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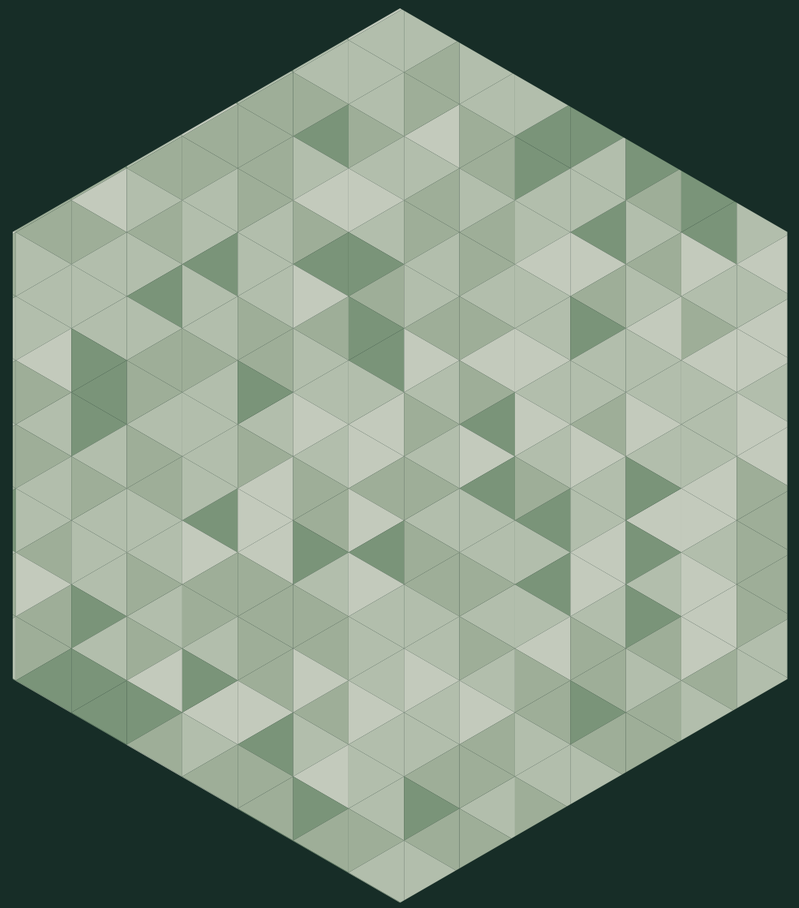

# SULFUR RECOVERY UNITS

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DESIGNER AND MANUFACTURER OF
**MECHANICAL,PROCESS EQUIPMENT** AND **PROCESS SKID PACKAGES**
FOR OIL, GAS, PETROCHEMICAL, POWER AND
UTILITIES INDUSTRIES

# SULFUR RECOVERY UNITS

Hydrogen sulfide is present in numerous gaseous waste streams from natural gas plants, oil refineries, and waste water treatments, among other processes. H2S is a highly toxic gas and contributes to SO2 emissions.

To comply with environmental regulations, sulfur species are converted to elemental sulfur and water via sulfur recovery technologies.

The Claus Process is the most widely used process for the conversion of H2S to elemental sulfur. The Claus Process technology can be divided into two stages: thermal and catalytic.

In the thermal stage, the thermal reactor converts %60-70 of H2S to elemental sulfur, and in the next catalytic stage, the catalytic reactors with Claus Catalysts increase sulfur recovery beyond 95%. The tail gas from the Claus Process still contains combustible components, so it is routed to the incinerator to oxidize the few remaining sulfur compounds.

In collaboration with our re-knowned international partners who are technology owner and license holder we can provide Process Design Package (PDP) and Basic Design including primary, sizing and equipment arrangement plan, catalyst specifications and process guarantee of a complete Sulfur Recovery Units.

IN ADDITION, MFS CAN PROVIDE FOLLOWING EQUIPMENT FOR CLAUS SULFUR RECOVERY UNITS:

- Thermal Reactors (Reaction Furnace)
- Claus Reactors
- Sulfur Condensers
- Incinerators
- Reheaters

1.

# THERMAL REACTORS

## REACTION FURNACE

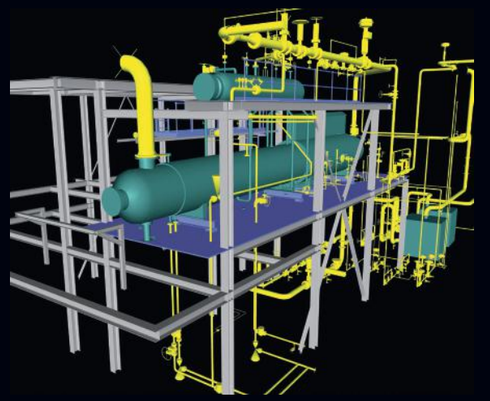
As described above, the thermal reactor is the main piece of equipment in the sulfur recovery unit, where 60- 70 % of the H2S will be converted to elemental sulfur. The thermal reactor mainly includes reaction furnace, burner, blower, WHB, steam drum and riser & downcomer.

**1.1: REACTION FURNACE:**

The operating temperature of the reaction furnace is normally between 1100-1400C. Depending on the project requirement, the supplied reaction furnace may be equipped with a choke ring and checker wall to facilitate the solid flow of the flue gas and mixing.
The inner surface of the reaction furnace will be lined with the proper refractory. To prevent corrosion, the thickness of the refractory will be calculated to be such that the temperature of the metal shell will not fall below acid dewpoint. The refractory lining will have sufficient thermal strength and be resistant to corrosion, thermal shock, heat vibration, etc.
Refractory required for thermal reactor has to be High Alumina refractory to either high & normal temperature service.
Choosing refractory, required thickness calculation and implementation are one of the important issues to increase thermal reactor extend the life that MFS has great experience on it.



In order to avoid acid corrosion and protect the lining, the supplied reaction furnace will be covered with a rain shield protection. The rain shield extends the life of the reaction furnace by protecting the carbon steel shell from thermal embrittlement in the lining material from heavy rain and cold wind. Moreover, it provides an insulated air gap to allow air convection. This layer stabilizes the shell temperature and prevents the shell from overcooling and corrosion caused by acid condensation.



## 1.2: BURNERS

Oxidation of acid gas starts in the burner flame and continues along the Thermal Reactor until a thermodynamic equilibrium is reached. The Burner has to work pressurized and highly sour environment. MFS supplied burner with fully customized design, together with extensive NDE allows for safe operation of Thermal reactor.

MFS selected burner for thermal reactor has large turn-down usually to 10:1 in order to have flexible operating and fine refractory dry-out. MFS supplied burner can be equipped with fixed or retractable pilot or simply only with ignition.

## 1.3: WASTE HEAT BOILERS

In order to use the large amount of heat generated in the reaction furnace; cool down the flue gas and sulfur elements to be condensated in upstream equipment; and further reduce operating costs: the waste heat boilers (WHB) are used in the downstream of the reaction furnace, generating steam for SRU plant operations or other plants. The waste heat recovery boiler is a typical fire tube boiler that is connected to the reaction furnace outlet. WHBs have two functions: recovering heat by generating medium steam and cooling the gas from 900-1300 °C to about 230-370 °C.

To prevent damage to the tube sheet and the tube sheet welds, the inlet tube sheet of the supplied waste heat boiler will typically be refractory lined with ceramic ferrules located on the inlet of each tube.



## 1.4: STEAM DRUMS

A drum located on top of the WHB connects to the riser and downcomer and acts as a phase-separator for steam/water mixtures, warming up the BFW.

An external steam drum with the riser and downcomer provides an adequate natural circulation of the steam-water mixture. The design of the riser and downcomer is quite important for the prevention of fine circulation and for cooling down flue gas through the WHB.

## 1.5: AVAILABLE ACCESSORIES ON REQUESTS

- BMS (burner management system)
- Fuel skid or fuel piping
- All instrumentations alongside TR, WHB and steam drum include pyrometer or type R thermocouple
- Burner flame scanner (UV)

| Applicable Design Codes: | Design Software's: |
|---|---|
| API 560, 535 BS, GPSA, NACE, ASTM, ISO | In-house modeling software Compress |
| ASME SEC. I & VIII Div 1 | PV Elite Ansys FE Pipe Nozzle Pro |

2.

# SULFUR CONDENSERS

The sulfur condenser is one of the key components of the SRU, which is a type of special heat exchanger.

The main function of the sulfur condenser is to condensate sulfur generated in upstream (thermal reactor or catalyst reactor).

Inside the condenser tubes, a recombination of sulfur species takes place through a set of chemical reactions, and the pathway for the liquid sulfur flow at heat exchange is modeled. As commercial software (such as HTRI) does not have a reactive model, MFS applies special in-house developed software is used to model the sulfur condenser.



**Applicable Design Codes:**

API ASME SEC VIII Div 1 & TEMA
BS, GPSA, NACE, ASTM, ISO

**Design Software's:**

In-house modeling software
PV Elite Compress Nozzle Pro
Ansys FE Pipe

3.

# INCINERATORS

The purpose of incinerators is to thermally oxidize the residual H2S contained in the tail gas. The most important parameters of the incinerator are:

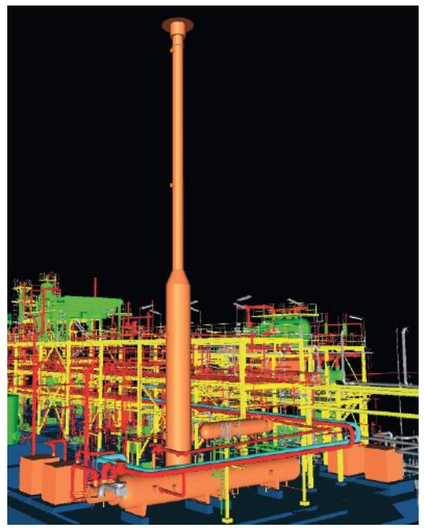
- Sufficient Temperature
- Residual Oxygen
- Residence Time
- Efficient Mixing.

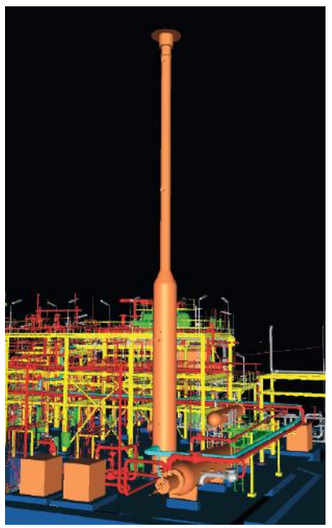
MFS-supplied incinerators use a safe and reliable design that are sized to fit the required flue gas specifications. In order to use the large amount of heat generated in the incinerator and further reduce operating costs, the waste heat boilers (WHB) can be implemented in the downstream of the combustion chamber of the incinerator, generating steam for other plant operations.

The waste heat recovery boiler can be a fire tube boiler or water tube boiler depending on the volume of flue gas. The WHB is connected to the combustion chamber outlet. WHBs have two functions; recovering heat by generating the medium steam and cooling the gas from 800 °C to about 230- 370 °C.

Incinerator burner supply need to have great knowledge to be sure oxidation the residual H2S and NOx reduction technology (fuel or air staging) with high turn-down capability. BMS (burner management system) or UCP(unit control system), Fuel skid or fuel piping, all instrumentations alongside include emission monitoring system, cems analyzer burner flame scanner (UV), etc. can be supplied based on purchaser request.

| **Applicable Design Codes:** | | **Design Software's:** | | |
|---|---|---|---|---|
| API 560, 535 | ASME SEC. I & VIII Div 1 | In-house modeling software | Nozzle Pro | Ansys |
| BS, GPSA, NACE, ASTM, ISO | | PV Elite | Compress | FE Pipe |





4.

# REHEATERS

In sulfur recovery units, the feed gas to catalytic reactors should be heated to the desired reaction initiation temperatures by reheaters.

**GENERALLY, THERE ARE TWO TYPES OF REHEATERS:**

- In-line Reheaters
- In-direct Steam Reheaters

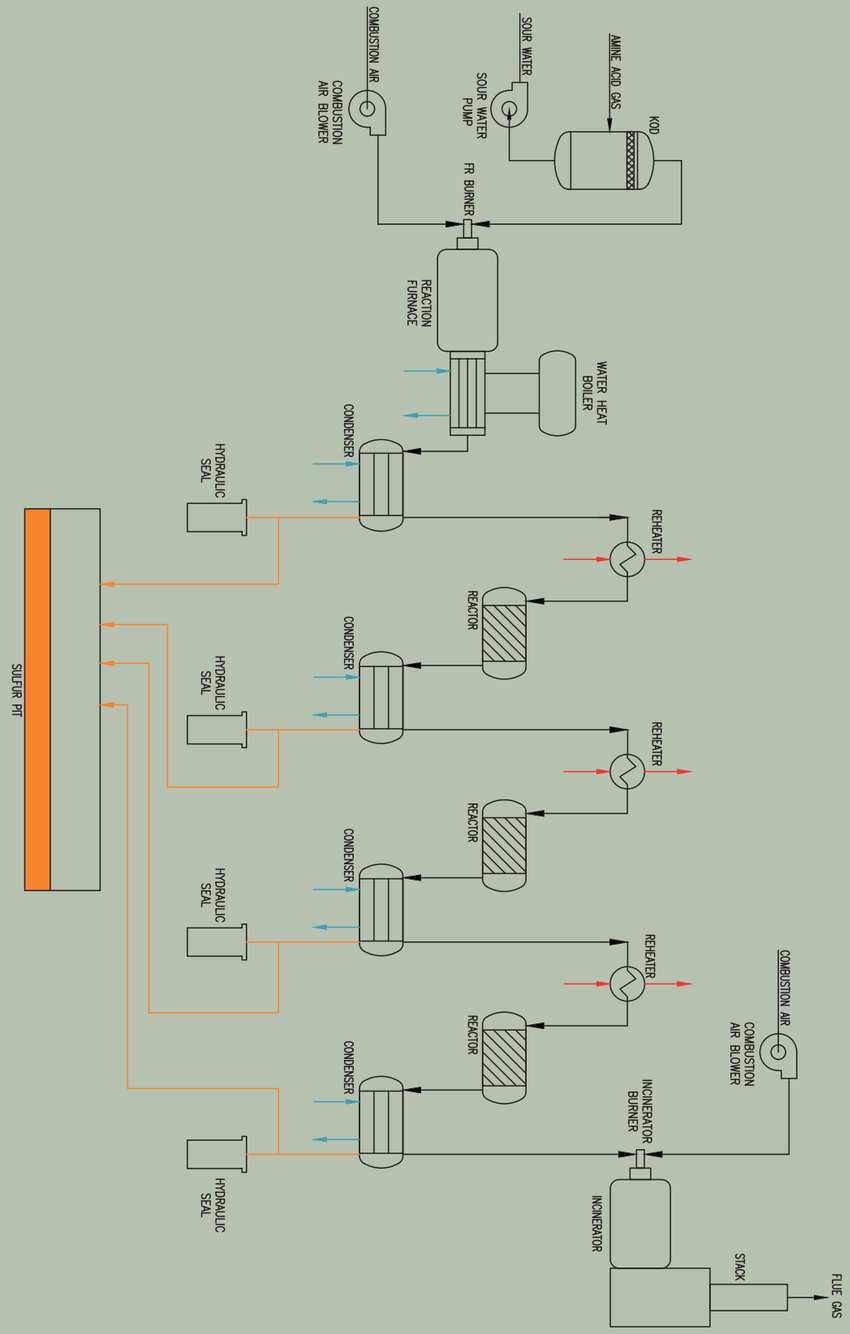
MFS offers both types based on the project requirements and the client's needs. Because process gas and flue gas produced by the burner are mixed in in-line heaters, the control of oxygen to prevent catalyst damage is an important issue. MFS provide our customers with necessary information and supplies the appropriate burner.

**Applicable Design Codes:**

API ASME SEC. I & VIII Div 1
BS, GPSA, NACE, ASTM, ISO

**Design Software's:**

In-house modeling software PV Elite
Compress Nozzle Pro Ansys
FE Pipe



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