The Differences Between Extractive and In-Situ Emissions Monitoring

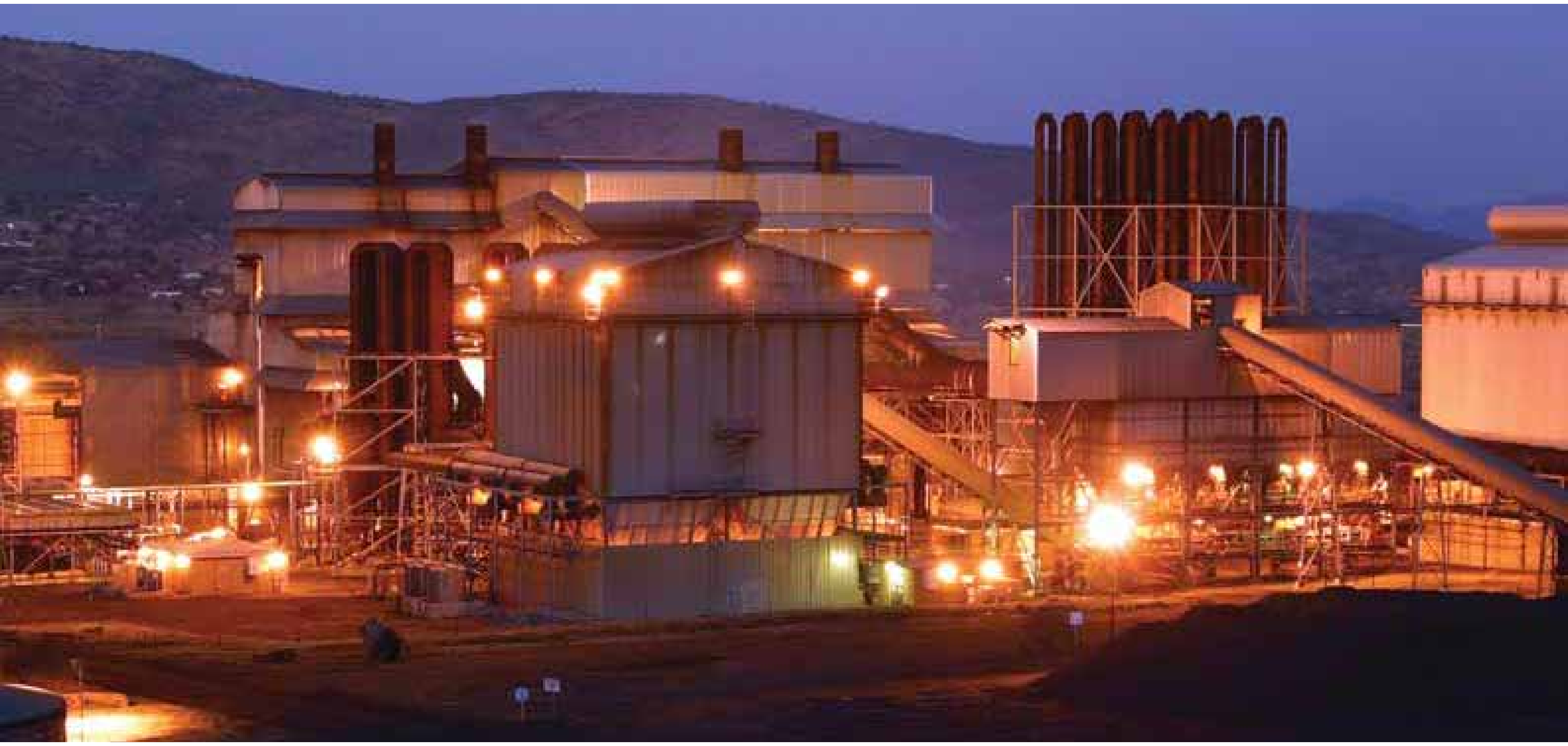
Emissions monitoring has become increasingly important for industrial facilities in recent past. Since the 1970's, the US Environmental Protection Agency (EPA) has been empowered to establish rules and regulations on air pollution in the USA, outlining guidelines for some industrial processes and ultimately imposing limits to emissions. Many other countries have modeled their government environmental programs after the US EPA.

In 1990, the US Clean Air Act also mandated enhanced programs of periodic monitoring of many pollutants from stationary sources. Effective emissions monitoring ensures that companies remain in compliance with regulatory or permit limits (under emissions trading programs), and contributes to a robust national emissions inventory data.

Emissions monitoring can also give companies an important insight into the operational efficiency of their industrial combustion processes. This may lead to reductions in fuel use and improvements to equipment maintenance and durability.

There are two main types of emissions monitoring systems: **in-situ** and **extractive**. In-situ measures the sample at the point source, whereas extractive extracts a sample for measurement away from the point source. We will discuss each in more detail hereafter.

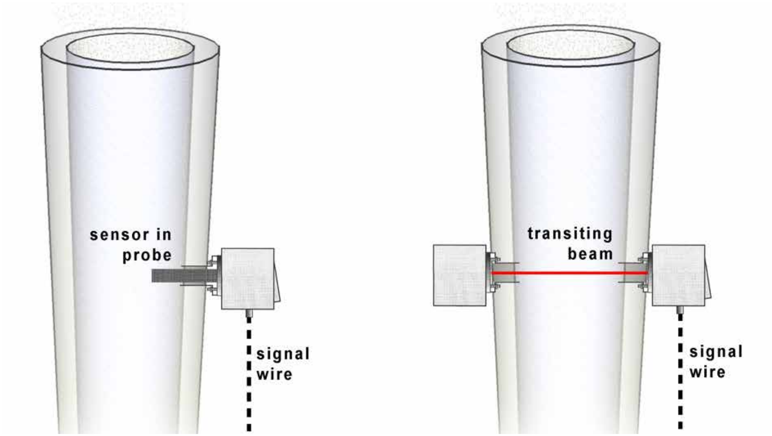
It should be noted that the different styles of monitoring systems can also be applied to process applications other than flue gas and emissions applications.



In-Situ Monitoring

With in-situ monitoring, the gas sensor / detector is placed directly at or inside the duct or stack. A portion of the measurement device is immersed in the sample gas – hence the term “in-situ”. These analyzers may feature optical or electrochemical types of sensors. These systems always have some type of signal output that corresponds to the gas reading.

There are two types of in-situ measurements: **point** (in-stack) and **path** (cross-stack).



In-Situ Monitoring *continued*

Point (in-stack) measurements are performed at the exact location of the sampling cell. The gas sensor is located in the probe that is immersed in the flowing sample gas. Electrochemical or zirconia sensors are commonly used in point style systems.

Path (cross-stack) measurements are taken across a path in the emissions stream. In most cases, path measurements are made by sending an optical signal such as a laser across the duct or stack and reflecting that signal back to a detector. Alternately, the detector may be located directly across from the signal generator without the need for a reflector. The instrument is set up so that specific pollutants selectively absorb some of the optical signal and are interpreted as concentrations of the overall gas sample.

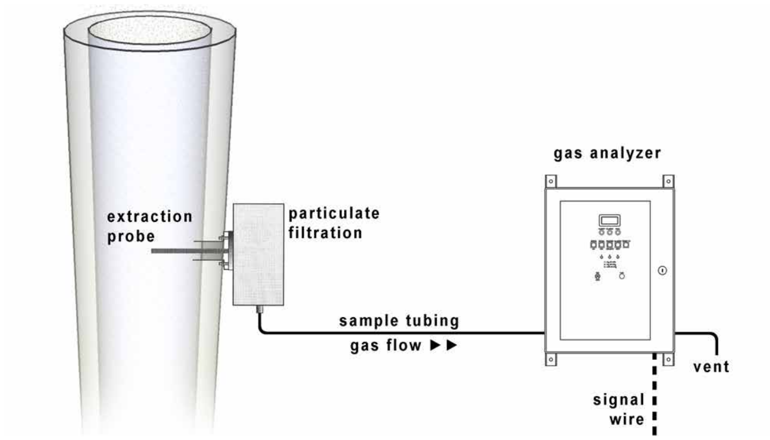
Applications In-situ analyzers are often used in the steel, paper, metal heat treating, and power industries. For example, an in-situ oxygen analyzer can be used to analyze flue gas streams from boilers. In-situ analyzers are also frequently used to measure carbon monoxide in heat treat furnaces or dew point in atmosphere gas generator lines.

Advantages of In-Situ Gas Analyzers The response time of in-situ systems is usually quite fast because the sensor is very close to the process. No sample gas is extracted from the stack in in-situ systems, which can simplify installation. Equipment cost is often less when only one or two gases need to be measured.

Disadvantages The sensors are directly exposed to untreated and potentially corrosive process gas in many cases. The system components may also be exposed to vibration & high temperatures. The measurement point may be within a classified hazardous area which may require special design considerations. Analytical interferences may reduce the accuracy of the measurement. In-situ systems that measure multiple gases within the sample gas are frequently quite expensive. Maintenance, when needed, can also be complicated by the fact that the equipment is mounted immediately adjacent to the process.

Extractive Monitoring

Extractive–style systems take a continuous gas sample from the process stream, remove impurities and water from it, and pump it to an analyzer which may be located some distance away from the extraction point.



This setup is especially convenient as it protects the device from the harmful exposure to the plant environment (high temperatures and pressures, corrosion, and damage caused by exposure to particulate matter) and can monitor the target gas with high accuracy, thanks to the dedicated and sheltered location of the measurement. Extractive systems may vary in design based on the type of sample conditioning that is required. Some systems maintain the sample gas temperature to prevent condensation of water vapor, while others allow the sample to cool and condensation to form.

The analyzer will usually have a local display of the gas reading. It can also send an electrical or digital signal to the customer's receiving device (DCS, PLC, etc.). Various diagnostic and alarming functions may also be available. Infrared, electrochemical, thermalconductivity, paramagnetic and other types of detectors can be used in extractive analyzers.

Applications Extractive systems are regularly used in all different types of combustion applications where the exhaust gas must be measured. Applications that produce process gas as an output, such as landfills, biogas reactors, and gasifiers, are well-suited for extractive analyzer systems, especially for dusty or corrosive applications.

Advantages of Extractive Systems Extractive style analyzers can be located away from the process in an easier-to-reach, climate-controlled location. More convenient location generally means easier maintenance and calibration. There is a wide choice of cabinet styles and configurations available. Extractive analyzers are readily available in multi-gas configurations that are less expensive than the in-situ equivalents. More stringent sample preparation and the ability to compensate for gas cross-interferences contribute to high accuracy and more choice of analysis ranges.

Disadvantages Extractive systems require the extraction of sample gas from the process, which may be undesirable in some cases. Sample tubing must be installed between the extraction point and the analyzer. Transporting the sample out of the process takes time which may result in a slower response time in the analyzer. Extractive systems frequently have a larger foot-print than some in-situ systems. Extractive systems that are only used for measurement of one gas in the sample may be more expensive than the in-situ equivalents.

Selecting an Analyzer System

In-situ and extractive analyzer systems each offer salient benefits and both continue to benefit from ongoing technology advances. The best type of analyzer in a given situation may depend on several factors including measurement ranges required, gas temperature and pressure, gas quality, and ambient conditions. The operator may have past expertise and a level of confidence with one type of system over another. Price, required accuracy, and required service duration may also be influencing factors.

Nova Solutions

Nova Analytical Systems specializes in the design and manufacture of extractive gas analyzer systems.

Our design philosophy includes the following goals for our gas analyzer products:

- Easy & intuitive to use and operate
- Accurate and reliable gas measurement data
- Easy to install
- Easy diagnostic and service, modular design with access to main components and voltage points
- Durable enclosures and sampling components
- Various sample conditioning options to match different applications
- Local displays and optional data outputs via analog/digital channels

Conclusion

The right type of emissions monitoring system depends on a number of factors including the site conditions, data requirements, and a cost-benefit analysis.

To learn more about extractive gas analysis, visit our website. You can also contact us if you have any questions about selecting the right gas analysis system. Our experts are always happy to help