



## Acid Gas – NO<sub>x</sub>, SO<sub>x</sub>, HCl

We focus on the issue of acid gases: aeriform substances with acid pH that are harmful, polluting and often corrosive

### What are the Acid Gas – NO<sub>x</sub>, SO<sub>x</sub>, HCl?

With the generic term “acid gases” it tends to identify a family of aeriform substances at acid pH that are harmful, polluting and often corrosive. To this category belong gases as nitric oxide, nitrogen dioxide, hydrogen sulfide, sulfur oxide, hydrochloric acid, and chlorinated gases mentioned in the title.

#### Nitrogen oxides

The NO<sub>x</sub> indicates the entire family of nitrogen oxides, typically produced during combustion processes with the use of oxygen (fireplace, boiler fired with natural gas, diesel or gasoline engine, thermoelectric power plants in a generic way). These pollutants are always present in mixtures of different compounds (nitrogen monoxide NO - nitrogen dioxide NO<sub>2</sub> - N<sub>2</sub>O<sub>3</sub> dinitrogen trioxide - etc ..).

The amount of NO<sub>x</sub>, or rather the concentration of these compounds in an emissive flow, depends on various factors including:

- Fuel used
- Combustion temperature range
- Oxidizing agent
- Combustion technology Type
- Environmental conditions



## Sulfur oxides

The SO<sub>x</sub> detects, similarly to the above, the family of sulfur oxides (SO<sub>2</sub>, SO<sub>3</sub>, ...).

Typically the sulfur oxides are present in higher concentration when they are used fuels such as coal, brown coal or other heavy fossil fuels. It can also result from specific chemical industrial cycles.

The combustion of wood biomass, in the aspect of the gaseous pollutants, is relatively harmless. However, it is important to take into account the emissions of acid gases, which usually have low concentrations, but can vary substantially depending on the actual type of biomass use.

## Hydrogen sulfide

It is a chemical compound with the formula H<sub>2</sub>S. It is a colorless gas with the characteristic foul odor of rotten eggs. It is very poisonous, corrosive, and flammable

## Hydrochloric acid

It is perhaps one of the most common acids released into the atmosphere, it is gaseous at room temperature.

## Acid gas treatment technologies

Depending on the concentrations, temperature, size of the flow to be treated and of further parameters, can be used different technologies for the treatment of acid gas emissions. Being a quick summary we can mention:

### Bag filters with reagent injection

The filters in flat bags are successfully used for the chemical absorption of acid gases such as HF, HCl and SO<sub>2</sub> in addition to the adsorption of other pollutant compounds. Generally it is used,

among others, calcium hydroxide ( $\text{Ca}(\text{OH})_2$ ) of typical commercial quality, which is injected in the gas stream before entering the filter. To achieve proper compliance with the emission limits required, the additive should be added in amounts over-stoichiometric (from 1.5 to 3 times).

## DeNOx: SCR catalytic reactors or SNCR

SCR (Selective Catalytic Reduction) Plant allows the deNOx reaction, as conversion of nitrogen oxides to  $\text{N}_2$  (molecular nitrogen) and  $\text{H}_2\text{O}$  (water). Such transformation is enabled by the use of a reducing agent like ammonia or urea and a appropriate catalyst, that guarantees adequate kinetic to the NOX reduction reactions.

SNCR (Selective Non Catalytic Reduction) plant allows the reduction of  $\text{NO}_x$  by injecting at high temperature ammonia or urea having as result molecular nitrogen  $\text{N}_2$  and water vapour.

## Scrubber

The most common acid gases emitted at industrial level are treated, often, using a wet abatement system usually also called Scrubber. This equipment, using a washing fluid to drag the gas, creates a perfect contact between the liquid and gaseous phase and facilitates the transfer of the acid species from the gas to the liquid. A use of reagent like caustic soda help to neutralize the recirculating liquid increasing also the environmental efficiency.