SRF Co-combustion at RWE

Recofuel Workshop

Hürth 29.05.2008

Franz-Josef Kipshagen, Bernhard Röper

RWE

The energy to lead

SRF Co-combustion at RWE

Outline of the presentation

- Co-combustion of secondary fuels in the RWE Power plants
  - Locations with SRF Co-combustion
  - Co-combustion in lignite fired power plants
  - Secondary fuels: properties and preconditions

- Test facilities for the Recofuel project
  - Description of the boilers
  - Installations for the tests with SRF
  - Operational results

- Summary of the operational experiences and perspectives

Co-combustion of secondary fuels derived from mixed solid wastes

Power plant locations of RWE Power AG

SRF *
MBM

SRF *
MBM, Sewage Sludge

SRF *
Sewage Sludge

Different lumpy mixed solid wastes

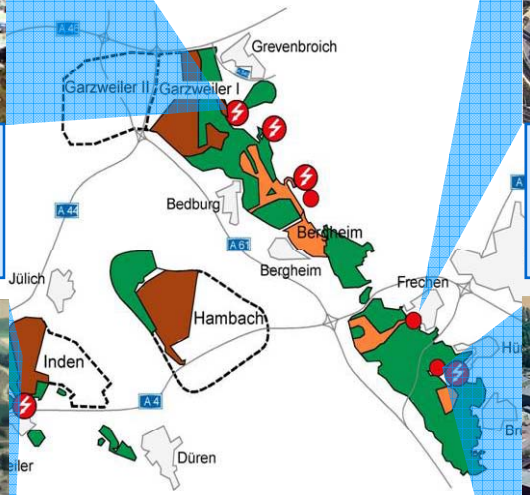
* **SRF** = **S**olid **R**ecovered **F**uels

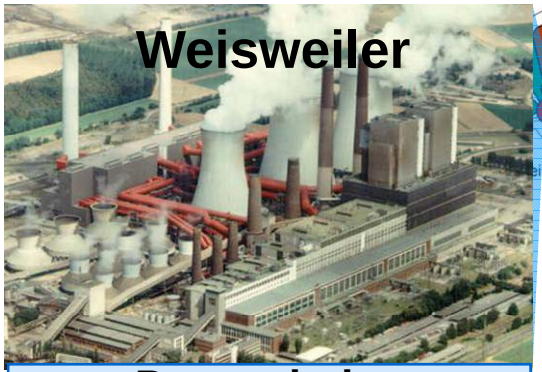
Co-combustion in lignite - fired power plants

Power plant locations of RWE Power AG

Paper sludge

Sewage sludge





Paper sludge
Sewage sludge
SRF * (Test)

Permitted Capacity: ca. 1,4 Mio. t/a

Sewage sludge
SRF *

* **SRF** = **S**olid **R**ecovered **F**uels

Characterization of lignite and secondary fuels

		Run-of-mine lignite	Paper sludge	Sewage sludge	SRF (SBS1)
Moisture	**% wt**	**51 - 58**	**45**	**70**	**30**
Ash	**% wt**	**2 - 5**	**24**	**15**	**10**
Combustible	**% wt**	**44**	**31**	**15**	**60**
LHV	**kJ/kg**	**8.000 - 10.200**	**ca.3.800**	**ca. 1.700**	**ca.14.000**
Biogenic share	**% C**	**-**	**98**	**99**	**ca. 60**
Chlorine	**mg/kg db**	**300**	**400**	**1.200**	**4.000**

Reference Values

Some Advantages of the co-combustion in power plants

- Saving of primary energy
  - Combustion of SRF in power plants with high efficieny (high steam parameters)
  - Saving of fossil fuels (CO_2-reduction and preservation of resources)
  - Also secondary fuels with low heating value can be used for energy production (sewage sludge, paper sludge)
- Economical advantages
  - Waste incineration is more expensive
  - Shortage in waste utilisation can be solved
  - Efficient energy use without subsidy
- Environmental effects
  - New emission limits are lower than the standard emission limits
  - Operational emissions are in the normal range or lower

Difficulties with secondary fuels

- Lumpy or granular secondary fuels are difficult to grind

  => problems in PC firing systems => preferable use in CFB boilers

- Secondary fuels contain normally more impurites and higher ash contents than fossil fuels

  => increased wear => increased costs for maintenance and trouble shooting

- Secondary fuels mostly have an increased chlorine content and a low ash melting point

  => Some power plants (not RWE), which co-combust SRF, have serious problems which slagging, fouling and chlorine corrosion

  => at RWE Power this issue has been studied in detail since many years

- **The technical feasibility of co-combustion must be investigated for each secondary fuel individually with respect to the boundary conditions on site**

Preconditions for the co-combustion of secondary fuels in power plants

- Production and availability at the power plant must be assured at any time
- Authorisation procedure for a permission to use secondary fuels
  - Public procedure with Environmental Impact Assessment
  - New Emission Limits (17.BImSchV, max. 25%-share of Heat Input)
- Economic boundary conditions
  - RWE Power uses secondary fuels only in combination with an additional payment
  - This addititonal payment is necessary for the investment and for the additional operational costs
- Note: the co-combustion of secondary fuel is only a small additive business compared to the production of electricity

SRF Co-combustion
at the Weisweiler Power plant

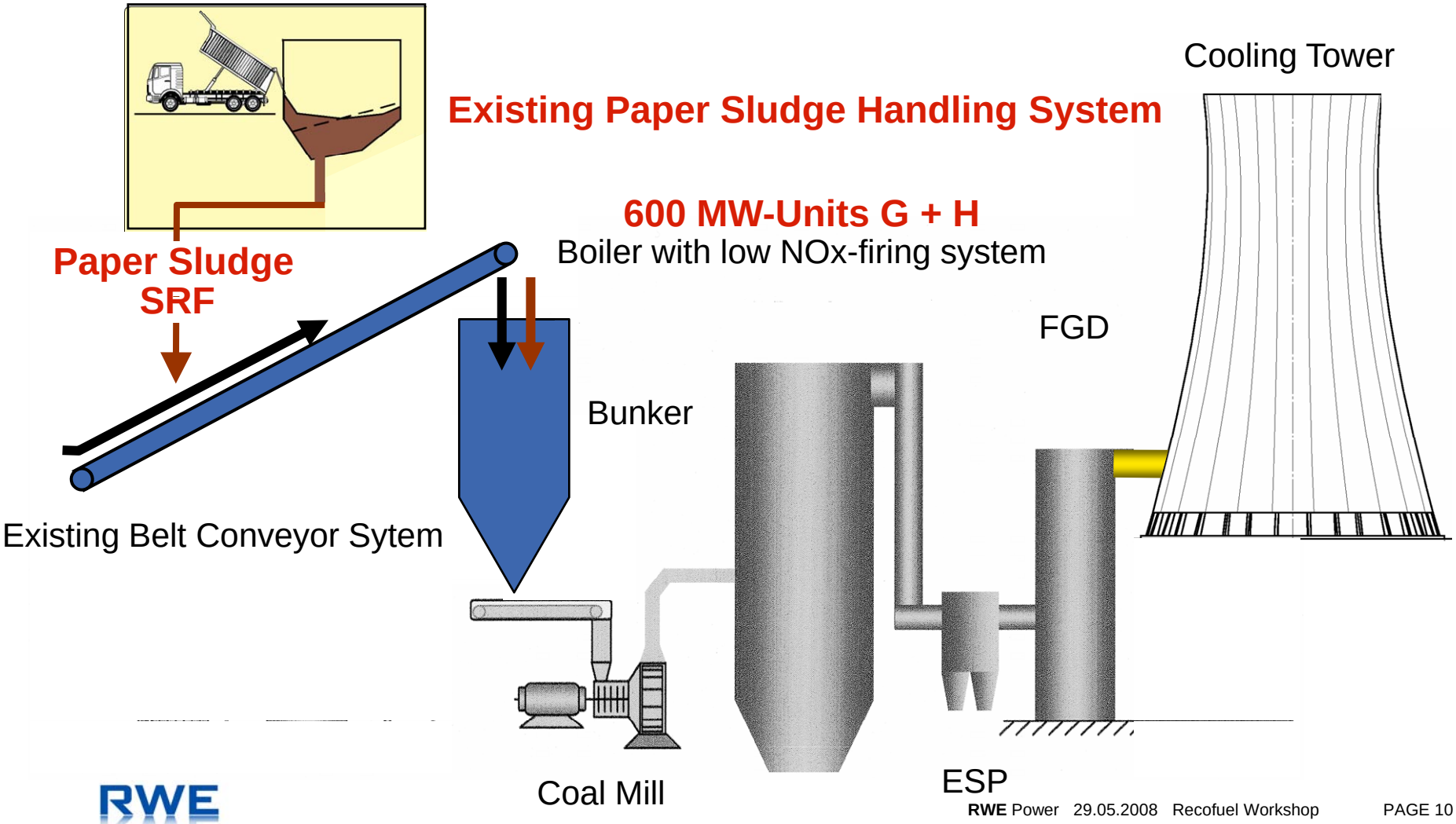
Pulverised fuel firing system

2 x 600 MW el

RWE The energy to lead

Co-combustion of SRF at the Weisweiler Power Plant

Process scheme: Unloading – Firing system – Flue gas treatment



Weisweiler Power plant

Existing Paper Sludge Handling System for discharge and metering

Steam generator
Unit G +H, Weisweiler
Sectional view

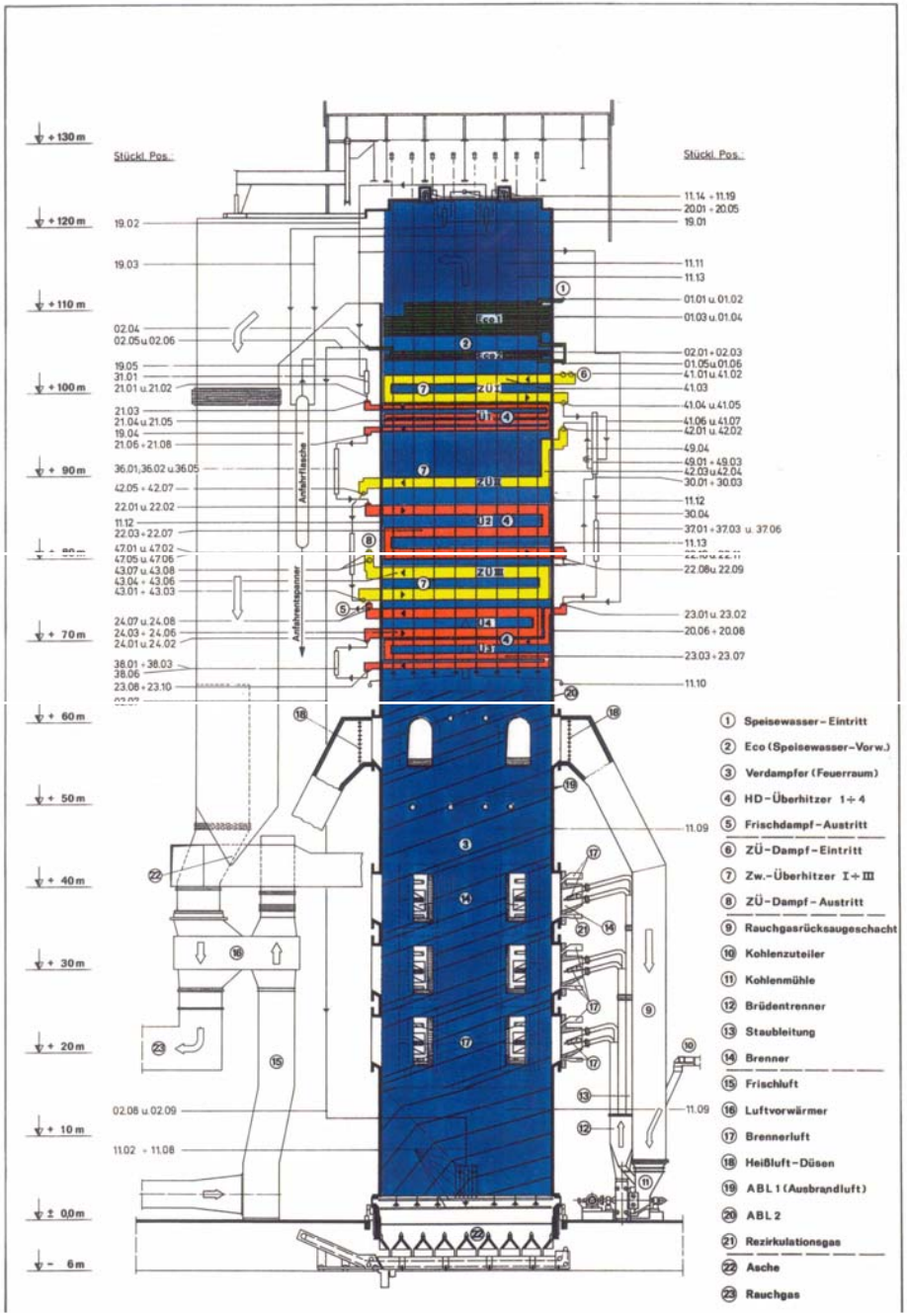
Steam data :

- **525 kg/s**
- **530 °C**
- **173 bar**

Fuels :

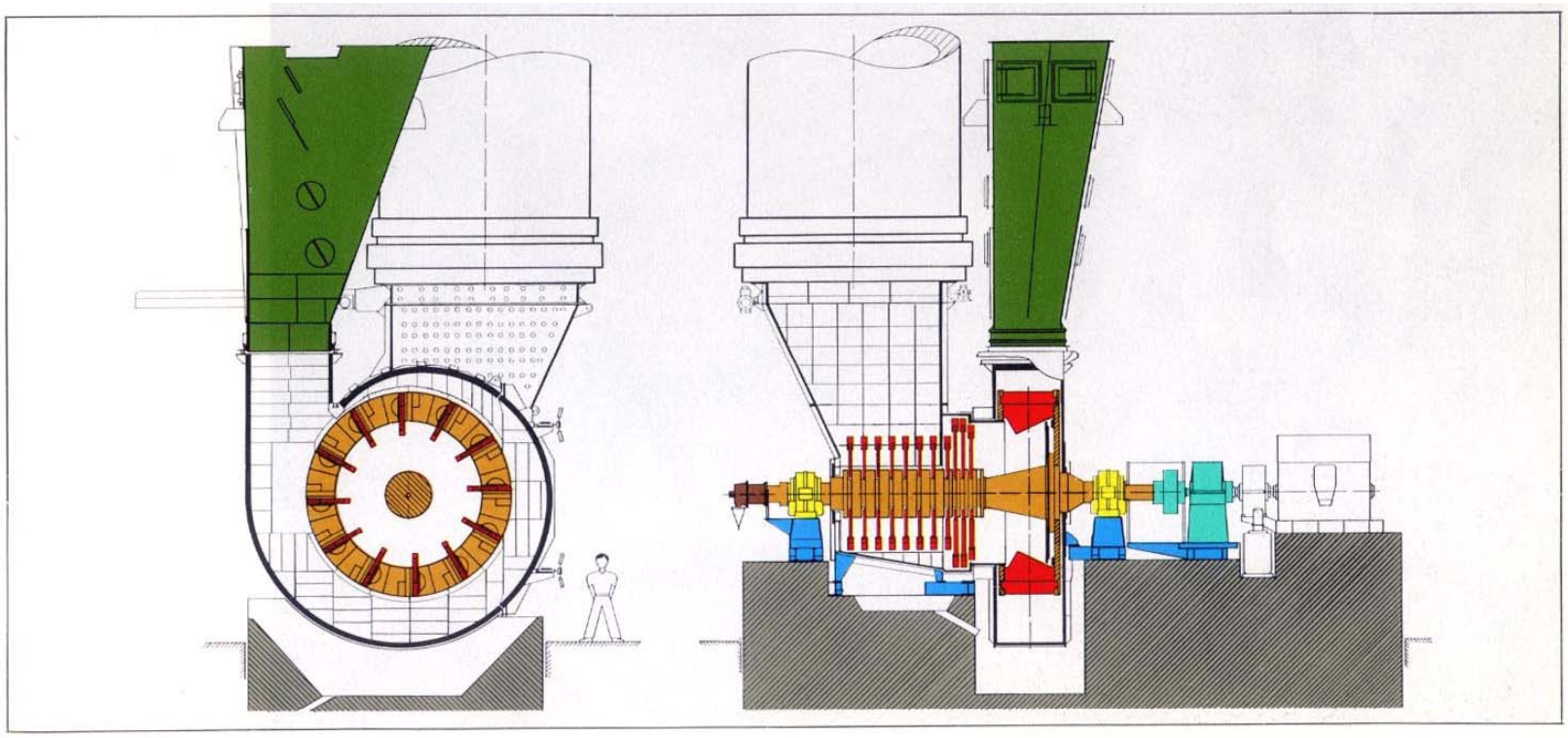
- **Lignite**
- **Paper sludge**
- **SRF (test)**

Boiler efficiency: 87,1%



RWE
The energy to lead

Coal mill – Sectional View



Alumina deposits in the coal mills

Note: Deposits occured only in the first test period

SRF Co-combustion at the Weisweiler power plant

Fuel input during the large-scale tests

Total fuel input during the test period in March 2005

- SRF 4.200 t
- Paper sludge 13.300 t
- Lignite 345.000 t

Hourly fuel input (in total for Unit G and H)

- SRF
  - at 2 % share of heat input ca. 21 - 24 t/h
  - at 4 % share of heat input (at times) ca. 40 - 46 t/h
- Paper sludge ca. 55 t/h
- Lignite ca. 1.500 t/h

SRF Co-combustion at the Weisweiler power plant
Results from the large scale tests

- Preparation and composition of the SRF 
- Unloading and handling of the SRF 
- Conveying and Feeding 
- Combustion behaviour (Ignition and burn out) 
- Capture of pollutants into the ash and the gypsum 
- Reduced emission limits (17. BImSchV) 
- Properties of ashes for landfill 

Co-combustion of SRF is feasible under the aspects „ Environmental impact“ and „ Technology“

SRF co-combustion at the Berrenrath co-generation power plant

CFB combustion system 2 x 235 MW th

Technical data of Berrenrath CFB boiler

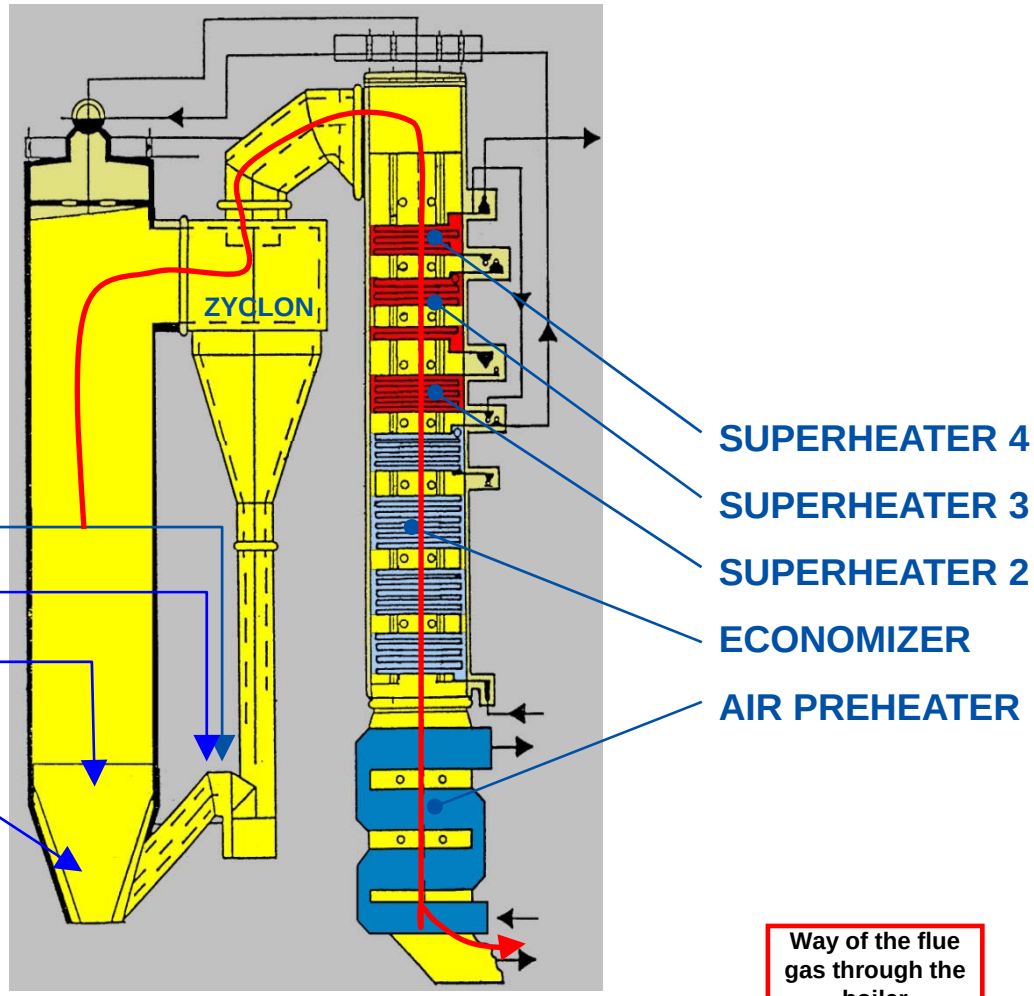
Steam data :

- **77.8 kg/s**
- **510 ºC**
- **90 bar**

Fuels :

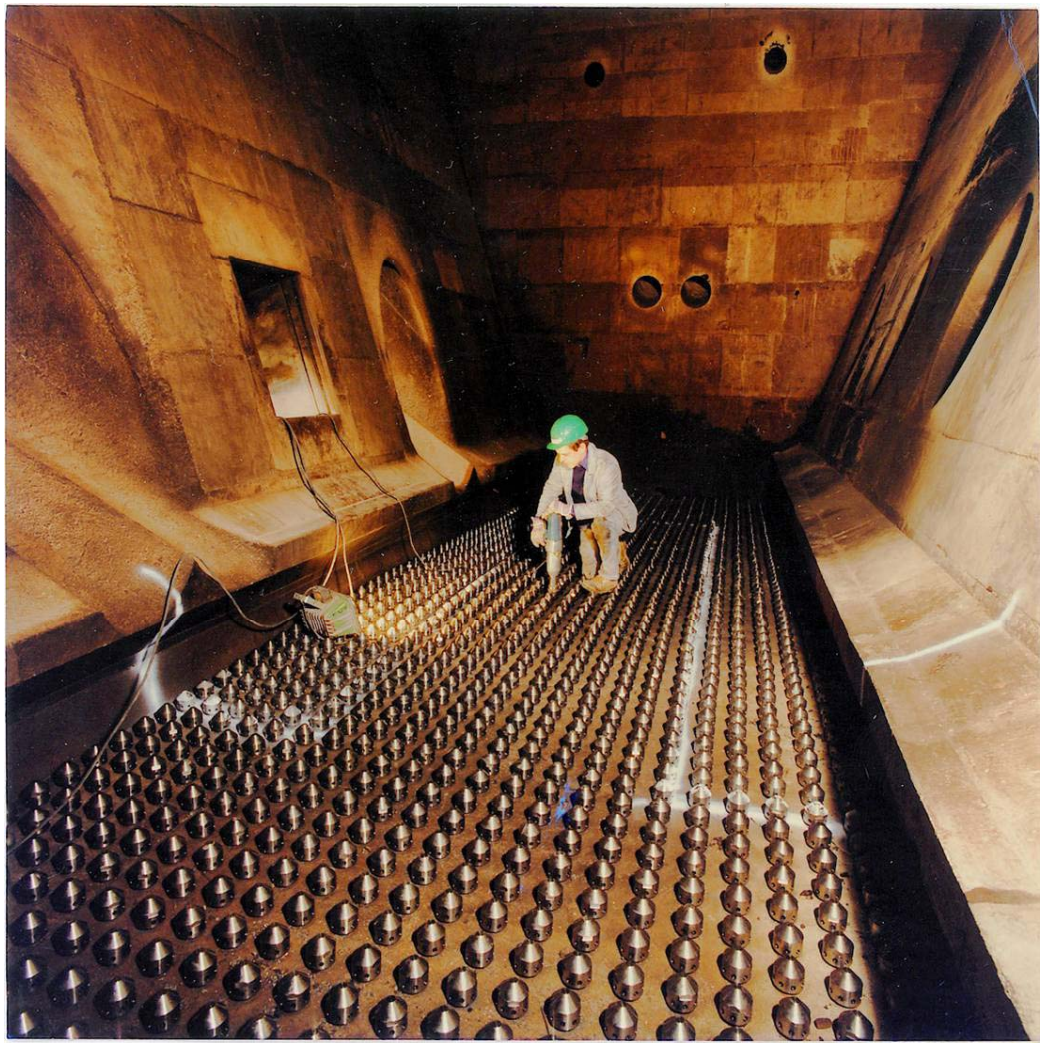
- **Lignite**
- **Sewage sludge**
- **Lignite sludge**
- **SRF**

Boiler efficiency: 91,4%



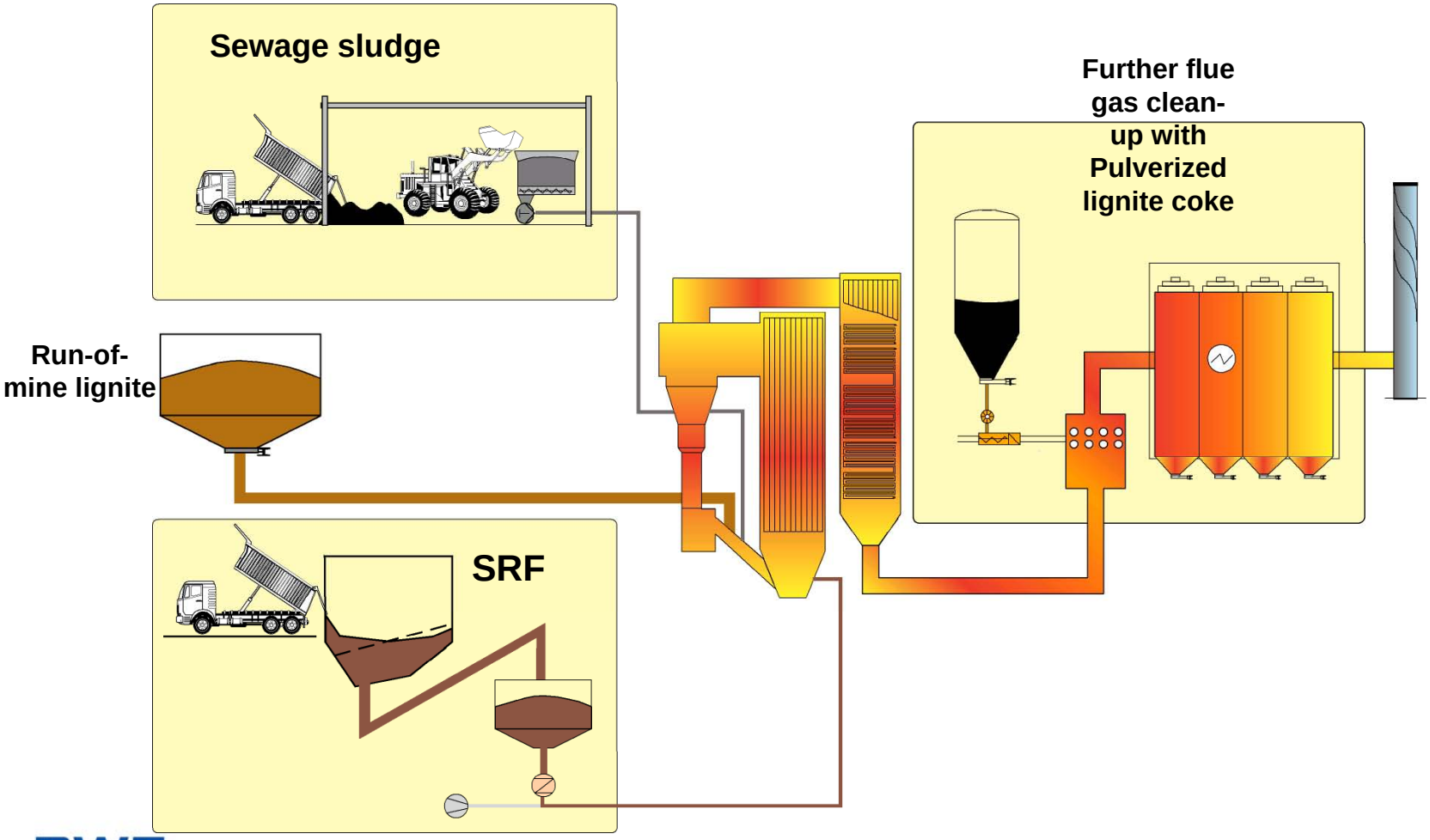
Way of the flue gas through the boiler

Circulating Fluidized Bed Firing System
Combustion chamber with nozzle grate

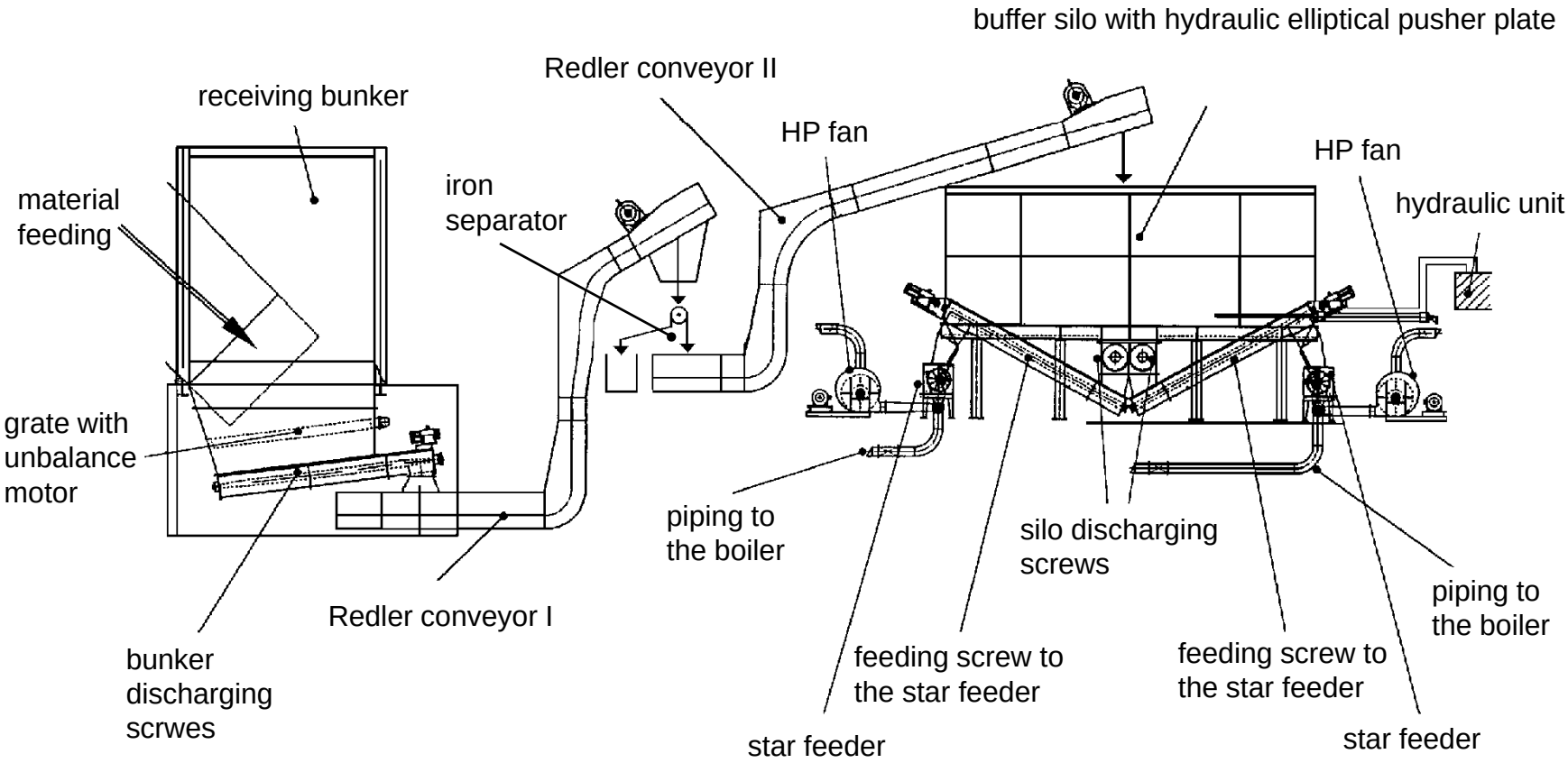


SRF- and Sewage sludge co-combustion at Berrenrath cogeneration power plant

Process scheme: Unloading – Firing system – Flue gas treatment



General diagramm of the installations for SRF
(originally designed for waste wood)

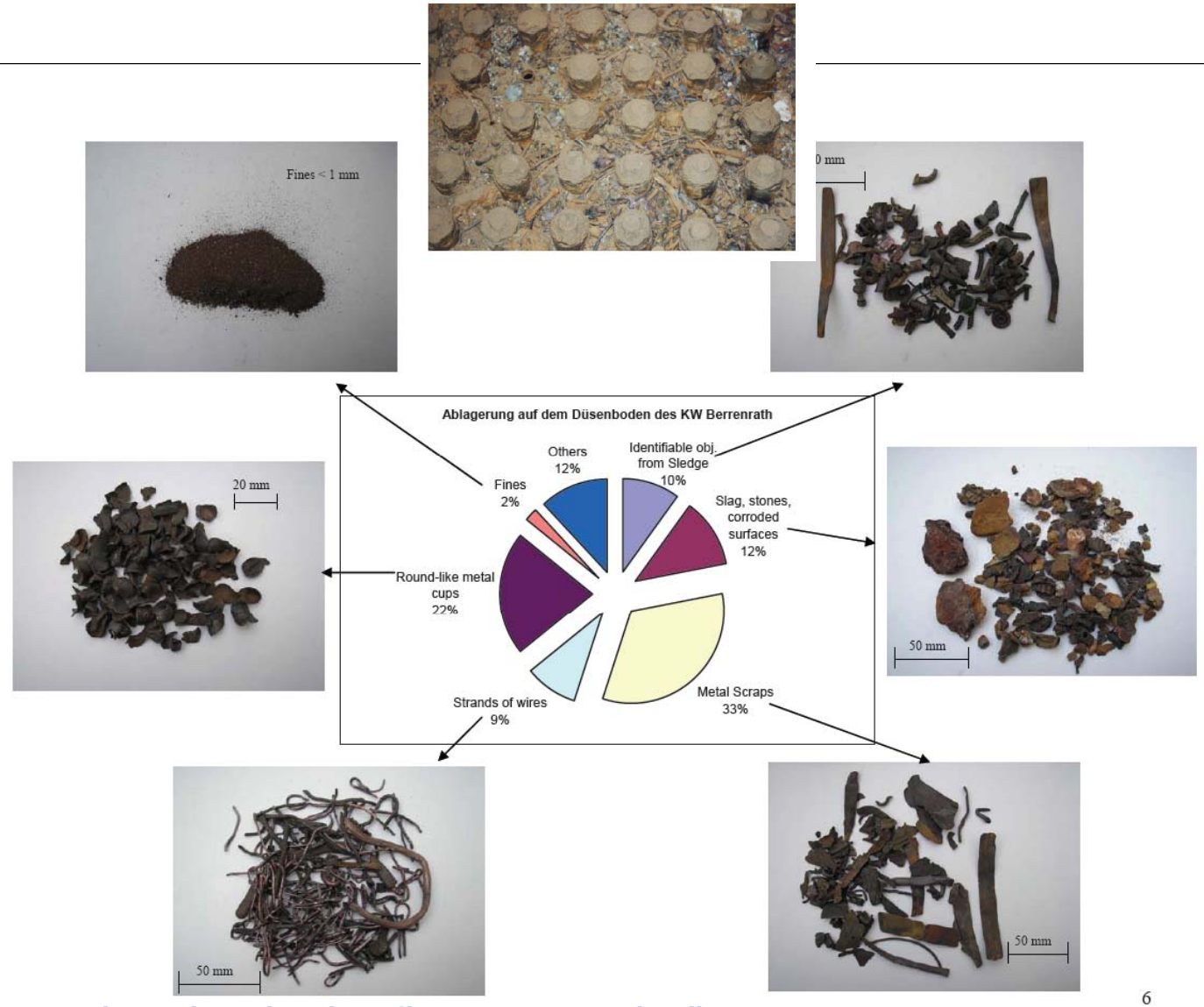


Installations for SRF handling and feeding

Buffer silo

Pneumatic feeding system

Detected types of impurities in the SRF

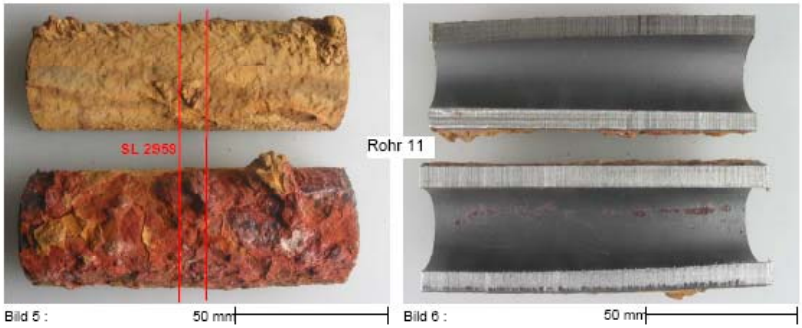


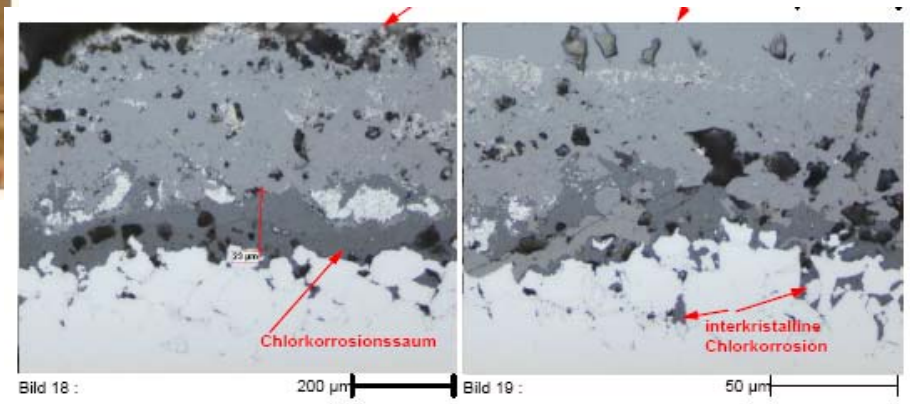
(Note: Situation in the first test period)

Plugging of the nozzle grate
after one of the first SRF co-combustion periods

Note: Situation has been improved significantly

Analysis of corroded superheater tubes after a previous period of SRF co-combustion





SRF Co-combustion at the Berrenrath power station

Fuel input during the large-scale demonstration period

Typical hourly fuel input for Unit 2

> SRF (ca. 15% share of heat input)	ca. 5 - 6 (=max) t/h
> Sewage sludge	ca. 20 t/h
> Lignite	ca. 60 t/h

Total fuel input during the large-scale demonstration

1. January 2007 - 30.May 2008

(in total for Unit 2 and 3, key date 18.5.08)

> SRF	80.400 t
> Sewage Sludge	297.900 t
> Lignite	1.146.000 t

➔ **Co-combustion of SRF saved more than 80.000 t of CO2**

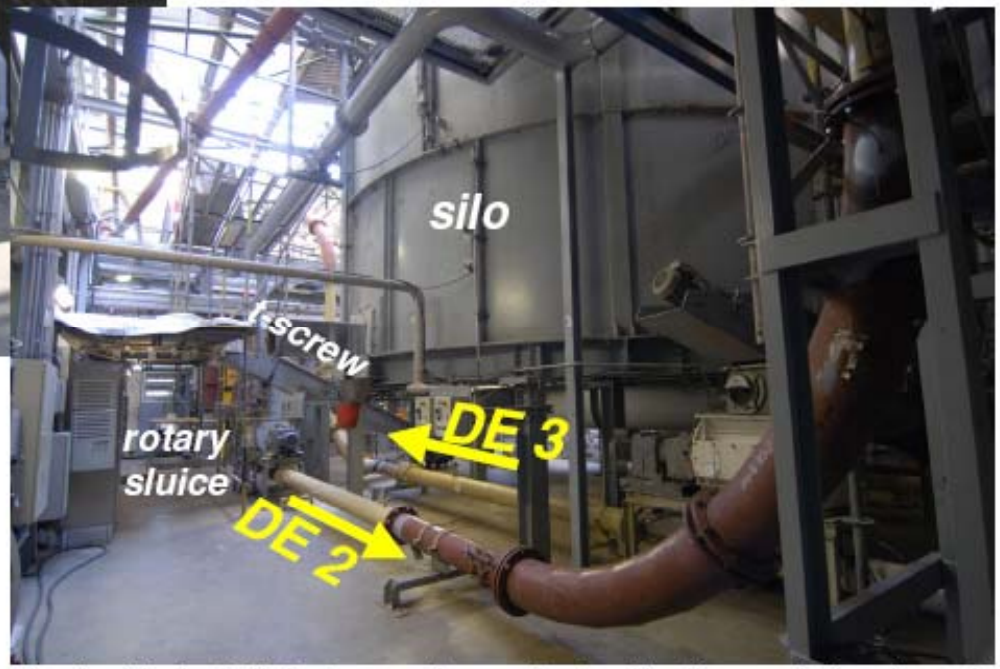
Optimisation measures at the Berrenrath power plant during the Recofuel project

- **Improvement of the SRF feeding**
  - Refitting of 2 additional pneumatic feeding lines due to a better distribution of the SRF in the combustion chamber

- **Online – monitoring of the SRF quality**
  - HCl-measuring device in the hot flue gas after cyclon
  - Refitting of a NIR-system at the SRF handling system

Improvement of the SRF feeding:
Refitting of 2 additional pneumatic feeding lines

2 existing and 2 new blowers



view inside the hall during erection works (roof is dismanteled and open)

Source:Remondis

New HCl-Measurement after cyclon

Operational experiences

- No problems occured concerning the combustion of SRF together with lignite
- CFB firing systems cope with much higher shares of SRF than PC firing systems
- Design of the feeding, metering and handling systems has to account for the special demanding mechanical properties of the SRF, in other respects the installations are relative simple
- Impurities (foreign material) cause increased wear and operating trouble, meanwhile the problem was reduced significantly during the project
- At the CFB: no significant increase in fouling of the heating tubes
- Due to avoid high temperature chlorine corrosion, it is imperative to carry out preexaminations and to define the required quality specifications for the SRF

→ **Co-combustion of Solid Recovered Fuels with low chlorine content (SBS1) is possible at a specific amount**

Summary of the operational results regarding the large-scale tests in the Recofuel project

- **Experiences with different Firing Technologies**
  - Low NOx pulverized fuel system
  - Circulating Fluidized Bed system
- **References for retrofitting feeding systems**
  - Feeding via existing belt conveyor
  - Feeding with additional pneumatic conveyor
- **Experieces with secondary fuels**
  - Quality requirements for SRF (Impurities, Chlorine, Aluminia, Alkalis)
  - Quality monitoring
  - Combination with other secondary fuels
- **Environmental aspects**
  - No negative impact on flue gas emissions
  - CO_2-reduction and preservation of resources

Future Developement and Exploitation Plans with SRF in the RWE lignite power plants

- Continuous operation of SRF Co-combustion in Berrenrath with 60.000t/a SRF
  - Improvement of availability and capacity utilisation by lessons learned during the Recofuel project
- Feasibility study for additional CFB boiler
- No further projects with SRF co-combustion in PC boilers with renish lignite
  - Inappropriate lignite quality (low sulphur, low ash, high alkali content) for a combination with SRF regarding slagging, fouling, corrosion
  - Large capacity baseload units (300 – 1000 MW) of the RWE PC boilers are economical critical due to a potential corrosion risk at high steam temperatures (525 – 600°C) and a 3 years revision schedule

THANK YOU VERY MUCH FOR YOUR ATTENTION

RWE
The energy to lead