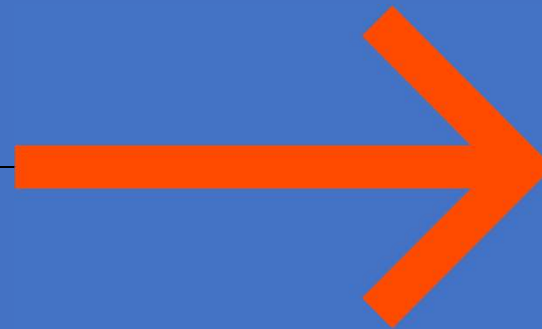
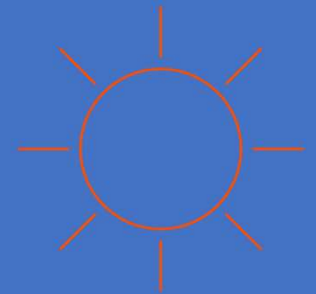


TOPCLAUS™ - DESTRUCTION OF SO₃ IN CLAUS THERMAL REACTORS

José Vicente Revilla Perez & Morten Thellefsen
TOPSOE

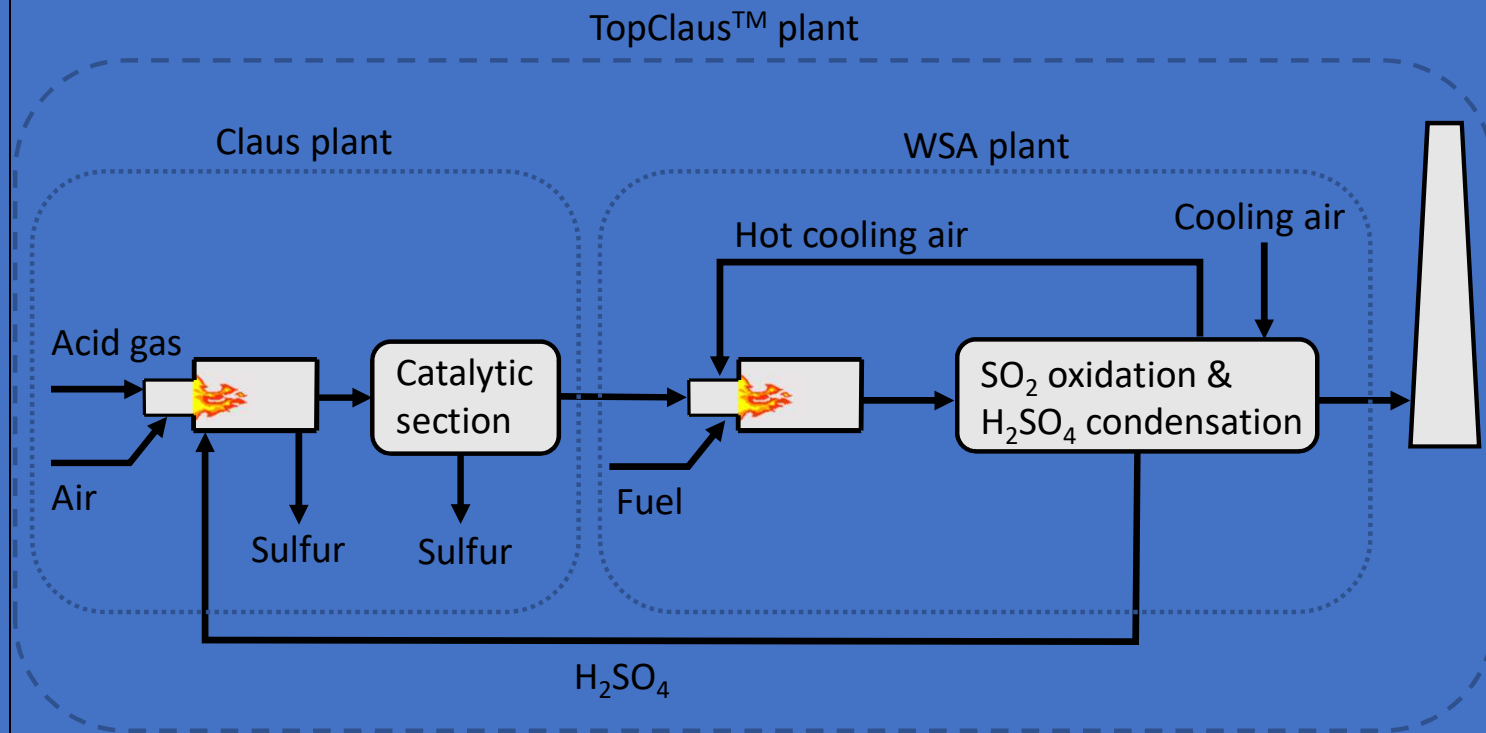


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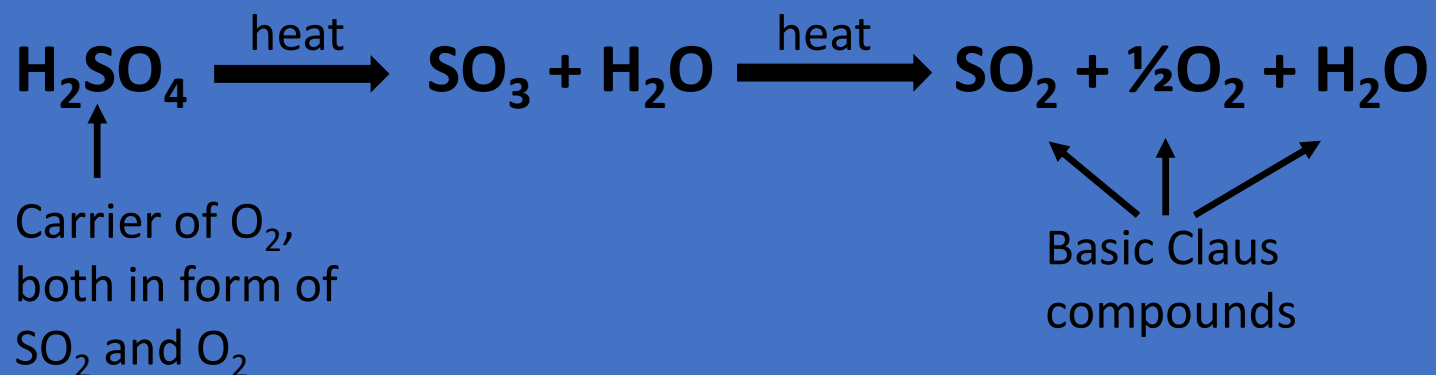


The TopClaus™ process – a novel combination of well-known technologies

- > 99.97 % sulfur recovery
- Up to 10% lower process gas flow in Claus plant
- Complete oxidation of sulfur compounds, H₂ and CO in WSA plant
- Very high energy recovery



Fate of H_2SO_4
in Claus
thermal reactor
– fast thermal
decomposition
into basic Claus
compounds

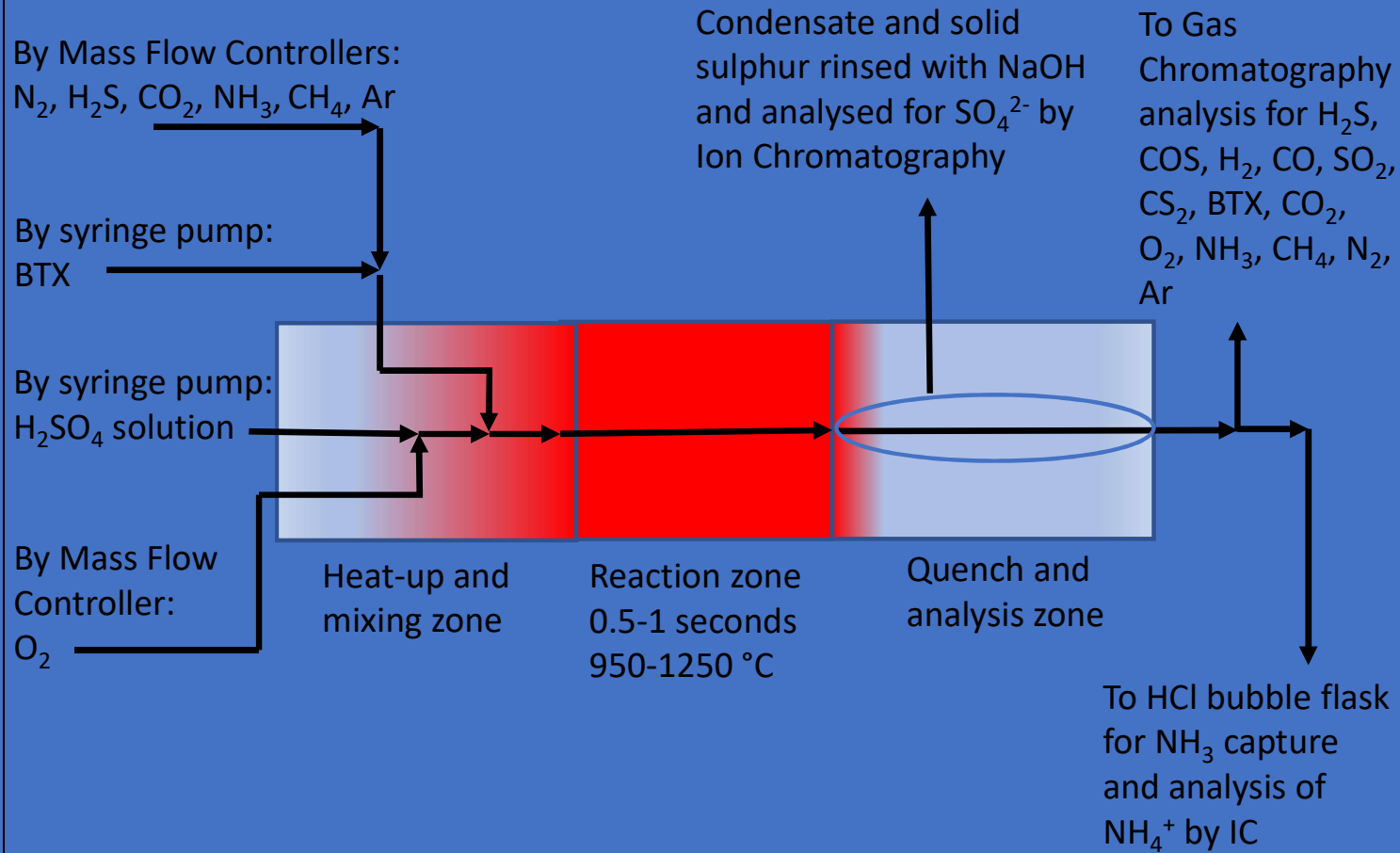


Thermodynamically, SO_3 and H_2SO_4 cannot exist in Claus process gas

Kinetically, are the chemical reactions fast enough to be completed in 1-2 seconds?

Will there be positive/negative interactions between H_2SO_4 and BTX and/or NH_3 ?

Laboratory setup to test thermal decomposition of H_2SO_4 in Claus thermal reactor – tests carried out at Alberta Sulphur Research Ltd.



H₂SO₄
destruction in
Claus process
gases,
experimental
work and
theoretical
modelling

H₂SO₄ VAPOR DESTRUCTION EXPERIMENTS:

ACID GAS FEED: 55 VOL% H₂S, 36 VOL% CO₂, 1.5 VOL% CH₄, 7.5 VOL% H₂O

REACTOR TEMPERATURE : 1050 °C

H ₂ SO ₄ feed	6 %	6 %	10 %	15 %
Residence time	1 sec	0.5 sec	1 sec	1 sec
H ₂ SO ₄ destruction	> 99.95 %	> 99.95 %	> 99.98 %	> 99.98 %

6 % H₂SO₄ of total sulfur feed correspond to ~15,000 ppmv H₂SO₄ in the feed gas

Normal residence time in Claus thermal reactor is 1-2 sec

H₂SO₄ outlet concentrations below quantification limit, estimated to ~ 10 ppmv

Theoretical modelling of H₂SO₄ destruction showed complete destruction within 0.002 sec.

H₂SO₄
destruction in
the presence
of BTX –
interactions
and/or side
reactions?

H₂SO₄ VAPOR DESTRUCTION EXPERIMENTS:

ACID GAS FEED: 55 VOL% H₂S, 36 VOL% CO₂, 1.5 VOL% CH₄, 7.5 VOL% H₂O

H₂SO₄: 6 % OF TOTAL SULFUR FEED

BTX: 2000 PPMV (4 BENZENE: 3 TOLUENE: 1 XYLENE)

REACTOR TEMPERATURE : 1050 °C

RESIDENCE TIME : 1 SEC

Temperature	1050 °C	950 °C
BTX destruction	99.5 %	85 %
H ₂ SO ₄ destruction	> 99.95 %	> 99.95 %

BTX destruction similar to H₂SO₄ free conditions.

Unconverted BTX was primarily Benzene

H₂SO₄ outlet concentrations below quantification limit, estimated to ~ 10 ppmv. Inlet

H₂SO₄ concentration ~15,000 ppmv

H₂SO₄
destruction in
the presence
of NH₃ –
interactions
and/or side
reactions?

H₂SO₄ VAPOR DESTRUCTION EXPERIMENTS:

ACID GAS AND SWS GAS FEED: 63 VOL% H₂S, 19 VOL% H₂O, AR BALANCE

H₂SO₄: 6 % OF TOTAL SULFUR FEED

NH₃: 13,000 PPMV

RESIDENCE TIME : 1 SEC

Temperature	1250 °C	1100 °C
NH ₃ destruction	> 99.95%	96.4 %
H ₂ SO ₄ destruction	> 99.95%	99.4 %

NH₃ destruction similar to H₂SO₄ free conditions

H₂SO₄ outlet concentrations below quantification limit at 1250 °C, estimated to ~ 10 ppmv.

Inlet H₂SO₄ concentrations ~15,000 ppmv

Incomplete H₂SO₄ destruction at 1100 °C could be a result of chemical reactions in the sampling system in the presence of unconverted NH₃

Conclusions:
 H_2SO_4 is quickly destroyed in the TopClaus™ process and will not effect the Claus chemistry

COMPLETE H_2SO_4 DESTRUCTION AT INDUSTRIAL CLAUS REACTION FURNACE CONDITIONS

- **BTX DESTRUCTION UNAFFECTED BY PRESENCE OF H_2SO_4**
- **NH_3 DESTRUCTION UNAFFECTED BY PRESENCE OF H_2SO_4**

TOPCLAUS™ PROCESS

- **NOVEL COMBINATION OF WELL-KNOWN CLAUS AND WSA TECHNOLOGIES**
- **DEVELOPED IN COOPERATION WITH COMPRIMO**
- **> 99.97 % SULFUR RECOVERY**
- **H_2SO_4 IS AN O_2 CARRIER, REDUCING NEED FOR AIR**
- **UP TO 10% LOWER PROCESS GAS FLOW FOR SAME CAPACITY**
- **HIGH THERMAL EFFICIENCY**

QUESTIONS?

Contact José or Morten
read IAPG paper

Visit www.topsoe.com

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