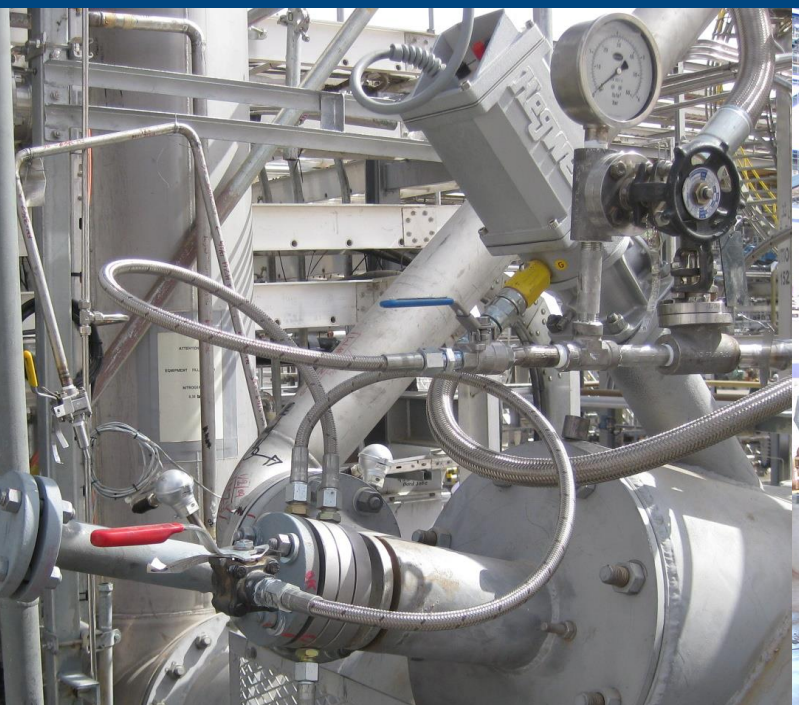
NORAM

SULFURIC ACID

Products and Services

CELLCHEM SULFUR BUNERS



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CELLCHEM SULFUR BURNERS

Cellchem Sulfur Burners

NORAM's line of Cellchem sulfur burners serve a variety of industries requiring relatively "small" quantities of sulfur dioxide (SO_2). Available standard capacities range from 0.5 to 100 tonne per day (TPD) sulfur burned, but have been customized up to 600 TPD. These sulfur burning systems can be tailored to produce a range of downstream products including SO_2 gas across the entire concentration range, liquid SO_2, sulfite and bisulfite solutions of varying concentration, and SO_2-water solutions (sulfurous acid). Note that for the larger capacities (>100 TPD) typical of sulfur burning sulfuric acid plants, NORAM also offers its standard, pressure-atomized sulfur burners covered under the brochure entitled Sulfur & Spent Acid Burners.

History

In 1960, a 20 TPD spiral flame (SF) sulfur burner was sold to the Nymölla sulfite pulp mill in southern Sweden, setting off a period of aggressive expansion for the Cellchem sulfur burner technology. Developed by Celleco of Sweden, the technology initially served Scandinavia's vast sulfite pulping industry. Since the original installation at the Nymölla mill, the technology has seen application at over 150 sites globally in an expanding array of industries.

In the early 1980's the development of the cyclone flame (CF) burner for applications requiring less than 8 TPD sulfur further solidified the technology's position as the global leader in sulfur burning for non-sulfuric acid plant applications. A series of innovations over the past decades have significantly improved the reliability and ease of operation of the burners.

NORAM's Swedish subsidiary, NORAM International AB, acquired the Cellchem burner technology from Akzo Nobel in 2013.

Technology Description

Sulfur Burning

The Cellchem burners produce relatively high strength SO_2 gas (up to 19% when burned in air) in a compact design. When the technology was introduced in 1960, the burner had less than one third the volume of a conventional burner. This was attained by producing small droplets of sulfur in a custom air atomization sulfur gun and by introducing high velocity combustion air tangential to the combustion chamber, thus giving the flame a spiral path. The units were thus dubbed the spiral flame or 'SF' sulfur burners. Standard SF designs ranging from 2 – 100 TPD sulfur are available, while custom SF burners have been designed up to 600 TPD. The burners are generally operated close to atmospheric pressure but pressurized designs are available for applications where downstream operations demand higher gas pressures.

With the inclusion of an integral after-burner, stable concentrations of 19.5 vol% SO_2 have been achieved without sulfur break-through. Producing SO_2 gas at high strength enables a compact furnace design, reduces the size of downstream operations, and results in a minimal amount of sulfur trioxide (SO_3) being formed in the furnace. Minimizing SO_3 formation reduces corrosion and product quality problems downstream since any SO_3 is typically converted to sulfuric acid or sulfate ions in downstream operations.

About 20 years after the development of the SF burner, the cyclone flame or 'CF' burner was developed for the smaller applications, specifically for capacities of 0.5 – 8 TPD sulfur. A further optimization of the flame path resulted in a burner volume of 1/4 the size of the larger SF burner. Stable gas concentrations above 18% SO_2 are achievable. The small footprint of the CF burners means they can easily be supplied modularized, i.e. skid-mounted.

The brick-lined Cellchem burners are designed to achieve a high enough temperature on the uninsulated carbon steel shell to avoid condensation of acid and subsequent corrosion. The temperature of the shell, however, cannot be so high that it compromises the mechanical integrity of the steel. For the CF burner, this is accomplished by natural convective heat losses to the environment; for the SF burner it is accomplished by running an air-cooled jacket around the burner.

Both the SF and CF burners can be pre-heated with a variety of fuels including diesel, LPG, and natural gas. Owing to the compact design, the burners can be pre-heated to 500°C in as little as 30 minutes, after which firing on sulfur can begin.

Skid-Mounted CF Burner with Quench Tower

Heat Recovery and Gas Quenching

Regardless of the application, SO_2 gas exiting the burner at >1200°C nearly always requires cooling before being delivered to downstream operations. At capacities below 100 TPD sulfur, the economics tend to favor gas cooling in a direct contact quench tower with water, with the heat of sulfur combustion ultimately rejected to the cooling tower. In some situations, particularly when there is existing steam infrastructure at site and there is a premium on energy consumption, the economics favor the installation of a waste heat boiler between the burner and the quench tower. Steam pressures up to about 3 MPa(g) are typical but higher pressure are achievable. The boiler produces about 2.5-3 tonnes of steam per tonne of sulfur burned. Both water tube and re tube designs are available.

Gas quenching to below 80°C is achieved in a countercurrent, direct contact spray tower where the evaporation of water serves to cool the gas. A rapid quench ensures minimal formation of additional SO_3.

Various grades of stainless steel are employed to avoid corrosion by the small amount of sulfuric and sulfurous acid that is formed in the quench tower. A particularly careful design is required around the gas inlet to the tower where the gas quickly transitions from >1200°C to less than 80°C.

Gas Absorption

Following gas quenching operations, a number of options are available for the SO_2 gas: it can be directly conveyed to the end use (e.g. ClO_2 generator), it can be absorbed into water to produce an acidic sulfurous acid solution (more commonly called SO_2-water), or it can be absorbed into an alkali to produce a sulfite or bisulfite solution.

Reliable operation of the absorption systems is achieved through appropriate materials of construction selection and a long history of tailoring absorption systems to specific customer needs.

Oxy-Fired Sulfur Burning

In certain applications it is advantageous to produce high strength (>21 vol%) SO_2 gas on-site and on-demand, for example, to replace the use of alternative hazardous or high cost chemicals like liquid SO_2 and sodium metabisulfite. While this is possible with sulfur burning in air and subsequent absorption and stripping operations, it tends to be energetically punitive and capital intensive. As such, an oxy-fired system has been developed wherein the sulfur is instead fired with cryogenic or pressure swing adsorption (PSA) "pure" oxygen to directly produce a high strength SO_2 gas.

Key Markets Served

The Cellchem technology has proven itself adaptable to a wide variety of industries and specialized applications.

- Pulp and paper: SO_2 gas for ClO_2 production, sulfite/bisulfite solutions for wood digestion, SO_2-water for pulp souring.
- Water treatment: sulfite/bisulfite solutions for waste water de-chlorination, bromine removal from brine.
- Food: 18-20 vol% SO_2 gas for juice sulfitation, steep acid (SO_2-water) for corn wet milling.
- Mining: 18-100 vol% SO_2 gas for cyanide destruction and leach processes.
- Sulfuric acid: SO_2 gas for contact process sulfuric acid production.

Typical System Performance

Raw material consumptions are presented on a per tonne of SO_2 produced basis.

Sulfur	0.5 tonne
Combustion air	2000 Nm^3
Steam (for sulfur melting)	0.1 tonne
Compressed air	300 Nm^3
Cooling water	50 m^3
Process water	2 m^3

Advantages of Cellchem Burners

Fast start-up,	0.5-1 hour
High SO2 gas concentration,	>18 vol%
High turndown ratio	
Unmatched reference list (150+ installations)	
Available as skid-mounted systems	

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- NORAM'S TURBOSCRUBBER FOR GAS SCRUBBING
- NORAM STAINLESS STEEL CATALYTIC CONVERTERS
- NORAM RF™ RADIAL FLOW GAS-TO-GAS HEAT EXCHANGERS
- NORAM SF™ SPLIT FLOW GAS-TO-GAS HEAT EXCHANGERS
- NORAM BRICK-LINED ACID TOWERS
- NORAM SULFUR & SPENT ACID BURNERS
- NORAM CELLCHEM SULFUR BURNERS
- NORAM ANODICALLY PROTECTED ACID COOLERS
- NORAM SX™ ACID COOLERS
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