“The Tray Absorber Technology for new FGD Plants and Retrofits of Coal Fired Power Plants“

Energetyka Belchatow 2013
At a Glance - Group Structure
Bilfinger Berger SE

Bilfinger Berger SE

Industrial Services
Power Services
Building and Facility Services
Construction
Concessions
Bilfinger SE (Shareholder)
Structure of BPS

Bilfinger SE, Mannheim

Bilfinger Power Systems GmbH, Oberhausen

Central departments

Energy Technology
- Babcock Borsig Steinmüller
- Bilfinger Power Africa

Piping Technology
- Bilfinger Pipe Tech
- Babcock MCE Berlin

Nuclear & Environmental Technologies
- Babcock Noell

Machinery & Apparatus Engineering
- Bilfinger Maschinenbau

Power Plants
- Envi Con & Plant Engineering
- Bilfinger MCE Aschersleben

Electrical and I&C Technology
- Bilfinger Mauell GmbH

Bilfinger Babcock CZ
Bilfinger Babcock Tyazhmash
Bilfinger Dakovic Montaza
Bilfinger Rotring Engineering
Bilfinger Rosink
Babcock Noell GmbH (BNG)
Scope of Supply and Services

• Design, engineering, delivery, complete installation and commissioning of Flue Gas Cleaning Systems:
  - wet / dry FGD
  - DeNOx
  - Filter (ESP, Bag Filter)

• Computational Fluid Dynamics (CFD) studies for flue gas systems

• Process Optimisation and Retrofitting / Upgrading of existing Flue Gas Cleaning Systems
The Tray

The Tray consists of a perforated sheet, which is located directly above the flue gas inlet.

The slurry together with the flue gas forms a very intensive turbulence above the Tray,

a hold-up time of the slurry,

which both significantly improves the mass transfer of the SO$_2$. 
FGD Boxberg Unit R

Scope:
Planning, construction, delivery, installation and commissioning of the FGD consisting of:
Absorber system, steel works, limestone slurry transport and dosing system, gypsum dewatering system

Technical Data:
Power per boiler unit: 670 MW
Flue gas flow: 2,600,000 Nm$^3$/h
Fuel: lignite
SO$_2$-inlet concentration: 8,400 mg/Nm$^3$, dry
SO$_2$ - removal: 97.5%
Number of absorber: 1

Location: Boxberg, Saxonia
Date of order: October 2005
Commissioning: January 2012
Hand over: October 2012
Client: Vattenfall Europe Generation AG

Vom-Stein-Strasse 39
D- 03050 Cottbus
FGD Power Plant Boxberg Unit R
Flue gas inlet duct
material: Alloy 59 cladded
• Absorber sump (rubber lining)

• Absorber internals (flue gas inlet duct and strainers)
FGD Power Plant Boxberg Unit R
The Tray (view in flue gas flow direction)
FGD Power Plant Boxberg Unit R
Absorber recycle pumps
FGD Power Plant Boxberg Unit R
Spray Header and Tray
Tray elements in stainless steel 1.4562
SO$_2$ - Removal Efficiency with and without Tray

- Difference 16.6% -

Removal Efficiency (%) vs. L/G (l/Sm$^3$ saturated)
Scope:
Planning, construction, delivery, installation and commissioning of the FGD
consisting of:
2 Absorber Systems with stacks on top, flue gas ducts, steel works, limestone preparation and dosing system, gypsum dewatering system

Technical data:
Number of units: 2
power per boiler unit: 820 MW
flue gas per unit: 2,276,000 Nm³/h
fuel: hard coal
SO₂-inlet 3,950 mg/Nm³, dry
SO₂ - removal 97,5 %
number of Absorber: 2
location: Hamburg-Moorburg, Germany

Date of order: March 2006
End of erection: December 2011
Commissioning:
Unit A: July 2013
Unit B: February 2013

Client:
Vattenfall Europe Generation AG
Vom-Stein-Strasse 39
D- 03050 Cottbus
**Scope:**
Engineering, design, delivery, installation and commissioning of a FGD consisting of:

- 2 Absorbersystems, chimneys placed directly on top, civil works, ducts, steel structure, 2 ID-fans, centrale lime stone supply, gypsum slurry discharge system

**Technical Data:**
- No. units: 2
- Unit size: 315 MW
- Amount of flue gas per unit: 2,080,000 Nm$^3$/h
- Fuel: Lignite
- SO$_2$ – inlet concentration: 5,543 mg/Nm$^3$, dry
- SO$_2$ – removal efficiency: 97.4%
- Number of Absorbers: 2

**Location:** Isalnita (close to Craiova), Romania

**Receipt of order:** August 2011

**Commissioning:** Spring 2014

**Client:** S.C. Complexul Energetic Craiova S. A.
str. Unirii nr. 147 jud. Dolj Craiova, Romania
Flue Gas Desulphurisation Plant
Isalnita Power Plant (Romania)
Units 7 & 8

Status of Erection
August 2013

2 Absorbers with steel structure for the stacks
Absorber recycle pumps
2 Limestone silos with slurry tanks
Govora Power Plant (Romania)
Unit 7
Flue Gas Desulphurisation Plant (FGD)

Scope:
Engineering, design, delivery, installation and commissioning of a FGD consisting of:

1 Tray-Absorbersystem, chimneys placed directly on top,
civil works, ducts, steel structure, 2 ID-fans,
lime stone supply, gypsum slurry discharge system

Technical Data:
No. units: 1
Unit size: 420 t/h steam
Amount of flue gas per unit: 760,000 Nm³/h
Fuel: Lignite
SO₂ – inlet concentration: 6.975 mg/Nm³, dry
SO₂ – removal efficiency: 97.5 %
Number of Absorbers: 1

Location: Govora, Ramnico Valcea
Romania

Receipt of order: May 2013
Commissioning: December 2015

Client: JUDETUL VALCEA (CONSILIUL JUDEȚAN VALCEA)
RM. VALCEA
STR: GENERAL PRAPORGESCU NR. 1-T
România
Absorber with flue gas cooler upstream

Tray - Absorber
Installation of 1 - 3 Trays possible

- $\text{SO}_2$ inlet: 12,000 mg/Nm$^3$ dry
- removal efficiency: > 99%

- diameter: 1.5 m
- height: 16.5 m
- separate oxidation tank
- product: gypsum slurry

(utilized at Schwarze Pumpe FGD)
Enlargement of Mass Transfer by Installation of the Tray

**Oxyfuel - Absorber without TRAY**

*Example FGD Oxfuel Pilot Plant Schwarze Pumpe*
Enlargement of Mass Transfer by Installation of the Tray

**Oxyfuel - Absorber with TRAY**

*Example FGD Oxfuel Pilot Plant Schwarze Pumpe*
Provisions for Upgrading of existing FGD systems

The following measures can be carried out in order to increase the SO$_2$ separation of the existing absorbers:

- Optimising of the nozzle equipment
- Increasing the l/g ratio (liquid/gas) internals for suppressing the wall effect
- Installation of a tray

With the existing pressure reserves of the installed fans, the installation of the tray represents the most effective solution.
Scope of Supply:

Optimisation of a double loop absorber by replacement of the existing wet film contact by a Tray, including design, delivery, installation and commissioning

Technical data:

Number of units: 1
Unit size: 420 MW
Amount of flue gas: 800,000 Sm³/h
Fuel: Hard coal
Dust in clean gas: < 15 mg/Sm³
Number of Absorbers: 1

Location: Altbach/Deizisau
Receipt of order: March 2008
Commissioning: June 2008
Hand over: 2009

Client: EnBW Kraftwerk AG
Heizkraftwerk
Altbach/Deizisau
Industriestraße 11
73776 Altbach
The Tray made of Polypropylene (PP)

The tray in PP design
Flue Gas Desulphurisation
Power Plant Ingolstadt Unit 4

Scope of Supply:
Optimisation of a double loop absorber by replacement of wet film contact by tray, incl. design, delivery, installation and commissioning

Technical data:
- Number of units: 1
- Unit size: 460 MW
- Amount of flue gas: 1.300.000 Sm³/h
- Fuel: Heavy-fuel oil ("special quality")
- Required SO₂ removal efficiency:
  - up to 3.000 mg/Sm³ > 98,5 %
  - up to 4.500 mg/Sm³ > 98,0 %
  - up to 5.500 mg/Sm³ > 97,5 %
- Dust in clean gas: < 10 mg/Sm³
- Number of absorbers: 1

Location: Ingolstadt
Receipt of order: January 2009
Commissioning: October 2009
Hand over: 2009
Client: E.on Kraftwerk Ingolstadt
Bayernwerkstraße 30
D-85098 Großmehring
The Tray at the FGD in Ingolstadt
material 1.4435
Absorber internals after six months of service
Retrofit options of the Tray in various Absorber Systems

η > 99% with Tray
2.800 mg/m³
η = 97.4% without Tray

Increase in SO₂ efficiency from 96.5% to > 99% due to Tray operation

Process data Power Plant Ingolstadt unit 4, E.ON - Tray in operation
Power Plant Boxberg Units Q1 & Q2
Flue Gas Desulfurisation
Tray-Retrofit

Scope of Supply:
Optimisation of a double-loop absorber, Tray-retrofit in the upper loop, incl. design, delivery, installation and commissioning.

Flue gas flow: 1,800,000 Nm³/h
SO₂-inlet concentration: 8,400 mg/Nm³ dry
spray-levels upper loop: 4 * 7,000 m³/h
spray-levels lower loop (Quencher): 3 * 3,600 m³/h
SOₓ - removal after Tray-retrofit: > 96 %.

Location: Boxberg, Saxonia
Date of order: January 2012
Hand over: October 2012
Client: Vattenfall Europe Generation AG

Vom-Stein-Strasse 30
D-03050 Cottbus
Retrofit Options of the Tray in various Absorber Systems

With the BNG Tray technology for the new plants and for retrofitting the following advantages will be achieved:

• Longer suspension residence time in the absorption zone
• Increase in SO$_2$ efficiency.
• Considerably improved dust and SO$_3$ separation in the absorber.
• Fewer / smaller circulation pumps or fewer spraying levels required (No spraying level required for the tray retrofits).
• Less power consumption for the absorber system.
• Savings in pipework, foundations and electrical / control technology.
• Less maintenance, e.g. on the pumps, due to a reduced quantity.
• Integrated maintenance platform directly beneath the spraying levels.
Latest order: Power Plant TUROW units 4, 5 and 6

Wet Flue Gas Desulfurization with the BABCOCK NOELL - Tray - Absorber System

Client: PGE Górnictwo i Energetyka Konwencjonalna S. A. – Oddział Elektrownia, Turów, Bogatynia

Fuel: local lignite and biomass
max. SO$_2$ - concentration: 2.500 mg/Nm$^3$ (dry 6 % O$_2$)
Number of Absorber systems: 3 (1 per unit)
Sorbent: ground limestone / limestone slurry

max. flue gas amount (unit): 1.200.000 Nm$^3$/h
max. SO$_2$ - removal efficiency: $\geq$ 97.5 %
End product: marketable gypsum
Thank you very much for your attention!