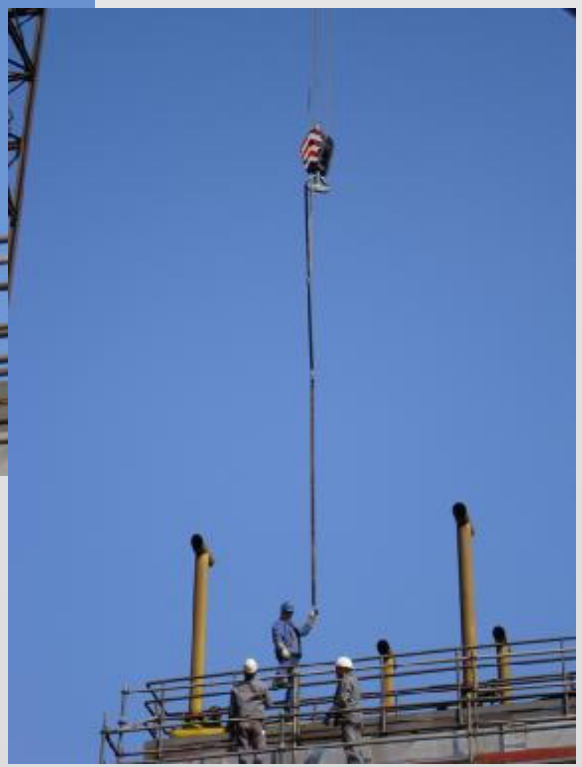

Single Heat Pipe


Partition plate the gas tight separation of both gas sides


Each singe Heat Pipe is tested in the thermal test box.
(100% tested)





Ecostat-Heat-Pipe-System - Changing of a single Heat Pipe

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Ecostat-Heat-Pipe-System – erection at CSC Taiwan BF 4

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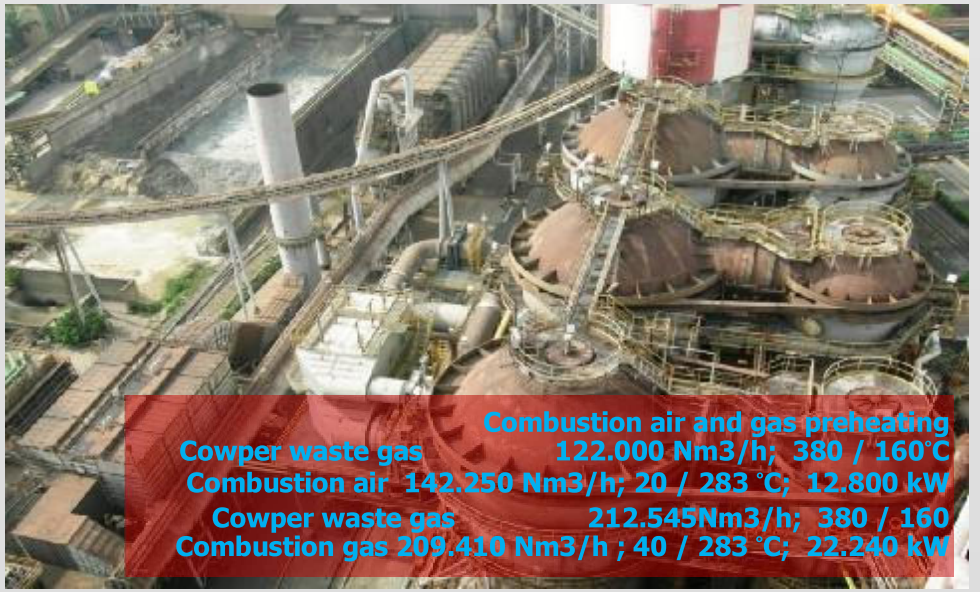

Ecostat-Heat-Pipe-System – erection at CSC Taiwan BF 4

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Ecostat-Heat-Pipe-System – Rogesa, Dilinger Stahlwerke, BF 5

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Ecostat-Heat-Pipe-System – JWS Steel Limited, BF 3

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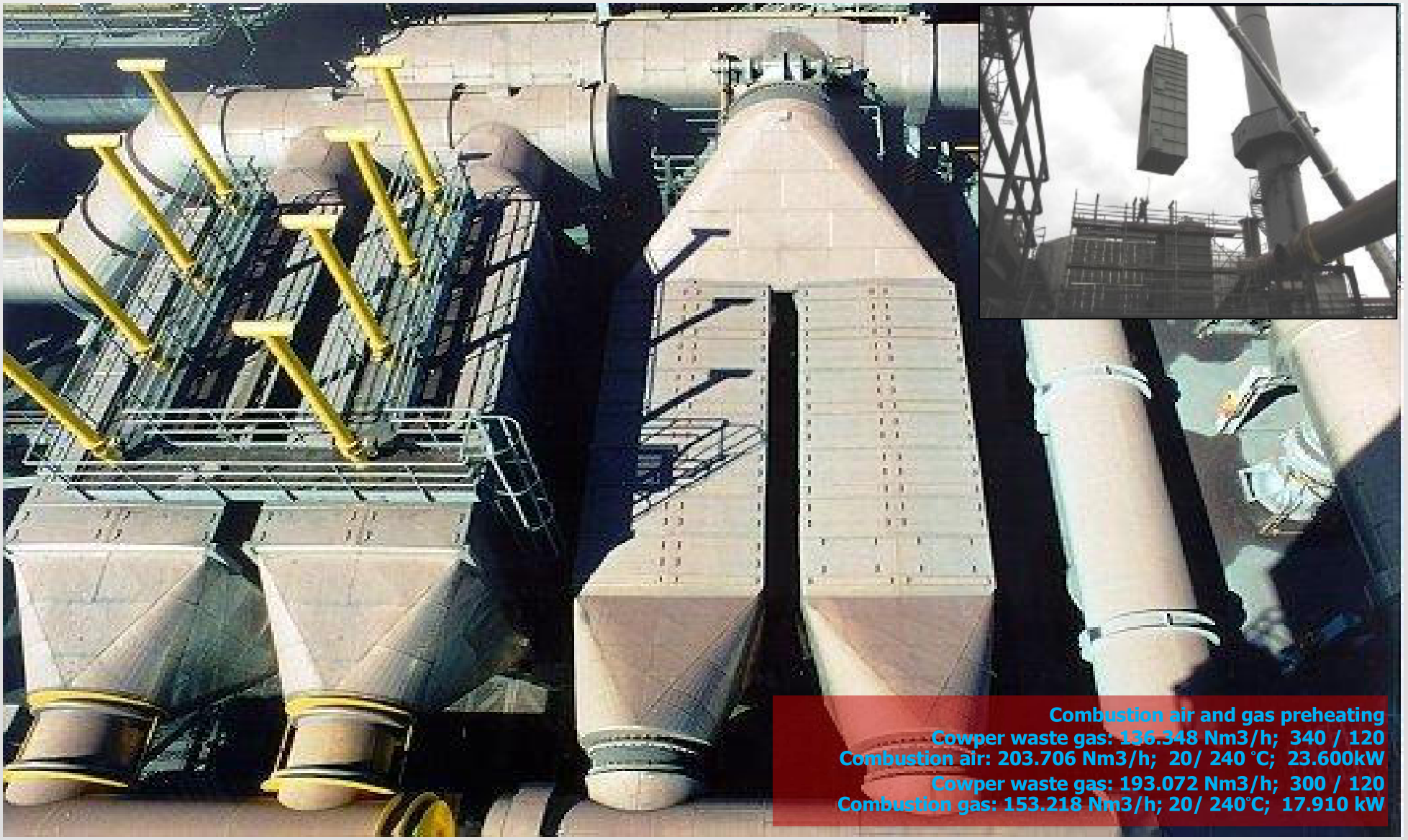

Ecostat-Heat-Pipe-System - HKM Duisburg BF B

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Ecostat-Heat-Pipe-System - GKW Dillingen
(blast furnance gas power plant) – model -

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Ecostat-Heat-Pipe-System - GKW Dillingen
(blast furnance gas power plant) – real execution -

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Combustion air and gas preheating
Waste gas: 83.840 Nm3/h; 305 / 150°C
Combustion air 94.155Nm3/h; 20/ 215°C; 6.710 kW
Waste gas: 108.700 Nm3/h; 305/ 150°C
Combustion gas 113215 Nm3/h; 20/ 215°C; 8355 kW

Ecostat-Heat-Pipe-System - CST Brasil BF 2

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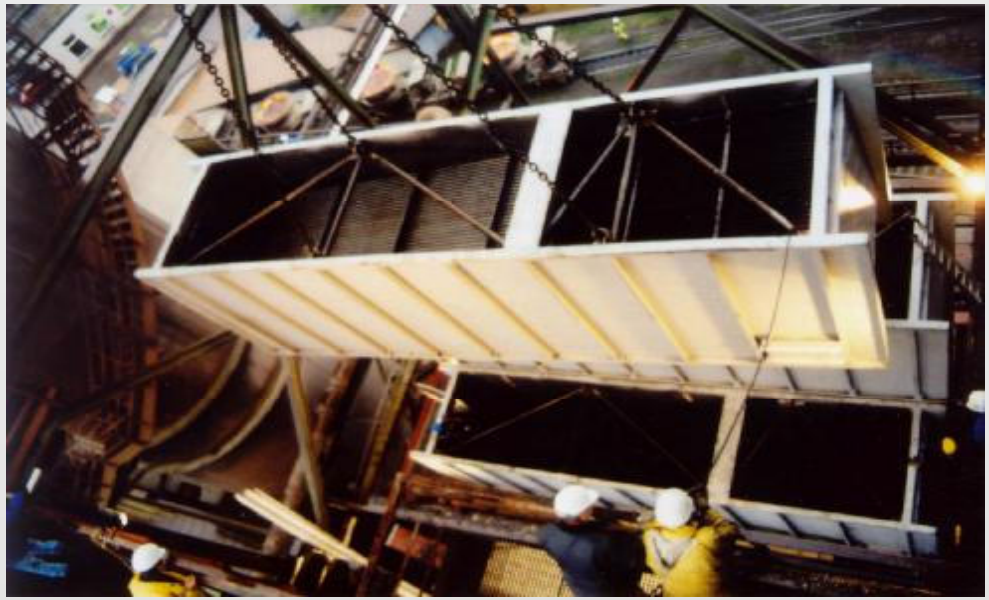

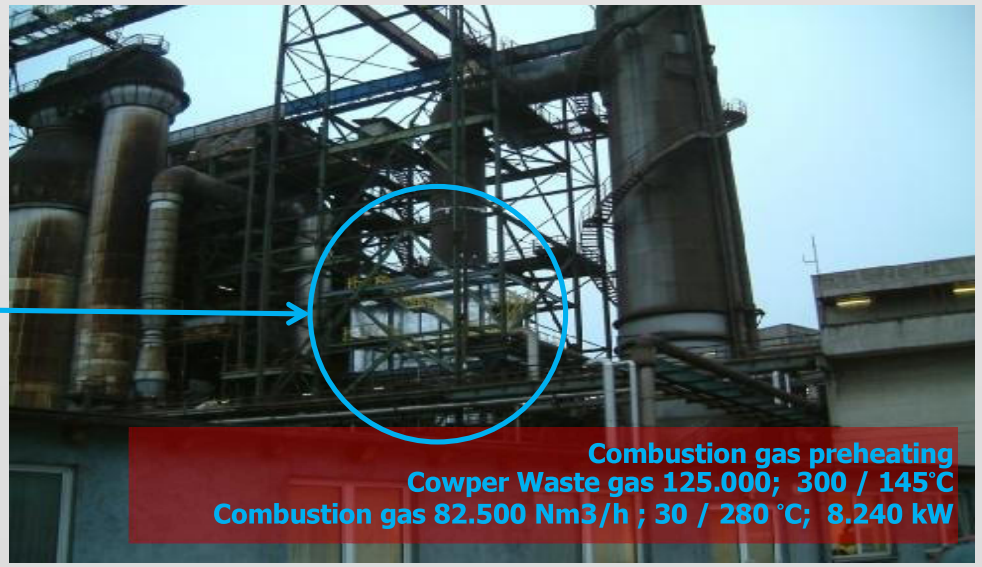

Ecostat-Heat Pipe – Replacement of a different type of heat exchanger at Voest BF, Austria

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Ecostat-Heat-Pipe-System – SSAB Oxelösund, Sweden

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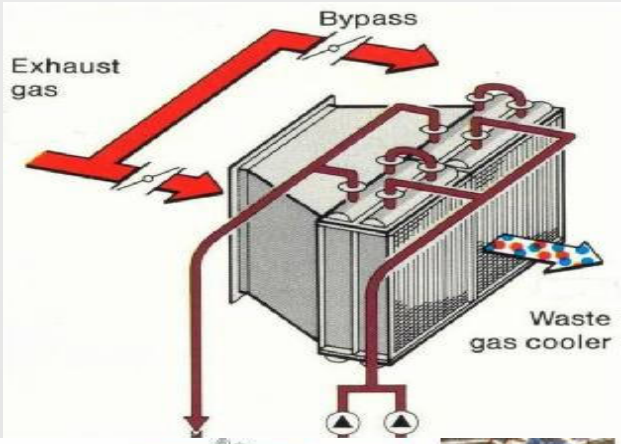
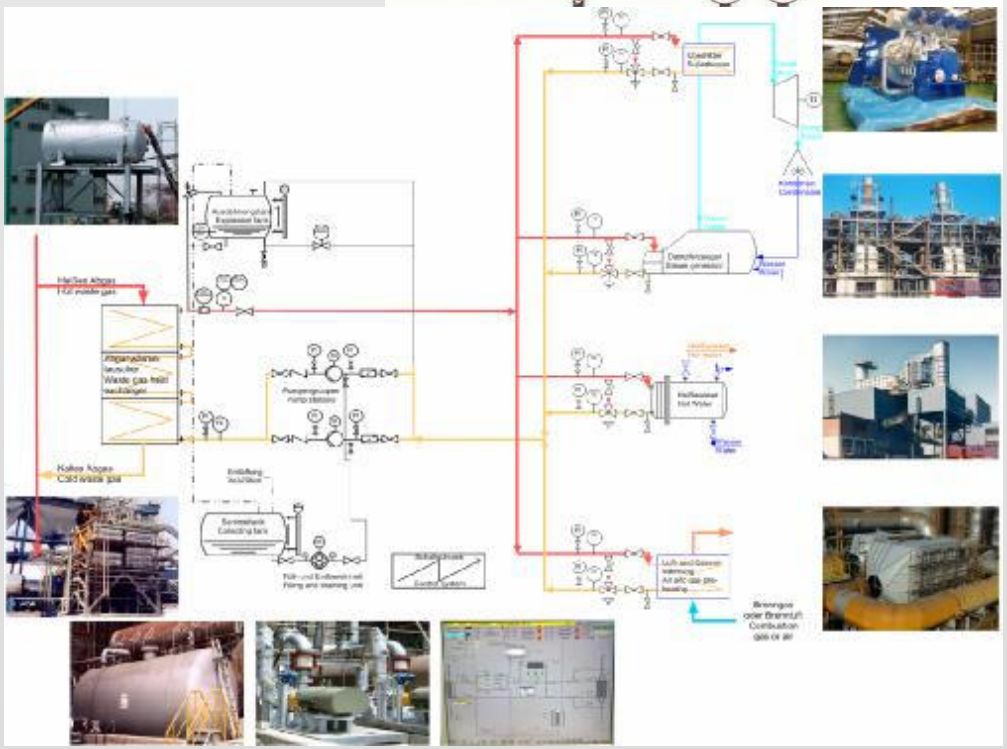
Content

2b Küttner Ecoflow System



- The Ecoflow System is used to recover and transfer heat from waste gases to any heat consumer by using a suitable heat transfer medium (steam, water, thermal oil).

- **Characteristics**
- Simple heat exchange technology
- Heat duties from 100 to 50.000 kW
- Heat Transfer fluid: prefered water or thermal oil
- Large distances between heat source and consumer
- High operational flexibility for any consumer
- Adaptable to the requirements of the consumer
- Opportunity for CHP with steam turbine or ORC
- High control ability



Ecoflow System - Principle

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Ecoflow in steel industry waste heat recovery from cupola furnance at Eisenwerk Brühl to gernerate hot water via thermal oil

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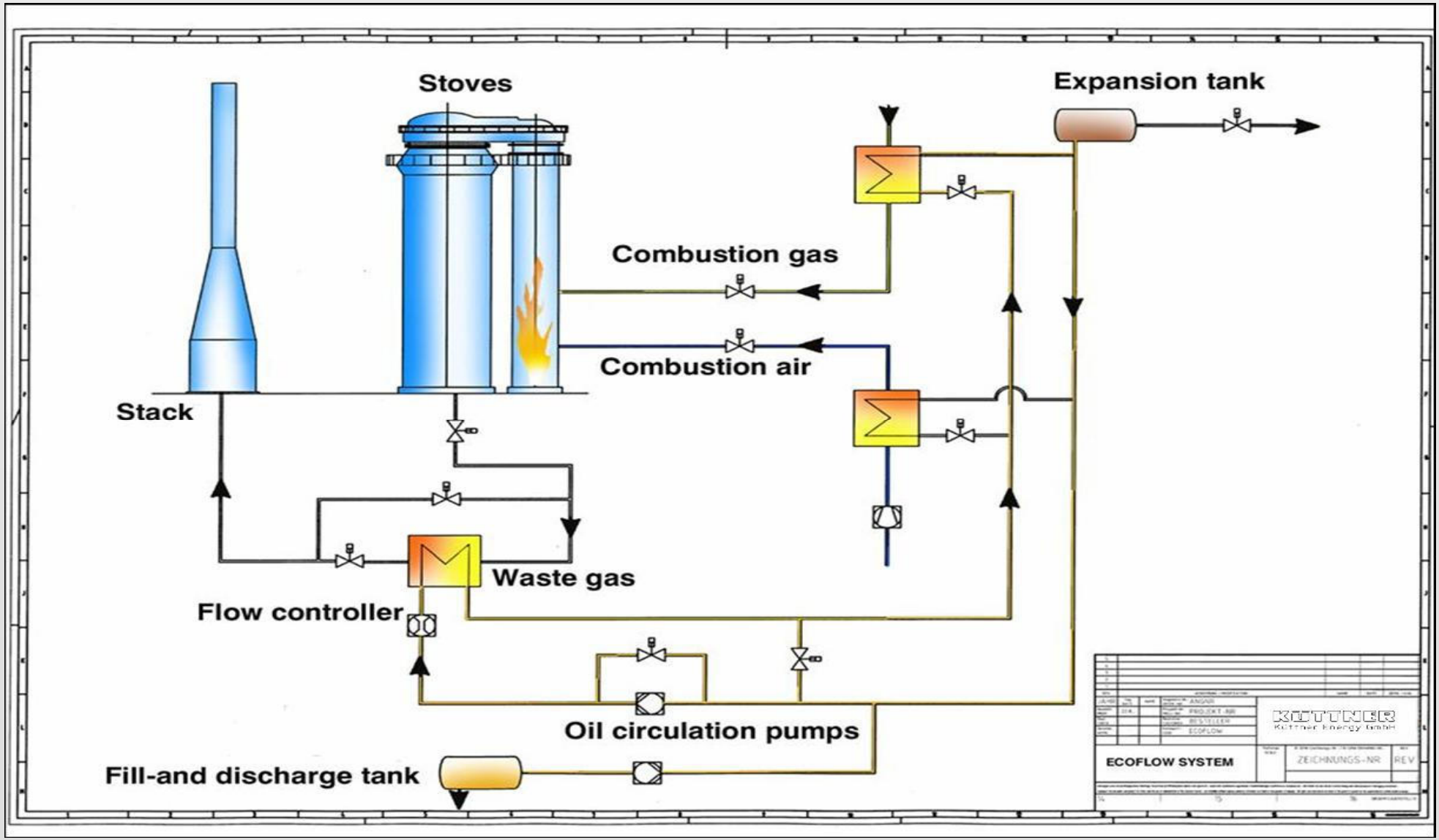
Stoves
Expansion tank
Combustion gas
Combustion air
Stack
Waste gas
Flow controller
Oil circulation pumps
Fill-and discharge tank
ECOFLOW SYSTEM
ZEICHNUNGS-NR
REV

Ecoflow with thermal oil in steel industry, erection at CSC Taiwan
BF3 waste gas side heat exchanger

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Combustion air and gas preheating
Waste gas: 122.000 Nm3/h; 275/ 135°C
Combustion air: 142.200 Nm3/h; 20 / 280°C;
Combustion gas: 220.040Nm3/h; 40 / 280°C;
23.320 kW -> 1. step (exhaust gas)
14.000 kW -> 2. step
(Thermal oil boiler fired by BF-gas)

Ecoflow with thermal oil in steel industry at CSC Taiwan BF3, additionally with direct fired thermoil oil heater

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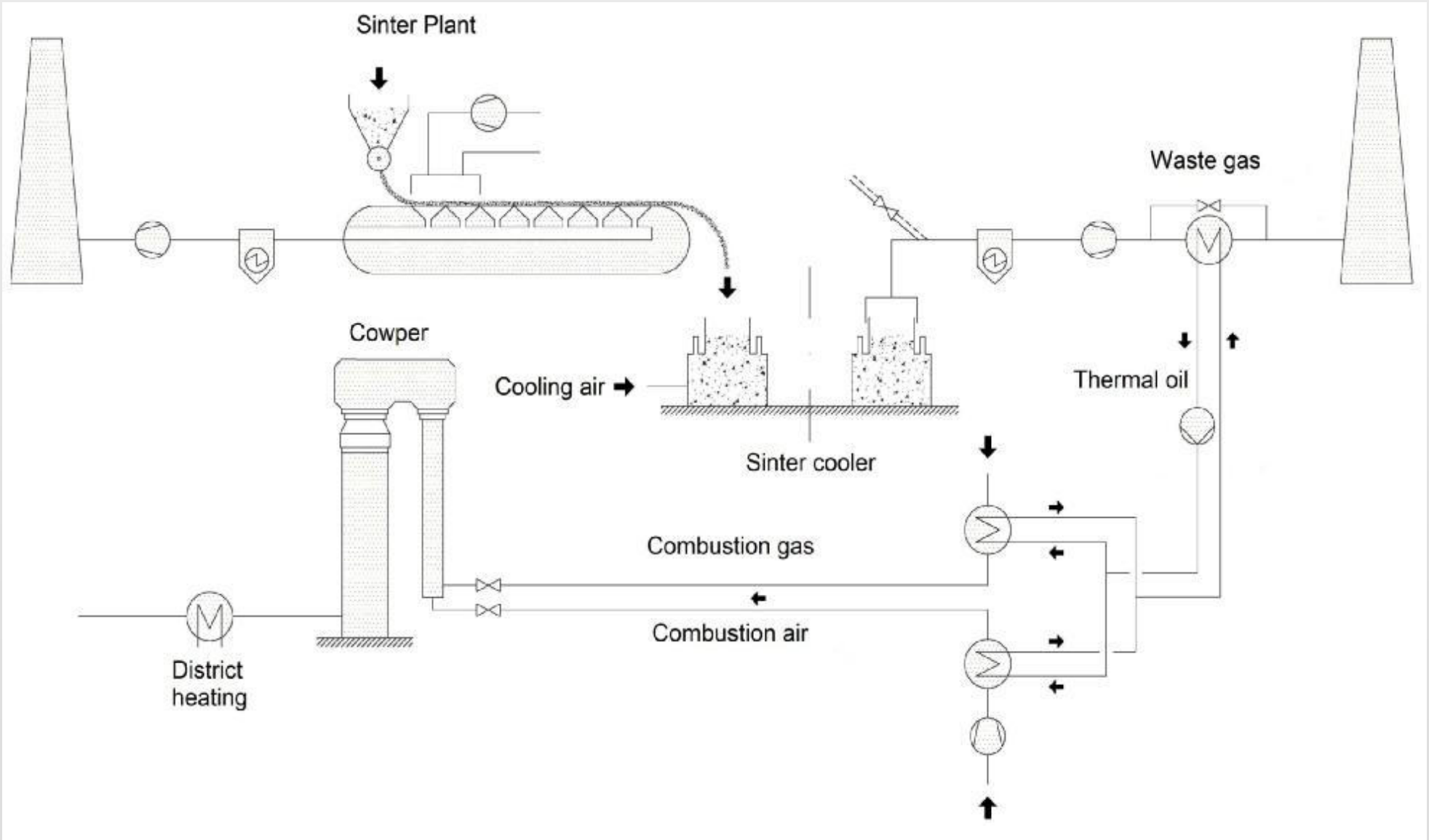
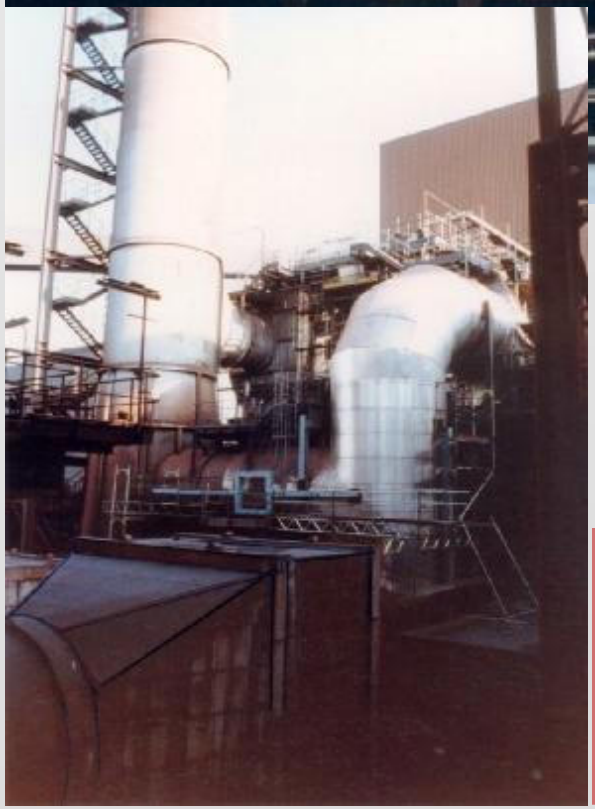


Ecoflow – System - 34 MW Heat recovery at Sinter Cooler Schwelgern, TKS Duisburg for air and gas preheating at BF1



Waste gas flow rate
400.000 Nm3/h
Waste gas temperature
340°C
Thermal oil temperature
95 /270 °C
Capacity
34,3 MW

Ecoflow in steel industry waste heat recovery from sinter cooler at TKS Duisburg Schwelgern for air and gas preheating at BF1

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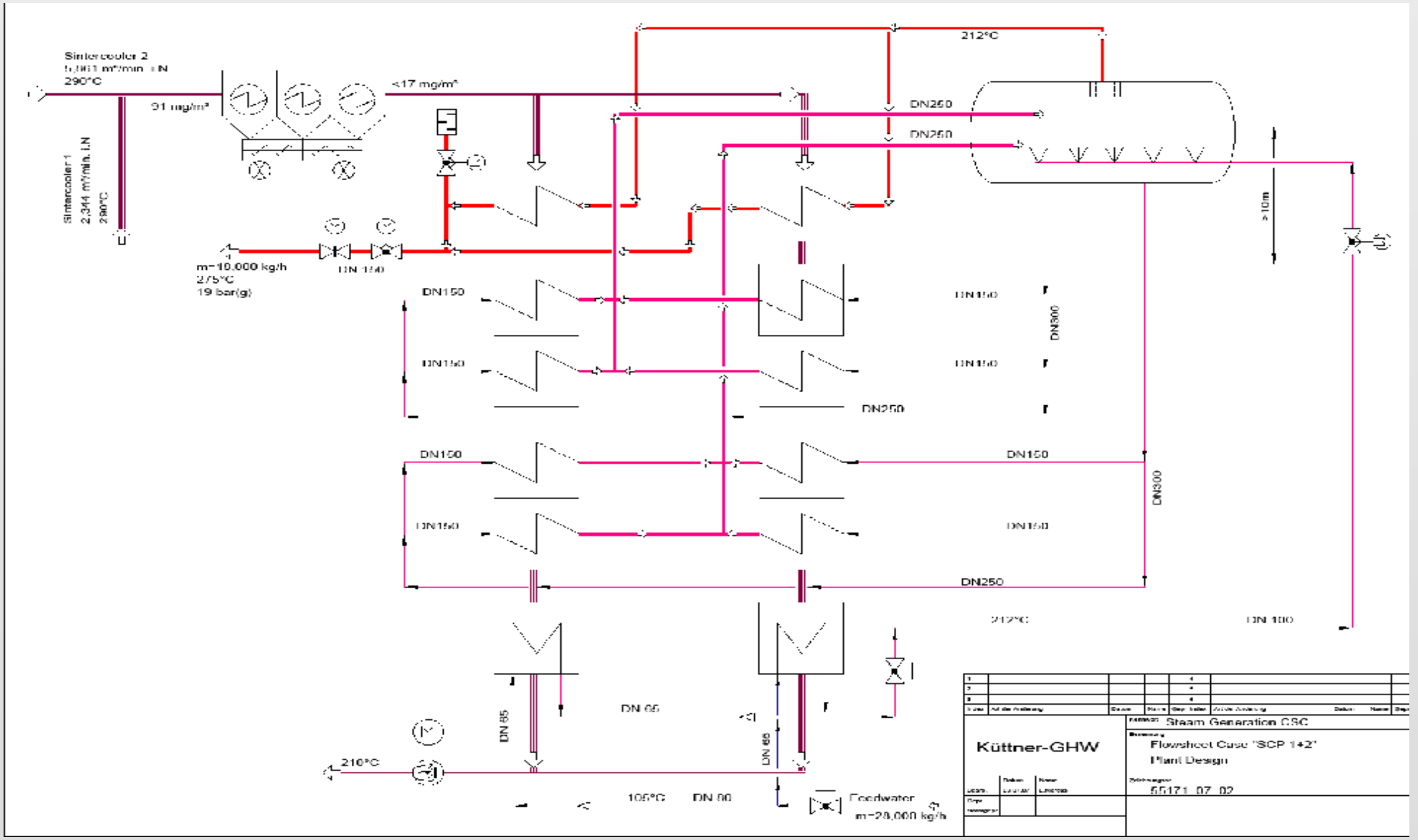
Sintercooler 2
290°C
91 mg/m³
<17 mg/m³
Sintercooler 1
2,344 m³/min, i.N
290°C
m=10,000 kg/h
275°C
19 bar(g)
DN 150
212°C
DN250
DN250
DN150
DN150
DN150
DN150
DN150
DN150
DN250
DN300
DN300
≥10m
DN 65
DN 65
DN 65
210°C
105°C
DN 80
Feedwater
m=28,000 kg/h
Küttner-GHW
Steam Generation GSC
Flowsheet Case "SCP 142"
Plant Design
55171_07_02

Ecoflow in steel industry waste heat recovery from sinter cooler 4 & 5 at Taranto, Italy to generate process steam

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Waste gas flow rate 130.000 Nm3/h
Temperature drop 620 / 250 °C
Hot water 160 / 195 °C
Capacity 20.000 kW_{th}

Ecoflow in glass industry waste heat recovery from flat glas line at Pilkington, Halmstad to generate pressurized hot water

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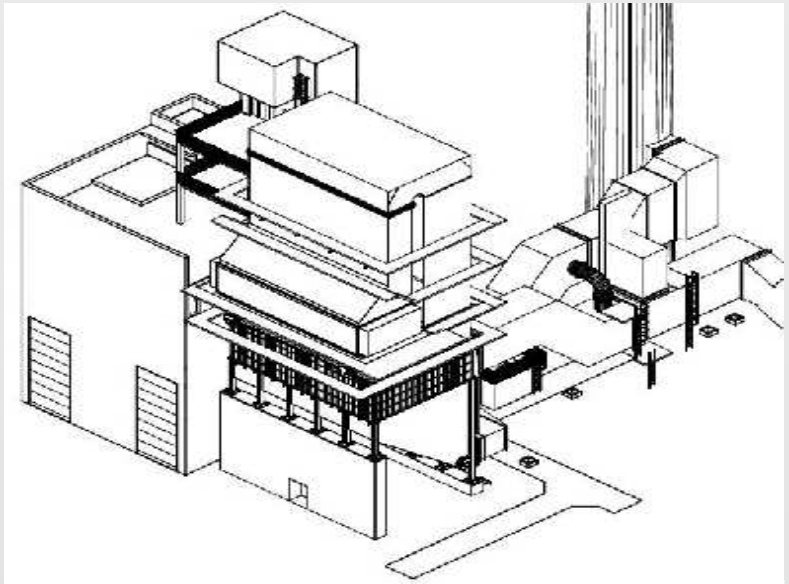
Rohrdorfer Zement, Germany



- Heat recovery from clinker cooling air displaced to waste gas of rotary kiln before SCR of Nox to achieved required temperature of catalyst of the SCR system
- Flow rate 48.000 – 62.000 Nm3/h
- Temperature 410 -> 255°C

- Via thermal oil circuit
- Flow rate 250 m3/h
- Temperature appr. 240 -> 260 °C

- To waste gas heater for SCR of NOx :
- Flow rate 300.000 – 400.000 Nm3/h
- Temperature appr. 230 -> 250°C
- Capacity 2.5 -3.5 MW

Clinker cooler heat exchanger

Heat exchanger at SCR

Ecoflow in cement industry waste heat recovery from clinker cooler at Rohrdorfer Zement to SCR

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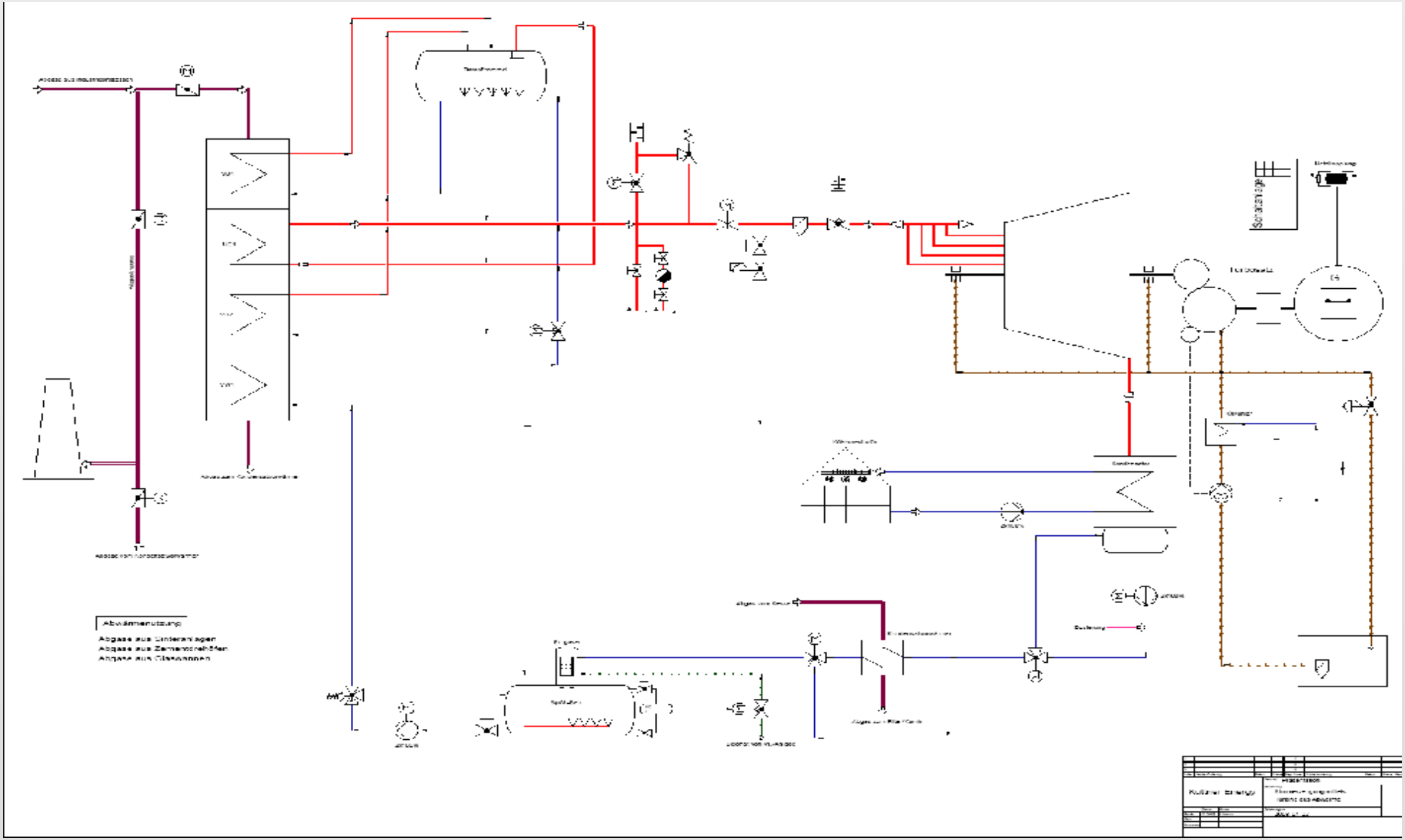
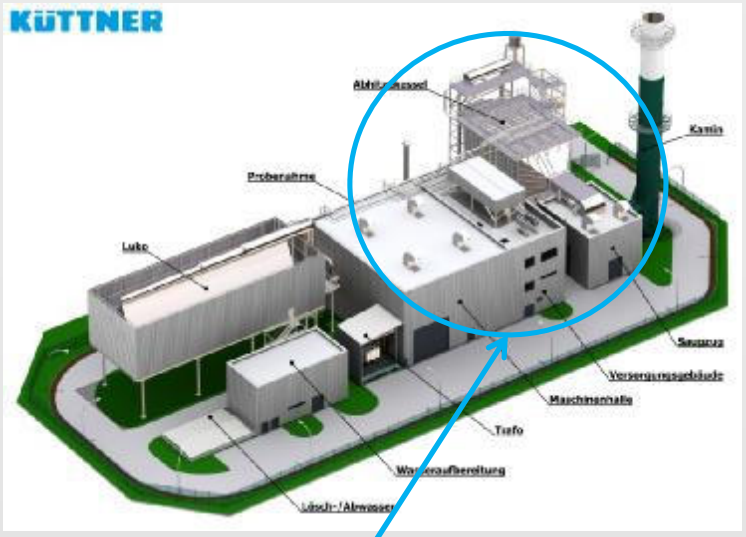


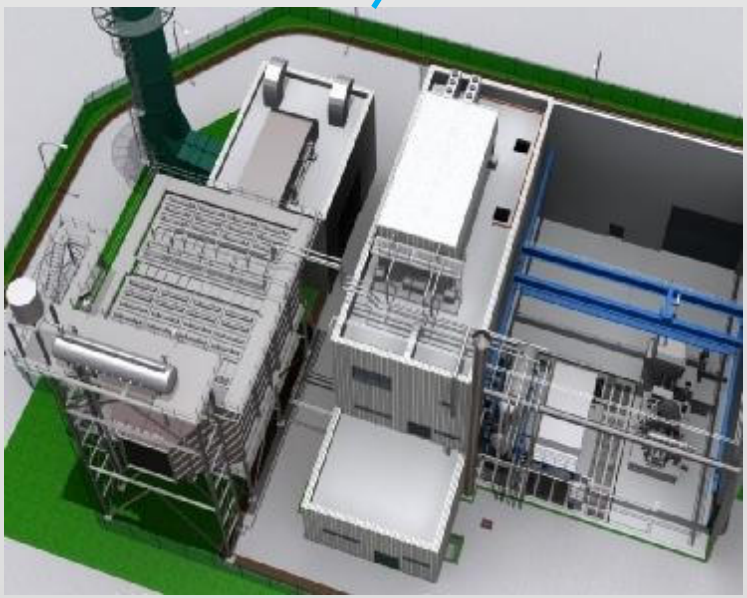
Ecoflow-System for heat recovery with steam and power generation

Trans Austria Gas (TAG), Weitendorf

- Trans Austria Gas Pipeline TAG supplies gas for Austria, northern Italian industrial districts, Slovenia
- TAG enlarges capacity by a gas compressor station

- Küttner **Waste heat recovery from gas compressor station**
- power generation from waste heat 16 MWel
  (Exhaust 390 000 Nm ^{3}/h; 569°C; steam 72 t/h, 480°C)
- corresponds to the needs of approximately 28 500 households with an annual demand of 3500kWh/a each and produced electricity of 100 GWh/a)
- no additional CO2 emissions, power generation from the waste heat of the existing gas compressor
- and 90,000 t/a CO2 are avoided compared to conventional power generation based on coal





Ecoflow in gas industry waste heat recovery from gas turbines in a gas compressor plant with steam and power generation

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Ecoflow at OMV, Austria - Turn key project including civil works, waste heat recovery plant for power generation

Ecoflow in chemical industry waste heat recovery from chemical process at VEBA Münchsmünster to generate steam and power

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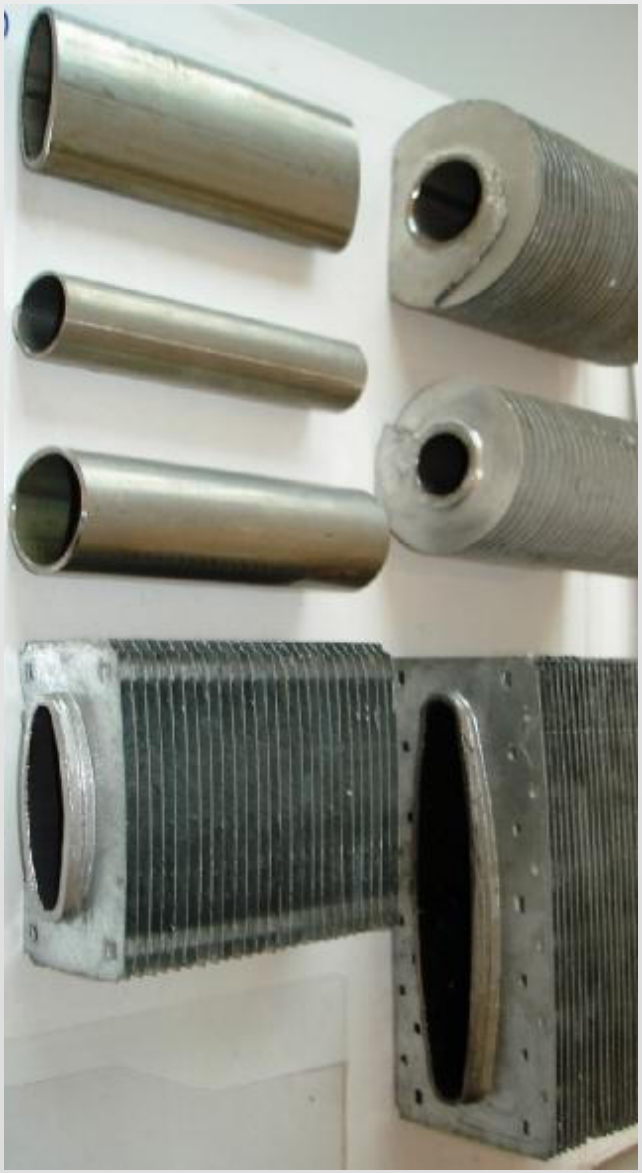
Content



Heat exchanger pipe type round or oval resp. bare or finned

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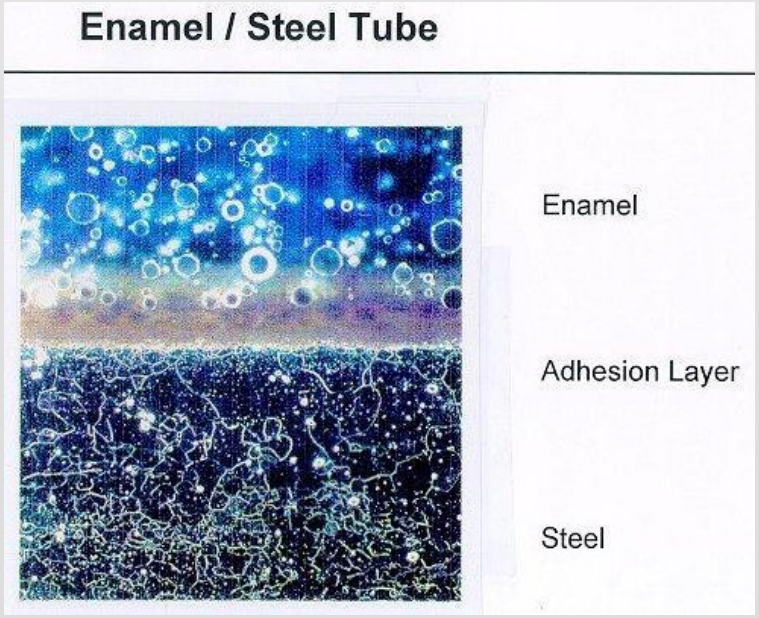
Heat Exchange Surface
deposits on round versus elliptical tubes

- Test series of:
  dust deposit behavior of round and elliptical tubes

- The picture demonstrates the low sensitivity to grow dust deposits on elliptical tubes

Heat Exchange Surface in Refinery

- 1. step heat exchange surface made of carbon steel
  -> temperature above dew point (200°C)
- 2. step heat exchange surface corrosion protected made of carbon steel and enamelled plus plastic coating
  -> temperature below dew point (200°C)



Ecostat-Heat Pipe - Heat exchange surface protected with enamelled

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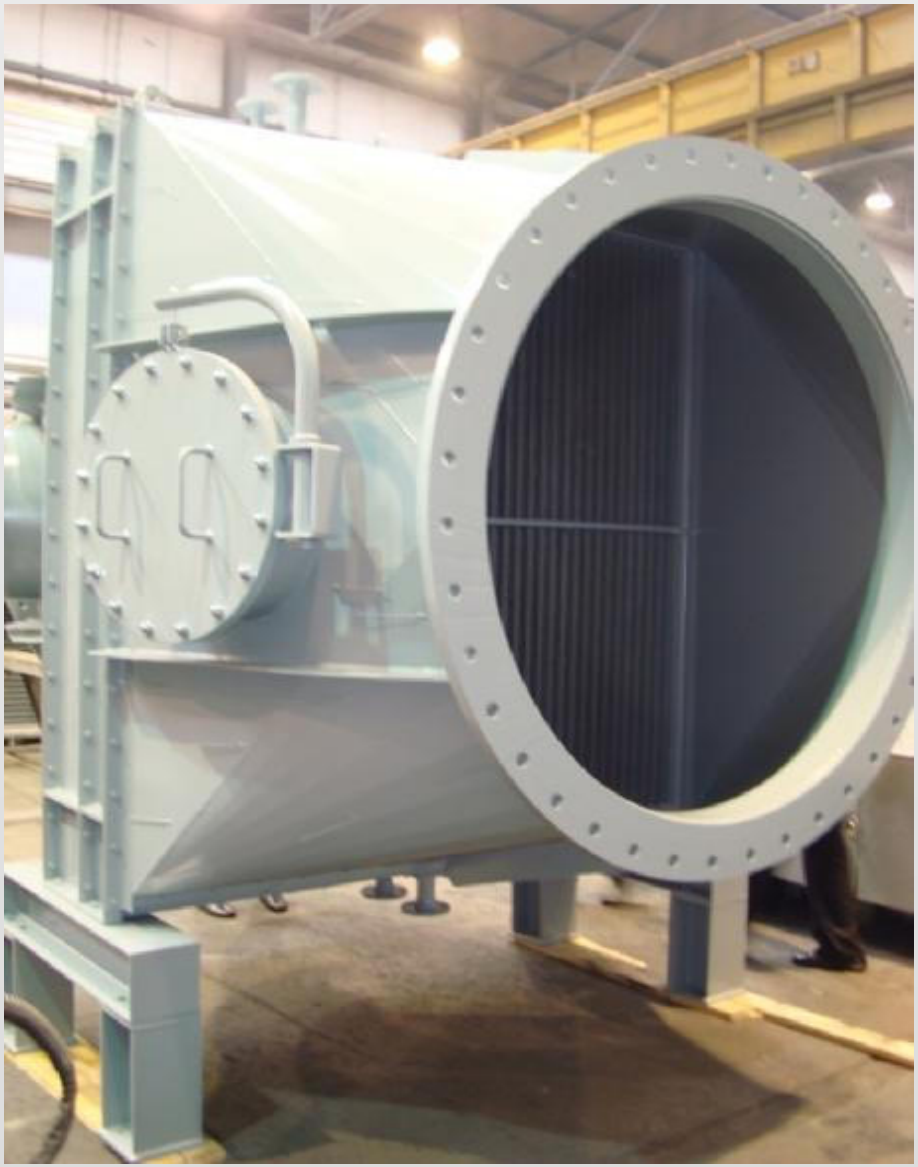

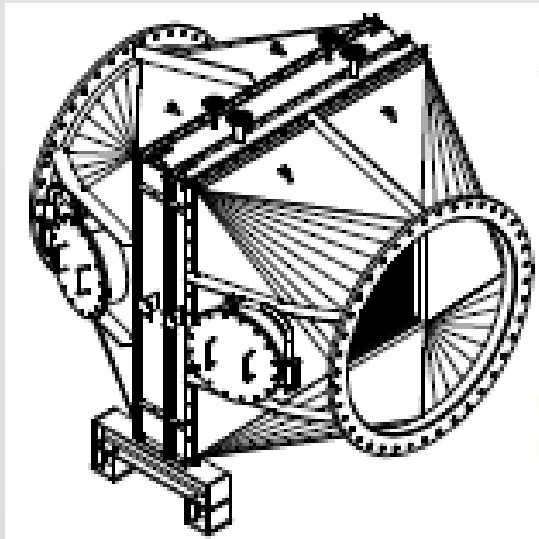

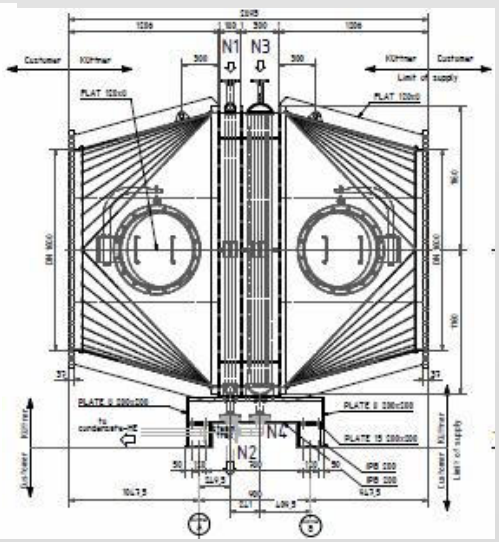

Heat exchanger steam air pre-heater

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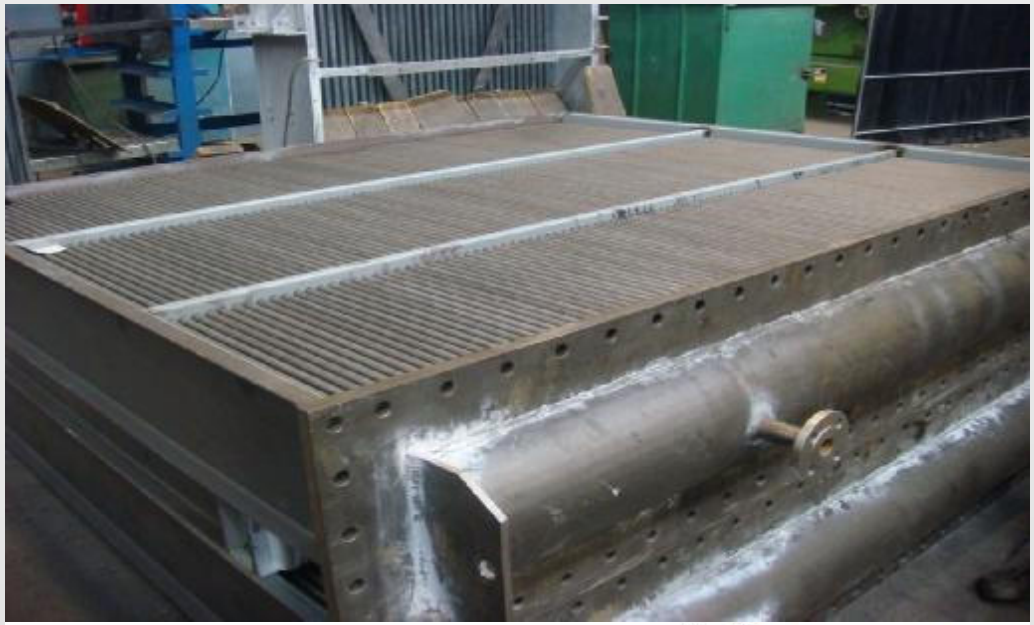

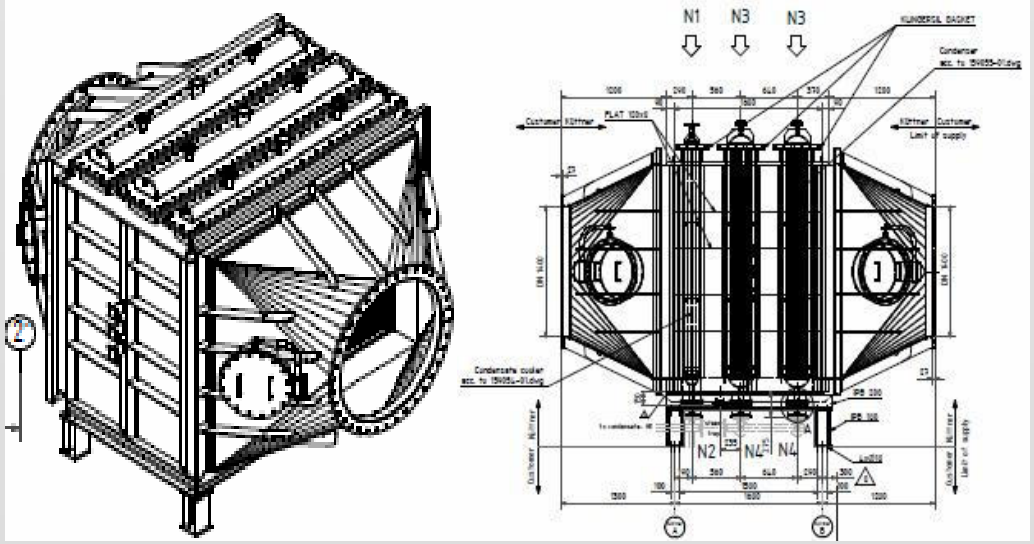

Heat exchanger steam air pre-heater slide-in registers

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Heat exchange surface protection principle

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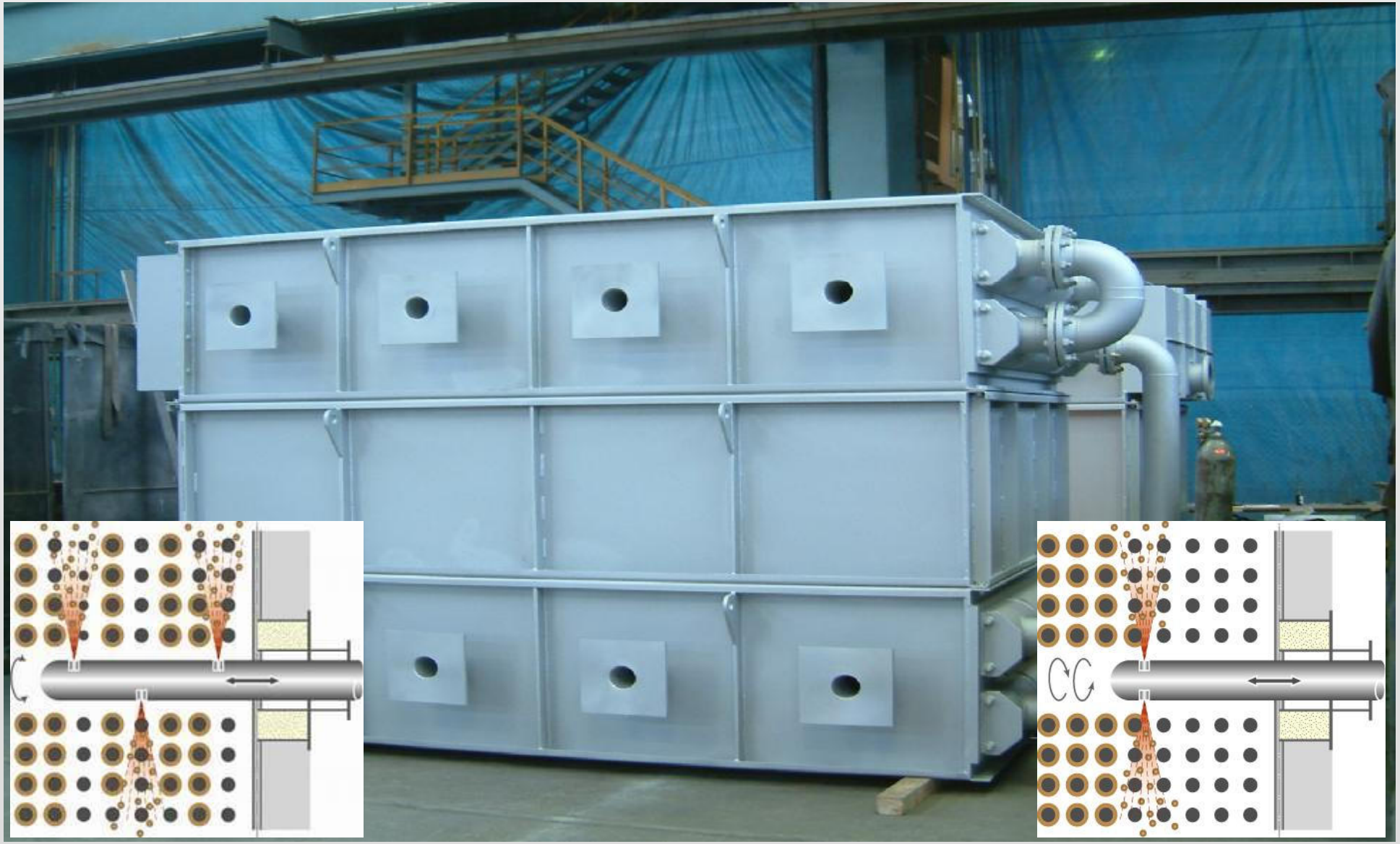
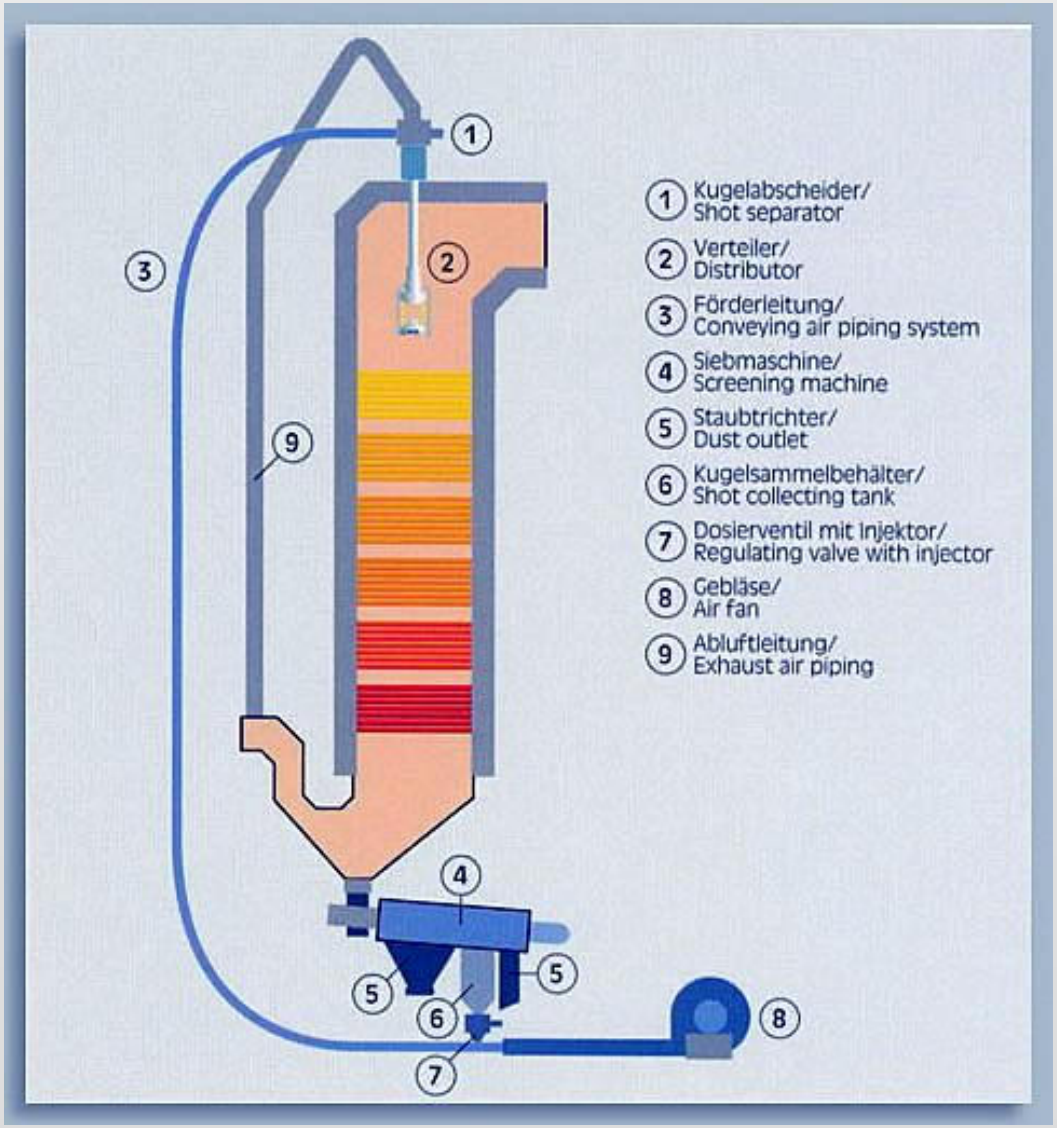


Heat exchange surface cleaning principle



Heat exchange surface cleaning system - shot ball cleaning system

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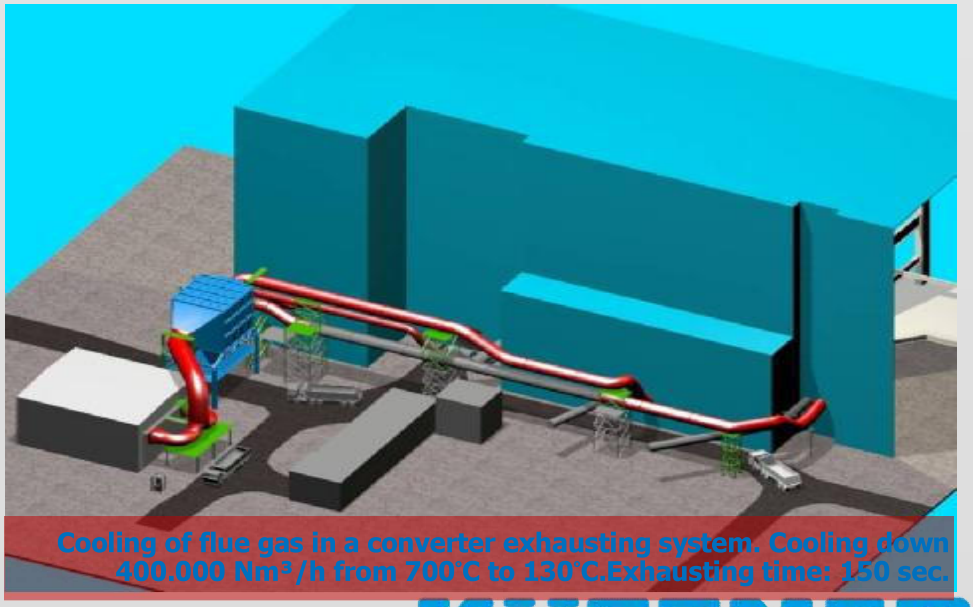
Content

4. Heat Accumulator System

- The Heat Accumulator System is used as heat exchanger to cool down exhaust gases in a certain time frame i.e. converter exhausting system.

- **<u>Characteristics</u>**
- Tailor made solution for each application depending on
  - Flow rate
  - Inlet temperature
  - Required outlet temperature
  - Required time for cooling process
  - Local conditions
  - No heat recovery



Cooling of flue gas in a converter exhausting system. Cooling down 400.000 Nm³/h from 700°C to 130°C.Exhausting time: 150 sec.

Heat Accumulator - ArcelorMittal Eisenhüttenstadt

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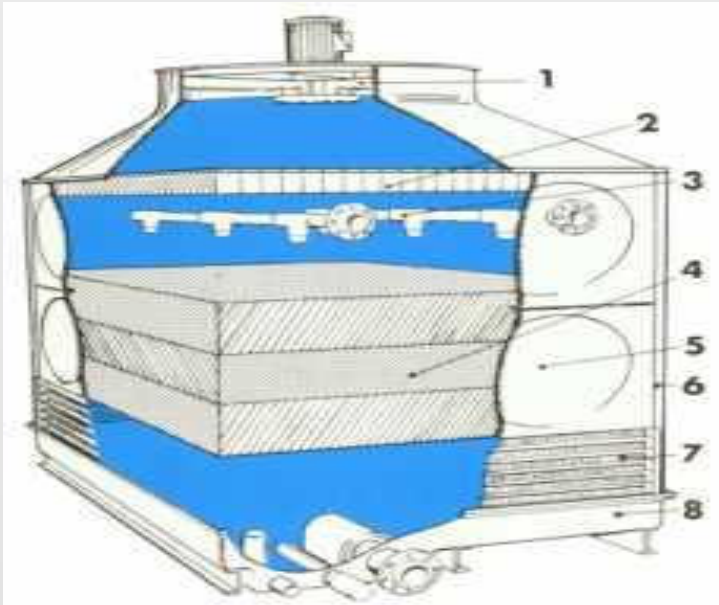
Content

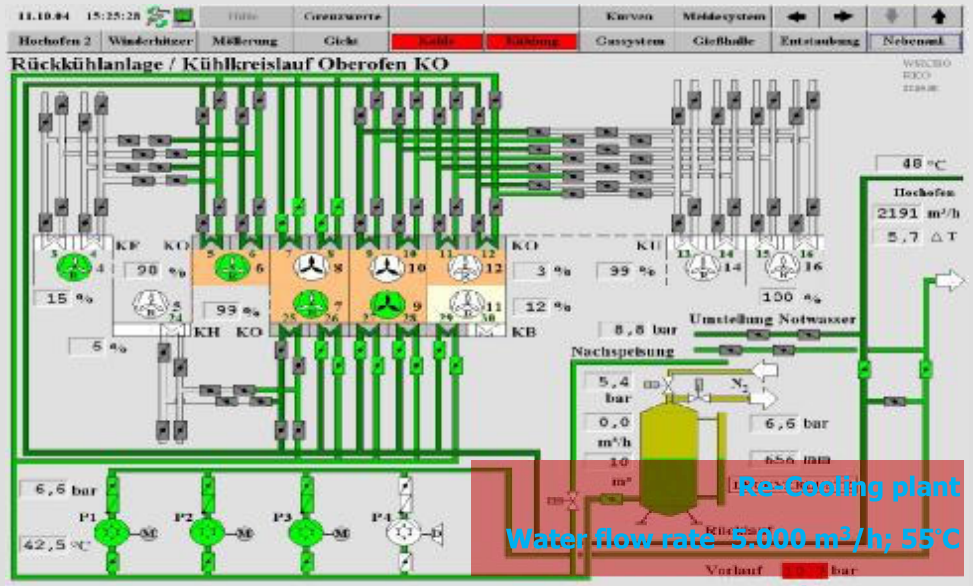
5. Re-Cooling System

- The Re-cooling System is used in industries for dissipating heat energy i.g. steel mills, glass or chemical industries or others.

- **Characteristics**
- Complete systems
  - cooling tower (wet or dry)
  - pump house
  - control unit
  - substation to be built together as a proper unit

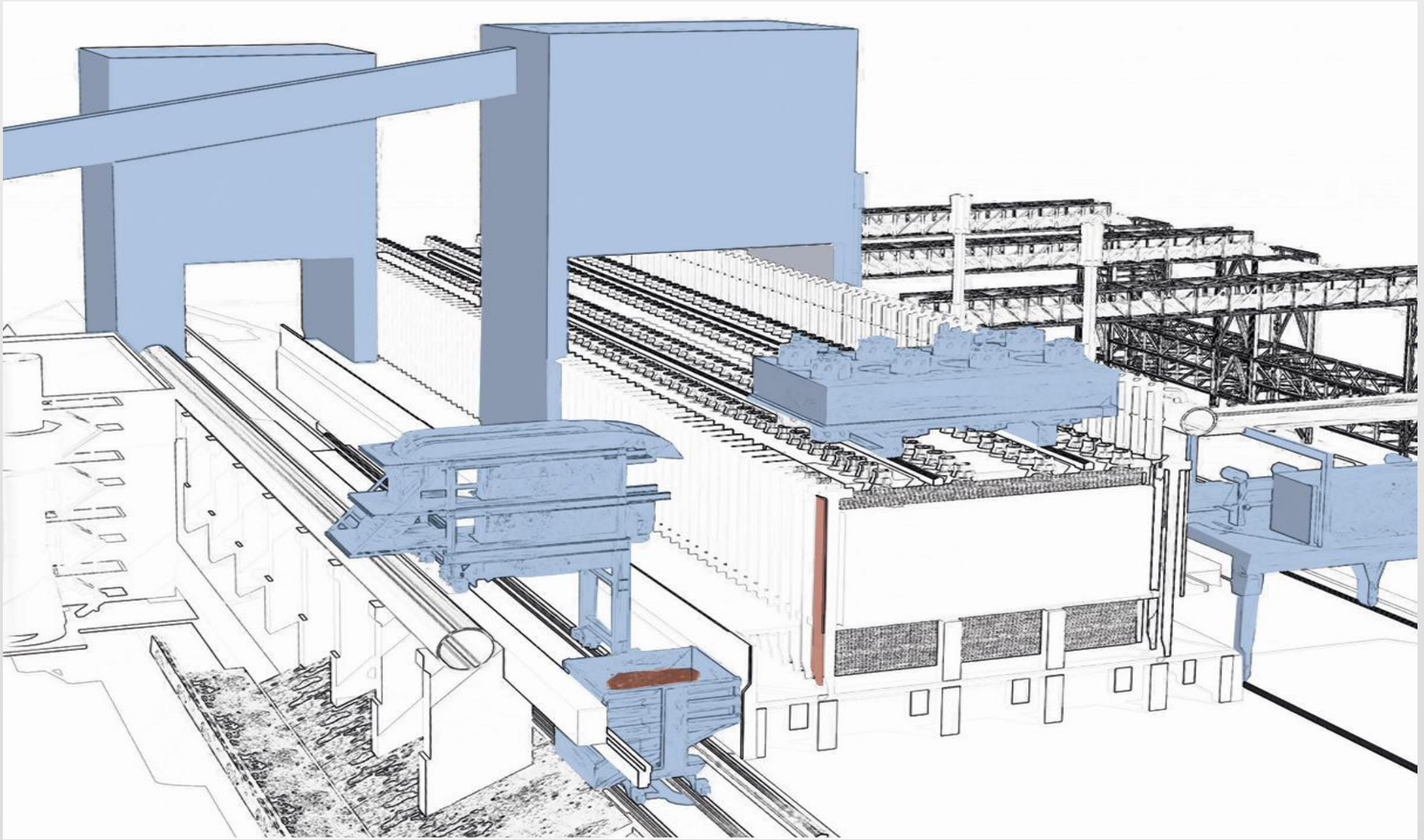


Cooling Tower Phenolchemie Antwerpen



Re-Cooling System Thyssen Krupp Steel BF8 - Duisburg

Content



Coking Technology - Coke battery, service cars

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Coking Technology - Coke transfer car

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Coking Technology - Coke transfer

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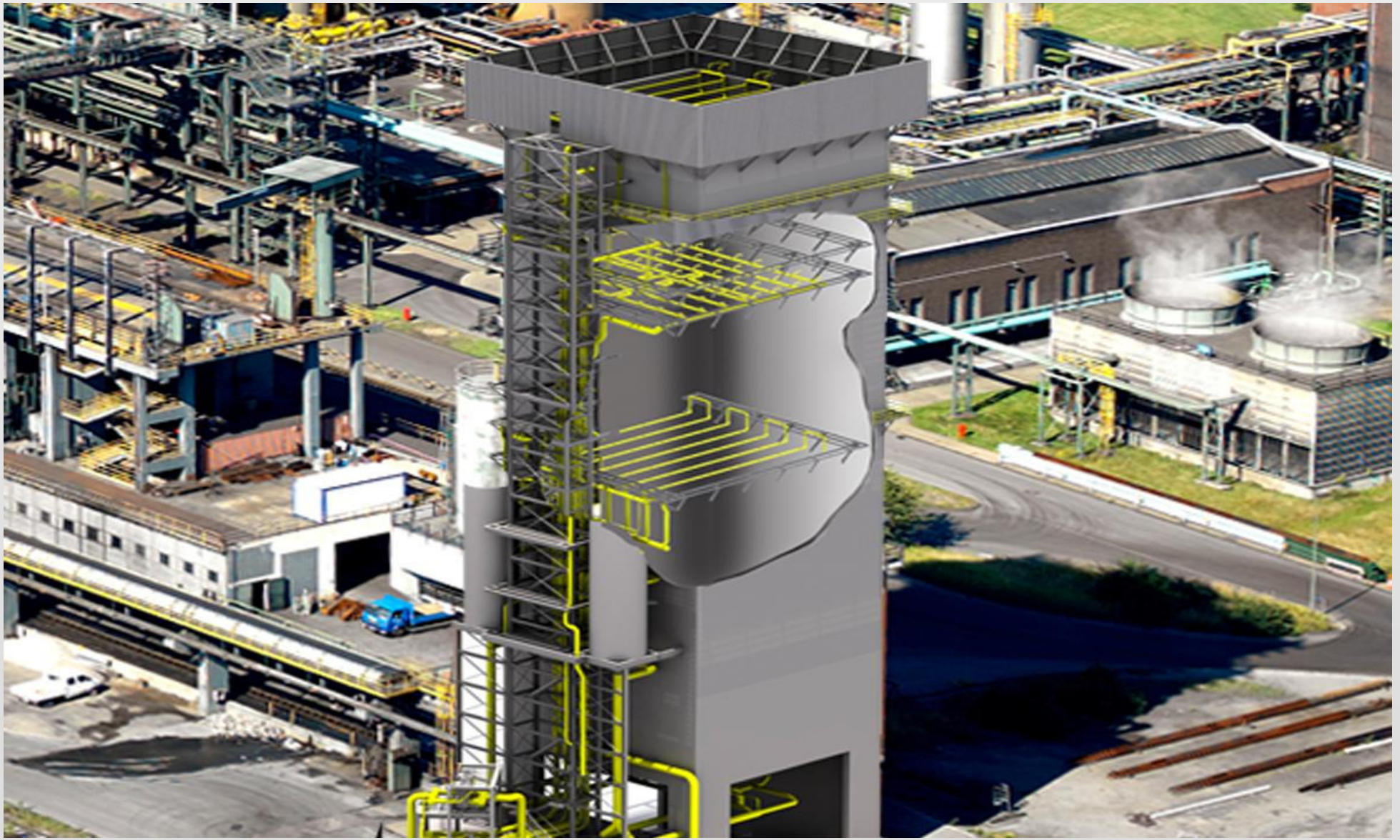

Coking Technology - Coke quenching

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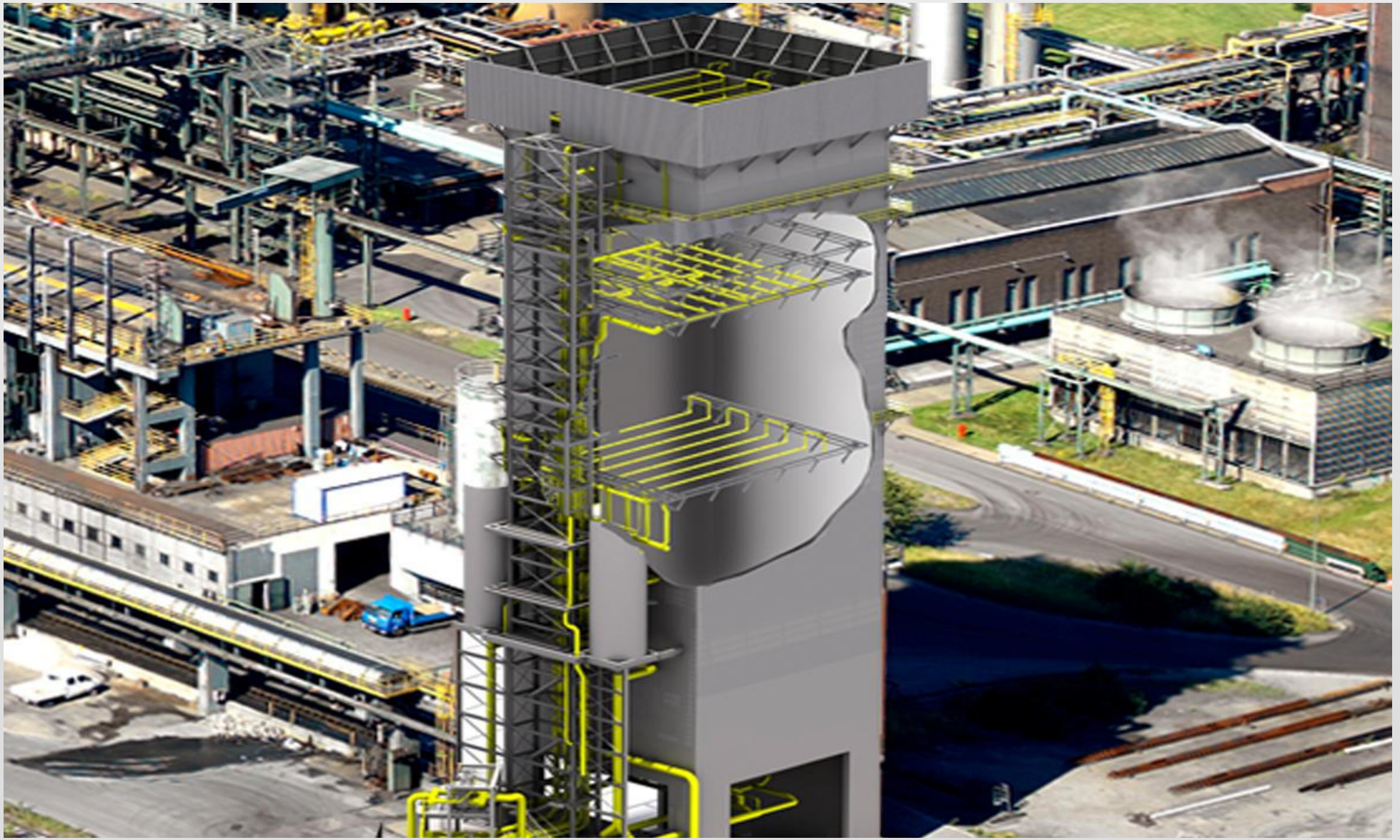

Coking Technology - Coke quenching

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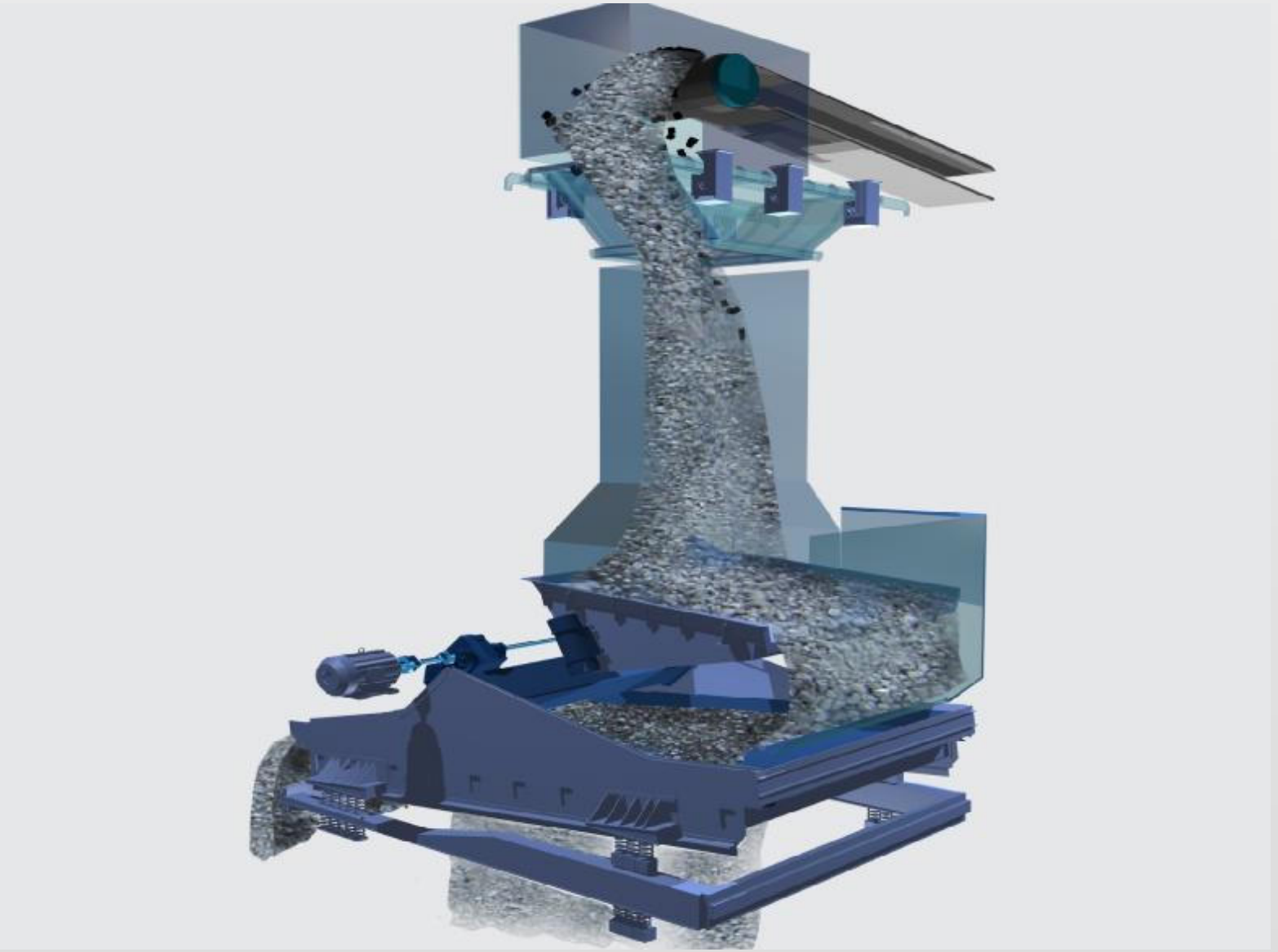

Coking Technology - Coke stabilization and sizing

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Coking Technology - Coal logistics for Schwelgern coke oven

Content

Industry	Project	Performance kW
Power Plants	Stadtwerke Wien (Vienna Municipal Utilities) Power Plant Simmering BKW 3, Austria	18.300
	Power Plant Werndorf II (STEWEAG), Austria, coupled heat recovery for preheating combustion air and condensate	3.700
	Drau-Kraftwerke (Power Plant) Voitsberg, Austria, District Heating	10.000
	Entsorgungsbetriebe Simmering (EBS) (Waste Water Treatment for Vienna), Austria	2.970
	Fernwärme Wien (Wien Energy) Spittelau , Austria, District Heating	5.700
	Fernwärme Wien (Wien Energy) Flötzersteig, Austria, District Heating	
	RWE Solutions, **Enameled Heat Pipes (23m)** Supply to RWE Power Plant Maritsa (Bulgaria)	
	SüdzuckerAG, Zeitz; Germany, Exhaust Vapors Condensation	32.000
	AE&E Inova (Alstom) **Ecostat** Vorwärmung Gichtgas, Germany	13.700
	Standardkessel GmbH, Mixed Gas Preheating, Salzgitter, Germany	6.000
	EBARA / BAMAG GmbH, **LuVo**, Combustion Air Preheating, Frankfurt a.M.	12.000

Industry	Project	Performance kW
Steelworks	Jindal, India, HRS at BF2, **Ecostat** auxiliary Burner fired by BF Gas	16.700
	CSC Taiwan, HRS at BF4, **Ecostat** auxiliary Burner fired by BF Gas	35.200
	TATA Steel, India, HRS at BF2, **Ecostat**	32.000
	EKO Stahl, Germany, HRS at BF 5A, **Ecoflow,** auxiliary Burner fired by BF Gas	26.700
	VAI UK, HRS at BF3, **Ecostat**	20.400
	CSC Taiwan, HRS at BF 2, Gas Preheating **Ecostat**	12.300
	Voest Austria, HRS at BF A, **Ecostat**	11.230
	CSC Taiwan, HRS at BF 3, **Ecoflow** auxiliary Burner fired by BF Gas	37.300
	TKS AG Germany, Extension Thermal Oil at BF 9, 4th Cowper, **Ecoflow**	
	TKS AG Germany, **Cole Pre Heating** BF1 (+ Extension)	
	VAI UK for Dragon Steel Taiwan, HRS at BF1, **Ecostat**	22.000
	TKS AG Germany, **Air-Cooling System** BF 8, Plant Hamborn	45.900
	SMS Basco **Air-Cooling System**, Kazakhstan	7.550

Industry	Project	Performance kW
Glass	Pilkington Group Ltd., **Ecoflow** Heat Exchanger -> District Heating, Sweden	20.000
Cement	Finnsementti, **Ecoflow** Heat Exchanger -> District Heating, Finnland	6.000
	Partek, **Ecoflow** Heat Exchanger -> District Heating, Finnland	11.000
	Rohdorf, **Ecoflow** Heat Exchanger -> District Heating, Finnland	2.500
	Leube, **Ecoflow** Heat Exchanger -> District Heating, Finnland	1.000
	Solnhofer Portland-Zementwerke, **Ecoflow** Heat Exchanger -> District Heating, Finnland	400
Waste Heat Recovery at Gas-Steam-Turbine-Block	EVN Power Plant Theiss, Austria	30.000
	Neusiedler Papier Ybbs AG, Hausmening, Austria	1.650
	CMOÖ Laakirchen, Austria	12.600
	Zellstoffwerk Kematen, Austria	1.300
	OMV Power International, Weitendorf, Austria	16.000 el

We thank you for your kind attention.

For further information, please contact:

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