



# **NO<sub>x</sub> Emissions:** Flue Gas Treatment Systems and Associated Challenges

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## **NO<sub>x</sub>: What is it? Why is it Important? How to reduce it?**

Nitrogen oxides (NO<sub>x</sub>) are poisonous, highly reactive gases that are often formed when fuel burns at high temperatures. NO<sub>x</sub> includes various nitrogen compounds such as nitric oxide (NO), nitrogen dioxide (NO<sub>2</sub>), and nitrous oxide (N<sub>2</sub>O). These compounds and the greenhouse gas that forms out of them promote poor air and water quality, cause acid rain, and contribute to smog.

Fortunately, while NO<sub>x</sub> is dangerous and detrimental to personal health and the environment as a whole, there are several methods that can be implemented to reduce NO<sub>x</sub> emissions and their effects. Reducing fuel consumption, low NO<sub>x</sub> burners, and utilizing flue gas treatment in SCRs and SNCRs are tools at our disposal to reduce NO<sub>x</sub> Emissions to acceptable levels.

## **SCRs, SNCRs, and the Fight Against NO<sub>x</sub> Emissions**

An SCR is a selective catalytic reduction reactor that works to reduce NO<sub>x</sub> through the use of ammonia injection in conjunction with catalyst to improve reactivity rate and are the most effective flue gas treatment systems. Similar to catalytic converters on vehicles, albeit on a much larger scale, industrial SCRs operate by breaking down NO<sub>x</sub> into harmless N<sub>2</sub> and H<sub>2</sub>O. SNCRs, or selective non-catalytic reduction reactors, are similar to SCRs but with the notable exception of a catalyst therefore they do not achieve the same NO<sub>x</sub> reduction rates.

It is critical for SCRs and SNCRs to be operated properly in order to achieve the required NO<sub>x</sub> reduction while still allowing maximum production rates. Allowing fibrous material to accumulate on and foul up the catalyst face and/or living with poor ammonia distribution will result in reduced production rates, forced outages, compliance issues, excessive ammonia slip, and shortened catalyst life.



## SCR Fouling and its Effects

SCR Fouling is typically caused by refractory or insulation fibers that accumulate and block the face of the catalyst, eventually leading to substantial flow disruption and excessive pressure drops, typically worsening over time. ***It is not “if” a plant will experience this issue, it is a matter of “when”.***

This pressure drop and flow maldistribution will cause production rate limitations, unplanned outages, and environmental compliance issues to occur if not addressed early on. The life of the catalyst can also decrease drastically if the issues are not addressed and corrected in the appropriate time frame





# Proven Methods for Keeping SCRs Operating Efficiently

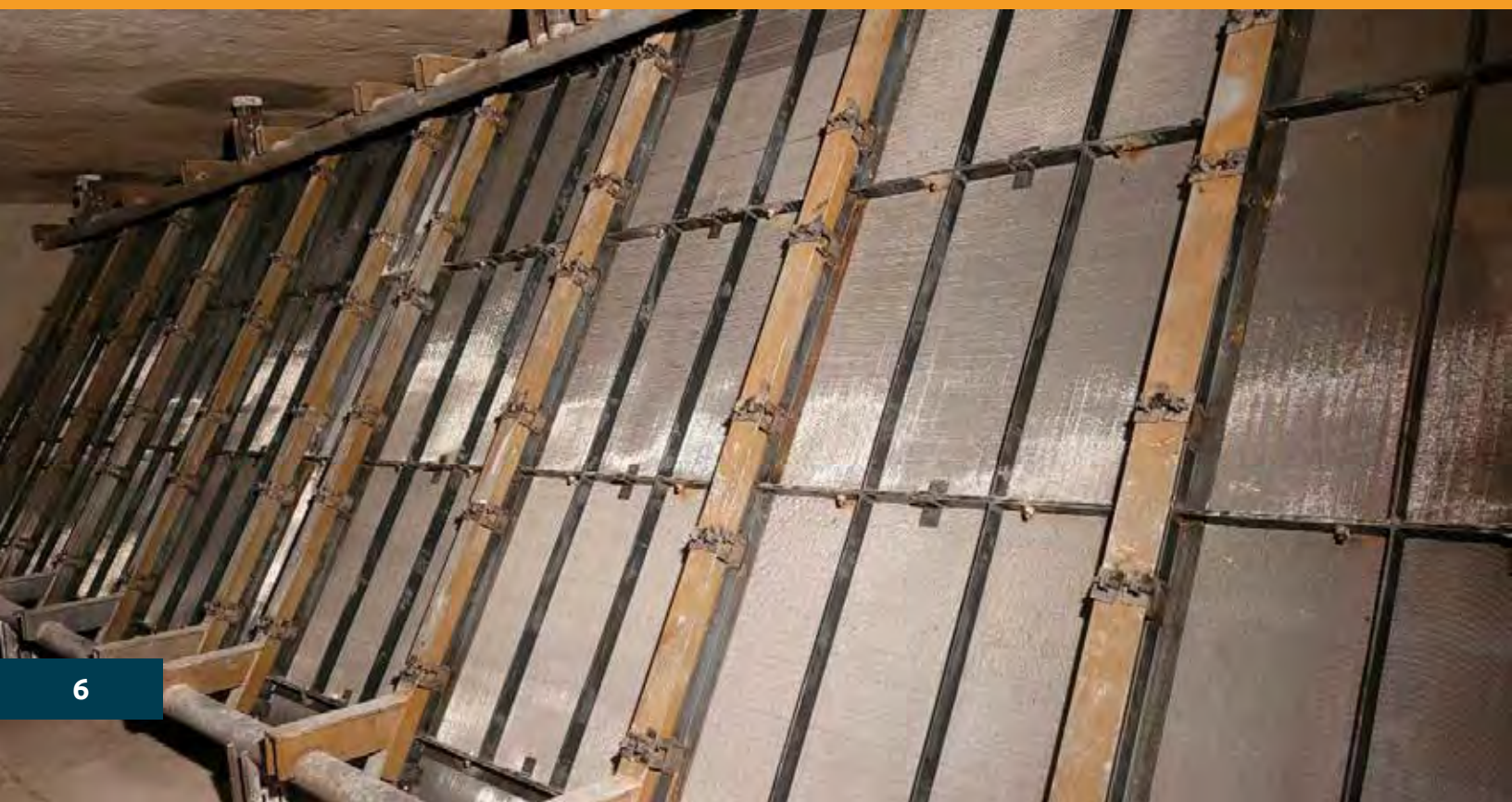
## Immediate Relief to Keep System Online: Hot-Tek Vacuum Services

If a facility is experiencing severe accumulation that is risking system derates and/or a forced shutdown to clean, Hot-Tek online SCR vacuuming can remove the accumulated material online, allowing immediate relief to the SCR system. Through an array of access ports that can be installed in advance or while the plant is online, this system is extremely effective at removing material from the catalyst face.

However, this option relieves the immediate pressure drop but does not prevent the buildup from reoccurring or eliminate these effects when it does. Therefore, it is recommended to evaluate a long-term preventative solution as well.

## Long Term Solution: Fine Particle Filtration

Fundamental to the IGS Clean SCR Guarantee, the fine particle filtration screen is designed to capture and remove fibrous material from the flue gas before it reaches the catalyst. Both single and dual layer filtration systems are available, depending on the plant's individual needs and severity of material fouling. Installed upstream of the SCR, this screen prevents the fibrous material from reaching the catalyst, eliminating SCR fouling.



### Removal of the Captured Material: Screen Online Cleaning System

Once the fibrous material accumulates atop the fine particle screen, a system of air cannons and specialized header nozzles remove the particles from the screen and sweeps them into a collection area, preventing them from being re-entrained into the flue gas stream. These cannons are set on a time schedule that allows them to fire at various intervals in order to proactively clean the face of the fine particle screen on a regular basis.





## Ammonia Mixing System

Understanding the flow distribution and ammonia mixing in SCR and SNCR applications is key to a successful installation. When required, IGS also incorporates an ammonia ( $\text{NH}_3$ ) mixing system to dramatically improve the ammonia mixing and distribution, critical to reducing  $\text{NO}_x$  levels and maximizing asset life. With the implementation of complex CFD studies and the installation of flow devices to optimize existing systems, the ammonia mixing system has been proven to reduce ammonia slip and consumption while supporting a longer catalyst life. This can be incorporated with the screen system or standalone if requested.





## Reducing the Volume of Fibrous Material: Refractory Encapsulation

Installation of a refractory coating is a great way to both increase the refractory life while also reducing the volume of free fibrous material in the flue gas stream. It is often impossible to completely eliminate the free fibrous material, so in most cases additional measures must be taken to completely protect the SCR. However, this is a key component to the 95% clean SCR package and guarantee, especially in the more severe examples. In addition to alleviating some strain on the SCR, this also slows fouling of the convection section, increasing thermal efficiency of the plant.

Additionally, this coating is able to change the emissivity of the surface, when desired, which can provide significant fuel savings in certain applications.

## Conclusion: A Comprehensive SCR Solution, Guaranteed!

By understanding the root causes of SCR fouling and poor mixing and applying a truly comprehensive solution, it is possible to restore the flue gas treatment systems to their design parameters and in some cases actually improve the original design performance! As a result, the facility is able to operate reliably at the full production capacity while remaining in compliance with their NO<sub>x</sub> emission regulations. In laymen's terms, making the most revenue while still being a good neighbor and friend to the environment!

In one severe example, a customer was experiencing production derates and forced outages due to SCR fouling and system pressure drops within two months of operation after each turnaround cycle. IGS designed and installed a turnkey comprehensive solution, and the facility has experienced over two years of operation with no SCR related derates. With the fine particle screen, online air cannon system, ammonia mixing system, refractory encapsulation, and hot vac access ports, this plant experienced a dramatic improvement to their production while seeing a return on investment in less than 2 months!

Contact an IGS fired heater expert today to get more information about the SCR solutions and start seeing immediate results! Visit: [www.integratedglobal.com](http://www.integratedglobal.com)

**“This plant experienced a dramatic improvement to their production while seeing a return on investment in less than 2 months!”**

# Our Services

We mitigate erosion and corrosion with the use of proprietary thermal spray technologies, including HVTs. Cetek coatings improve fired heater efficiency, while Hot-tek services maintain fired heaters between turnarounds. Our environmental services provide industrial cleaning solutions.

- **Stop corrosion and erosion**
- **Maximize fired heater efficiency**
- **Prevent fired heater shutdown**
- **Eliminate SCR Fouling and  $\text{NH}_3$  Slip**

# Industries We Serve



**Oil and Gas**



**Coal Power**



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**Metals and Mining**



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