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An Efficient Ammonia-based SRU Tail Gas Desulfurization Process

REFCOMM
GALVESTON
MAY 2-6 2016

Jiangnan Environmental Technology, Inc.

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Topics

1. **Ammonia-based desulfurization**
2. **EADS Process**
3. **Ammonia Slip and Aerosol Generation Control**
4. **SRU Tail Gas Treatment**

What is Ammonia-based Desulfurization?

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Reaction between SO_2 and NH_3 to produce ammonium sulfate.

$$SO_2 + H_2O + xNH_3 \xrightarrow[(1)]{} (NH_4)_xH_{2-x}SO_3$$

$$(NH_4)_xH_{2-x}SO_3 + \tfrac{1}{2}O_2 + (2-x)NH_3 \longrightarrow (NH_4)_2SO_4 \quad (2)$$

$$2NH_3 + SO_2 + \tfrac{1}{2}O_2 \longrightarrow (NH_4)_2SO_4$$

1 ton SO_2: 0.5ton NH_3 ⟶ 2 ton $(NH_4)_2SO_4$

Ammonia: Pro & Con

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Properties of NH_3

- Gas at atmospheric pressure, easy to liquefy
- Dissolves easily in water
- Highly alkaline, Highly reactive

High reactivity of NH_3

- High absorption efficiency
- Low liquid recirculation
- Low system pressure
- Low power consumption
- Easy to evaporate
- Easy to react with acidic molecules and yield aerosol

Technical challengers

Efficient Ammonia-based Desulfurization (EADS) Technology

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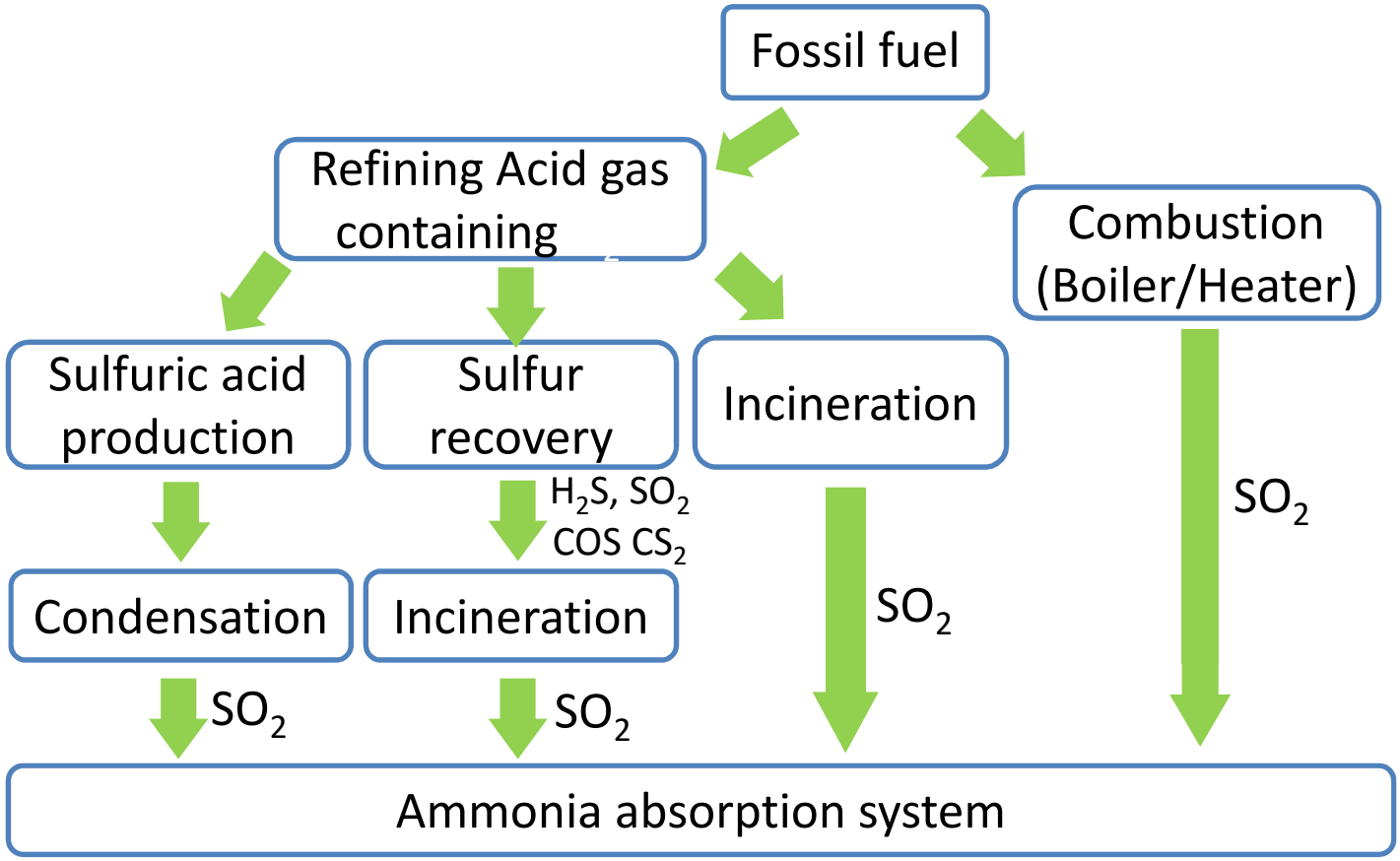
- JET's patented technology
- Efficient and economical
- Successfully addressed ammonia slip and aerosol issues

Applications

Boiler/power plant flue gas desulfurization	**Sour/acid gas** treatment + **SRU tail gas** treatment	**FCCU** & **Sintering** machine flue gas desulfurization and PM control
• 90 projects • 200+ absorber installations	• 11 projects	• 4 projects

EADS Applications: Acid Gas Treatment



More Stringent Air Quality Regulations

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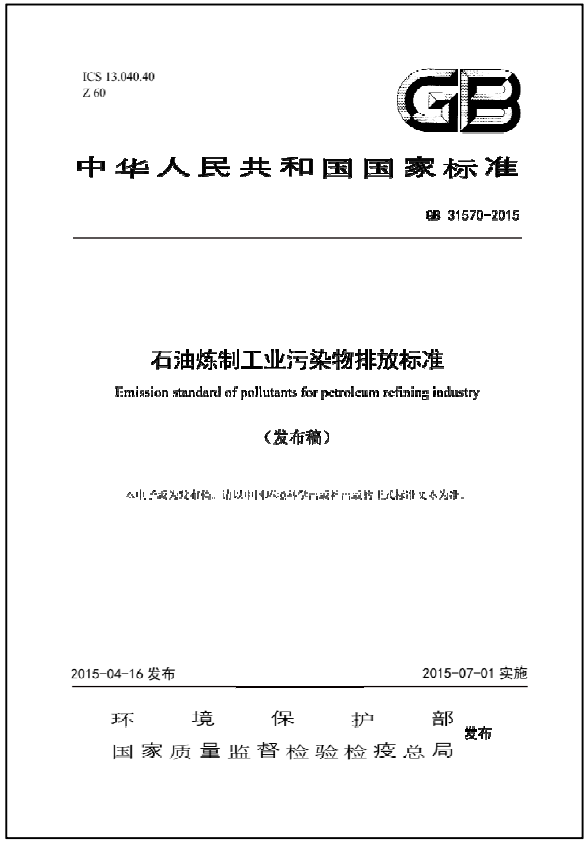

ICS 13.040.40
Z 60

中华人民共和国国家标准

GB 31570-2015

石油炼制工业污染物排放标准

Emission standard of pollutants for petroleum refining industry

（发布稿）

2015-04-16 发布　　2015-07-01 实施

环境保护部
国家质量监督检验检疫总局　发布

GB 31570-2015: the most stringent emission regulations for refineries in the world

SO_2 emissions:

≤ 400 mg/Nm^3 for any refineries in China

≤ 100 mg/Nm^3 For strictly controlled areas

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Process Mechanism

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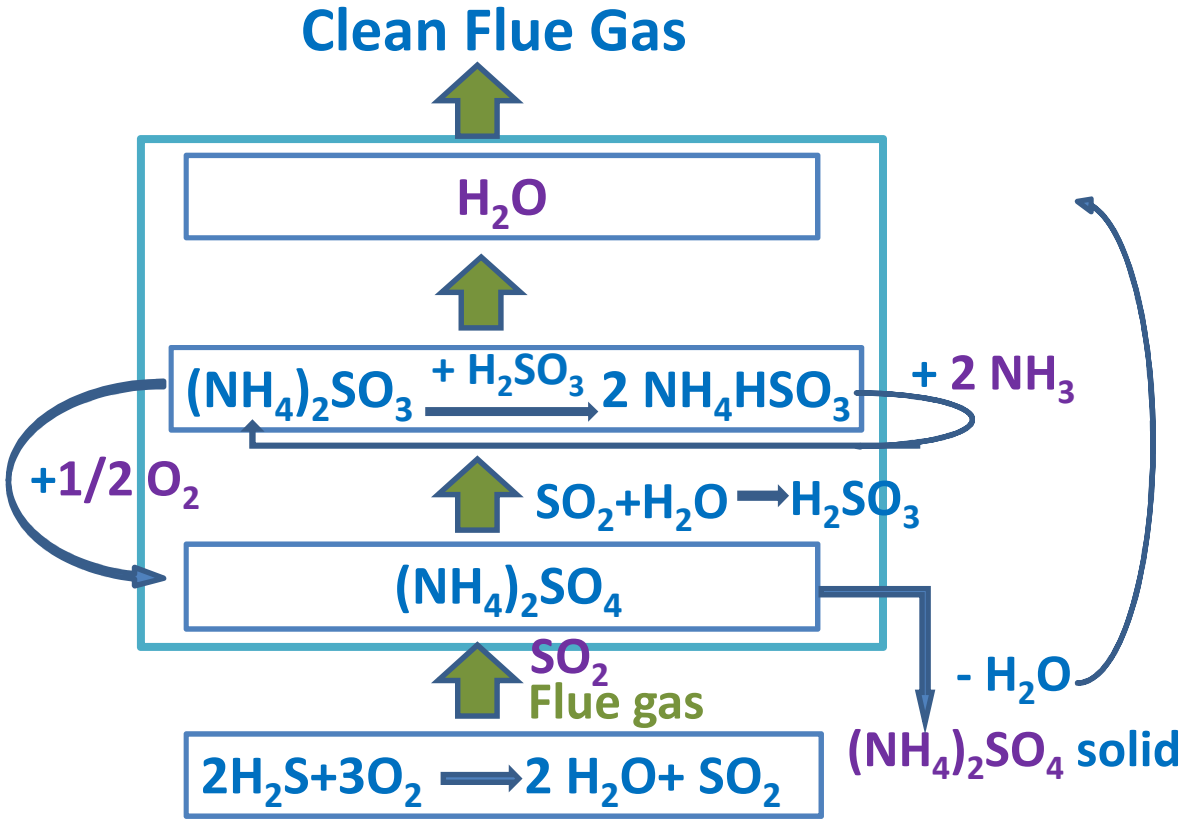

Scrubbing/Demisting

Ammoniating

Absorption

Cooling/Evaporation

Separation/Drying

Incineration

Process Description

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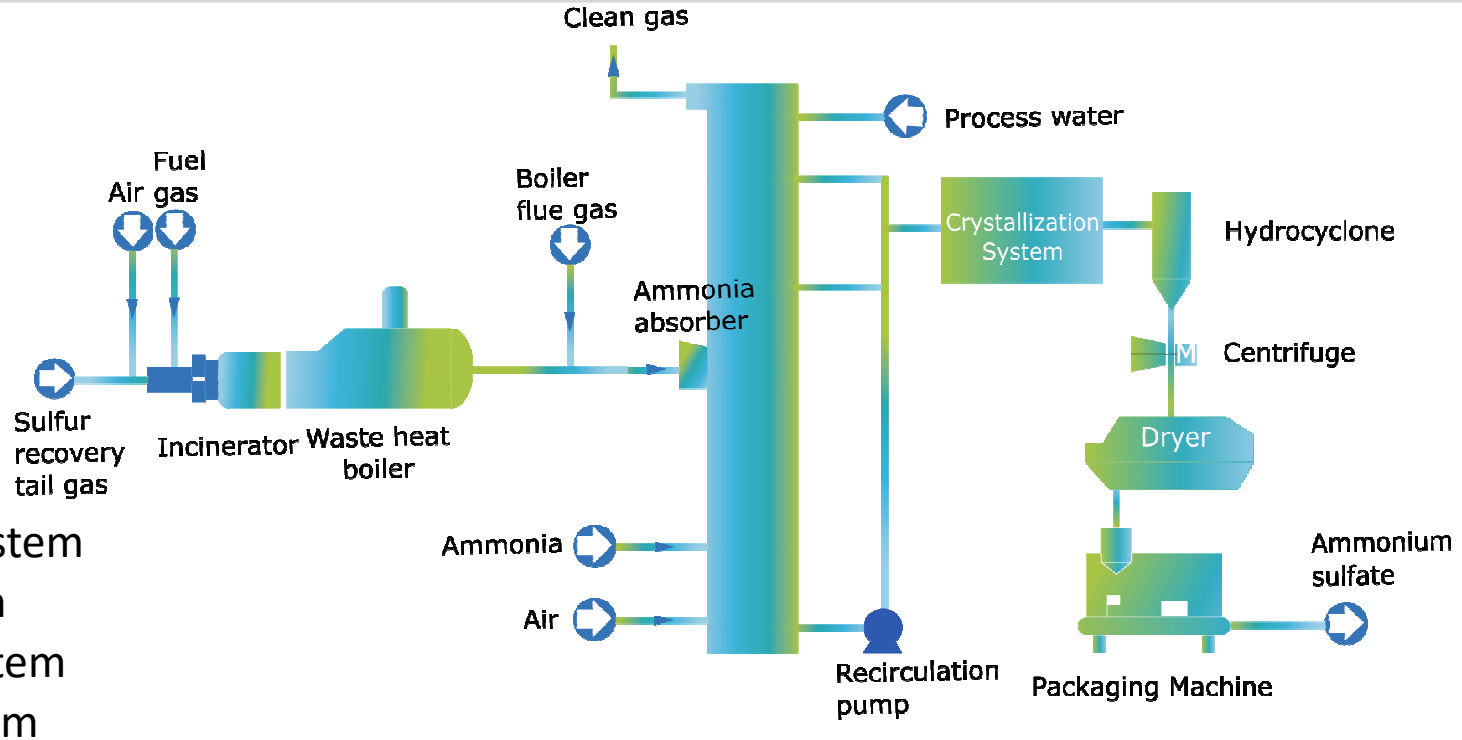

Process Systems

- Incineration system
- Flue gas system
- Absorption system
- Oxidation system
- Ammonium sulfate system

EADS Technology: Features and Advantages

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High SO_2 removal efficiency: ***98% or higher***

Environmentally friendly: ***low emission, no waste waster or solid, less energy consumption***

Favorable economics: ***Lower CAPEX & OPEX*** *(3.8 ton AS/ton NH_3)*

High turndown ratio: ***30 – 110%***

Absorbent: ***gaseous, liquid, or aqueous ammonia***

Flexible and customized system design

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Ammonia Loss: Challenge for Ammonia Desulfurization

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$$\text{Ammonia recovery} = \frac{\text{Ammonia in the product}}{\text{Total ammonia consumption}}$$

Ammonia recovery

- A key performance index for ammonia desulfurization
- Directly reflects the utilization of ammonia

Reduce ammonia loss

- Ammonia slip: Free ammonia that escapes with treated flue gas
- Aerosol: Unstable particles of ammonium sulfite, which eventually break down to SO_2 and ammonia and are difficult to capture

Ammonia Loss: Challenge of Ammonia Desulfurization

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Low ammonia Recovery rate

High ammonia recovery rate

Ammonia Loss Control Strategies

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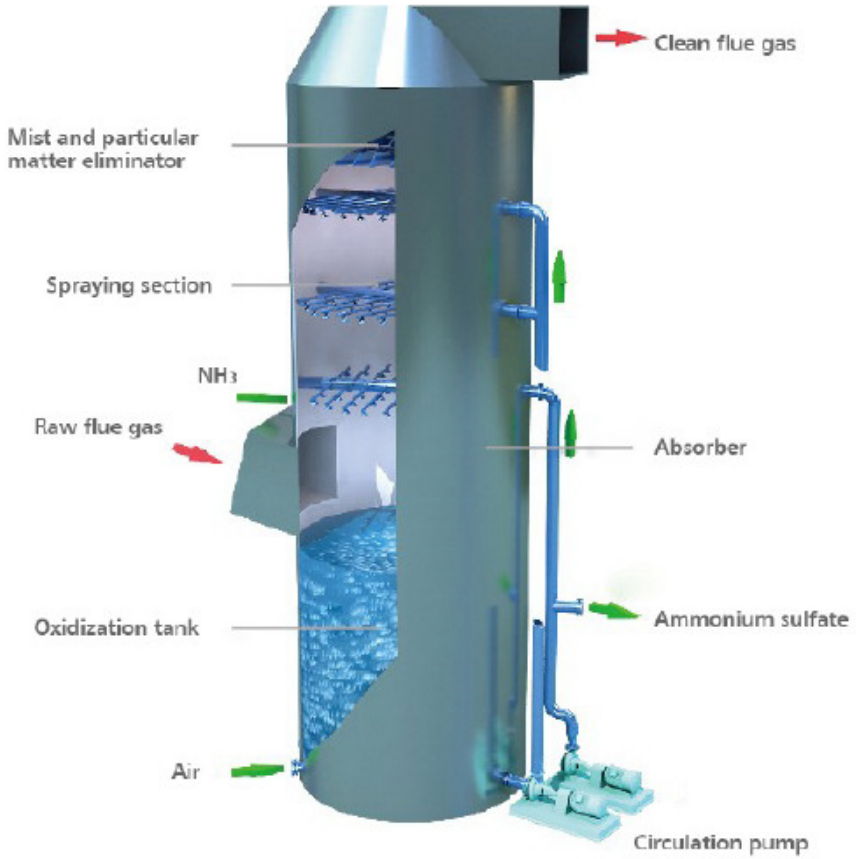

- Optimized temperature and pH control
- Precise ammonia addition control
- Complete oxidation
- Patented demising system

Ultrasonic Enhanced PM Control- Acoustic Agglomeration Mechanism

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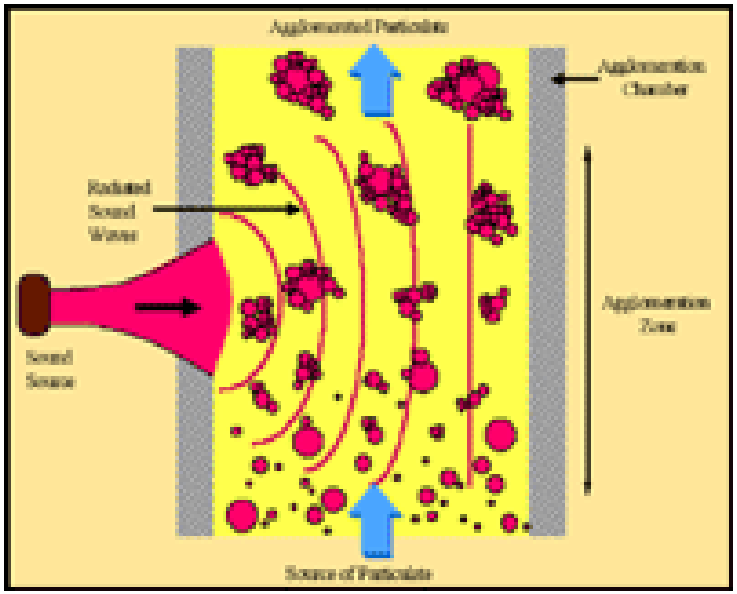
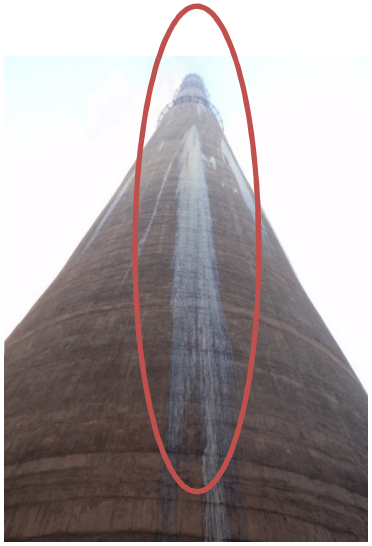
- **Collision between particles with different sizes**, which vibrate at different amplitudes when ultrasound is applied.
- **Fluid attraction between particles** due to the gas velocity relative to particles.
- **Precipitation of particles on the wave loop** of a standing sound wave caused by acoustic radiation pressure, greatly increasing the possibility of particle collision.



Sinopec Qilu Petrochemical

- 4X410 t/h coal-fired boilers
- Competitive ammonia-based FGD unit installed in 2008
- Ammonia slip and “ammonium sulfate rain”

Exhaust plume



$(NH_4)_2SO_4$ seepage

Solid material carried out by clean flue gas

Sinopec Qilu Petrochemical

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- Boiler: **4×410t/h coal fired boilers**
- Start-up: **2012**
- Contract: **EPC, retrofit of a 2008 competitive system**
- Desulfurization efficiency : **> 98%**
- SO_2 emission **< 40 ppmv**
- Ammonia Recovery **> 99.2%** (from **74.9%**)
- Ammonia slip **< 3 mg/Nm3** (from **62.1** mg/Nm3)
- Total OPEX saving: **$3.7 MM** (power, AS, NH_3)

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EADS vs. Reduction TGTU

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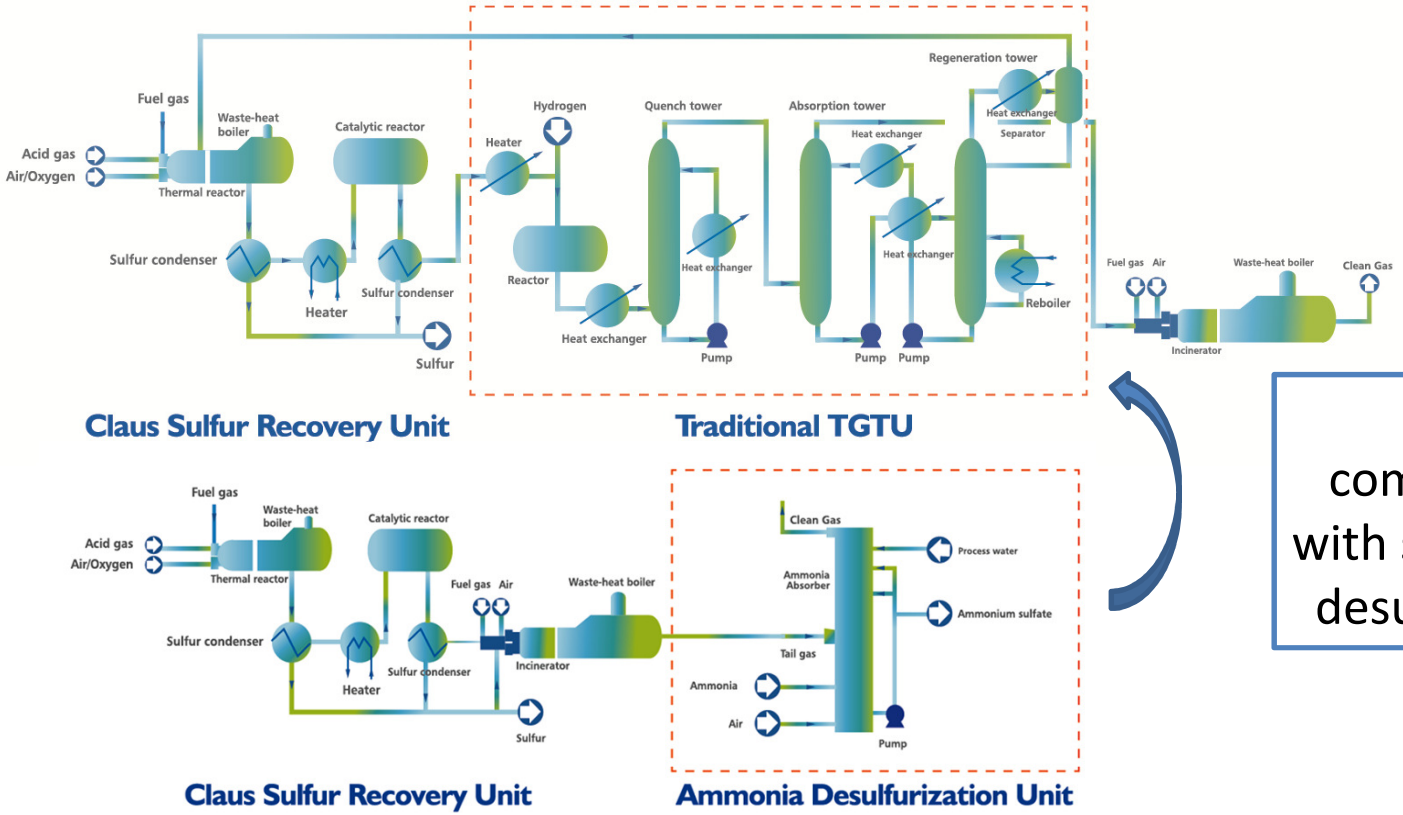

Replace the complicated TGTU with simple ammonia desulfurization unit

Ammonia Desulfurization vs. Reduction TGTU

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- Simpler process
- 35-50% less capital cost
- 40-60% less operating cost
- Higher total sulfur recovery efficiency (≥99.95%)
- Lower SO_2 emissions: 20 ppmv (SCOT: 70 - 140 ppmv)

Installations: SRU + Tail Gas Treatment

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	Client Name	Capacity, tpd *Sulfur + $(NH4)_2SO4$*	SO_2 emission ppmv
1	Yili Xintian Coal Chemical Co., Ltd.	130 + 26	20
2	Inner Mongolia Boda Shidi Chemical Co. Ltd.	140 +28	40
3	Liaoning Datang International Fuxin Coal-to-SNG Co., Ltd.	150 + 30	20
4	Yancon Cathay Coal Chemicals Co., Ltd	60 +18	20
5	China National Chemical Engineering Group Corporation Shanxi Yiye Energy Investment Co., Ltd	60 + 20	40
6	Datang International Hexigten Coal-to-SNG Co. , Ltd.	160 + 35 (Phase I)	20
7	Yitai Xinjiang Energy Co., Ltd., Yili Project	2*80 t/d sulfur	20
8	Yitai Xinjiang Energy Co., Ltd. , Ganquanbao project	91 + 11.5	15
9	Inner Mongolia Connell Chemical Industry Co., Ltd.	10.8 + 2.4	28
10	Hanggin Banner Yitai chemical industry Co., Ltd.	2*60 + 24	40
11	Hebei Qianhai Petrochemical Co., Ltd	43 + 8.6	40

Datang International, Hexigten Coal-to-SNG Co., Ltd.

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- Designed flow rate: **120,000 SCFM**
- SO_2 concentration: **4,500 ppmv**
- AS post treatment: **Shared with boiler FGD system**
- Ammonia source: **from aqueous ammonia purification system**

Datang International, Hexigten Coal-to-SNG Co., Ltd.

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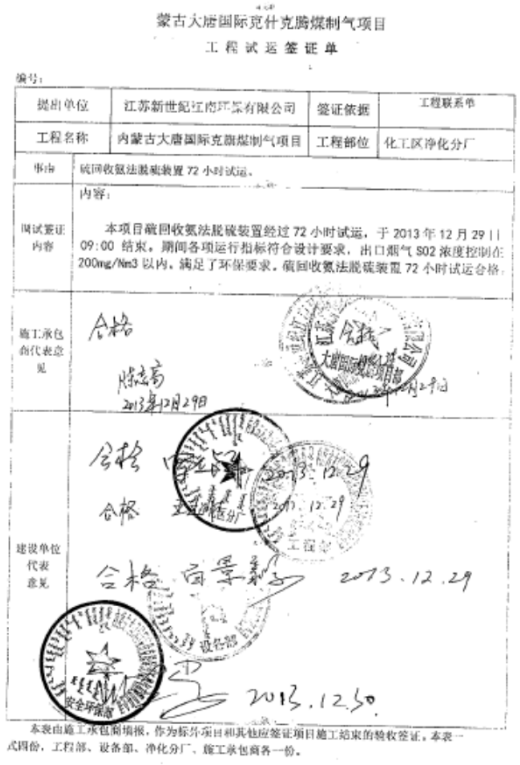
Technical parameters from 48-hour performance test

NO.		Unit	Designed value	Operation value
1	Flow rate	SCFM	≤ 121,000	26,100
2	Inlet SO_2	ppmv	≤ 4,410	4,310
3	Outlet SO_2	ppmv	≤ 70	27.7
4	Desulfurization efficiency	%	≥98	99.4
5	Outlet NH_3	ppmv	≤ 8	3.4
6	Ammonia recovery	%	≥ 97	99.2



蒙古大唐国际克什克腾煤制气项目

工程试运签证单

编号：

提出单位	江苏新世纪江南环保有限公司	签证依据	工程联系单
工程名称	内蒙古大唐国际克旗煤制气项目	工程部位	化工区净化分厂

事由：硫回收氨法脱硫装置 72 小时试运。

内容：

试运签证内容：本项目硫回收氨法脱硫装置经过 72 小时试运，于 2013 年 12 月 29 日 09:00 结束，期间各项运行指标符合设计要求，出口烟气 SO2 浓度控制在 200mg/Nm3 以内，满足了环保要求，硫回收氨法脱硫装置 72 小时试运合格。

施工承包商代表意见：合格

建设单位代表意见：合格 2013.12.29

2013.12.30

本表由施工承包商填报，作为标书项目和其他应签证项目施工结束的验收签证。本表一式四份，工程部、设备部、净化分厂、施工承包商各一份。

Thank You!

Contact Info

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