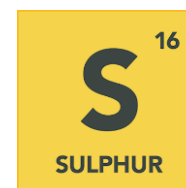
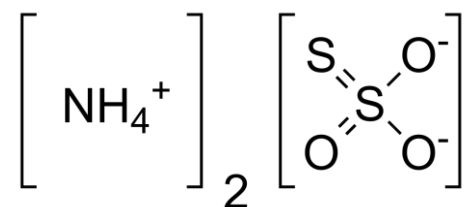


UNCONVENTIONAL SRU CAPACITY DEBOTTLENECKING VIA ATS PRODUCTION

JOZEF HALÁS

10/2017 – Budapest – RefComm® Conference



BASIC INFORMATION ON EXISTING SRU

- Units (Year of Commissioning): **SRU 100** (2000), **SRU 200** (1998)
- Licensor: Jacobs' Comprimo® Sulfur Solutions (NL)
- Contractor: Jacobs' Comprimo® Sulfur Solutions (NL)
- Process: **SuperClaus®**
- Design Capacity: **2x 135 t/day**
- Max. Capacity: **2x 142 t/day**
- Max. S Content in Crude Oil: **1,76 % wt.**
- Sulphur Recovery Efficiency: **min. 99 % (≈ 99,3 %)**

1)



4)

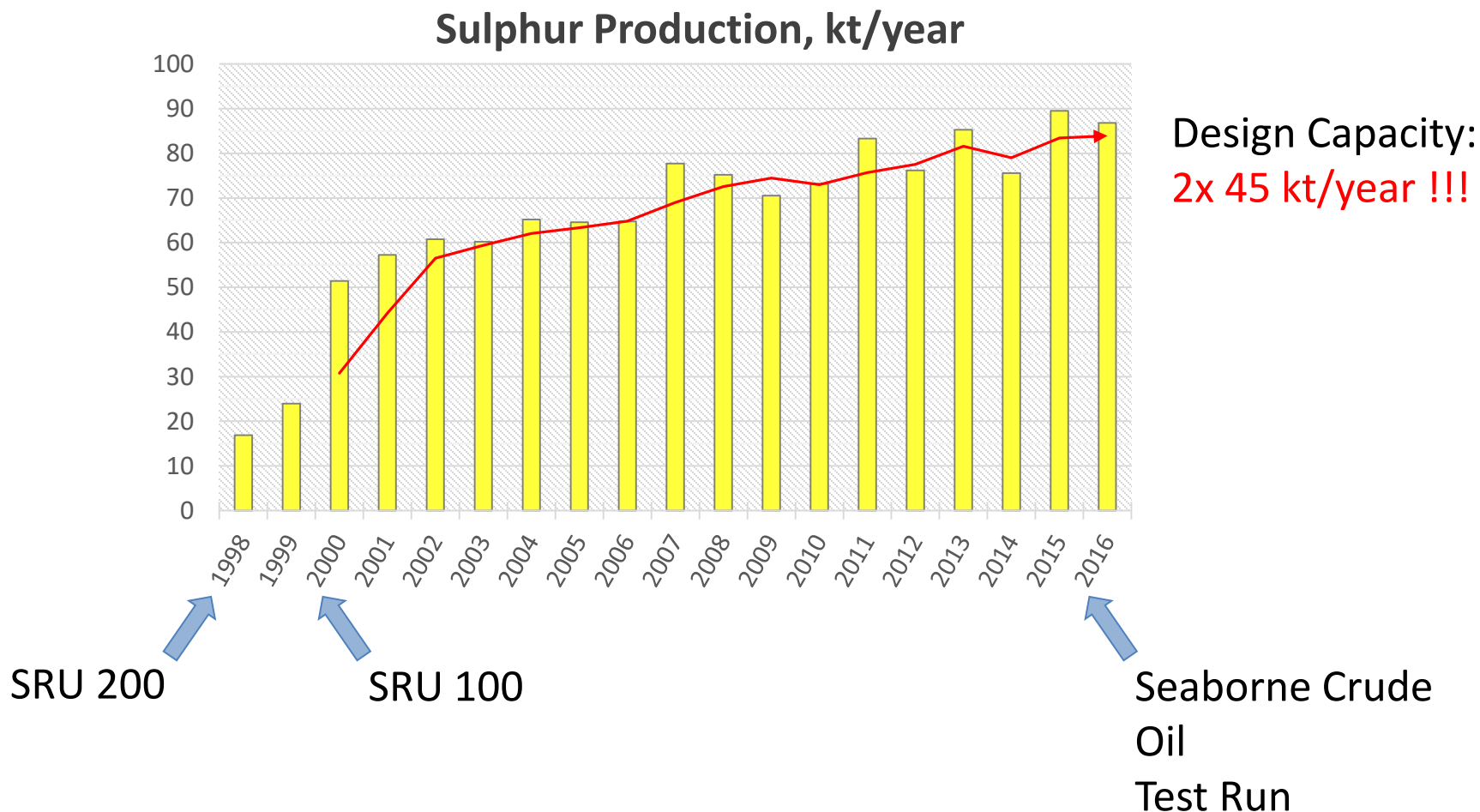


2)



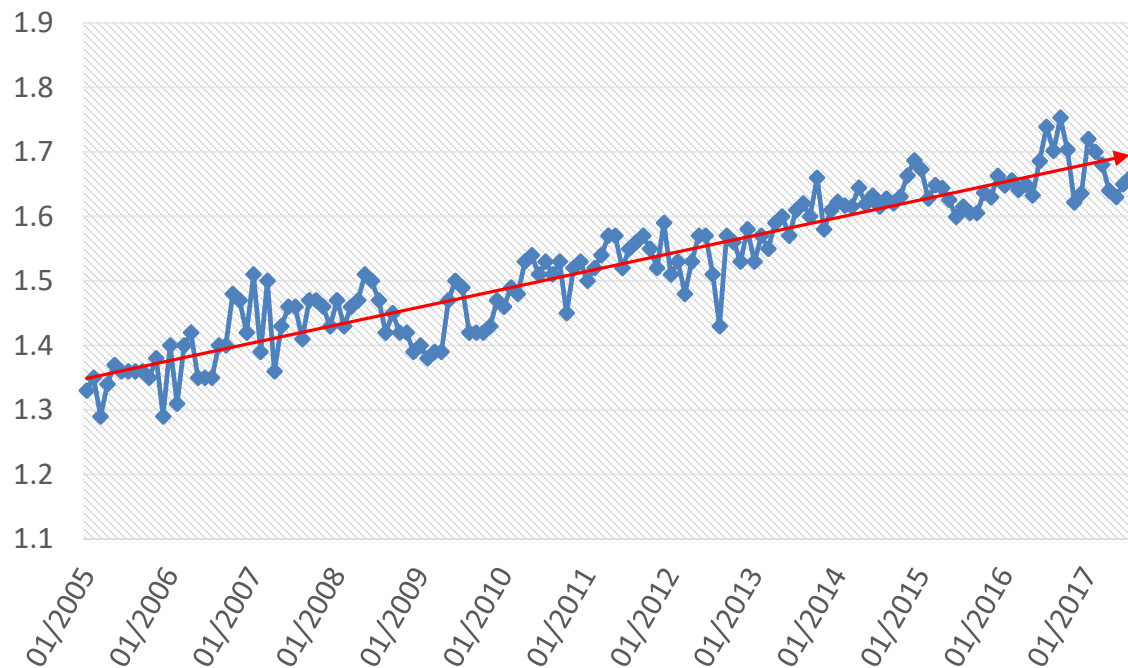
3)

LOCATING BOTTLENECK



IDENTIFYING ROOT CAUSE

REB Sulphur Content, % wt.



Max. Sulphur Content
in Crude Oil:
1,76 % wt. !!!

HOW TO INCREASE ACID GASES PROCESSING CAPACITY?

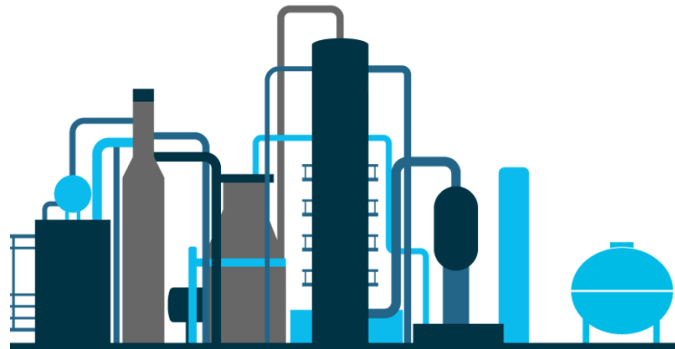
Expand SRU Capacity:

- ▶ O₂ Enrichment;
- ▶ Revamp of Existing SRU;
- ▶ New SRU;

Sulphur: Co-Product or By-Product?.

Other options:

- Two-Stage SWS
- Two-Stage SWS + SCO
- SWAATS®

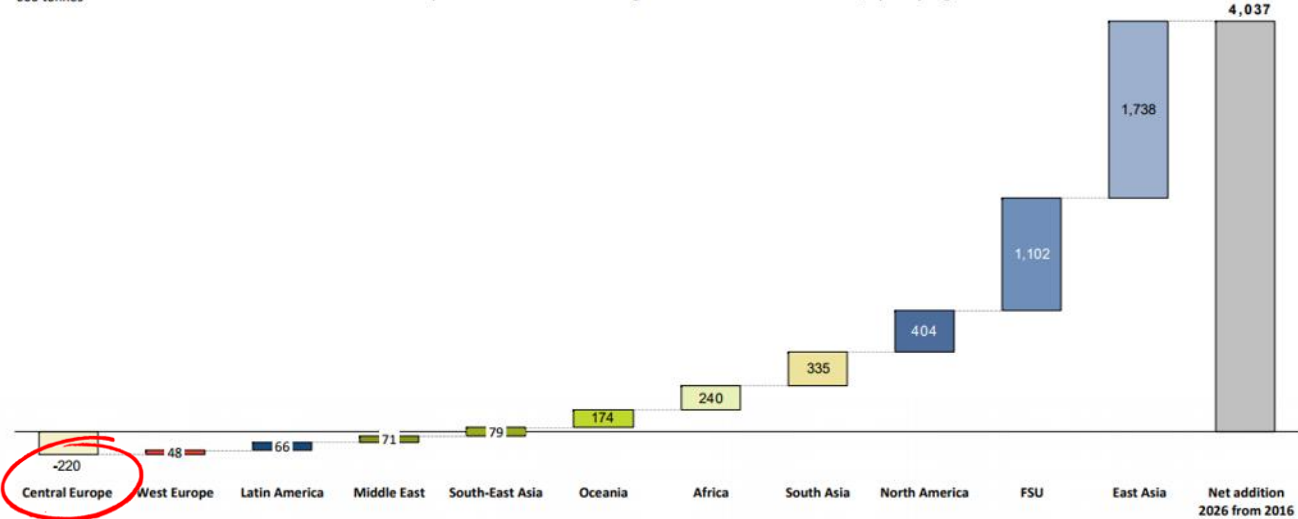


SULPHUR MARKET OUTLOOK

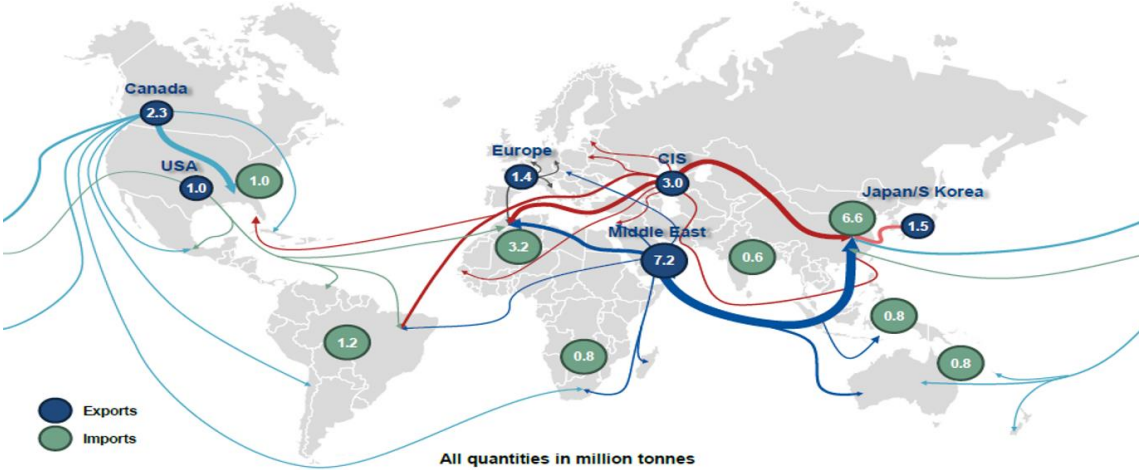
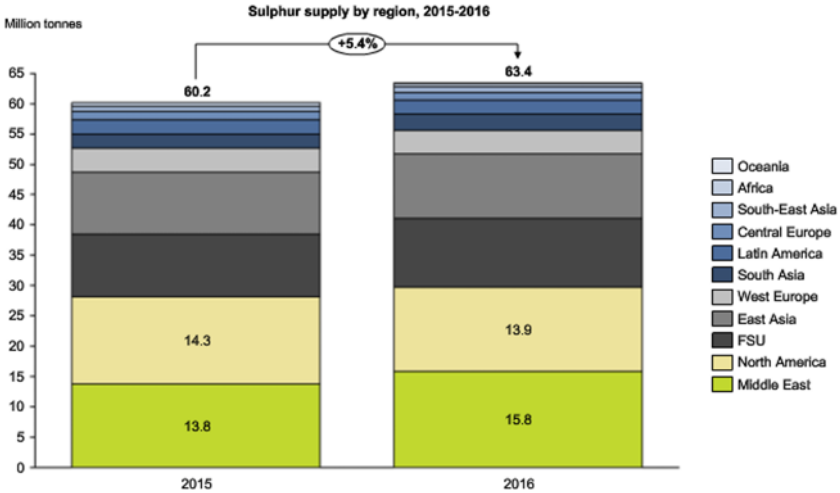
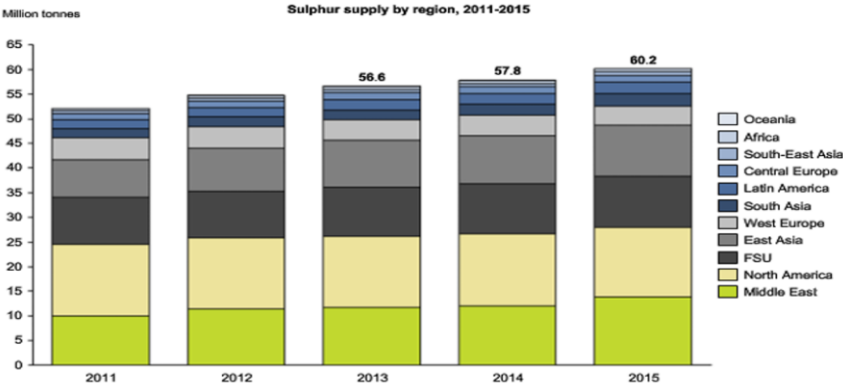


'000 tonnes

Net sulphur non-fertilizer demand growth between 2016 and 2026, split by region



SULPHUR MARKET OUTLOOK



HOW TO INCREASE ACID GASES PROCESSING CAPACITY?

Expand SRU Capacity:

- O₂ Enrichment
- Revamp of Existing SRU
- New SRU



Other options:

- ▶ Two-Stage SWS;
- ▶ Two-Stage SWS + SCO $\rightarrow 4\text{NH}_3 + 3\text{O}_2 \leftrightarrow 2\text{N}_2 + 6\text{H}_2\text{O};$
- ▶ SWAATS® $\rightarrow 6\text{NH}_3 + 4\text{SO}_2 + 2\text{H}_2\text{S} + \text{H}_2\text{O} \leftrightarrow 3(\text{NH}_4)_2\text{S}_2\text{O}_3.$

AMMONIUM THIOSULPHATE

Applications:

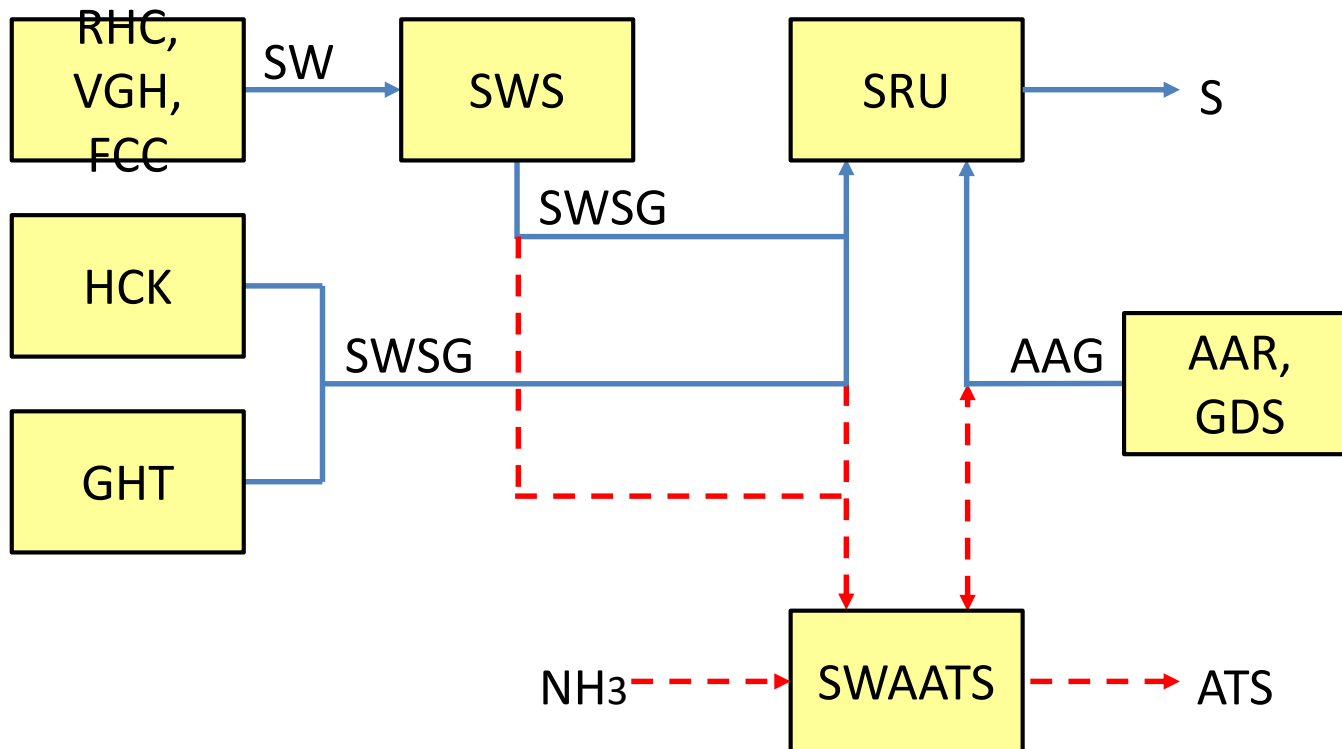
- (Rapid Photographic Fixer);
- Catalyst in Precious Metals Leaching;
- **Fertilizer**;
- Additive to Coal-Waste Mixtures (?);



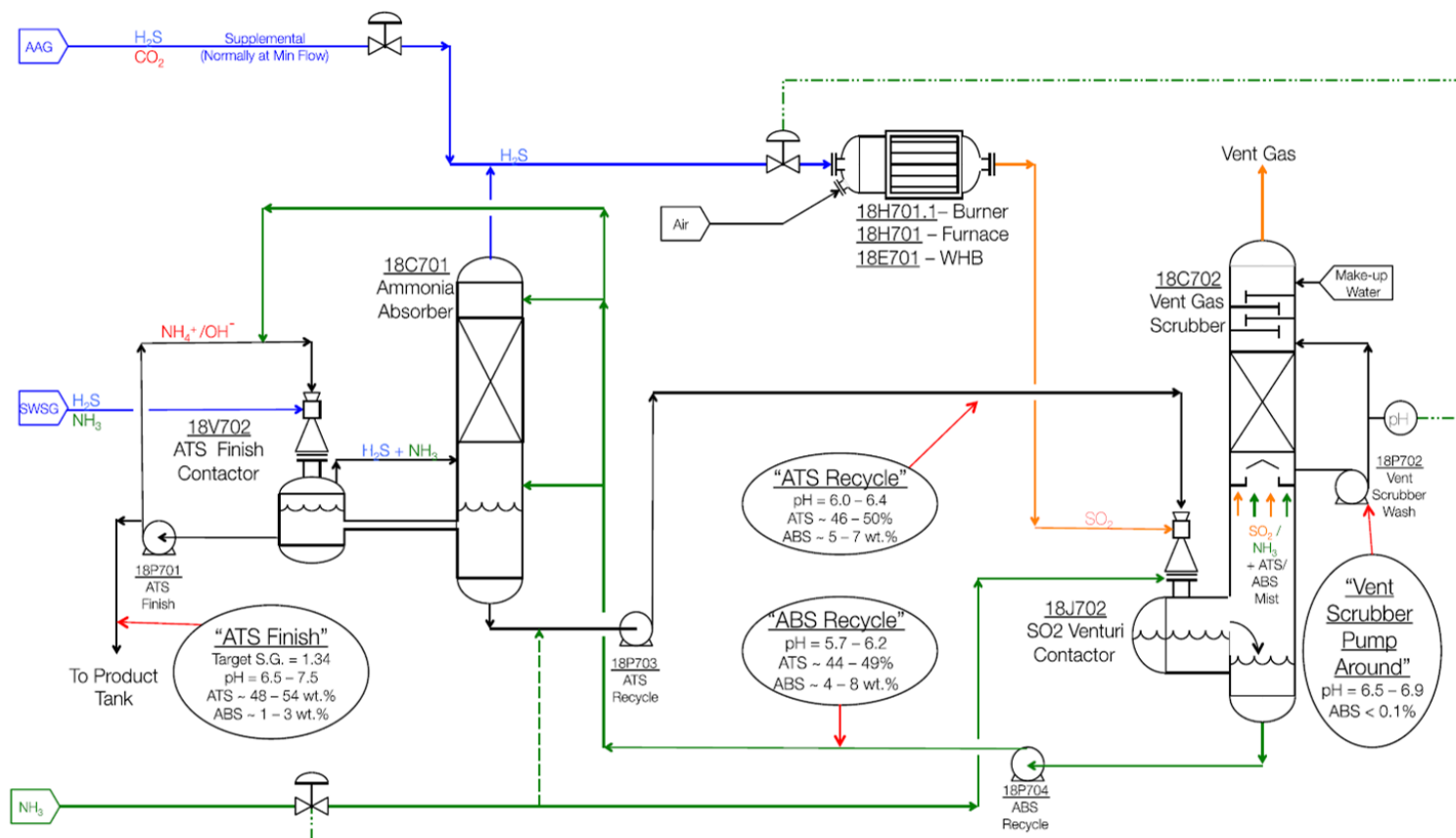
Typical Product Properties:

- State: Aqueous Solution, 52,0 – 62,0 Wt%;
- N content: 11,5 – 12,5 Wt%;
- S content: 25,5 – 26,5 Wt%;
- pH: 6,5 – 8,0.

SWAATS® – SRU RELATION



SWAATS® – PROCESS DIAGRAM



Ammonium Bisulfite (ABS):	$(\text{NH}_4)\text{HSO}_3$
Di-Ammonium Sulfite (DAS):	$(\text{NH}_4)_2\text{SO}_3$
Ammonium Thiosulfate (ATS):	$(\text{NH}_4)_2\text{S}_2\text{O}_3$

SWAATS® & ECONOMICS

1. Frees Capacity on SRU for 141 t/day of H₂S;
2. Reduced Operating Costs & Better Process Control in SRU;
 - MP Steam from SWAATS;
 - Longer Catalyst Life;
3. Lower CAPEX than Claus and Amine-Base Tail Gas Treatment of SWSG;
4. Negative Operating Costs;
 - Electricity Consumption vs MP Steam Production;
5. Increased Value of S in Form of ATS;
6. No Increase in Operator Count.

NEW SRU CAPABILITIES

	Design	Forecast
• Capacity: t/day	2x 135 t/day	2x 165
• Max. S Content in Crude Oil: 2,27 % wt.	1,76 % wt.	
• Sulphur Recovery Efficiency: ≈ 99,5 %	min. 99 % (≈ 99,3 %)	

Thermal Stage: $\text{H}_2\text{S} + 1,5\text{O}_2 \leftrightarrow \text{SO}_2 + \text{H}_2\text{O}$;

Claus Reaction: $2\text{H}_2\text{S} + \text{SO}_2 \leftrightarrow 3/8\text{S}_8 + 2\text{H}_2\text{O}$;

Overall Reaction: $1\text{H}_2\text{S} + 0,5\text{O}_2 \leftrightarrow 1/8\text{S}_8 + \text{H}_2\text{O}$;

NH_3 Combustion: $1\text{NH}_3 + 1,5\text{O}_2 \leftrightarrow 0,5\text{N}_2 + 1,5\text{H}_2\text{O}$.

SWAATS® & OPERATION

1. Improved Control over H₂S/SO₂ Ratio in SRU;
2. Low Demand for Operator Attention;
3. Able to Recover from Upsets;
 - Dissolving Elemental  $S + SO_3^{2-} \leftrightarrow S_2O_3^{2-}$.



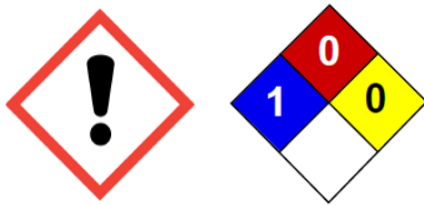
SWAATS® & ENVIRONMENT

1. Reduced SO₂ Emissions;
 - Multistage Liquid Scrubbing of Vent Gas (SRE: 99,75 %);
 - Improved S Conversion and Recovery in SRU (SRE: 99,5 %);
2. Reduced CO₂ Emissions;
 - MP Steam from SWAATS;
 - No Fuel Consumption;
 - No Need for NH₃ Synthesis;
3. Reduced requirements for N Fertilizers and loss of (NO₃)⁻ to ground water;
 - Improved Crop Utilization of Fertilizer N.



SWAATS® & HEALTH & SAFETY

1. ATS Has Low Toxicity and Is Stored at Atmospheric Pressure and
ire;

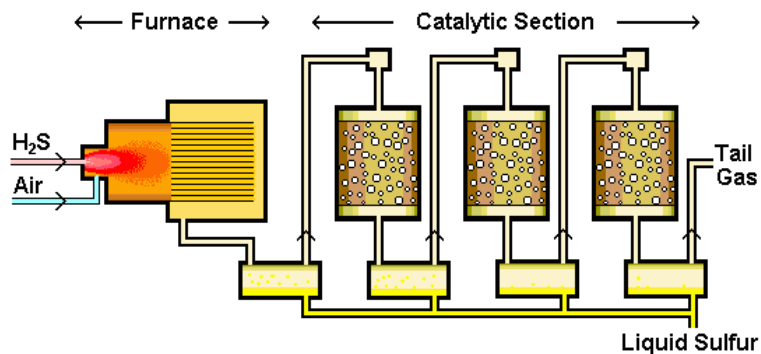


2. Chemistry Minimizes Risk of H₂S Escape Resulting from Liquid Leakage.



SWAATS® NOW UNDER
CONSTRUCTION

THANK YOU FOR YOUR ATTENTION
IF YOU HAVE ANY QUERIES, PLEASE, FEEL FREE TO ASK..



..OR CONTACT US:



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