



**CANSOLV TECHNOLOGIES INC.**

# **Leading Edge of SO<sub>2</sub> Scrubbing Technology**



# CANSOLV<sup>®</sup> SYSTEM TECHNOLOGY

- **A REGENERABLE SO<sub>2</sub> ABSORPTION PROCESS**
- **SIMILAR TO H<sub>2</sub>S/CO<sub>2</sub> AMINE TREATERS**
- **USES CONVENTIONAL EQUIPMENT**
- **AQUEOUS DIAMINE SOLVENT IS HIGHLY SELECTIVE FOR SO<sub>2</sub>**
- **PURE, WATER SATURATED SO<sub>2</sub> BYPRODUCT**
- **A VERY ROBUST, EASY TO OPERATE PROCESS**
- **ALMOST ZERO EMISSIONS AT LOW COST**
- **PATENTED TECHNOLOGY**

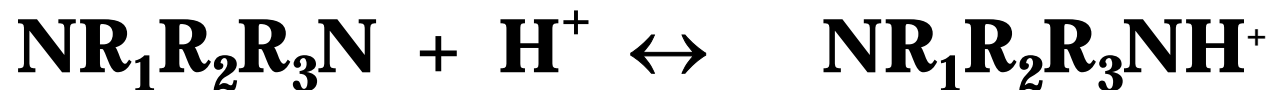
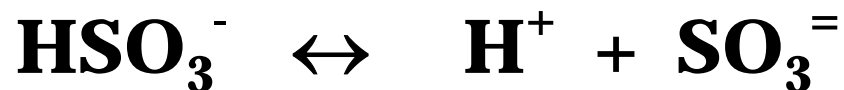
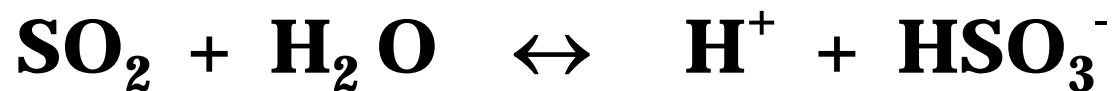
# BACKGROUND

- **CANSOLV® PROCESS INVENTED IN 1988 AT UNION CARBIDE**
- **PILOTED 9 MONTHS AT SUNCOR IN 1991**
- **SPUN OFF IN EMPLOYEE LED BUYOUT IN 1997**
- **10 PILOT PLANT TEST STARTING IN 1998**
- **FIRST 3 COMMERCIAL UNITS TO START-UP IN EARLY 2002**

# PROCESS CHEMISTRY

- **AQUEOUS DIAMINE SOLVENT SOLUTION**
- **BUFFERING PROVIDES HIGH CAPACITY FOR SO<sub>2</sub> ABSORPTION**
- **PROPRIETARY SOLVENT HAS THE PROPER ABSORPTION/DESORPTION BALANCE**
- **SOLVENT AMINE IS TOTALLY NON-VOLATILE SINCE IT IS ALWAYS IN SALT FORM**
- **REGENERATION PROVIDES PURE, WATER SATURATED SO<sub>2</sub> AS BYPRODUCT**

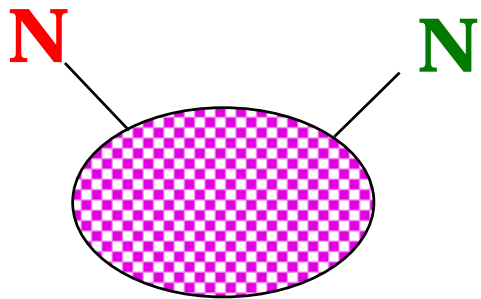
# PROCESS CHEMISTRY



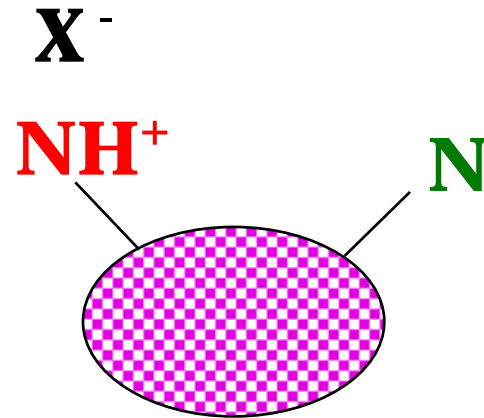
# DIAMINE ABSORBENT

- **THE UNIQUE DIAMINE ABSORBENT IS THE KEY TO CANSOLV® SYSTEM SUPERIORITY**
- **THE STRONGLY BASIC AMINE GROUP IS ALWAYS IN SALT FORM PROVIDING ABSORBENT NON-VOLATILITY**
- **THE SECOND AMINE HAS THE OPTIMUM STRENGTH FOR BALANCED ABSORPTION AND REGENERATION**
- **THE AMINE DOES NOT REACT WITH SO<sub>2</sub> BUT SERVES AS A BUFFER.**

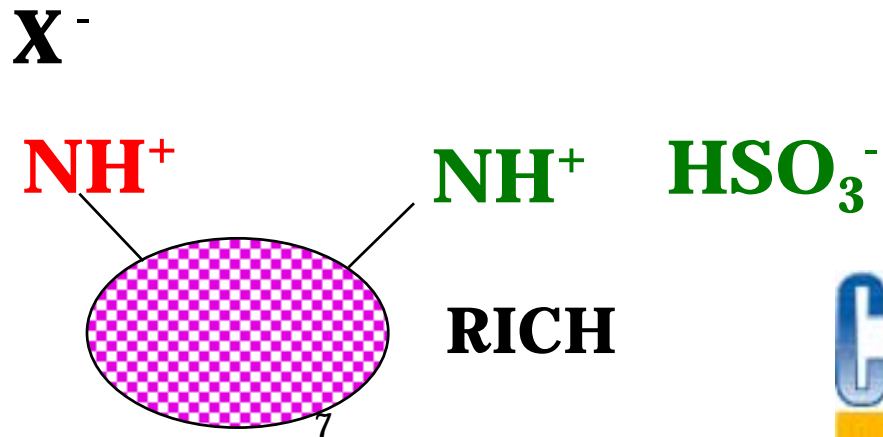
# PROCESS CHEMISTRY



**FREE BASE**



**LEAN**



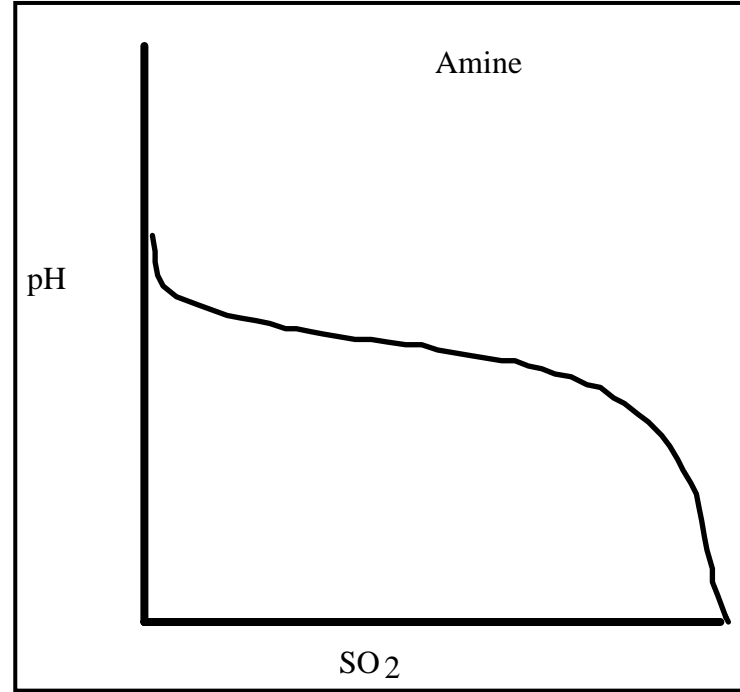
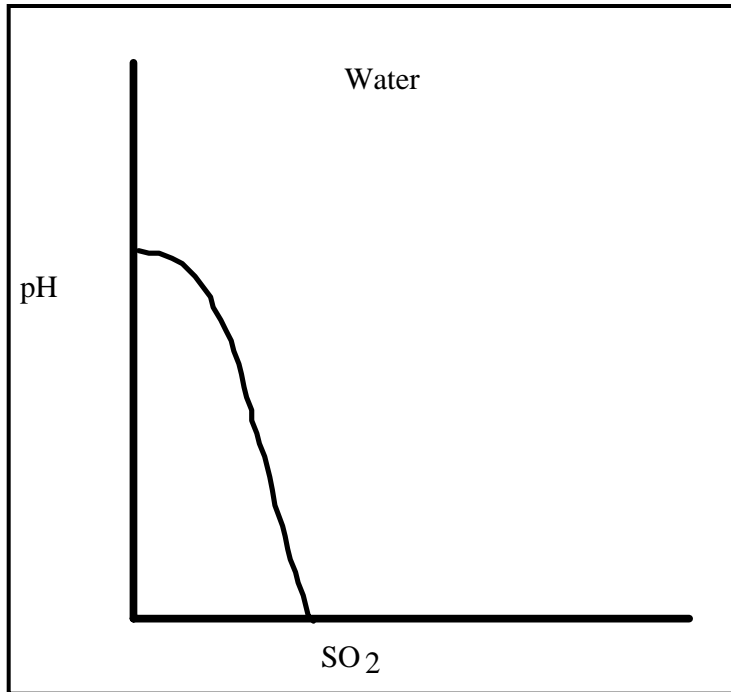
**RICH**

# PROCESS CHEMISTRY

- **pKa IS A MEASURE OF ACID/BASE STRENGTH**
- **STRONG BASES HAVE HIGH VALUES, STRONG ACID LOW VALUES**
- **EXAMPLES OF pKa**
  - **NaOH: 12+**
  - **MEA 9.5**
  - **MDEA: 8.5**
  - **H<sub>2</sub>S: 6.4**
  - **CO<sub>2</sub> 6.8**
  - **Sulfite 6.8**
  - **SO<sub>2</sub> 1.8**
  - **H<sub>2</sub>SO<sub>4</sub> 0**
  - **CANSOLV DS <<6**

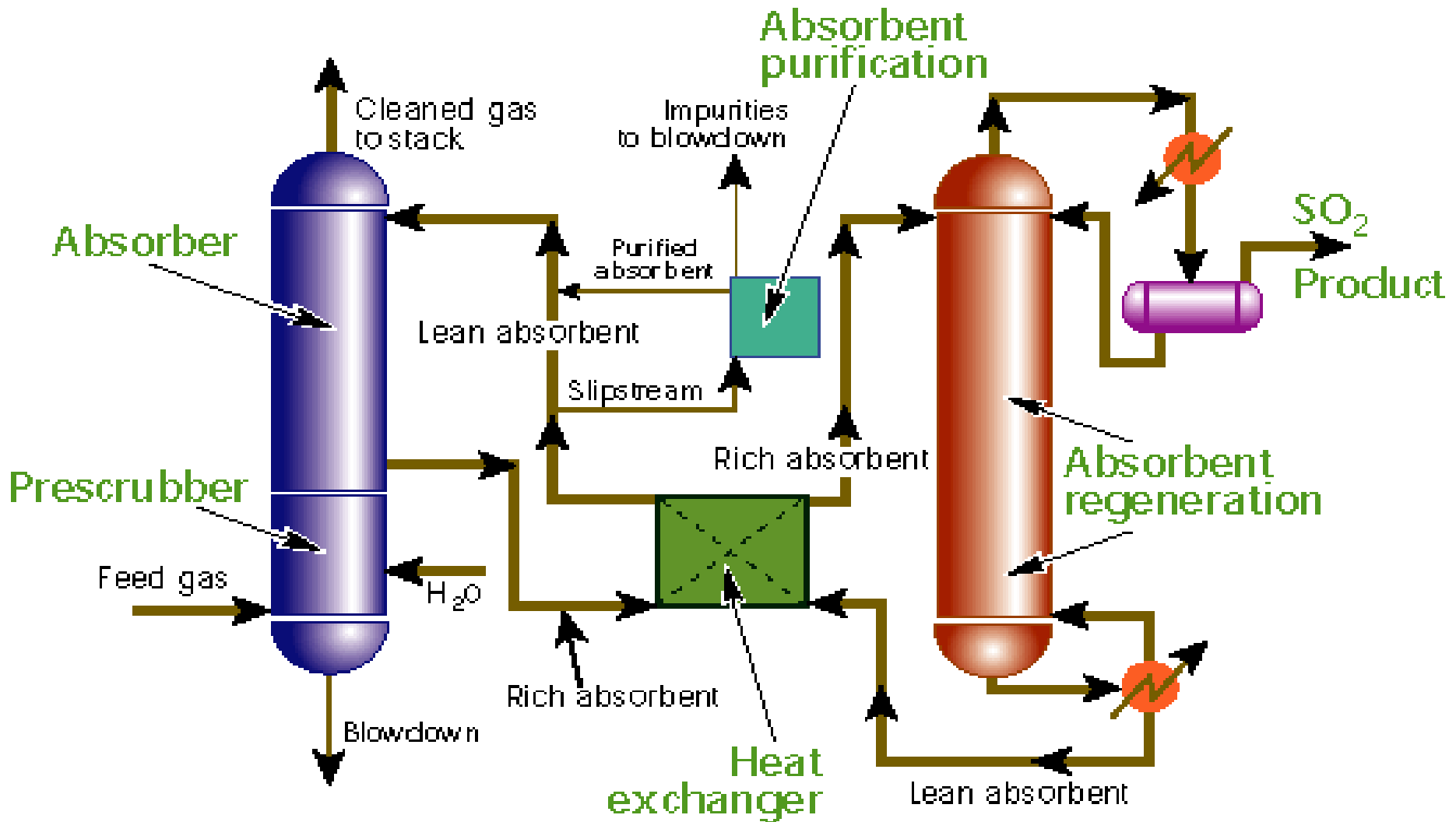


# PROCESS CHEMISTRY



# CANSOLV<sup>®</sup> SOLVENT ADVANTAGES

- **NON-VOLATILE**
- **INHIBITS SO<sub>2</sub> OXIDATION**
- **LOW DEGRADATION RATE**
- **SEQUESTERS STRONG ACIDS**
- **EFFICIENT HEAT STABLE SALT REMOVAL THROUGH SMALL SLIPSTREAM PURIFICATION**



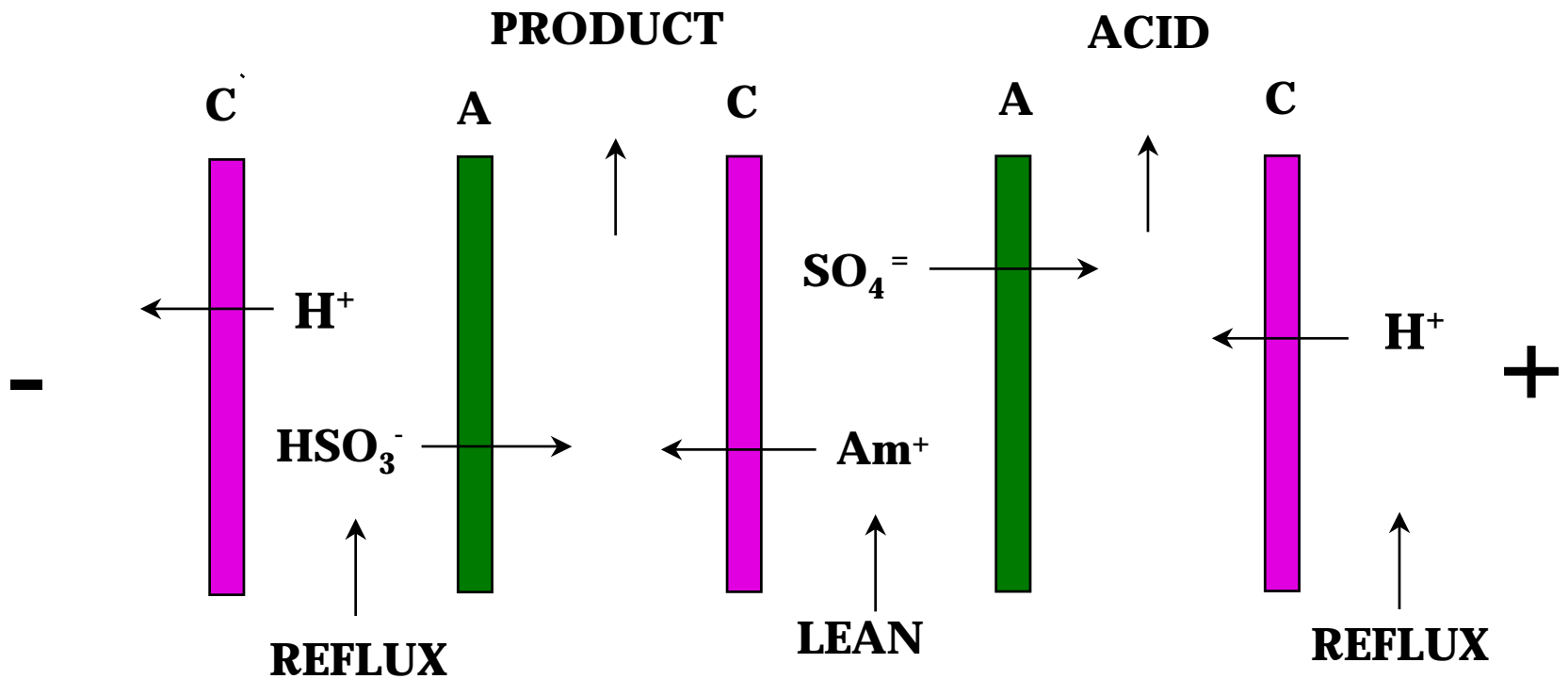
# HEAT STABLE SALTS

- **STEAM NON-REGENERABLE AMINE SALTS OF STRONG ACIDS (LIKE SULFURIC) ARE CALLED HEAT STABLE SALTS (HSS)**
- **FEED GAS AND DISPROPORTIONATION OF SULFITE CONTRIBUTE STRONG ACIDS**
- **THE FIRST AMINE SEQUESTERS UP TO 1 EQ/MOLE OF STRONG ACIDS**
- **HSS ARE CONTROLLED TO AVOID NEUTRALIZING THE SORBING NITROGEN**

# ELECTRODIALYSIS

- **ELECTRODIALYSIS (ED) IS USED TO REMOVE HSS FROM A SMALL SLIPSTREAM**
- **ED IS A PROVEN UNIT OPERATION**
- **METATHESIS ED IN CANSOLV UNIT DOES NOT REQUIRE ADDITION OF REAGENTS**
- **THE HIGH HSS CONCENTRATION AND DIFFERENTIAL REMOVAL ED MAXIMIZES EFFICIENCY AND ECONOMICS**

# ELECTRODIALYSIS



# PROCESSES OFFERED

- **CANSOLV<sup>®</sup> System SO<sub>2</sub> Removal Process**
  - Regenerable SO<sub>2</sub> scrubbing to < 100 ppm in treated gas
- **CANSOLV<sup>®</sup> SRU Process**
  - Expand sulfur recovery unit **and** decrease emissions at less cost than current technology
- **SO<sub>2</sub>SAFE<sup>®</sup> System Technology**
  - Intrinsically safer storage, transportation and on-demand generation of SO<sub>2</sub>

# APPLICATIONS

- **ACID PLANTS - TAIL GAS CLEANUP**
- **SPENT ACID RECOVERY - WEAK SO<sub>2</sub> STREAMS**
- **SMELTERS - FUGITIVE EMISSIONS, WEAK SO<sub>2</sub> CONCENTRATION, SMELTER/ACID PLANT DECOUPLING, PURE SO<sub>2</sub> PRODUCTION**
- **PULP MILLS - RECOVERY BOILER FGD, SULFUR BURNER SHUTDOWN, BLOWPIT AND VENT GASES, FUGITIVE EMISSIONS**



# APPLICATIONS (2)

- **REFINERIES - SRU TAIL GAS CLEANUP AND CAPACITY EXPANSION, POWER BOILER FGD, FCCU TAIL GAS, COGENERATION, TOTAL SULFUR MANAGEMENT**
- **NATURAL GAS - SRU APPLICATIONS**
- **POWER GENERATION**
- **MISCELLANEOUS - CERAMIC KILNS, CHEMICAL PLANTS**

# Cansolv Technology Processes in Sulfuric Acid Plants and Smelters

## Cansolv<sup>®</sup> System SO<sub>2</sub> Removal Process

- Fugitive emissions
- Tap-Hole emissions
- Tail gas - single, double absorption plants
- Cogeneration, Trigeneration

## Cansolv SO<sub>2</sub>SAFE<sup>®</sup> Process

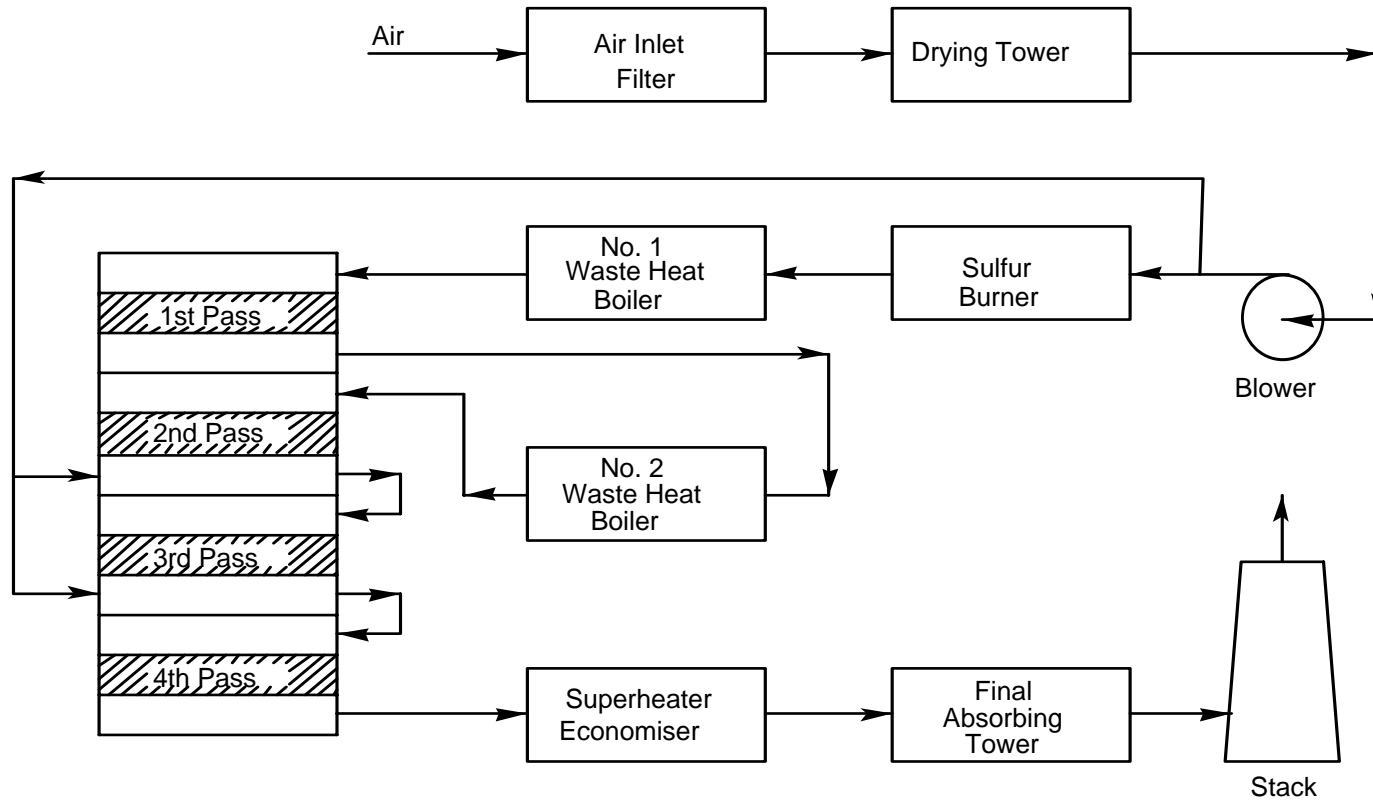
- for smelter
  - load levelling, SO<sub>2</sub> production
  - uncoupling the acid plant from the smelter



# Sulfur Burning Sulfuric Acid Plant

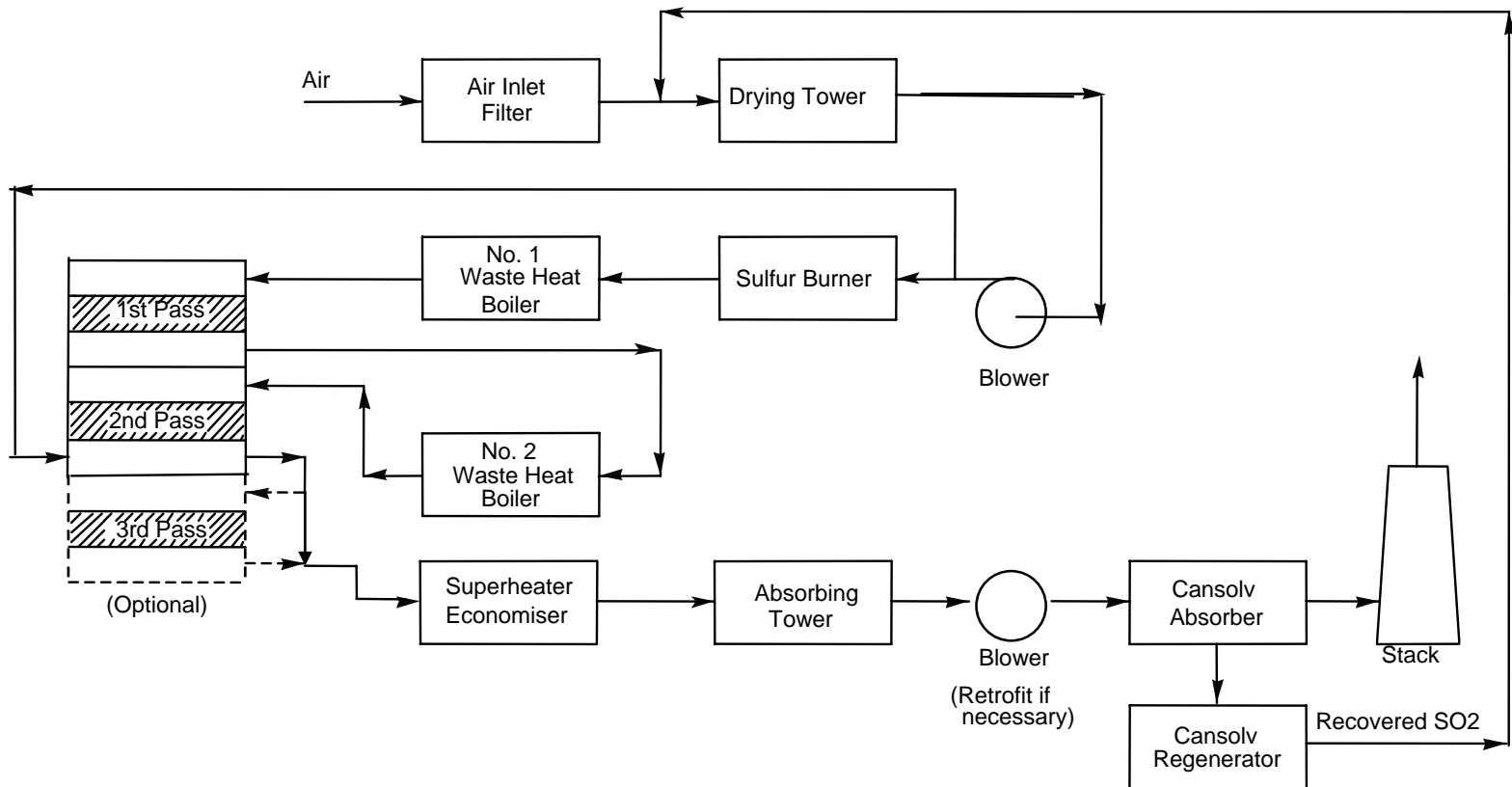
## Single Absorption

### Gas Flow Diagram





# Sulfur Burning Sulfuric Acid Plant Single Absorption with Cansolv System Gas Flow Diagram



# SO<sub>2</sub> IN PULP MILLS

- **USES**

- ↗ **COOKING LIQUOR**
- ↗ **ClO<sub>2</sub> PREPARATION**
- ↗ **PEROXIDE KILL**
- ↗ **SOURING**

- **SOURCES**

- ↗ **RECOVERY AND RECYCLE**
- ↗ **SULFUR BURNER**
- ↗ **LIQUID SO<sub>2</sub>**

# SO<sub>2</sub> IN PULP MILLS

## DEFICIENCIES OF CURRENT TECHNOLOGY

- **CHEMICAL LOSSES BY INEFFICIENT RECOVERY**
- **LOSSES TO OXIDATION ARE >10%**
- **AIR AND WATER EMISSIONS**
- **DIFFICULT MILL CHEMICAL BALANCE**
- **OPERATING COMPLEXITY AND COST**
- **HIGH MAINTENANCE**
- **HIGH CAPITAL COST**

# CANSOLV<sup>®</sup> TECHNOLOGY

- **PRODUCES 97% SO<sub>2</sub> BYPRODUCT**
- **NIL AIR AND WATER EMISSIONS**
- **APPLICABLE TO ALL STREAMS**
  - ↗ **RECOVERY BOILER**
  - ↗ **BLOWPIT GAS**
  - ↗ **VENT GASES**
- **SO<sub>2</sub>SAFE TECHNOLOGY AVOIDS RISK OF LIQUID SO<sub>2</sub> STORAGE**

# Refinery and Natural Gas Applications

## **SULPHUR RECOVERY**

- **CLAUS TAIL GAS CLEANUP, LOW COST UNIT CAPACITY EXPANSION, TROUBLE FREE PROCESSING OF SWS GAS OR HYDROCARBON RICH**

## **FLUE GAS DESULPHURISATION**

- **FGD OF UTILITY OF COGENERATION BOILERS BURNING HIGH SULPHUR FUELS; FCCU TGCU**

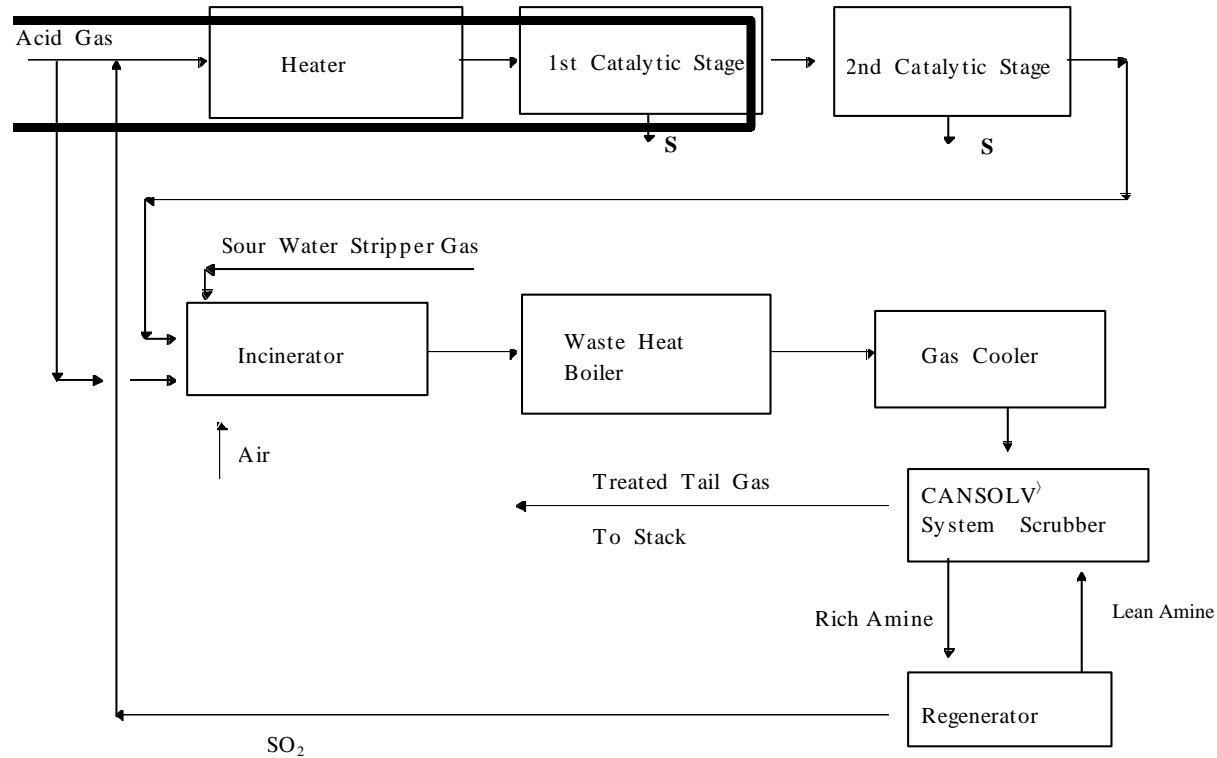


# REFINERY SULFUR MANAGEMENT

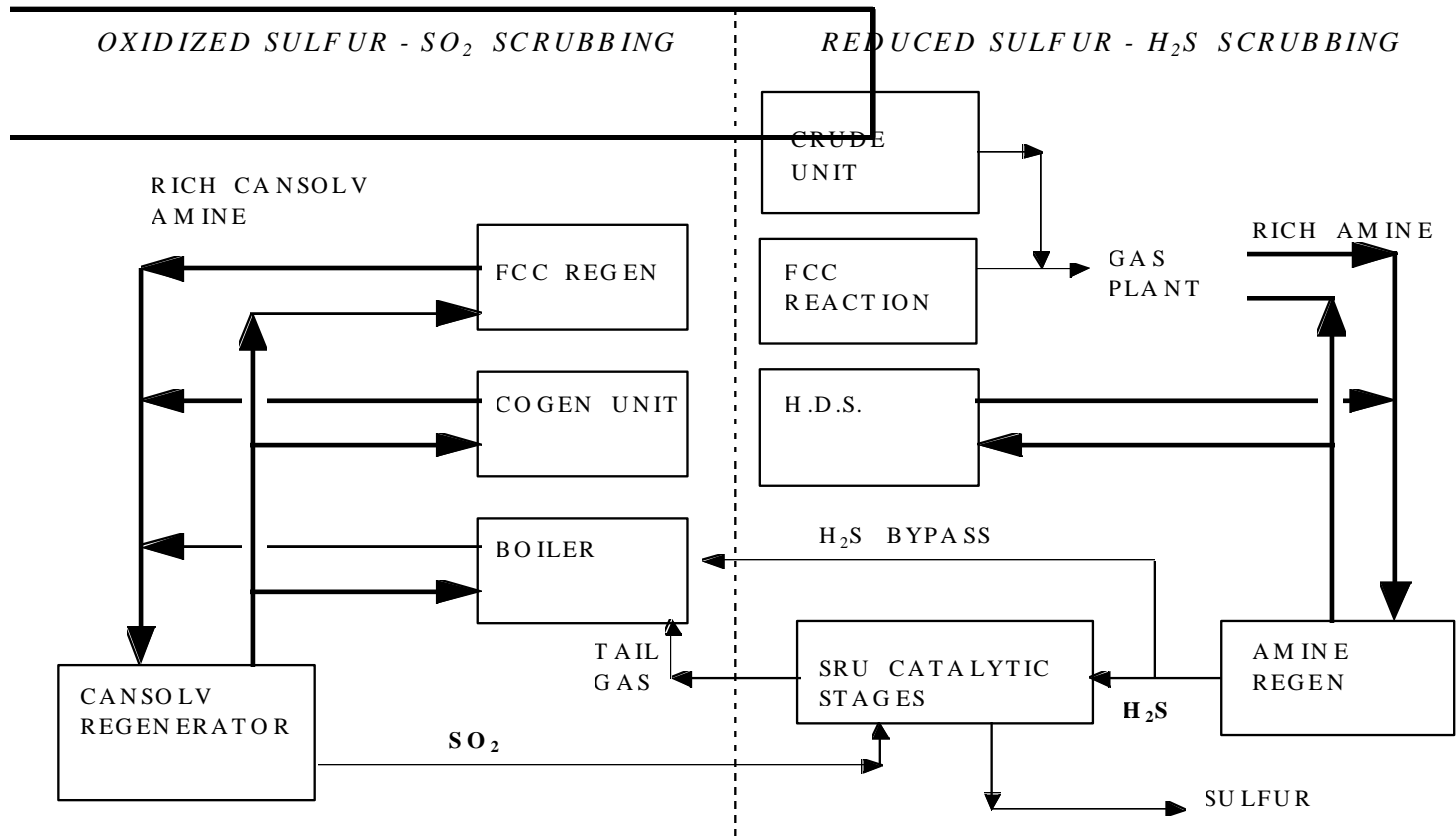
- **INTEGRATING CANSOLV® SYSTEM SO<sub>2</sub> SCRUBBING INTO REFINERY OPERATIONS REVOLUTIONISES SULPHUR MANAGEMENT**
- **COSTS ARE LOWER THAN CONVENTIONAL TECHNOLOGY**
- **ALMOST ZERO SO<sub>2</sub> EMISSIONS CAN BE ACHIEVED**
- **OPERATION IS SIMPLIFIED**



# CANSOLV SRU



# REFINERY SULFUR MANAGEMENT



# SUMMARY

- **CANSOLV<sup>®</sup> SYSTEM TECHNOLOGY OFFERS HIGHEST EFFICIENCY, COST COMPETITIVE SO<sub>2</sub> REMOVAL FROM MOST GAS STREAMS**
- **INTEGRATION OF THE TECHNOLOGY INTO PLANT PROCESS SCHEMES REDUCES COSTS AND SIMPLIFIES OPERATION**