Seawater Flue Gas Desulphurisation
THE IDEAL SOLUTION FOR COASTAL LOCATIONS
Principle of seawater - scrubbing

- Stack
- Raw gas from boiler
- Oxidation air
- Seawater feed
- Absorber
- Oxidation Basin
- Seawater discharge to sea
Chemical reactions in the absorption zone

Flue gas from boiler → Oxidation air → Seawater from condenser

- SO$_2$ + H$_2$O → HSO$_3^-$ + H$^+$
- HSO$_3^-$ → SO$_3^{2-}$ + H$^+$
- CO$_2$(l) + H$_2$O → HCO$_3^-$ + H$^+$
- HCO$_3^-$ → CO$_3^{2-}$ + H$^+$
- HSO$_3^-$ + $\frac{1}{2}$O$_2$ → SO$_4^{2-}$ + H$^+$
- SO$_3^{2-}$ + $\frac{1}{2}$O$_2$ → SO$_4^{2-}$

Clean gas
Chemical reactions in the absorber sump

Flue gas from boiler → HCO\(_3^-\) + CO\(_3^{2-}\)

Oxidation air

Clean gas

Air - O\(_2\)

Seawater from condenser

SO\(_3^-\) + 1/2 O\(_2\) → SO\(_4^{2-}\)

HCO\(_3^-\) + H\(^+\) → CO\(_2\)(l) + H\(_2\)O

Seawater

HCO\(_3^-\) + H\(^+\) → HCO\(_3^-\)

HCO\(_3^-\) + 1/2 O\(_2\) → SO\(_4^{2-}\)

CO\(_3^{2-}\) + H\(^+\) → HCO\(_3^-\)

HSO\(_3^-\) + 1/2 O\(_2\) → SO\(_4^{2-}\) + H\(^+\)
SBEng - Seawater - FGD
Design features optimised by CFD & Physical Laboratory
SBE ENG SW - FGD : Reference Plants

Shuaibah III

Alba Bahrain

Puerto Coronel
SW-FGD Alba Bahrain /150 MW

- 1 absorber serving 2 boilers
- fuel: green coke, 5% S
- seawater application
- total flue gas flow rate 490,000 m³/h (STP, wet)
- SO₂ inlet 5000 mg/m³ (STP, dry)
  SO₂ outlet 500 mg/m³ (STP, dry)
- SO₂ removal > 90%
- absorber sump made of concrete completion time 14 months
- start-up February 2003
Brine (Seawater) from Desalination Plant to FGD-Plant

ID-Fan

Raw Gas from Filter Bag House Unit 1

Existing Bypass Stack

Raw Gas from Filter Bag House Unit 2

ID-Fan

Booster Fan

Absorber

Stack

Clean Gas

Quench Pump

Oxidation air

3x Feed Pumps

Dosing pump

NaOH-Tank

Brine (Seawater) Discharge to Sea

NaOH

Existing Bypass Stack

Alba Bahrain
SW - FGD Alba Bahrain

Spray banks

FRP-Absorber sump
SW - FGD Shuaibah III / Saudi Arabia

3 x 660 MW_{el} (eq)

Taking-Over: 2009
SW - FGD Shuaibah III/ Saudi Arabia

- Flue gas from boiler
  - Oxidation air
  - Seawater from condenser
  - Absorber
- Stack
- Sea water discharge to sea

**SO\textsubscript{x} = 3500 mg/m\textsuperscript{3} STP dry**

**SO\textsubscript{x} < 150 mg/m\textsuperscript{3} STP dry**

- pH > 6
- \(O\textsubscript{2} - \text{Saturation} > 70\%\)
- Oxidation rate > 95\%
SW - FGD Shuaibah III / Oxidation basin & Discharge culverts
SW- FGD Shuaibah III
Pump arrangement
SW - FGD Shuaibah III - Absorber sump & Oxidation basin
SW - FGD Shuaibah III
Oxidation ring

Aeration Vanes
Highlights of the SBENG Seawater Process

- **Ideal solution for coastal locations**
  - Uses seawater as the absorbent, a free source

- **Low impact on the environment**
  - Seawater returned to the sea in an environmentally responsible manner
  - No waste products or residues

- **SO₂ removal efficiencies of up to 99%**
  - Thanks to the use of spray tower absorber
Highlights of the SBENG Seawater Process

- Small footprint
- Space-saving arrangement
- Short construction time based on an optimised assembly concept
Highlights of the SBENG Seawater Process

- Energy-optimised plant operation thanks to flexible adaption to boiler operation
  - Spray bank pumps can be shut down individually
  - Variable oxidation air supply
- Maximum plant availability with optimum life-cycle value
- Can be used for all fossil fuels, such as coal, oil and petroleum coke
WE MAKE THE WORLD A CLEANER PLACE

Let's work it out together.

INDURE
ISO 9001:2008

Steinmüller Babcock Environment
NIPPON STEEL & SUMIKIN ENGINEERING GROUP