Process control for SO₂ and HCl scrubbers

Components to be measured:
- SO₂
- HCl
- H₂O
- O₂

ABB Solution:
- ACF5000
- ACX plus LS25

Measurement made easy

Introduction
Incineration is a waste treatment process that involves the combustion of organic substances contained in waste materials. Waste incinerators reduce the solid mass of the original waste by 80 to 85 % and the volume by 95 to 96 %. This means that while incineration does not completely replace landfilling, it significantly reduces the necessary volume for disposal. Furthermore, incineration has strong benefits for the treatment of certain waste types such as clinical wastes and hazardous wastes where pathogens and toxins can be destroyed by high temperatures.

During burning, waste pollutants are created, that are emitted with the flue gas. Depending on the composition of the material incinerated and on the operating conditions, smaller amounts of CO, HCl, HF, HBr, NOₓ, SO₂, VOCs, PCDD/F, PCBs and heavy metal compounds (among others) are formed or remain. To protect the environment most countries have adapted laws to restrict the emission.

HCl is not only of importance due to environmental issues, it also might be harmful to the plant equipment. Many wastes contain chlorinated organic compounds or chlorides. In municipal waste typically approximately 50 % of the chlorides come from PVC. In the incineration process, the organic component of these compounds is destroyed and the chlorine is converted to HCl. HCl is a colorless and pungent-smelling gas, which forms corrosive hydrochloric acid in conjunction with atmospheric humidity.

Typically affected plants:
- Waste incinermators (municipal, hazardous and sewage sludge).
- Plants that use waste for co-incineration (e.g. cement plants, power plants or biomass plants).
Techniques for the reduction of acid gases

SO₂, HCl and HF are generally cleaned from the flue-gas using alkaline reagents. The following flue-gas cleaning processes are applied.

- **Dry processes**: A dry sorption agent (e.g. lime, sodium bicarbonate) is added to the flue-gas flow. The reaction product is also dry.
- **Semi-wet processes**: Also called semi-dry, the sorption agent added to the flue-gas flow is an aqueous solution (e.g. lime milk) or suspension (e.g. as a slurry). The water solution evaporates and the reaction products are dry. The residue may be re-circulated to improve reagent utilization. A sub-set of this technique are flash-dry processes which consist of injection of water (giving fast gas cooling) and reagent at the filter inlet.
- **Wet processes**: The flue-gas flow is fed into water, hydrogen peroxide, or/and a washing solution containing part of the reagent (e.g. sodium hydroxide solution). The reaction product is aqueous.

**Motivation**

Optimum scrubber plant control with maximum efficiency to comply environmental regulations (minimal use of reagent and plant condition monitoring). Additionally, a by-product (gypsum) is produced that can be sold because it fulfills the required quality.

**Task: SO₂ and HCl Scrubber Process**

Two parameters are required for acid gas scrubbing.

- SO₂, HCl and H₂O before scrubber to control the treatment process.
- SO₂, HCl and H₂O after scrubber to monitor efficiency.

The control process is derived from these two values. Additionally, oxygen may be measured to detect leakages.

Typical measuring ranges before scrubber:

- SO₂ 0 to 200 / 1000 / 3000 mg/m³
- HCl 0 to 500 / 2000 / 5000 mg/m³
- H₂O 0 to 10 / 20 / 30 / 40 Vol%
- O₂ 0 to 10 / 25 Vol%

Typical measuring ranges after scrubber:

- SO₂ 0 to 75 / 300 mg/m³
- HCl 0 to 15 / 100 mg/m³
- H₂O 0 to 10 / 20 / 30 / 40 Vol%
- O₂ 0 to 10 / 25 Vol%
ABB alternative solutions:

**ACX with LS25, ACF5000**

ACX plus LS25 connected over ethernet is a solution for both the upstream and the downstream measurement.

ACX is a complete system for extractive continuous gas analysis. The system can be fully operated from the outside. Inside, the well-established reliable analyzers of the Advance Optima series work with the proven components for sample conditioning. The ACX system is particularly easy to maintain as a result of the standardized design. Comprehensive digital communication allows global remote maintenance and control with AnalyzeIT Explorer.

**LS25** is an in situ laser analyzer which selectively measures HCl and water concentration.

The laser operates according to the principle of single-line spectroscopy. For measurement purposes a single absorption line is selected from the gas to be measured in the near infrared spectral range, at which no cross-sensitivity from other gases occurs. The absorption line is scanned and the receiver located opposite detects the absorption caused by the sample gas and calculates the gas concentration from this.

The key advantages of the LS25 are:

- Very short response time (T90).
- In situ measurement without sample handling system as this would be require a much more complex system for hydrogen chloride.
- Minimum maintenance due to missing sample handling components.
- Remote maintenance via AnalyzeIT Explorer is require.
- The customer prefers a cross-stack averaged concentration.
- Maximum dust loads or humidity does not prevent cross-stack measurement ABB offers special technical solutions such as insertion tubes in order to reduce the impact of high dust loads please contact for a detailed feasibility check and advice.

**ACF5000** is another solution for upstream and downstream measurement.

ACF5000 combines the advantages of an infrared spectrometer using Fourier transformations with the proven technology of ZrO2 analyzer modules. There is no need for frequent calibration. The high resolution FTIR spectrometer provides selective infrared measurement of the active gas molecules with great sensitivity and stability. Comprehensive digital communication allows global remote maintenance and control with AnalyzeIT Explorer.

This solution is preferable if:

- High dust loads prevent using in situ technology and a back-purge option is required.
- Further measuring components other than HCl and SO2 need to be monitored the FTIR technology allows to add further components such as NH3, HF.
- A consistent extractive solution is preferred over a mix of extractive and in situ.

**Customer benefits**

- Improved efficiency
- Secured economics