SPRING 2019 PAPTAC BLEACHING COMMITTEE MEETING, QUINNESEC-MI

Sulphuric Acid for Bleach Plant from NCGs

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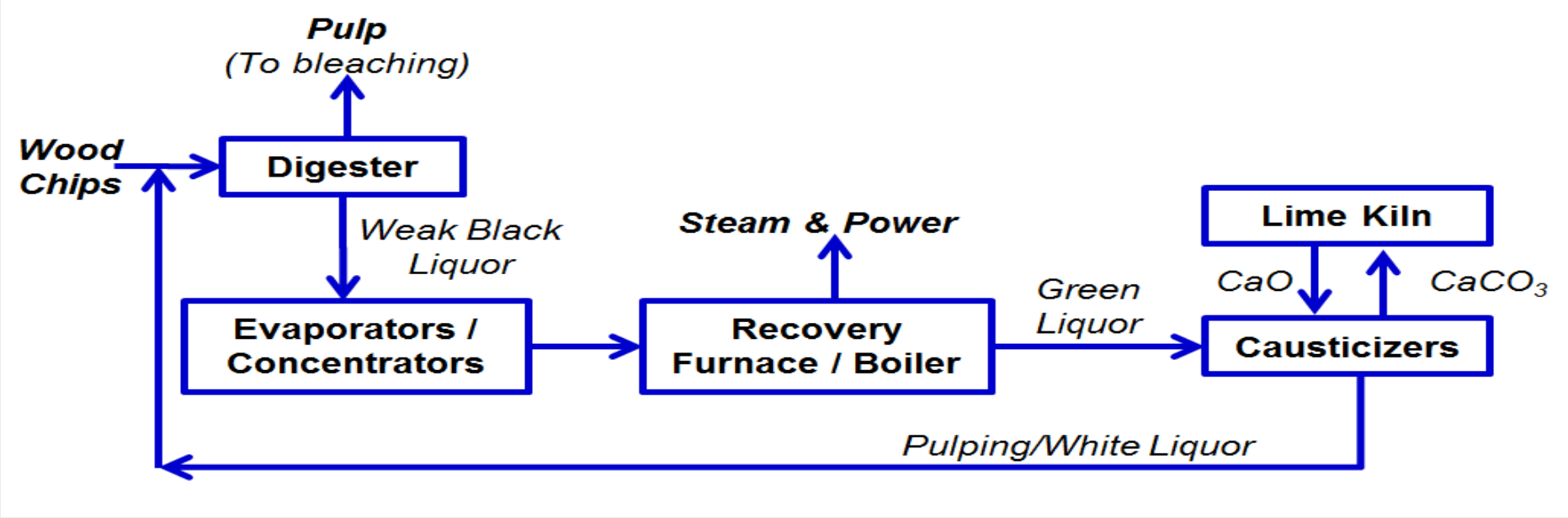
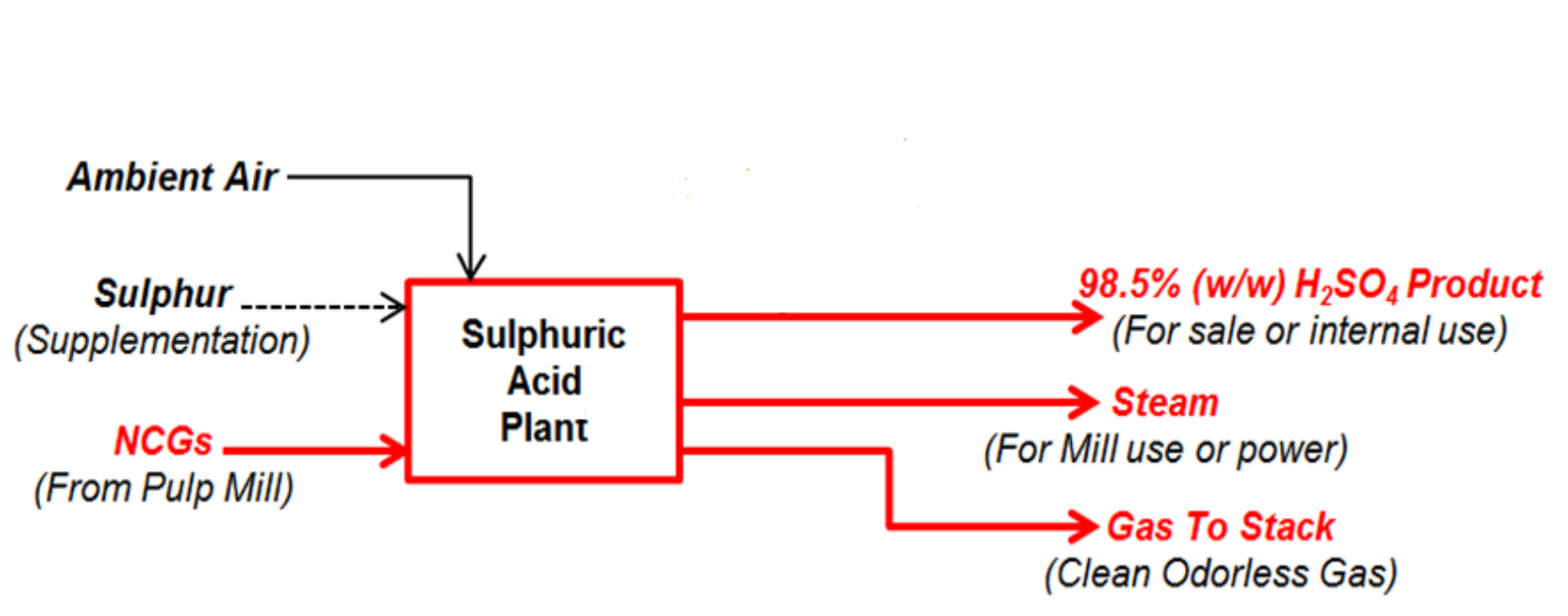
KRAFT PROCESS GENERAL DIAGRAM



Sulphuric Acid from NCGs Diagram



CONCENTRATED NCG OVERVIEW

- Hazardous (odorous) gas emitted in a Kraft cycle from digester and evaporator areas
- Contains reduced sulphur compounds
  - Hydrogen sulfide, Methyl Mercaptan, Dimethyl-sulfide, Dimethyl-disulfide
  - 2 - 5 kg of Sulphur in NCG / ton of pulp
- CNCG gases are typically treated by incineration in a power boiler, recovery boiler, lime kiln or a dedicated incinerator

NCG Acid Technology

Process

- **Combustion of Sulphur-Containing Species**

$$2H_2S + 3O_2 \longrightarrow 2SO_2 + 2H_2O \qquad \Delta H^{\circ}_{298} = -518 \quad kJ \cdot mol^{-1}$$

$$S + O_2 \longrightarrow SO_2 \qquad \Delta H^{\circ}_{298} = -297 \quad kJ \cdot mol^{-1}$$

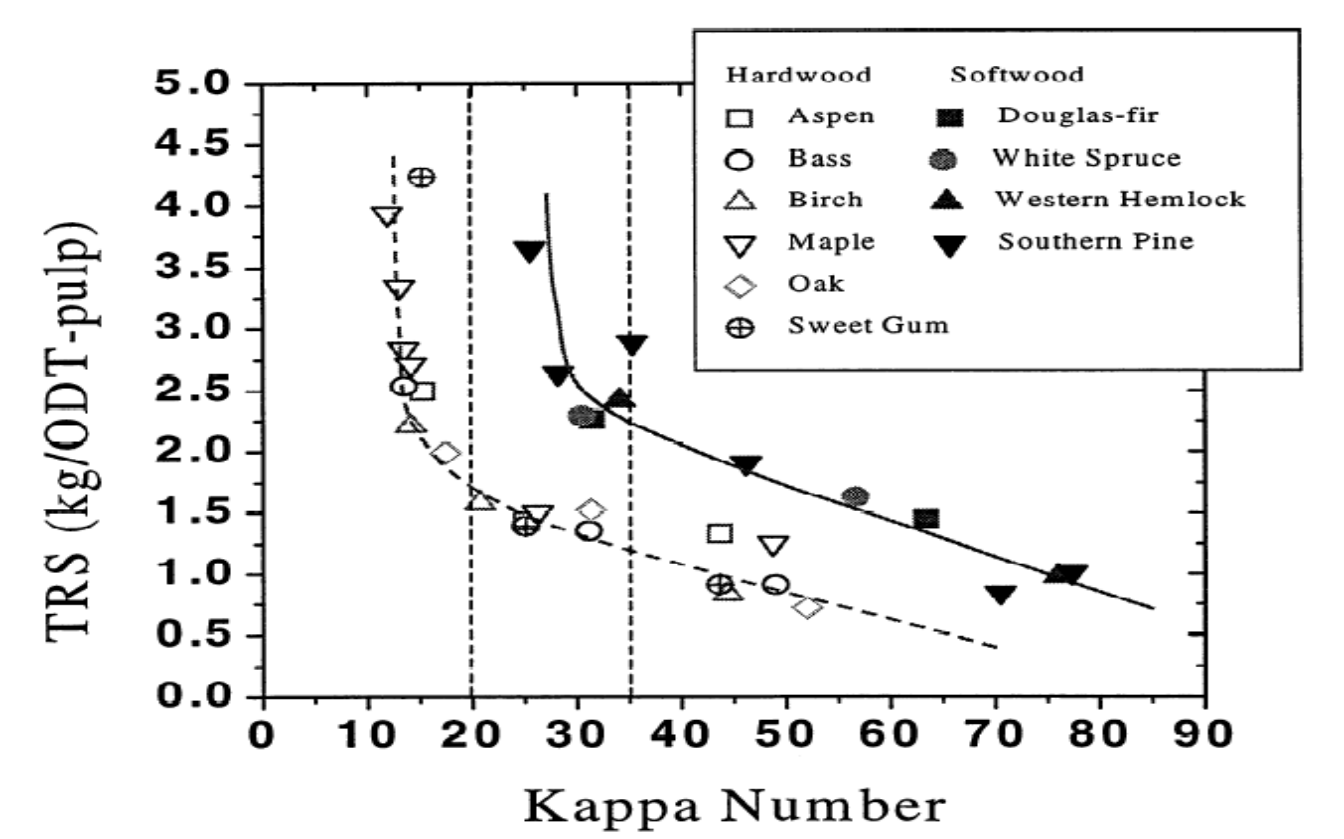
- **Reaction in Catalytic Converter (High-Vanadium Catalyst)**

$$SO_2 + \frac{1}{2}O_2 \leftrightarrow SO_3 \qquad \Delta H^{\circ}_{298} = -99 \quad kJ \cdot mol^{-1}$$

- **Hydration of Sulphur Trioxide**

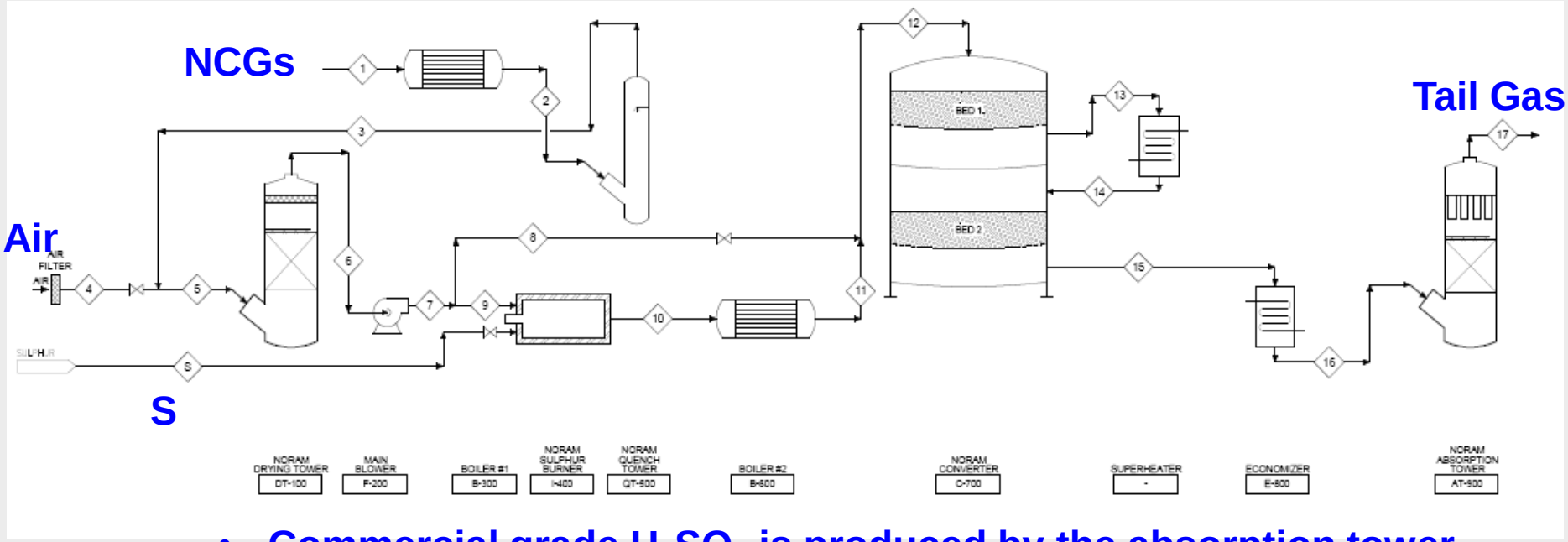
$$SO_3 + H_2O \rightarrow H_2SO_4 \qquad \Delta H^{\circ}_{298} = -101 \quad kJ \cdot mol^{-1}$$

VARIABILITY OF NCG CONDITIONS DEPENDING ON PULPING CONDITIONS



NCG Acid Technology

Process



- Commercial grade H_2SO_4 is produced by the absorption tower
- High-pressure steam is produced by the steam system.

NCG Acid Technology

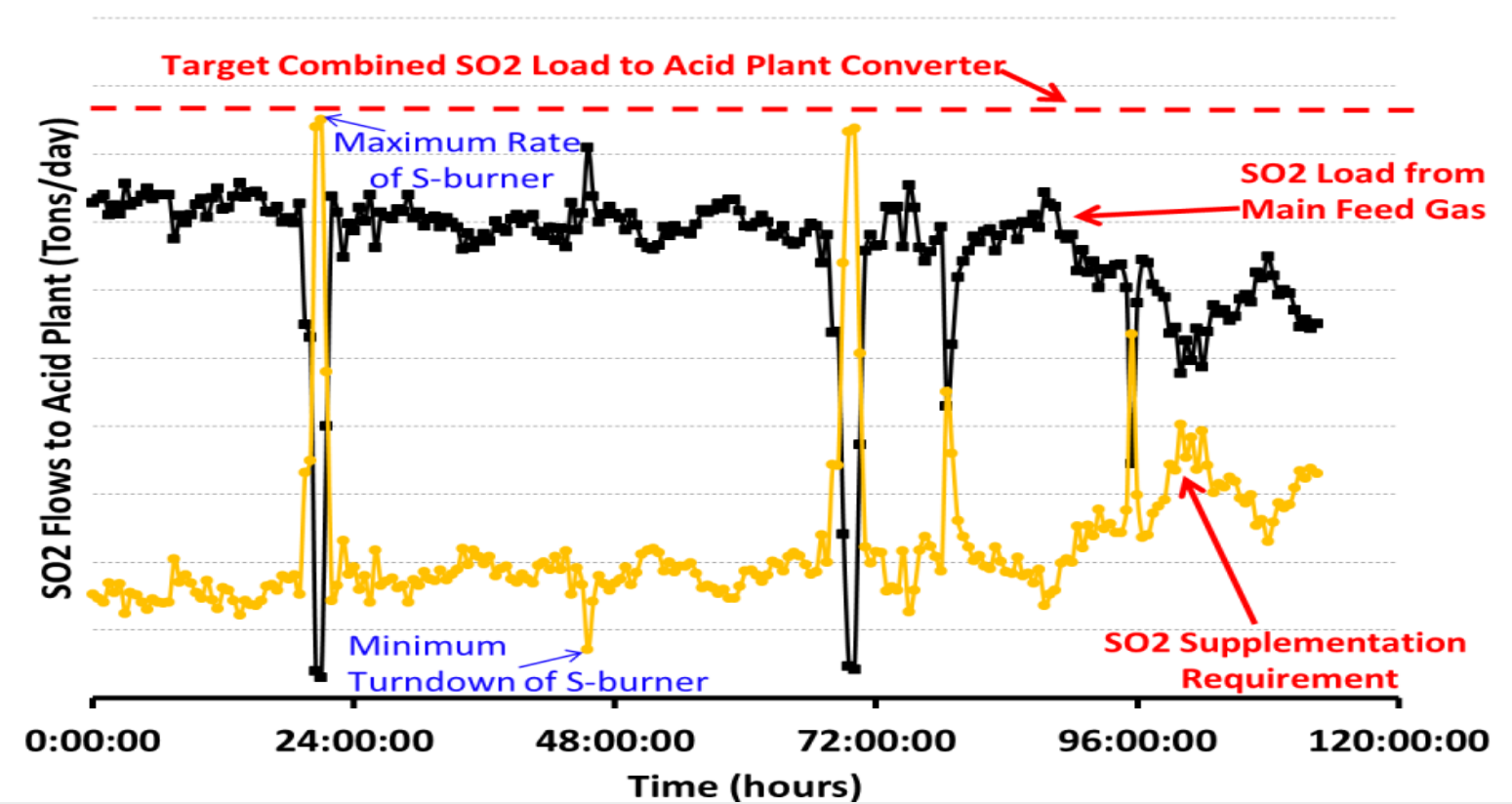
Process

By supplementing sulphur, SO_2 concentrations of 8+% (vol/vol) can be achieved, allowing for higher acid and steam production rates with a relatively small impact on capital expense.

The production rate can be more than doubled for a given equipment size.

This higher capacity allows the plant to produce acid for internal use as well as for use in other processes and for sales.

EXAMPLE OF SO_2 SUPPLEMENTATION TO DEAL WITH VARIABLE LOADS SCENARIOS



NCG Acid Technology

Advantages

- High strength commercial grade sulphuric acid **>93%** which reduces corrosion risk and allows use of carbon steel equipment
- Ability to deal with **feed variability** while maintaining high reliability
- Ability to maintain **constant SO_2 concentration** to acid plant
    - Minimization of thermal recycling
    - Minimization of risk of corrosion due to acid condensation
    - Operation above the water-balance limit
    - Operation above the autothermal limit
- Good operability

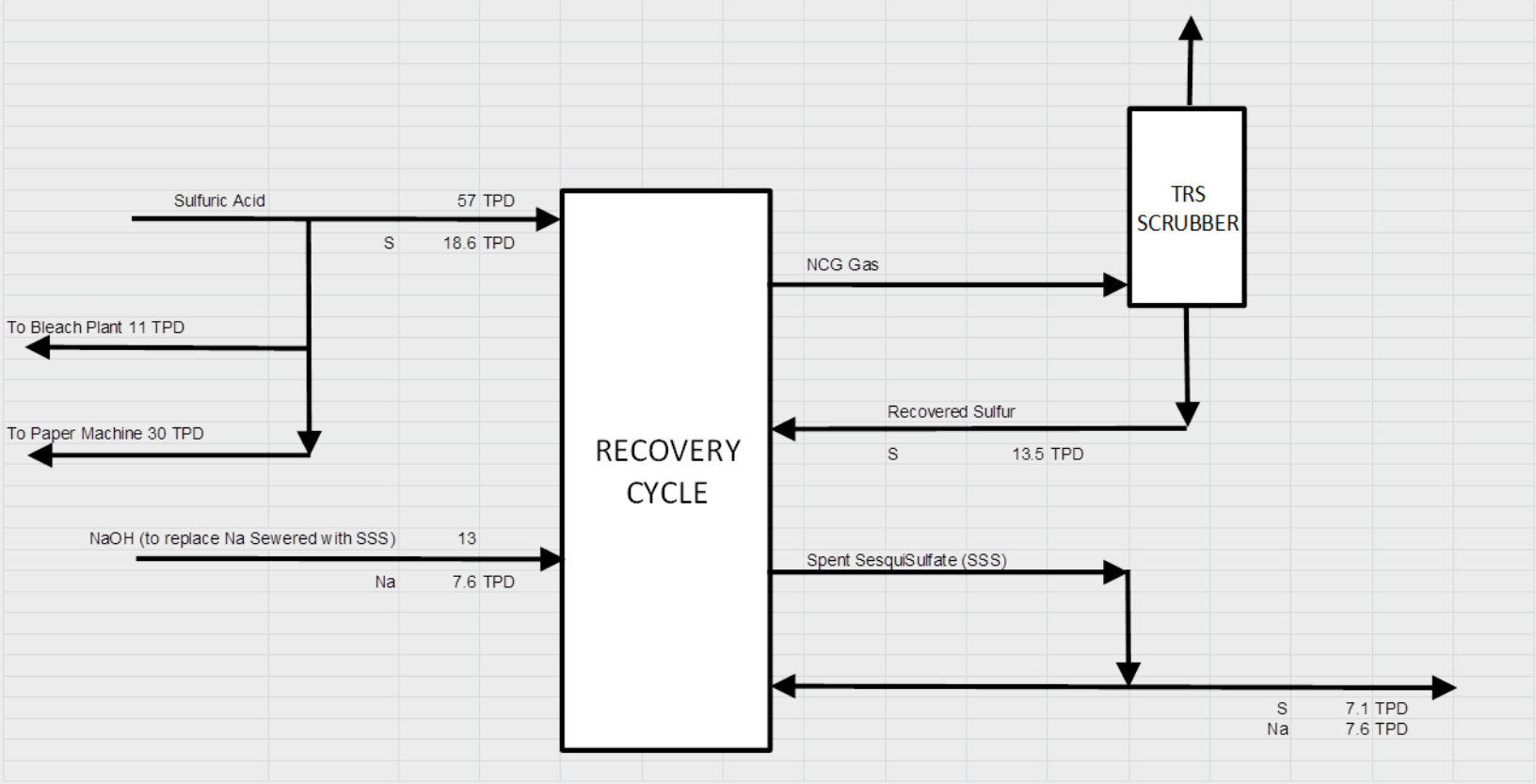
NCG Acid Technology

Advantages

- **Savings** due to a reduction in purchased NaOH
- **Revenue** from commercial grade H_2SO_4 product
- **Revenue** from steam production
- Proven equipment designs and long track record in the sulphuric acid industry.

Example Mill Acid Plant

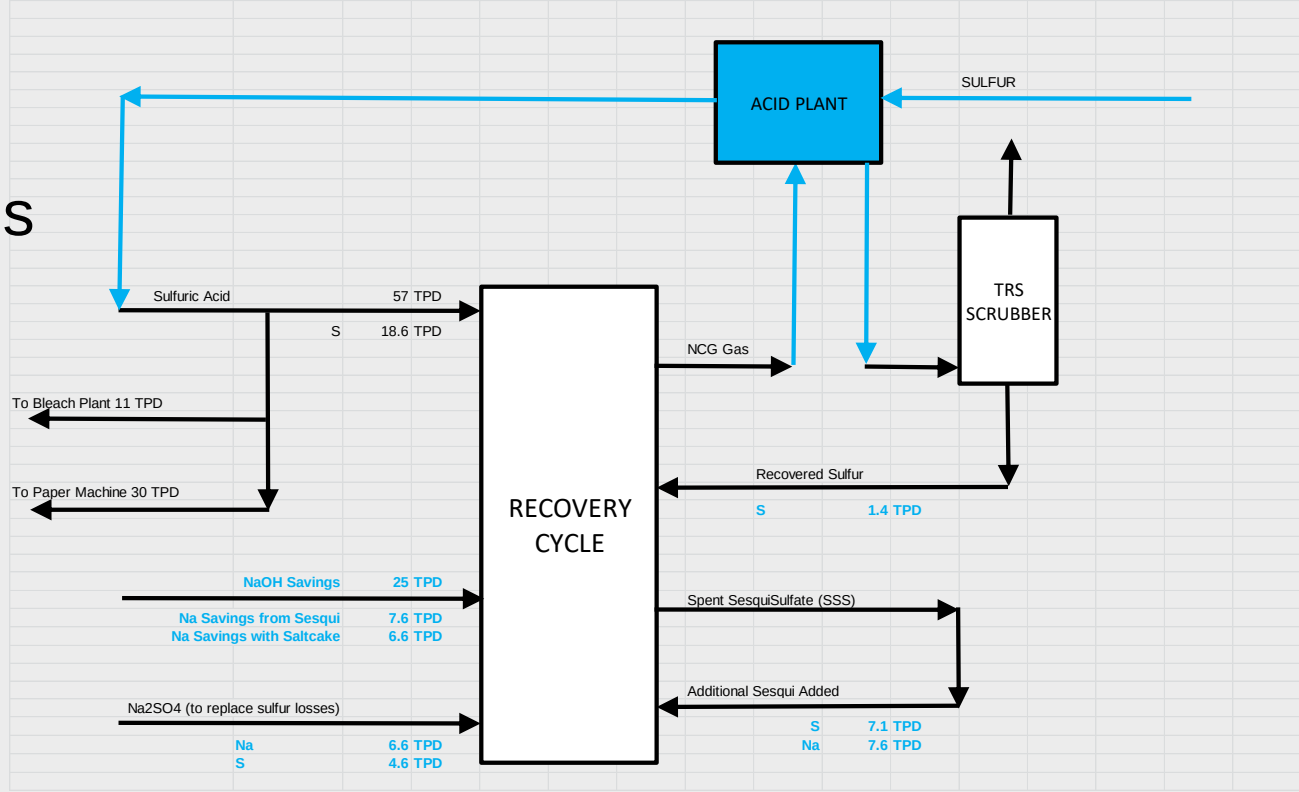
Mill Balance - Current



Example Mill Acid Plant

Mill Balance – with Acid Plant

- Acid Savings
  - 98 TPD
- Caustic Savings
  - 25 TPD

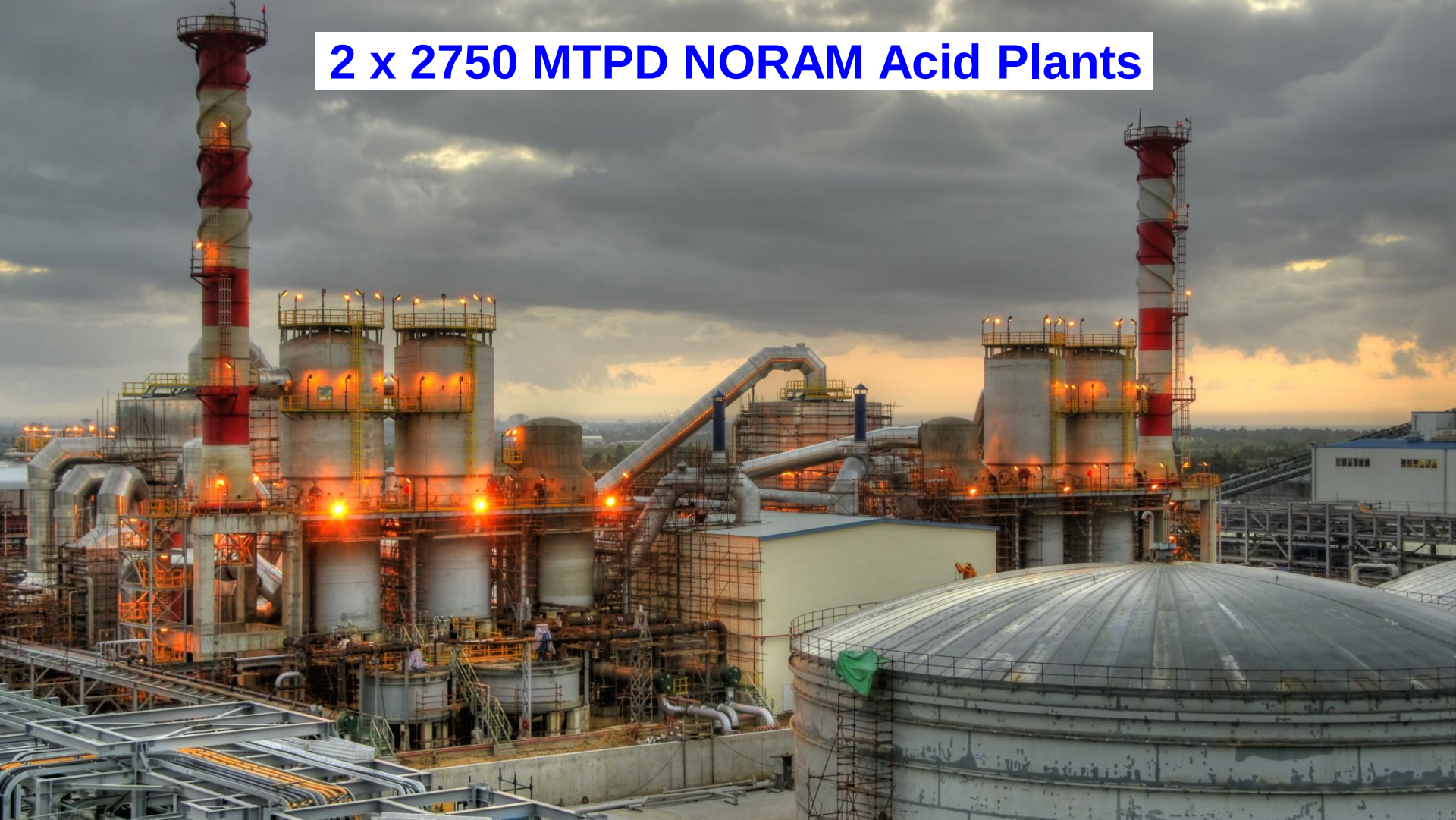


NCG Acid Technology

Economics

- Savings $8.1 million annually
  - Sulfuric Acid 98 TPD $3,300,000
  - Caustic 25 TPD $3,600,000
  - CaO 16 TPD $600,000
  - Steam Production $600,000
- Costs $2.25 million
  - Sulfur 25 TPD ($1,200,000)
  - Electricity 0.522 MW ($250,000)
  - Na_2SO_4 20 TPD ($840,000)
- Net Savings $5.85 million annually
- Two year payback for this particular case

2 x 2750 MTPD NORAM Acid Plants



300 MTPD NORAM SO2 Plant

THANK YOU