

CONTINUOUS RELIABLE CONTROL MONITORING FOR SCR

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BACKGROUND:

The basic principle to a Selective Catalytic Reduction System (SCR) is to reduce the NO_x (NO+NO₂) to a level below the legal allowable limit. Depending on the area of the country, this limit can be so low that a measurement may become difficult to obtain.

Proper operation of an SCR depends on the reliability of the control system to monitor NO_x concentrations in the flue gas at the inlet and the outlet of the SCR catalytic reactor. Emphasis must be placed on these measurements because of the requirements for high NO_x (NO + NO₂) emission control efficiency and low ammonia slip from the process. In order for the SCR to work properly and maintain the NO_x levels required, a process monitoring system must be incorporated for feed-forward and feed-back control. The control system must be accurate and reliable with minimum maintenance. For the supplier, low cost would be a benefit. This may not appear to be a difficult task at first glance, however, presence of SO₃, NH₃, and high particulate must be accounted for. If sample temperatures drop below 550°F, sulfuric acid, ammonia bi-sulfates and condensed SO₃ can form and create a sampling nightmare. As the NO_x levels go down from the SCR reactions to the flue gases, the ratio of the NO₂ to NO increase making traditional NO_x monitors less accurate due to the loss of NO₂ loss in the oxidizer. Improper control of the system will lead to poor NO_x emission control and potential problems with resultant ammonia slip.

New technologies in sampling and NO_x monitoring have made it possible to provide accurate readings both before and after the SCR system. This method allows for continuous averaged, multi-point sampling (for large ducts) with fast and reliable response times of total NO_x values measured as NO and NO₂.

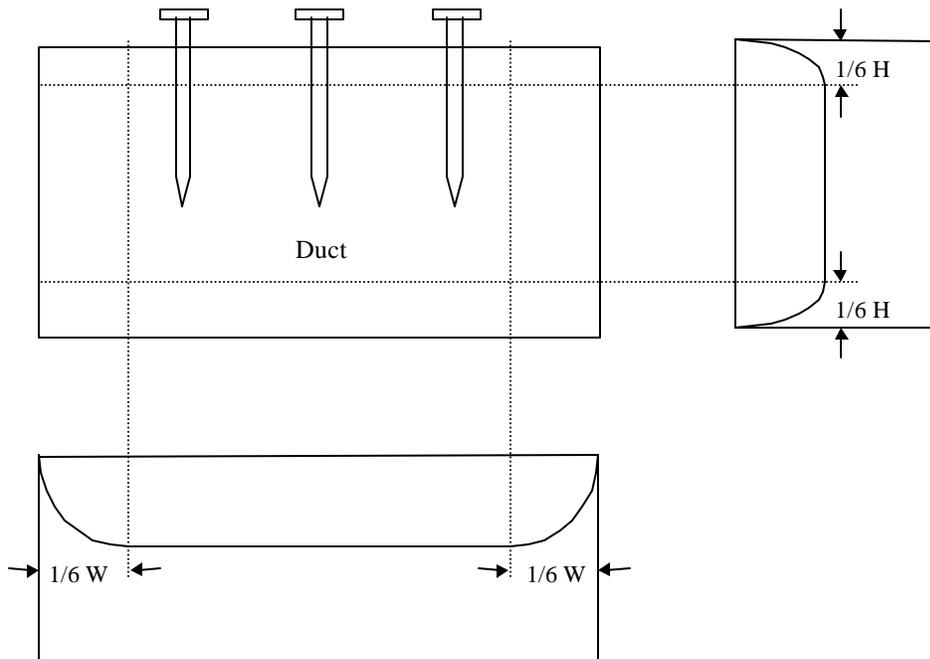
REPRESENTATIVE SAMPLE:

Coal fired plants that will require SCR controls generally have a large cross-sectional flue gas duct system. This tends to generate unique flow profiles in the duct which create a situation where a single point sample will not necessarily provide a representative sample.

The sampling system must have a method of averaging a sample over the entire duct cross-sectional profile. This has to be accomplished by the use of multiple ports in the duct work. The best way to determine the actual duct profile at the point of measure is to have a testing company perform a load profile "map". This will ultimately provide the best sampling points, as well as the number of points required.

NOTE: If a profile cannot be run, and the point of measure is straight with little disturbance before or after the measuring point, a profile based from standard wind tunnel testing can be used (see figure below).

Measurement Profile Across Rectangular Duct



If a profile is generated by a testing company under varied loads, then the number of probes as well as the position and length of the probes will be different than the diagram provided.

SAMPLE INTEGRITY:

A very important design consideration is the ability to maintain the quality of the sampled gas from the sample point to the analyzer. Particular attention must be given to removing dust from the sample, and keeping the sample well above sulfur-related dewpoints (such as SO_3/H_2SO_4) prior to the analyzer.

At the SCR outlet, the sampled gas will contain ammonia of varying concentrations. This ammonia is a by-product of the SCR process and will gradually increase as the catalyst deactivates. For reliable performance of the control system, the temperature of the sample must be well above the calculated dewpoint of $NH_3(SO_3)_2$ (ammonium bi-sulfate) as well as SO_3 and H_2SO_4 . Formation of this compound will plug sample lines and possibly analyzers.

RECOMMENDATIONS:

Number of Sample Points:

Minimum 3 (for large-duct, coal fired plants). Actual number may increase based on flow profiles.

Type of Sample Measurement:

Pure extractive (un-diluted) sample must be maintained above all dewpoints at all times. Blowback air and all components that are in contact with the sample gas must be maintained above the dewpoint prior to removal of sulfur related and ammonium sulfates/bi-sulfates compounds.

Loss of NO_x components must be maintained at a minimum. NO_x must be measured as NO and NO₂ independently without sample oxidation.

Temperature of Sample:

Flue gas sample must be maintained above 550°F (prior to conditioning) in order to maintain the integrity of the sample and prevent corrosion and plugging of the sample and analyzer system.

Maximum Sample Line Length:

Sample line length is directly accountable to system response. The longer the sample line length, the longer the system response. It is recommended that sample line length for the inlet and outlet sampling of the SCR be equal. This reduces the number of components and calculations required in the PID control system for the SCR, i.e., lag time for the flow through the SCR will only need be accounted for and not monitoring lag time differences.

Dust Filtration:

Sample gas will need filtering at temperatures above all dewpoints. Filter porosity should be no greater than 2 micron prior to the analyzer. Probe filters must have site adjustable timers for blow-back and the blow-back air must be maintained above 550°F. This prevents corrosion and solids buildup.

Analyzer Response:

Actual system response from probe tip through analyzer should be 30 seconds or less.