APPLICATION GUIDE

How and Why One Should Measure NOx

NOx emissions (NO & NO_2) *must be closely monitored with a gas analyzer to ensure that combustion systems, such as boilers and engines, are running safely and efficiently as well as complying with environmental regulations.*

COMBUSTION TURBINE SITE

Traditional methods for measuring NOx involve the extraction and analysis of a representative flue gas sample from the stack or exhaust of a combustion source. Common sensor technologies for measuring NOx include electrochemical, non-dispersive infrared (NDIR), and chemiluminescence technologies. Depending on the application and motivation for testing, there are three common approaches for obtaining NOx measurement. Let's take a look at how Simple NOx, Total NOx and True NOx differ from one another. Other variables to consider include understanding the importance of O_2 reference as well as low NOx for tuning in your combustion systems.

Simple NOx Also known as Calculated NOx, this method involves the direct measurement of Nitric Oxide *(NO),* and the subsequent calculation of the expected Nitrogen Dioxide *(NO_2)* content using an assumed NO to NO_2 ratio (typically 1.05). For example, a direct NO measurement of 50 ppm would be multiplied by 1.05 for a NOx reading of 52.5 ppm. While this method of measurement may be acceptable for certain applications, it is not the most accurate method because the ratio may vary depending on the fuel type and combustion process.

Total NOx

This method is significantly more accurate than a *Simple NOx* reading because it involves the direct measurement of both NO and NO_2 using separate high accuracy gas sensors *(commonly electromechanical sensors).* The *Total NOx* reading is therefore the sum of the measured NO and the measured NO_2. Certain environmental agencies, like the U.S. EPA, may require this more accurate NOx reading.

True NOx

This is the most accurate method of NOx measurement because it considers the water solubility of NO_2. When NO_2 comes into contact with condensation, as much as half of the gas concentration can dissolve and significantly affect (reduce) the gas measurement. To account for this, certain sampling techniques can be employed to maintain the integrity of the gas sample and eliminate any water that may accumulate within the sample line.

The most common and effective of these techniques involves a cooling system, like a thermoelectric chiller, which rapidly cools and dries the flue gas sample prior to entering the sample hose and the gas analyzer. This measurement method ensures that the NO and NO_2 readings are highly accurate and representative of the NOx emissions being released from the combustion process.

Figure 2*: ECOM-J2KN Pro Industrial Emission Analyzer is a state-of-the-art analyzer with both remote and wireless control.*

The Importance of Oxygen Reference

Monitoring and reporting NOx emissions levels are critical duties for engineers working in certain industries that utilize fossil fuel-fired combustion systems. In order to prevent facilities from intentionally diluting their emissions readings with O_2 to artificially reduce NOx levels, regulatory agencies often require emissions readings to be reported based on standard O_2 reference levels.

This process allows regulatory agencies to prevent these attempts to falsely reduce reported NOx emissions levels. Emissions from boilers are commonly calculated to a 3% O_2 reference level, and engine emissions are commonly calculated to a 15% O_2 reference level.

Figure 3: The VISION Burner technology ensures complete and efficient combustion with very low emissions; < 30 ppm NOx with low FGR rates.

What is Low NOx?

As we become increasingly aware of the negative impact that fossil fuel emissions have on human and environment health, federal and state environmental agencies are instituting more stringent emissions restrictions and decreasing the permissible emissions levels of certain toxic gases like NOx.

Manufacturers of combustion systems are now required to ensure that their equipment is low NOx compliant (as seen in Figure 3), and technicians working in the residential, commercial, and industrial sectors are required to install and maintain equipment that meets the low NOx emissions regulations.

The term "Low NOx" commonly refers to NOx emissions levels below 500 ppm, but certain regulations require emissions to be below 10 ppm. At these low levels, it is imperative to measure True NOx (i.e., NO + NO_2) to reduce the error, as a few ppm accounts for a significant portion of the NOx emissions. A resolution of 0.1 ppm is often needed at these low levels to increase accuracy when measuring.

Figure 4: ECOM Flue Gas Analyzers for NOx measurement for every coverage.

Figure 5: More than 8-gases measurable (Long-life sensors + NDIR) are available on the ECOM Pro Tech Series.

Measurement for Industrial Applications

- Aluminum processing
- Coke oven gas processes
- Cement processing
- Asphalt mixing plants
- Steel and metal processing
- Power plants
- Refineries
- Chemical processes
- Incinerators
- in every industrial activity involving a combustion process

Figure 6: Industrial Process where emissions analyzers make an improvement in burner efficiencies.

What is a MACT Standard?

The Maximum Achievable Control Technology (MACT) standard is a level of control that was introduced by Title III of the 1990 Clean Air Act Amendments. The purpose of these Amendments was to expedite the development of standards that would reduce hazardous air pollutant (HAP) emissions.

Section 112 (c) of the Clean Air Act (CAA) requires U.S. EPA to publish a list of industry group (major source and area source) categories and subcategories that employ, manufacture or emit hazardous air pollutants (HAP). The 1990 CAA Amendments require U.S. EPA to promulgate technology-based emission standards and allow for the possible supplementation of health-based standards. The regulatory standard for the HAP sources is the Maximum Achievable Control Technology (MACT) standard. Prior to the 1990 CAA Amendments, the regulatory standards for the HAP sources were health-based standards. The 1970 CAA Amendments had established the National Emission Standards for Hazardous Air Pollutants (NESHAP) program, establishing standards and providing national conformity. A NESHAP based on Maximum Achievable Control Technology is called a MACT standard or simply a MACT.

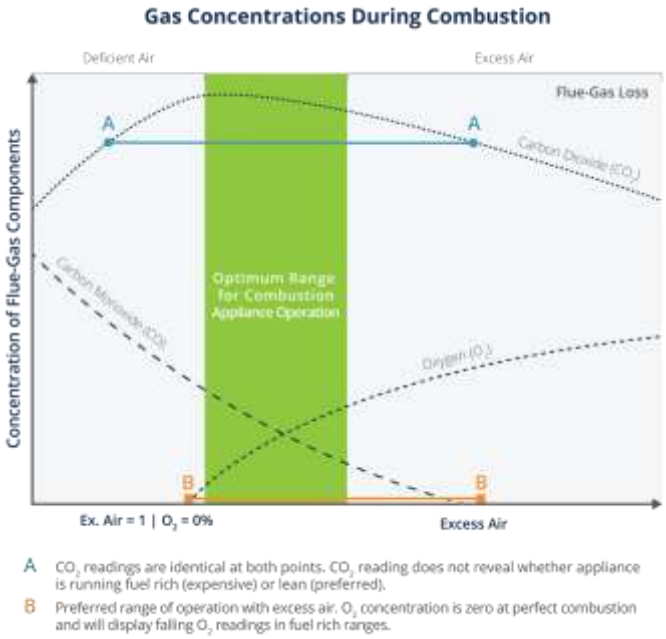

Figure 7: O2 vs CO2 Measurements in Combustion Analysis

Changes in O_2 concentrations are much larger and easier to read than the comparative changes in CO_2 for a given excess air level. O_2 readings are also less sensitive to variations in the chemical composition of the fuel. When combustion is perfect or when the process is burning excess fuel, the O_2 measurement will decrease to zero percent. When combustion is running on the preferred excess air side of the process, the O_2 reading will increase. These reliable patterns make monitoring a combustion process simple and easy *(see "B" in the figure above)*.

Conclusions

Ensuring that your equipment is safe and up to code is a necessary part of the job. ECOM makes it easy with fast and reliable portable emission analyzers. Engineered to deliver instant, accurate results every time. Their lightweight design & rugged build help you to quickly test so you can get back to work.

 When evaluating emissions to meet any standards, be sure to consider portable industrial analyzers to make emissions monitoring fast, accurate and painless.

 Consider the benefits of using WiFI & Bluetooth capable handheld units with remote display, allowing for remote mobile applications to make viewing & storing your testing results easy. Be sure you are able to save/export data to PDF or CSV files and have the capability of printing the results to your analyzer.

 Make sure you know what gases you are measuring. It is also important to know the accuracy you want to achieve, what range of PPM is acceptable and what increments you would like the device to read.