High efficient multi-fuel CYMIC concept for biomass, rejects and coal for Hamburger Hungaria

28.4.2016

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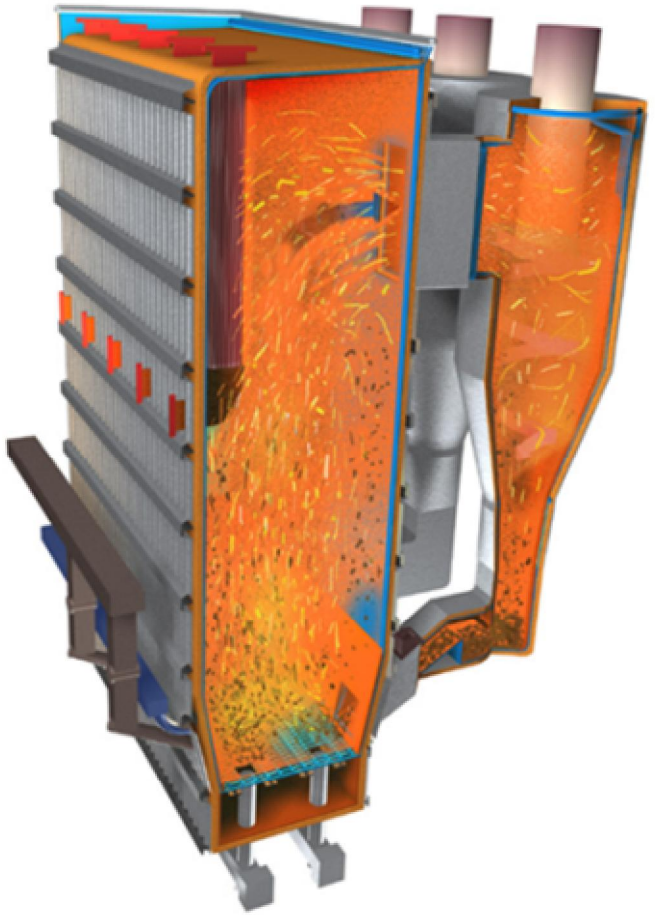
CYMIC – Multi-Fuel Design Concept: general and case example Hamburger Hungaria

Presentation outline:

- Fuel based challenges
- Solutions to selected challenges
- Fuel based CFB concepts
- Bio / Multifuel concept
  - Design features
- Case example: Hamburger Hungaria Power project
  - Design data
  - Design features
  - Main components
- Conclucions



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Fuel based challenges

Challenge field	FUEL				
	Fossil	Wood	Agro	Recycled wood	SRF
High temp corrosion	0	0...1	1	1	2
Mid temp corrosion	0	0	0	2	2
Cold end corrosion	0	0...1	1	2	2
Superheater fouling	0...2	0...1	2	1	2
Cold end cleaning	0	0	1	1	1
Bed agglomeration	0...2	0...1	2	1	1
Loop agglomeration	0...2	0...1	2	0	1
High bottom ash/debris flow	0...2	0...1	1	1...2	2
High fly ash flow	0...2	0	0	1	1
Back pass erosion	1	0	0	1	2
Emissions	1	1	1	1	1

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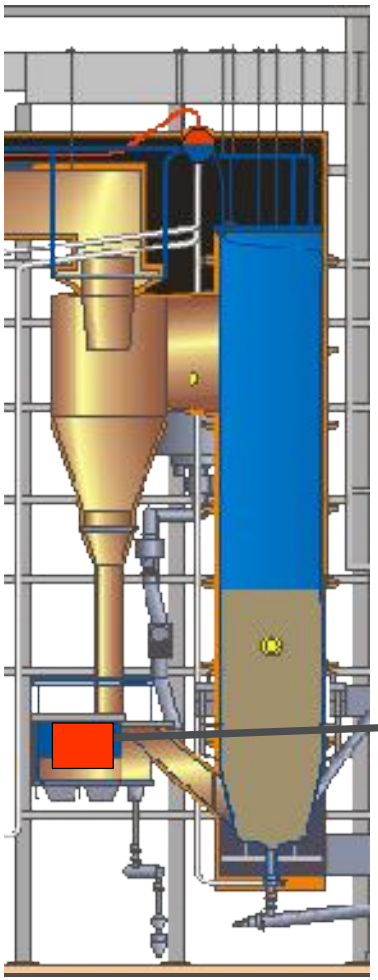
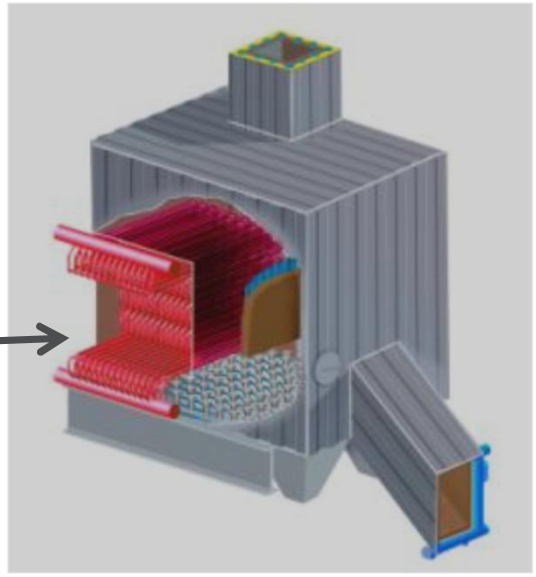
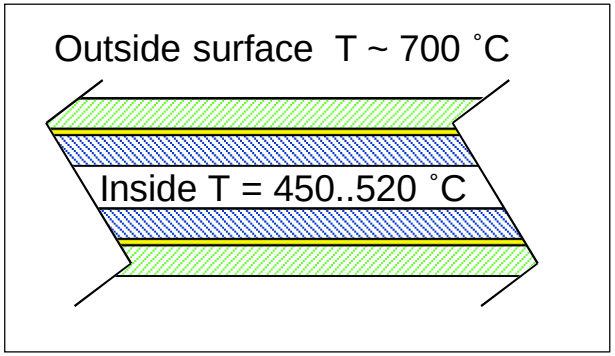
Challenge: High temp corrosion

Solution: Fluidized bed heat exchanger



- Final superheater is located in loop seal, effective gas flow isolation from both furnace and cyclone side
- Gas atmosphere is much less corrosive compared to furnace or back pass location
- Layered tube design for SRF applications to avoid alkali chlorine condensation





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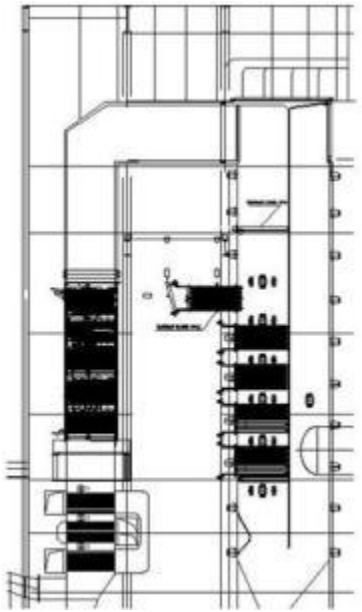
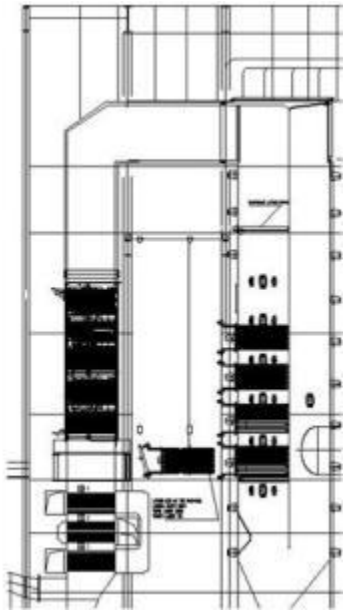
Challenge: Mid temp corrosion

Solution: Easily replaceable superheaters

- To minimize the downtime of the boiler when Pb induced corrosion cannot be fully prevented
- 5 days replacing time per bundle





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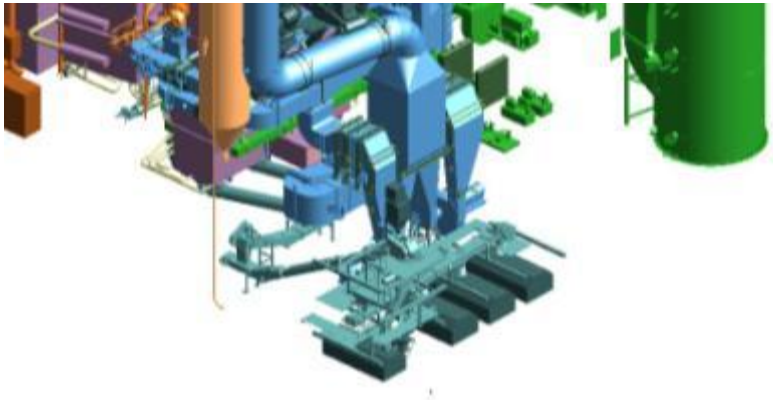
Challenge: High debris flow / bed agglomeration

Solution: Grid design and bed ash recirculation



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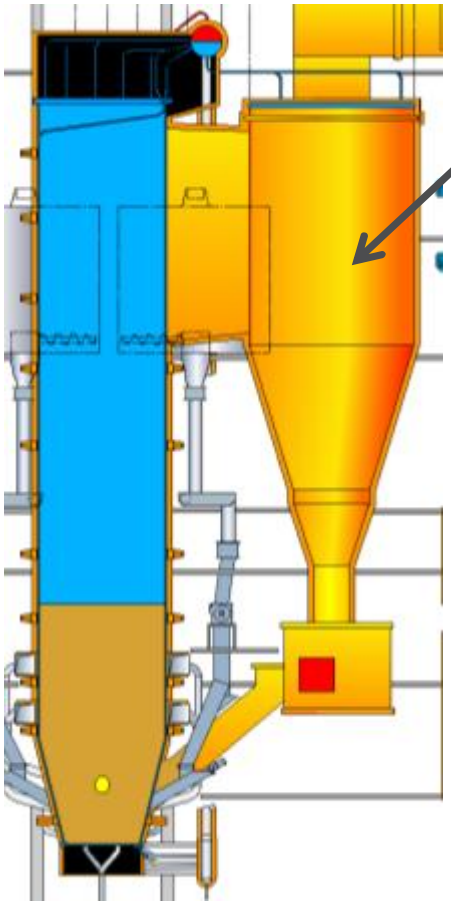
Challenge: Erosion / Emissions

Solution: Cyclone with high collection efficiency



Benefits of high collection efficiency:

- Fine particles stay in hot loop circulation:
  - Even temperature profile
  - High combustion efficiency
  - Low NOx
  - High inherent SO_2 capture by fuel alkalis
  - Low erosion in furnace and back pass (critical for PbCl induced corrosion/erosion)
- High bottom ash/fly ash flow ratio
  - Reduced dumping cost
- Minimized make-up sand consumption

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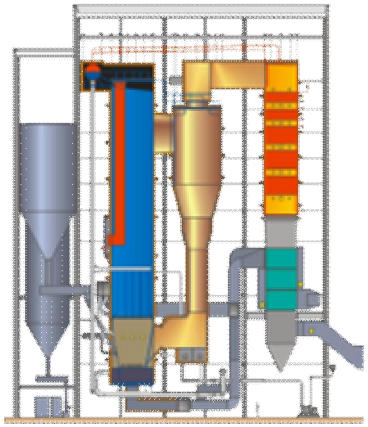
Fuel based CYMIC CFB concepts

Fossil

•Low solids
•High solids

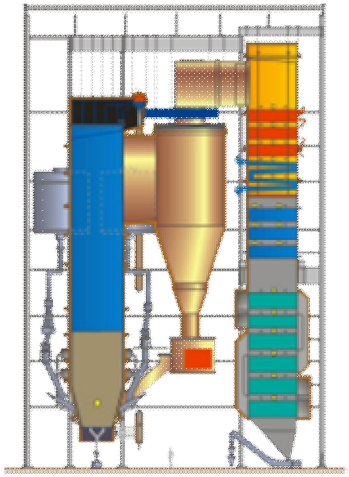


•100 - 1200 MW_{th}

•Max 565 C, 175 bar

Bio/Multi

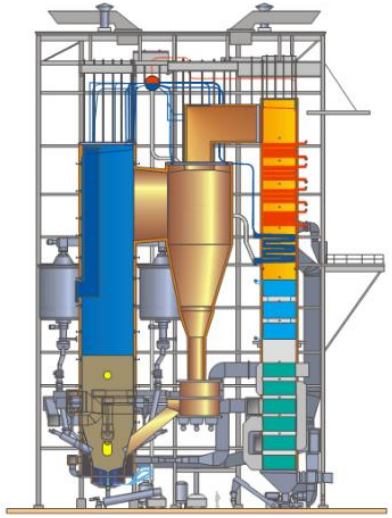
•Agro
•Wood
•Portion of SRF



•75 - 900 MW_{th}

•Max 545…565 C, 175 bar

Recycled Wood

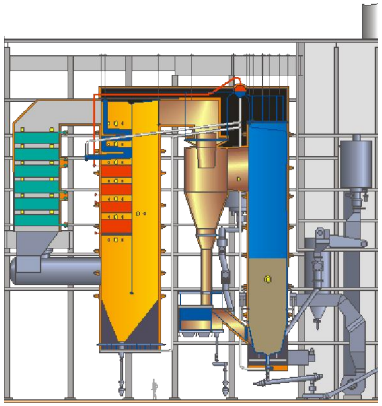


•75 - MW_{th}

•520...540 C / 90 bar

SRF

•Multifuel



•75 - 200 MW_{th}

•480 C / 70 bar… 520 / 90 bar

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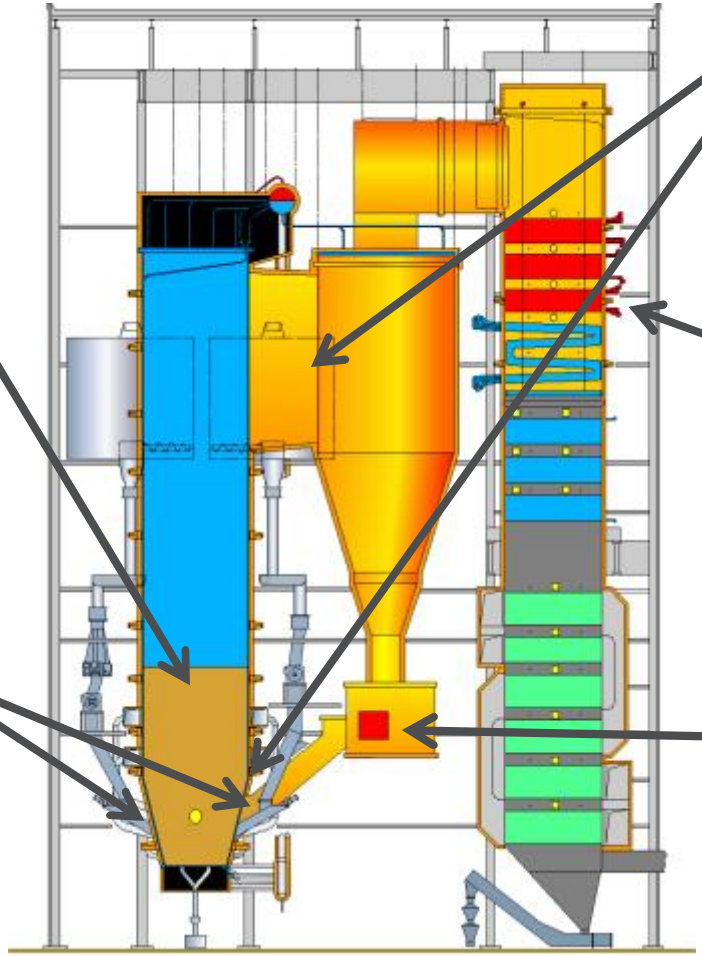
CYMIC for Bio / Multifuel

Special design features

Extended refractory in the furnace for WID compliance on 2 s in 850°C in waste co-combustion

Two wall fuel feeding for high reliability



Possibility for additive injection

Appropriate arrangement and spacing of the superheater surfaces against fouling and corrosion

Final superheater in the loop seal bed

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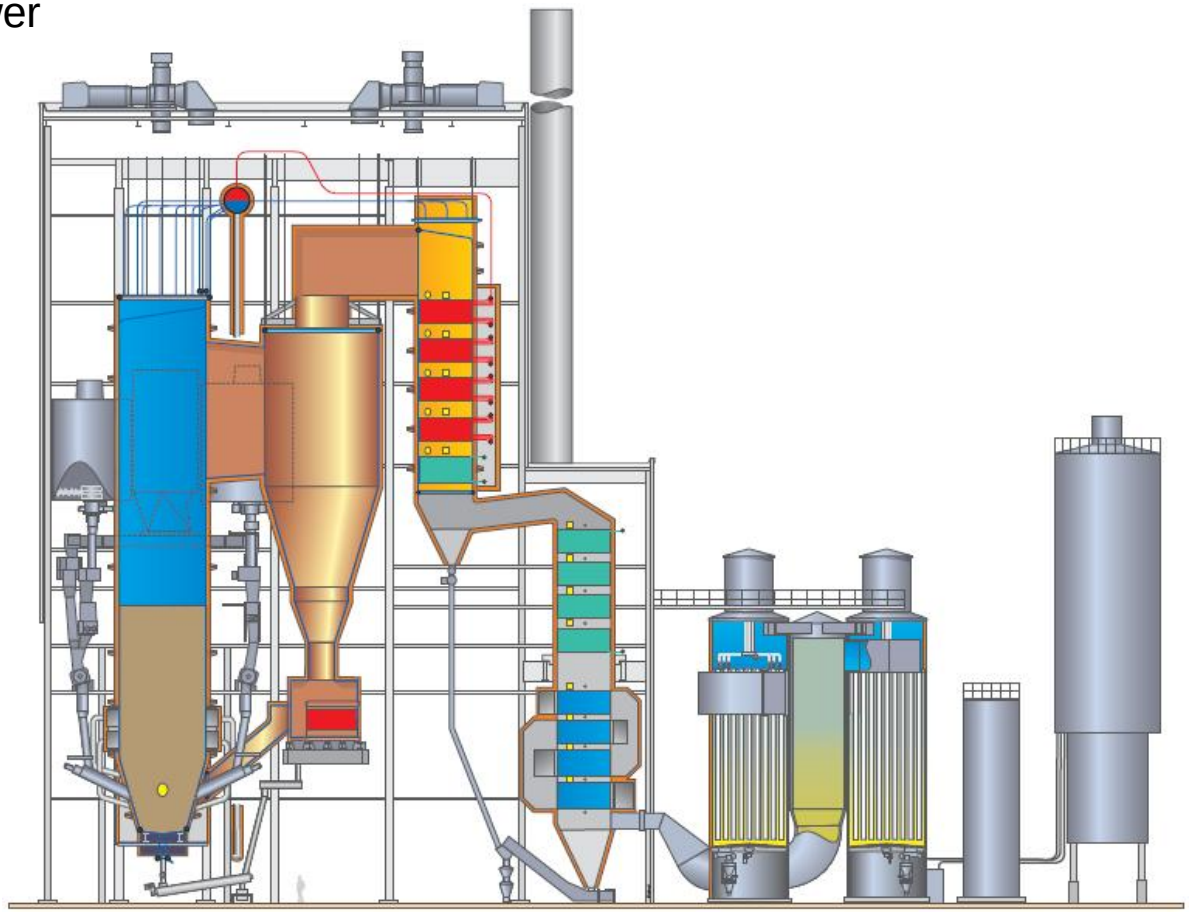
CYMIC boiler

Circulating Fluidized Bed (CFB) technology

Hamburger Hungaria Power
Dunaujvaros
Hungary

Steam	158 MW_{th} 62 kg/s 113 bar 520°C
Fuels	Biomass, coal, reject, sludge, biogas, RDF
Start-up	2015



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Hamburger Hungária Power, Dunaújváros, Hungary

Design fuels

CYMIC boiler - Circulating Fluidized Bed (CFB) technology

Type	Moisture %	LHV MJ/kg	Ash % of DS	Nitrogen % of DS	Sulphur % of DS	Chlorine % of DS	% of fuel heat input
Biomass	39	10	1,3				0 – 65
Coal	10	24	10				0 – 97
Rejects	42	13	9				0 – 18
Sludge	55	5	18				0 – 7
RDF	14	17	20				0 – 12
Biogas							3 - 8
Design ranges	44,2...5,0	9,6...28	...25	...1,5	...2,5	...0,3	
Natural gas				Start-up			

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Emission guarantees

CYMIC boiler - Circulating Fluidized Bed (CFB) technology

	mg/Nm^3
NO_x	200
SO_2	180
Dust	10
CO	50
HCl	50
HF	14
Cd+Tl	0,05
Hg	0,05
Sb+As+Pb+Cr+Co+Cu+Mn+Ni+V	0,5
Dioxins and furans, I-TEQ, ng/Nm^3	0,1
TOC	10

Values are at dry gas corrected to 6% O_2 (dry)

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Hamburger Hungária Power, Dunaújváros, Hungary

Description of Basic Components

Component	Dunaujvaros
Furnace	Extended lining
Grid	Directional nozzle
PSH	Back pass
SSH	Back pass
TSH	FBHE
AH	Tubular
Emission control	Limestone, SNCR, BHF, HL, AC
Corrosion management	Steam Data, FBHE (opt. Additive injection)

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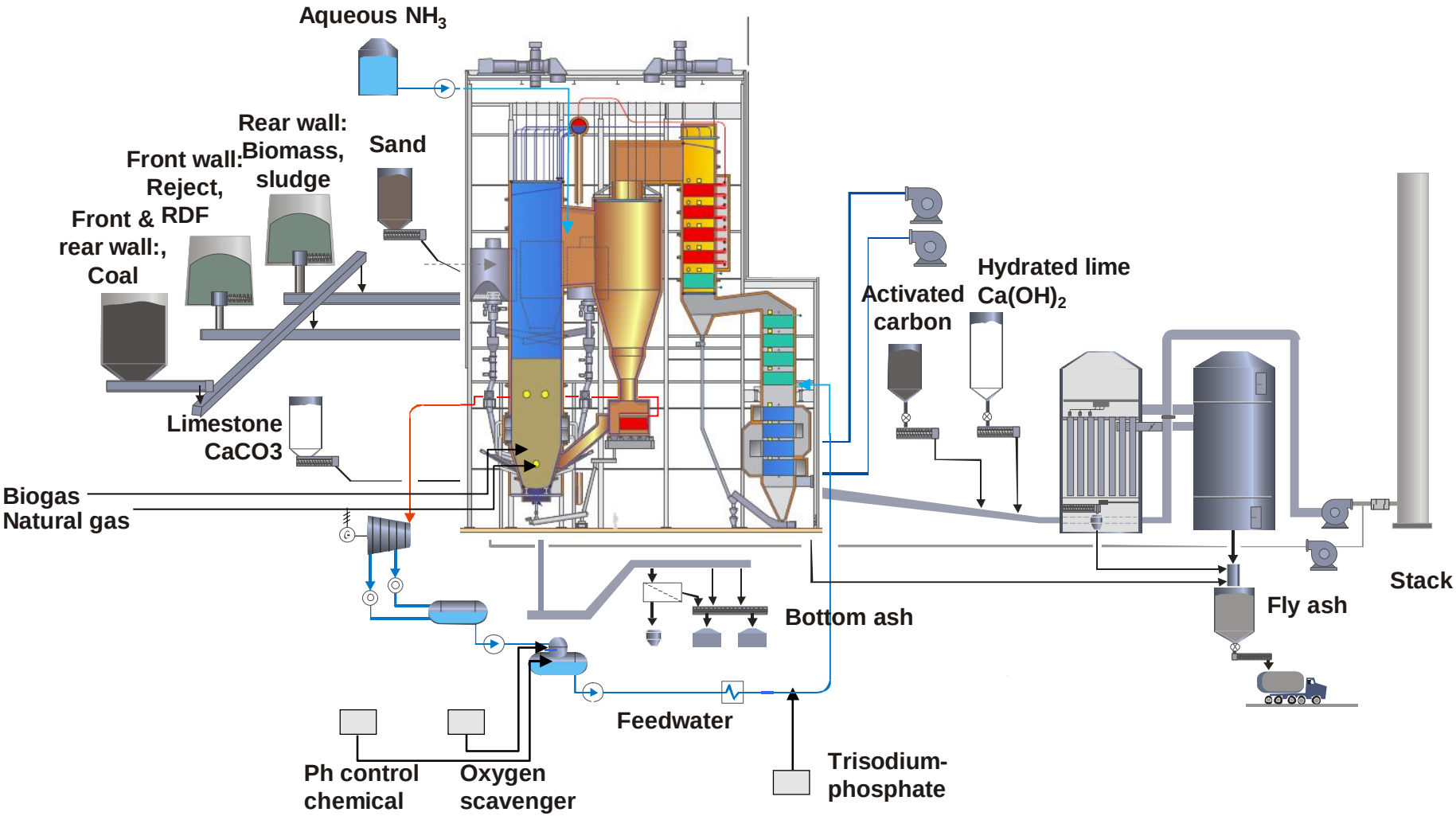
Hamburger Hungária Power, Dunaújváros, Hungary

Overview of the Plant Systems



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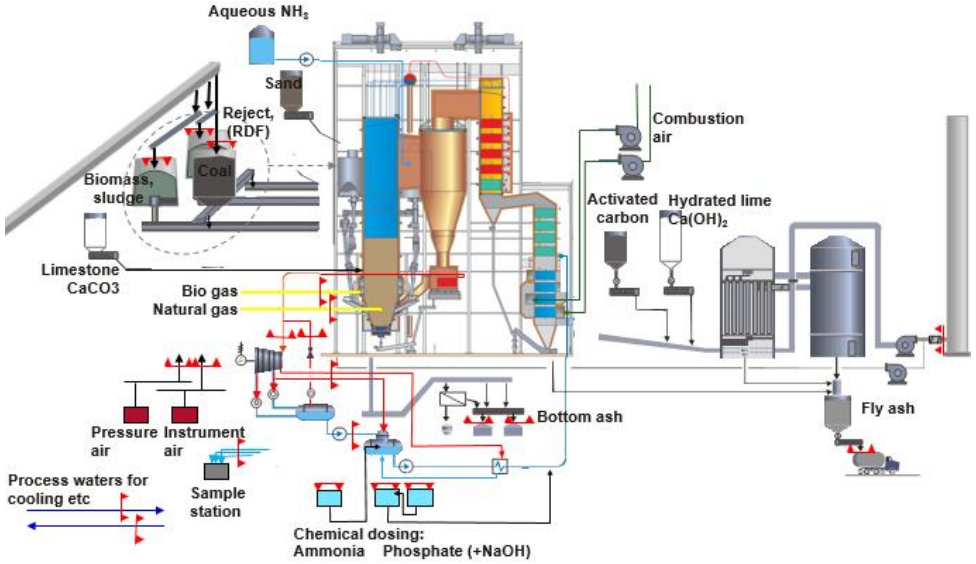
Main systems in boiler plant (1/2)

By Valmet's system definition

1. Feed water system
2. **Boiler water and steam system**
3. Sootblowing system
4. Blow down system
5. **Combustion air system**
6. **Flue gas system**
7. Flue gas treatment
8. Aqueous ammonia system
9. Limestone feeding system
10. N/A (Sulphur feeding system: not applicable)
11. **Solid fuel feeding system**
12. Sand feeding system
13. Bottom ash system
14. Fly ash system
15. Auxiliary fuel systems
16. Cooling and service water systems
17. Boiler plant safety systems
18. Compressed air and instrument air system
19. Civil construction
20. Auxiliary steam systems
21. Sampling and analyzing system
22. Chemical dosing system
23. Ventilation system



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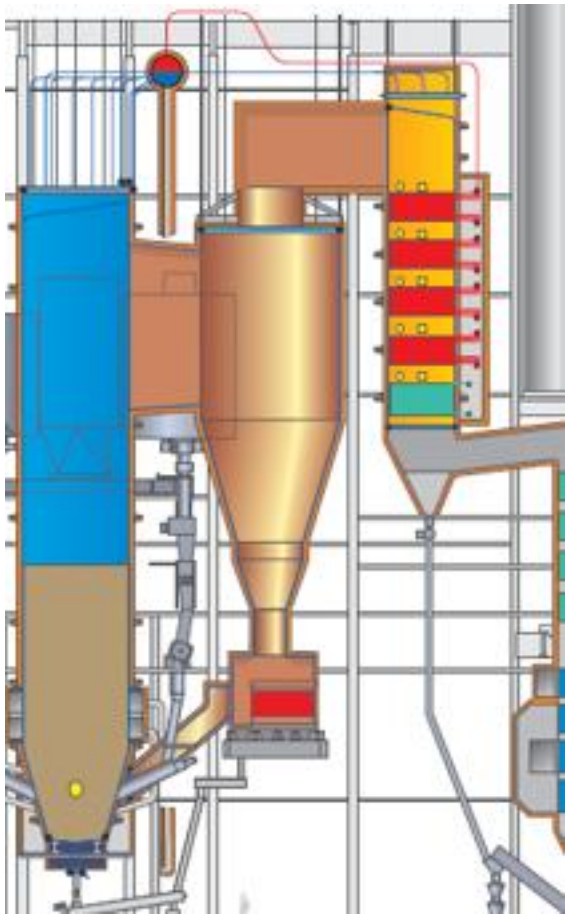
2. Boiler water and steam system

- Economizers (5 pcs), bare tube
- Steam drum
- Steam generator:
  - furnace walls (inc. refractory)
  - loop seal + cyclone walls (incl. refractory)
  - 2nd pass walls
- Primary (2 pcs), Secondary (2 pcs) and Tertiary superheaters (1 pc)
- Steam attemperators (3 pcs in 2 stages)



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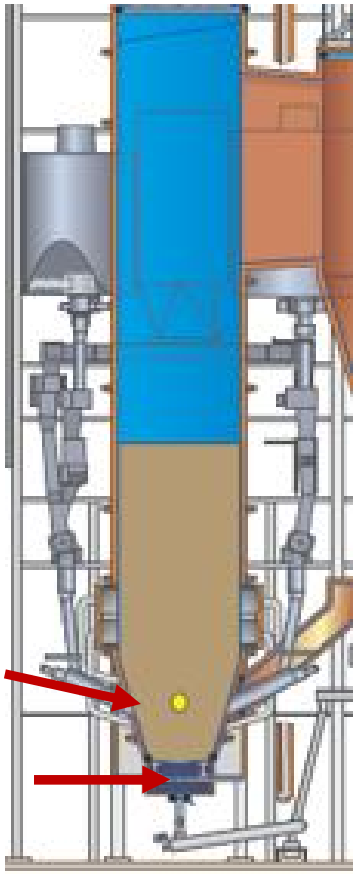
5. Combustion air system

Primary air

- Primary air fan (1 pc)
  - Combustion (fluidizing) air
  - Fuel feeding air (cooling, purging, sealing)
- Steam coil primary air preheater
- Flue gas air preheaters (2 pcs)

Secondary air

- Secondary air fan (1 pc)
  - Combustion (staging) air
  - Combustion air to start-up burners
  - Combustion air to gas lances
  - Sand feeding air (purging and cooling)
- Steam coil primary air preheater
- Flue gas air preheaters (2 pcs)



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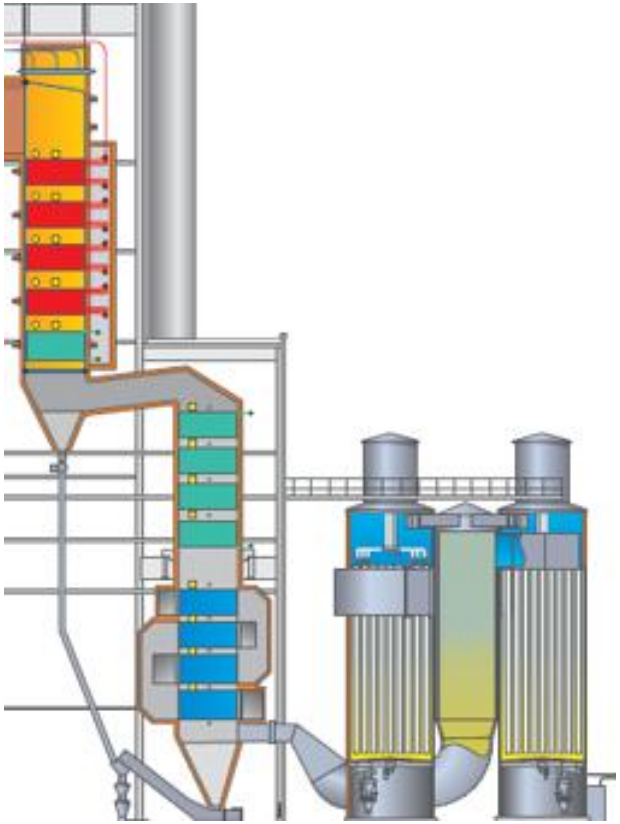
6. Flue gas system

- Furnace
- Cyclone and Loopseal
- Manifold duct
- 2nd pass
- 3rd pass
- Flue gas ducting and dampers
- Bag House Filter (BHF)
- Flue gas (induced draft) fan (1 pc)
- Flue gas recirculation fan (1 pc)
- Recirculation gas ducting and nozzles
- Stack and CEMS (not by Valmet)



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11. Solid fuel feeding system

Front and rear wall

Reject + RDF (yellow):

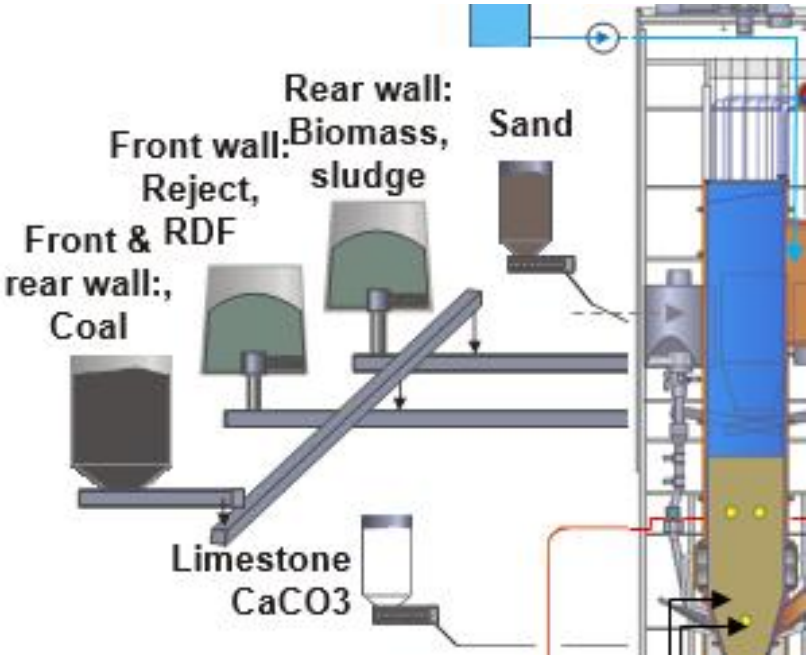
- Feeding to front wall

Biomass + sludge (brown):

- Feeding to rear wall
- Reject silo can also be utilized to bio/sludge feeding

Coal to front and rear wall (red)

- Dedicated feeding in front wall, common feeding system in rear wall with bio



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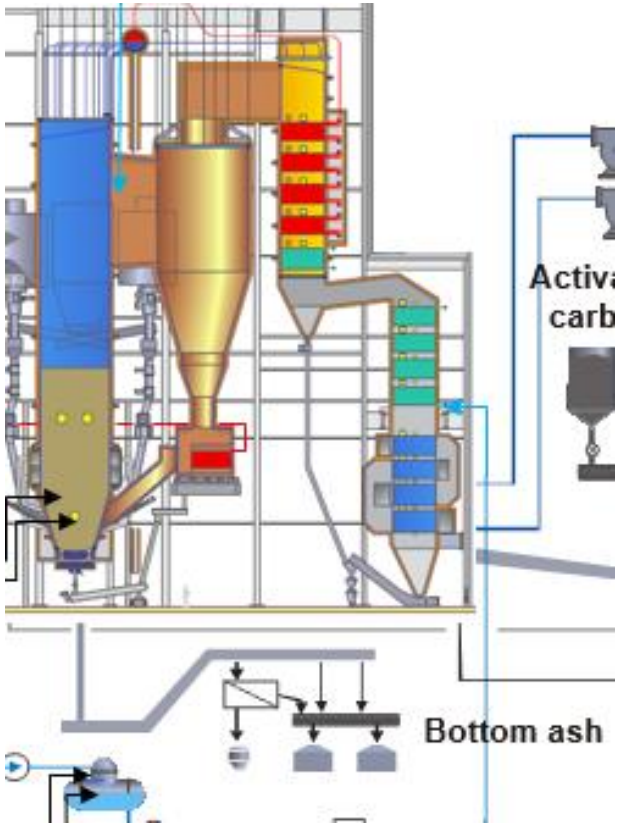
13. Bottom ash system

Bottom ash:

- Bottom ash hoppers
- Water cooled screws
- Drag chain conveyor

Bottom + loopseal ash handling, recycling and discharging:

- Magnet with a drop pipe for separated metal particles
- Sieve
- Pneumatic transmitter for sieved returnable bed material (fines)
- Discharge conveyor to containers



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Conclusions

- Fuel based CYMIC CFB concepts have been created to
  - Fossil fuels
  - Bio / Multi Fuel
  - Recycled Wood
  - SRF
- CYMIC for Bio/Multifuel in Hamburger Hungária Power, Dunaújváros, Hungary plant has proven it's performance
  - Taking over of the boiler 22.3.2016
- Key design features in multifuel concept are:
  - High efficiency cyclone for good emissions and low erosion rate
  - Robust fuel feeding and bottom ash equipment
  - Sophisticated final superheater design

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