WSA technology for treatment of SO$_2$ off-gases

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WSA = Wet (gas) Sulphuric Acid Technology

Main Features:

• Removal of SO$_2$ in off-gases from roasters, furnaces and converters

• Reduces SO$_2$ by up to 99.6% with single condensation step

• Higher SO$_2$ removal is possible with double condensation or H$_2$O$_2$ scrubber

• Only one end product (H$_2$SO$_4$)

• High energy recovery
1. WSA technology - applications

- Refining and petrochemical industry
- **Metallurgical industry**
- Coal-based industry (coking and gasification)
- Power industry
- Viscose industry
- Sulphuric acid industry
2. Principles of the WSA process, SO$_2$ gas

- Pre-heating
- SO$_2$ conversion
- Gas cooling
- Acid condensation

SO$_2$ rich off-gas

Hot air for preheating

Clean process gas to stack

Cooling water

Product acid

HP superheated steam

Atmospheric air

Cooling water return

**Totally 290 kJ/mole of SO$_2$ is generated**

- > 90% heat is recovered as steam or hot air
- < 10% is discharged by CW
2. WSA Plant in the Metallurgical Industry

- Feed Gas
- Feed Gas Preheater
- Start-up/Support Burner
- Natural Gas
- Interbed Cooler
- Gas Cooler
- Salt Pump
- SO₂ Converter
- WSA Condenser
- Stack Gas
- Air Blower
- Air
- Salt Tank
- Boiler
- Salt Circulation System
- Acid Pump
- Acid Cooler
- Product Acid
2. WSA plant – H$_2$S or sulfur feed
2. Model of WSA Plant
3. SO₂ Converter Details

Off-gas with SO₂

SO₂ Converter

400 - 420°C

Catalyst Layer

Gas Cooler

Catalyst Layer

Steam

Heat Recovery System

265 - 290°C

Off-gas with H₂SO₄ (gas)
3. SO$_2$ converter
3. Heat transfer system
3. WSA condenser details

- Cooling air inlet
- Clean gas outlet
- Hot air outlet
- Acid gas inlet
- Sulphuric acid
3. WSA Condenser Bottom Section
3. WSA condenser internals
3. Installation of WSA condenser module
3. Shell of 12-Module WSA Condenser
3. WSA condenser - principle design
3. WSA acid cooling system
4. Zinc plant – Former Soviet Union

Metallurgical complex consisting of:

- 180,000 MTPY Zinc refinery
- 140,000 MTPY Lead smelter
- Precious metal refinery
- Employs some 22,000 people
Design Conditions

125,000 Nm³/hr
6.5% SO₂
5% H₂O
14% O₂

WSA

0.1% SO₂ (98.1% reduction)

854 MTPD H₂SO₄ (98% purity)
Smelter in Mexico

Commissioned: 2001
Inlet gas: SO$_2$ from MoS$_2$ roaster
Flow: 20,000 Nm$^3$/hr
SO$_2$: 2 – 4.5 %
H$_2$SO$_4$: 65 MTPD
4. WSA/SNOX References

Gas flow: 2,000 – 1,200,000 Nm³/hr
Acid production: 4 – 1,140 MTPD
More than 80 units

- Power plants
- Oil refining and petrochemical industry
- Metallurgical and minerals industry
- Coke and coke chemical industry
- Sundry applications

September 2006
4. WSA plants

Contracted plants:

- 28 in refining and petrochemical industry
- 12 in metallurgical industry – 3Pb, 1 Zn, 7 Mo, 1 Cu
- 19 in coking industry
- 16 in gasification industry
- 5 in viscose industry
- 7 others including SNOX units
5. Salient features of WSA

- More than 99% of the sulphur content is recovered
- Sulphur is recovered as concentrated sulphuric acid of commercial quality (~98%)
- Very low consumption of cooling water
- Accepts feed streams with NH$_3$
- No waste products or waste water
- No consumption of chemicals or other additives
5. Salient features (cont.)

- Efficient heat recovery
  - superheated high pressure steam export

- Wide turn-down range (up to 1:10)

- Simple lay-out, small plot area

- Low investment and attractive operating economy