The emissions solutions and energy savings you need now.
Delivering Innovation

CRI Catalyst Company is part of CRI/Criterion, Inc., the global catalyst technology company of the Shell Group. Through Shell, we have access to state-of-the-art research laboratories, development facilities, manufacturing plants and business units throughout the world.

We are dedicated to delivering the most effective and cost-efficient catalysts and technologies available.
Compliance, environmental responsibility and energy-cost management are now all part of the emissions-control landscape. Today’s industrial facilities are not only looking to reduce their emissions, they are also seeking immediate, cost-effective and proven technologies to lessen environmental impact and energy use. CRI Catalyst Company offers catalyst technologies that can help your facility reach these goals today.
EMISSIONS CONTROL, REGULATORY COMPLIANCE AND REDUCING ENERGY CONSUMPTION ARE HIGH-PRIORITY ISSUES IN MANUFACTURING ENVIRONMENTS.

CRI Catalyst Company provides reliable and cost-effective catalyst solutions and systems for environmental emissions control, including flue gas treatment catalysts, for:

- NOx Removal via Selective Catalytic Reduction
- Catalytic Dioxin Destruction
- \( \text{N}_2\text{O} \) Decomposition
- Oxidation of Volatile Organic Compounds and Carbon Monoxide

The Performance Difference: CRI’s Lateral Flow Reactor

At the heart of all our catalyst systems is the Shell-engineered Lateral Flow Reactor (LFR), which enables optimal contact between the flue gas and the catalyst. This reactor, combined with our extremely active catalysts, allows for the highest levels of gas-to-catalyst contact and conversion.

Low pressure drop

The LFR is a packed-bed type reactor in which the catalyst pellets are contained in thin layers between gas channels. The flue gas is forced laterally through the catalyst layers, which provides the most efficient utilization of the catalyst while minimizing pressure drop – even at high velocities.

Energy conservation

Combining low-temperature activity and low pressure drop can significantly lower your plant’s energy usage, reducing operating costs and your carbon footprint.
NOx Removal Via Selective Catalytic Reduction

CRI provides highly reliable technology for Selective Catalytic Reduction (SCR) of nitrogen oxides (NOx) from stationary and mobile combustion sources and chemical processes.

Proven around the world, CRI SCR/Shell DeNOx System (SDS) catalyst technology is unique in its ability to provide 98%+ NOx reduction across a broad range of conditions. At low temperatures, it outperforms any other catalyst system, making it a highly cost-effective retrofit for existing facilities where exhaust temperatures are low.

About CRI’s Selective Catalytic Reduction System

The CRI SCR System is based on the addition of ammonia (NH₃) to the NOx-containing flue gas and passing the mixture over an active catalyst. This converts the nitrogen oxides (NO and NO₂) to nitrogen (N₂) and water (H₂O). Together, our high-activity catalyst and low pressure drop result in cost-effective NOx reduction.

CRI SCR technology is impressively cost-efficient compared to other NOx control technologies. In addition, because of its LFR-based design, low-temperature activity and extremely low pressure drop, it delivers the performance you require while consuming less energy – supporting your facility’s overall energy reduction program. For certain applications, it can be installed between the economizer/HRSG and the stack, helping to reduce installation costs, plant downtime and disruption.

Backed by the strength of Shell, the CRI SCR System not only delivers powerful environmental and cost benefits, it also comes with the service and support you expect from a respected global leader.

Applications

With its proven performance at a variety of operating temperatures and compact size, CRI SCR technology can be applied to a wide range of combustion, chemical and incineration processes, both in new or existing facilities:

Gas turbines
Unlike alternative NOx control technologies, the CRI SCR System does not disrupt turbine or heat-recovery equipment operation.

Nitric acid and other chemical plants
The CRI SCR System can be installed in either the high-pressure position upstream of the expander or in the low-pressure position downstream of the expander at very low oxygen concentrations.

Waste incineration
High NOx removal capability at low temperatures allows the CRI SCR System to be integrated at the end of flue gas treatment systems on waste incineration plants – with minimal or no gas reheat.

Catalyst manufacturing
Enhanced ammonia adsorption accommodates changing flue gas streams and composition (e.g., high NO₂ concentrations) while exceeding performance requirements.
CRI Catalytic Dioxin Destruction Technology

CRI provides technology for the catalytic destruction of dioxins and furans from municipal solid and hazardous liquid waste incineration facilities. CRI catalyst technology allows customers to cost-effectively meet the most stringent worldwide dioxin emission requirements. From installation to ongoing maintenance, the Shell Dioxin Destruction System (SDDS) minimizes the costs and complexity of dioxin abatement.

SDDS from CRI is the most cost-effective, efficient and complete low-temperature technology for flue gas dioxin emission destruction. Its LFR-based design is proven in numerous incineration and industrial environments, offering excellent cost/performance benefits compared to other dioxin emission control technologies along with the ability to operate with greater energy efficiency.

By sharing in our experience and operating per CRI guidelines, your dioxin destruction catalyst performance can be guaranteed.

**Single-step simplicity**

Unlike technologies based on carbon adsorption, the CRI catalytic system destroys dioxin compounds in a single process step, in a single layer, and with no reactants, solid waste disposal or subsequent processing needed. In addition, the CRI process does not require the addition of any reactant beyond the oxygen already in the flue gas.

\[ \text{C}_{12} \text{H}_{n} \text{Cl}_{8-n} \text{O}_{2} + (9 + 0.5n) \text{O}_{2} \rightarrow (n-4) \text{H}_{2}\text{O} + 12 \text{CO}_{2} + (8-n) \text{HCl} \]

**Low emissions at low temperatures**

The CRI dioxin destruction catalyst enables dioxins to be reduced to extremely low levels at low flue gas temperatures, even as low as 320°F (160°C).

**Compact and flexible**

Because the CRI catalyst is more active than competitive catalysts, SDDS is more compact and lightweight. Catalyst volumes can be a fraction of conventional catalyst systems—especially at lower temperatures. This compact form factor helps provide an easier retrofit into your existing plant. In addition, because it normally operates as the final step in your process, just prior to the stack, there is minimal downtime or disruption for installation. The majority of the installation work can be done while your process is operating, which means only the tie-ins require a shutdown.
High destruction efficiency
The combination of high catalyst activity and low pressure drop makes the SDDS highly efficient at dioxin destruction. From the highest inlet concentrations, the system can achieve over 99.9% destruction of dioxins and furans, down to the lowest worldwide regulated emission limit.

Easy retrofit
The compact, lightweight nature of the system allows easy retrofit onto existing facilities where space is limited. Installation at the end of the process results in significant savings in installation and operating costs, with minimal downtime for installation.

Less maintenance and downtime
A durable and robust steel module and long-lasting catalyst allows your system to run reliably and with minimal maintenance downtime or catalyst renewal.

Applications
CRI catalytic dioxin destruction technology has been successfully applied to both liquid waste incinerators after the wet acid gas scrubber and to solid waste incinerators after the acid gas and particulate removal systems. Low operating temperature and the ability to design for low pressure drop allow the Shell Dioxin Destruction System to be positioned at the tail end of most existing processes, just prior to the stack.

With the injection of ammonia, your SDDS system can be designed to remove both nitrogen oxides and dioxins, so you can address two emission concerns with one cost-effective system.
CRI N₂O Abatement Technology (C-NAT)

**Tertiary treatment**

With an environmental impact 310 times higher per unit than CO₂, nitrous oxide (N₂O) has been identified as a significant greenhouse gas (GHG) under the Kyoto Protocol. To combat this environmental threat and enable industrial plants to both meet clean air regulations and participate in carbon credit programs, CRI offers an innovative, energy-efficient solution for N₂O decomposition based on our unique LFR technology.

This CRI technology destroys N₂O, converting it into nitrogen (N₂) and oxygen (O₂). It is well-suited to reducing N₂O emissions from the tail gas streams of industrial and chemical process plants such as nitric acid, caprolactam and adipic acid plants – all significant emitters of N₂O. C-NAT has been tested under a wide range of conditions and is capable of achieving N₂O reductions of more than 98%.

C-NAT is a direct N₂O decomposition process that does not require the addition of any reducing agent or other reactant. N₂O destruction of 98% or higher can be achieved over a range of temperatures and pressures, and no undesirable by-products are formed.

**Robust yet cost effective**

The CRI N₂O Abatement Technology is a dependable system and far more cost effective than other technologies available on the market.

**Eligible for carbon credits**

In regions where carbon markets are in effect, N₂O reduction projects can be used to generate tradable carbon credits and financial revenues.

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**Environmental and financial benefits**

N₂O reduction projects can be used to generate tradable carbon credits and financial revenues.
CRI N2O Abatement Technology (C-NAT)

Tertiary treatment

With an environmental impact 310 times higher per unit than CO2, nitrous oxide (N2O) has been identified as a significant greenhouse gas (GHG) under the Kyoto Protocol. To combat this environmental threat and enable industrial plants to both meet clean air regulations and participate in carbon credit programs, CRI offers an innovative, energy-efficient solution for N2O decomposition based on our unique LFR technology.

This CRI technology destroys N2O, converting it into nitrogen (N2) and oxygen (O2). It is well-suited to reducing N2O emissions from the tail gas streams of industrial and chemical process plants such as nitric acid, caprolactam and adipic acid plants – all significant emitters of N2O. C-NAT has been tested under a wide range of conditions and is capable of achieving N2O reductions of more than 98%.

C-NAT is a direct N2O decomposition process that does not require the addition of any reducing agent or other reactant. N2O destruction of 98% or higher can be achieved over a range of temperatures and pressures, and no undesirable by-products are formed.

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Applications

Nitric acid plants

C-NAT can be installed in either the high-pressure position upstream of the expander or in the low-pressure position downstream of the expander. Both options benefit from low pressure drop by utilizing the LFR.

Caprolactam plants

Certain processes for the manufacture of caprolactam can have high N2O emissions. The CRI N2O decomposition catalyst is stable in the presence of small quantities of sulfur oxide (SOx) sometimes present in caprolactam process tail gas.

Adipic acid plants

Exceptional performance benefits can be gained by employing a highly active catalyst on tail gas emissions, offering significant N2O reductions while maintaining low pressure drop.
Catalysts for the Oxidation of Volatile Organic Compounds (VOCs) and Carbon Monoxide (CO)

Some volatile organic compounds (VOCs) are harmful by-products of a wide range of industrial processes. CRI VOC and CO removal technology allows for removal of these compounds via catalytic oxidation. Catalytic oxidation converts VOCs into gas containing commonly occurring carbon dioxide and water. The use of CRI catalysts in the oxidation process and our LFR module configuration allows this reaction to take place at lower temperatures than thermal oxidation, saving fuel and operating costs. With the proper design, VOC conversions can be as high as 99.9%, well exceeding current EPA requirements and regulations worldwide.

Applications:

- Printing
- Oven off-gassing
- Food manufacturing and coffee roasting
- Painting/coating operations
- Landfills
- Metal coating operations
- Pharmaceutical manufacturing
- Soil remediation
- Chemical and petrochemicals production, including terephthalic acid, formaldehyde, cumene and styrene
- LNG transfer sites
- Bakeries
CHEMICAL PROCESS CATALYSTS
State-of-the-Art Catalytic Solutions

TECHNOLOGIES

Ethylene Oxide Catalyst

Hydrogenation and Specialty Catalysts

Upstream and Renewables

Environmental Catalyst and Systems

SERVICES

Process Modeling

Process Licensing

Joint Catalyst Development

Catalyst Scale-up and Manufacturing

Reactor Internal Design