

BIOMASS CO-FIRING

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1. Background

Combustion Technologies in Fortum

- Expertise, solutions and products related to different kind of combustion and fuels related issues at power plant
- Know-how and products on low-NO_x systems for pulverized hard coal, peat, biomass and oil&gas fired boilers
- Biomass co-firing solutions for pulverized fired boilers
- Design, project and site operations, commissioning, operation and maintenance, warranty inspections and repairs and after sales services
- Combustion consultancy such as boiler performance analyses, combustion process optimization and operation load range improvements
- Feasibility studies and tailor-made solutions
- Analyses and recommendations on suitability of new fuels

Fortum expertise

- Problem mitigation and trouble shooting including:
 - Start-up and ignition systems and other auxiliary equipment
 - Slagging, fouling and high temperature corrosion
 - Combustion system and burner upgrades
- Solutions for wall and tangential firing system including over fire air system
- Computational modeling of combustion (CFD)
- Patented & licensed technology
- Co-operation with Japanese Babcock-Hitachi
- In-house expertise inside Fortum group
- More than 600 low-NO_x burners delivered

Low-NOx co-firing project in Poland



2. General

Project Overview

1. Fortum scope

- Feasibility study
- Dual-fuel low-NOx burners (16 pcs) equipped with biomass co-firing possibilities + OFA air system
- Control principle for biomass co-firing
- 100% coal firing (345 MW_f) and 35% by fuel biomass co-firing (121 MW_f)
- Different biomass qualities (wooden biomass – agro biomass)
- Fortum was responsible for emissions, boiler behaviour and boiler efficiency and also gave warranties on those items

2. Client's scope

- Boiler silo and feeding silos for each burner level and related equipments
- Biomass receiving station and storage silos
- Biomass crushers

Basic feature of the biomass installation

- Biomass share 35 % by fuel = 121 MW_{fuel}
- Biomass mass flow 7-9 kg/s (25-33 t/h)
- Biomass volume flow (after mills) 70-90 m³/h
- Biomass heating value 15-18 MJ/kg
- Biomass bulk density after the mills 300-400 kg/m³

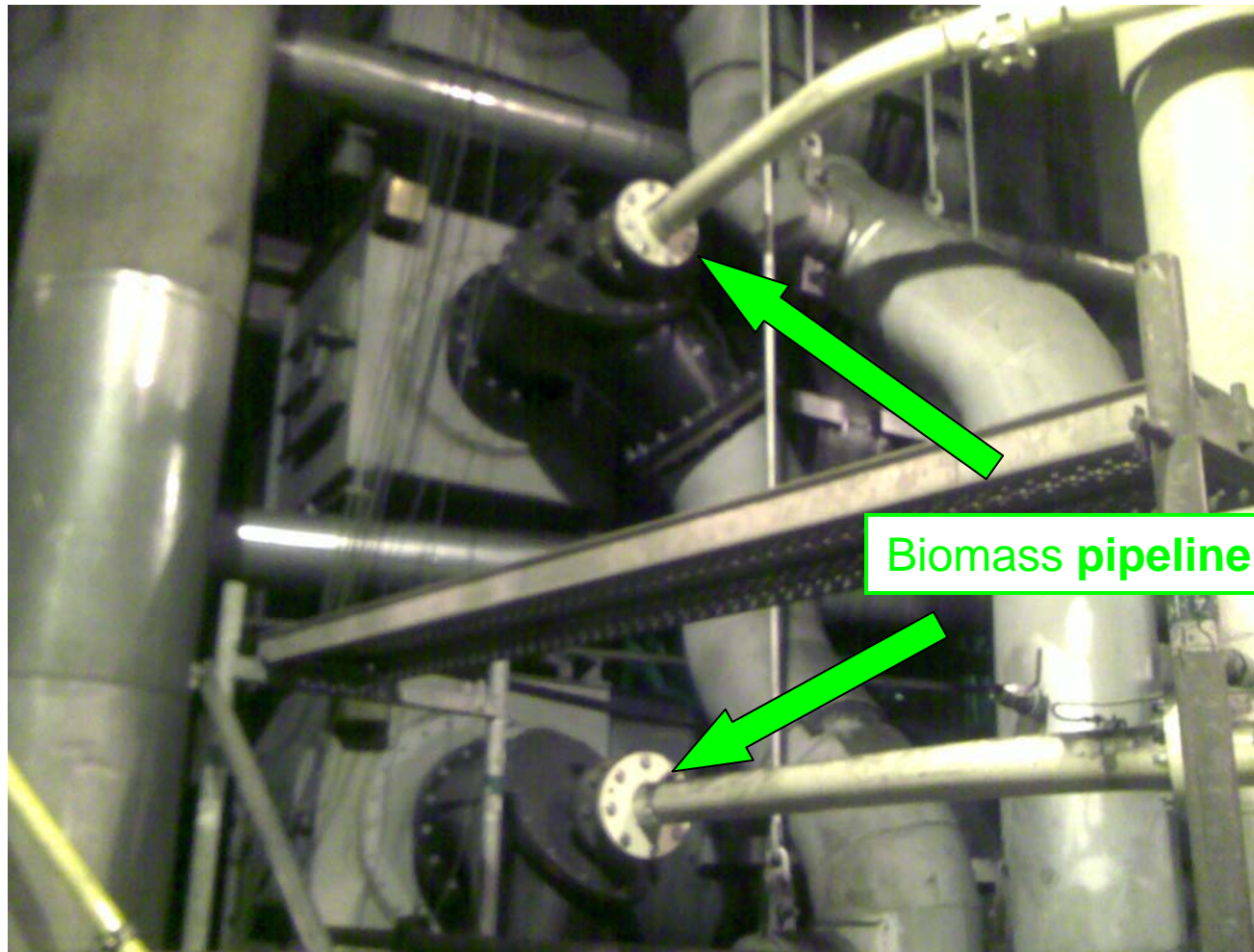
3. Biomass handling

Biomass handling

The following installation includes in the biomass handling system:

- Biomass receiving station
- Biomass storage silos
- Biomass crushing with hammer mills
- Biomass transportation from the mills to the boiler
- Biomass feeding from the boiler silo to the burners

Dual-fuel burners for co-firing coal and biomass



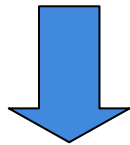
4. Biomass quality at design phase

Biomass quality 1/2

		Wood pellets	Straw pellets	Sunflower husk pellets	Rapeseed pressing
Moisture	%	9,82	11,05	7,46	13,36
Ash, dry	%	1,0	6,6	3,4	8,0
Nitrogen, N	%	< 0,1	0,8	0,9	6,5
Sulphur, S	%	0,0078	0,13	0,13	0,74
Chlorine, Cl	%	0,004	0,17	0,095	0,065
Sodium, Na	%	0,001	0,011	0,001	0,04
Potassium, K	%	0,030	0,75	0,73	1,0
Lower heating value, LHV	MJ/kg	18,1	16,2	17,9	15,2

Biomass quality 2/2

- Wooden biomass:
 - Low Cl-content
 - Low Na and K-content
- Agricultural waste:
 - High Cl-content
 - High Na and K-content



Risk for slagging, fouling and corrosion

5. Commissioning

Commissioning of the biomass system

- Biomass system commissioning was done during the autumn 2010
- Biomass feeding system at boiler house was commissioned till the end of October
- Commissioning and optimization of the biomass combustion system were carried out in November
- Biomass quality during the commissioning and warranty tests: wooden biomass and sunflowers
- Both fuels were burned alone and in a mixture
- Maximum continuous biomass share 40 % by fuel basis (both wooden biomass and sunflowers)

Flame stability and boiler behaviour

- Flame was very bright and stable at biomass co-firing
- Boiler behaviour was normal
- Spray water amount to the SH and RH sections was slightly increased
- Flue gas temperature after LUVO was slightly increased
- No slagging and fouling was observed during the commissioning of the biomass system

6. Summary

Summary

- 20-40 % coal was substituted with biomass (wood and sunflower) by energy basis successfully
- NOx emission was decreased 20-30 %
- NOx emission values 220-270 mg/m³n were reached with biomass co-firing
- UBC in the fly ash was same or even reduced with biomass co-firing
- Boiler behaviour was normal
- Slight increase in spray water flow to SH/RH sections
- Flue gas temperature after LUVO was increased slightly
- Important is to control the combustion by burners and have a suitable mix of different kind of biomasses