# Noram Sulphur Burners

***The NORAM Spiral Flame™ and Cyclone Flame™ sulphur burners were developed by Cellchem AB in Sweden, with the first compact design appearing in a P&P plant in the 1960's. Since then over 180 plants have been installed worldwide, ranging in capacity from 0.5 metric tons of sulphur per day (MTPD) to 600 MTPD. NORAM acquired the technology from Eka Engineering AB (now AkzoNobel) in 2013.***

**Sulphur Dioxide ($SO_2$) Generation**

The Spiral Flame™ (Type SF) sulphur burner first introduced in 1960 required only one third the volume of conventional burners, thanks to a novel design configuration whereby high-velocity combustion air was introduced tangentially to the combustion chamber, imparting a spiral path to the flame. The turbulence resulted in very effective mixing of the gas reactants, and a downstream afterburner made concentrations of up to 19% $SO_2$ attainable without risk of sublimation. A demand for even smaller burners led to the introduction of the Cyclone Flame™ (Type CF) burner. A number of refinements since then have led to the evolution of the current generation of burners.

**The Spiral Flame™ Sulphur Burner**

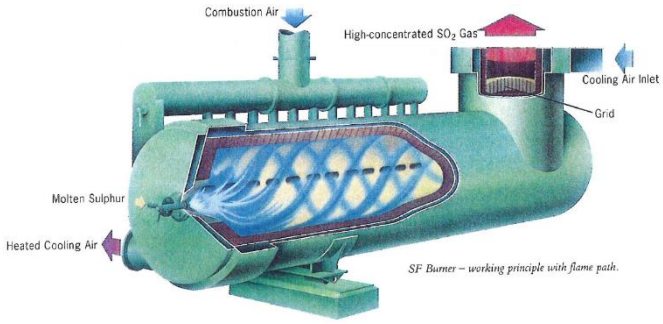
The Type SF Burner consists of the following main parts:

- Sulphur Gun Station
- Combustion Chamber
- After-Burner Chamber

Filtered, molten sulphur is introduced into the combustion chamber in atomized from, by using compressed air. The sulphur gun, as well as the nozzles from combustion air, is specifically located within the combustion chamber to maximize burning efficiency and minimize space.

To react any remaining free sulphur, final combustion takes place in the after-burner chamber. This chamber consists of a bed of inert pebbles creating very high turbulence and an intimate mixing of the gases. Efficient oxidation of the remaining free sulphur is thus assured. This is the primary reason a concentration of 19% $SO_2$ can be achieved without risk of sublimation.

Type SF burners in the capacity range of 5-100 MTPD of sulphur are standardized. The largest burner built has a capacity of 600 MTPD and the smallest 2 MTPD.



*SF Burner – working principle with flame path.*

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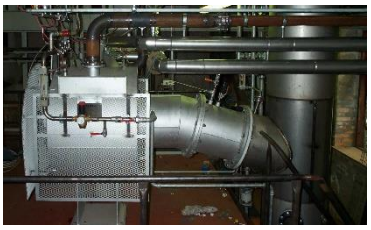

**The Cyclone Flame™ Sulphur Burner**

Type SF burners consists of the following main parts:

- Sulphur Gun Station
- Combustion Chamber

The CF Burner is fed with liquid sulphur via a dosing pump. Filtered, molten sulphur is introduced into the combustion chamber in atomized form, by using compressed air. The sulphur gun, as well as the nozzles for combustion air, is specifically located within the combustion chamber to maximize burning efficiency and minimize space.

The capacity is easily varied to suit subsequent processes. The CF burner may be operated manually, or automatically by flow ratio control of liquid sulphur and combustion air. Changing capacity takes only a few seconds and can be effected from the control room.

Two size of the CF burners are available as standard. Practical operating capacity ranges are 0.5-4 and 1-8 MTPD of sulphur respectively. A plant, based on the CF burner may be supplied as complete, skid mounted units to enable a simplified installation with a compact layout. One unit contains the sulphur melter, filters and sulphur pumps. Another unit contains the CF burner, the gas cooling tower, strainers, pump and cooler for the circulating water. The units have the size of a standard 20-foot container.

**Pressurized Operation**

The entire plant is gas tight. The burners as well as the other components in the plant may be operated under pressure. The pressure is created by the sulphur burner fan, blower or compressor for combustion air. This eliminates the need for $SO_2$ fans or gas compressors, thus reducing costly maintenance and simplifies operation. The standard operating pressure is around 20 kPa(g), although burners have been installed for operations of over 100 kPa(g).

**Heat Recovery Boiler**

For larger sulphur burning capacities, it is often economical to recover heat released in the combustion reaction. This is done by passing the hot $SO_2$ gas from the burner through a waste heat boiler, generating steam.



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**Gas Cooling**

Hot $SO_2$ gas of approximately 1000-1300 °C enters the cooling tower. The tower works without packing. The main cooling is done by quenching with sprayed water. Adiabatic cooling by evaporation of water, which saturates the $SO_2$ gas, cools the gas to around 80 °C. By addition of external cooling of the circulating water, the gas can be further cooled to 40-50 °C, depending on the cooling water temperature.

**Gas Absorption**

The cooled $SO_2$ gas is normally absorbed in water or chemically reacted with other reaction media. NORAM supplies absorption systems for the following applications:

- $SO_2$ water
- Sulphite/bisulphite (caustic soda, soda ash, ammonia, slaked lime, magnesium hydroxide).

Appropriate material selection and extensive experience ensures reliable operation of the absorption systems.

**Liquefaction**

The cooled $SO_2$ gas may also be used for the production of liquid $SO_2$. There are different process options of $SO_2$ liquefaction depending on the economic impact of power and/or chemicals. NORAM supplies $SO_2$ liquefaction systems.



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