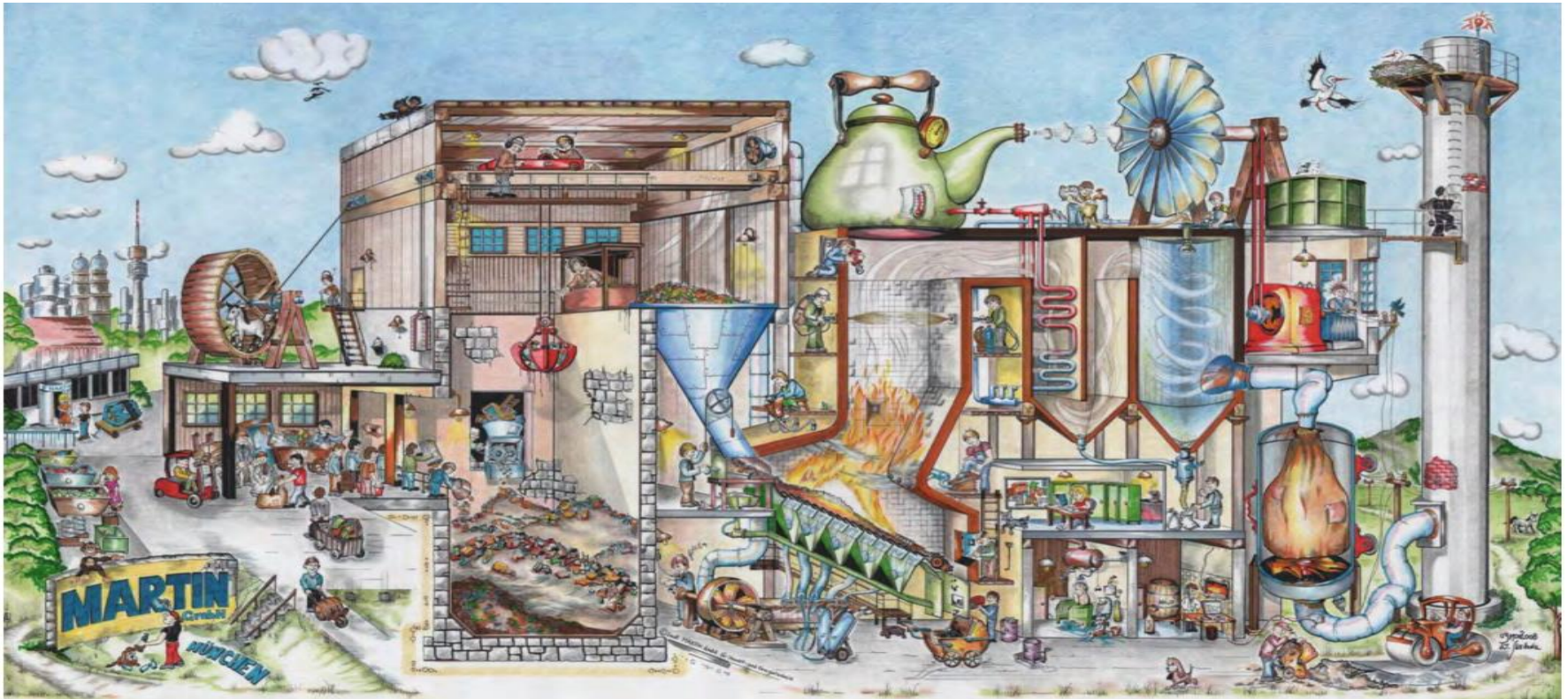


Waste Incineration Technology

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College of Energy Engineering, Zhejiang University

#38 Zheda Road, Hangzhou, China (310027)

Tel: +86-571-87952834. Fax: +86-571-87952438

Email: hqx@zju.edu.cn

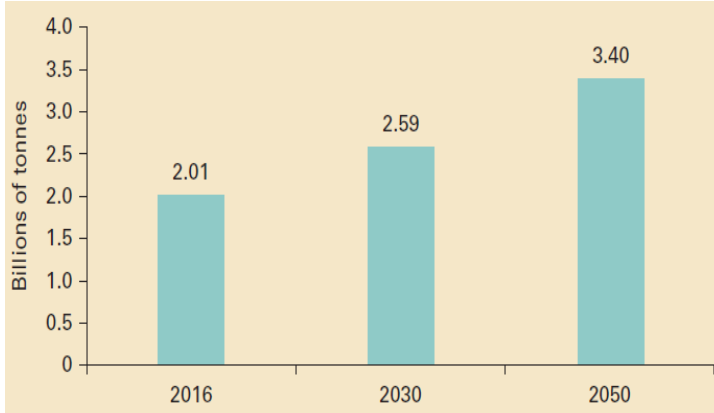
Research Interests

- 1) Thermal conversion mechanism of combustible solid waste in controlled atmosphere; Upgrading of tar containing syngas;
- 2) Petroleum sludge treatment
- 3) Efficient and clean thermal disposal technology for rural and small-scale wastes;
- 4) Efficient phase separation technology for oily sludge;
- 5) Catalytic cracking and plasma technology for oily sludge;
- 6) Radiation characteristics and transfer model of particulate pollutants during combustion;
- 7) Non-contacting measurement technology of temperature Distribution during combustion.

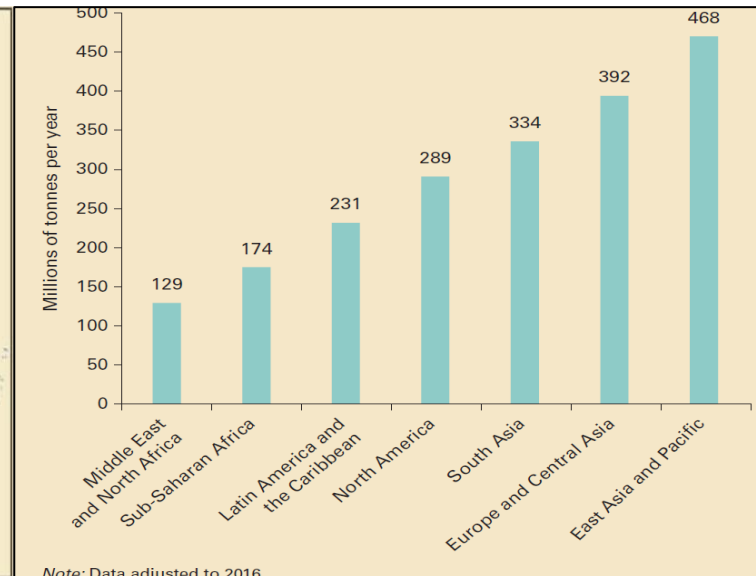
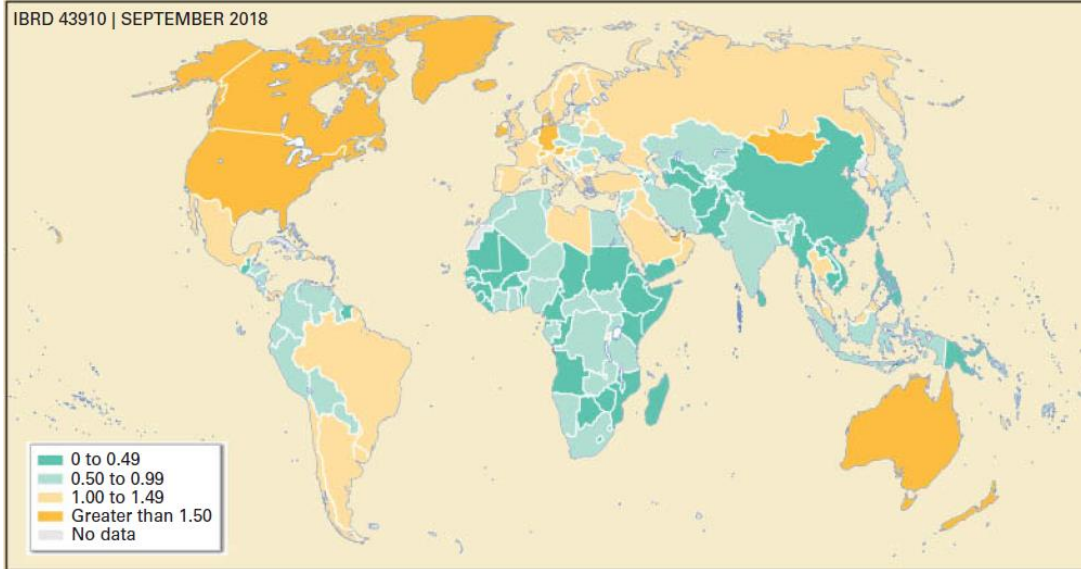
Global waste generation



➤ 2016, the worlds' cities generated 2.01 billion tonnes of solid waste, amounting to a footprint of 0.74 kilograms per person per day



IBRD 43910 | SEPTEMBER 2018

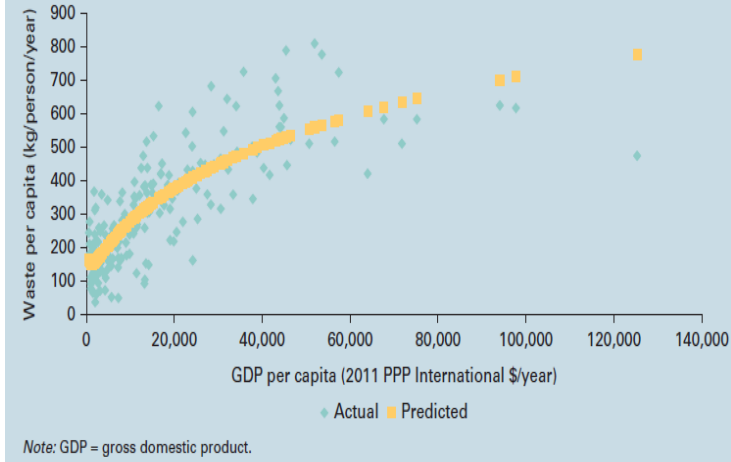
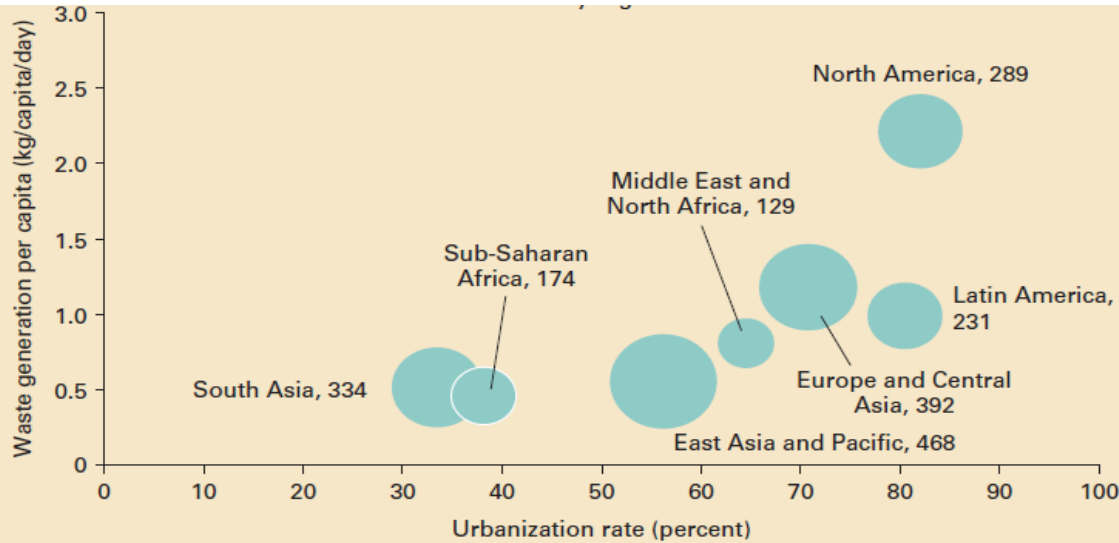


Note: Data adjusted to 2016.

Global waste generation

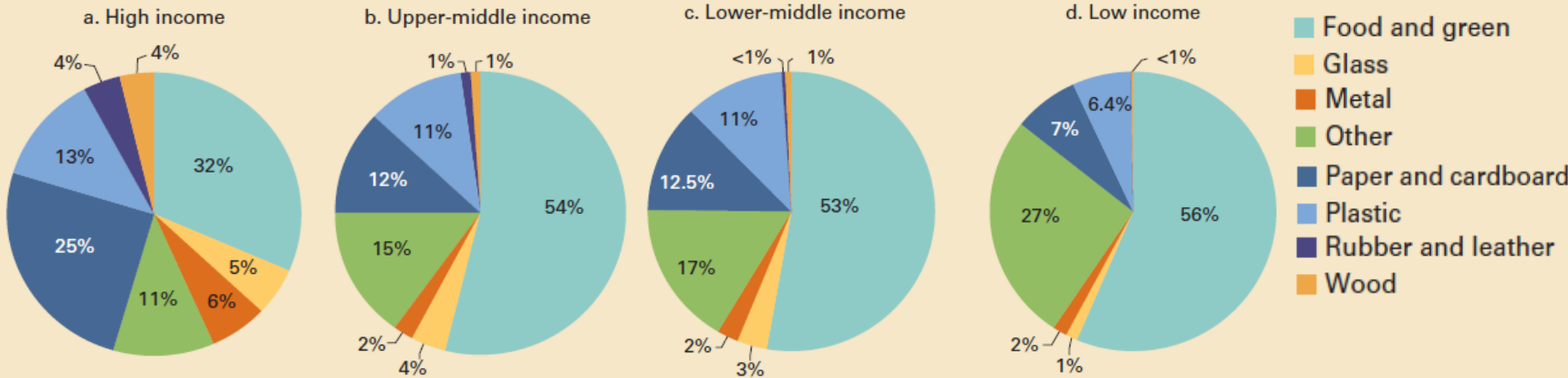


- Waste generation strongly relates with local economic and urbanization rate
- Rich people generate **4.8 times more** waste than low-income people



Note: Data in panel a are from originally reported year. Data in panels b and c are adjusted to 2016. Size of bubble in panels b and c denotes total waste generation in millions of tonnes annually; kg = kilogram.

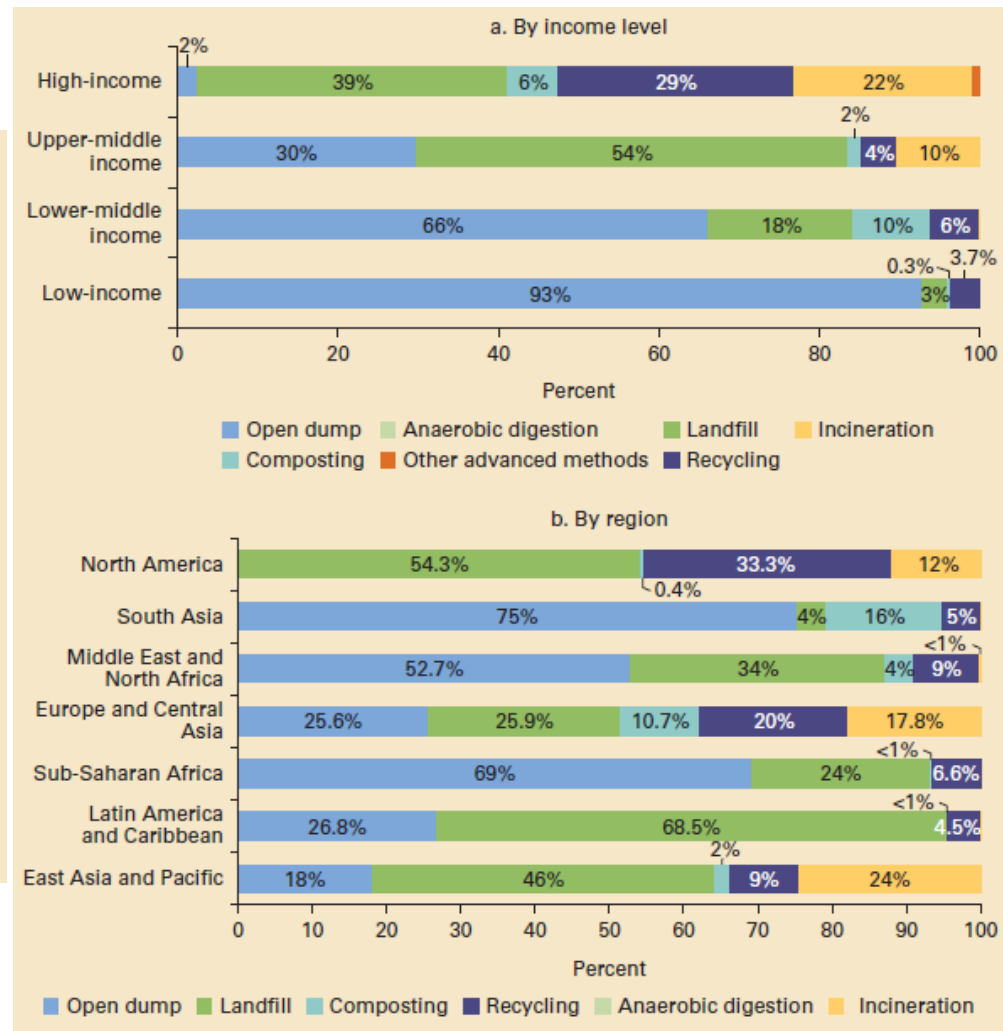
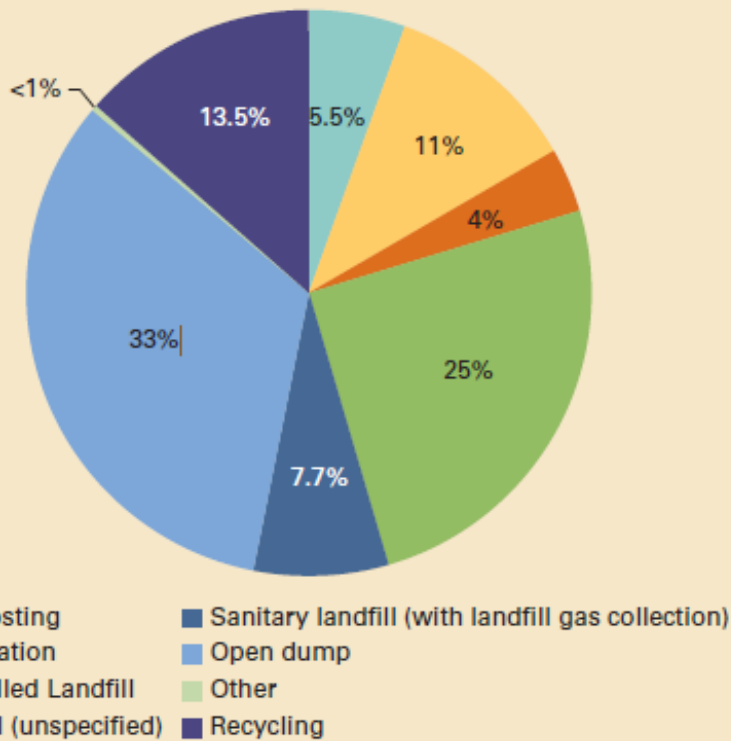
Proxy waste generation per capita
 $= 1647.41 - 419.73 \ln(\text{GDP per capita}) + 29.43 \ln(\text{GDP per capita})^2$



Global waste treatment (2019)



- 33% solid waste was open dumped
- Only 11% solid waste was incinerated for energy recovery



Waste treatment technology

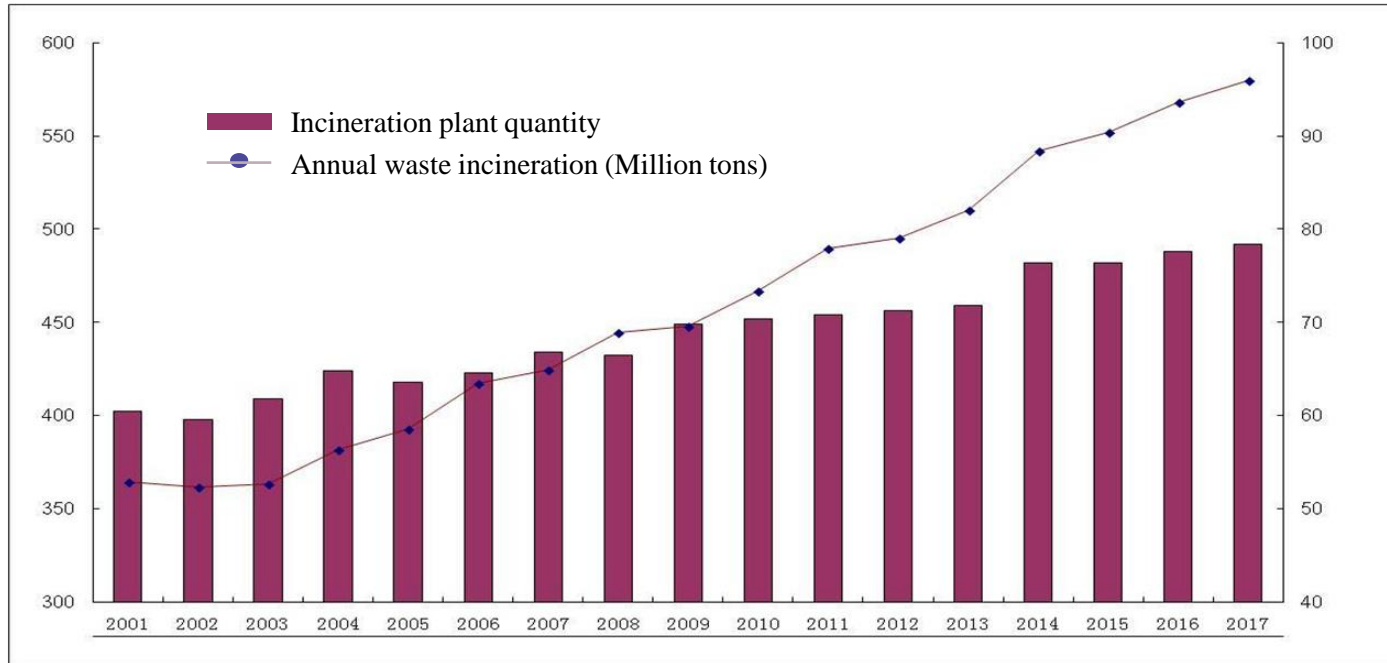


➤ Comparing with other techs, waste-to-energy is more efficient and expensive



	Sanitary Landfill	Composting	Anaerobic Digestion	WTE
Basic Process	Disposal	Biological treatment	Biological treatment	Thermal treatment
Ideal Types of Waste	Municipal solid waste, construction and demolition waste, wastewater sludge, non-hazardous industrial wastes	Food waste (including wastes from households, restaurants and markets), fats/ oils/ grease, paper and cardboard, landscaping and garden waste	Food waste (including wastes from households, restaurants and markets), fats/ oils/grease, slaughterhouse waste and garden waste	Mixed municipal solid waste, medical waste, demolition wood, auto shredder residue, dried sewage sludge, and some industrial solid wastes
Waste to Avoid	Medical	Non-biodegradable wastes (plastic, glass, metal, inerts)	Non-biodegradable wastes (plastic, glass, metal, inerts), tree clippings	Yard leaves or source-separated food waste
Mass Reduction of Waste (%)		0.5	0.5	80-85%
(kWh/tonne of MSW)	65 (landfill gas)		165 - 245	500-600
Capital costs (US\$/annual tonne)	5 - 52 (US\$/tonne over lifetime)	30-400	220 - 660	190-1000
Operating costs (US\$/tonne)	7 – 30 (up to120)	12-100	22-57	12-55

WTE in Europe



Waste-to-Energy in Europe in 2017

■ WtE Plants operating in Europe (not including hazardous waste incineration plants) : **492**

■ Waste thermally treated in WtE plants (in million tonnes): **96**

Data supplied by CEWEP members and national sources

* Includes plant in Andorra and SAICA plant



WTE in USA



WTE Capacity



Total Capacity U.S. Facilities (by energy)



No. of Operating Facilities in the U.S.

		Ownership		Operation	
Operating Facilities	77	Private	41	Private	65
States with WTE	22	Public	36	Public	12

WTE in Japan

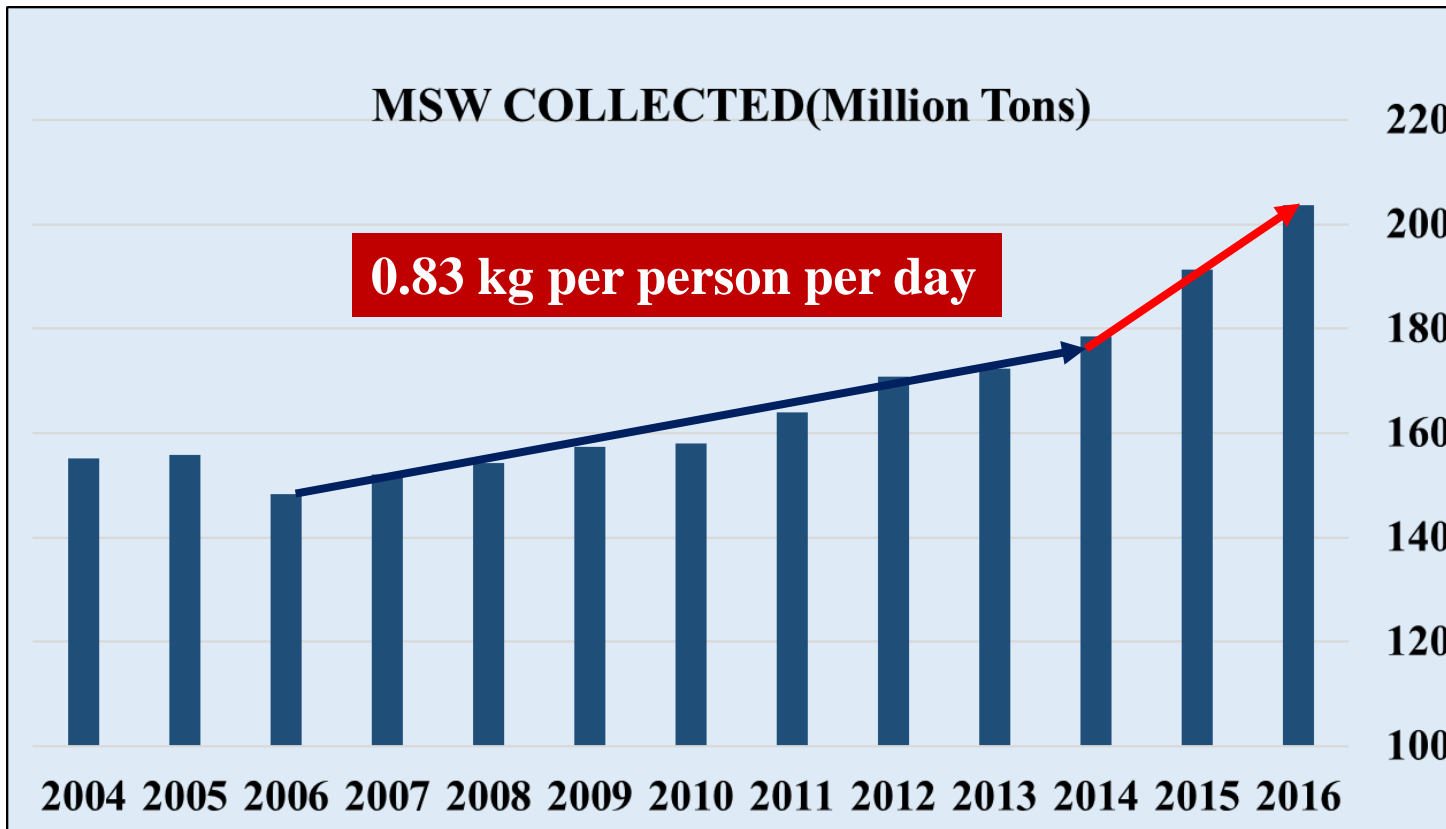


- **The total processing scale is basically unchanged**
- **The number of incinerators decreased, and the treatment scale of single furnace increased**
- **Incineration accounts for more than 80%**

MSW in China



- 2016, MSW collected in **660 cities** reached **203.62 million tons** for **665.57 million people in city**
- From 2006 to 2012, MSW increased at average rate of **4.5%**
- From 2014 to 2017, MSW increased at average rate of **7%**



NEWS

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Asia China India

China waste plant protest in Hangzhou 'injures dozens'

© 11 May 2014

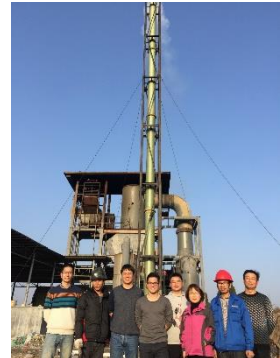
19 记者调查

年份	垃圾产量	垃圾无害化处理率
2015	1000	90%
2014	950	88%
2013	900	85%
2012	850	82%
2011	800	80%
2010	750	78%
2009	700	75%
2008	650	72%
2007	600	70%
2006	550	68%
2005	500	65%
2004	450	62%

Rural Solid Waste in China



- 2016, **667 million people** are living in rural area
- 2016, **70 million tons RSW** was collected
- **~0.3 kg** per person per day in rural area



WTE capacity in China



By 2019, 408 plants are operating burning **120 million tons** of MSW every year, another **120 plants** under constructing and another **102** is preparing
Average operating hours of waste incineration power generation: **5981 hours per year**

WTE technology	Plant Number	Capacity(ton/day)	Power capacity
Moving grate	330	350000	7025
CFB	78	70000	1730
Total	408	420000	8755

MSW power generation capacity



The total power generation capacity is **8.751 million kilowatts**, accounting for **52%** of the total installed capacity of biomass power generation, generating **37.514 billion kwh per year**.

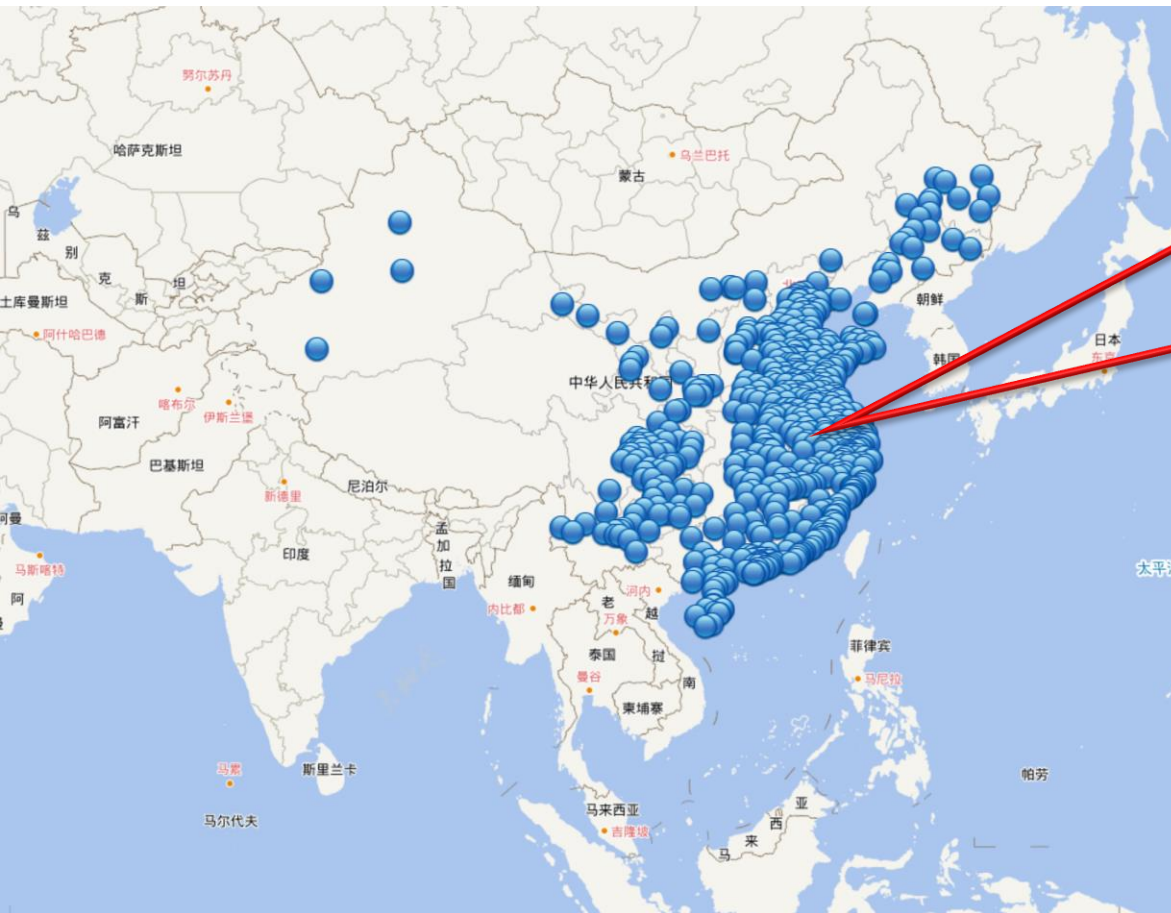


- ◆ In coastal developed areas, **Zhejiang, Jiangsu, Guangdong, Shandong and Fujian provinces** account for **61%** of the total installed capacity
- ◆ In undeveloped areas of western China, the total installed capacity is relatively lower.

MSW power generation capacity



Chinese EPA has setup the on-line monitoring system of all MSW plants at <https://ljgk.envsc.cn/index.html>



光大环保能源（杭州）有限公司

企业名称	光大环保能源（杭州）有限公司				
企业地址	杭州市余杭区中泰街道南峰村大坞里				
统一社会信用代码	913301003295246355				
行政区划	浙江-杭州-余杭	法人代表	梁海东	投产日期	2017-11-26
信息公开负责人	石小伟	联系方式	15151509110		

焚烧炉数: 4 设计处理能力: 3000t/d 发电功率: 40000KW

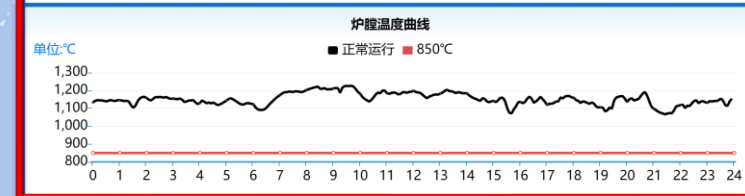
焚烧炉名称	炉型	投产日期	设计处理能力 (t/d)
排放口#1	炉排炉	2017-11-26	750
排放口#2	炉排炉	2017-11-26	750
排放口#3	炉排炉	2017-11-26	750
排放口#4	炉排炉	2017-11-26	750

光大环保能源（杭州）有限公司

排放口#1	排放口#2	排放口#3	排放口#4
-------	-------	-------	-------

2021-10-10 日均值 (单位:mg/m³)

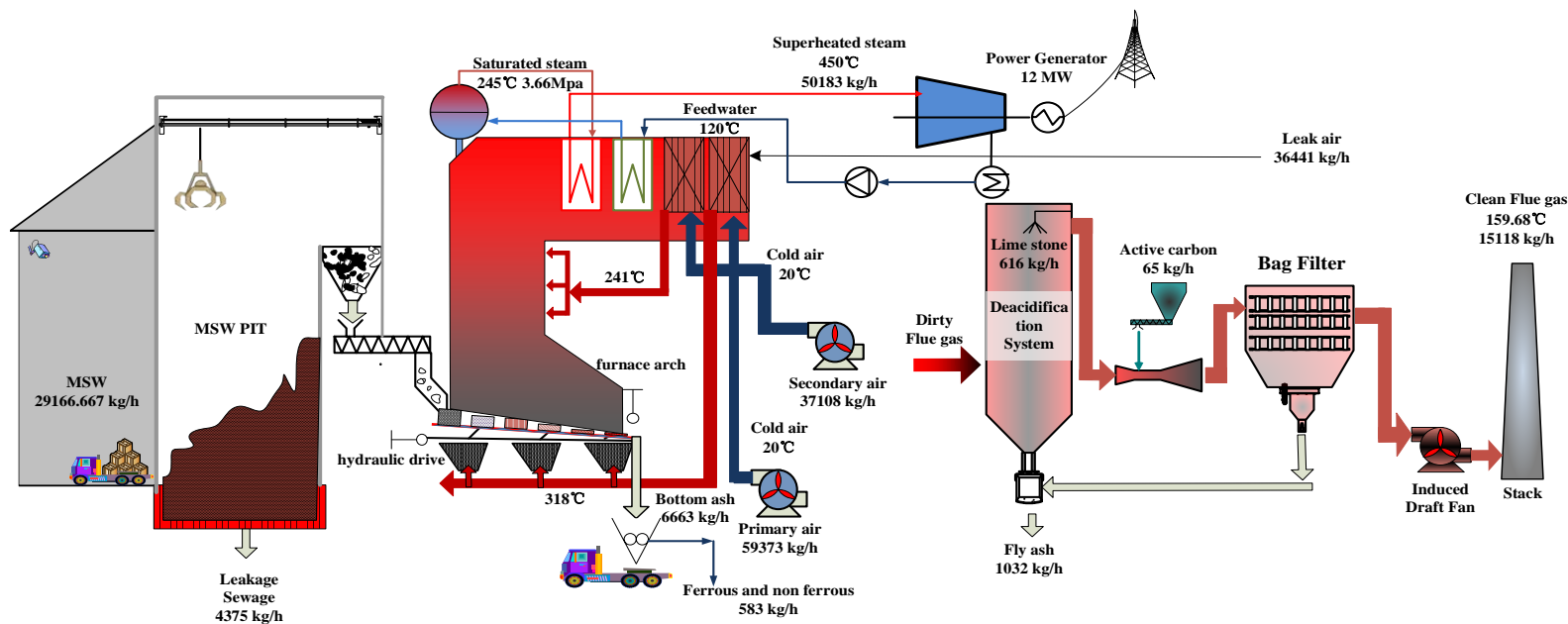
监测因子	折算浓度	标准值	日均值	CEMS备注
颗粒物	2.6	20		--
氮氧化物	49.29	250		--
二氧化硫	7.01	80		--
氯化氢	2.3	50		--
一氧化碳	4.35	80		--
工况说明	--			



Moving Grate WTE



Waste-to-Energy Plant layout (Moving Grate, 700 t/d)



Ever Bright



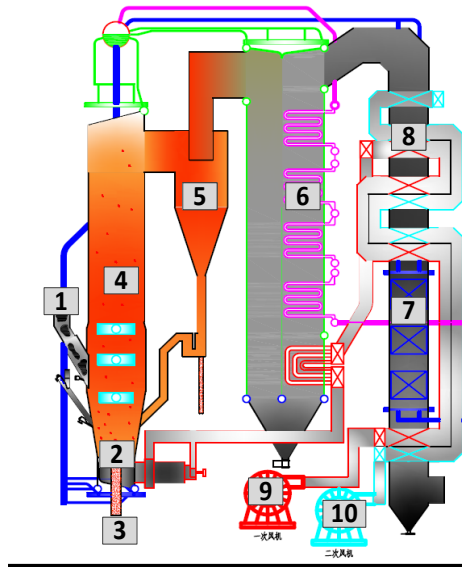
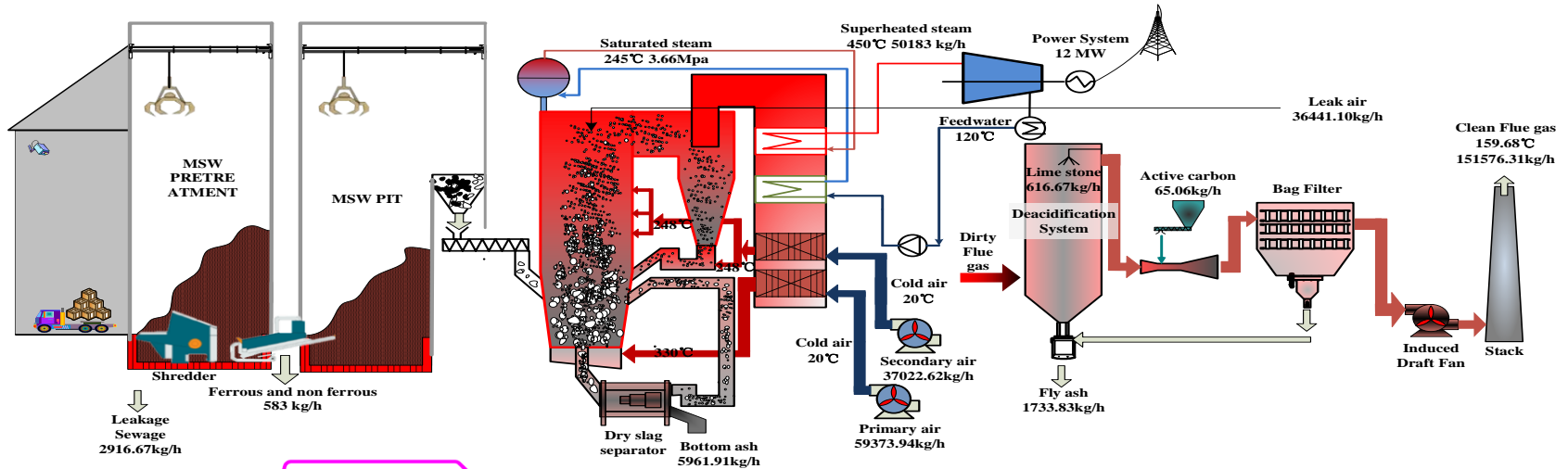
Sanfeng, Martin



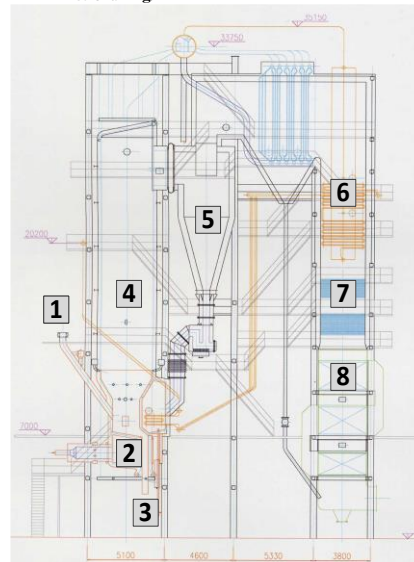
Kangheng Sus

CFB WTE system

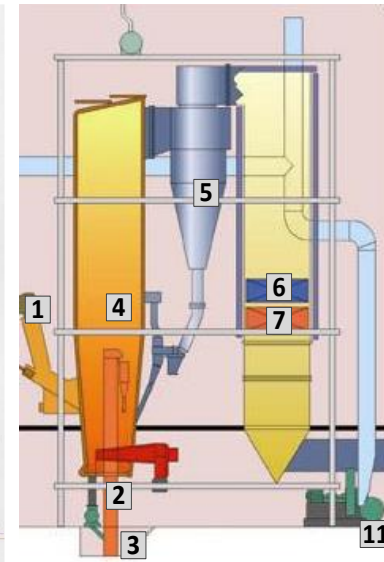
Waste-to-Energy with Circulating Fluidized Bed (700 t/d)



Zhejiang Univ



CAS



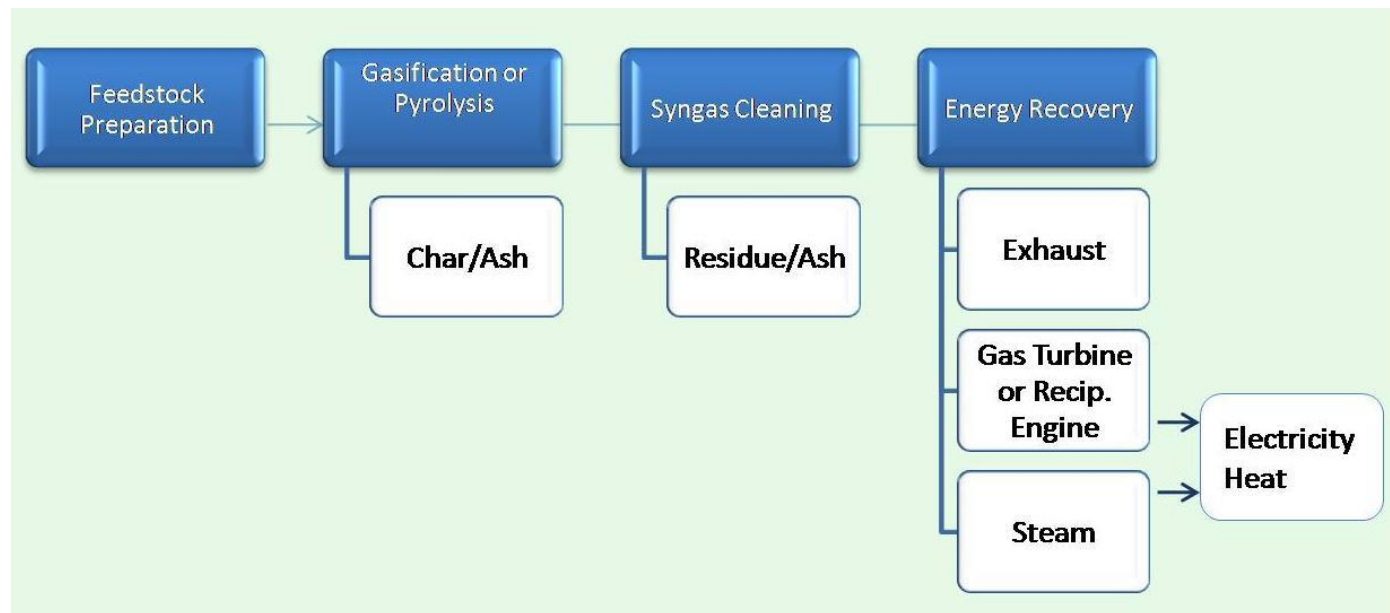
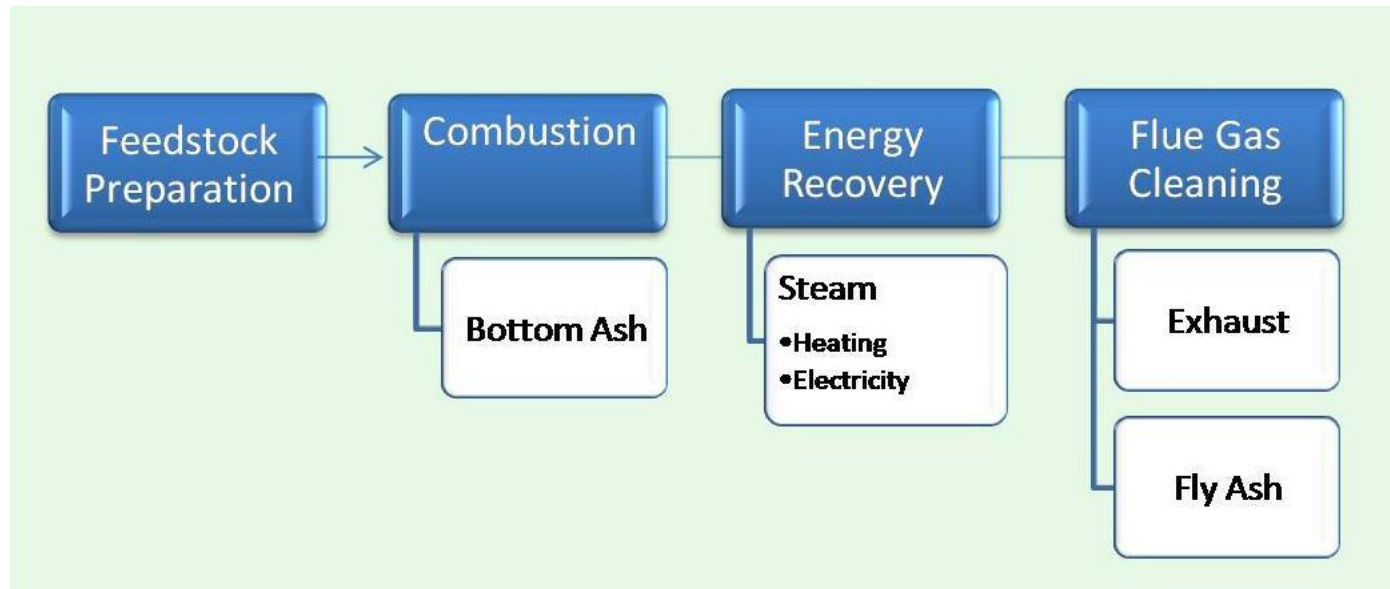
Tsinghua Univ

Outlines

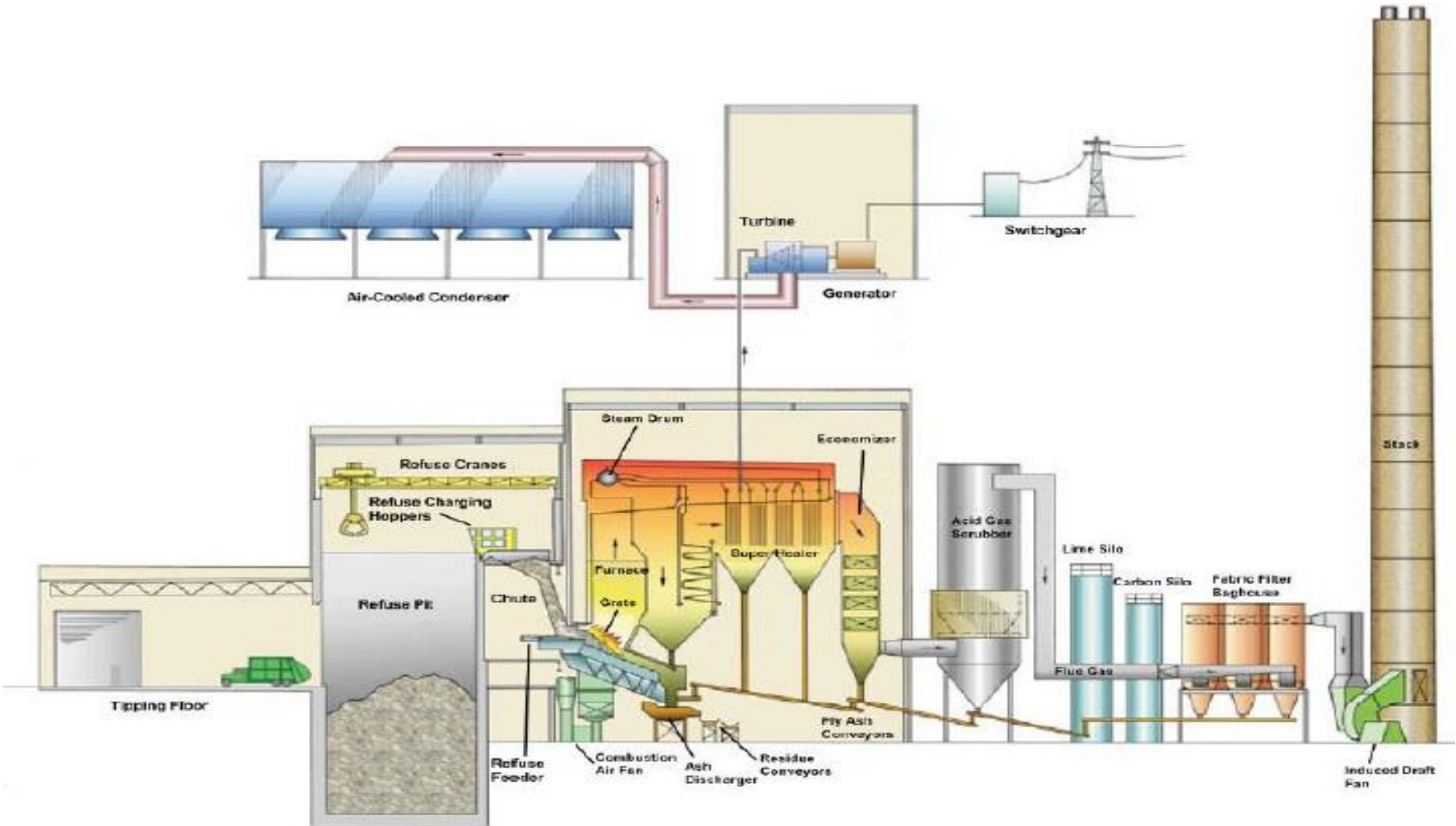


- **Grate Combustion**
- **Typical grate provider**
- **WTE system**
- **Cases Study**

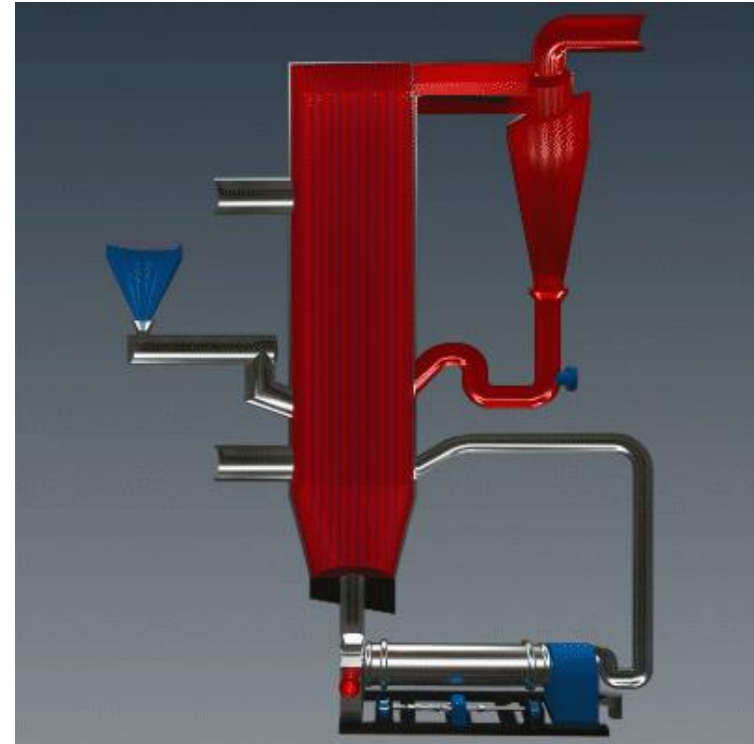
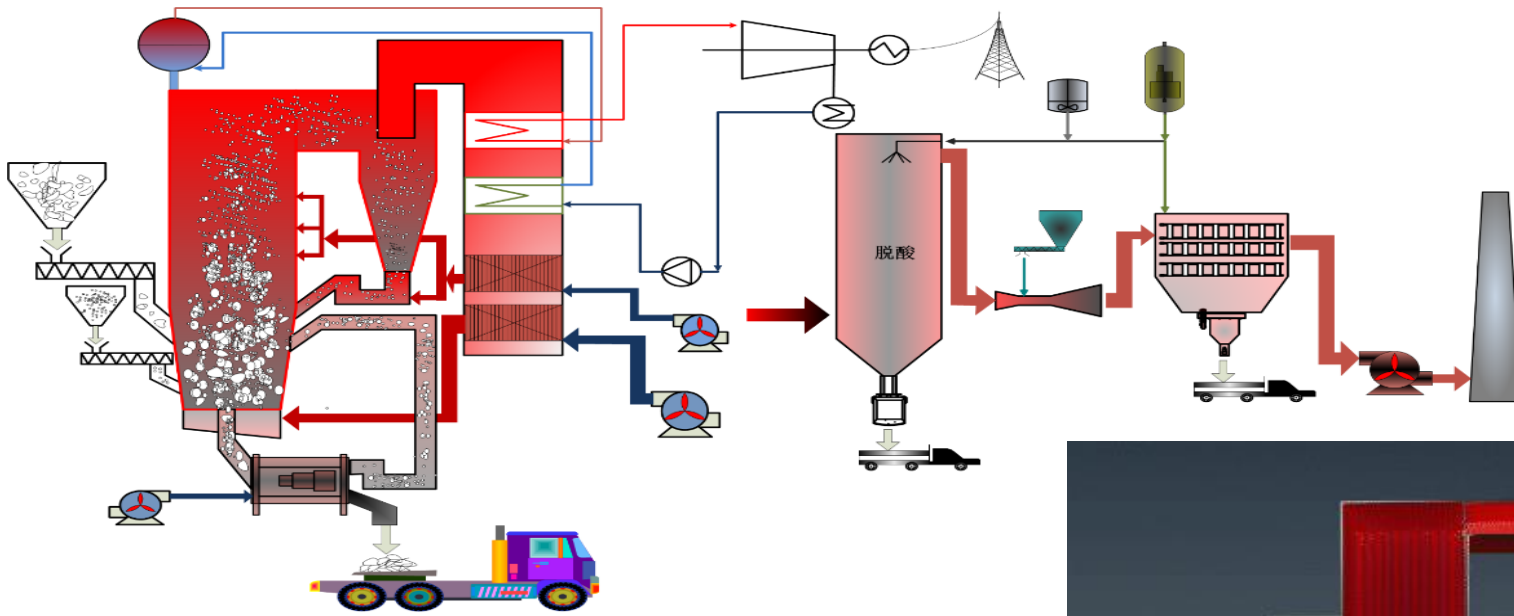
Waste to Energy



Grate Incinerator



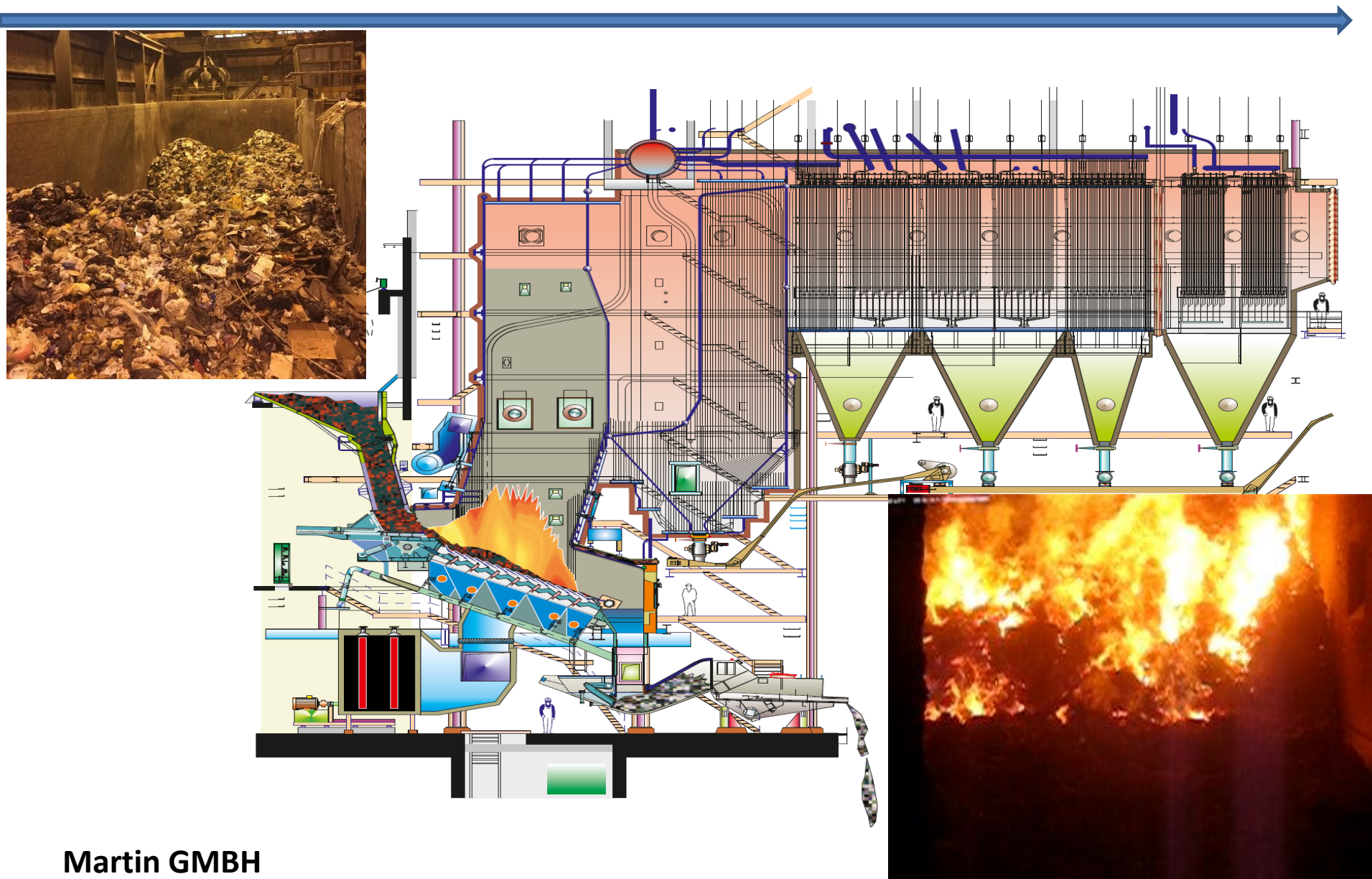
CFB incinerator



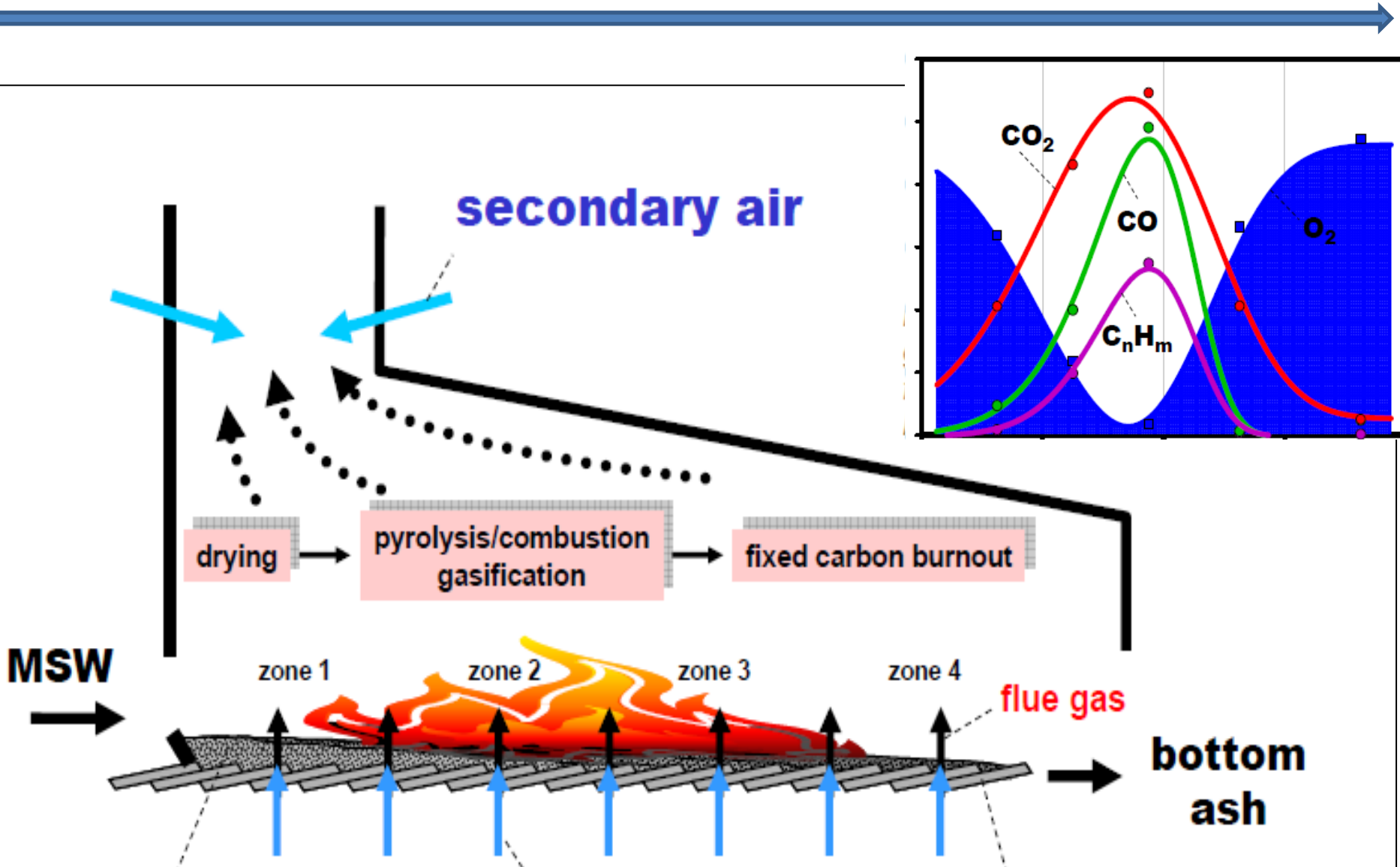
Rotary Kiln incinerator



Waste Incinerator using moving grate



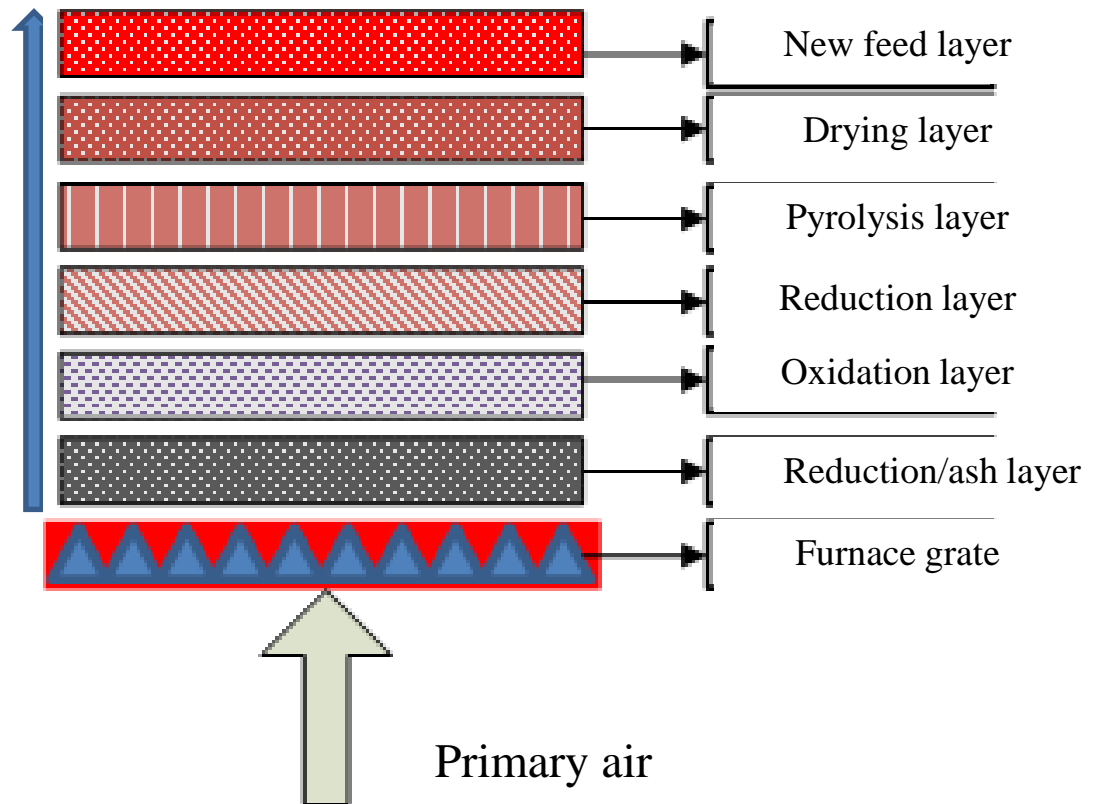
Combustion on moving grate



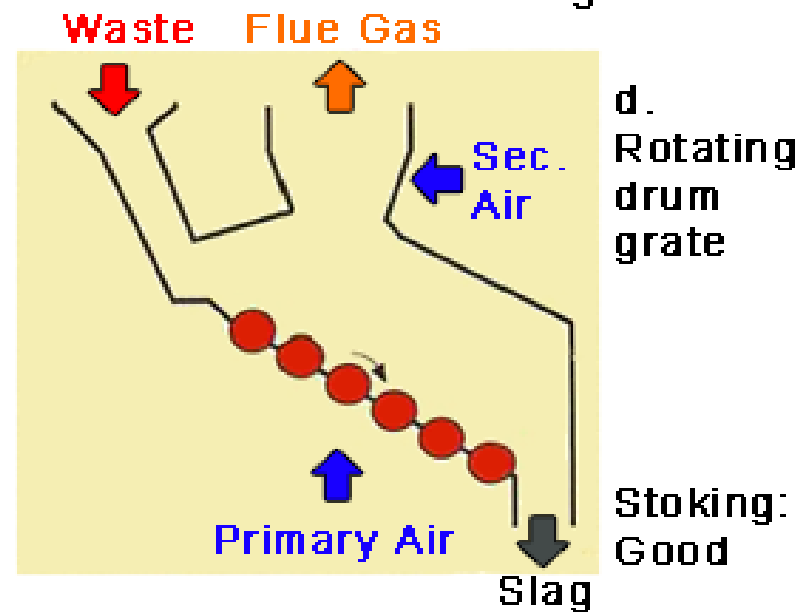
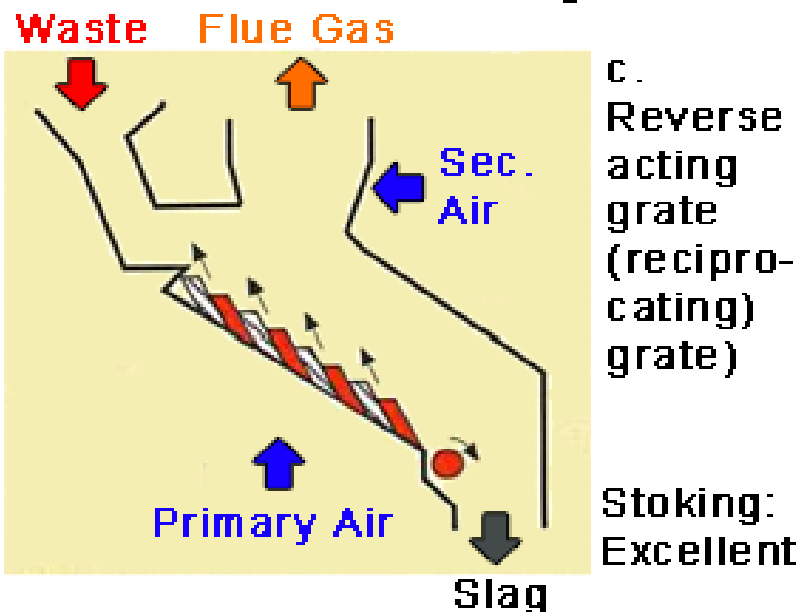
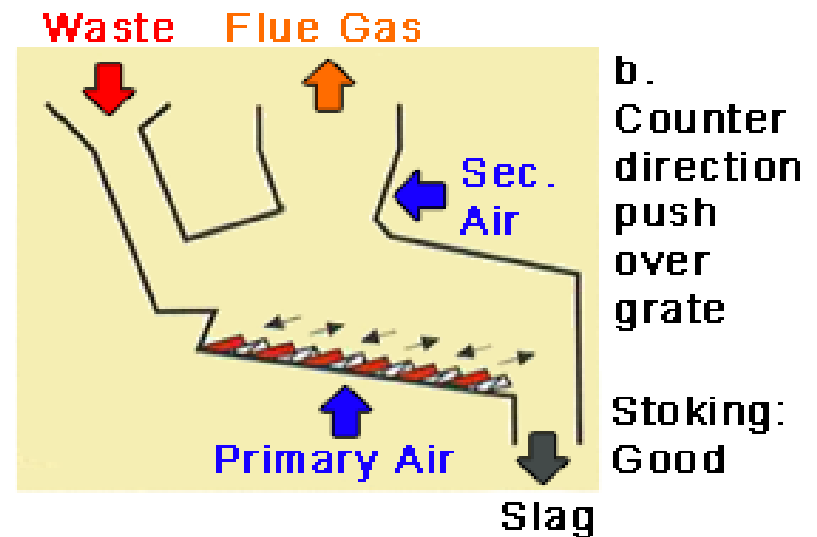
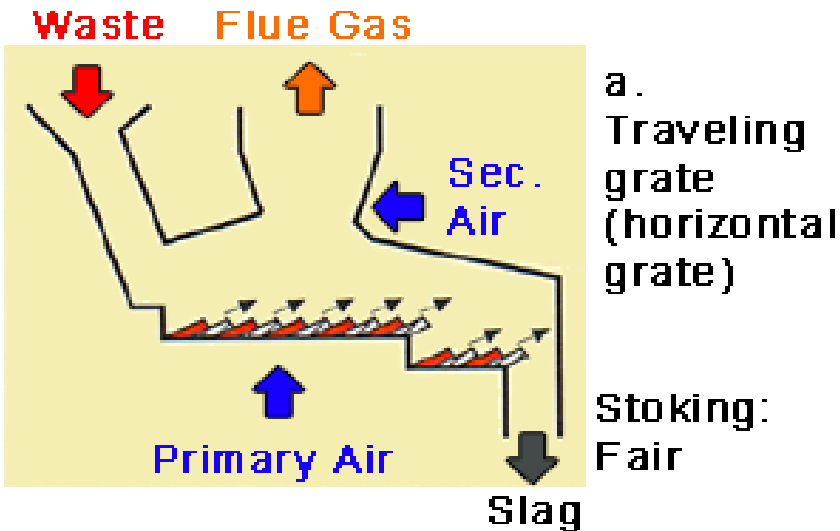
Combustion on moving grate



The feed is placed on a grate to form a fuel layer of a certain thickness, and the air needed for the combustion is furnished through the lower part of the grate



Grate Incinerator design



Typical grate stoker types



1、 Chain grate stoker

Chain belt type

Cross girder type

Flake type

2、 Vibrating grate stoker

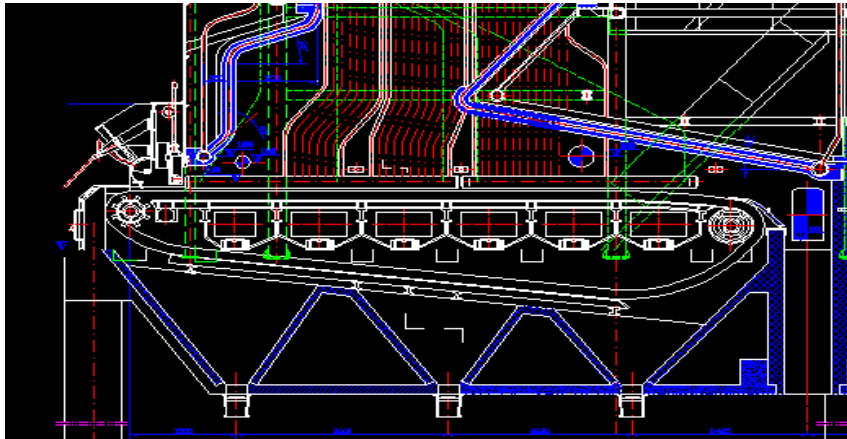
3、 Rotary grate stoker

4、 Reciprocating grate stoker

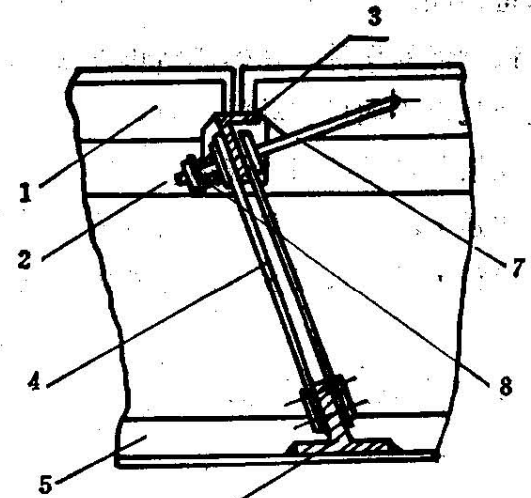
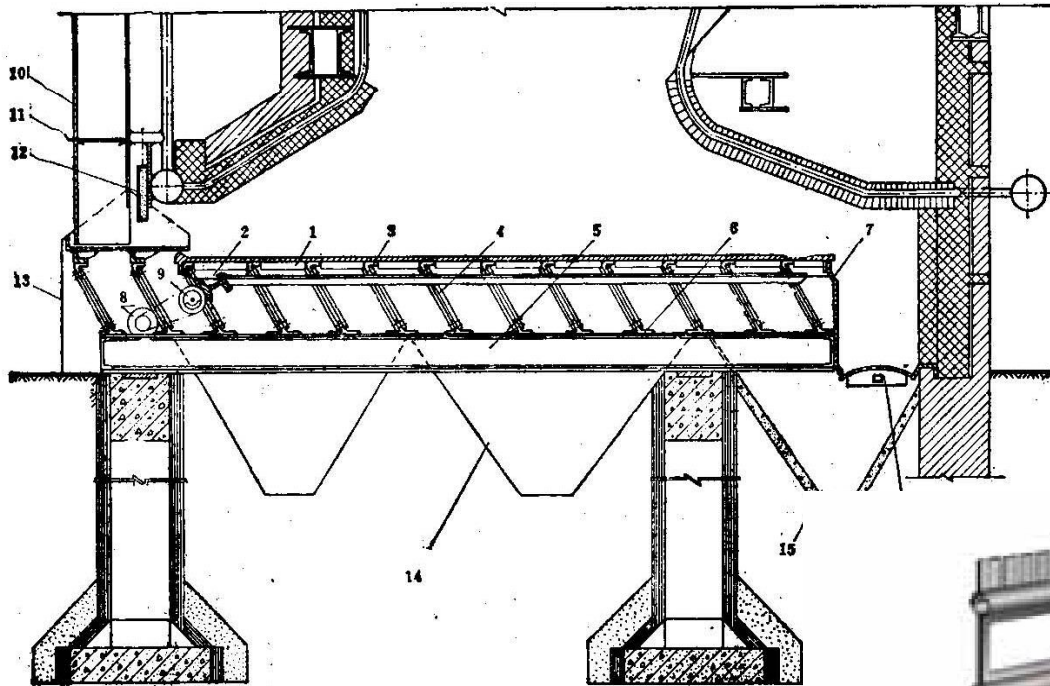
Horizontal reciprocating

Inclined reciprocating

Chain grate stoker



Vibrating grate



Rotary grate stoker

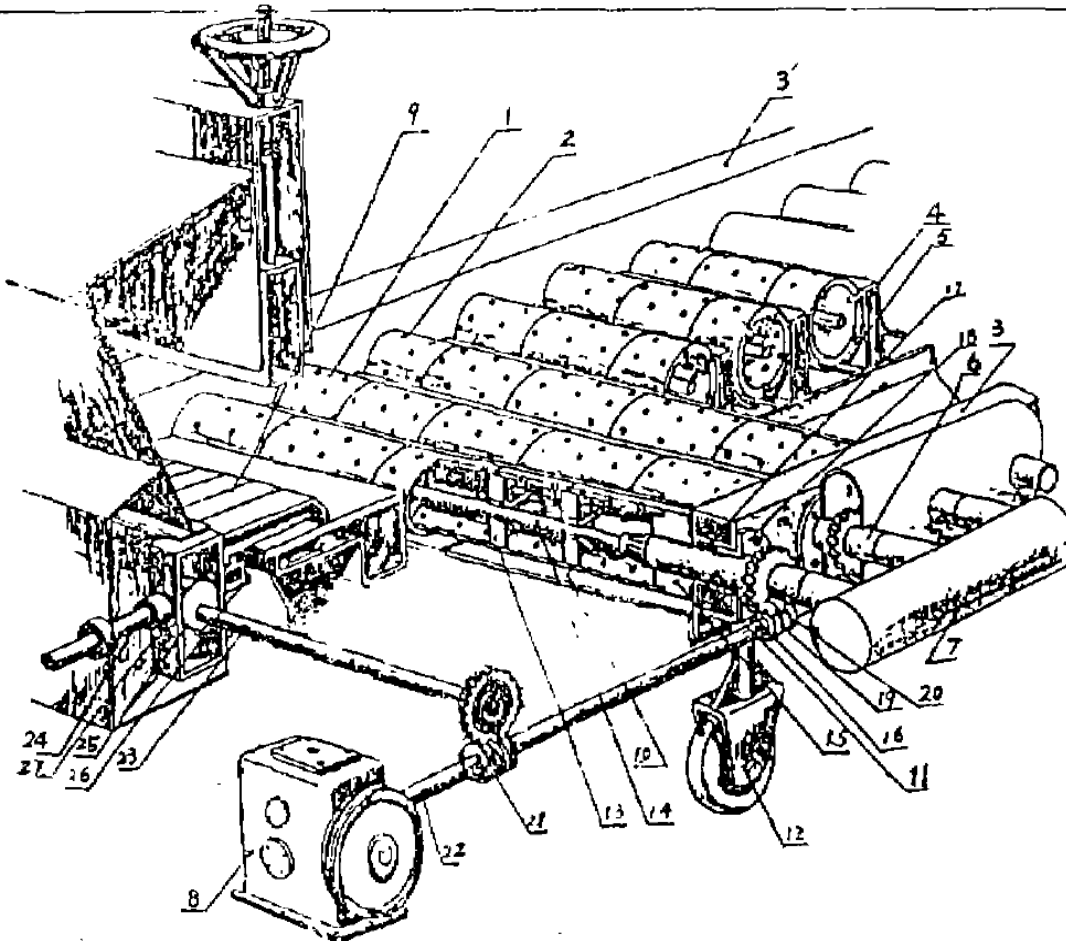


图1 滚筒炉排燃煤机整体结构示意图

1-滚筒; 2-分液筒; 3-总水箱; 4-滚筒冷却水槽; 5-挡风板; 6-风管; 7-总风管; 8-减速机构; 9-助推柱复炉排; 10-槽支撑板; 11-水槽上孔; 12-支腿; 13-加强筋; 14-轴; 15-套; 16-连接轴; 17-密封垫; 18-压套; 19-蜗杆; 20, 21-蜗轮; 22, 23-传动轴; 24-轴; 25-偏心轮; 26-槽钢; 27-导向盒。

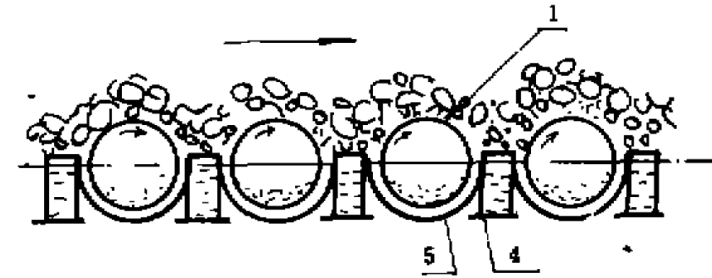


图3 滚筒与煤层运动图

1-滚筒; 4-冷却水槽; 5-挡风板。

1. The roller grate is constituted by over a plurality of hollow roller arranged in parallel
2. The rollers are separated from each other by a cooling water tank
3. There are many small holes on the surface of the roller.

From VIP - industrial furnace

Reciprocating grate stoker

- Most types, the most widely used
- Wide fuel adaptability
- Poor cooling of grate, easy to overheat and burn

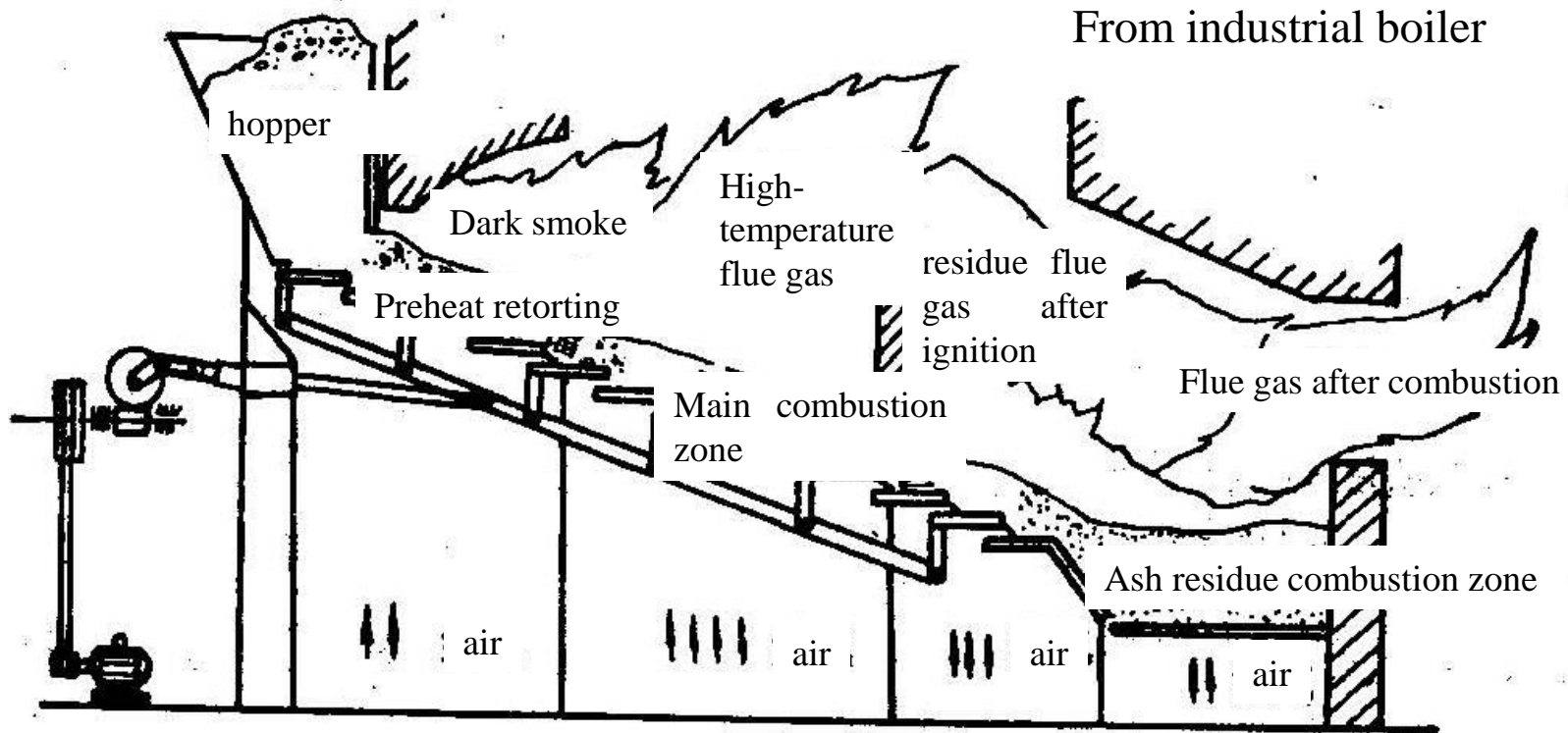
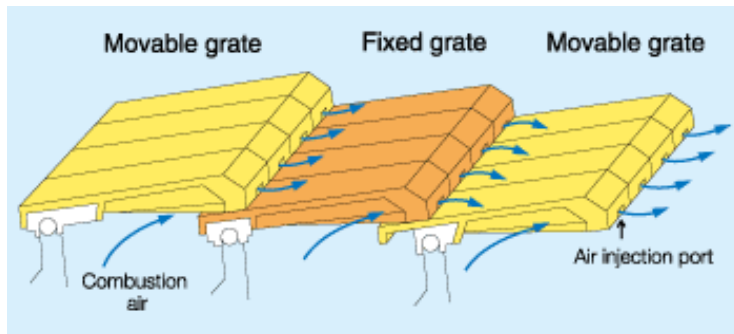


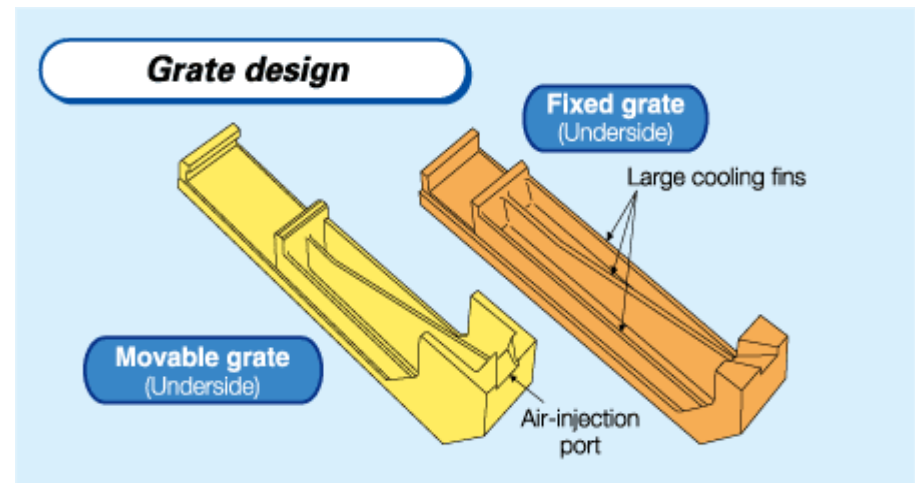
图3—47 Combustion process schematic of reciprocating furnace fuel

The structure of reciprocating grate stoker

- Grate moving distance 30~100mm
- frequency 1~5 Hz/min,
- MSW thickness 500~1000mm
- grate ventilation area ratio 7~12%

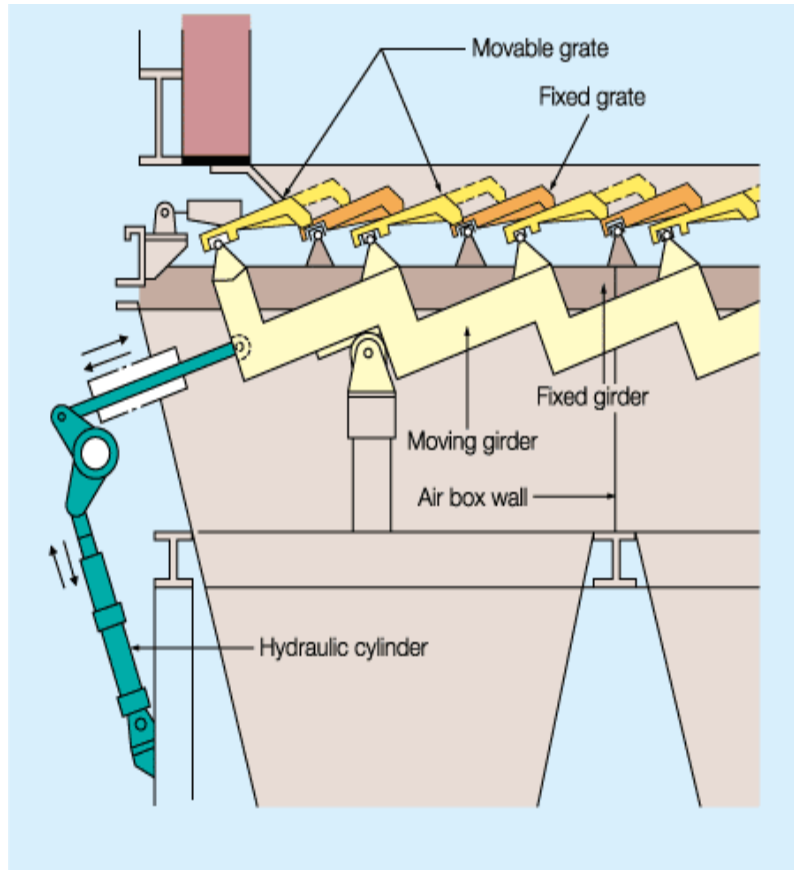


From JFE website



From JFE website

Horizontal reciprocating grate



From JFE website



From Martin website

Inclined reciprocating grate

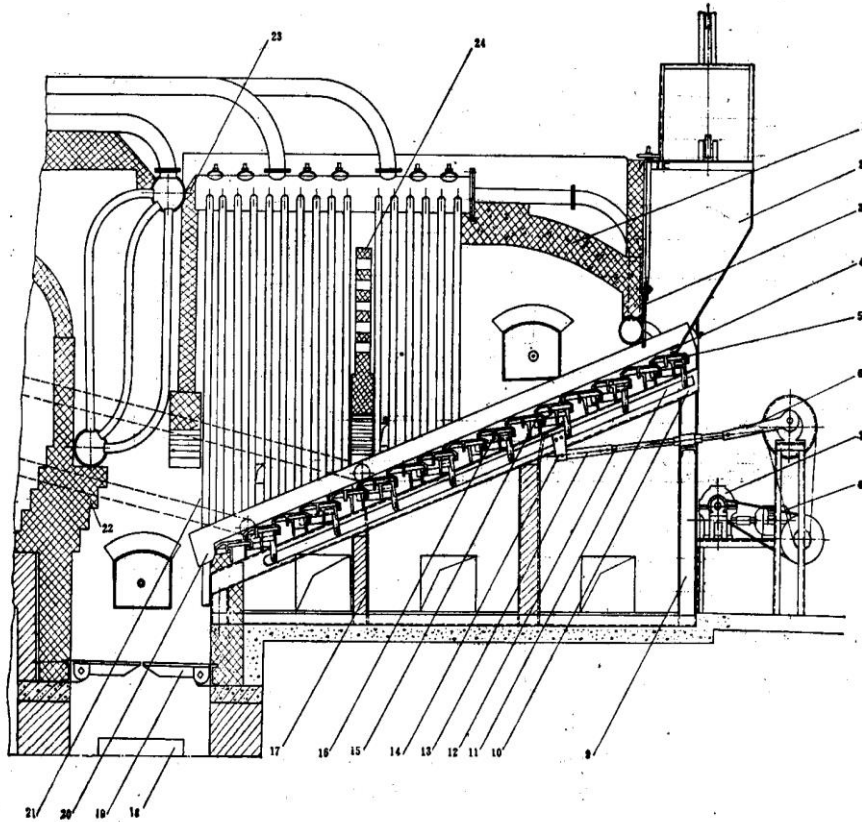


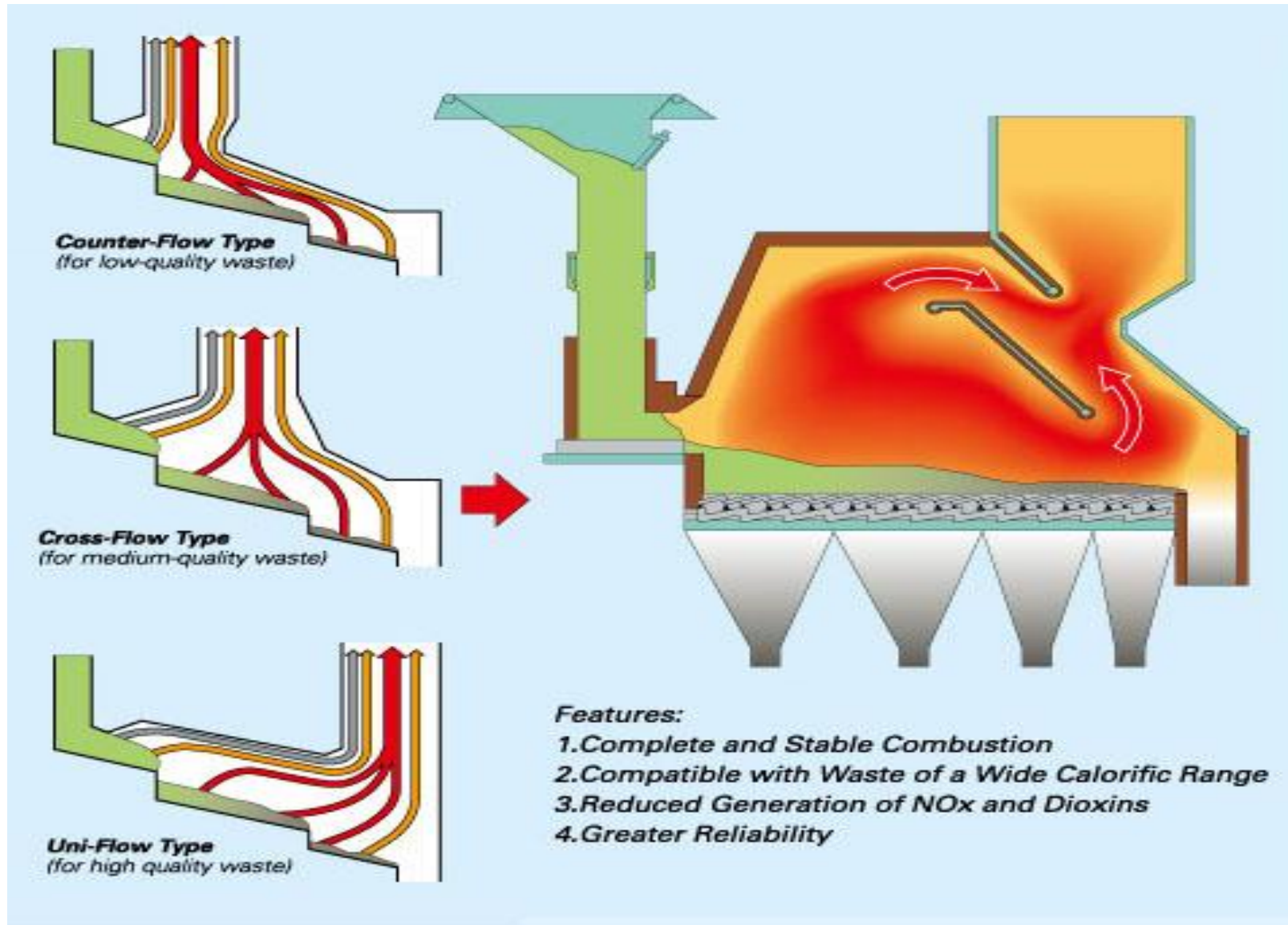
图3-48 往复推动炉排的结构

1. 抛物线引燃拱 2. 煤斗 3. 煤闸门 4. 护板 5. 无孔大炉排 6. 偏心轮拉杆
7. 变速机构 8. 电动机 9. 钢架 10. 固定炉排架 11. 活动炉排架 12. 推拉杆
13. 人字拉杆 14. 连板 15. 固定炉排片 16. 活炉排片 17. 隔风板 18. 出渣口
19. 余燃炉排 20. 斜联箱 21. 炉膛出口 22. 后拱 23. 后隔墙 24. 中隔墙

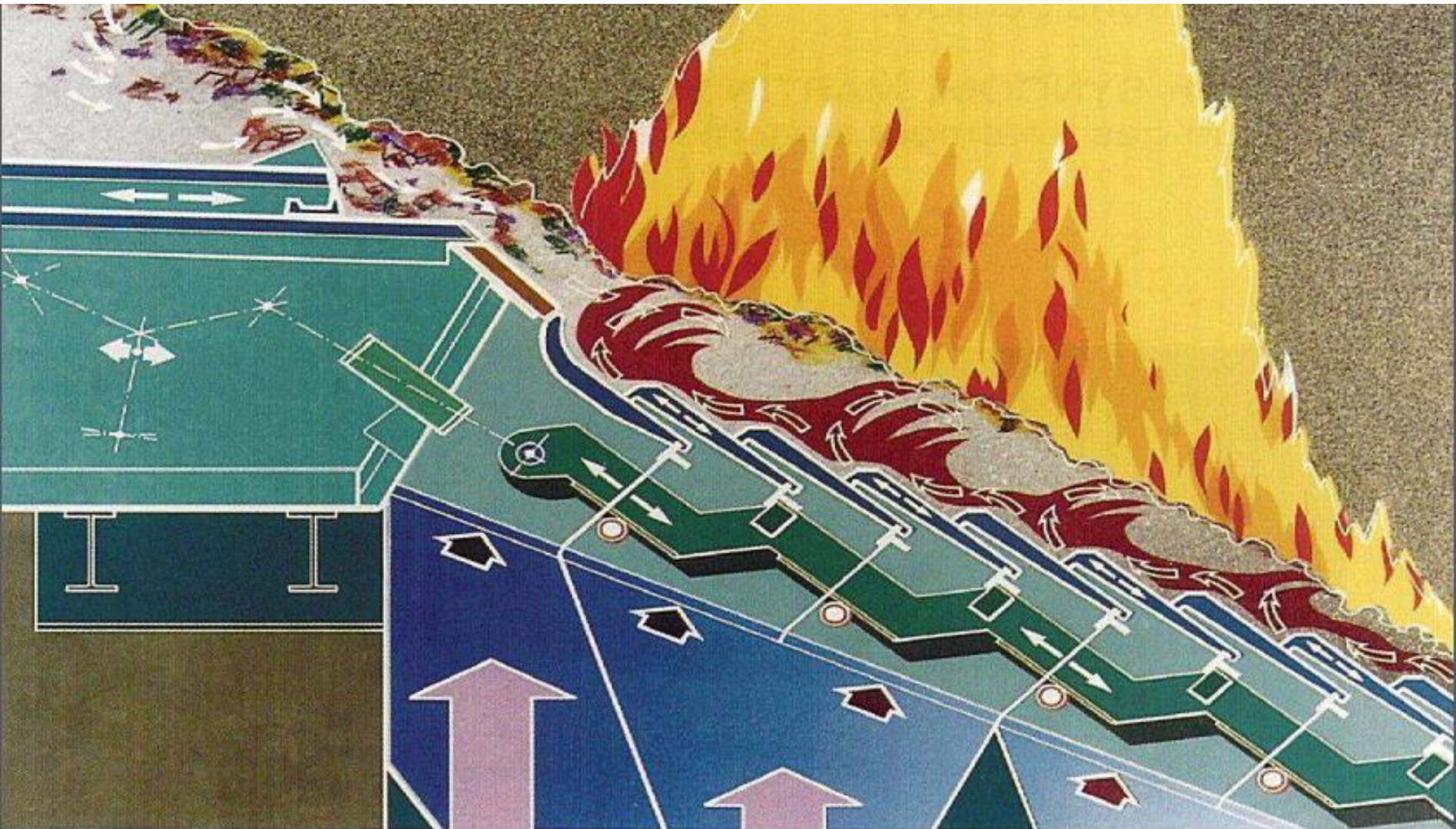


From Martin website

grate furnace structure



Reverse reciprocating grate - martin

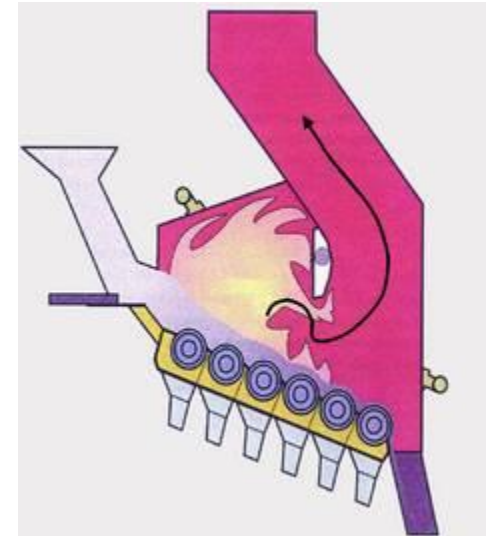


FISIA Babcock, Germany

rotating grate



Capacity [t/h] 7-40
LHV [MJ/kg] 8-13.5
Width [m] 2.5 - 7.5
Length [m] 10.5
per track 5-7 rollers usually
No. of grate steps none
Inclination[°] 20, 25,30



From fisia babcock website

Typical Grate stoker Provider



- **Martin, Germany (horizontal reciprocating, inclined back stepping reciprocating)**
- Noel kerz, Germany (stepped horizontal reciprocating) (acquired by fisia Babcock)
- Segers SHA multi pole furnace (multi-stage reciprocating, horizontal, vertical reciprocating)
- FISIA Babcock rotary grate, Germany (desulfurization technology)
- Babcock & Wilcox company, Denmark (reciprocating grate, grate vibration)

- Takuma, Japan (SN type grate)
- Hitachi Shipbuilding Corporation, Japan (reciprocating grate with vertical dial fire)
- JFE, Japan (super reciprocating grate)

- New century, Hangzhou (two-stage backstepping-forwardstepping type fire grate, based on Martin Technology)
- Wei Ming, Wenzhou (two-stage HMW grate furnace)

German Martin

cooperative partner

CNIM

COVANTA

Mitsubishi

authorized use

Sumitomo Heavy Industries

Chongqing Luneng



Thermal waste treatment facilities using MARTIN technologies

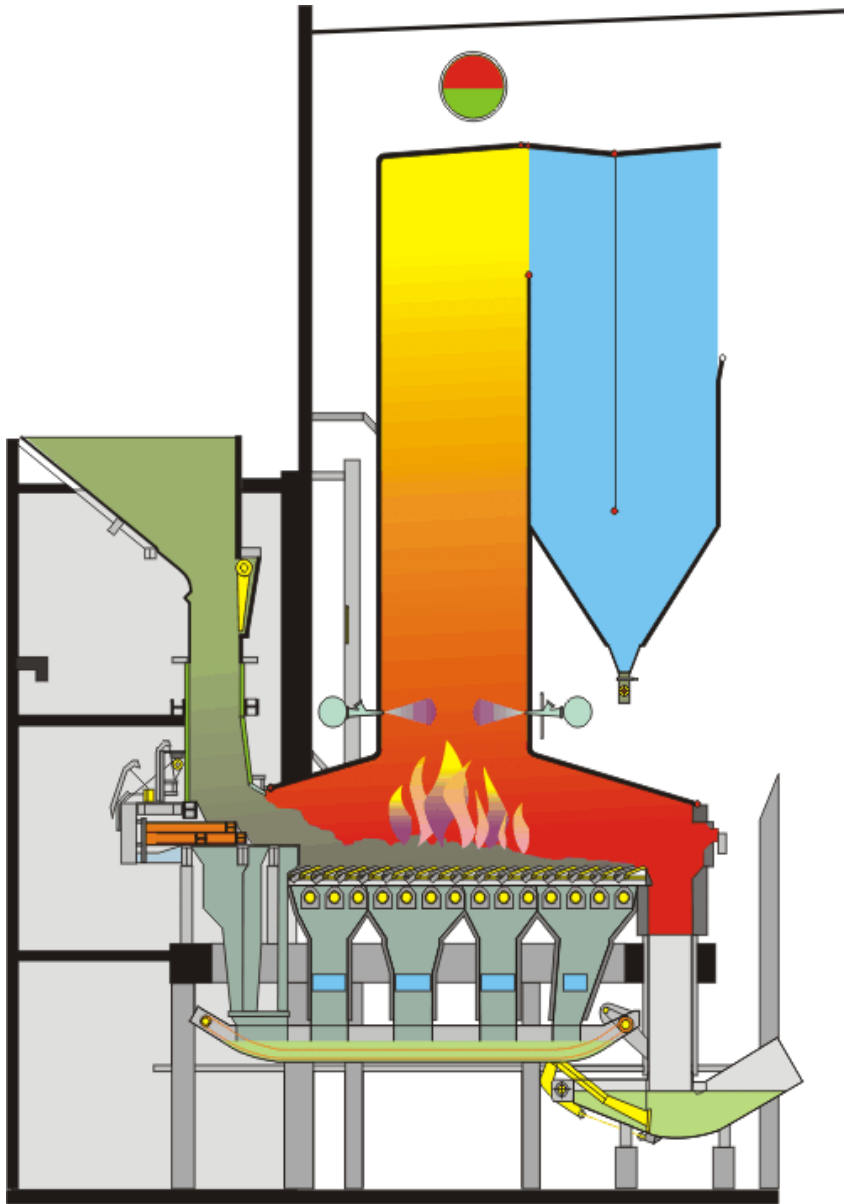
Anlagen zur thermischen Abfallbehandlung mit MARTIN Technologien

Usines de traitement thermique des déchets urbains avec les technologies MARTIN

Impianti per il trattamento termico di rifiuti urbani con le tecnologie MARTIN

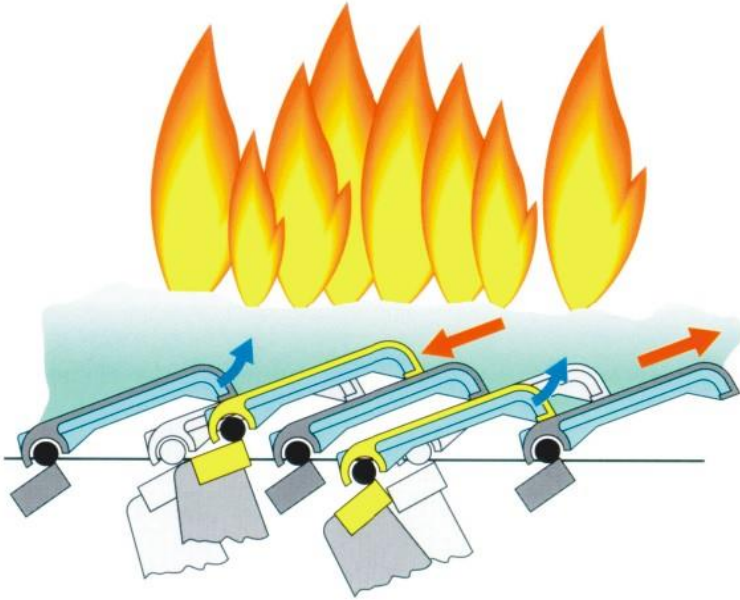
Country	Number of plants	Number of lines	Throughput Mg/d
<i>Land Pays Paese</i>	<i>Anzahl Anlagen Nombre d'usines Numero impianti</i>	<i>Anzahl Linien Nombre de lignes Numero linee</i>	<i>Durchsatz Capacité Capacità</i>
Austria	6	10	3188
Azerbaijan	1	2	1584
Belgium	6	11	3878
Brazil	2	4	600
Canada	3	5	1156
China	64	134	67344
Czech Republic	2	3	1015
Denmark	3	3	1560
Estonia	1	1	660
Ethiopia	1	2	1234
France	65	113	28656
Germany	30	47	19609
India	1	2	1200
Italy	13	22	9528
Japan	85	193	33490
Jersey	2	4	654
Korea, Rep. of	10	17	3825
Luxembourg	2	3	720
Macao	3	6	1728
Monaco	2	3	417
Netherlands	14	33	13936
Norway	3	6	1056
Poland	1	1	288
Portugal	1	2	1280
Russian Fed.	3	5	1000
Singapore	4	21	13992
Slovakia	1	2	524
Spain	3	5	1344
Sweden	11	13	4642
Switzerland	36	45	11754
Taiwan	7	18	7400
Thailand	1	1	250
United Kingdom	22	39	15500
United States	32	72	31592
TOTAL	441	848	286605

Horizontal reciprocating grate



water cooling

MARTIN horizontal grate



Motion of the grate bars



Grate bar configuration

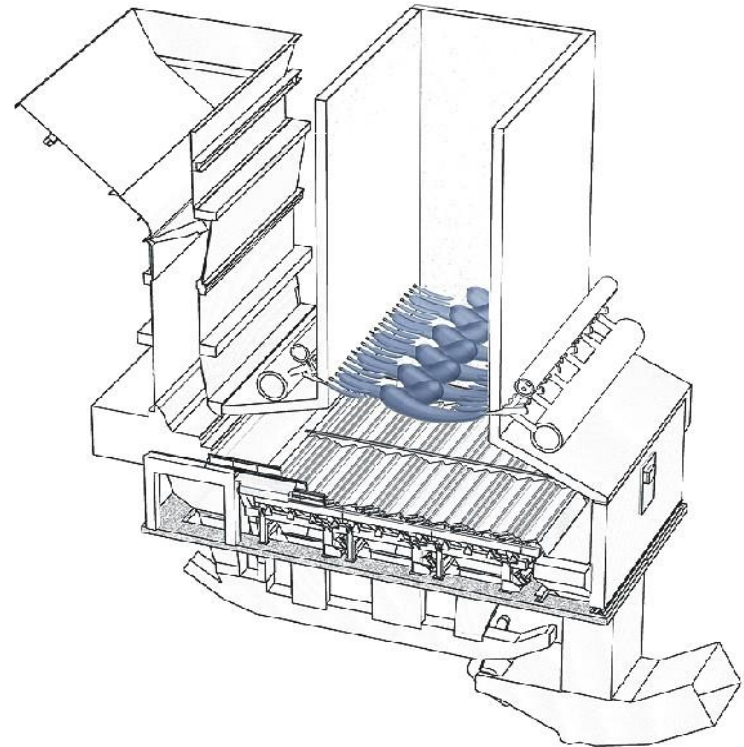
The horizontal grate is of modular design. The length of each module is fixed but the width may vary according to specific requirements. Each module has its own drive and supply of underfired air, both of which can be controlled separately. A typical grate configuration consists of 3 modules in the waste flow direction. There may be between 1 and 3 runs depending on requirements.



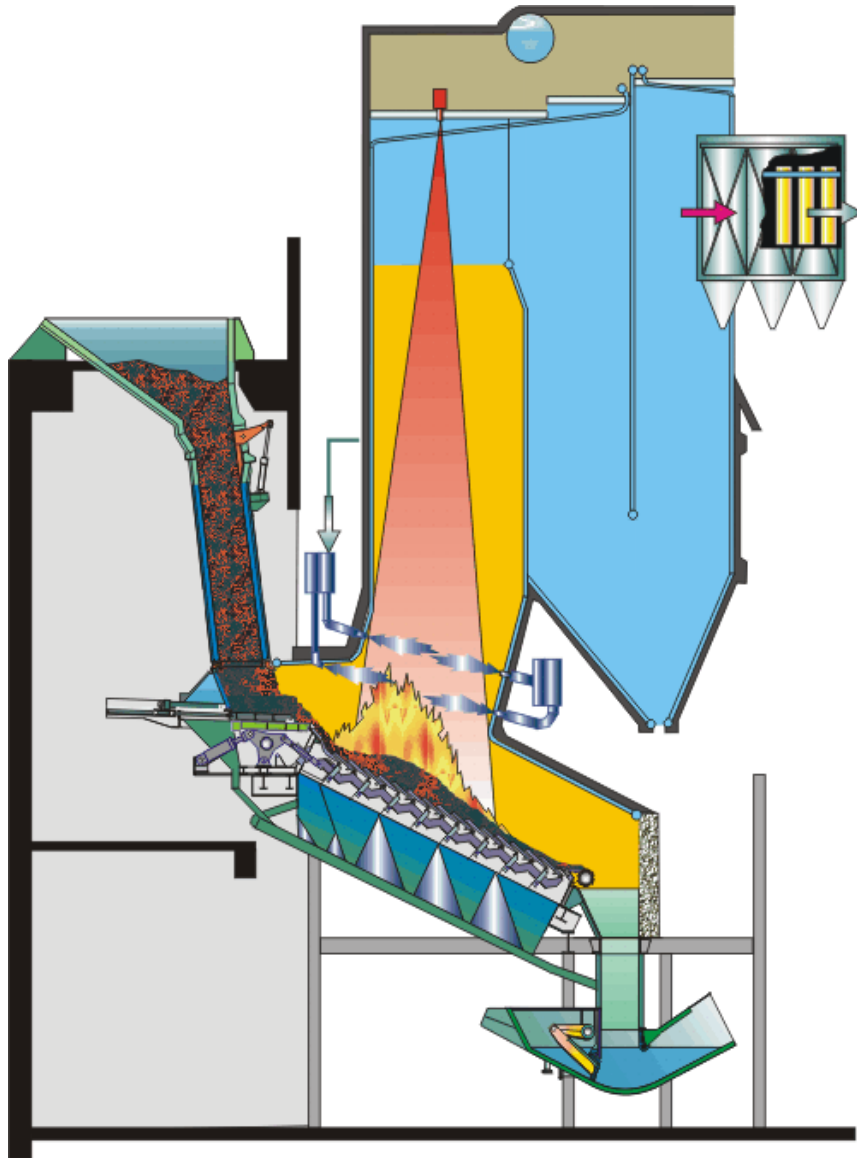
Water-cooled grate plate

The development of water-cooled grate bars are necessary to achieve acceptable service lives. An added benefit of this system is that underfired air is no longer needed to cool the grate bars and is controlled only as and when required by the combustion process. The heat dissipated by means of the water-cooling system can be returned in full to the process.

Furnace geometry, the arrangement of the overfired air nozzles, and the choice of refractory material are crucial to ensure good burnout of the bottom ash and flue gas.



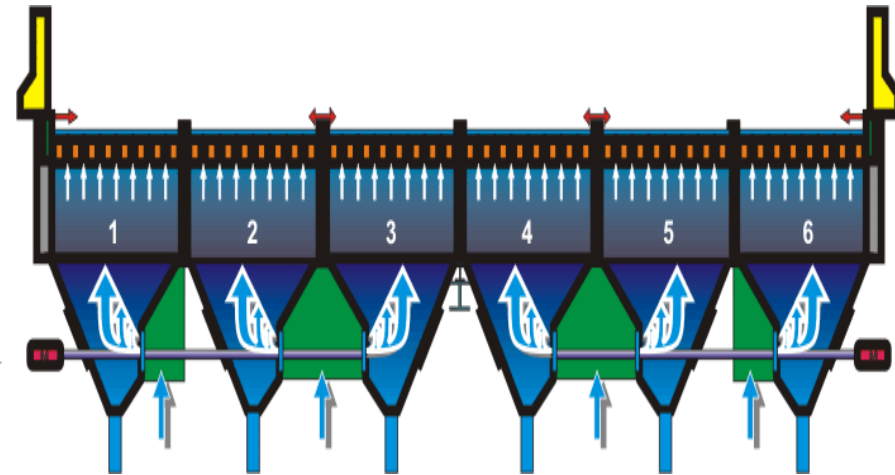
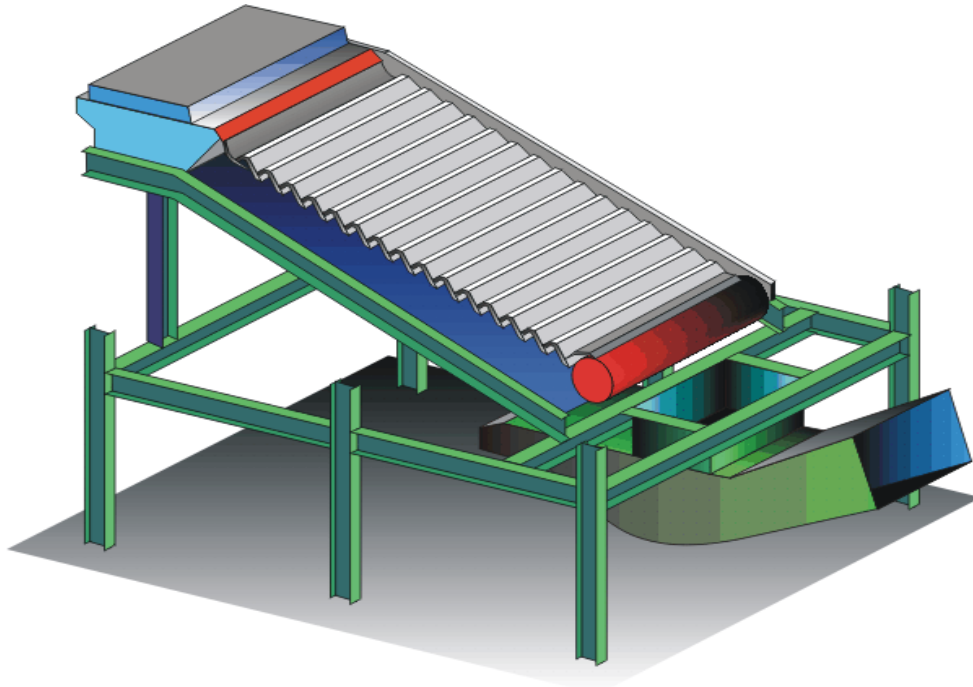
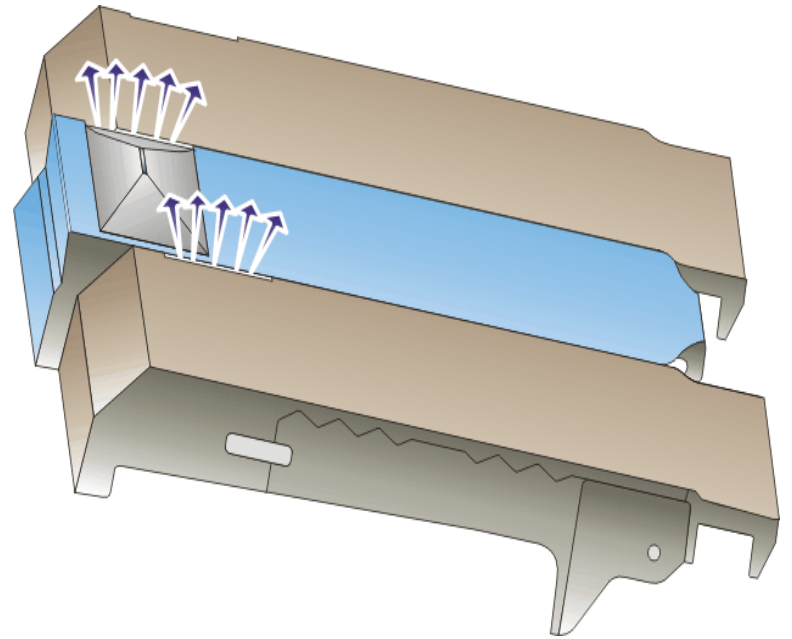
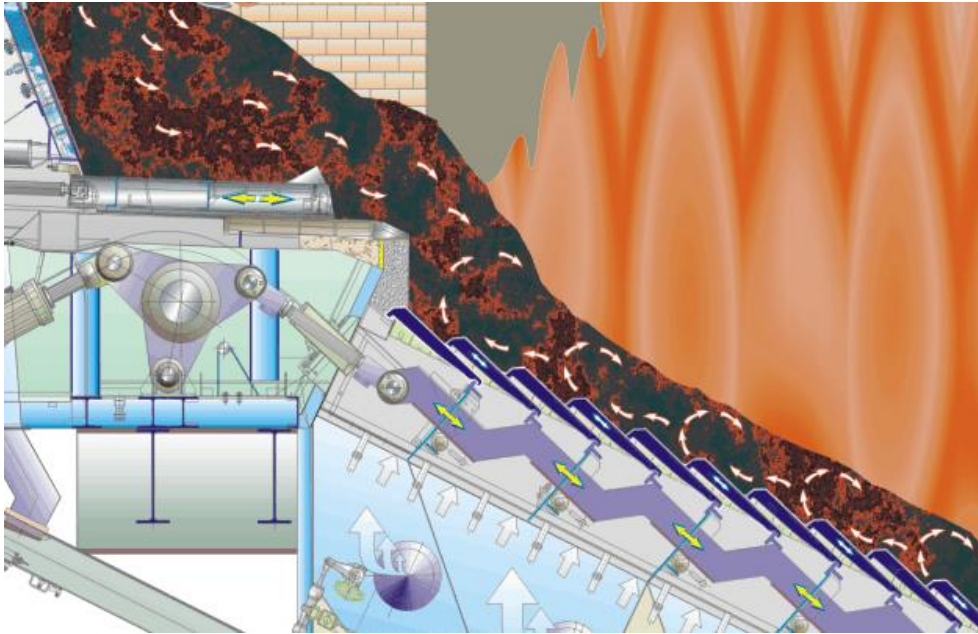
Combustion chamber geometry



Reverse inclined reciprocating grate



Dip angle: 26°
 Monolithic grate width: 1.5~2 m
 Type of cooling: air cooling
 Peak flame temperature: 1200°C



MARTIN reverse-acting grate



The MARTIN reverse-acting grate is inclined in the direction of transport and comprises several stair-like grate steps. The up-and-down motion against the grate inclination of every second step constantly mixes the red hot mass with the newly fed waste and facilitates uniform and stable operation of the combustion process at temperatures sometimes exceeding 1,000° C.

MARTIN's latest development, the reverse-acting grate



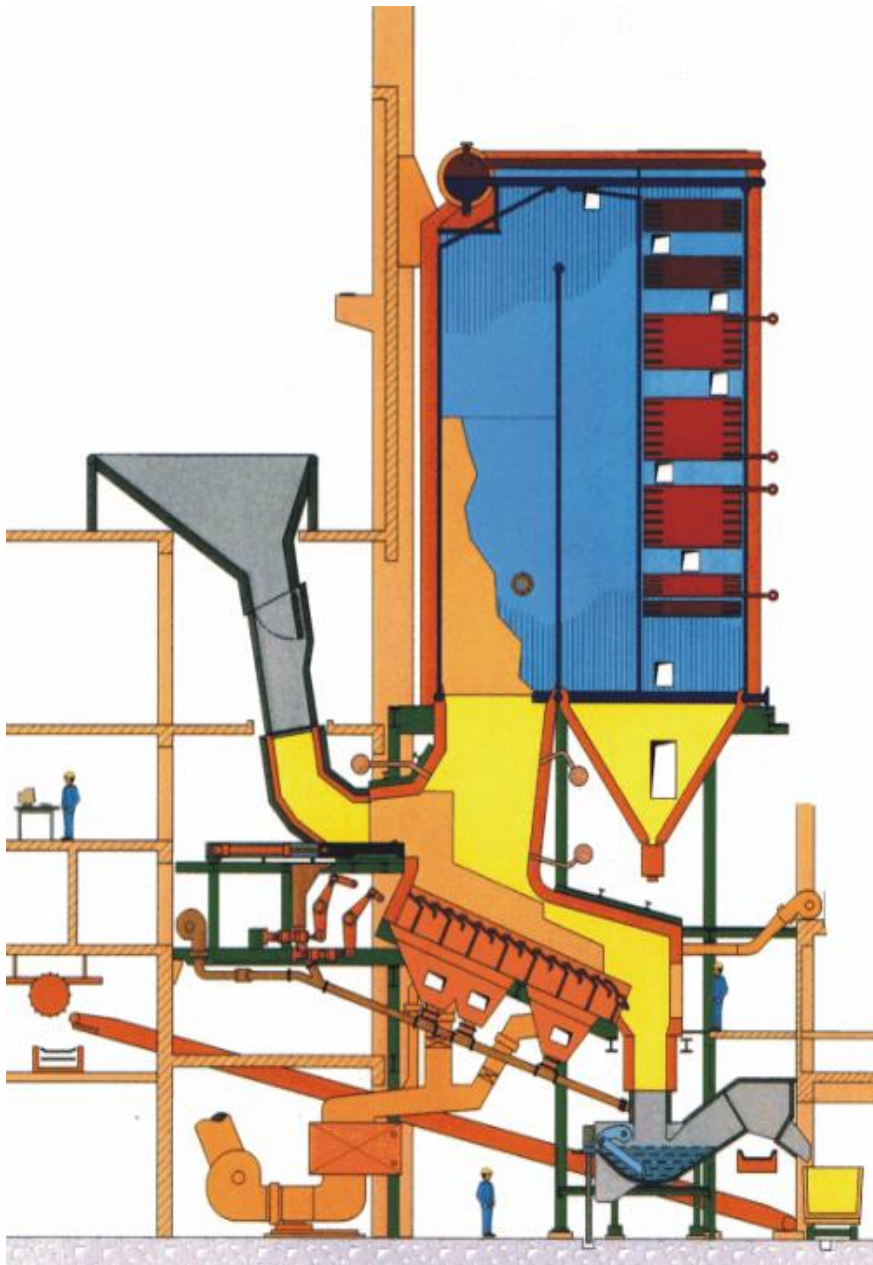
The three drive zones now available with the system can be controlled individually. The speed at which the fuel is fed and the combustion conditions can be optimally adjusted to the fluctuating waste quality. This makes it possible to agitate the fuel/the combustion residues in several zones without adversely affecting the residence time

Stationary and moving grate steps

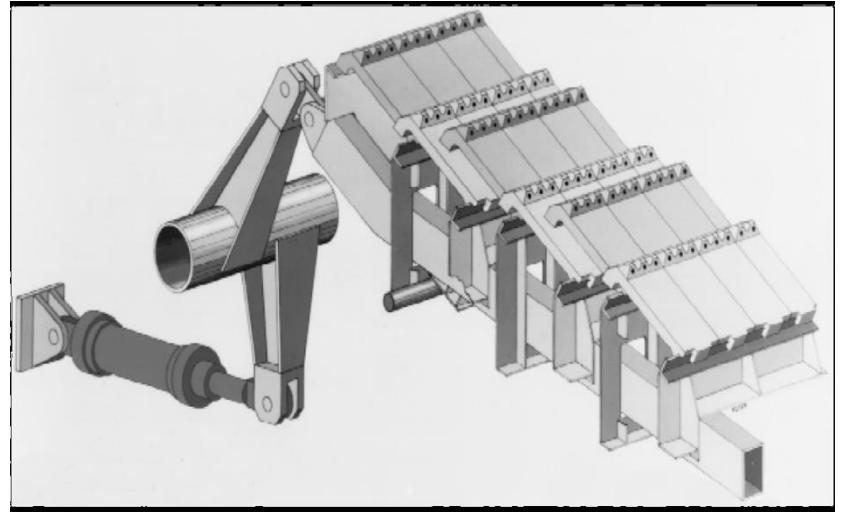
It is not necessary to cool the MARTIN reverse-acting grate even when heating values are very high. Its unique drive concept constantly maintains a stable covering on the grate and consequently the grate elements are protected from excessive thermal loads.



Grate driving cylinder



SITY200 grate (original ALSTOM)

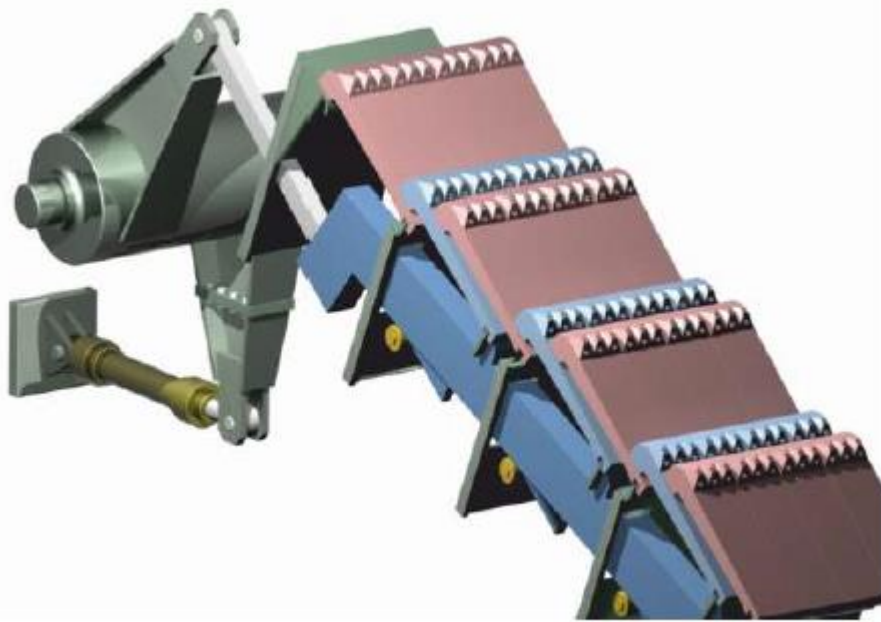


Tilt type reverse moving grate

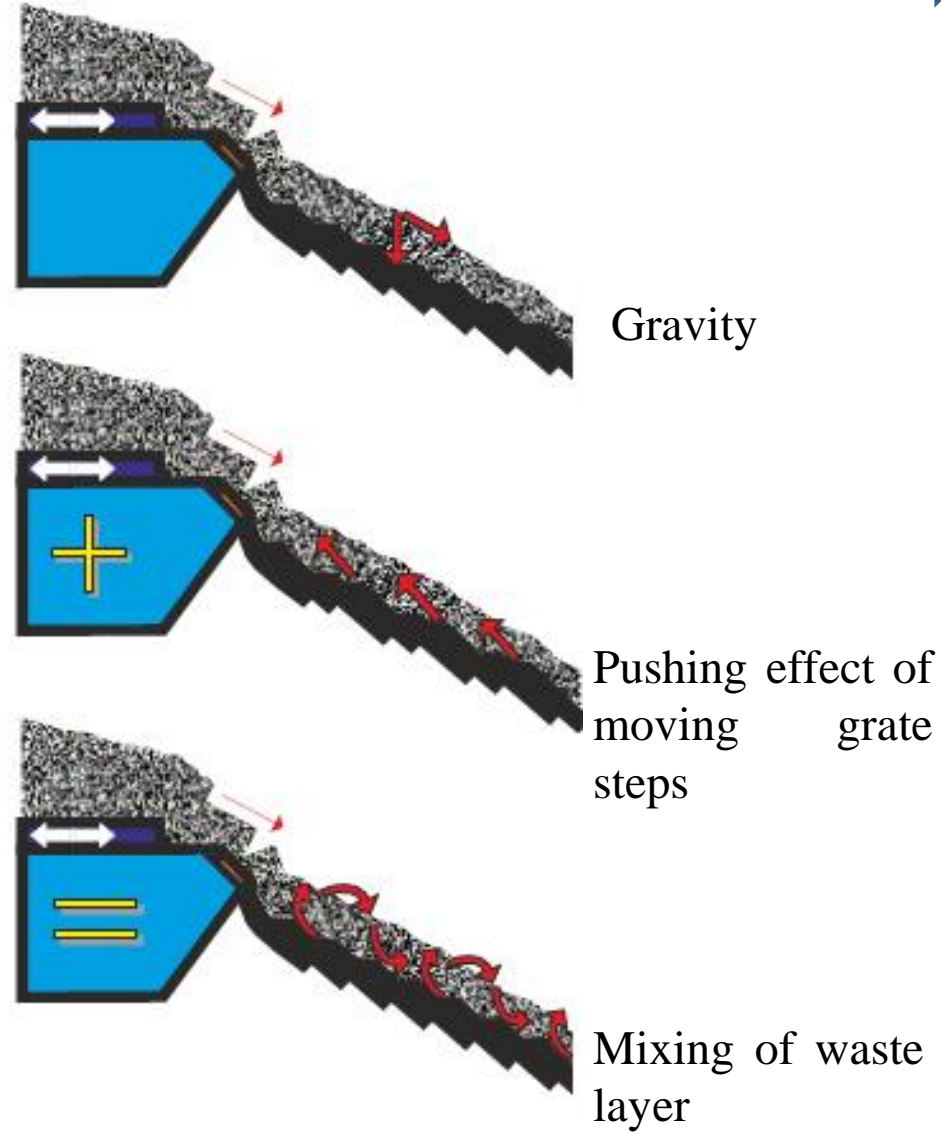
Incline angle: 24°

Through the up-and-down motion of movable grate at once every 5 minutes, grate is cooled

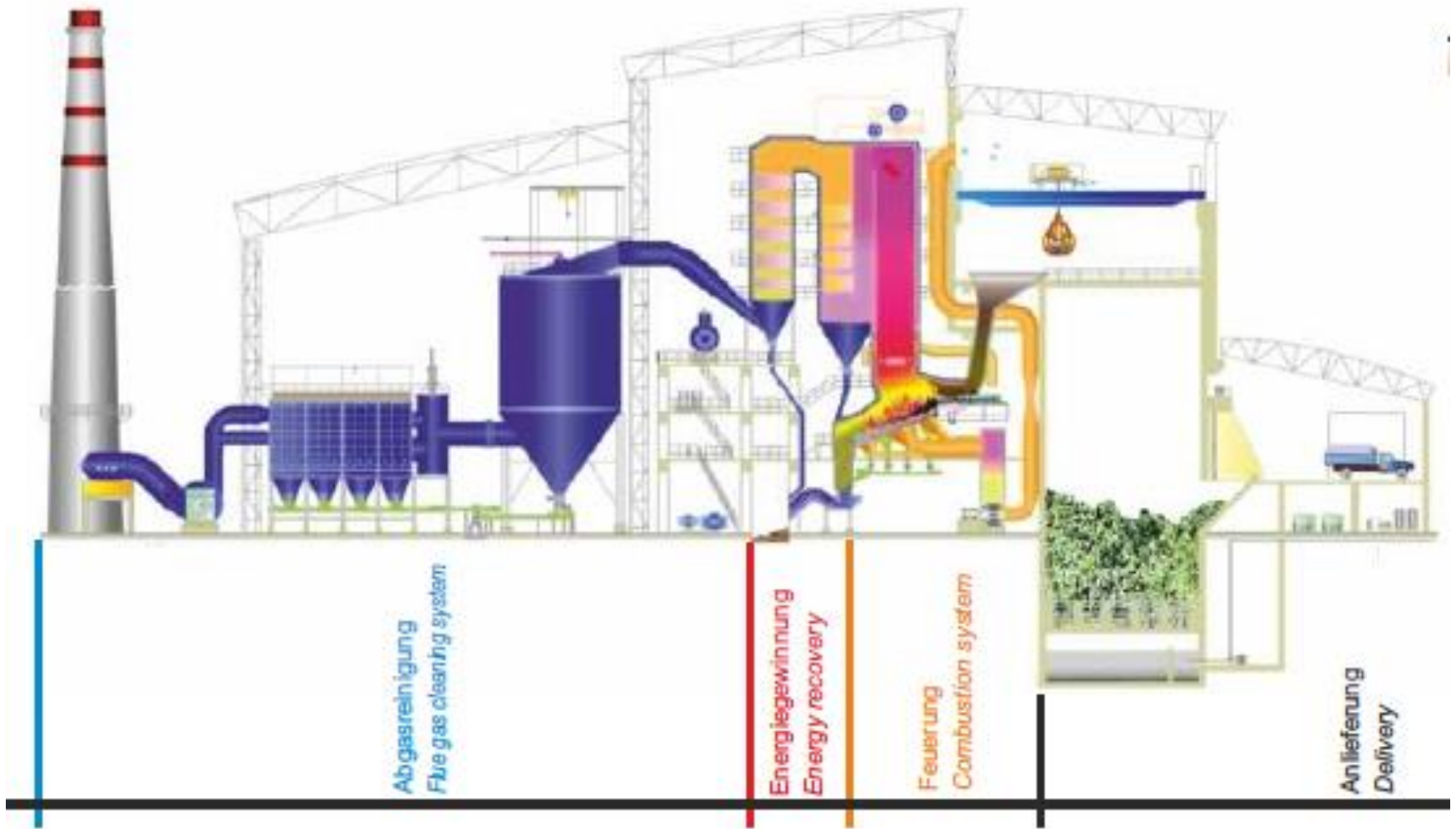
by primary air



SITY 2000 grate - ideal for waste in Asia



MARTIN reverse-acting grate SITY 2000



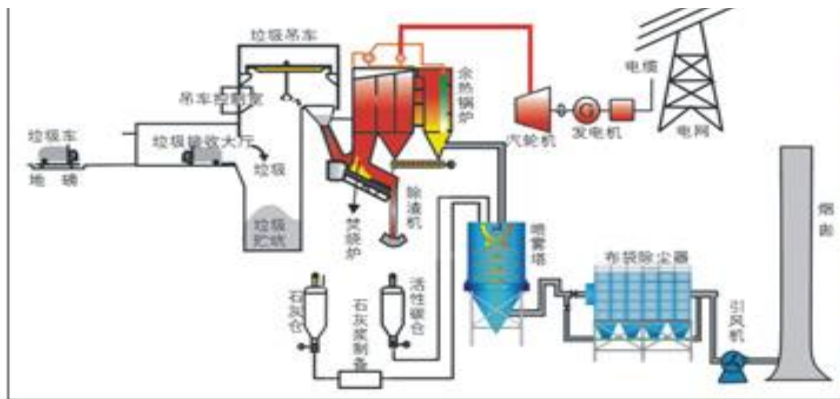
The MARTIN reverse-acting grate SITY 2000 plant system

Chongqing Tongxing waste treatment Co. Ltd.

The system of incinerator and heat recovery boiler

The project adopts mechanical grate system, the specific shape design of furnace combustion system is set for efficiently complete combustion of waste, and the residence time of flue gas at a temperature over 850°C furnace is more than 2 seconds, maximizing the dioxin full decomposition

The project adopts two steam boilers of 58.39 t/h, natural circulation, feed water temperature 130°C, flue gas temperature 210°C, steam pressure 4.0MPa, steam temperature 400°C



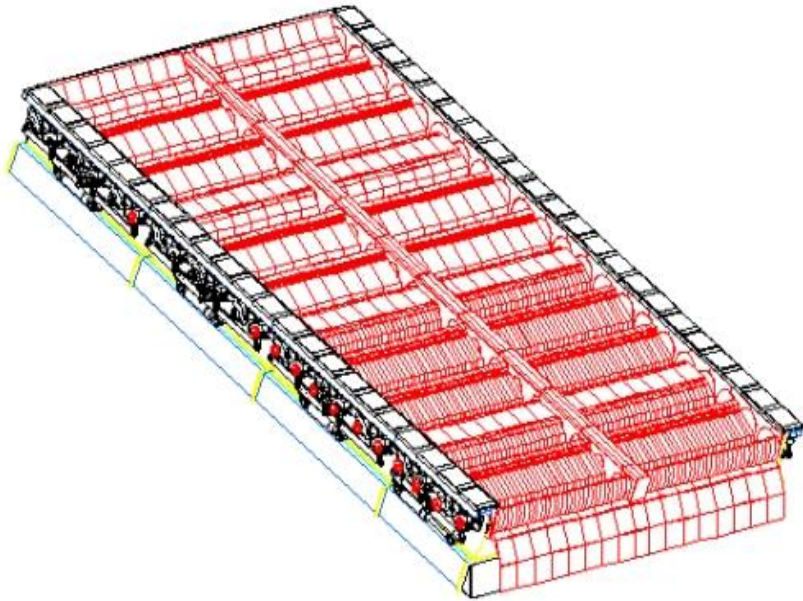
Data is from the Chongqing three peak site

Principle technical parameters

Waste treatment capacity	2*600 t/d		
Waste adaption of low heat value	4500-10000 kj/kg		
Designed LHV waste	7000 kj/kg		
Residence time of waste incineration	1.5-2.5 h		
Clinker ignition loss of slag	<3 %		
The residence time of flue gas at a temperature over 850°C furnace	>2 seconds		
Annual service hours	8000 h		
Nominal steam pressure in heat recovery boiler	4.0 Mpa	Temperature	400°C
Rated evaporation	58.39 t/h (each line)		
Turbine capacity	2*12 MW		

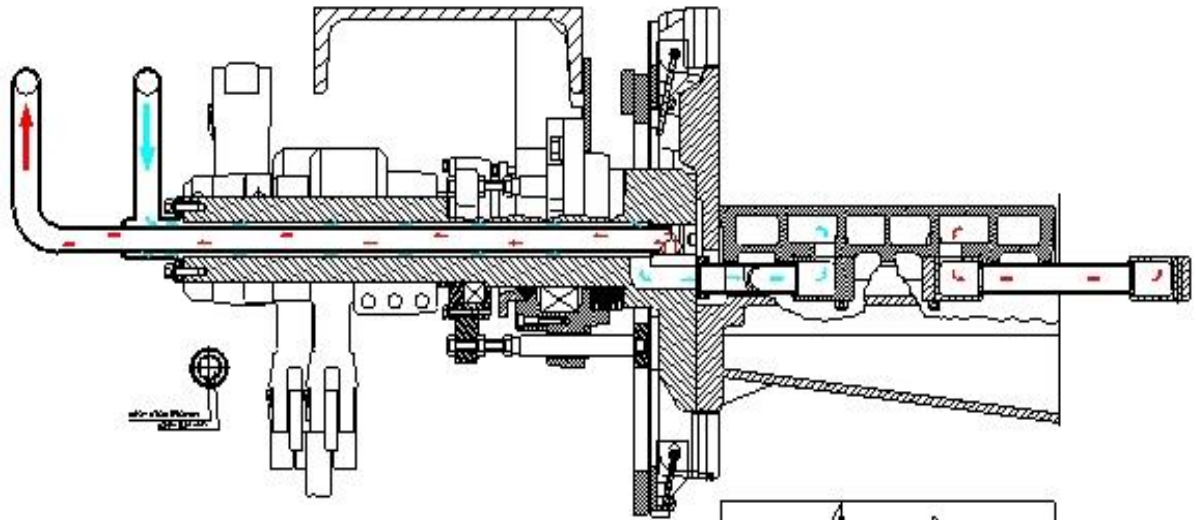
Babcock & Wilcox, Denmark

www.volund.dk acquired by B&W in 2000

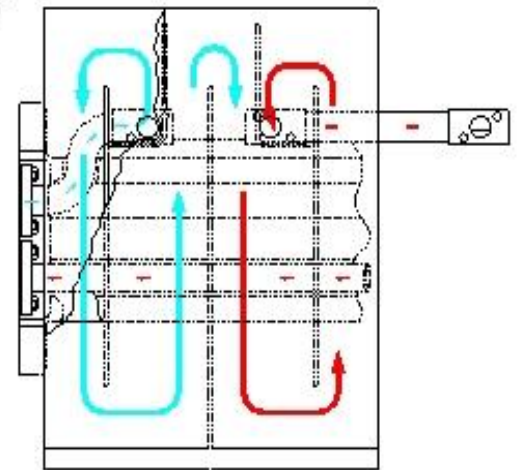


- **W-grate (BS) Mark 5 air-cooled**
- Combustion of all types of waste
- Capacity: 3 - 30 t/h
- High thermal efficiency
- Can handle unsorted waste
- Low total organic carbon in ash content
- Possibility of biomass co-firing
- Air gap of 1.5-1.8% of projection area

From babcock website



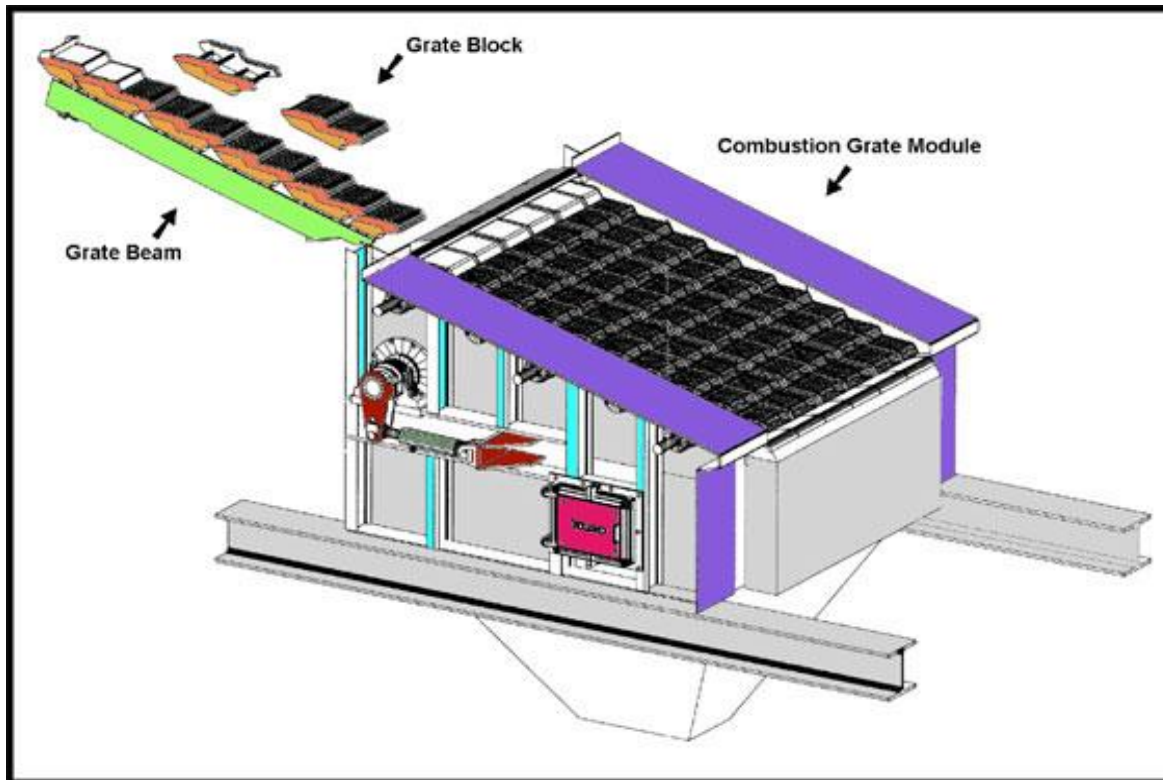
- **W-grate (BS) Mark 6 water-cooled**
- for high calorific refuse
- Combustion of all types of waste
- Steam, hot water and district heating
- Capacity: 3 - 30 t/h
- Can handle unsorted waste
- **High calorific** waste up to 25 MJ/kg
- Optimal primary air addition
- Possibility of biomass co-firing



From babcock website

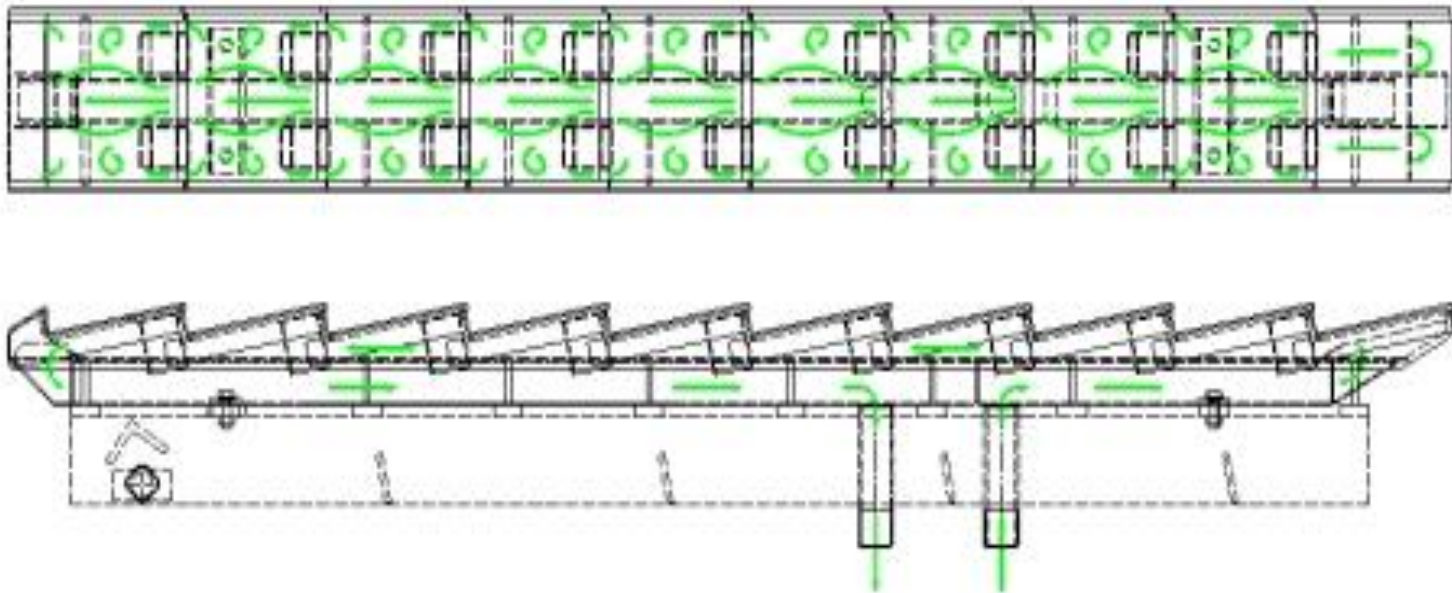
- **W-grate (Vølund) air-cooled**

From babcock website



- **W-grate (Vølund) water-cooled**

From babcock website



Grate surface cooling is independent of combustion air so that air can be added and adjusted for optimum combustion

Minimal corrosion due to low grate surface temperature

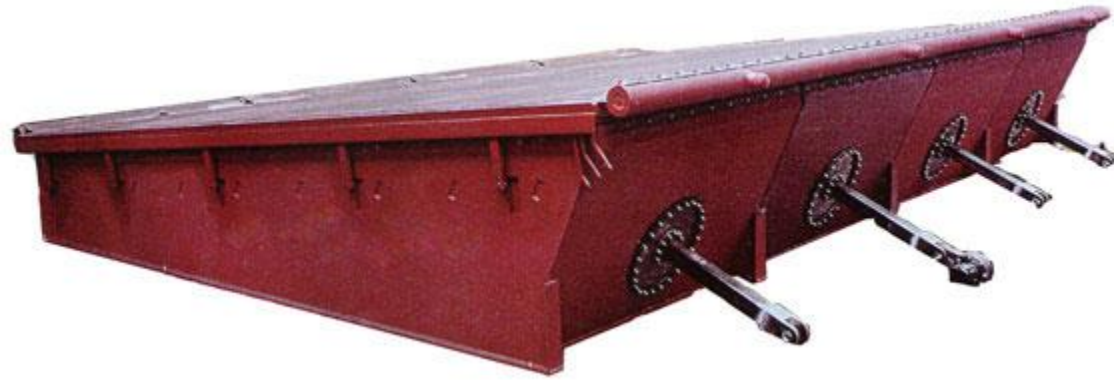
Energy from grate cooling used for air preheating

Constant high cooling water flows under the grate surface preventing boiling

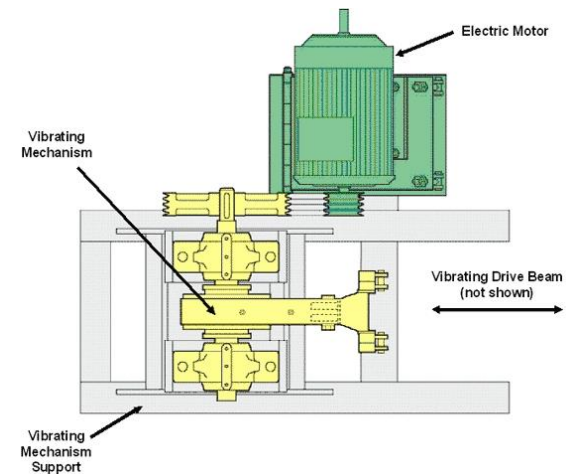
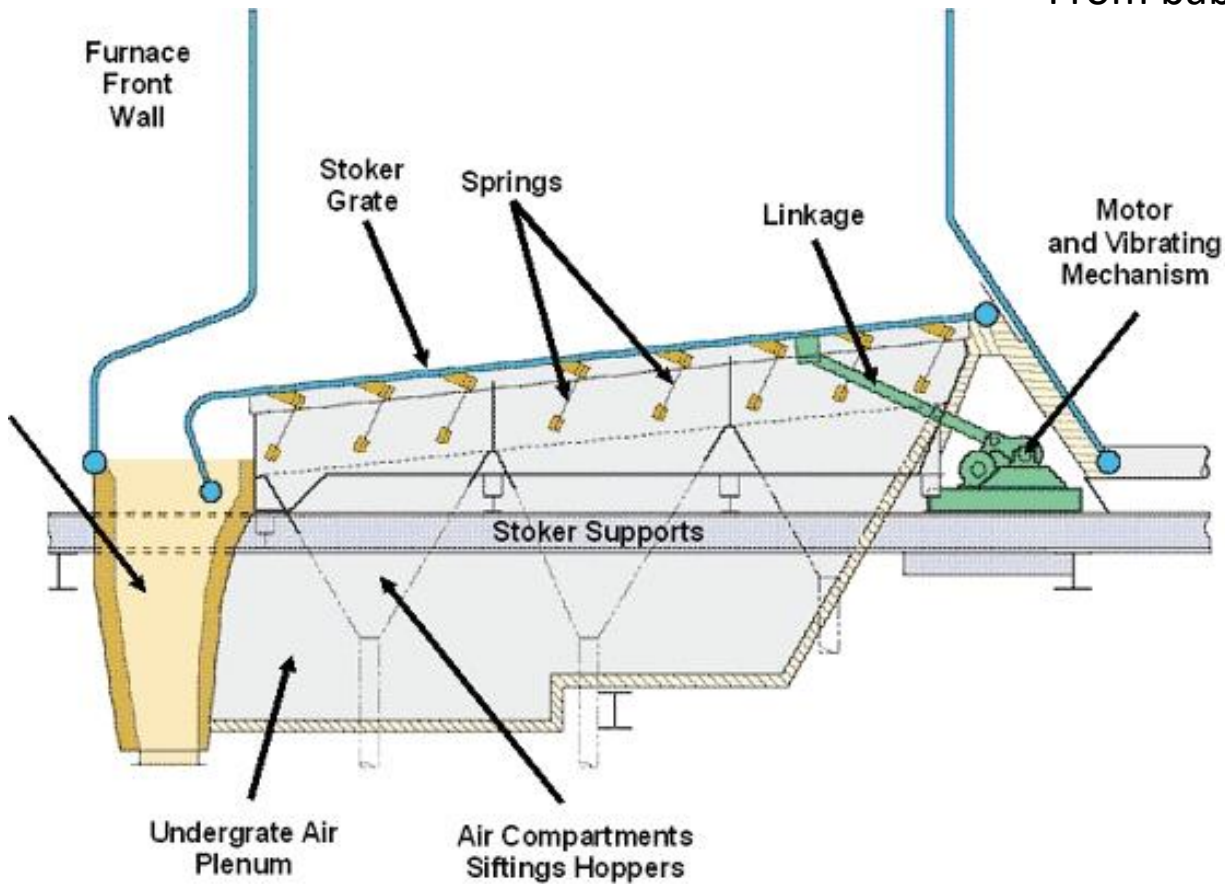
Low differential temperature over the grate results in low thermal stress

Simple control

- vibrating grate



From babcock website



Plant Data

Steam flow 144 t/h

Steam pressure 310 bar

Steam temperature 583° C

Energy input 105 MW

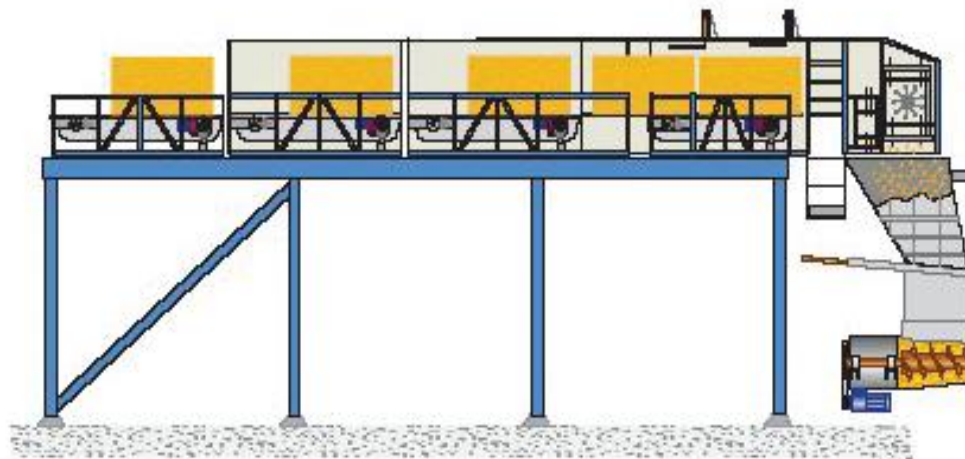
Fuel input 26.5 t/h

Feedwater temperature 230° C

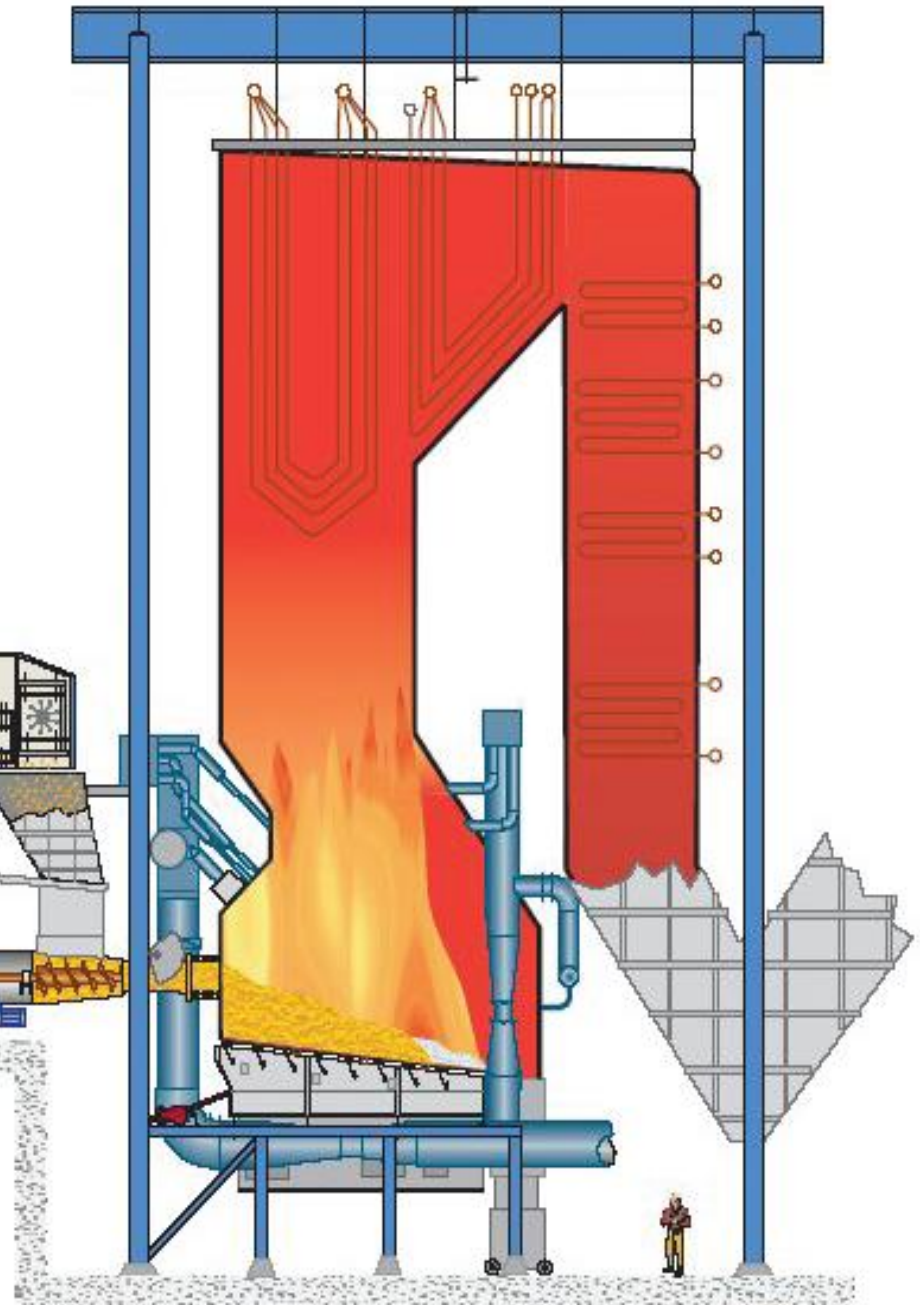
Flue gas temperature after air heater 115° C

Thermal efficiency 93.2 %

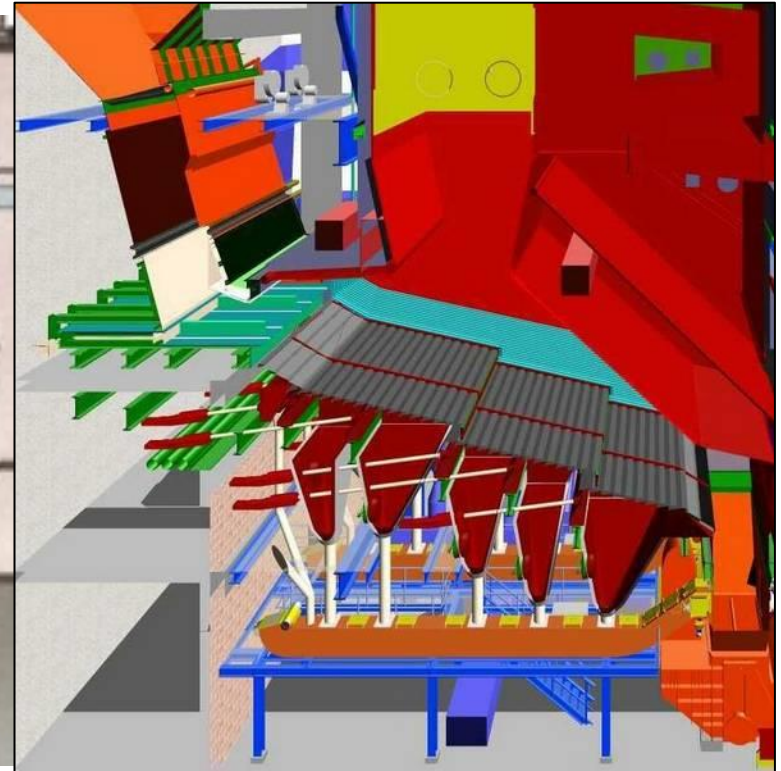
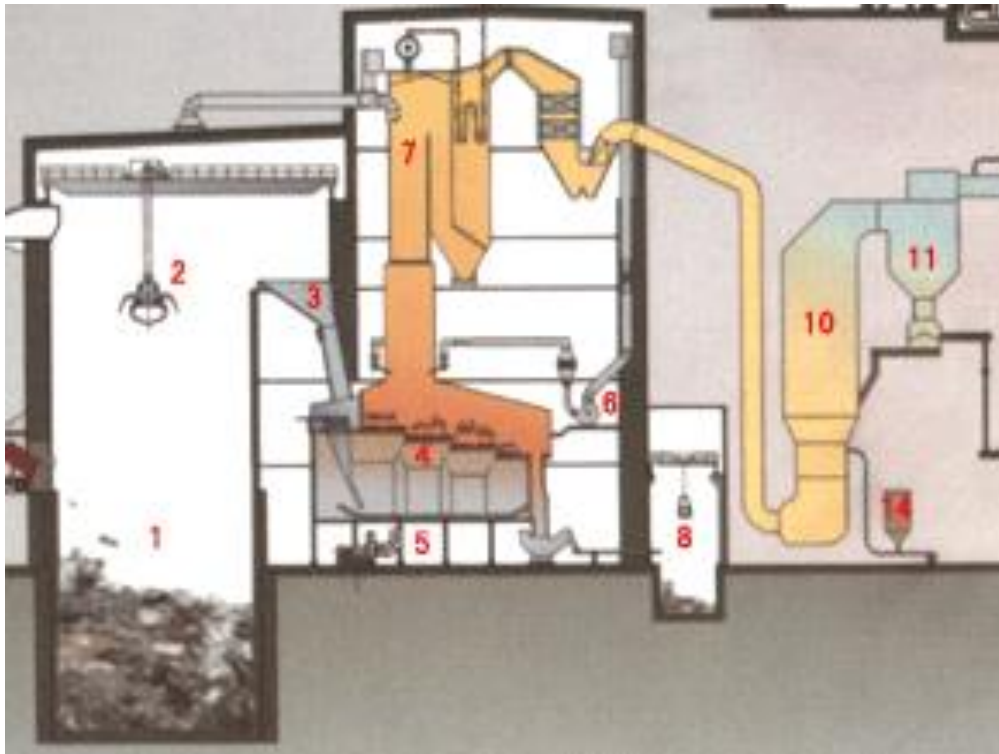
Electrical efficiency, total 49,5 %



From babcock website



The Steinmuller grate (now steinmuller babcock)



Ningbo Fenglin waste incineration power plant

Pictures from Ningbo Fenglin website

Forwards stepped grate: the whole burning area is divided into two columns, each column is divided into four districts, each district is filled with grate stones composed by pieces of grate tiles, connecting in rows and overlapping, static grates and movable grates are arranged alternately, each independent grate tile is made by heat resisting chromium steel cast, the gap between two adjacent grates can be adjusted to ensure the compact surfaces of grates.



Grate area: 74m²

Handling capacity: 350t/d

Oil consumption for ignition: 1.5t

Mismatching phenomenon in hydraulic system

Blowout the furnace once in four months

The use of biogas for afterburning 500m³/h

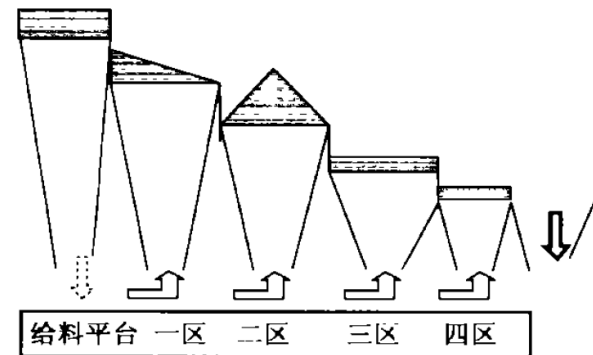
More wear and deformation in the second and third district

grate replacement above 1/3

Flue gas temperature: >180°C

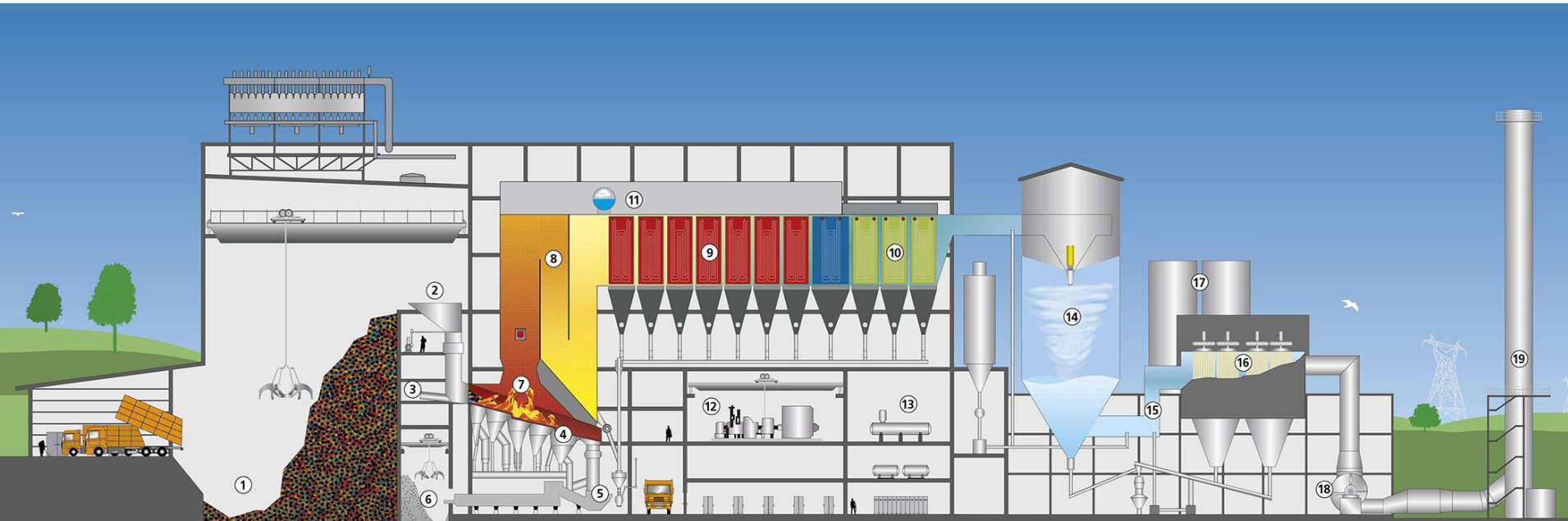
Waste thickness in the first and second district are about 0.5m~0.8m,

In the third and fourth district: 0.3m~0.5m



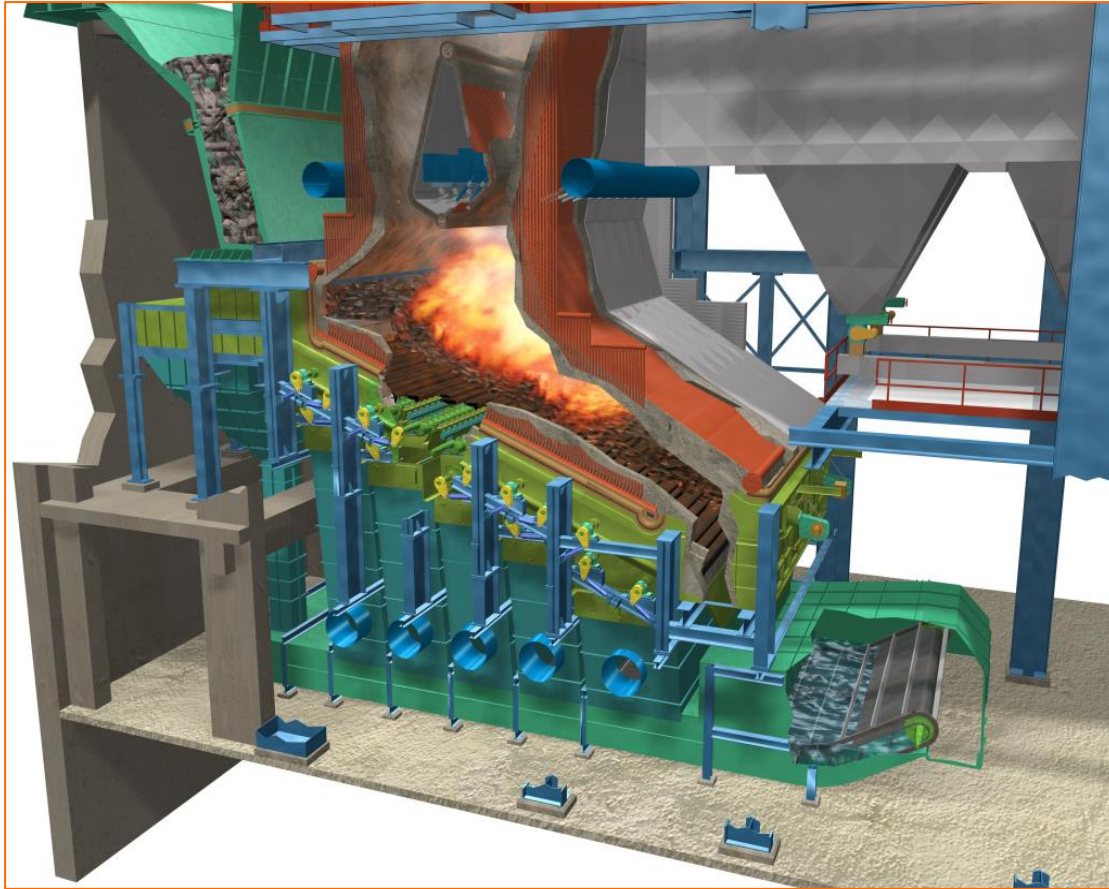
The leakage of waste leachate in the first district

Steinmuller air-cooled grates



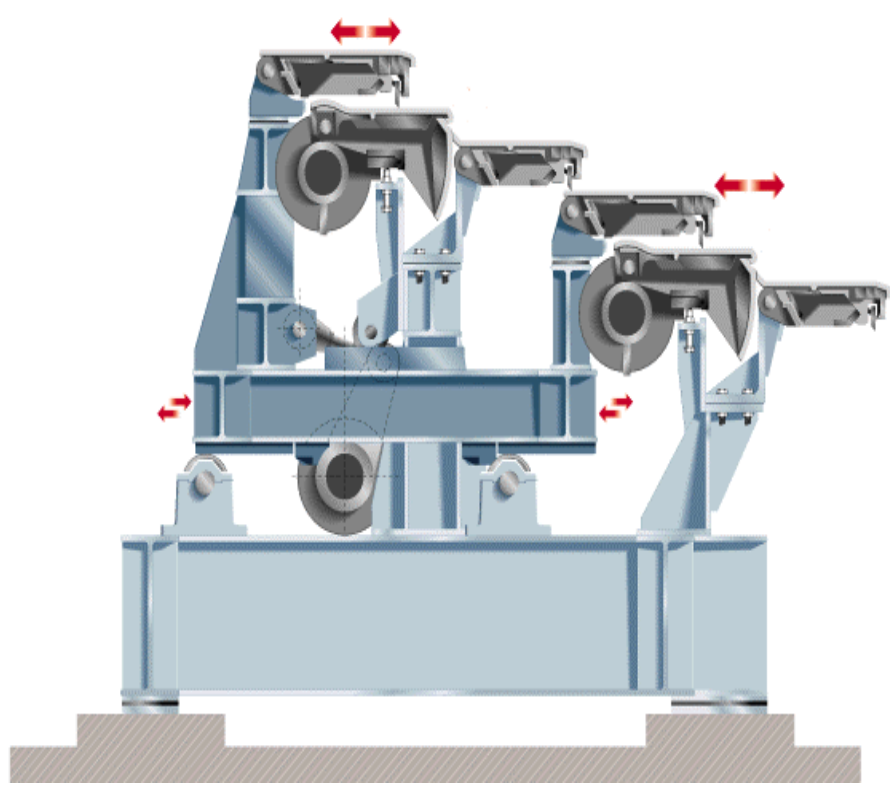
Steinmuller has both an air-cooled and a watercooled version of the grate technology. The designs are interchangeable if a retrofit is desired after the initial installation. The boiler proposed had three vertical empty passes and a horizontal pass with superheater, generator and economizer sections.

Gio Bal Seghers multistage grate furnace, Seghers, Belgium

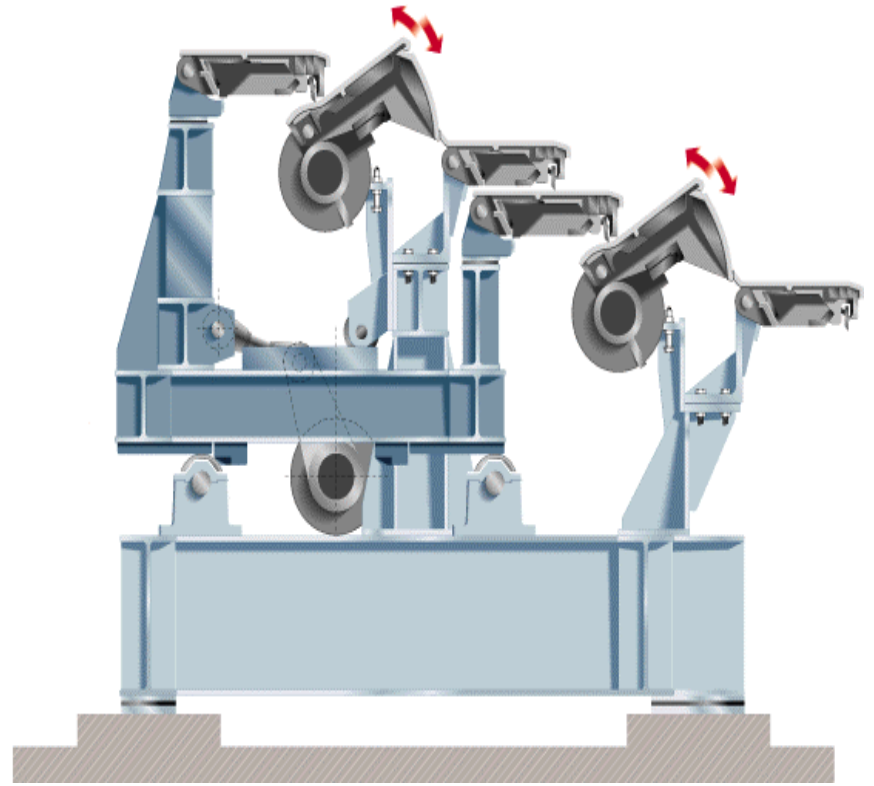


Domestic performance

深圳盐田垃圾焚烧发电厂	450
深圳宝安老虎坑垃圾焚烧发电厂	1200
深圳龙岗大工业区垃圾焚烧厂	800
深圳南山垃圾焚烧发电厂	800
常熟垃圾发电厂	900
苏州苏能垃圾发电有限公司	1000



Horizontal motion



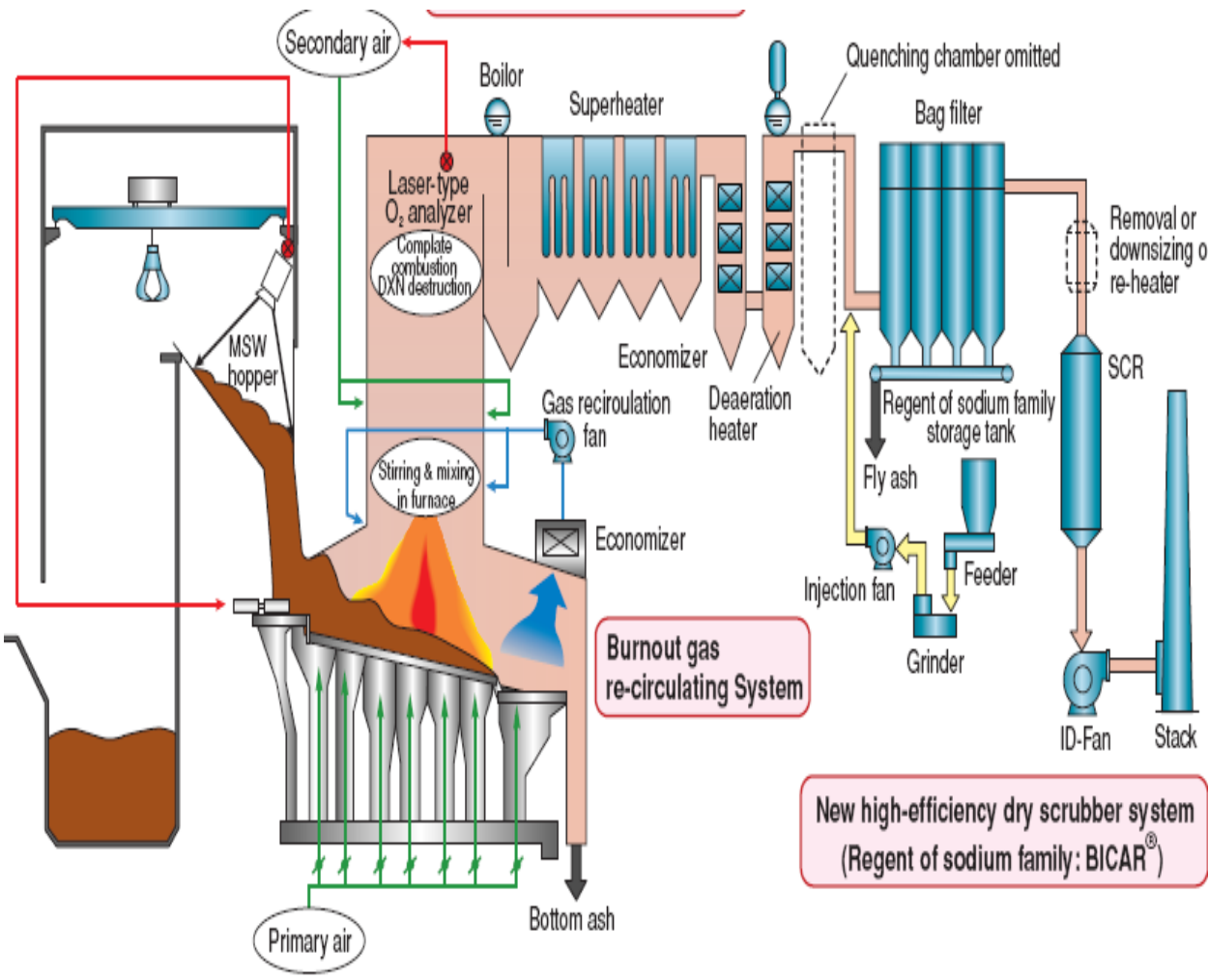
Vertical motion

- The grate control system will separate the transport (horizontal movement), stirring and ventilation motion (vertical motion)
- Sliding grate put waste motion forward and determine the waste layer thickness and residence time
- Swinging grate is used for waste mixing
- There is water cooling (high heat value waste) and air cooling

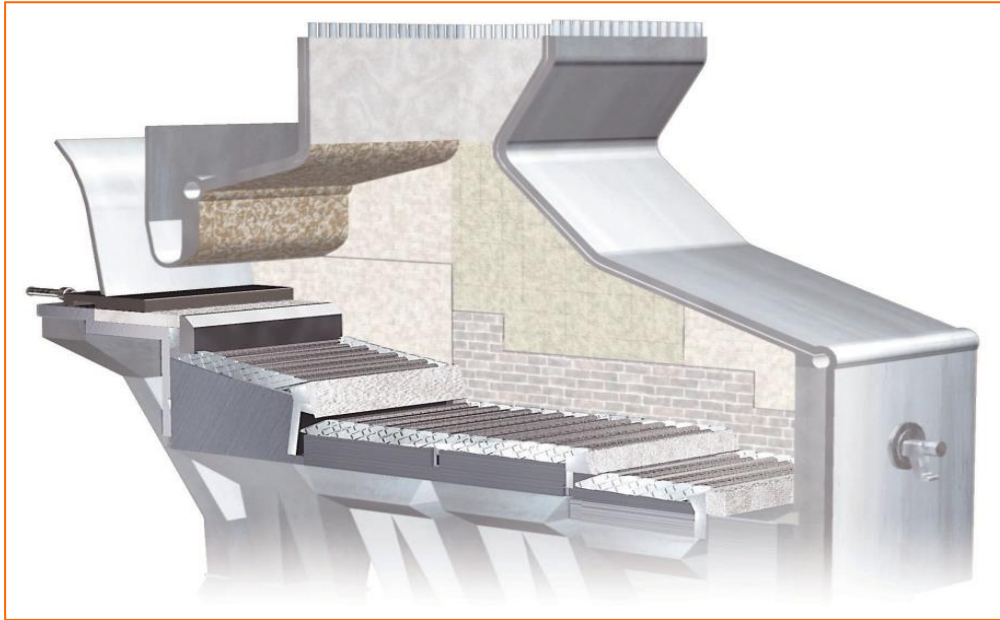
Takuma SN type grate, Japan

Takuma, Japan

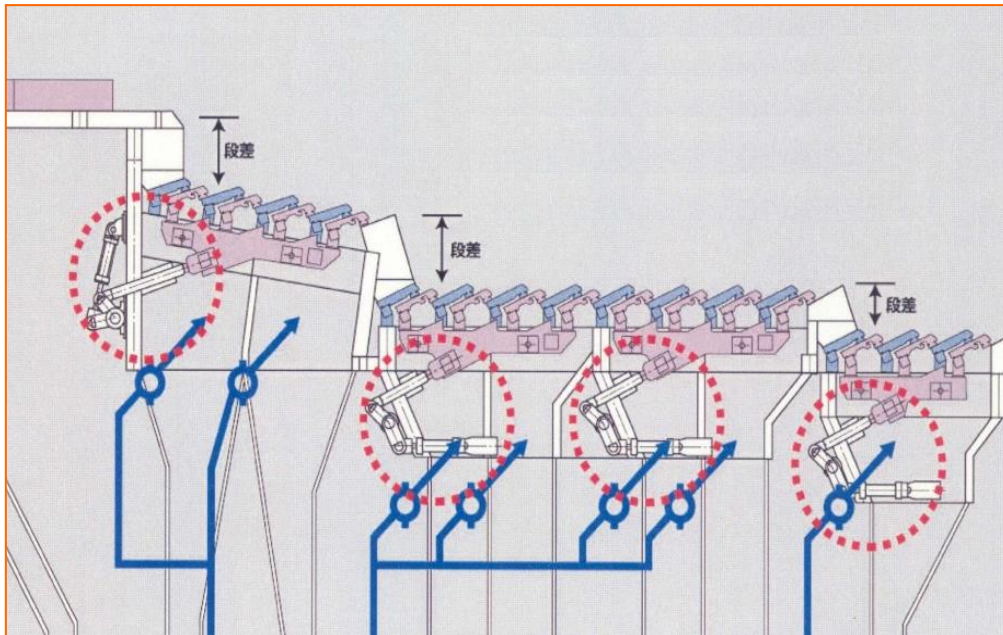
From GEC & takuma website

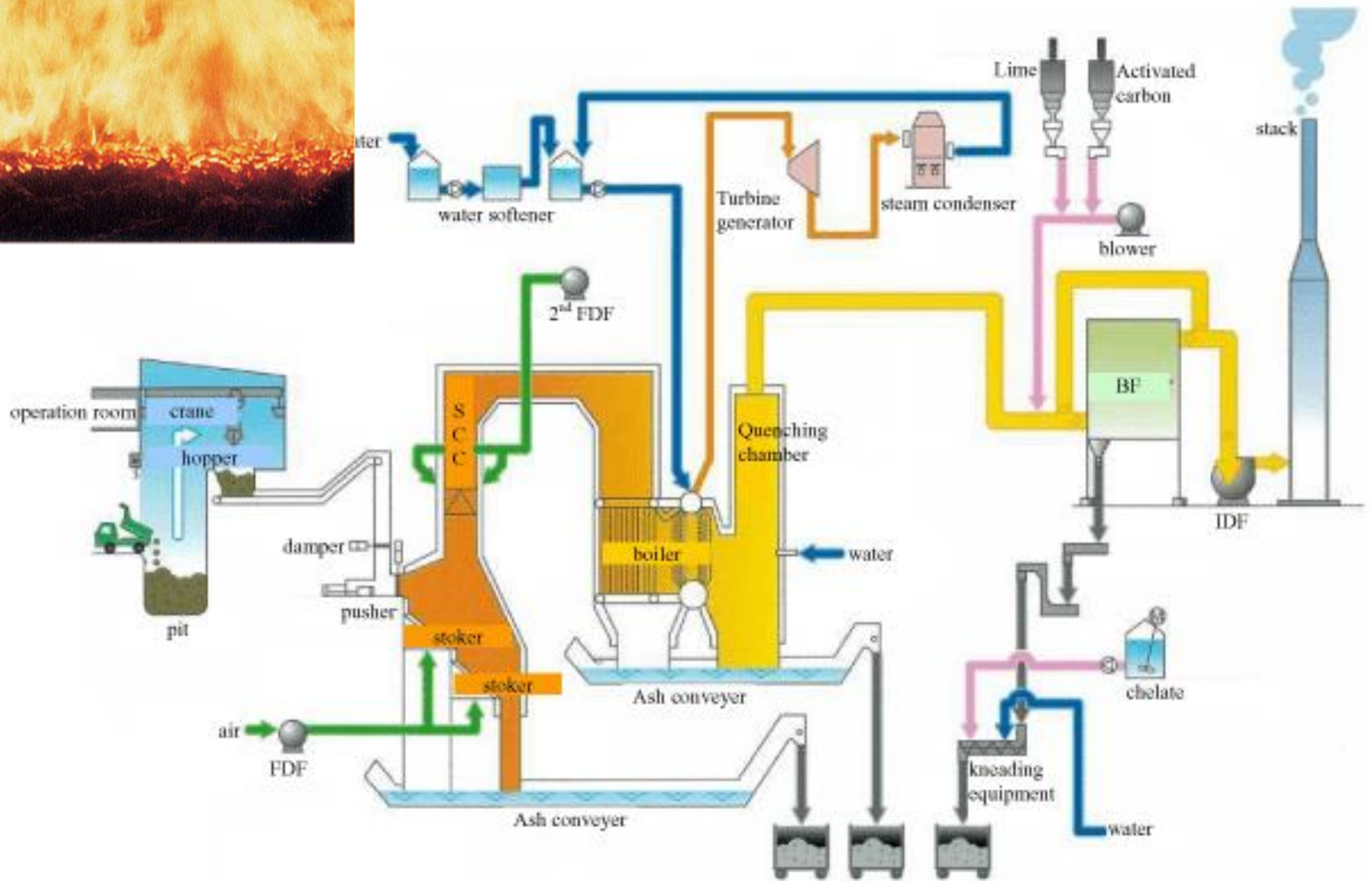


Zhang jiagang waste power plant	600
Chang zhou waste power plant	800
Jiang yin waste power plant	800
Gao antun waste power plant, Peking	1600
Shuang gang waste power plant, Tianjin	1200

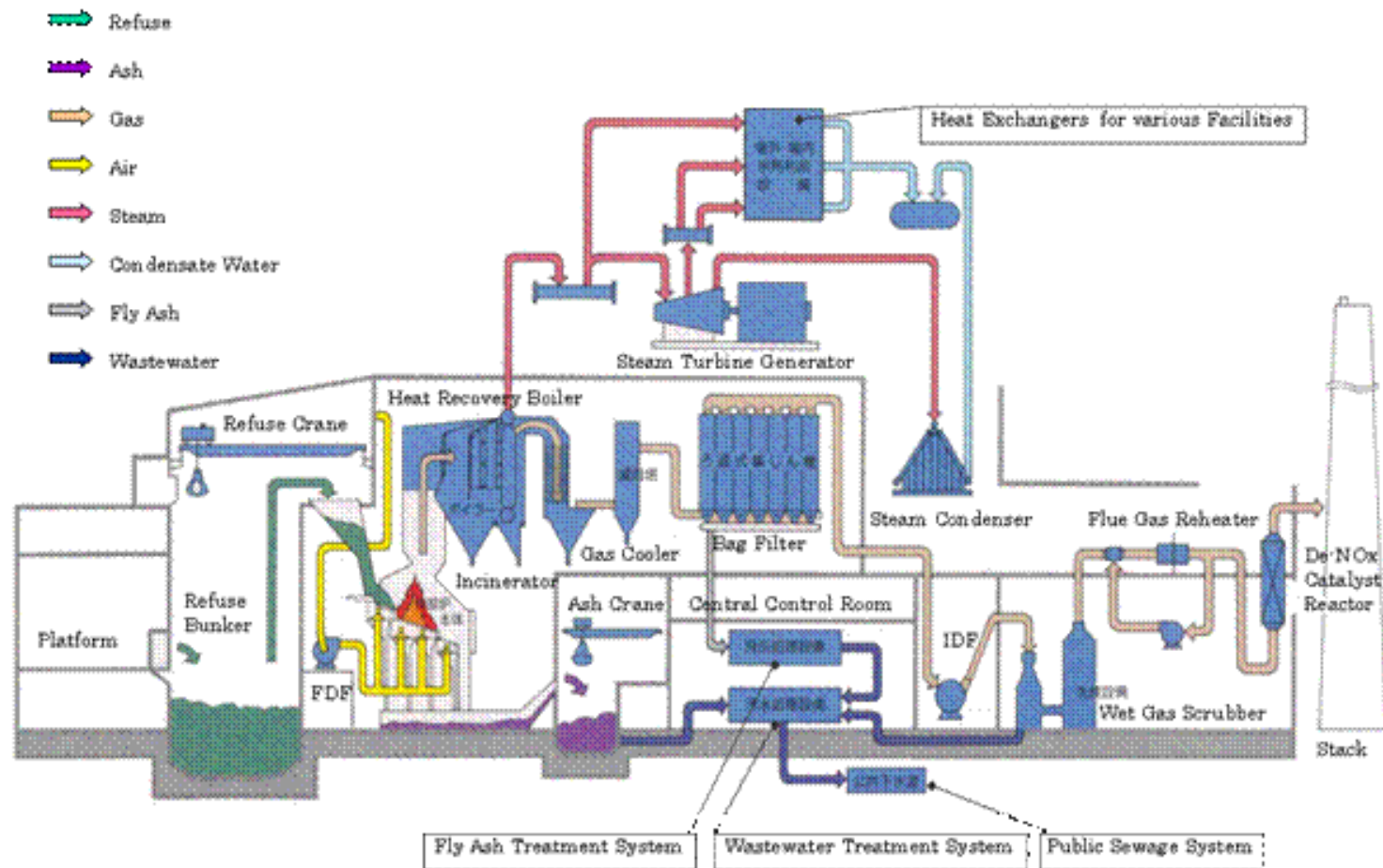


- Two steps are installed and the grate area is enough for the waste combustion and rolling in the furnace;
- Using four driving units: one in the drying stage, the second in the combustion stage and another in burnout stage. Therefore, controlling the waste and dust layer thickness through the speed adjustment of each independent drive unit





System flow of TAKUMA stoker type industrial waste incineration plant



[Capacity]

The largest plant in Japan delivered by TAKUMA, the Tokyo 1,800 tons per day plant operates effectively.

[Sphere of application]

TAKUMA step grate type burning stoker can be applied to any municipal solid waste.

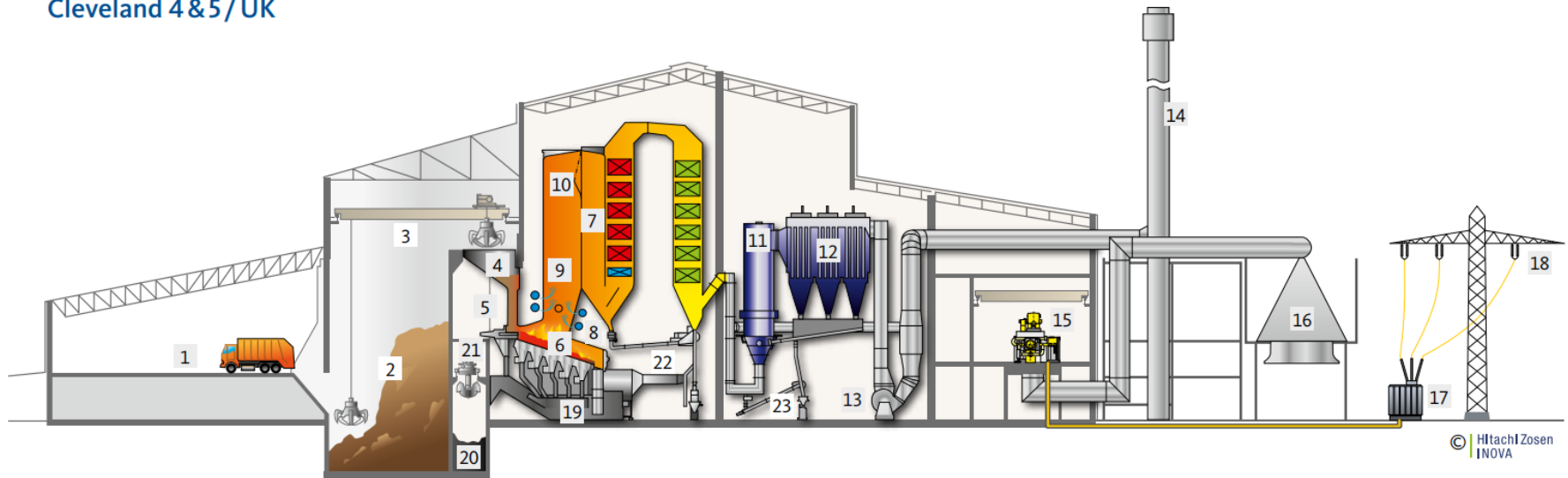
[Actual results]

TAKUMA has installed over 350 plants in Japan. This incineration capacity is more than 74,000 tons per day.

Hitachi shipbuilding Hitachi Zosen, Japan

Von Roll technology

Cleveland 4 & 5 / UK



© Hitachi Zosen
INOVA

Waste Delivery and Storage

- 1 Tipping hall
- 2 Waste pit
- 3 Waste crane

Combustion and Boiler

- 4 Feed hopper
- 5 Ram feeder
- 6 Hitachi Zosen Inova grate
- 7 Four pass boiler
- 8 Secondary air injection
- 9 Start-up burner

Flue Gas Treatment

- 10 SNCR injection levels
- 11 SemiDry reactor
- 12 Fabric filter
- 13 Induced draft fan
- 14 Stack

Energy Recovery

- 15 Extraction-condensation turbine
- 16 Air cooled condenser
- 17 Transformer
- 18 Electricity export

Residue Handling and Treatment

- 19 Bottom ash extractor
- 20 Bottom ash bunker
- 21 Bottom ash crane
- 22 Boiler ash conveying system
- 23 Residue conveying system

Dublin



Hitachi shipbuilding Hitachi Zosen, Japan

1. Super low dioxin air heater

- High-temperature air heater (3T-R system)
- High-temperature combustion (950°C-1,000°C)
[Fire-resistant tiles, water-cooled stokers]

Comparison with the conventional level **1/10 !!**

2. Substantial reduction of exhaust gas

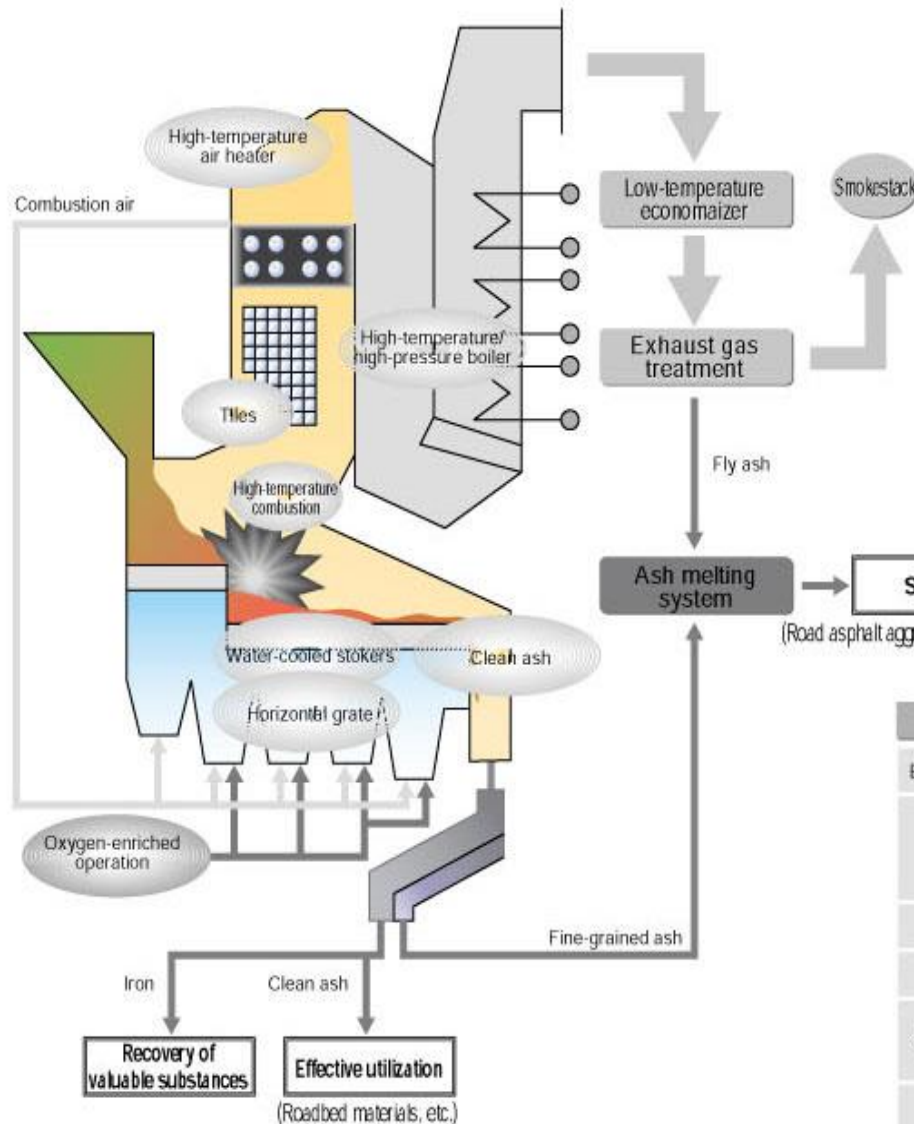
- Low air-ratio combustion
- Oxygen-enriched combustion

Comparison with the conventional level **A decrease of 30%!**

3. Complete reuse of ash

- Recycling of clean ash [in the form of sand]
- Recycling of slag

Sharp reduction of disposal volume at landfill sites!



4. Sharp reduction of running cost

- Adoption of eco-burners

Conversion of waste plastic into fuel

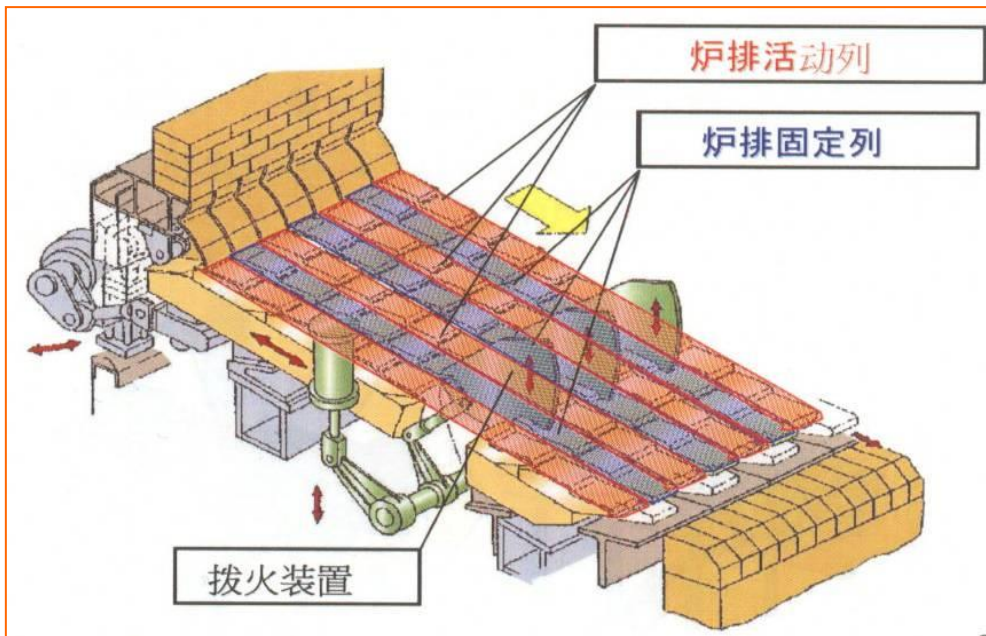
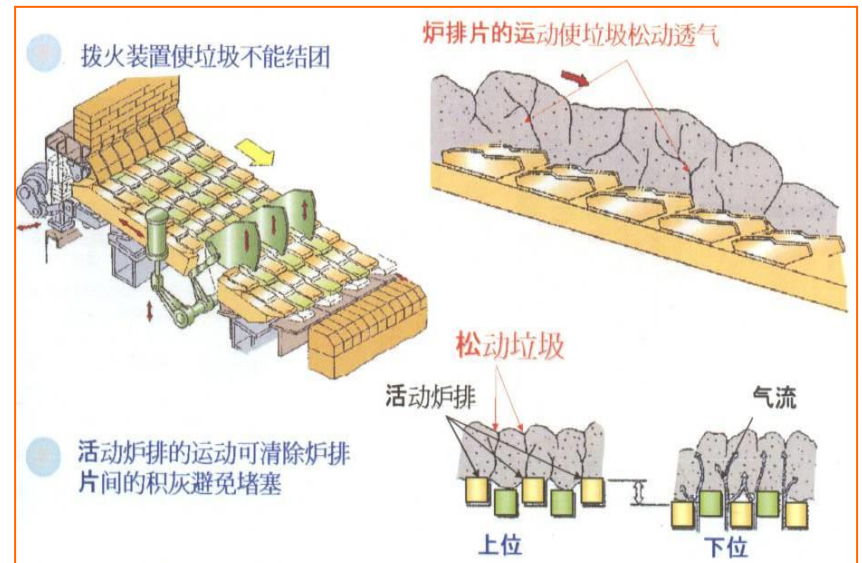
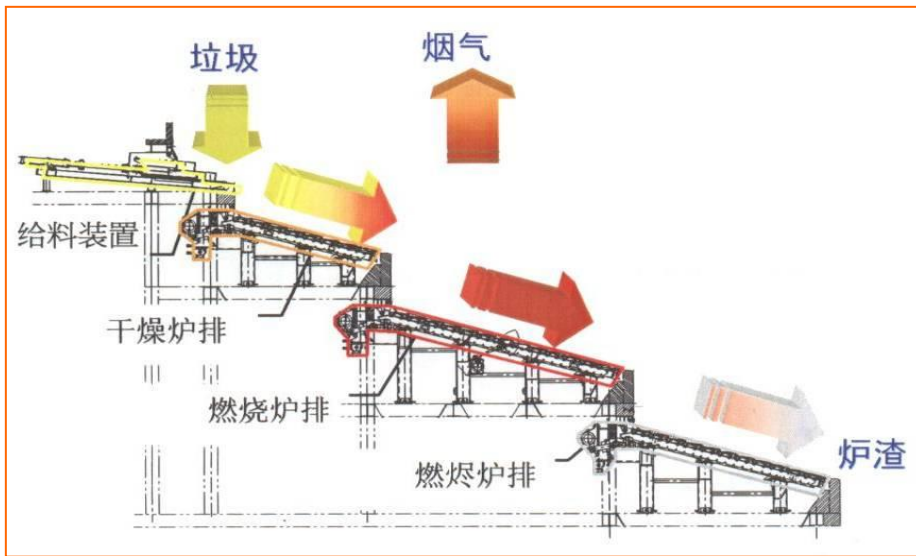
- Waste plastic derived fuel
Partial melting of ash

Sharp reduction of melting energy required

from gec.jp website

Target performance data

Excessive air rate	1.3~1.5
Dioxins	Boiler outlet : less than 0.5ng-TEQ/m ³ Chimney outlet : less than 0.01ng-TEQ/m ³ Total emission : less than 1.0 μg-TEQ/t-waste
CO	less than 10ppm (peak : less than 50ppm)
NOx	less than 80ppm (at incinerator outlet)
Steam condition	Pressure 60ata Temperature 450°C
Heat recovery efficiency	Electricity generation efficiency : 23% Boiler efficiency : 90%



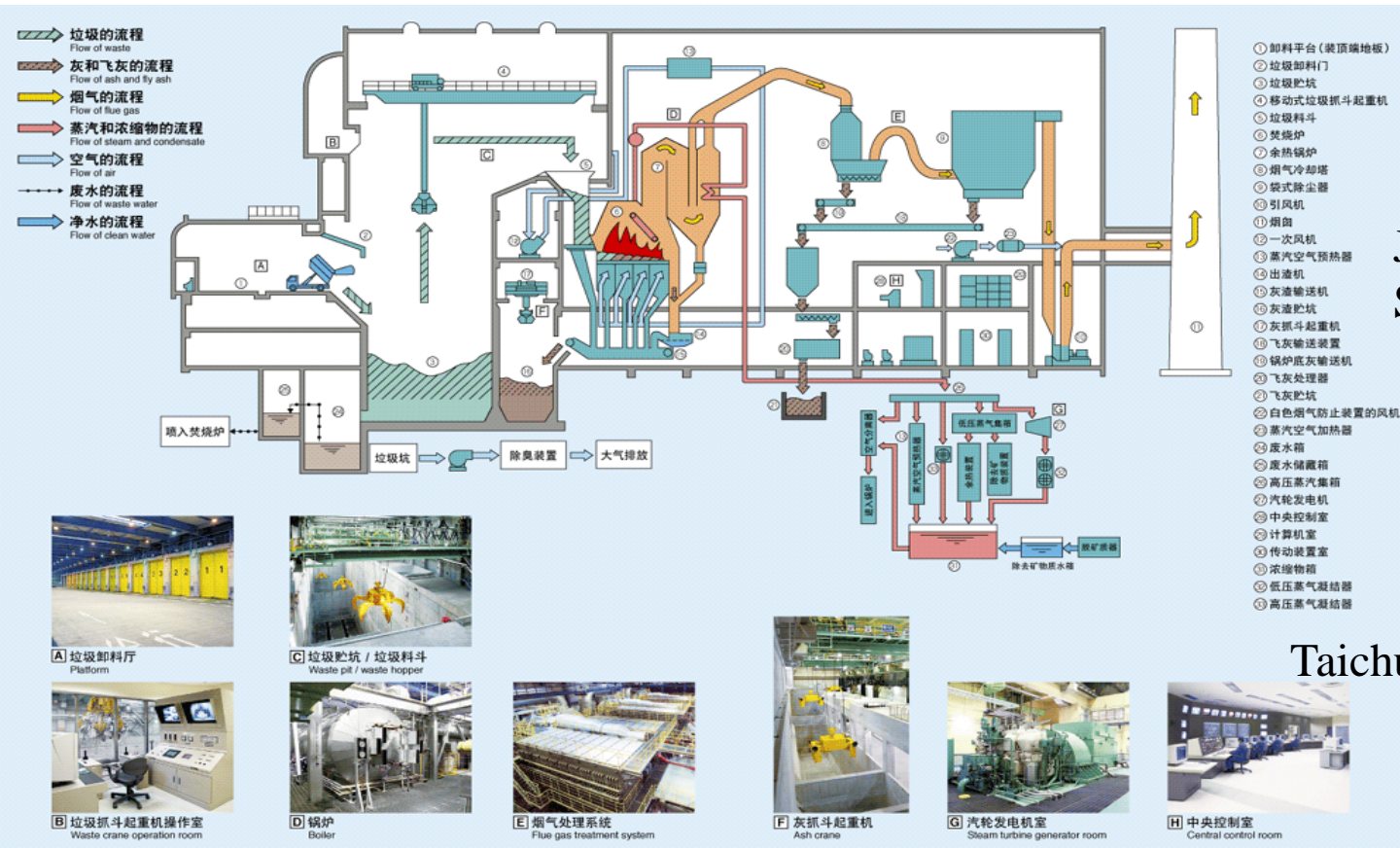
- Setting the gap on the grate for flipping and loosening wastes
- The movement of a movable grate with a fixed grate can remove dust between the grate and avoid clogging
- Setting the fire equipment

JFE, Japan

Iron and steel engineering holding Steel Corp, Japan

From JFE website

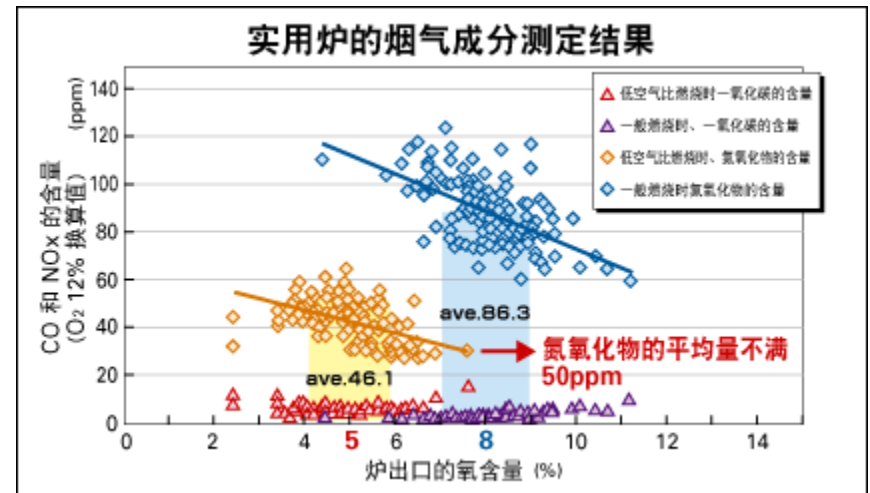
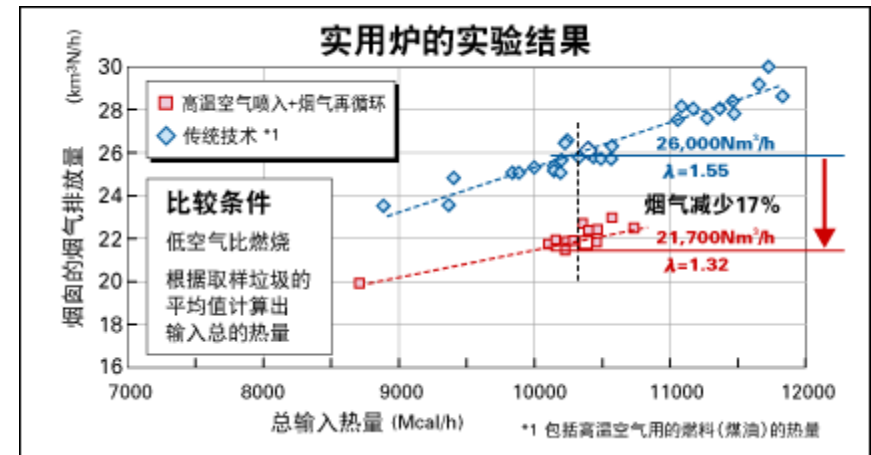
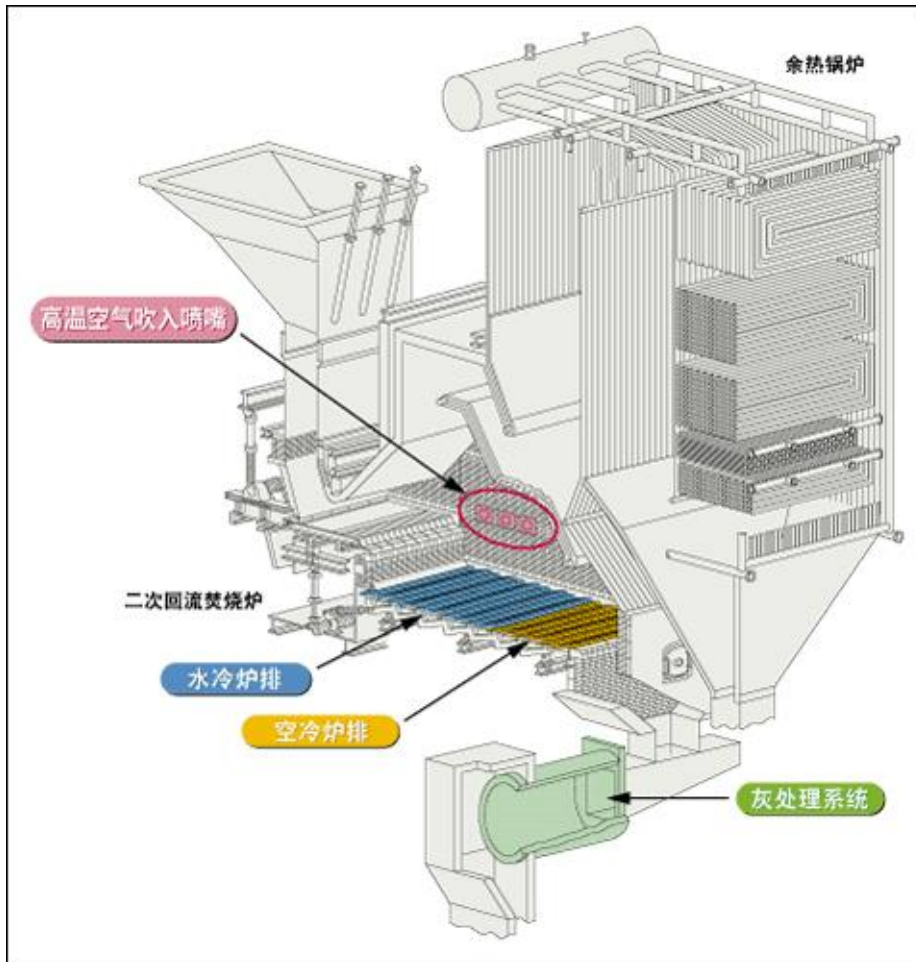
JFE
Super reciprocating grate



Taichung City - Taiwan, China

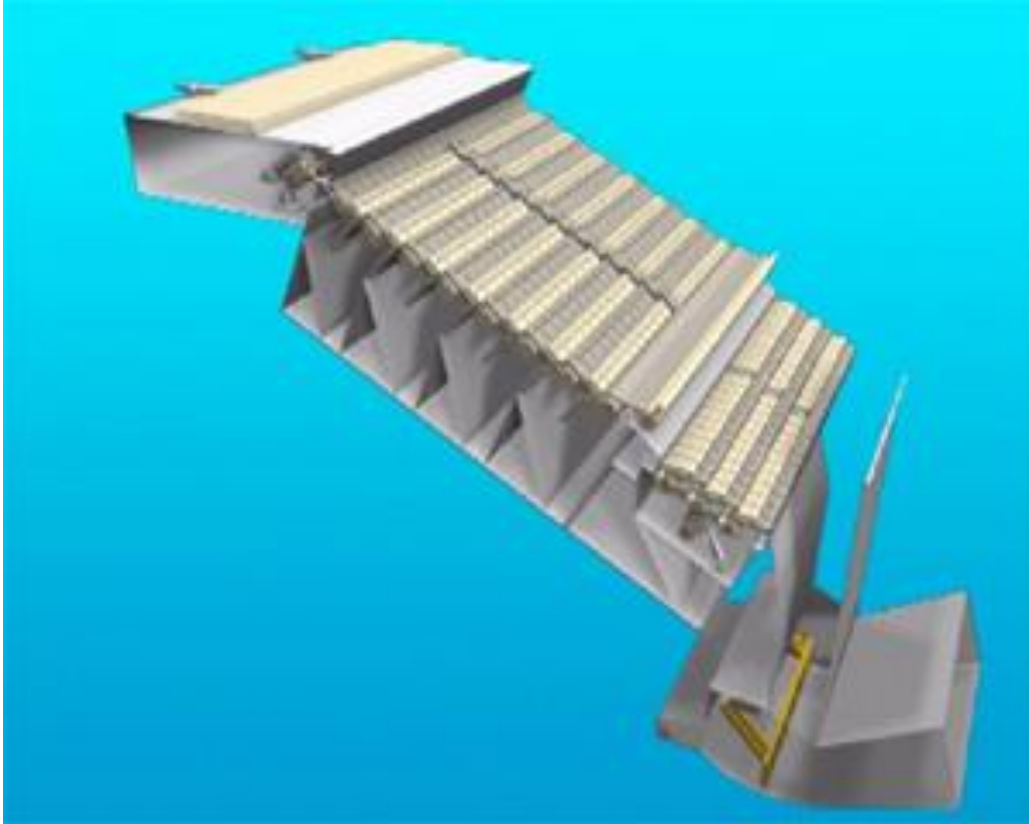
The system can guarantee stable and uniform complete combustion of the complex waste. The JFE unique design is employed in fire grate system, and the middle partition board formed secondary reflux incineration system and the automatic combustion control system realizes the stable and complete combustion.

JFE Super 21 reciprocating grate

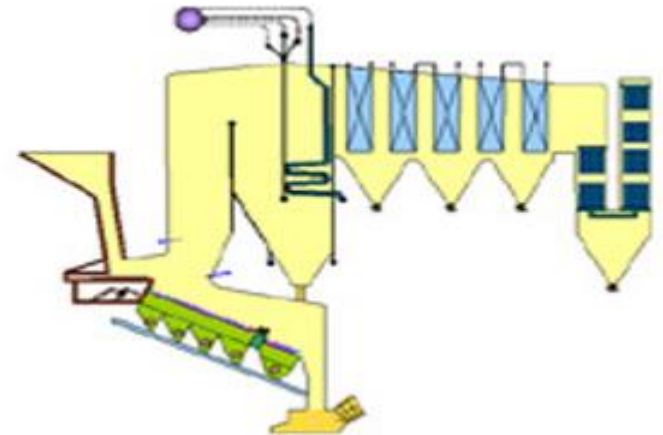
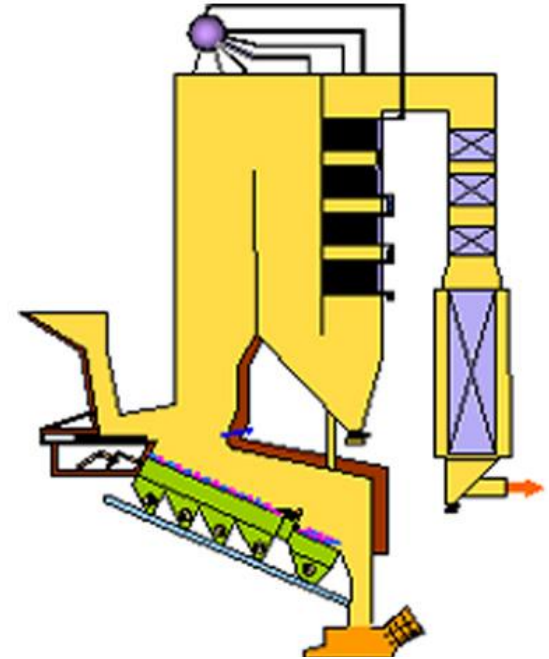


On the basis of super reciprocating grate incinerator,, new technology of "high temperature air combustion" considering the "blowing hot air and flue gas recirculation" factors are developed. Through the new technology, the low air ratio, stable combustion and heat loss reduction are promoted, reducing the amount of flue gas and environmental pollution substances (such as dioxins) emissions, increasing the generating capacity and reducing the load on the landfill simultaneously.

New century, Hangzhou

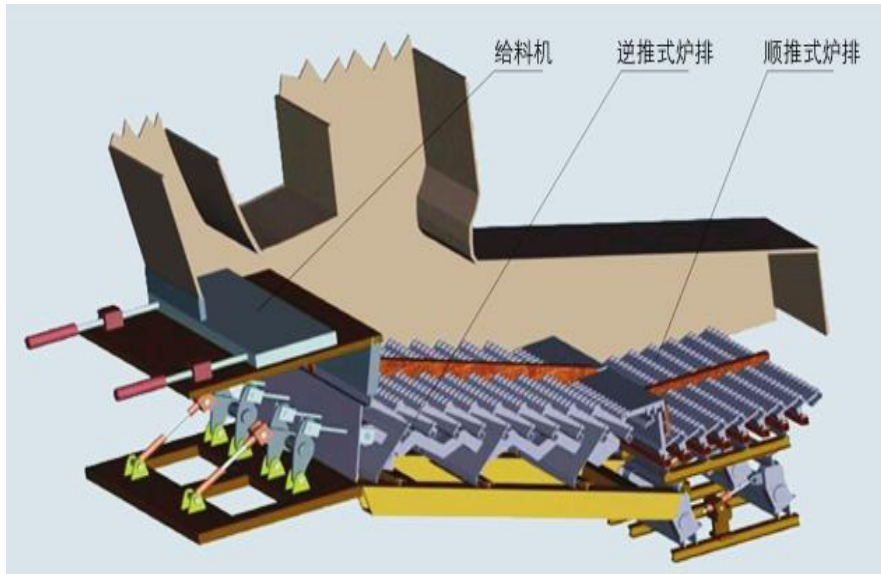


From new century website



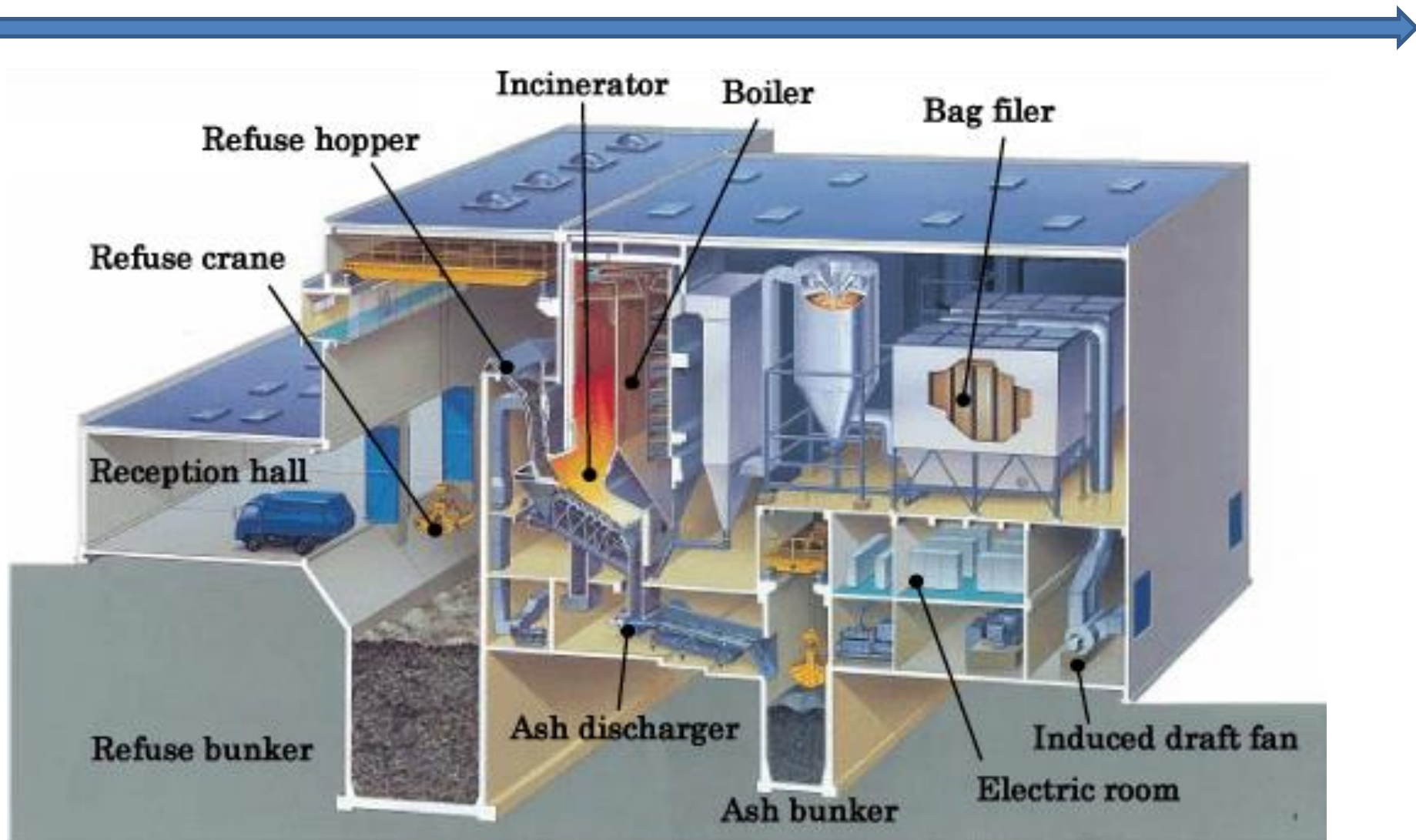
Wei Ming Group Co., Ltd, Wenzhou

From Wei Ming website

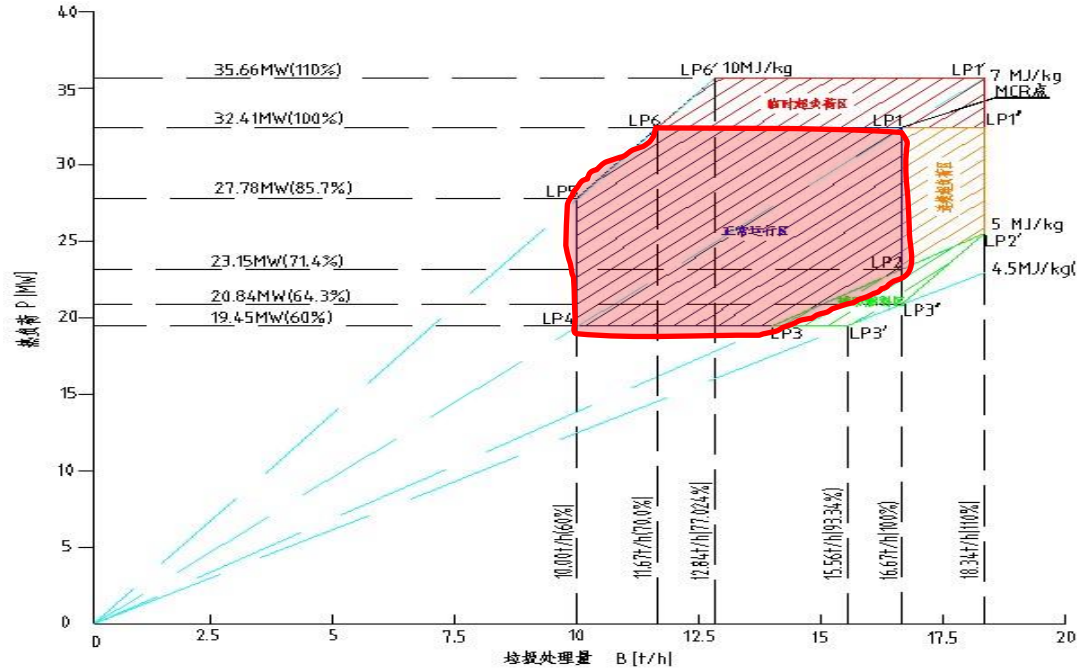


额定垃圾焚烧处理量	160t/d~600t/d	蒸汽压力	3.82~4.0Mpa
垃圾在炉排上停留时间	60~90min	蒸汽温度	400~150°
锅炉出口烟气温度	220°	给水温度	130~140°
垃圾热值适应范围	3600KJ/kg~7500KJ/kg	热灼减率	≤5%

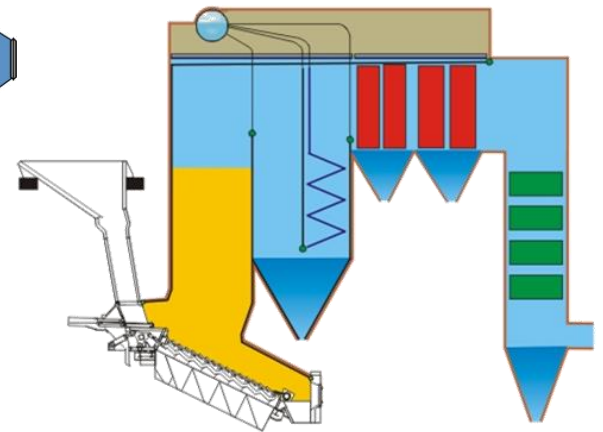
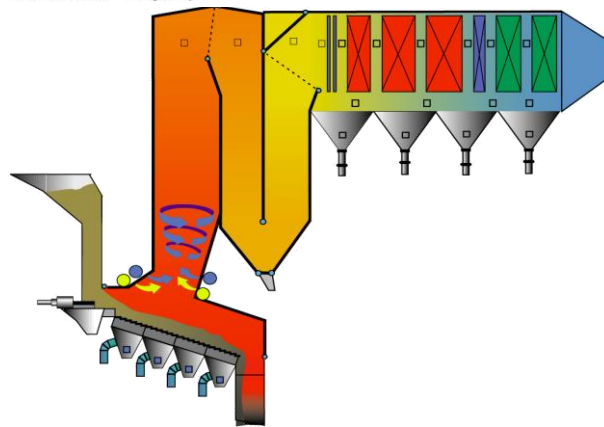
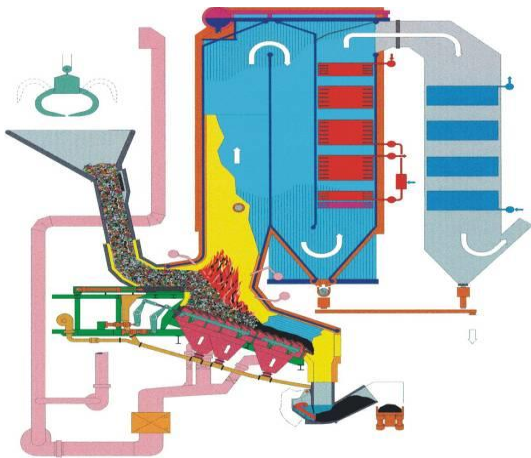
Waste to Energy System



Heat Recovery

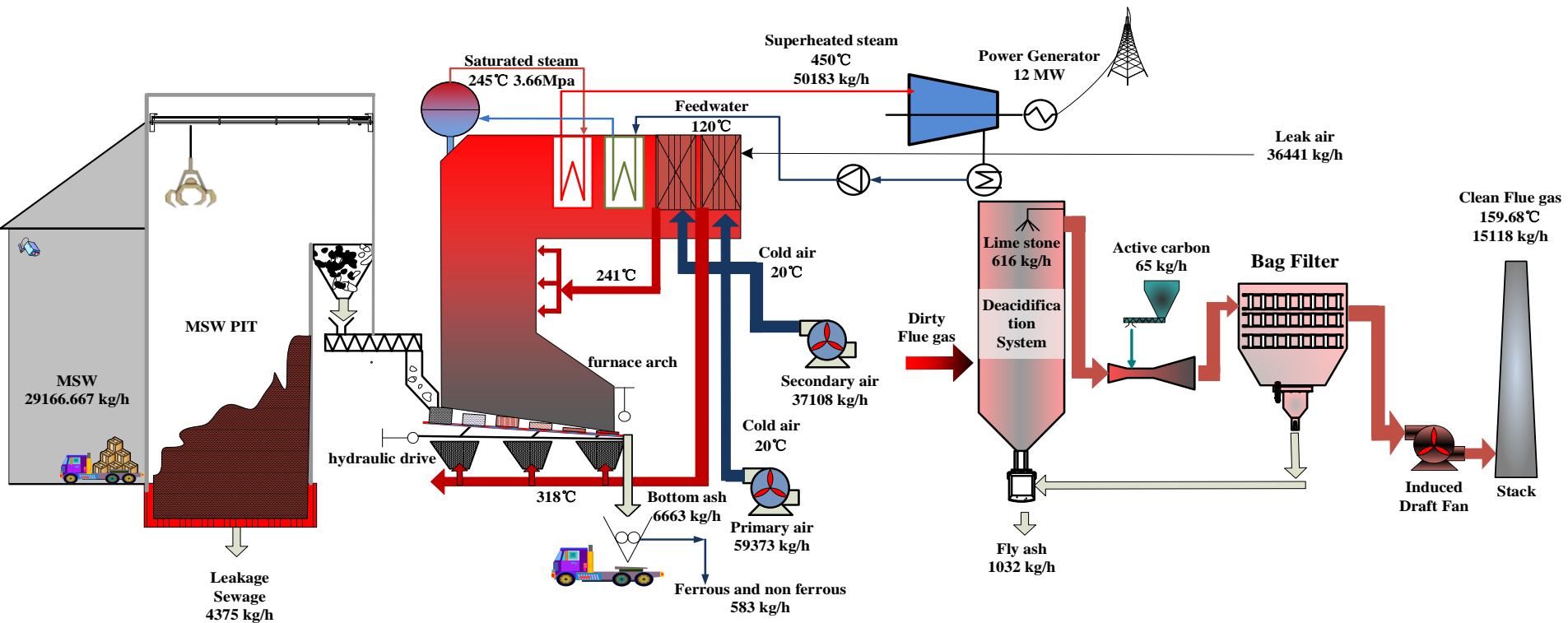


Typical Steam Parameters:
 400 °C, 4~5MPa
 Heat recovery Efficiency:
 65%~82%

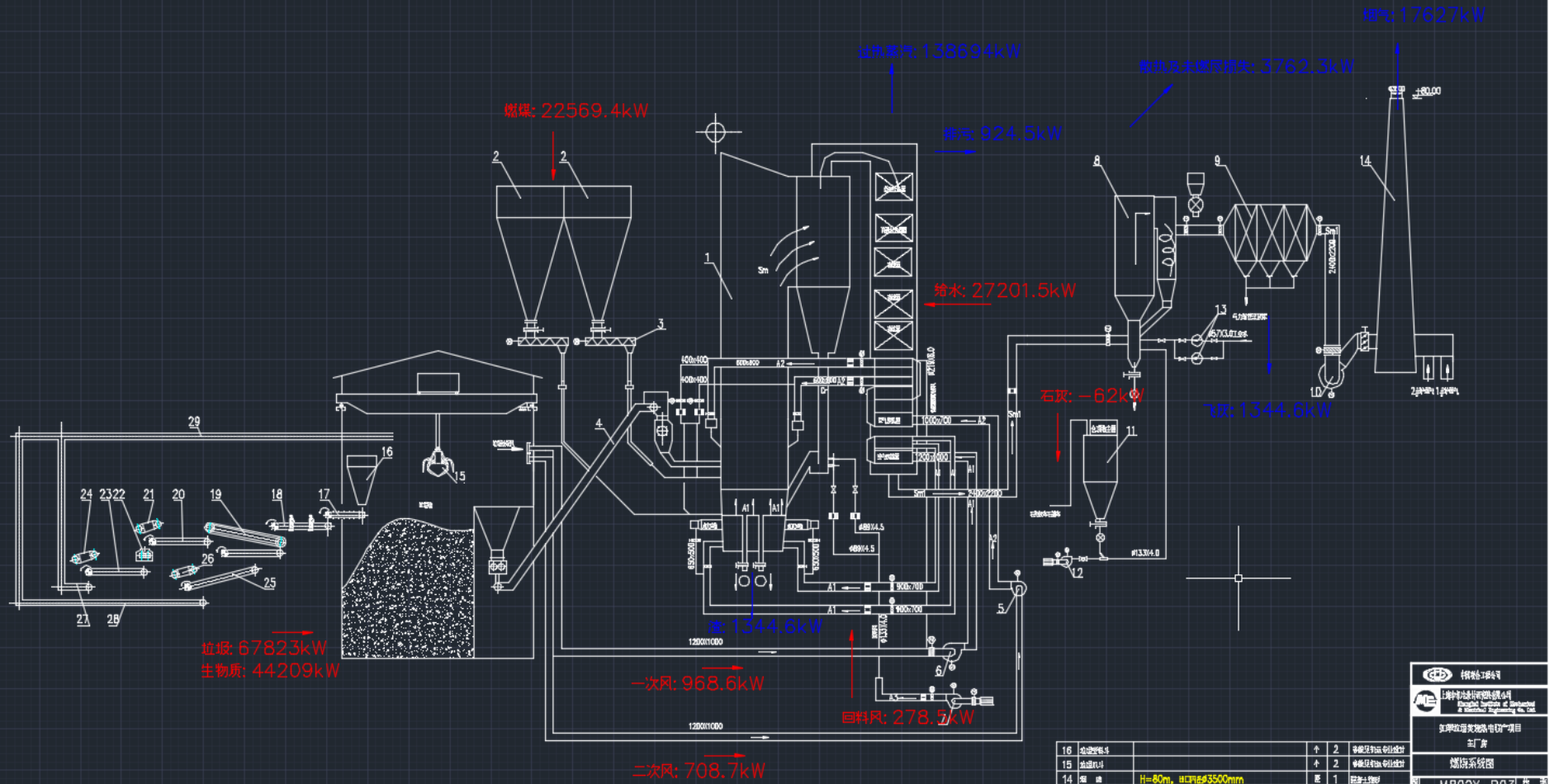


Mass balance

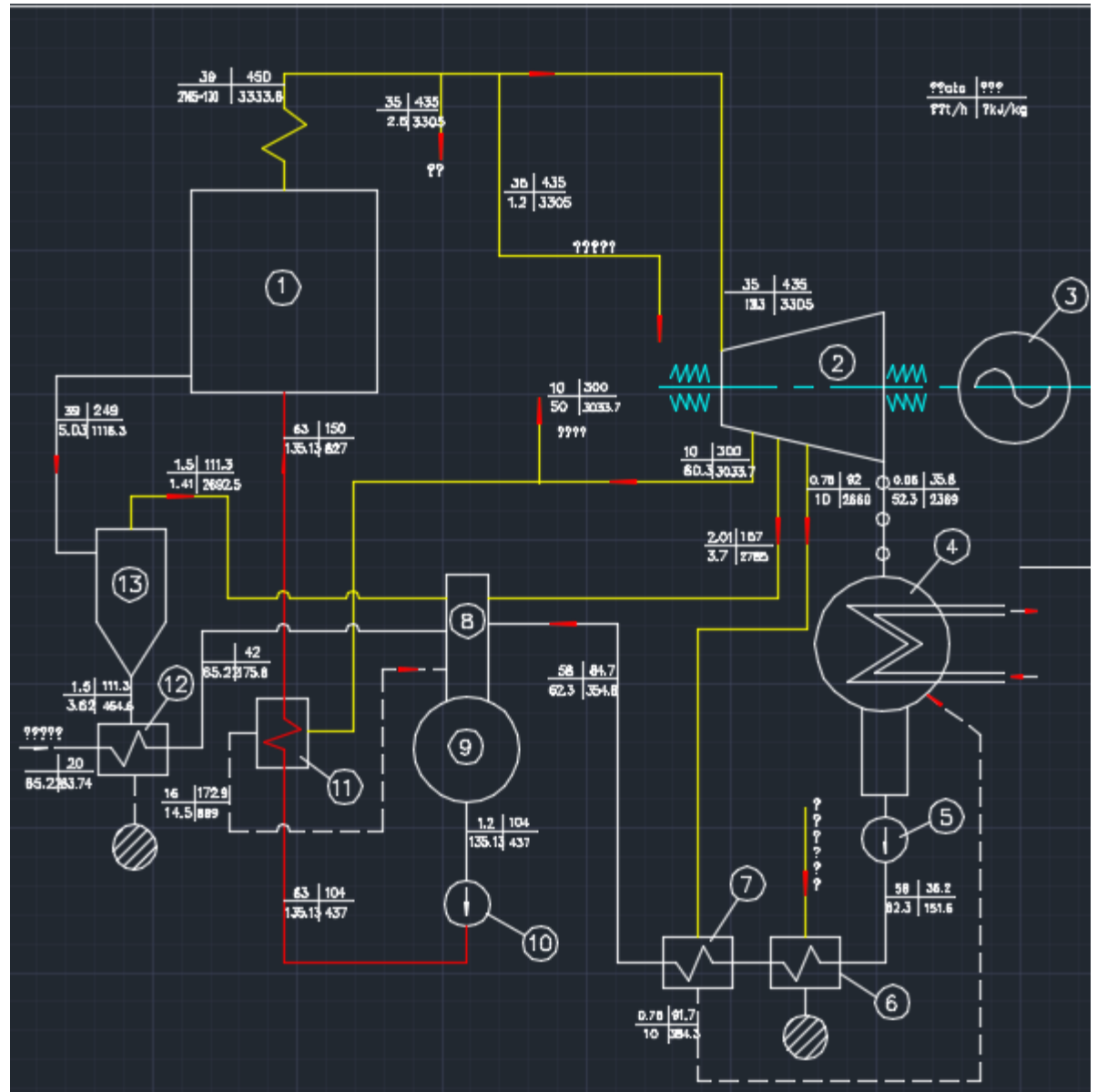
Waste-to-Energy Plant layout (Moving Grate, 700 t/d)



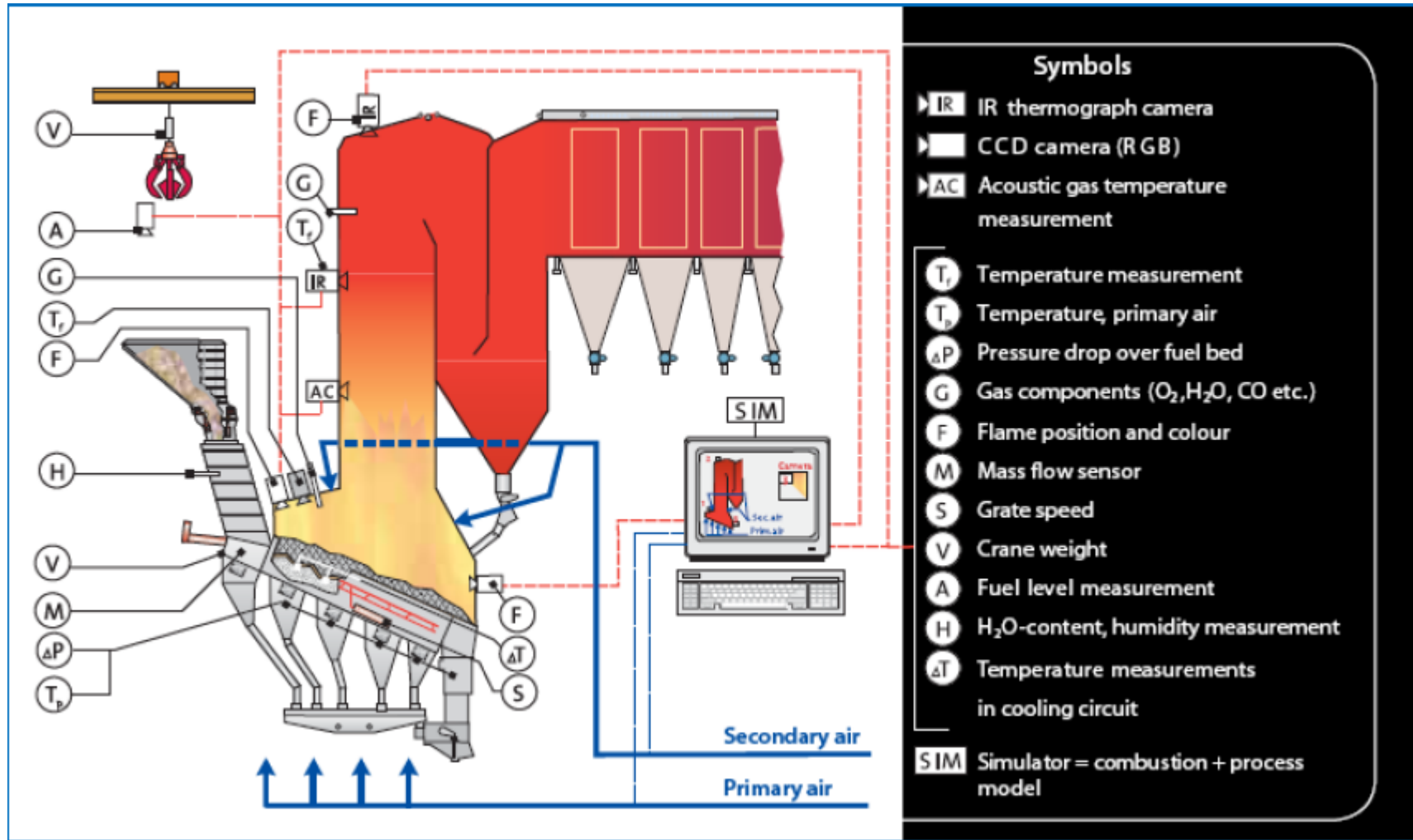
Energy balance



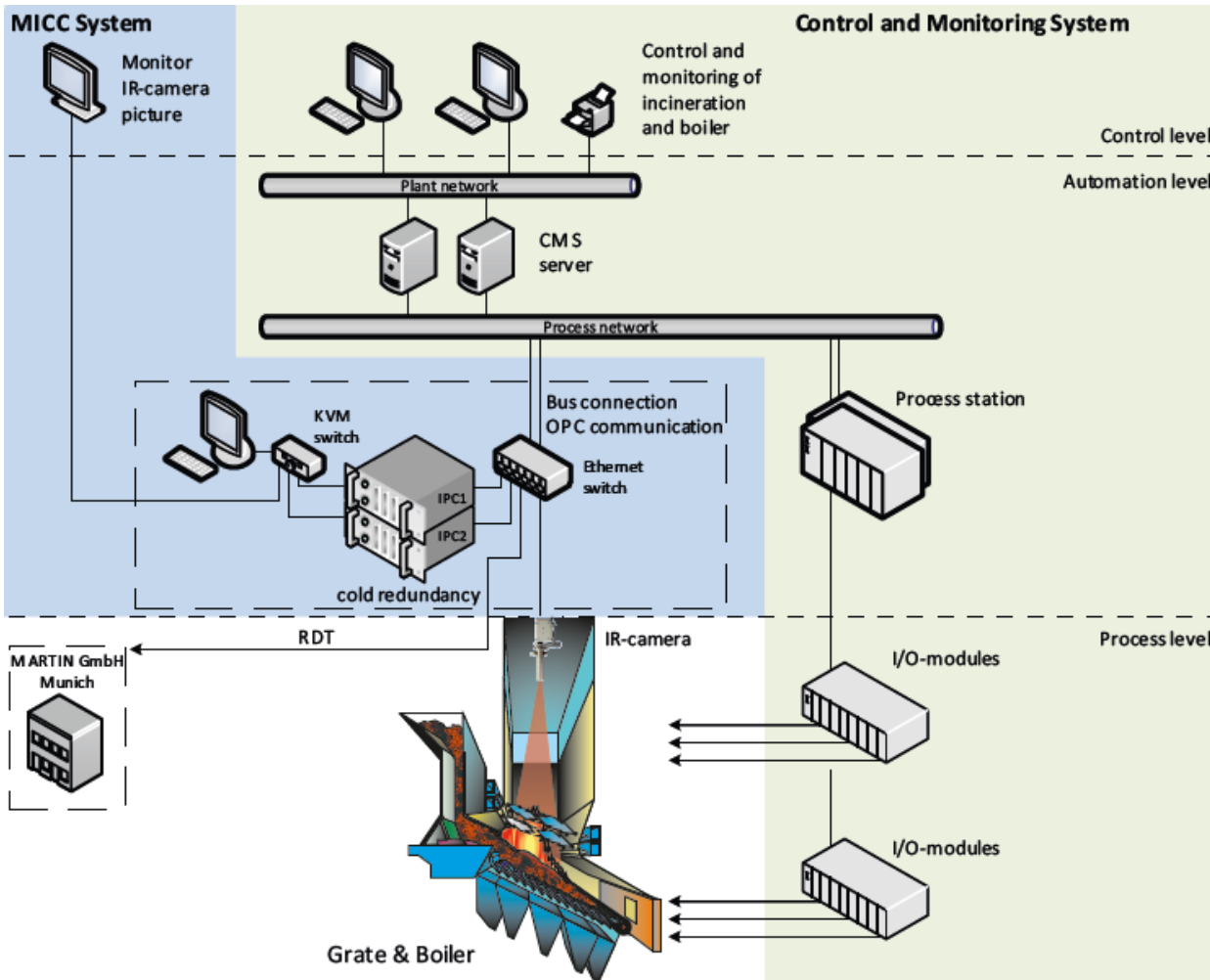
Thermodynamic



combustion control system



combustion control system

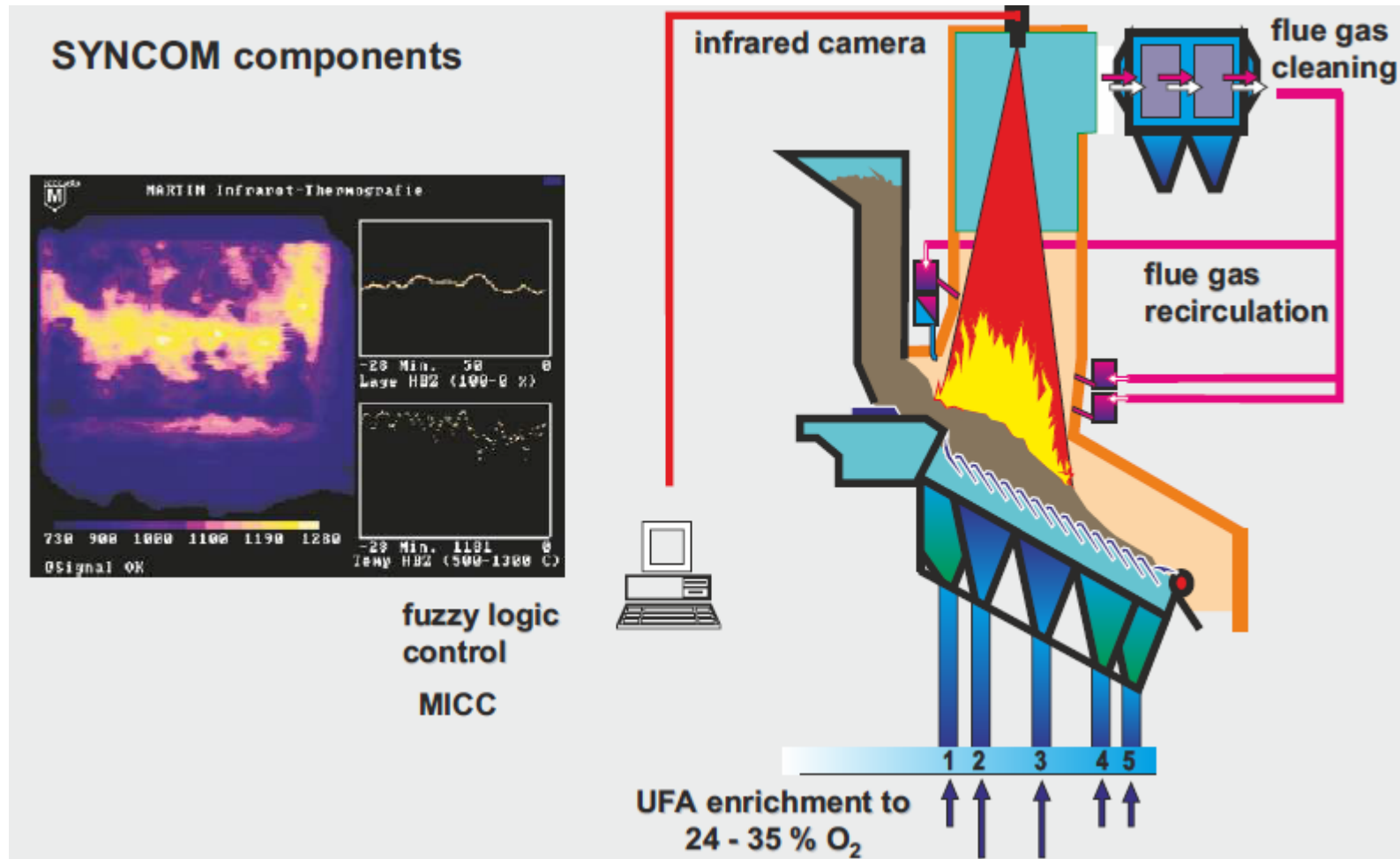


Ensuring optimum and constant combustion conditions to achieve the following goals:

- Almost complete burnout of bottom ash and fly ash
- Almost complete burnout flue gases
- Keeping steam flow as constant as possible
- Low fly ash discharge

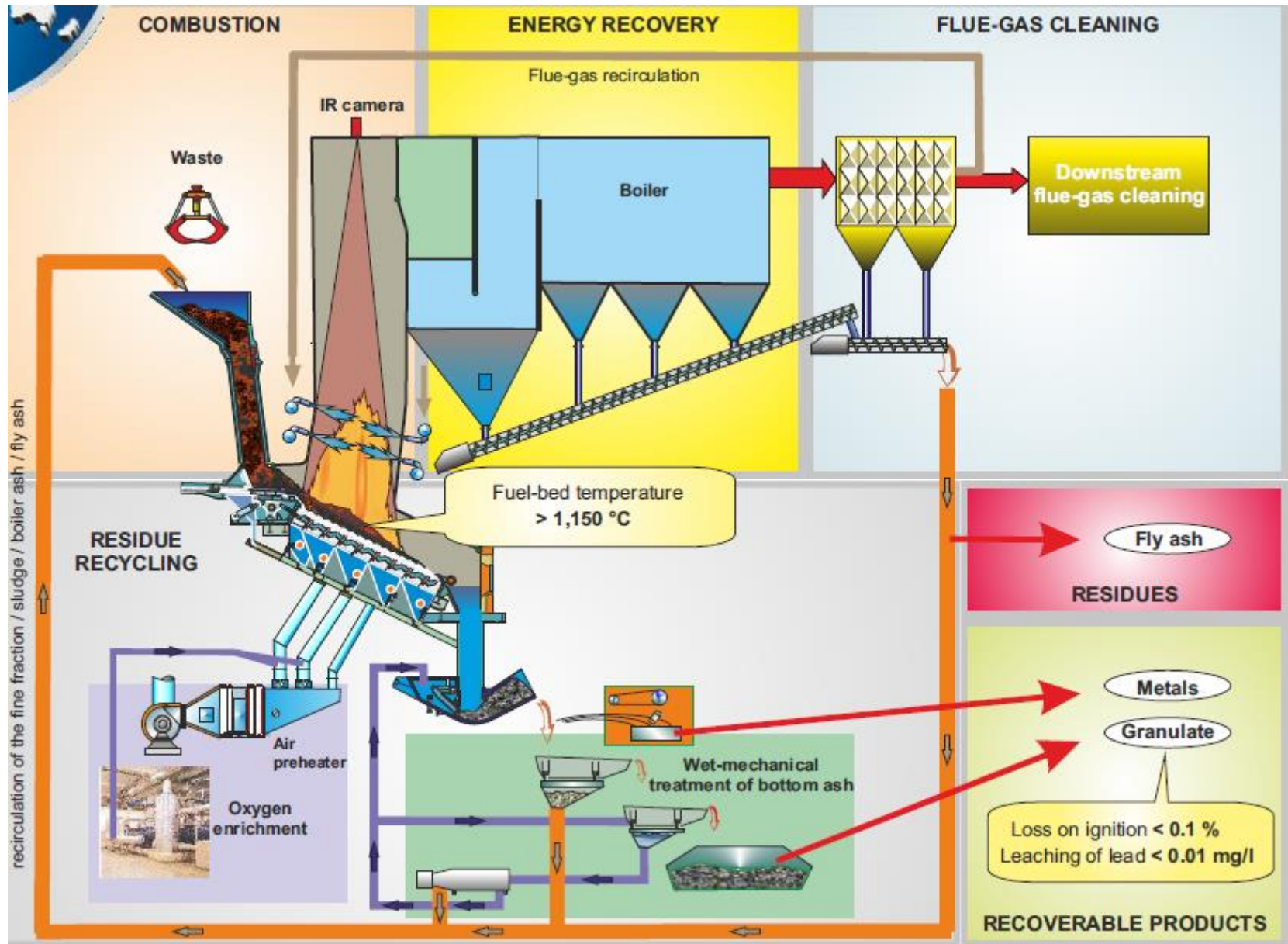
Martin, IR-camera Asst.

MARTIN SYNCOM process



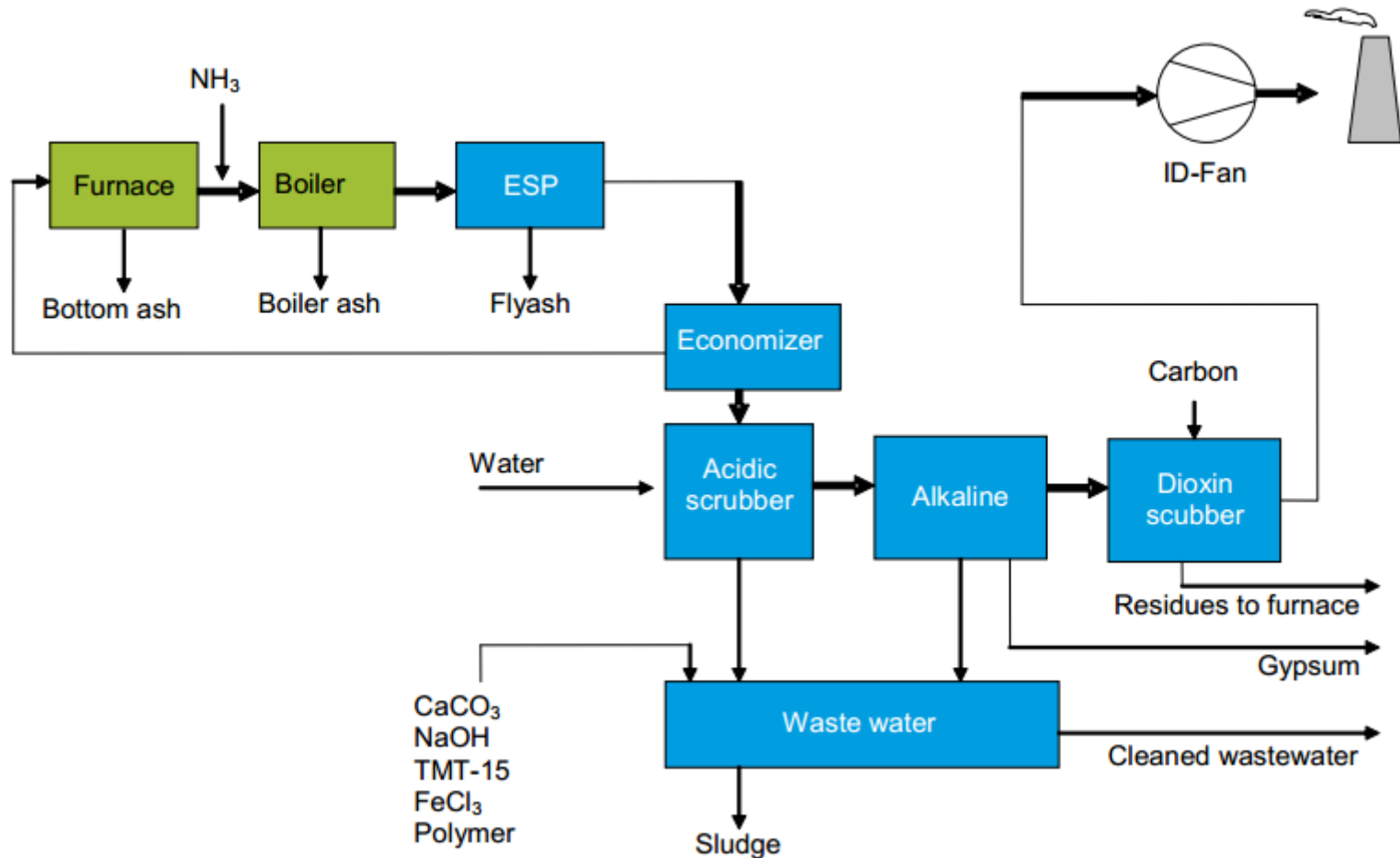
- Grate-based system using the reverse-acting grate
- Oxygen enrichment of underfire air
- Combustion control system using infrared (IR) thermography
- Overfire air system with 4 nozzle rows - "4-row stitching"
- Flue gas recirculation

MARTIN SYNCOM-Plus process



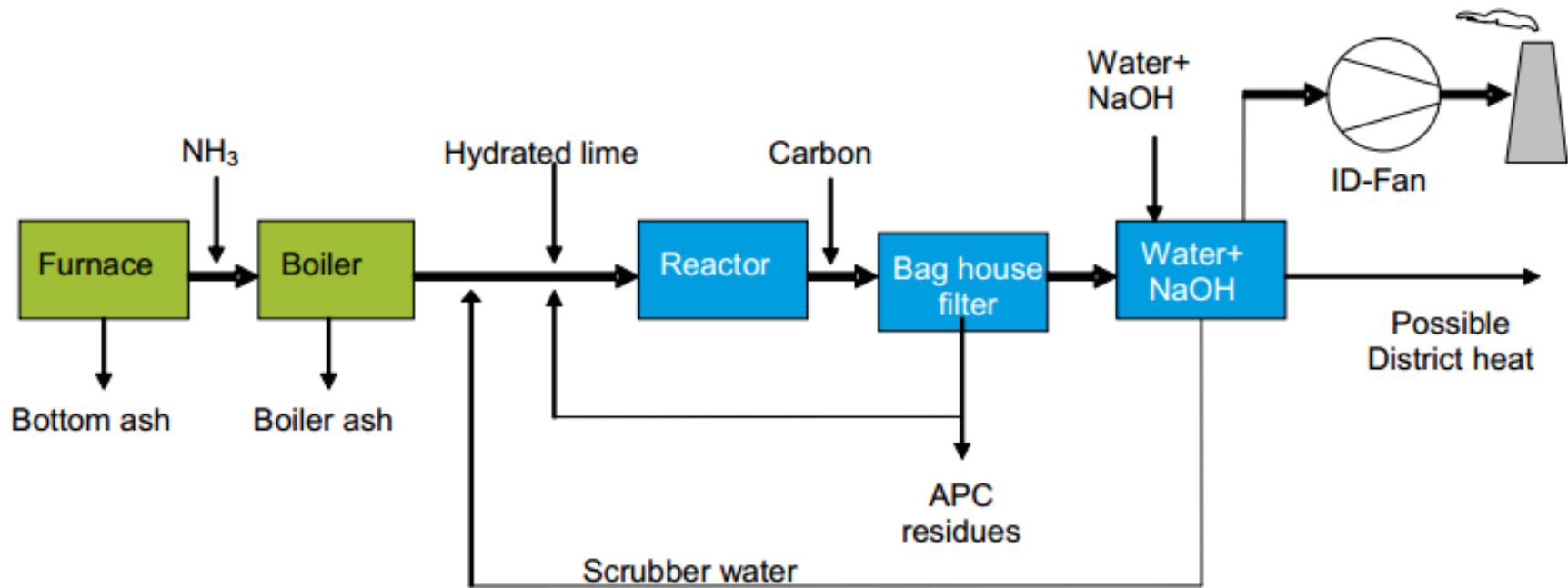
Air pollutants control system

WET SYSTEM



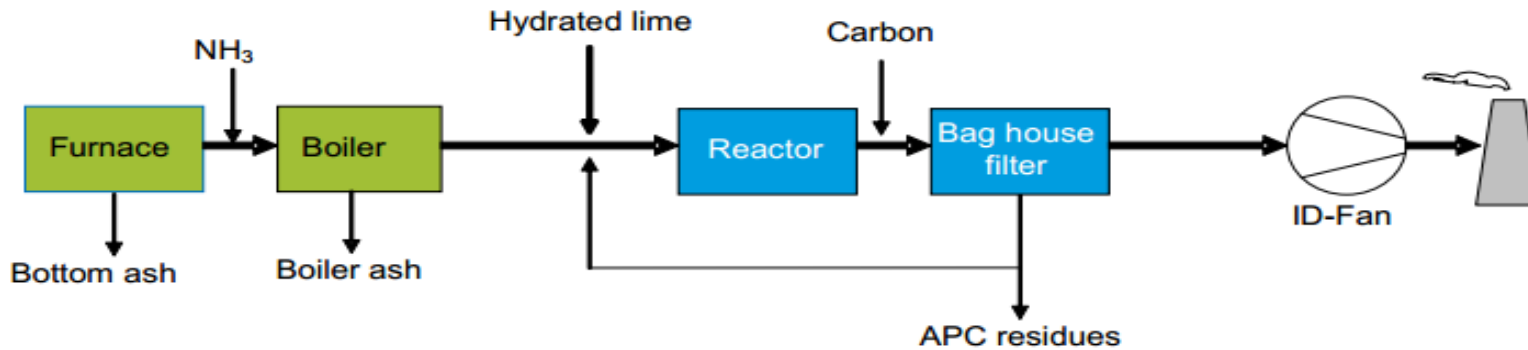
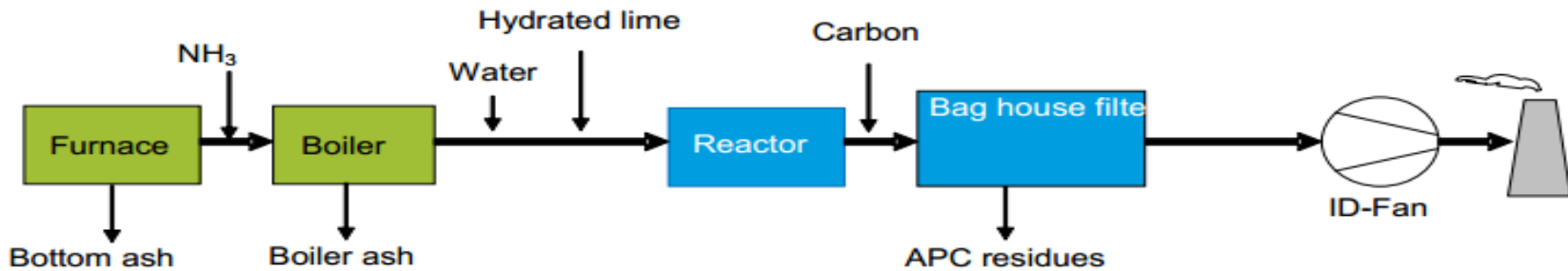
Air pollutants control system

SEMI-DRY SYSTEM



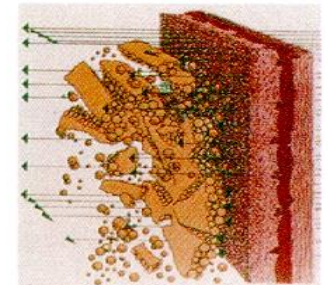
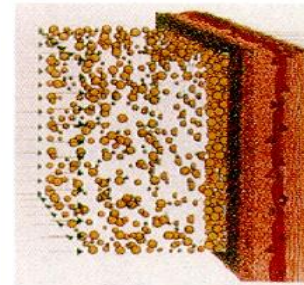
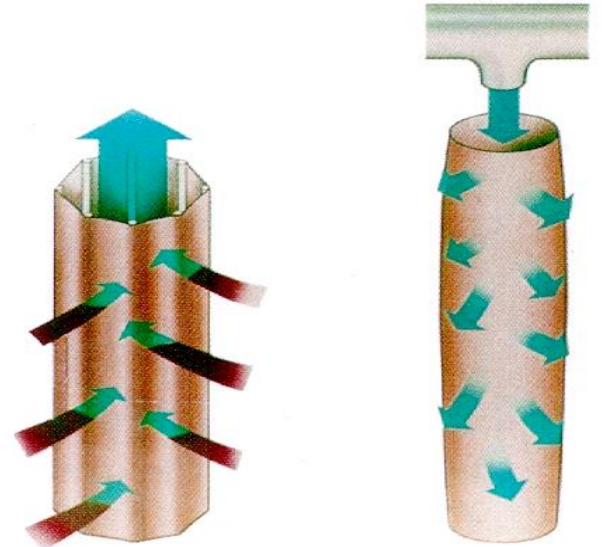
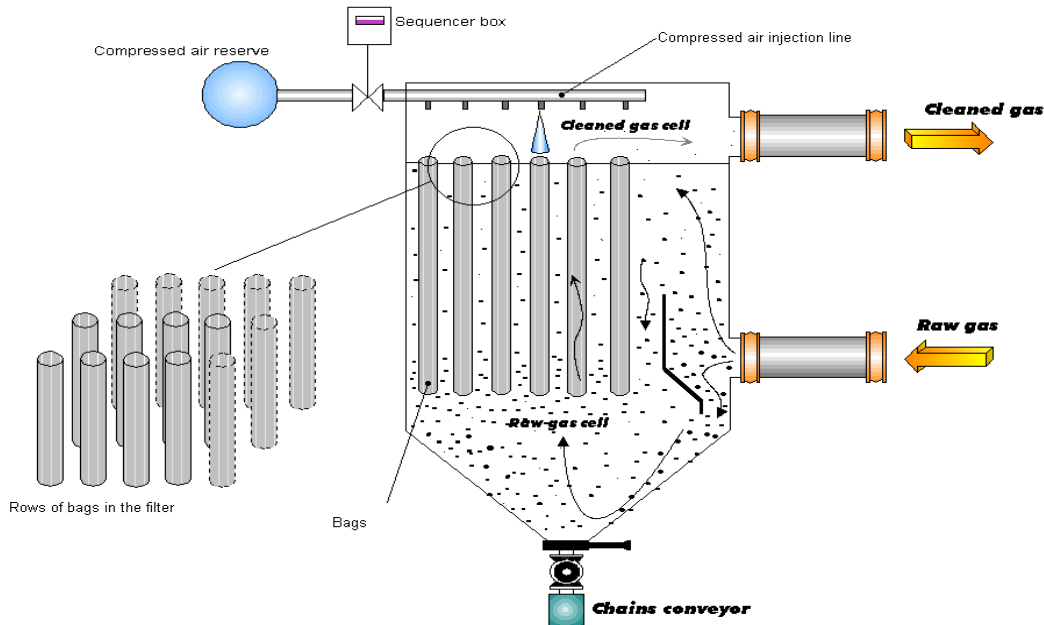
Air pollutants control system

DRY SYSTEM

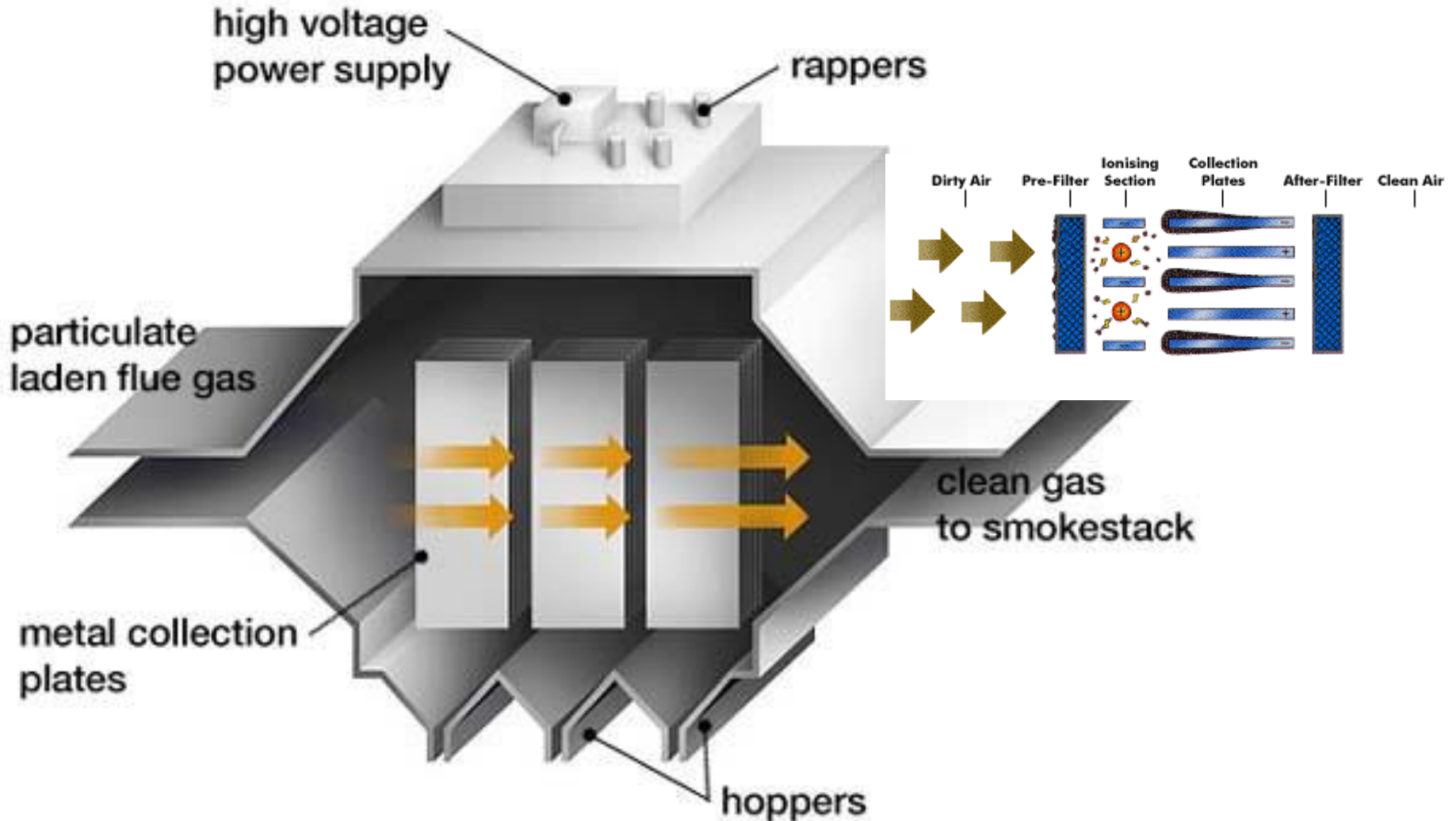


Particle remove system

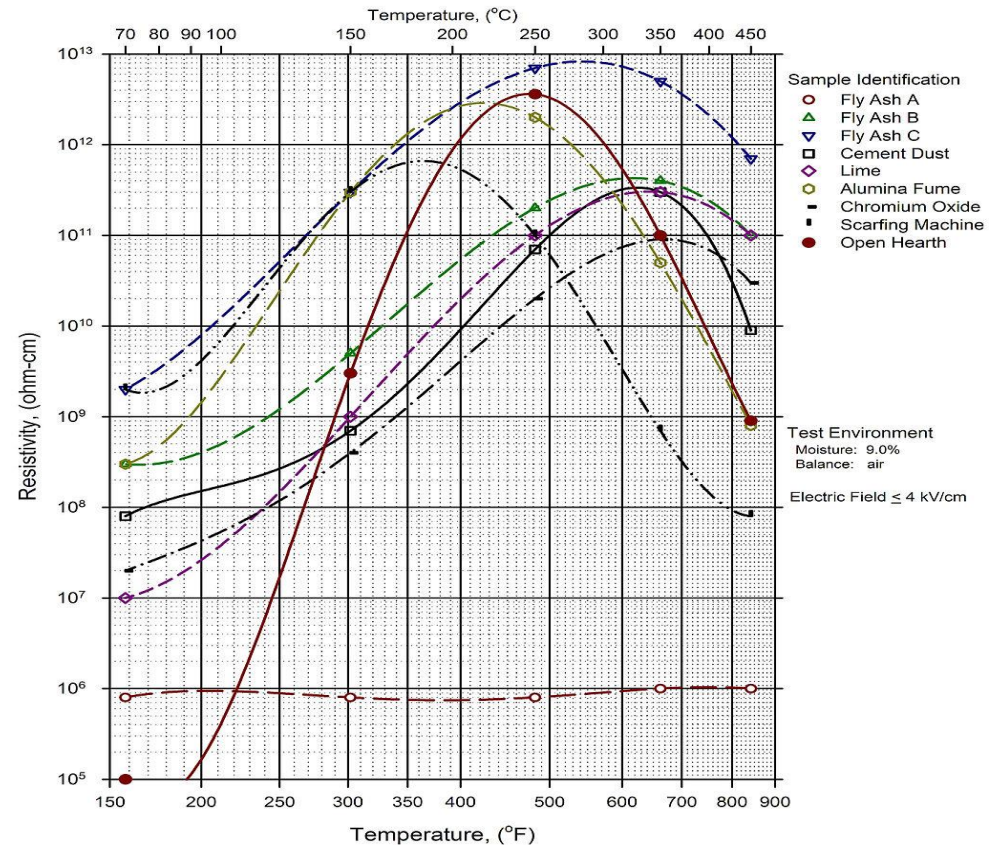
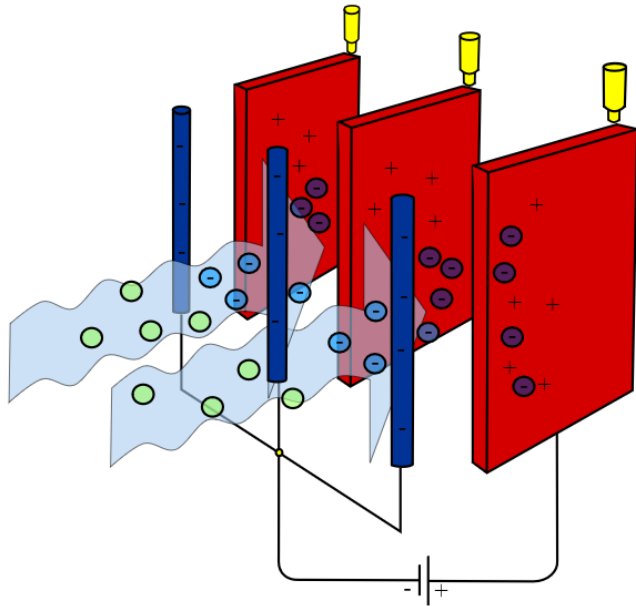
BAG HOUSE FILTER



Particle remove system



Particle remove system



Resistivity

Range of Measurement

Low

between 10^4 and 10^7 ohm-cm

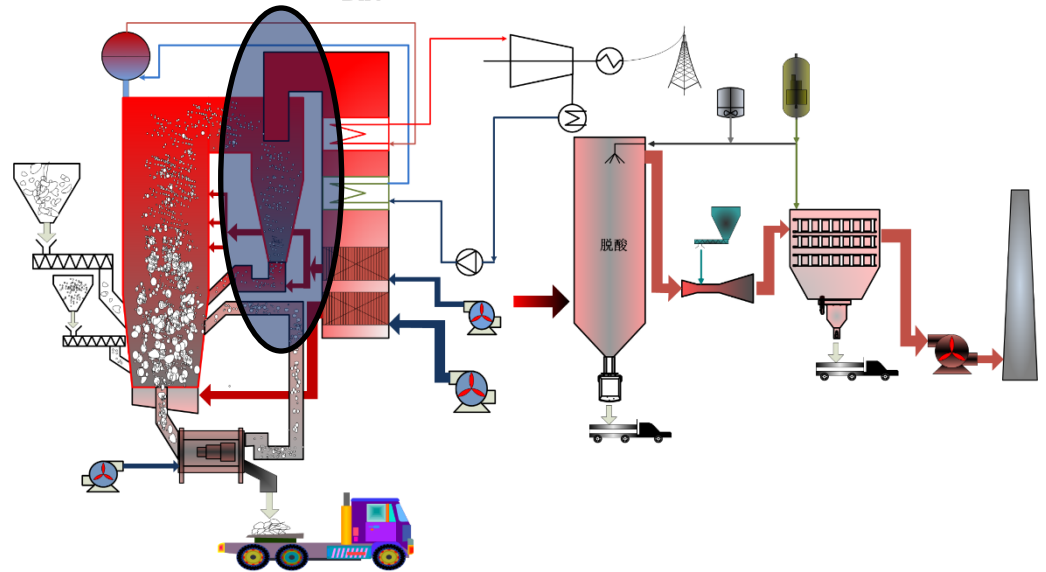
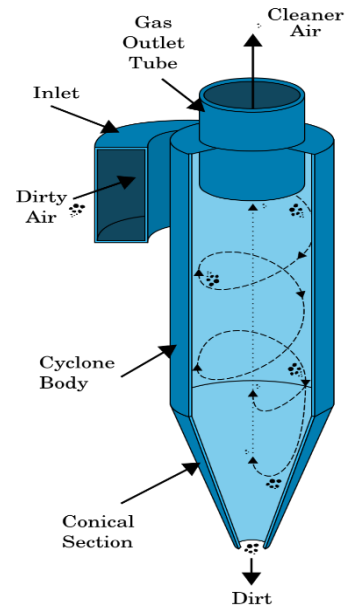
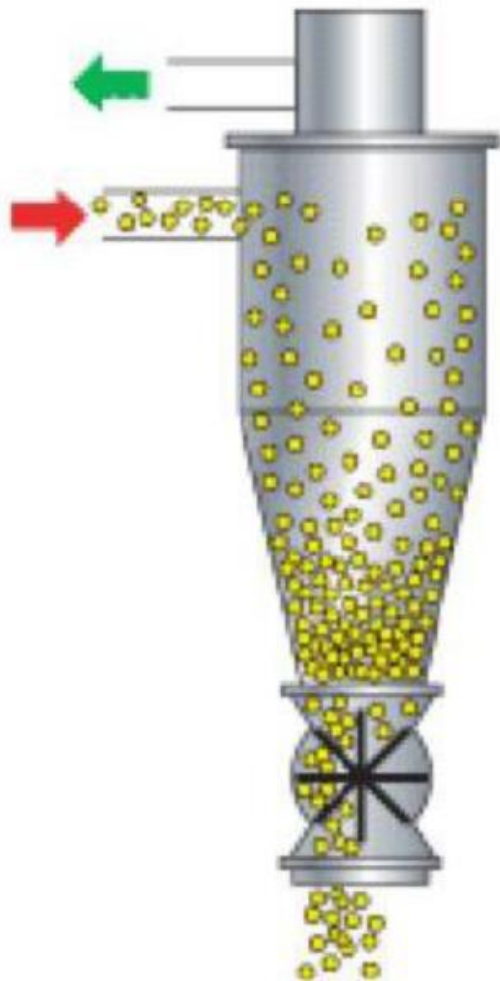
Normal

between 10^7 and 2×10^{10} ohm-cm

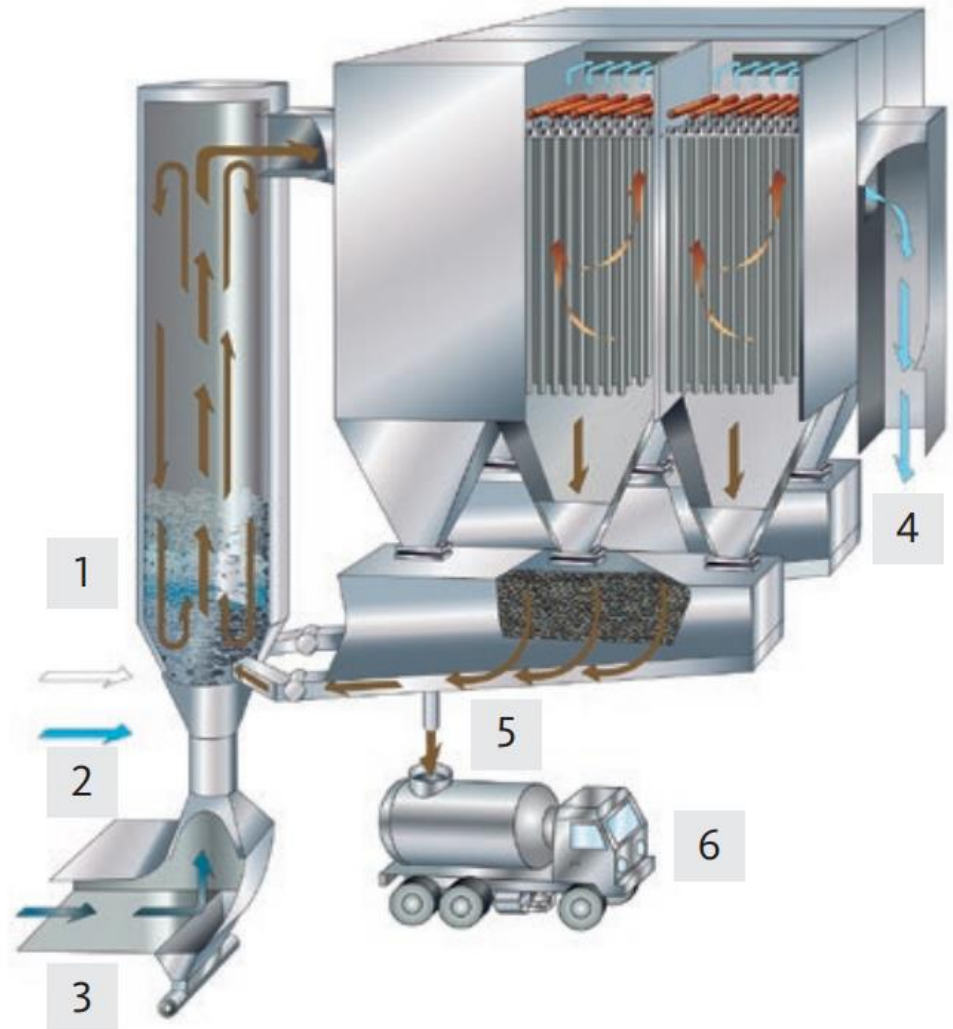
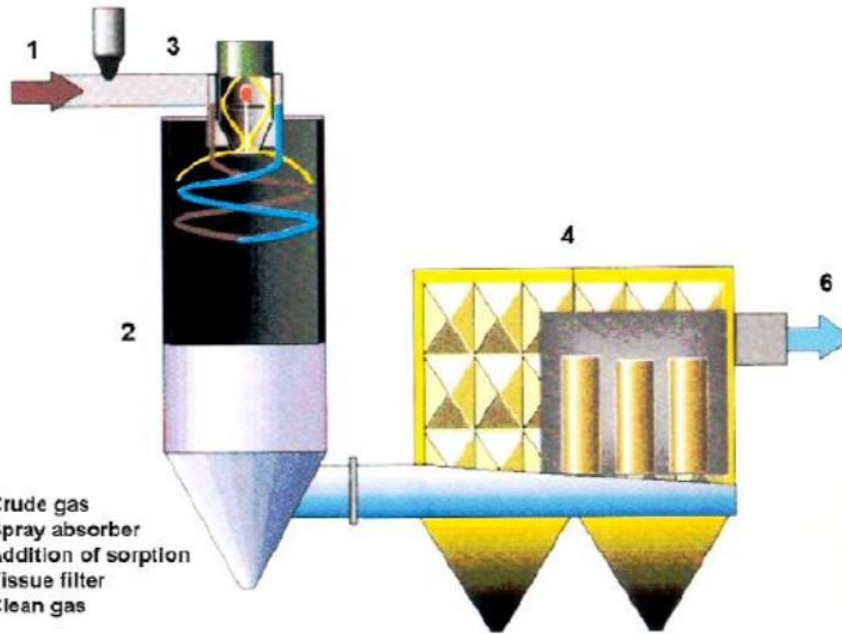
High

above 2×10^{10} ohm-cm

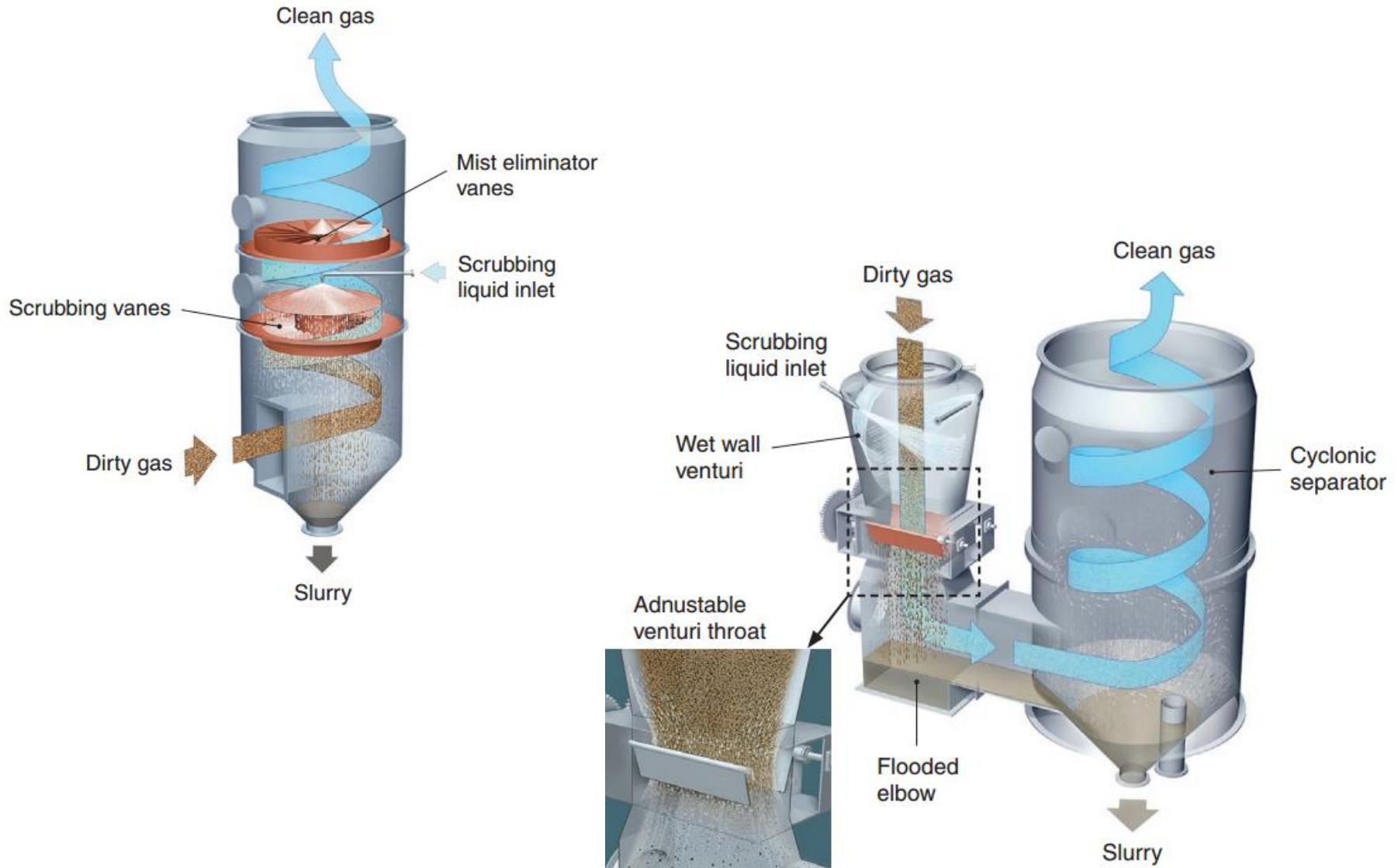
Particle remove system



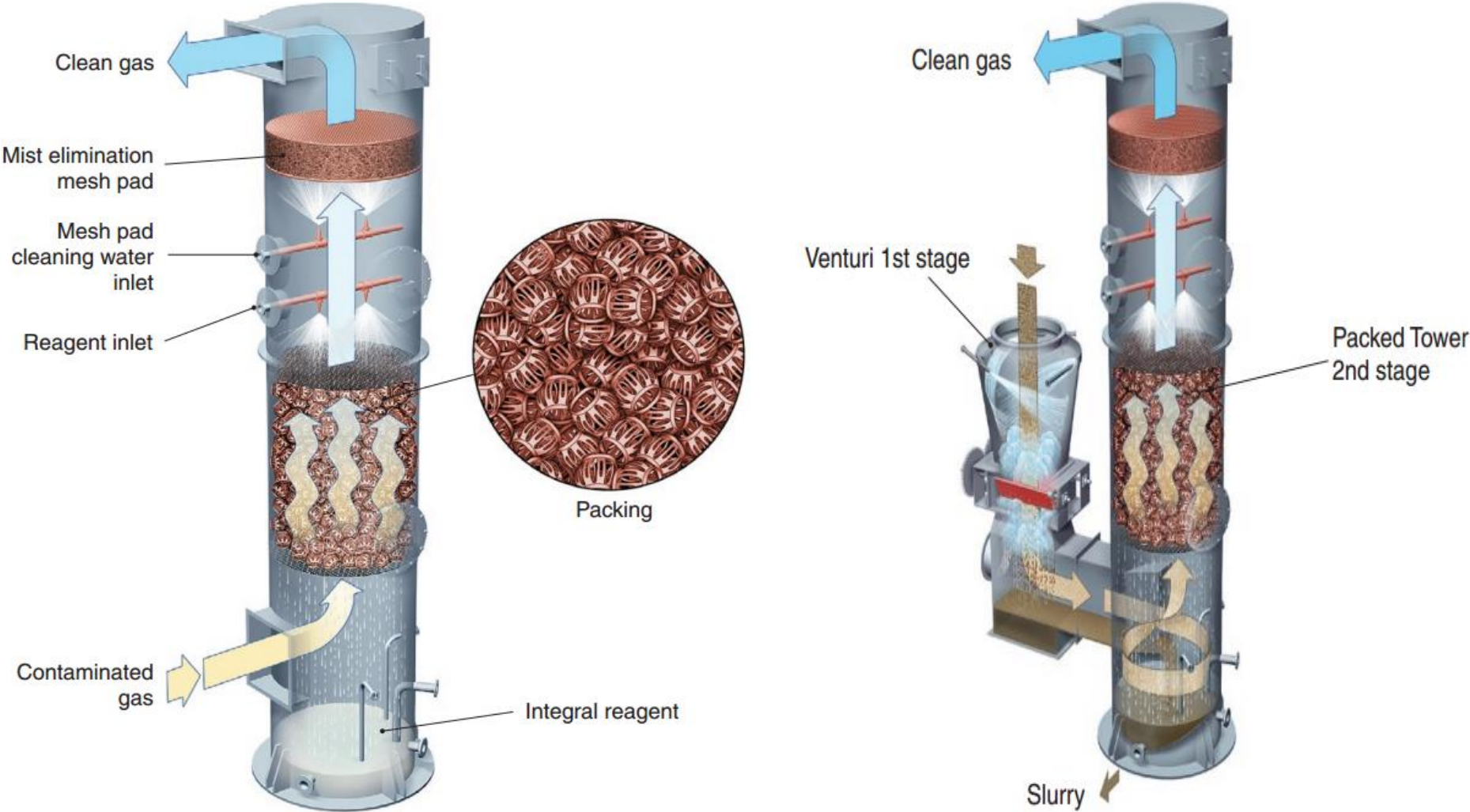
Acid gas remove system (dry/semi-dry, scrubber)



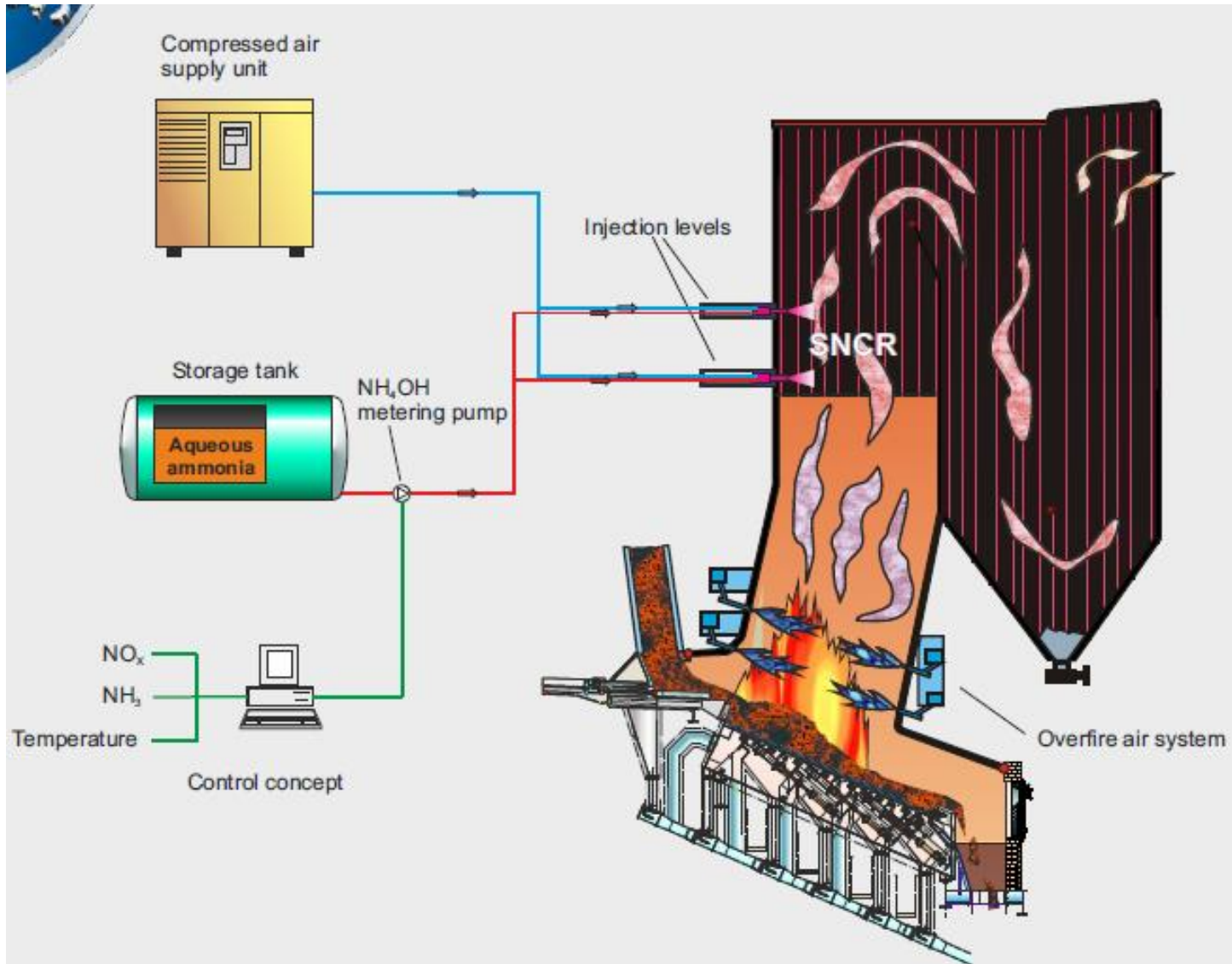
Acid gas remove system (wet scrubber)



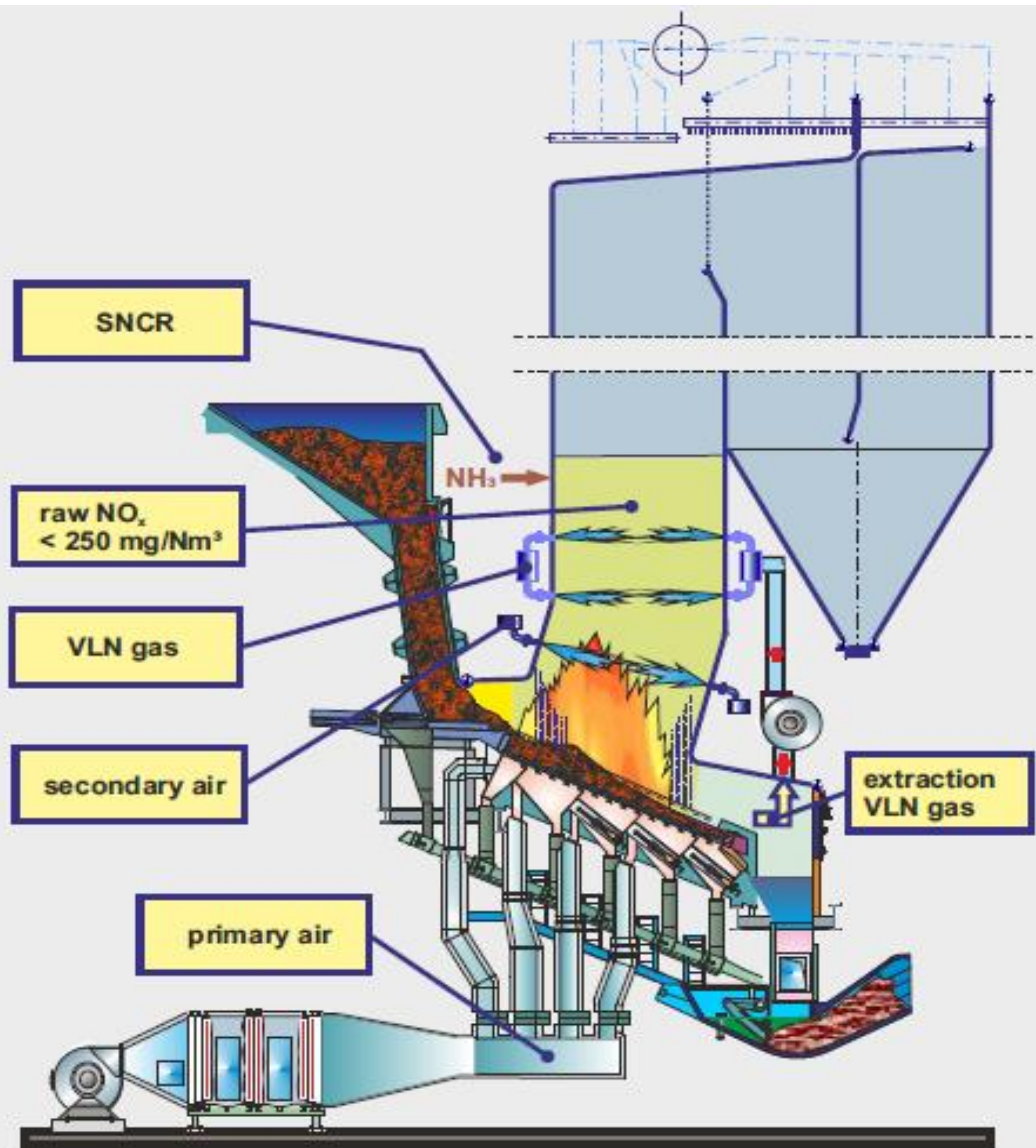
Acid gas remove system (Packed Tower)



NO_x reducing system-SNCR

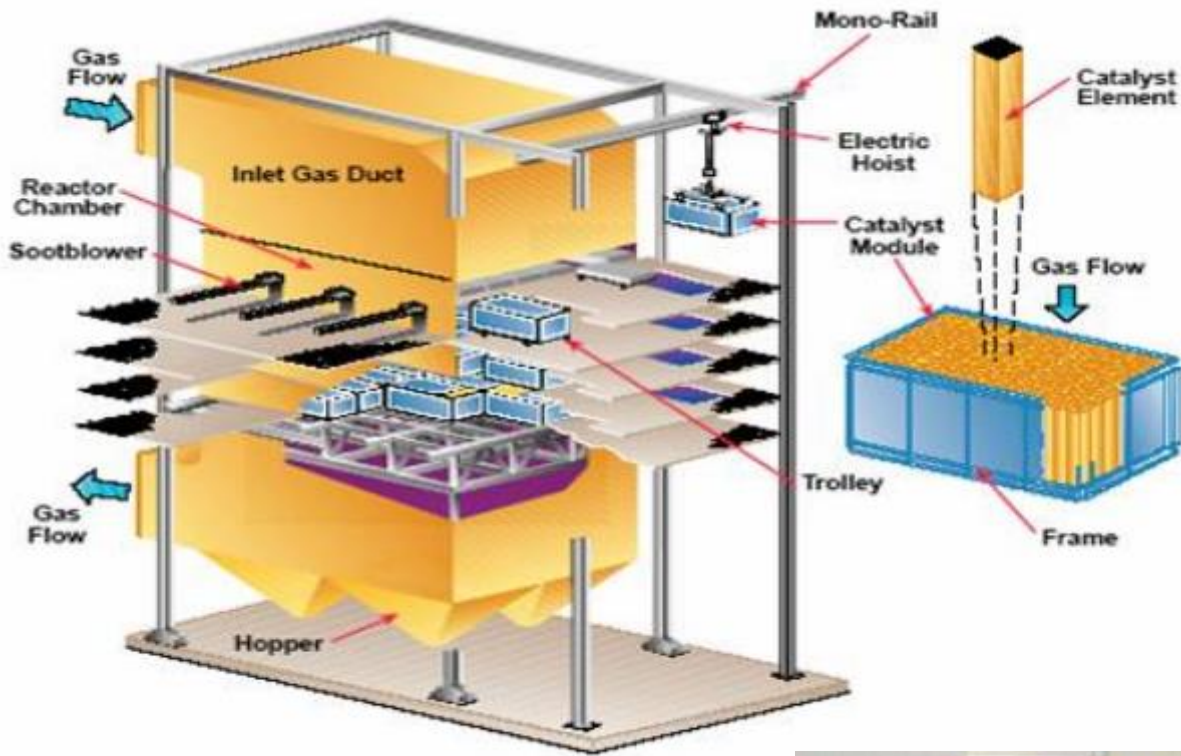


NO_x reducing system-SNCR

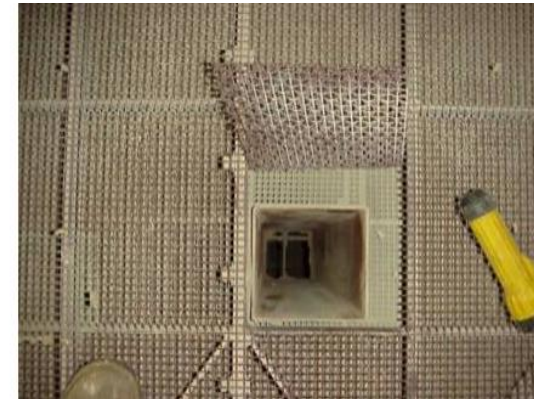
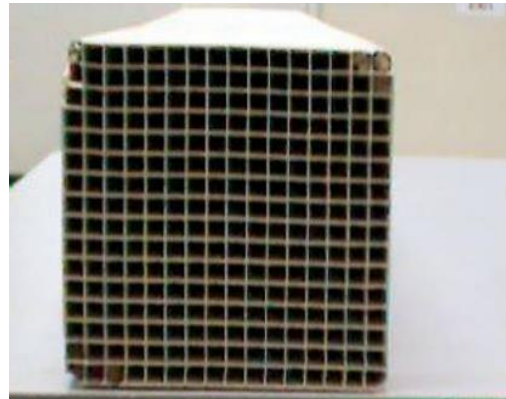


- ❑ The VLN (Very Low NO) process combines the extraction of excess combustion gases above the rear end of the grate and reduced overfired air pressures. As a result, excess oxygen is reduced and temperatures are increased in the lower part of the furnace. This promotes the chemical reactions which convert the NO_x emitted from the fuel back to nitrogen.
- ❑ The extracted VLN gas is returned as mixing gas in the upper part of the furnace. This ensures optimal mixing of the flue gases with the ammonia or urea (SNCR) that may be injected at this level.

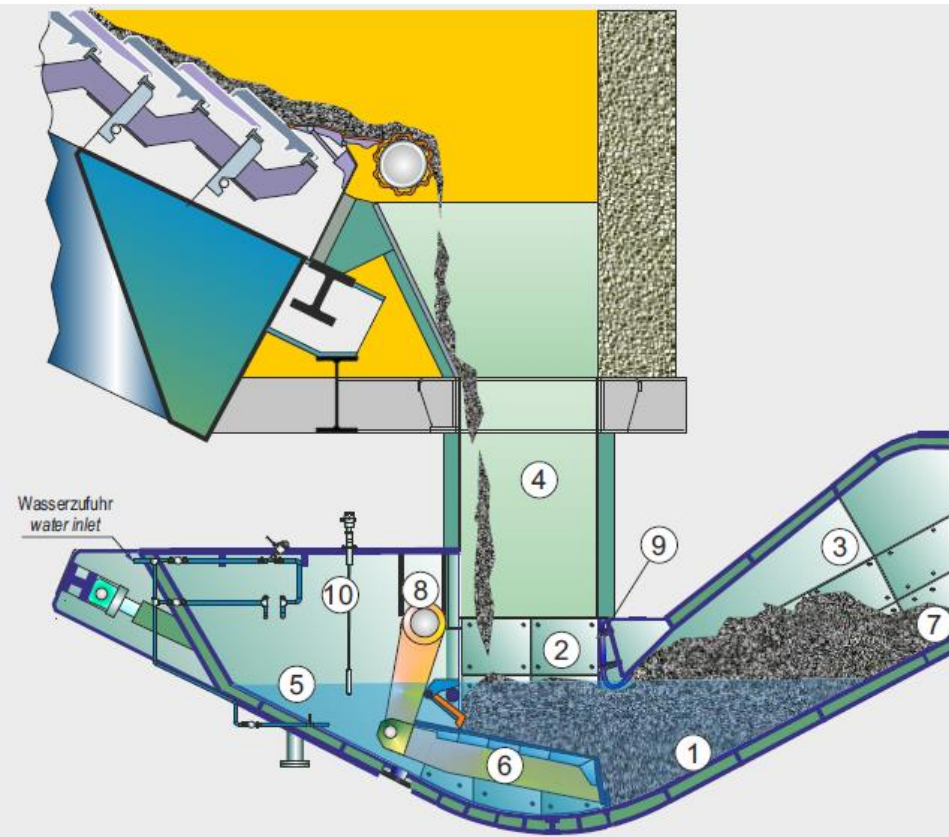
NO_x removing system-SCR



Vertical-flow fixed-bed type reactor chamber



Wet Bottom Ash discharger

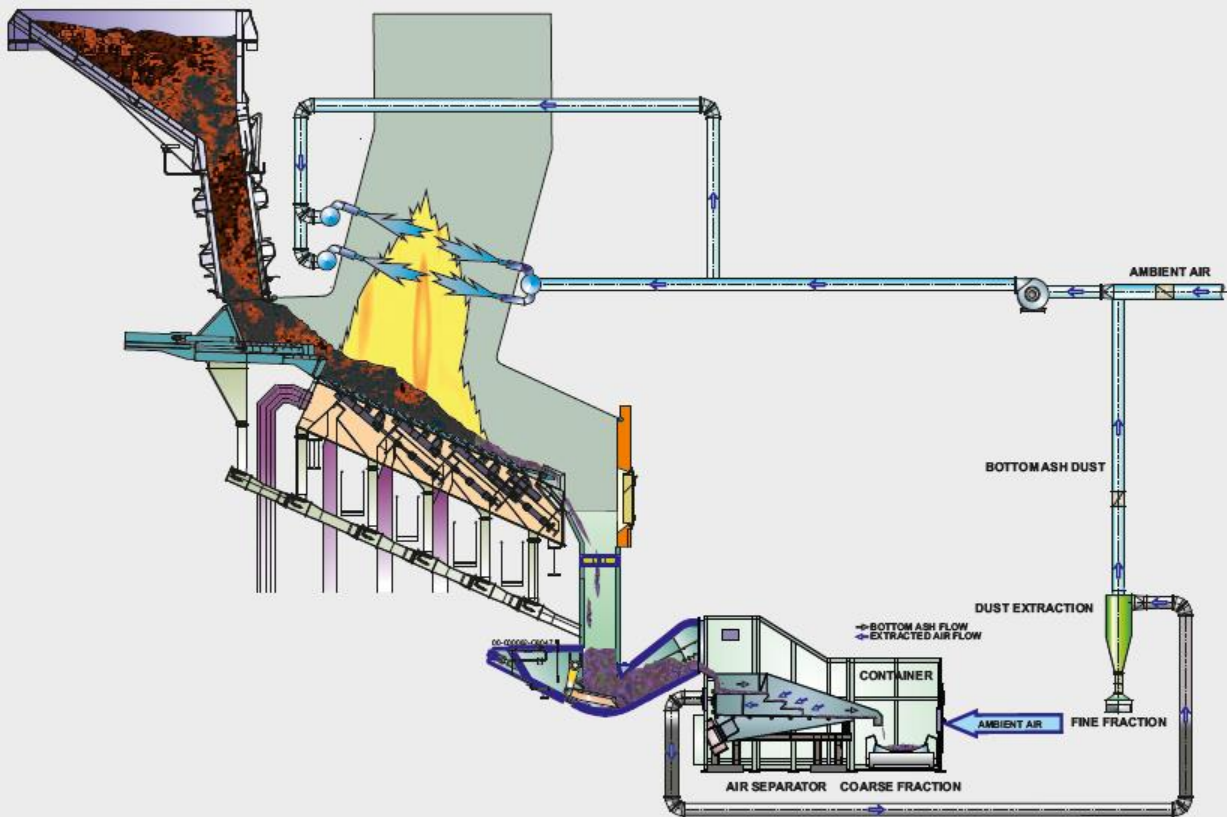


1 Discharger tube, 2 Inlet section, 3 Outlet chute, 4 Connecting piece, 5 Water level, 6 Discharge ram, 7 Drop-off edge, 8 Drive shaft, 9 Air sealing wall, 10 Electrically-controlled level metering system

The discharger is filled with water and a constant amount of bottom ash up to the level of the front air sealing wall. Then the discharging ram pushes the bottom ash under the air sealing wall towards the drop-off edge. As a result, the bottom ash is discharged in a dust-off and odourless manner.



Dry bottom ash discharge and sorting



The dry discharge system consists of the following components:

- ram-type discharger
- Air separator enclosed in housing
- Dust removal system
- Air system

In times of diminishing resources and increased environmental awareness, the bottom ash that remains on the grate after combustion, in particular the ferrous and non-ferrous metals contained in the bottom ash should be recycled. Dry discharge offers significant advantages in this respect. Not only are the recoverable metals of a better quality, the fine fraction can also be separated from the coarse fraction more effectively and recycled separately.

Ferro and non-ferro metals separator



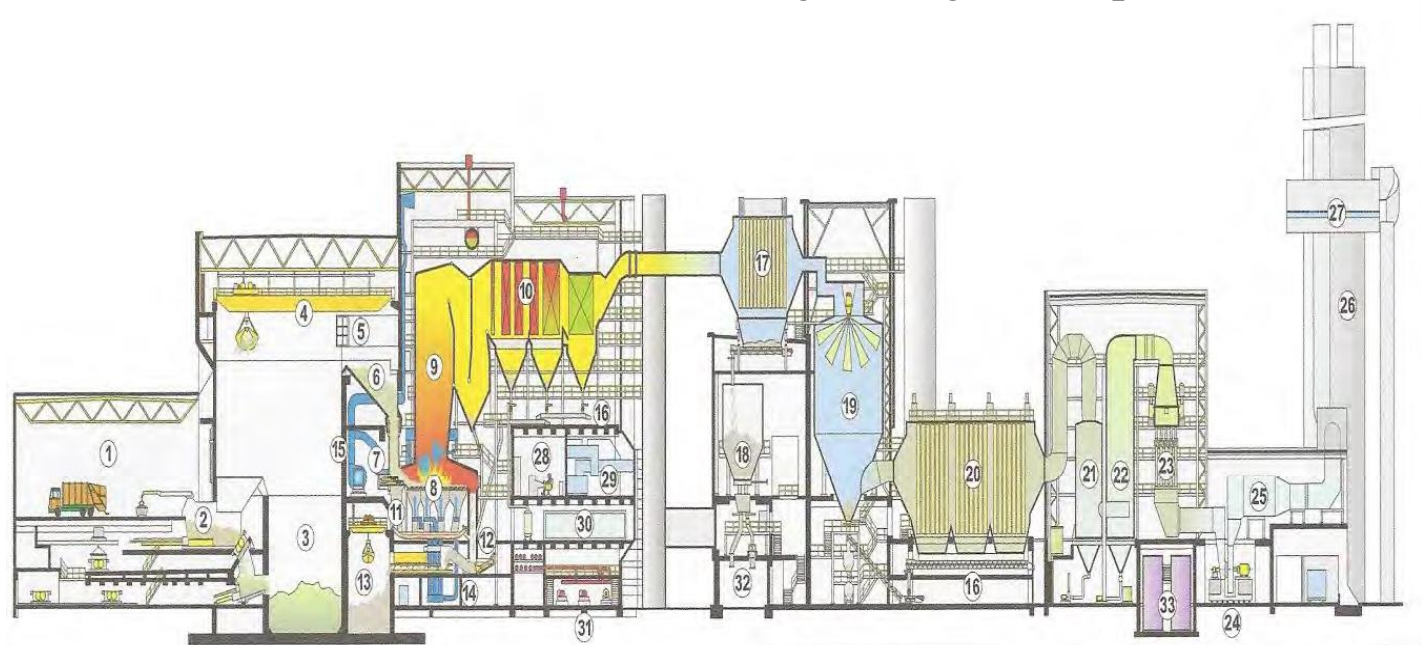
Cases study



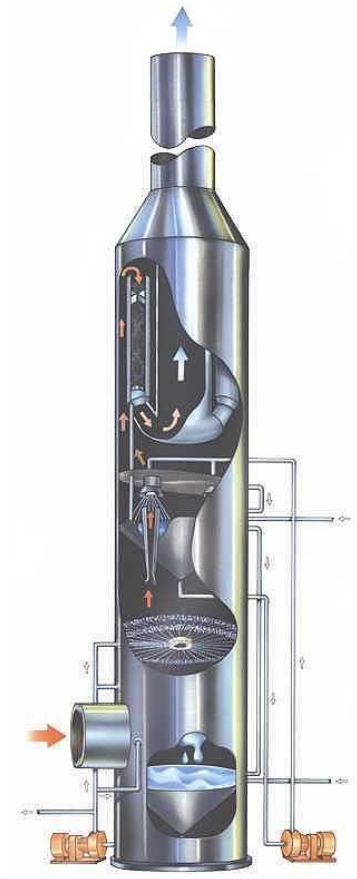
- 1、 Case Study 1 – AEB, Amsterdam, The Netherlands**
- 2、 Case Study 2 – Spittelau, Vienna, Austria**
- 3、 Case Study 3 – Issy les Moulineaux, Paris, France**
- 4、 Case Study 4 – Reno Nord, Aalborg, Denmark**
- 5、 Case Study 5 – Nanjing, Jiangsu province, China**
- 6、 Case Study 6 – Suzhou, Jiangsu province, China**
- 7、 Case Study 7 – Chongqing, China**

Case Study 1 – AEB, Amsterdam, The Netherlands

- Capacity: 3700 t/d
- Six incineration lines
- Process domain: all of the household, industrial and commercial waste from Amsterdam and 27 neighboring municipalities



Technical data	Start-up 1994	2007	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33			
Number of lines:	4	2	Tipping hall	Bulky waste cutter	Waste bunker	Waste crane	Crane control cabin	Feed hopper	Feeder	MARTIN horizontal grate	Furnace	Steam boiler	Grate sittings conveyor	Ram-type discharger	Bottom ash bunker	Underfire air system with air preheater	Overfire air system	Fly ash transport	Electrostatic precipitator	Fly ash silo	Absorber	Electrostatic precipitator	Wet scrubber (acidic)	Wet scrubber (alkaline)	EDV scrubber	ID fan	Silencer	Stack	Measuring station	Control room	Ventilation room	Boiler blow-down tank	Feed water pumps	Fly ash loading	Chemical storage			
Waste capacity per line:	30 t/h	33.6 t/h																																				
Thermal capacity per line:	73 MW	93.3 MW																																				
Steam output per line:	77 t/h	102 t/h																																				
Steam pressure:	43 bar	130 bar																																				
Steam temperature:	415 °C	420 °C																																				



EDV wet scrubber

Schematic of the moving grate process at Amsterdam

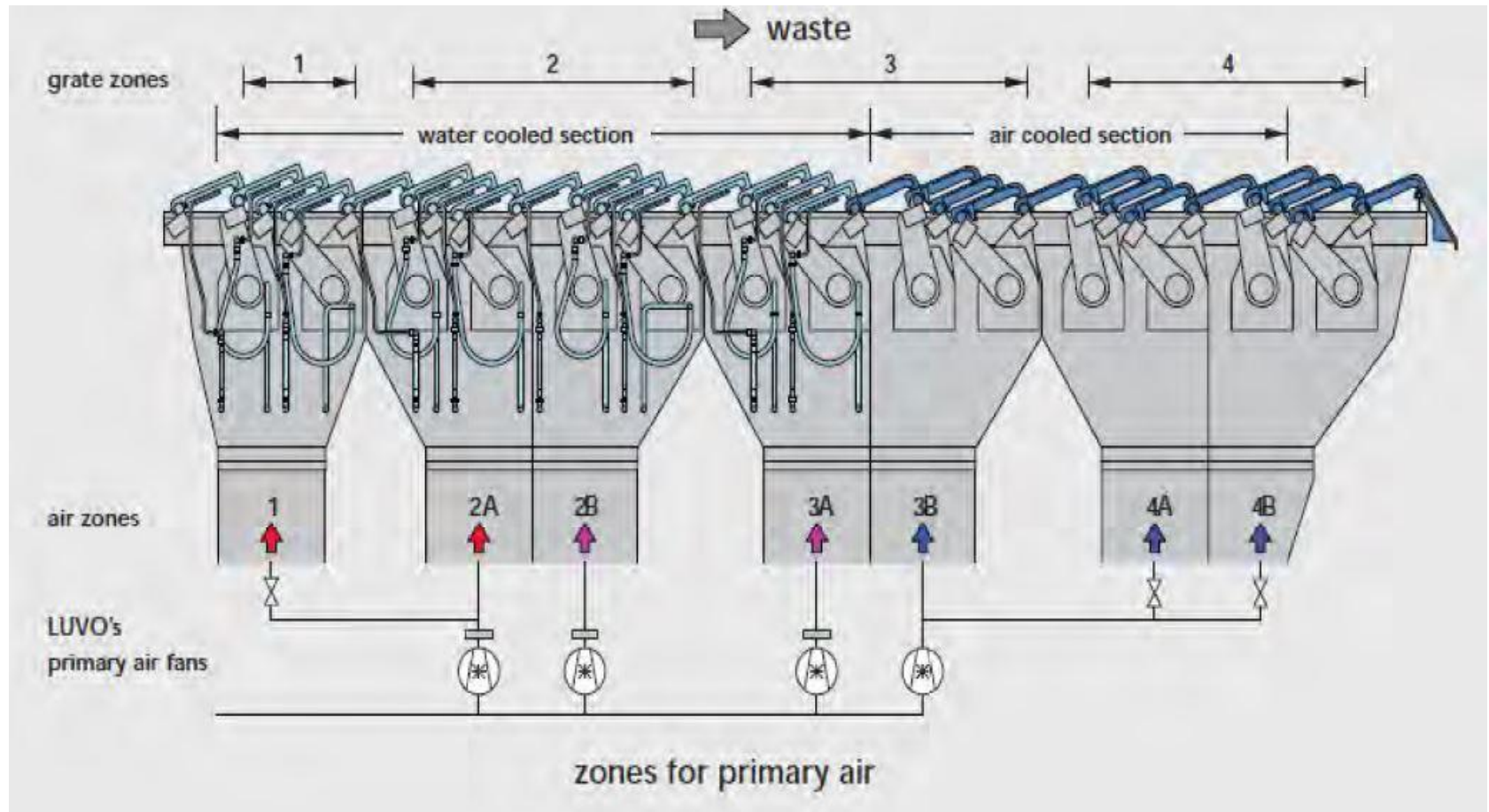
The horizontal grate system employed at Amsterdam

The original four line plant uses W&E horizontal grates. The two new lines employ Martin horizontal grates, which is the same technology having been acquired from Martin. The grates consist of alternating rows of fixed and moving grate bars. Neighbouring moving grate bar rows make a counter movement, thus effectively transporting and mixing the waste to ensure good burnout.



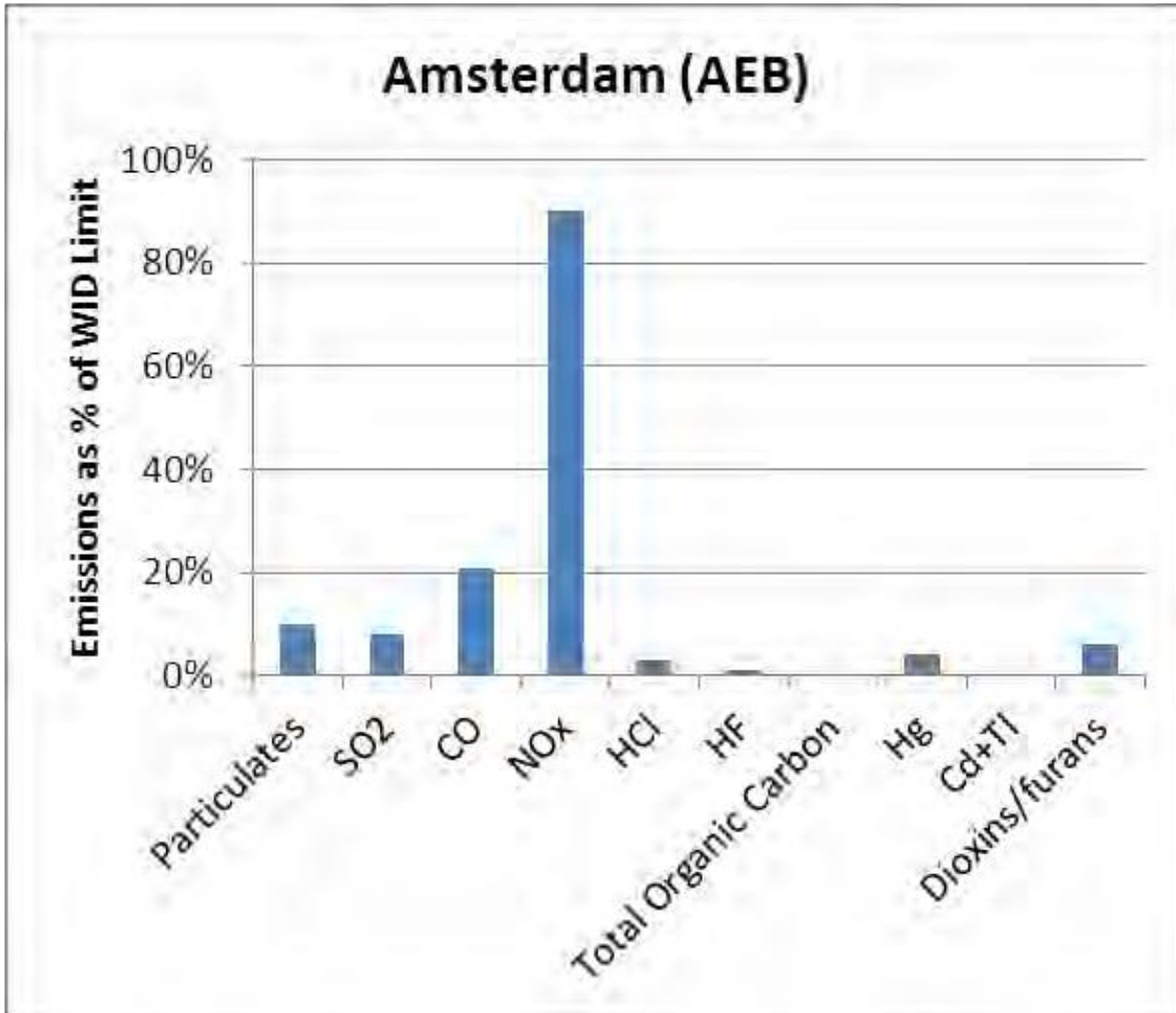
The horizontal grate is of modular design. The length of each module is fixed but the width may vary depending on the design. Each module has its own drive and supply of underfire air, both of which can be controlled separately. A typical grate configuration consists of 3 modules in the waste flow direction.

The waste is burned on horizontal grates that are identical to the existing ones but are partially water-cooled. The grate is of the double-motion over thrust type (W&E design) and comprises three parallel runs, each with seven air zones.



Schematic of the grate bar design

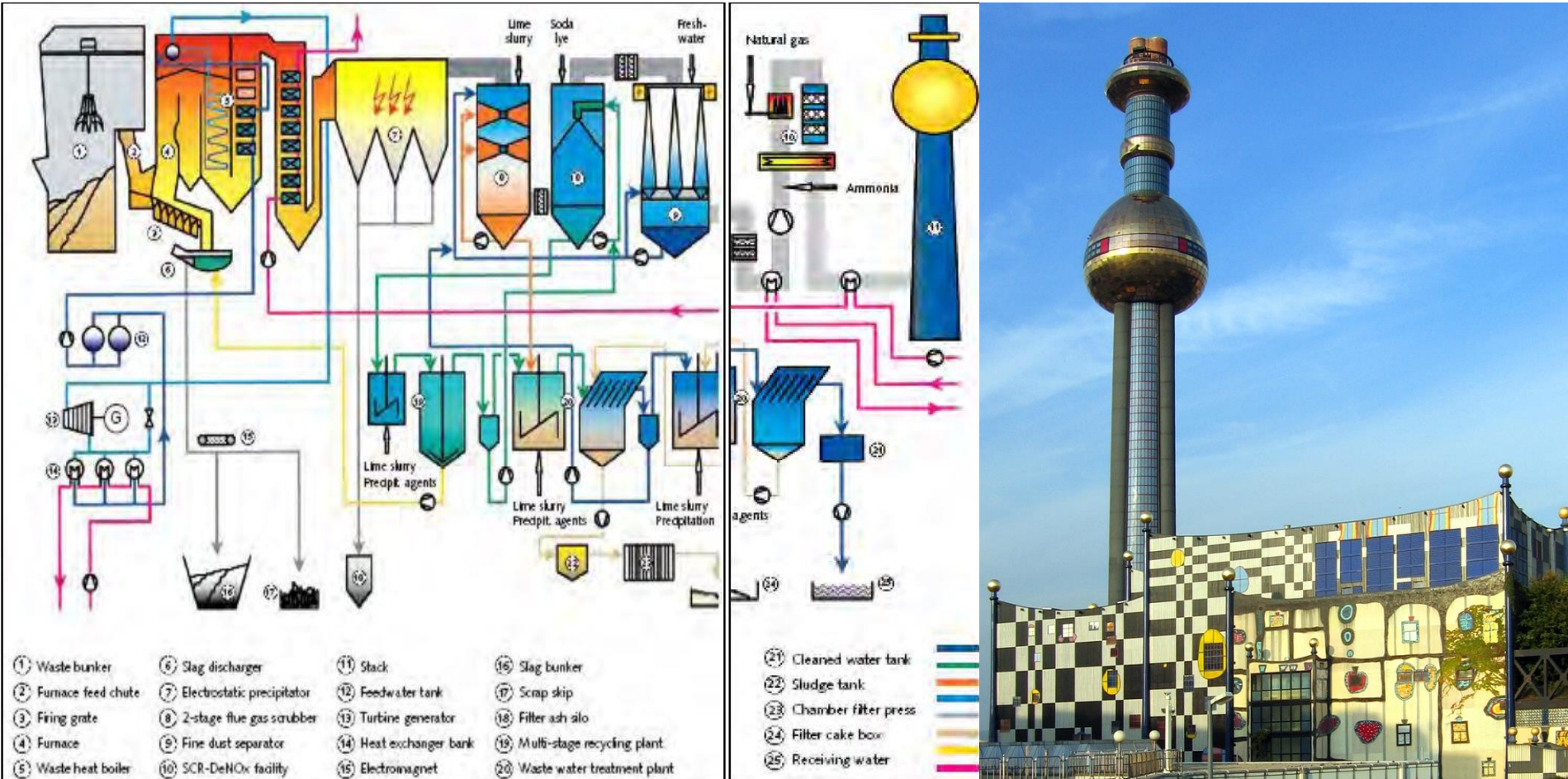
Emission performance at Amsterdam



- NO_x reduction: Selective Non-Catalytic Reduction (SNCR)
- Pre-separation of fly ash: an electrostatic precipitator
- Fine particles removing: a fabric filter
- Cleaning acid components and ammonia: the hydrochloric acid and Sulphur dioxide scrubbers

Case Study 2 –Spittelau, Vienna, Austria

The Spittelau plant was erected at its current location in order to provide heating to the new Vienna General Hospital (AKH) situated around 2 km away.

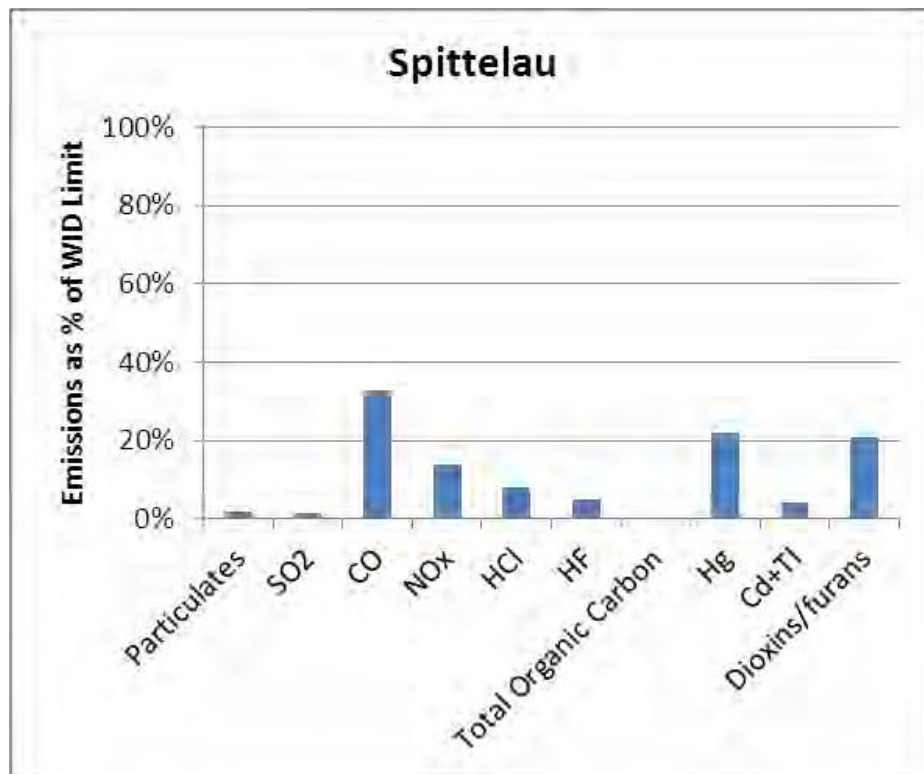


Schematic process flow diagram for the Spittelau facility

Spittelau waste to energy plant technical data

Weighing device	Weighbridge, number:	2
Waste bunker:	Capacity:	7,000m ³
	Tipping points:	8
Combustion chamber feed	Bridge crane with hydraulic polyp grabs, number:	2
	Capacity per grab:	4 m ³
Firing	Number of combustion lines:	2
	Maximum throughput capacity per line:	18t/h
Grate	Air cooled twin-track reciprocating grate:	
	Grate length:	7.5m
	Grate width:	4.6m
	Inclination:	26°
Combustion chamber	Fuel thermal output per line:	41.1MW
	Waste thermal value:	8,200 – 9,600 kJ/kg
	Primary air heating:	180°C
Slag removal	Ram-wet slag remover	
	Slag remover volume:	5m ³
Waste heat boiler	Natural circulation radiation boiler	
	Maximum steam output per line:	44t/h (saturated steam)
	Maximum operating pressure:	34 bar
	Maximum operation temperature:	245°C
	Heating surface:	2,420m ²
Turbine and generator	Saturated steam back-pressure turbine	
	Maximum electrical output:	6.4MW
	Back pressure:	4.5 bar

Emission values in the stack gas (2006) at Spittelau



Flue gas cleaning	Number of lines:	2 (deNO _x plant: 1)
	Flue gas volume per line:	85,000 sm ³ /hr (wet)
Electro-static precipitator	Operating voltage:	60kV
	Dust separation efficiency:	>99.5%
Flue gas wet scrubber	1 st stage:	Quencher/separation of hydrogen chloride (HCl), hydrogen fluoride (HF), dust, heavy metals
	Design:	Cross-flow scrubber
	Absorption agents:	Water/lime slurry
	HCl separation rate:	>98%
	2 nd stage:	Separation of sulphur dioxide (SO ₂)
	Design:	Counter-current
Absorption agents:	NaOH solution	
SO ₂ separation rate:	>98%	
DeNO _x & dioxin destruction system	SCR catalytic converter, number of catalytic converter systems:	3
	Operational temperature:	280°C
	NO _x destruction rate:	>95%
	Dioxin destruction rate:	>95%
Chimney	Design:	Steel/brick
	Height:	126m
	Diameter:	2.5m

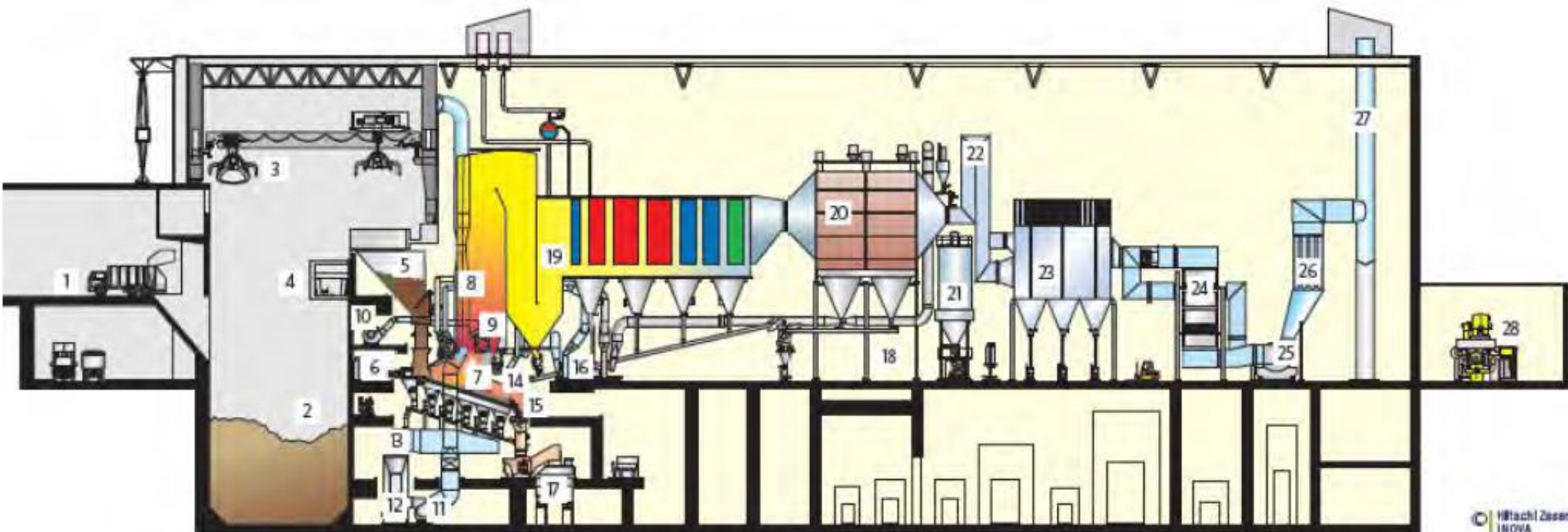
Case Study 3 – Issy les Moulineaux, Paris, France

The plant is a two-line water-cooled grate incinerator, incorporating a conventional steam cycle. The two lines have a combined thermal capacity of 170MW, and steam is passed to a single 52MW controlled extraction condensing steam turbine to generate electricity as well as enabling the offtake of low pressure steam to supply 80,000 households with heat via a hot water district heating network



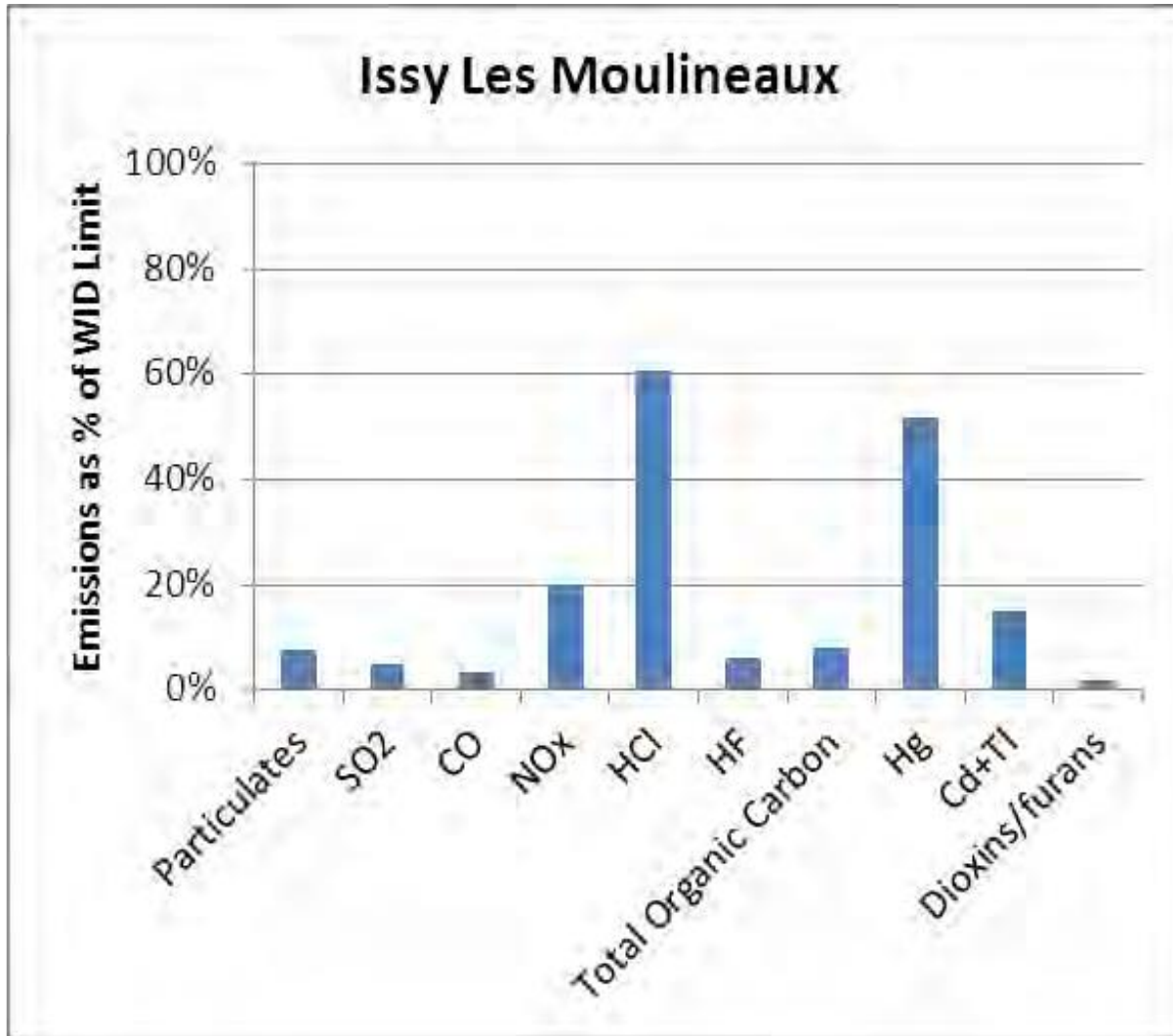
Combustion

- ◆ Waste is combusted on one of two **Hitachi Zosen Inova water-cooled grates**. **Each grate** measures 10m by 10m and has five zones, the initial three being water cooled. Hot gases then exit the furnace into a secondary combustion chamber and are transferred through a 4-pass horizontal boiler. This system has a relatively low profile which helps to minimise the building height.
- ◆ The sophisticated combustion control system includes an infrared camera to monitor combustion and enable adjustments to be made to respond to varying waste feedstock and optimise burn-out.



Process schematic of the ISSEANE plant

Emission limits for the ISSEANE plant in Paris for 2011



Flue gases are first passed through an **electrostatic precipitator (ESP)** which removes the vast majority of particulate matter (around 99%). A **dry sorption sodium bicarbonate system** neutralises acid gases (in particular SO₂), and an **activated carbon system** further removes pollutants and dioxins in particular. A **fabric filter** removes particulate matter not captured by the ESP and products from the acid gas removal and activated carbon systems. Finally, a low temperature **Selective Catalytic Reduction (SCR)** deNO_x system removes a proportion of NO_x in the flue gases by injection of ammonia in the presence of a catalyst at around 220° C. The cleaned gas then exits via the two low profile stacks.

Case Study 4 – Reno Nord, Aalborg, Denmark

According to literature supplied by **Babcock and Wilcox Vølund**, line 4's power and energy generation levels are as follows:

Electricity (gross): 17,918 kW

Heat from district-heating condensers: 43,412 kW

Condensation heat from the flue gas cleaning system: 4,000 kW

Condensation heat with the current district heating water return temperature: 7,000 kW (max.)

Resulting gross electrical efficiency: 27%

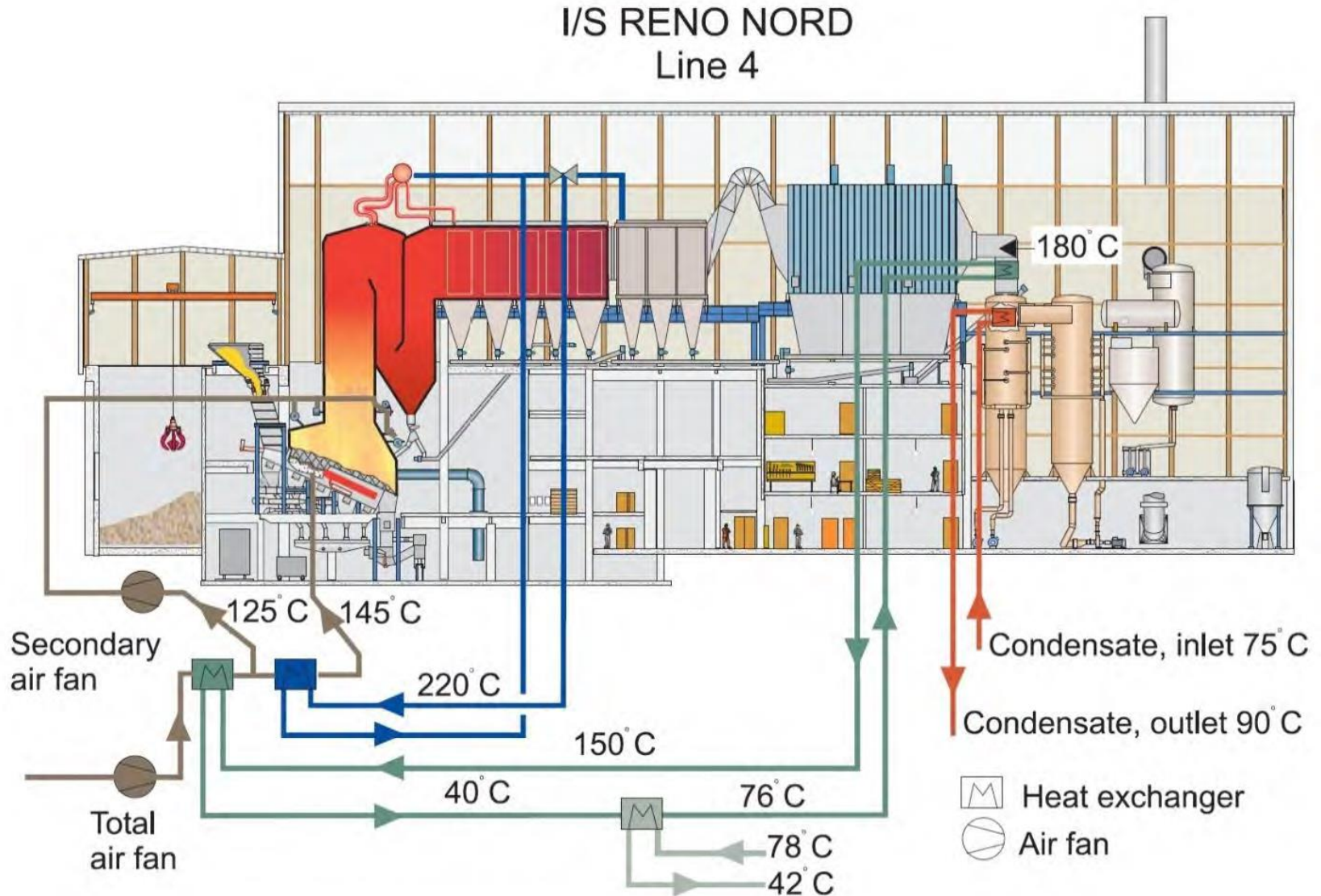
Resulting overall thermal efficiency: 98%

Boiler efficiency: 92%



Process schematic for the Reno Nord waste to energy plant

Line 4 is fitted with a Babcock and Wilcox Vølund BS-W Mark 5 air-cooled grate which is suitable for conversion to water cooling in the future.

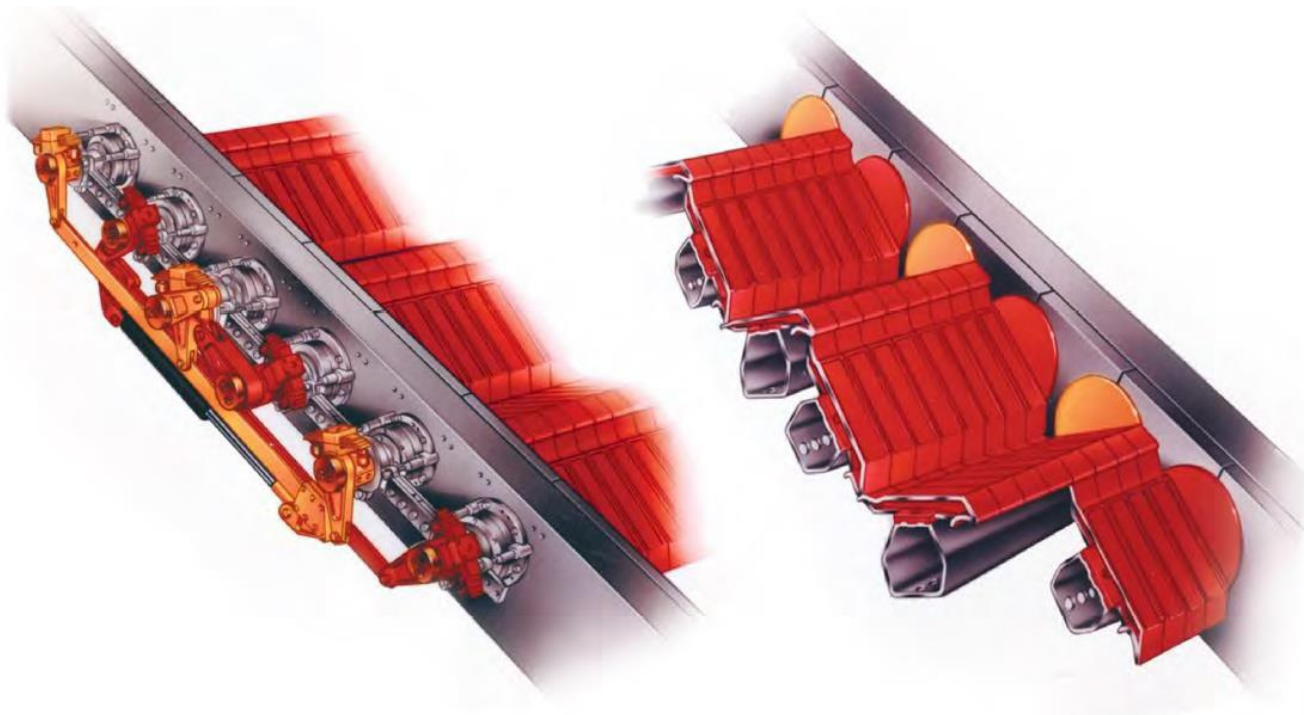


The technical data for Line 4 of the Reno Nord plant

Waste silo	Capacity	12,500 m ³
	Number of dumping bays	5
Waste handling cranes	Quantity	2
	Grab volume	8 m ³
	Type	Fully automatic
	Supplier	Kone Cranes
Combustion System	Throughput	20 t/h
	Grate type	BS-W, air cooled
	Grate length	9.9 m
	Grate width	9.1 m (usable width 8.8 m)
	Supplier	Babcock & Wilcox Vølund A/S
Boiler	Boiler wall protection	Inconel / refractory
	Burners	Oil, 2x 25 MW
	Thermal energy input	66.7 MW
	Steam generation	22.2 kg/s
	Steam pressure:	50 bar (a)
	Steam temperature:	425 °C
	NO _x reduction	SNCR
	Supplier	Babcock & Wilcox Vølund A/S
Turbine/generator	Output	17.9 MW
	Temperature / pressure	422 °C / 48 bar
	Supplier	B+V Industrietechnik GmbH

Combustion

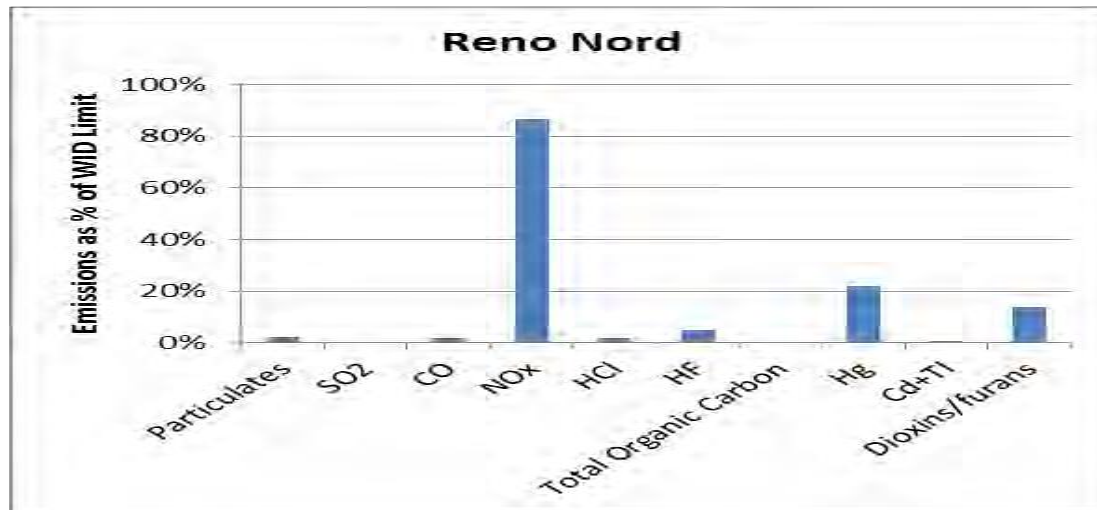
- The Reno-Nord line 4 utilises a Babcock and Wilcox Vølund BS-W mark 5 air cooled combustion grate which consists of two parallel grate lanes, each with a width of 4.4m.
- The BS-W grate system can handle all types of unsorted solid waste and can be used for combined fueling with biomass.
- The grates resemble a set of stairs and the individual grate bars are arranged in alternating horizontal and vertical orientation. The grate bars are in turn fitted to shafts so the bars of two adjoining shafts can join to yield a continuous grate surface



The design of the grate used in the Reno Nord plant

Emission limits for the Reno Nord plant in Aalborg for 2011

Dust removal	Type	Electrostatic filter
	Number of fields	3
	Capacity	Less than 10 mg/Nm ³
	Manufacturer	Alstom
	Supplier	Babcock & Wilcox Vølund A/S
Flue gas cleaning	Flow	112,000 Nm ³ /h
	Type	Wet flue gas cleaning
	Components	Quencher, acid scrubber, limestone-based alkali scrubber, HOK-based dioxin scrubber, venturi scrubber with agglomeration filter, exhaust blower
	Condensation stage	Direct cooling with district heating water Heat generation for district heating: 4 MJ/s
	Supplier	LAB S.A.



Case Study 5 – Nanjing, Jiangsu province, China

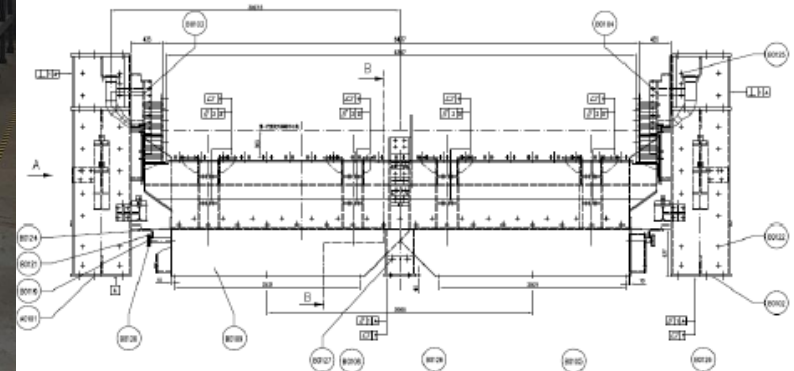
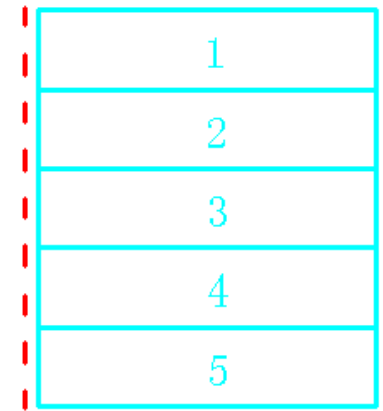
Nanjing municipal solid waste incineration power plant (4*500t/d) is located in Gaochun district, Nanjing with the moving grate designed by everbright international environmental protection.



Nanjing municipal solid waste incineration power generation project (4*500t/d)

Everbright grate

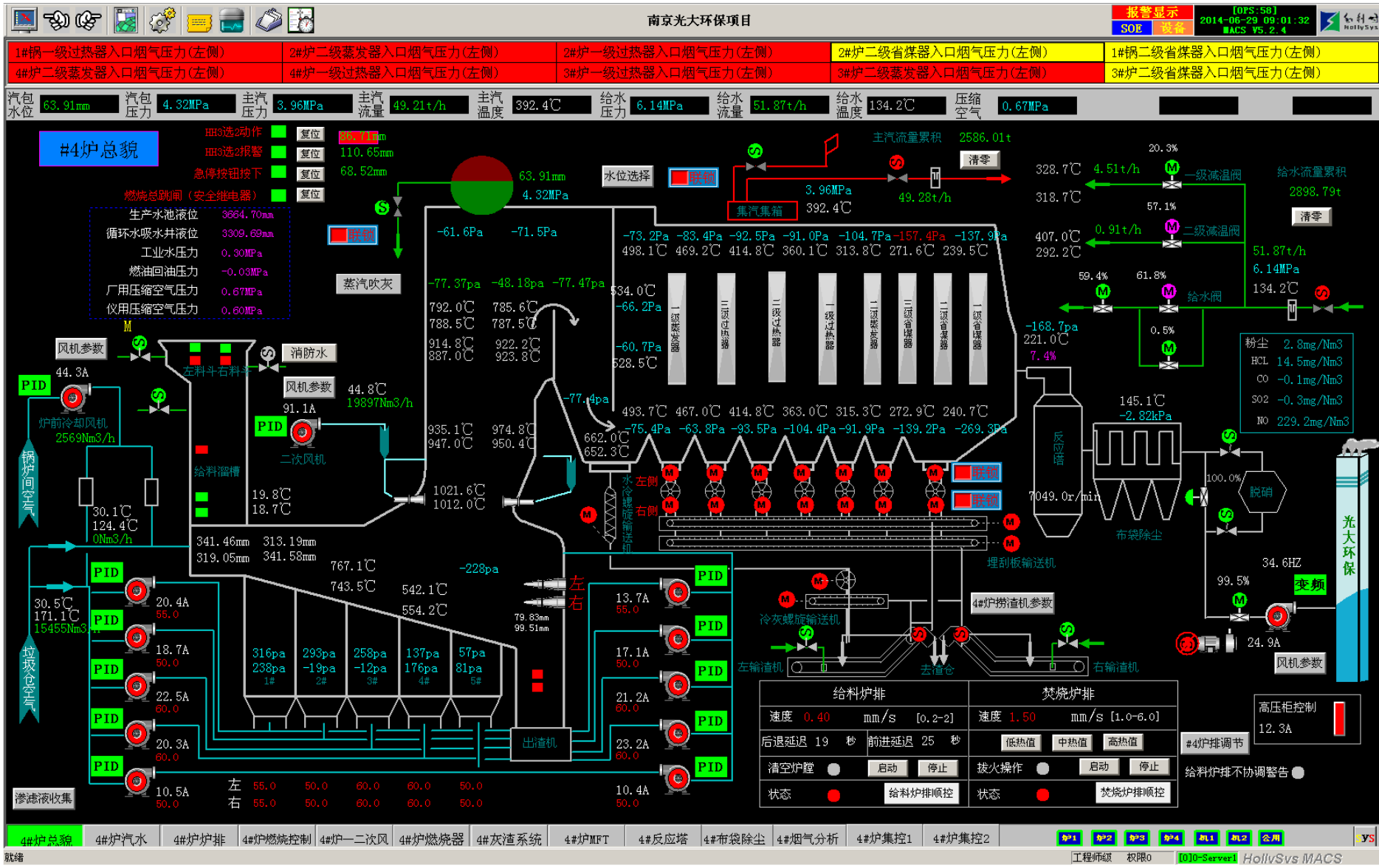
Independent research and development of over 500 t/d grate has been successfully run on the basis of 400 t/d, 350 t/d and 300 t/d, improved through the exposed problems of imported equipment in the operation and use, the shape and structure of the device are completely different from the imported equipment.



longitudinal arrangement for imported grate

transversal arrangement for independent grate

Operating control system

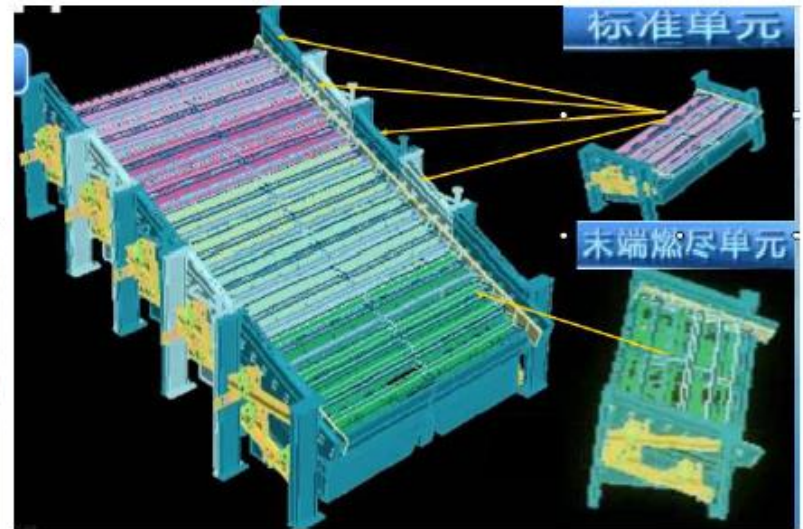


Case Study 6 – Suzhou, Jiangsu province, China



Suzhou municipal solid waste incineration power generation the third-stage project (3*500t/d)

Grate



Longitudinal divided into five units, including four standard units and a lengthened final unit

- ◆ Dry stage: the first and second standard unit
- ◆ Combustion stage: the third and fourth standard unit
- ◆ Burnout stage: lengthened final unit

Each unit can be moderated independently

Running state

Three grate furnaces of Suzhou MSW power plant have been run Since January 14, 2013 to January 14, 2014 , for every furnace:

Operation time per year: 8,390 hours

Capacity per year: 180,000 t

Generating capacity: 450 kWh/t

Average mechanical load rate: 102%

Loss of slag ignition: < 3%

三期 1#		三期 2#		三期 3#	
G14-01-95		G14-01-96		G14-01-97	
1.74	1.70	1.65	1.68	1.62	1.67
1.67		1.63		1.72	
1.73		1.75		1.60	
1.76		1.67		1.79	
1.73		1.78		1.73	
1.64		1.67		1.70	
1.79		1.69		1.57	
1.73		1.72		1.69	
1.64		1.61		1.70	
1.60		1.65		1.58	

上海市环境工程设计科学研究院有限公司
检测报告

环卫报告 (2014) 第 1 页 共 1 页

样品名称: 炉渣
样品性状: 固体
采样日期: 2014.1.3
技术依据: HJ/T20-1998, GB18485-2001
检测结果: 热灼减率

样品数量: 60 个
样品来源: 来自苏州生活垃圾焚烧厂
检测完成日期: 2014.1.7
检测项目: 热灼减率

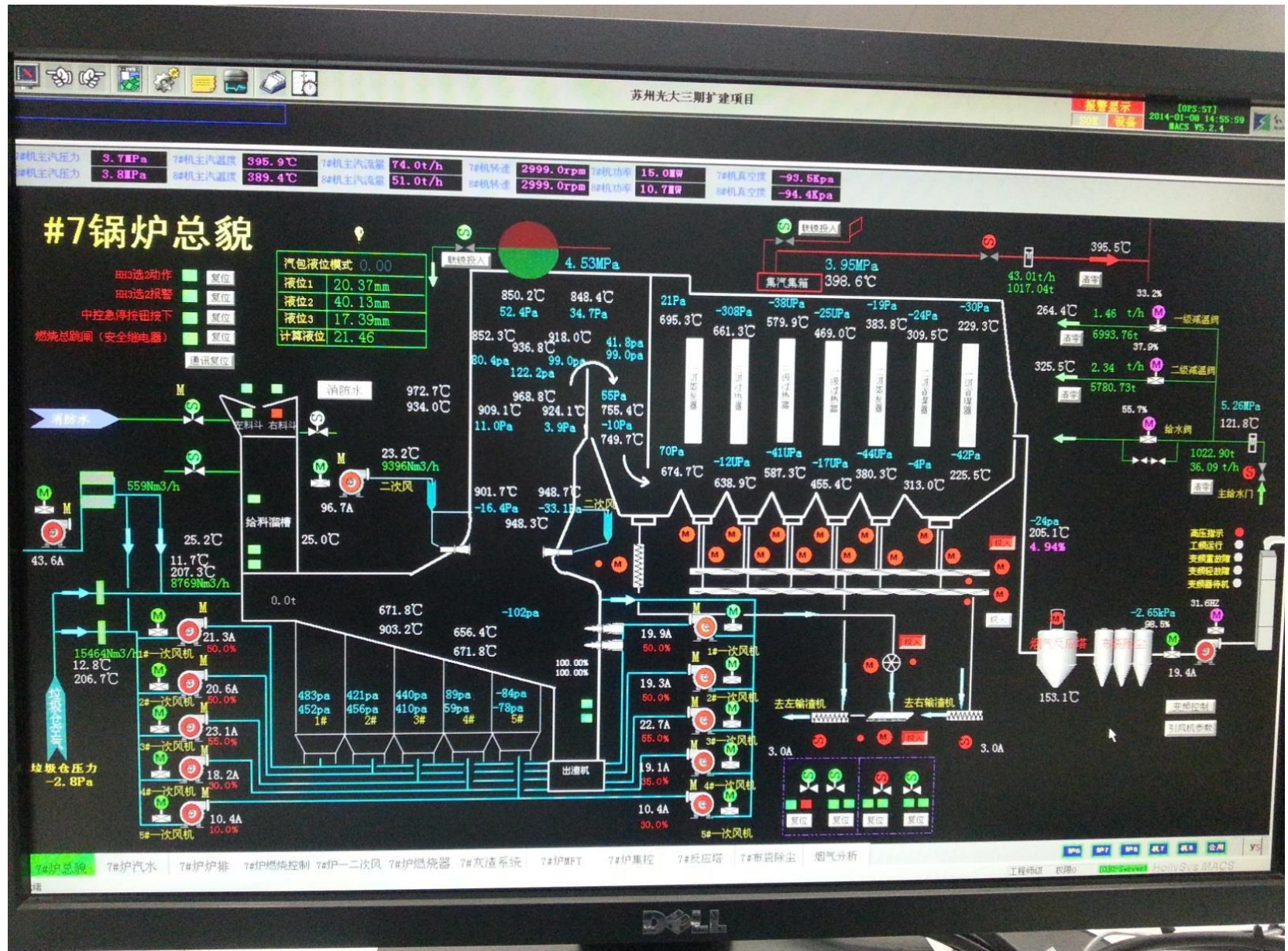
项目 编号/地点	热灼减率 (%)									
	一期 1# G14-01-92	二期 2# —	一期 3# G14-01-93	二期 1# G14-01-94	二期 2# —	三期 1# G14-01-95	三期 2# G14-01-96	三期 3# G14-01-97		
炉渣	3.26	3.30	4.85	3.10	3.10	1.74	1.65	1.62		
	3.32		4.82	3.11		1.67	1.63	1.72		
	3.24		4.97	3.07		1.73	1.75	1.60		
	3.35		4.82	3.15		1.76	1.67	1.79		
	3.21		4.88	3.05		1.73	1.78	1.73		
	3.34		4.90	3.10		1.64	1.67	1.70		
	3.37		4.85	3.04		1.79	1.69	1.57		
	3.29		4.82	3.02		1.73	1.72	1.69		
	3.36		4.94	3.19		1.64	1.61	1.70		
	3.29		4.89	3.15		1.60	1.65	1.58		

编制: 沈可莹
审核: 王...
批准: 李...
2014年1月22日

检测报告
专用章

Test results for the loss of slag ignition

Operating data



Measured value of burning pollutants

Pollutant (mg/Nm ³)	Boiler output	Between the reaction tower and bag	chimney inlet	EU 2000 emission standards
particulate matter	2410	5214	6	10
HCl	538	41.9	6	10
SO ₂	195	25.6	1.3	50
NO _x	130	128	126	200
CO	11.65	6.4	5.8	50
Dioxin (ngTEQ/Nm ³)	0.6	-	<0.03	0.1

Case Study 7 – Chongqing, China



Project scale: 2*600 t/d, 2*12 MW

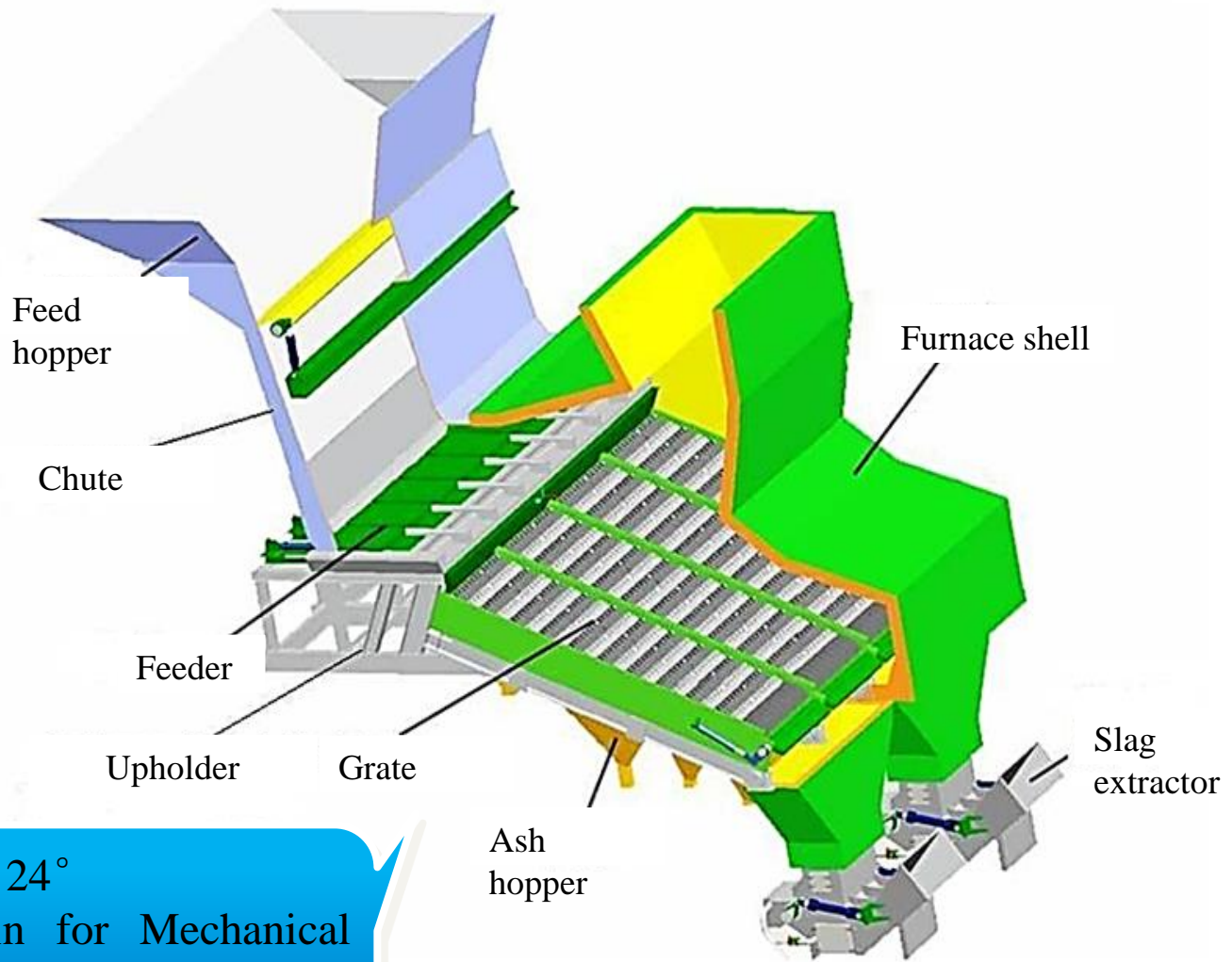
Running time per year: $\geq 8,000$ h

Capacity per year: 560,000 t

On-grid energy per year: 1.35 GHW

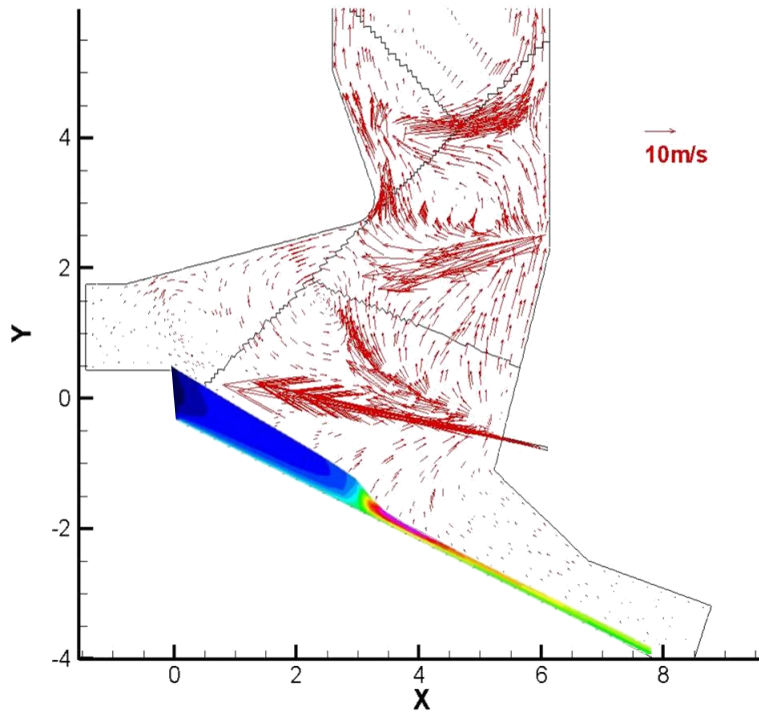
Tongxing municipal solid waste incineration power generation project (2*600t/d)

Incinerator model

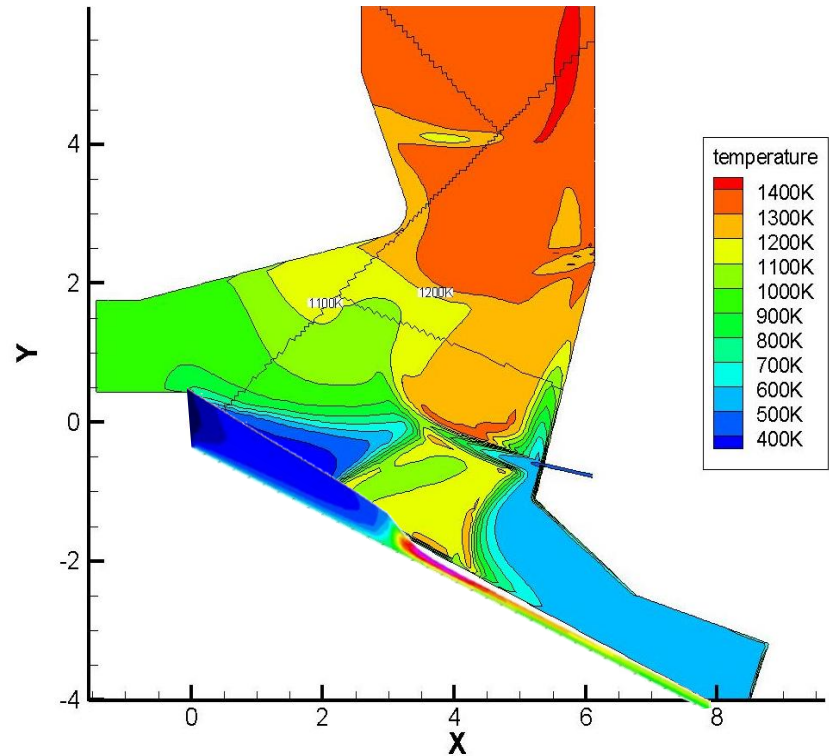


Furnace dip angle: 24°
Adaptation domain for Mechanical load and thermal load: 60-100% MCR

Combustion simulation



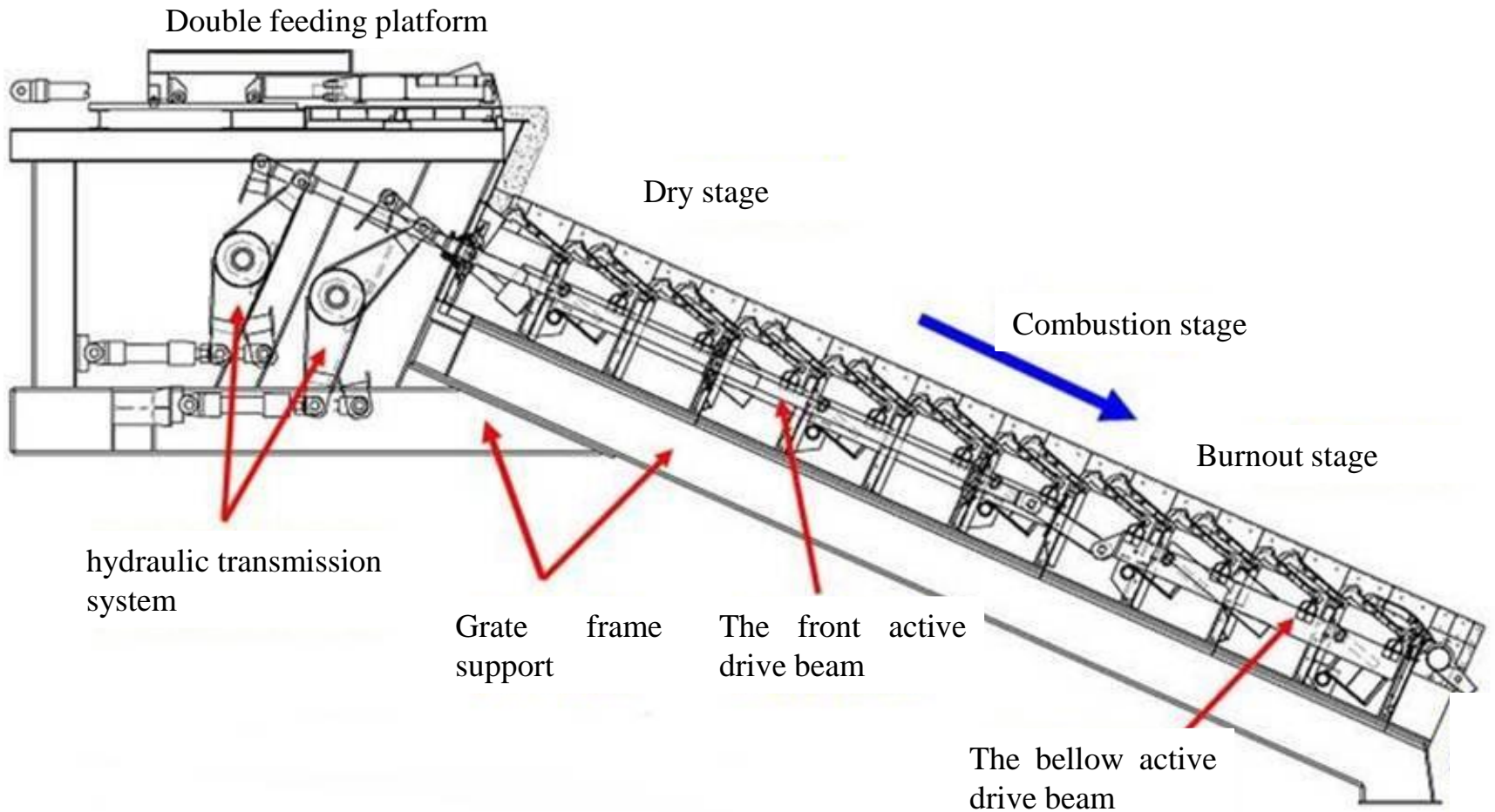
velocity field



Temperature field

Using CFD technology, and optimize the design of the furnace grate, ensure complete combustion, reduce pollutant emissions

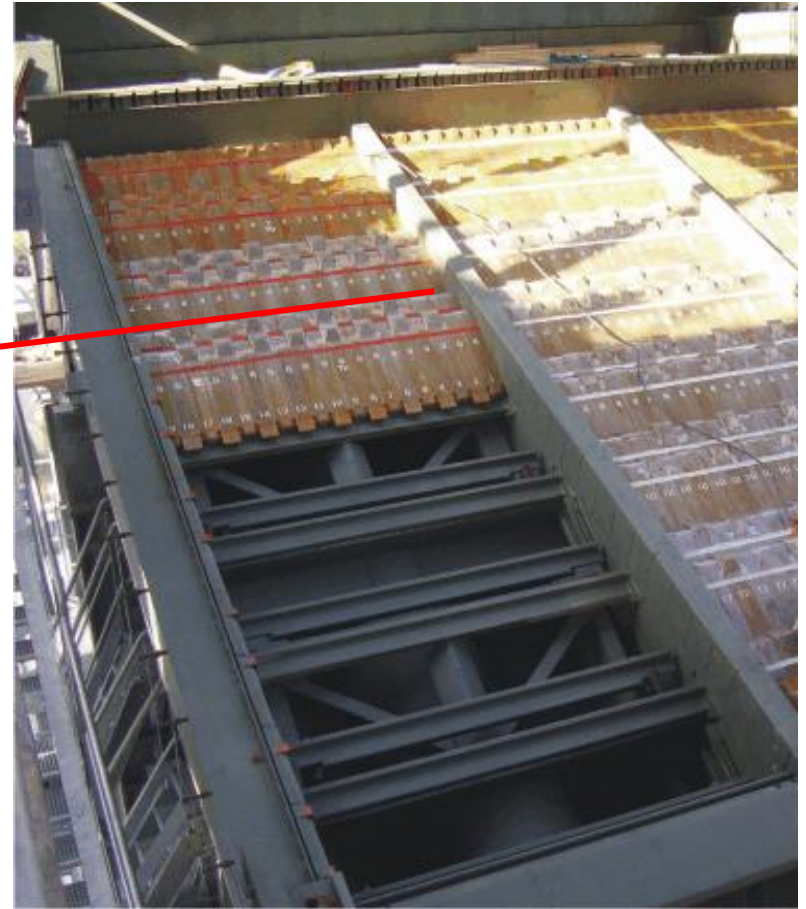
Grate system



Detail parts of grate



According to the grate material coefficient of thermal expansion, a reasonable set of static gap and the side wall of the grate



Online monitoring data

重庆川仪

成都九江环保发电有限公司烟气处理

2012-3-29 15:38:15

User: ADMIN1

石灰乳制备 活性炭系统 SNCR 布袋除尘器1 布袋除尘器2 布袋除尘器3 烟气分析 历史趋势 总貌画面

名称	测量值	单位	名称	状态
HCL浓度	4.2	mg/Nm3	HCL量程	0-50mg/Nm3
HF浓度	0.0	mg/Nm3	HF量程	0-5mg/Nm3
CO浓度	0.1	mg/Nm3	CO量程	0-100mg/Nm3
NOX浓度	120.9	mg/Nm3	NOX量程	0-300mg/Nm3
SO2浓度	18.6	mg/Nm3	SO2量程	0-100mg/Nm3
CO2浓度	12.2	%	系统维护	<input type="text"/>
H2O含量	31.2	%	系统维护请求	<input type="checkbox"/>
O2浓度	7.4	%	系统故障	<input type="text"/>
烟尘浓度	0.3	mg/Nm3	测尘仪维护	<input type="text"/>
烟气流量	51739.1	m3/h	测尘仪故障	<input type="text"/>
烟气温度	19035	℃	#1 焚烧炉 烟气分析	
烟气压力	3.1	KPa		
炉膛温度1	936.0	℃		
炉膛温度2	1097.	℃		

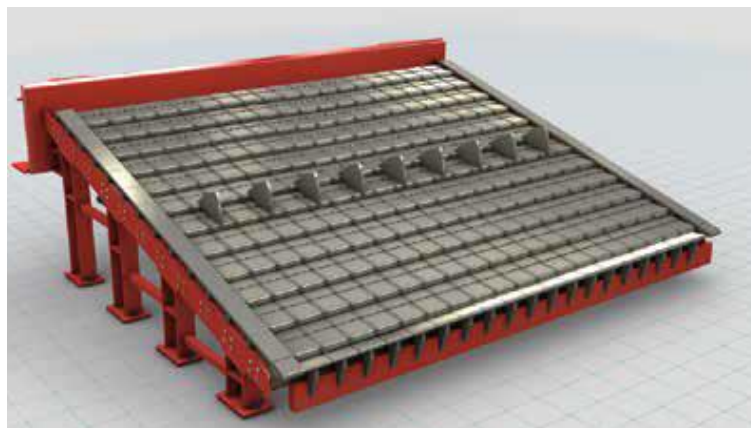
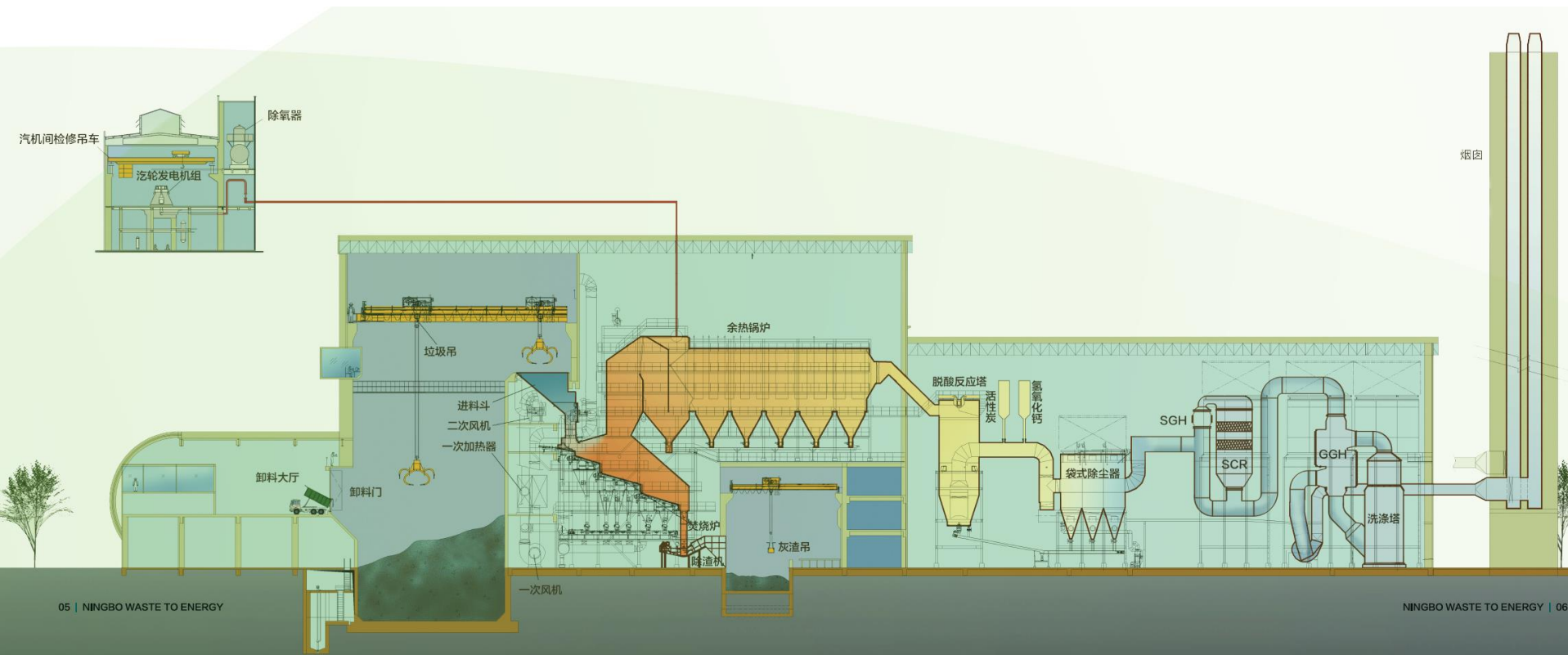
名称	测量值	单位	名称	状态
HCL浓度	1.4	mg/Nm3	HCL量程	0-50mg/Nm3
HF浓度	0.0	mg/Nm3	HF量程	0-5mg/Nm3
CO浓度	0.0	mg/Nm3	CO量程	0-100mg/Nm3
NOX浓度	145.6	mg/Nm3	NOX量程	0-300mg/Nm3
SO2浓度	11.8	mg/Nm3	SO2量程	0-100mg/Nm3
CO2浓度	8.5	%	系统维护	<input type="text"/>
H2O含量	20.7	%	系统维护请求	<input type="text"/>
O2浓度	6.1	%	系统故障	<input type="text"/>
烟尘浓度	0.3	mg/Nm3	测尘仪维护	<input type="text"/>
烟气流量	47250.0	m3/h	测尘仪故障	<input type="text"/>
烟气温度	136.7	℃	#2 焚烧炉 烟气分析	
烟气压力	2.9	KPa		
炉膛温度1	1022.	℃		
炉膛温度2	1126.	℃		

名称	测量值	单位	名称	状态
HCL浓度	1.2	mg/Nm3	HCL量程	0-50mg/Nm3
HF浓度	0.1	mg/Nm3	HF量程	0-5mg/Nm3
CO浓度	0.0	mg/Nm3	CO量程	0-100mg/Nm3
NOX浓度	166.5	mg/Nm3	NOX量程	0-300mg/Nm3
SO2浓度	4.2	mg/Nm3	SO2量程	0-100mg/Nm3
CO2浓度	10.4	%	系统维护	<input type="text"/>
H2O含量	24.4	%	系统维护请求	<input type="text"/>
O2浓度	14.3	%	系统故障	<input type="text"/>
烟尘浓度	0.4	mg/Nm3	测尘仪维护	<input type="text"/>
烟气流量	57442.7	m3/h	测尘仪故障	<input type="text"/>
烟气温度	139.4	℃	#3 焚烧炉 烟气分析	
烟气压力	2.8	KPa		
炉膛温度1	1032.	℃		
炉膛温度2	1007.	℃		

Zhejiang Ningbo WtE

Capacity: 2250t/d,
3 X750 t/d VonRoll Hitz moving grate
2X25MW steam Turbine





序号	污染物名称	单位	GB18485-2014		欧盟2010/76/EC			本项目环评要求		本项目运营目标值	
			日均值	小时平均	日平均值	半小时平均值 100% 97%		日均值	小时平均值	日均值	小时平均值
1	颗粒物	mg/Nm ³	20	30	10	30	10	10	30	3	5
2	HC1	mg/Nm ³	50	60	10	60	10	10	10	5	10
3	HF	mg/Nm ³	-	-	1	4	2	1	4	0.2	1
4	SO ₂	mg/Nm ³	80	100	50	200	50	50	100	5	10
5	NO _x	mg/Nm ³	250	300	200	400	200	75	75	50	60
6	CO	mg/Nm ³	80	100	50	100	150 ⁽²⁾	50	100	30	80
7	TOC	mg/Nm ³	-	-	10	20	10	10	10	5	
测定均值											
8	Hg及其化合物	mg/Nm ³	0.05		0.05			0.05		0.01	
9	Cd+T1及其化合物	mg/Nm ³	0.1		0.05			0.03		0.01	
10	Sb+As+Pb+Cr+Co+Cu+Mn+Ni及其化合物	mg/Nm ³	1.0		0.5			0.5		0.1	
11	二噁英类	ng-TEQ/Nm ³	0.1		0.1			0.08		0.01	

Grate incinerator summary

- The waste agitating and mixing are achieved by the mechanical motion of the grate, complete waste combustion is promoted and every furnace grate producer owns its characteristic design of the grate;
- A wide range of waste application, It can adapt to the high heat value waste in Europe, also be suitable for the low heat value waste with high water content in Asia, and the heat efficiency is low.
- Stable operation, and short maintenance time (2~3 days), equipment operating time up to 8000 hours or more;
- Equipment handling capacity of 100~700 t/d, suitable for large-scale waste treatment

Question?