

**OXYSULF**

sulfuric acid recovery

**OXYSULF MET**

metallurgical processes

**OXYSULF SCU**

spent acid regeneration

**OXYSULF SAR**

sulfuric acid recovery

## OXYSULF

The OXYSULF process is a customized highly energy-efficient technology used for the cleaning of wet waste gases containing sulfur compounds and for the production of sulfuric acid.

Application	Separation of sulfur bearing-compounds from wet process streams to produce concentrated sulfuric acid
Typical Process Gas Flow	10.000 - 500.000 Nm <sup>3</sup> /h
Sulfur Compounds	SO <sub>2</sub> , H <sub>2</sub> S, COS, CS <sub>2</sub> , Mercaptanes concentration in gas stream: 2-200 g/Nm <sup>3</sup>
Final Product	(H <sub>2</sub> SO <sub>4</sub> ) 96-98 %/w
Sulfur Recovery	up to 99,98%
SO <sub>2</sub> Emissions	<50mg/Nm <sup>3</sup>
Application Field	Refineries & petrochemical industry Coal based fertilizer and chemical industry Cokes manufacturing Non ferro metallurgical industry (Mo, Pb...) Power industry Viscose industry Natural gas processing

The process is based on the catalytic or the combination of thermal and catalytic oxidation of sulfur-bearing compounds by forming sulfuric acid. It is able to handle contaminants such as SO<sub>2</sub>, H<sub>2</sub>S, COS or CS<sub>2</sub> at a wide concentration range. Sustainability and guaranteed low emissions go together with the economical benefit.

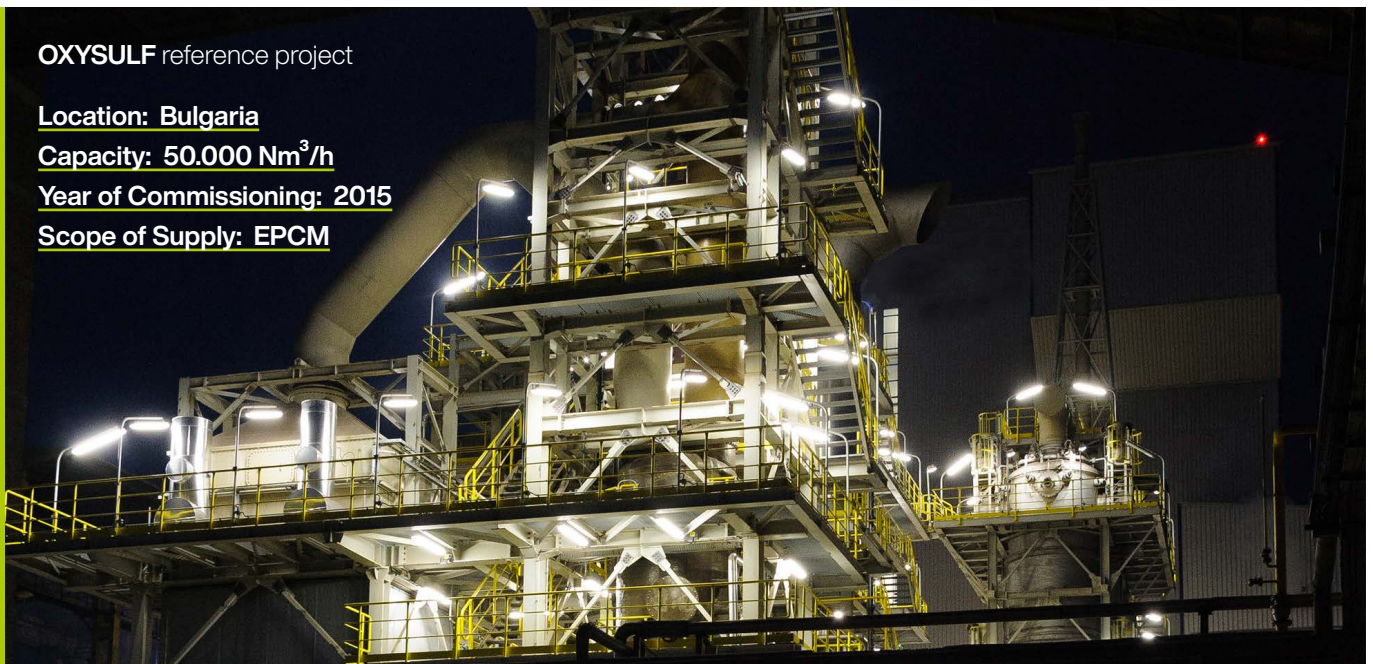
**OXYSULF** reference project

**Location:** Bulgaria

**Capacity:** 50.000 Nm<sup>3</sup>/h

**Year of Commissioning:** 2015

**Scope of Supply:** EPCM



## Your Advantages at a Glance

### **Customized Modular Plant Configuration**

The acid condensation column is based on a new KVT proprietary design which ensures reliability, high on-stream time and low maintenance costs. The column is made of a lined stainless steel concept which ensures the required corrosion resistance.

### **High Sulfur Oxidation Efficiency**

A special designed KVT catalyst ensures the maximum oxidation efficiency. The KVT vanadium catalyst is designed for the conversion of SO<sub>2</sub> for wet application. The KVT noble metal based catalyst TARDIGRAD is designed for low concentration, able to work at a wide temperature range (250-600 °C) at low pressure drop .

### **Highly Efficient Heat Recovery System**

The heat recovery system uses a heat transfer fluid in order to achieve the maximum efficiency. Due to the exclusive design, the excess heat is recovered and used efficiently in the process and for external purpose.

### **Guaranteed low SO<sub>2</sub> and Acid Mist Emissions**

The Wet Electrostatic Precipitator (WESP) removes the sulfuric acid aerosols formed during the condensation in the condensation column. When required, an additional tail gas reactor can ensure sulfur oxidation efficiency up to 99,98%.

### **Simple Automated Operation**

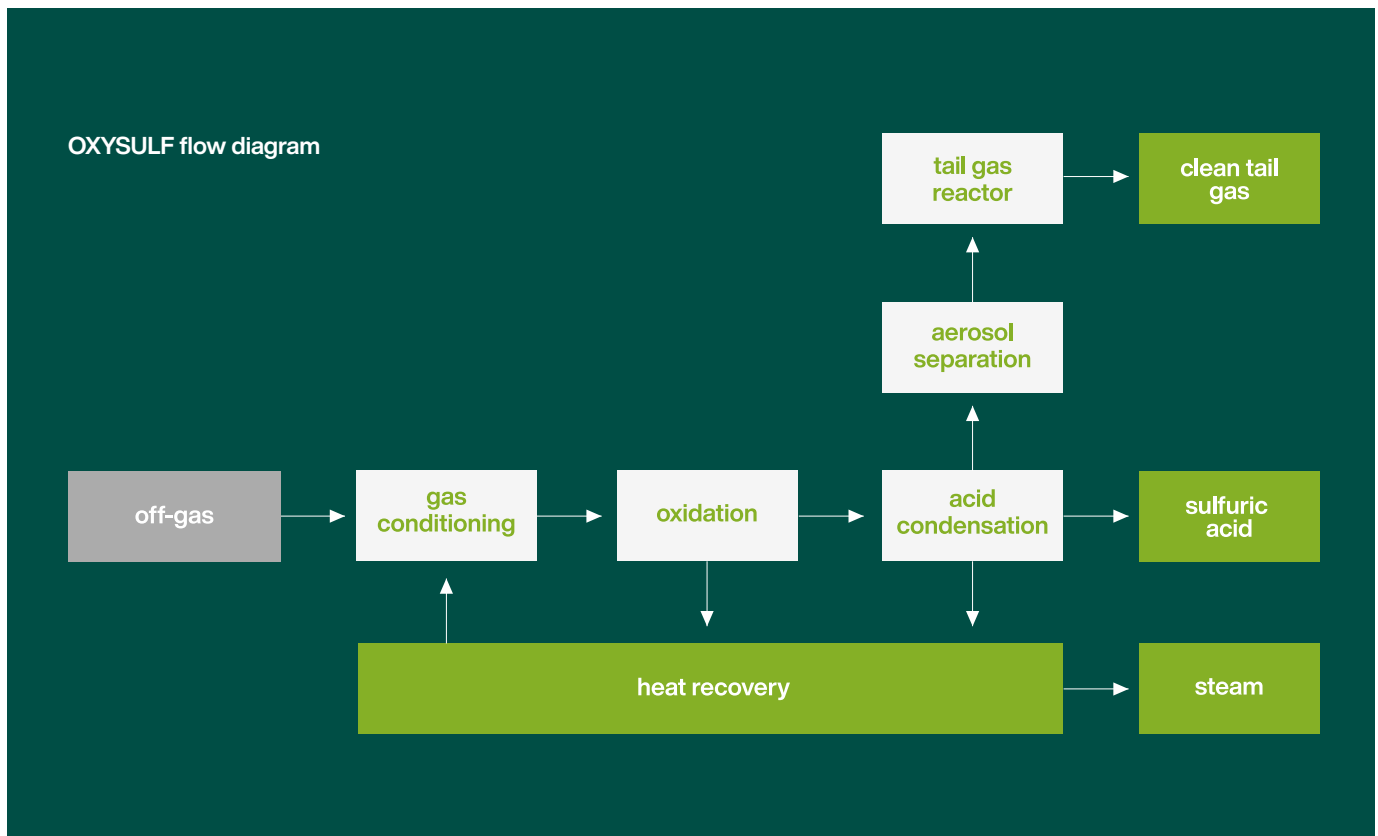
OXYSULF plants are highly automated in order to reduce operator and maintenance time to a minimum.

### **Compact, Modular Concept OXYSULF**

Plants have a compact design which allows easy installation and integration into existing industrial plants.



# OXYSULF



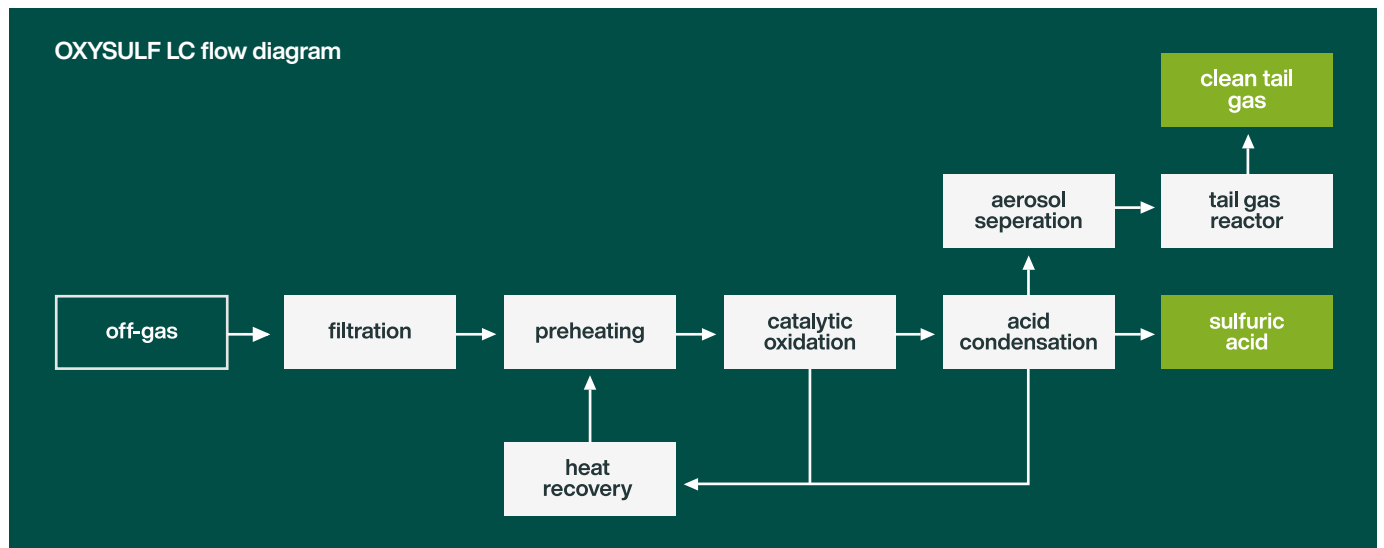
## Process Description:

1. The off-gas passes the gas conditioning system which may consist of a combustion chamber, a prefilter, a scrubber, Dry-Fil hot gas filter (KVT exclusive) or a preheater depending on the Wet Gas Clean Plant.
2. The gas passes over the multibed reactor where the catalytic oxidation of sulfur compounds takes place and gaseous sulfuric acid is formed. The heat of the exothermic reaction and the heat of the process gas cooling is used within the Heat Recovery System.
3. The Heat Recovery System is individually designed as per process and client requirements. Several options are available such as heat transfer fluid systems or a waste heat boiler for steam generation.
4. In the acid condensation column the sulfuric acid is condensed with up to 98%w concentrated acid. The hot acid is cooled within acid coolers and stored at the sulfuric acid tank.
5. The gas downstream of the condensation column is routed to the Wet Electrostatic Precipitator (WESP) where the sulfuric acid aerosols are precipitated. An optional tail gas reactor stage increases the sulfur oxidation efficiency to meet most stringent emission requirements.

### The OXYSULF technology can be classified into the following five main types:

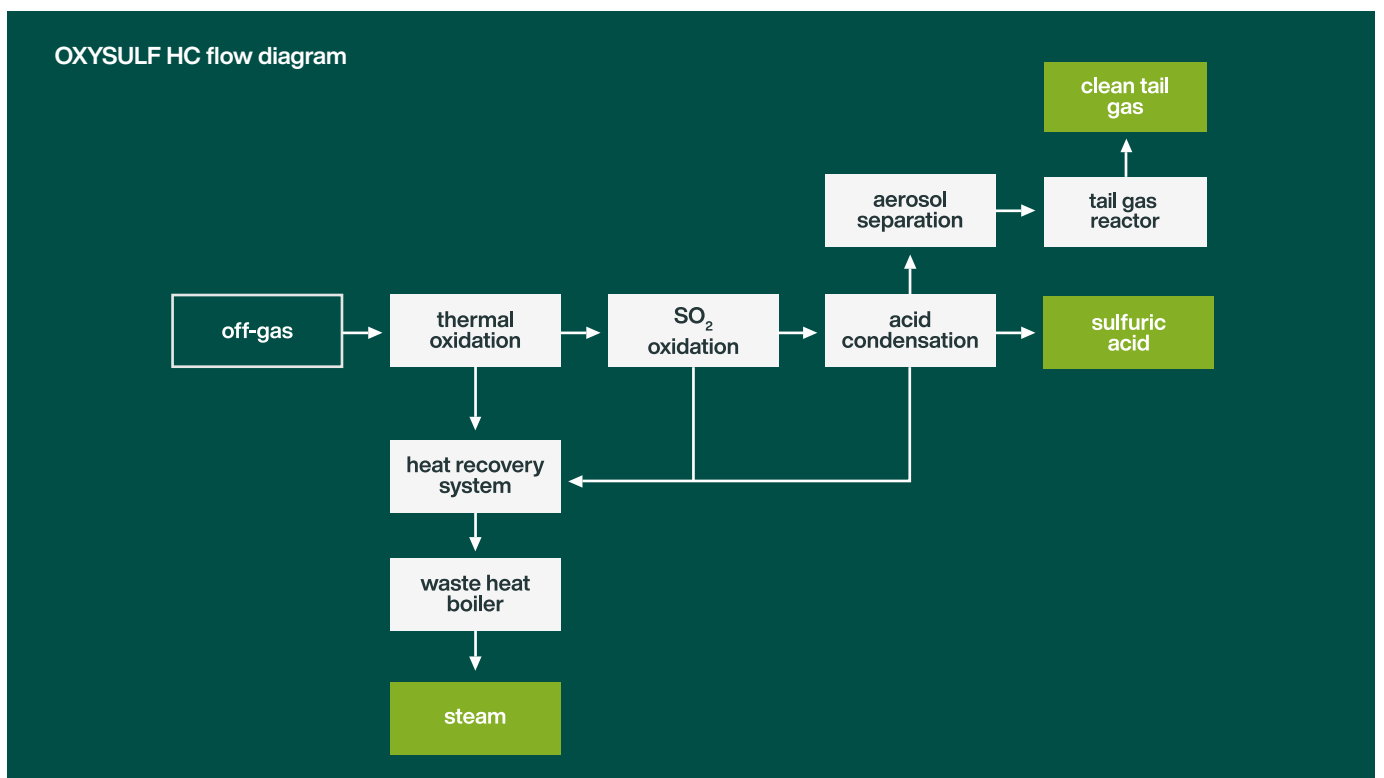
- OXYSULF LC for low concentrations
- OXYSULF HC for high concentrations
- OXYSULF MET following metallurgical processes
- OXYSULF SCU for H<sub>2</sub>SO<sub>4</sub> and or SO<sub>2</sub> production
- OXYSULF SAR for spent acid regeneration

## OXYSULF LC



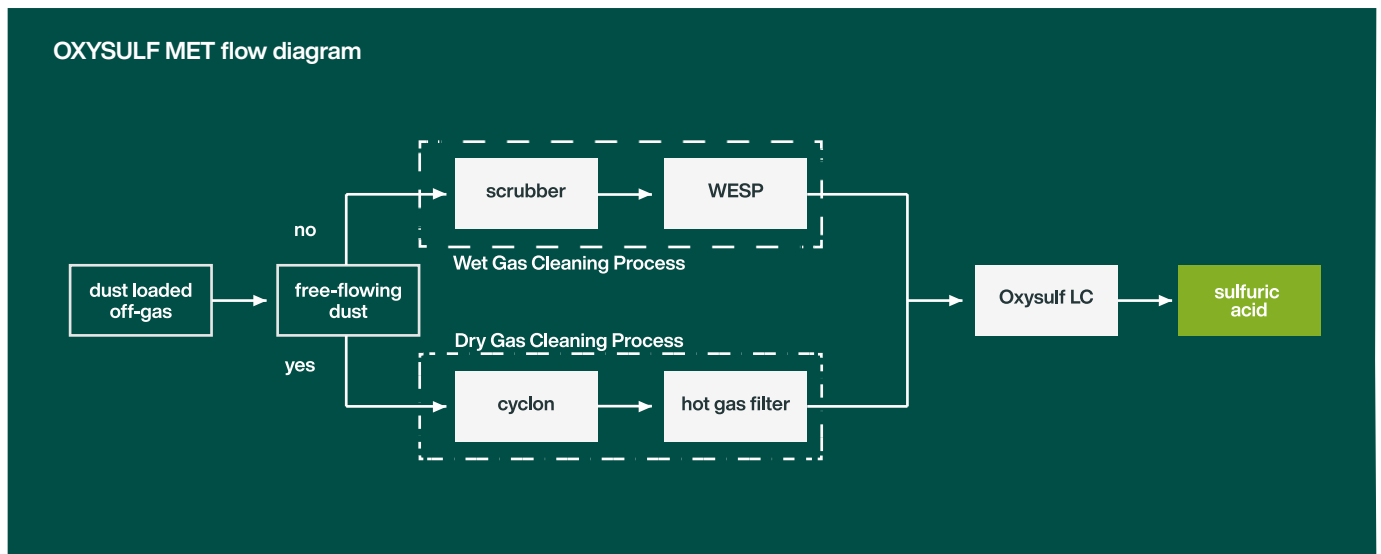
The **OXYSULF LC** technology is used for lean  $H_2S$  and  $SO_2$  off gas feed streams. In the reactor the  $H_2S$  and  $SO_2$  is converted to  $SO_2$  by the proprietary Tardigrad catalyst. For concentrations below the autothermal condition, an additional raw gas preheating is required. With an optional Tail Gas Reactor,  $SO_2$  required emission limits are achieved. Typical OXYSULF LC application are in viscose industry, natural gas processing, power and metallurgical industry.

## OXYSULF HC



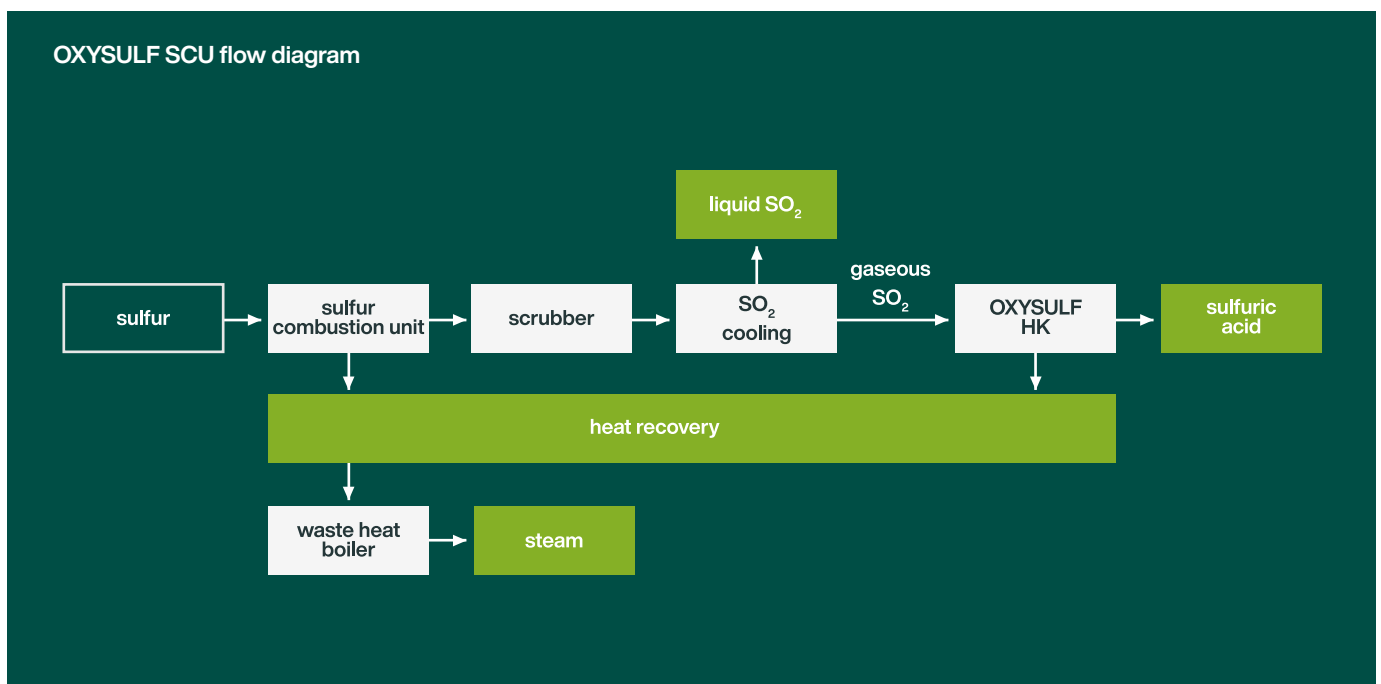
The **OXYSULF HC** technology is used for concentrated  $H_2S$  off gas feed streams. The process includes a combustion chamber for the thermal oxidation of sulfur compounds. To raise the sulfuric acid output, additional sulfur can be burnt in the combustion chamber. A Waste Heat Boiler is part of the Heat Recovery System to recover the excess heat after the combustion chamber and from the reactor. With an optional Tail Gas Reactor the maximum conversion rate can be achieved. Typical OXYSULF HC applications are in the oil, gas, steel and power industry.

## OXYSULF MET



The **OXYSULF MET** has been developed to meet the requirements of the metallurgical industry where dust loaded roast gases with dust concentration up to 180g/Nm<sup>3</sup> have to be treated. The roast gas from the furnace is cooled down to the operation temperature of the downstream cleaning process. The physical properties of the dust dictate the cleaning technology to be used: for “free-flowing dust” the gas stream is treated with a Dry Gas Cleaning Process. The cooled gas passes over a cyclone where large particulate are settled, followed by a proprietary Dry-Fil Hot Gas Filter for further filtration; for “not free-flowing dust” the gas stream is treated with a wet process. Here the cooled gas passes over a scrubber followed by a proprietary Wet Electrostatic Precipitator (WESP) for gas cleaning. After the gas cleaning system, the off-gas is treated with the OXYSULF LC process.

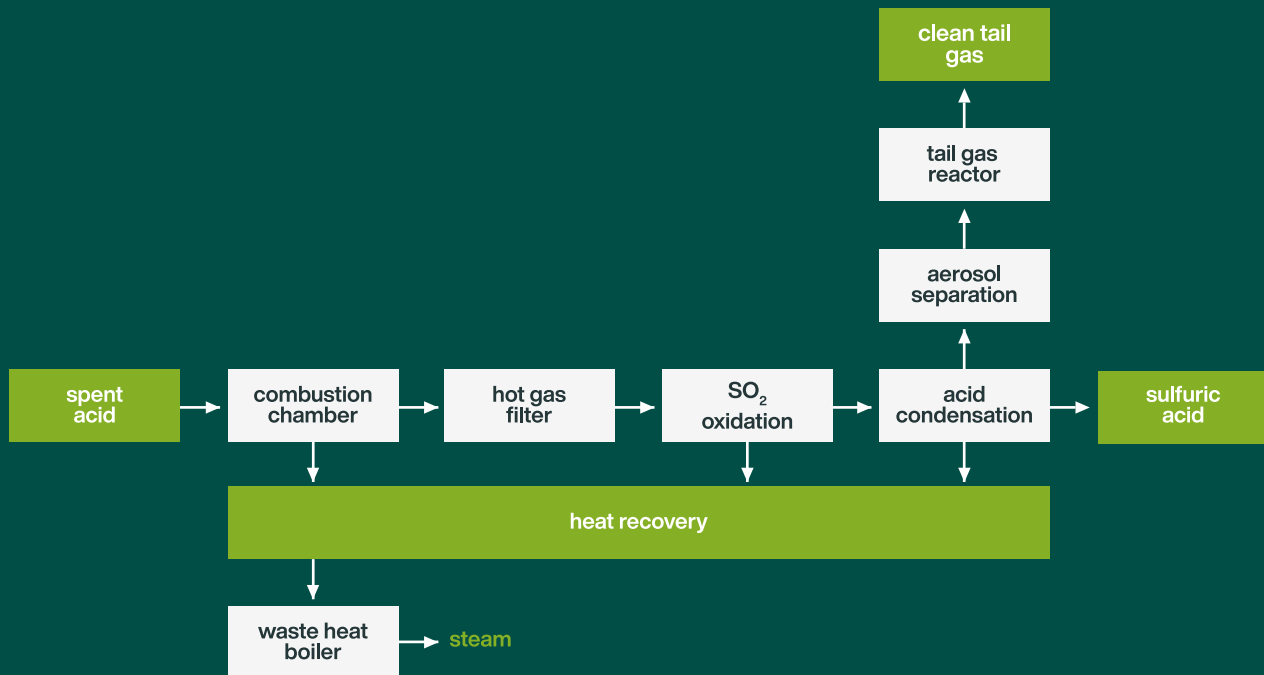
## OXYSULF SCU



**OXYSULF SCU** is applied when SO<sub>2</sub> and H<sub>2</sub>SO<sub>4</sub> production is required. Liquid sulfur is fed into a specially designed combustion chamber to form SO<sub>2</sub>. The resulting process gas is fed into the scrubber to absorb the small quantity of potentially formed SO<sub>3</sub>. After the scrubber, part of the SO<sub>2</sub> is cooled and condensed. The remaining SO<sub>2</sub> is sent to the OXYSULF HK plant where the conversion of SO<sub>2</sub> to SO<sub>3</sub> and then the hydrolysis to sulfuric acid takes place.

## OXYSULF SAR

OXYSULF SAR flow diagram



For the spent acid and sulfate regeneration the **OXYSULF SAR** is used.

The spent acid with the fuel gas is fed into a special designed combustion chamber to form SO<sub>2</sub>. The acid together with fuel gas is fed into the burner through compressed air and ultrasonic atomizing. For special applications there is the possibility to use H<sub>2</sub>S gas or S feed instead of fuel gas to reduce energy cost. Depending on the acid composition and possible impurities a hot gas filter after the combustion chamber maybe required to remove the solid impurities from the SO<sub>2</sub> gas stream.

After the hot gas filter, the gas stream is treated with an OXYSULF HC plant where the conversion of SO<sub>2</sub> to SO<sub>3</sub> and then the hydrolysis to sulfuric acid takes place. The clean gas is discharged to the atmosphere through the main stack.

## about kvf

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