



CSM

Worldwide

CSM INTRODUCES THE REDOx™ SYSTEM

for NOx and CO ABATEMENT

The REDOx™ System is a selective catalytic reduction (SCR) NOx abatement system that uses the latest SCR catalyst technology to achieve up to 95% NOx reduction while also getting up to 95% CO reduction.

The REDOx™ System can most economically be adapted to many Packaged Boiler and Process Heater designs. REDOx™ can be used on both new equipment or be field retrofit to existing equipment.



THE REDOx™ SYSTEM FEATURES :

- NOx reductions of up to 95% that meet Southern California's latest stringent regulations for the year 2000 and beyond
- CO reductions of up to 95%
- Minimal ammonia slip of less than 5 ppm
- Very low overall system pressure drop (often less than 2" w/c)
- No lost energy nor loss of heating efficiency when REDOx™ is located within the 450-550F temperature zone of the applicable packaged boiler or process heater
- Often can be utilized without NOx analyzers for ammonia injection control
- This new SCR catalyst is now being used in six (6) commercial gas turbine applications

With the proliferation of air pollution control regulations confronting manufacturers, NOx and CO have become dirty words. Fortunately, technical advances have enabled manufacturers to utilize new ways to clean air emitted by industrial processes. CSM Worldwide, Inc., a leading supplier of products

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and systems that remove hazardous pollutants from the air, can help you meet these requirements.

NEW CATALYST AND APPLICATION TECHNOLOGY PROVIDES ECONOMICAL APPLICATION OF SCR FOR SMALL TO MEDIUM APPLICATIONS

SCR technology is traditionally used for large flow applications such as 500MW power generation plants. Recently CSM has developed a technology designed for smaller applications such as packaged boilers and process heaters and medium sized applications including chemical plants and other industrial sources.

The difficulty in making SCR economical to smaller installations is that certain components of SCR systems do not significantly reduce in cost as size is reduced. For example, the NOx analyzer used for measuring NOx and controlling the amount of ammonia to inject into the stream is a constant cost regardless of SCR size. This ratio of NH₃ to NOx had to be closely controlled because with conventional SCR catalysts any excess ammonia beyond that required for NOx destruction, would result in ammonia slip into the exhaust stream and therefore, excessive emissions into the environment.

The REDOx™ system is less sensitive to NH₃ to NOx ratio and has, in many cases, eliminated the need for NOx analyzers to control injection of ammonia. This has resulted in lower costs for smaller process applications.

NEW REDOx™ CATALYST SYSTEM

The heart of this technology is a newly developed SCR/Oxidation catalyst system. There are now three types of catalyst for the SCR reaction:

Zeolite Catalyst - high temperature operation

Vanadium/Titanium Catalyst - medium temperature operation

Precious Metal Catalyst - low temperature operation

Likewise, typical CO and hydrocarbon oxidation catalysts can be classified as:

Precious Metal Catalyst - gives complete oxidation over a wide range of temperatures

Base Metal Catalyst - gives selective or partial oxidation at low temperature

CSM has extensive knowledge of catalysts of all types and keeps current with the latest developments by the world's top catalyst manufacturers. CSM offers the best catalyst technology to match our customers' goals of minimized investment and operating cost at maximized operating performance.

The REDOx™ System uses a combination of reduction and oxidation catalysts at operating conditions necessary to yield performance that works.

HOW IT WORKS

To get the maximum benefit from implementing REDOx™ technology in a conventional gas fired packaged boiler or process heater, locate the area where the exhaust gas is in the temperature zone of 450-550F during most modes of operation. Divert the exhaust gas into the REDOx™ system or insert the REDOx™ system into this section of the boiler.

The REDOx™ system consists of an ammonia injection grid and a catalyst bed. A burner-firing signal from the burner control system provides an indication of NOx production; this signal feeds forward to the ammonia injection controller. A slight excess of ammonia to NOx is delivered to the inlet to the catalyst bed.

In the first bed of reduction catalyst, NOx and ammonia partially react to form nitrogen and water. Residual NOx and ammonia leave the first catalyst and enter the second catalyst bed. There the SCR reaction continues to minimize NOx concentration with excess ammonia. The excess ammonia is simultaneously destroyed in a competing reaction to form nitrogen and water vapor.

A thermocouple at the catalyst bed inlet monitors catalyst inlet temperature. If needed, temperature adjustment can be added: cooling by injecting ambient air with the ammonia injection grid; heating by sending a signal to the burner to increase firing.

COMMERCIAL APPLICATIONS

The catalyst used in the REDOx™ system was commercialized in the early 1990's and is now used in six (6) gas turbine applications.

The CSM REDOx™ catalyst system is operating in six (6) industrial emission control systems without NOx analyzers to control ammonia injection. Ammonia slip of less than 3ppm has been measured. NOx emissions were reduced by more than 90% compared to conditions prior to the use of the REDOx™ system.

A Mid West boiler manufacturer, achieving a NOx effluent of 20ppm from low NOx burner technology, can now expand his market penetration into locations requiring more stringent emissions, like California, by implementing REDOx™ to his packaged boiler product line.

Also, the REDOx™ system is being considered with conventional SCR technology in areas where extremely low ammonia slip is required.

PARTNER WITH CSM

When confronted with the complex and ever-changing Federal and State environmental regulations, partner with CSM Worldwide, the industrial leader in SCR NOx abatement catalyst technology. CSM will work with you on applications, both large and small, to provide the most economical solution.

