Adaption of Large-Scale Biomass CHP Into Future Energy Market - 29 MW_{th} Biomass CHP Kufstein (Austria) as Example for Transformation from Power-Oriented to Heat-Oriented Operation

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Introduction & Background

The current decoupling of economic framework of biomass CHP plants from the electricity stock market will expire stepwise from 2017 onwards according to Austria's green electricity act. Consequently, biomass CHP facilities are forced to compete with low market prices for electricity in the future and therefore novel and innovative operation concepts for biomass CHP plants are required. The contribution describes the design and operational concept for a bioenergy integrated system, which was implemented in 2014 at the biomass CHP Kufstein.

CHP Kufstein – Overview & Facts

The CHP Kufstein is under the ownership of Stadtwerke Kufstein and Tiroler Wasserkraft AG (TIWAG). The facility with a fuel power of 29 MW_{th} went into operation in 2004 and was previously operated as power-oriented CHP with a nominal power of 6.5 MW_{el}.

- boiler manufacturer: Bertsch
- grate firing/system: Danish Energy Systems
- SNCR-Equipment: Mehldau & Steinfath Umwelttechnik
- nominal steam capacity: 29 t/h at 65 bara und 450 ˚C
- biomass fuel input: 28,5 MW_{th}

- the CHP's grate furnace is fuelled with a mixture of biomass with an overall water content from 45 to 58 $\%_{w.b.}$:
  - 30-50 wt.-% wood chips
  - 30-40 wt.-% bark/forestal wood chips
  - 20 wt.-% sawdust

former plant operation

- power-oriented plant operation
- extraction condensing turbine with nominal power of 6.5 MW_{el}
- max. heat extraction of 15 MW_{th}
- typical operational boiler load range from 28 - 31 t/h

after adaption

- heat-oriented operation
- back-pressure turbine with maximal power of 5 MW_{el}
- max. heat extraction of 18 MW_{th}
- load range from 12 (40%) to 31,5t/h
- <u>novel combustion control system (BCS)</u>

Objectives, Adaptions & Operational Results

- extension of operational load range of the boiler towards minimal load of 40% (12 t/h)
- adaptation of operational mode of the plant towards heat-oriented operation
- combustion/boiler control system to realize high dynamic and frequent load change of the heating grid

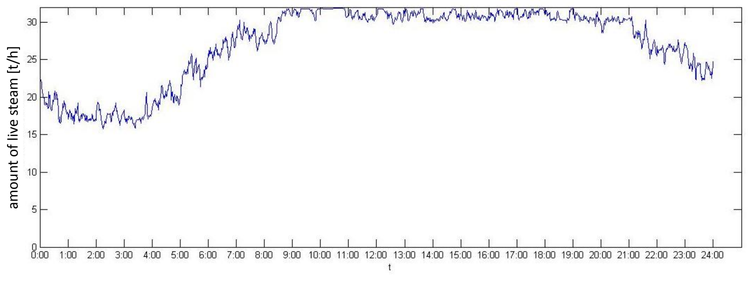

Fig. 1: 24-hours trend of boiler load/live steam supply according to heating grid demand for typical weekend day in January 2015 (heating period)

- partially retrofitting of the combustion system, e.g. by modification of the secondary air nozzles, distribution of recirculation gas, adaptation of grate hydraulics for flexible movement (speed and lift) of grate zones for part load operation
- modification in the water/steam-cycle, e.g. by integration of a feedwater bypass around the economizer to keep primary air preheating and exhaust gas temperature at part load operation
- modification of the basic automation, e.g. to realize the heat-oriented operation by control of back-pressure of the turbine
- implementation of a novel combustion control system (BiomassControlSolution) by **VOIGT+WIPP Engineers GmbH**, to keep constant process values:
  - live steam pressure
  - combustion temperature
  - position of combustion flame front

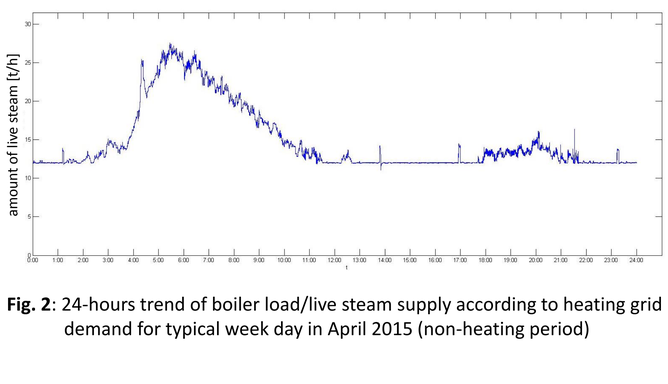

Fig. 2: 24-hours trend of boiler load/live steam supply according to heating grid demand for typical week day in April 2015 (non-heating period)

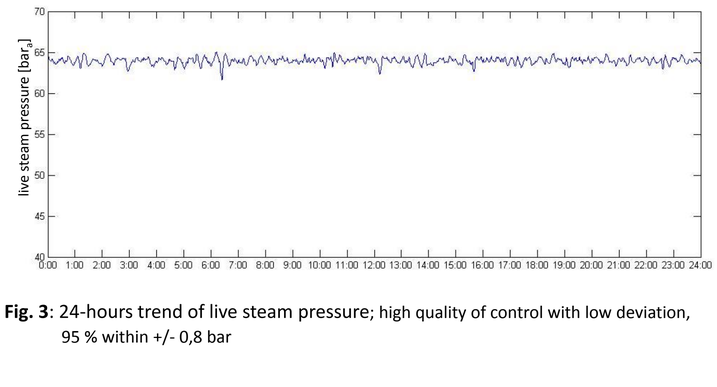

Fig. 3: 24-hours trend of live steam pressure; high quality of control with low deviation, 95 % within +/- 0,8 bar

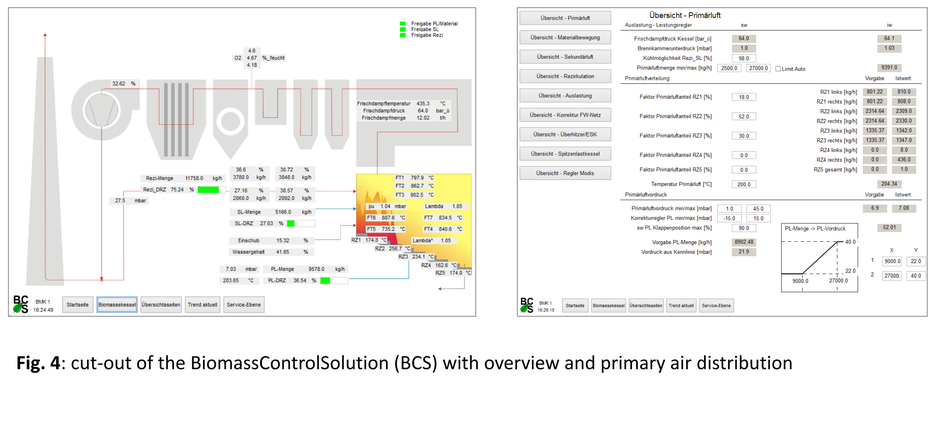

Fig. 4: cut-out of the BiomassControlSolution (BCS) with overview and primary air distribution

Conclusion & Summary

- successful adaptation to heat-oriented operation according to the demand of the heating grid
- dynamic and stable boiler operation within the boiler limitations (e.g. live steam supply, live steam temperature)
- optimized combustion conditions by enhancement of secondary air recirculation gas supply/injection
- operation of the turbine within the manufacture specifications (e.g. live steam temperature at part load of 40 %)
- the minimal superheater temperature is kept by the controlled operation of the boiler
- keep limit values for: carbon monoxide (CO) below 100mg/mN^3 @ 13v-% O2) and nitrous gases (NOx) below 80mg/mN^3@ 13v-% O2)

Acknowledgment

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