# World-Class SCR Technology and Product Lineup of Mitsubishi Hitachi Power Systems, Ltd.


**Air Quality Control Systems Business Department,**
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Mitsubishi Hitachi Power Systems, Ltd. (MHPS) commercialized its first SCR (Selective Catalytic NOx Reduction) system for a Japanese thermal power plant in 1977 – the earliest anywhere in the world – and now provides SCR systems or SCR catalysts to no less than 1,700 facilities. Taking advantage of its strength as a pioneer of the SCR system and the advantages of a manufacturer capable of providing both SCR system and catalysts, MHPS proposes solutions that meet the demands of all customers for the reduction of nitrogen oxides (NOx).

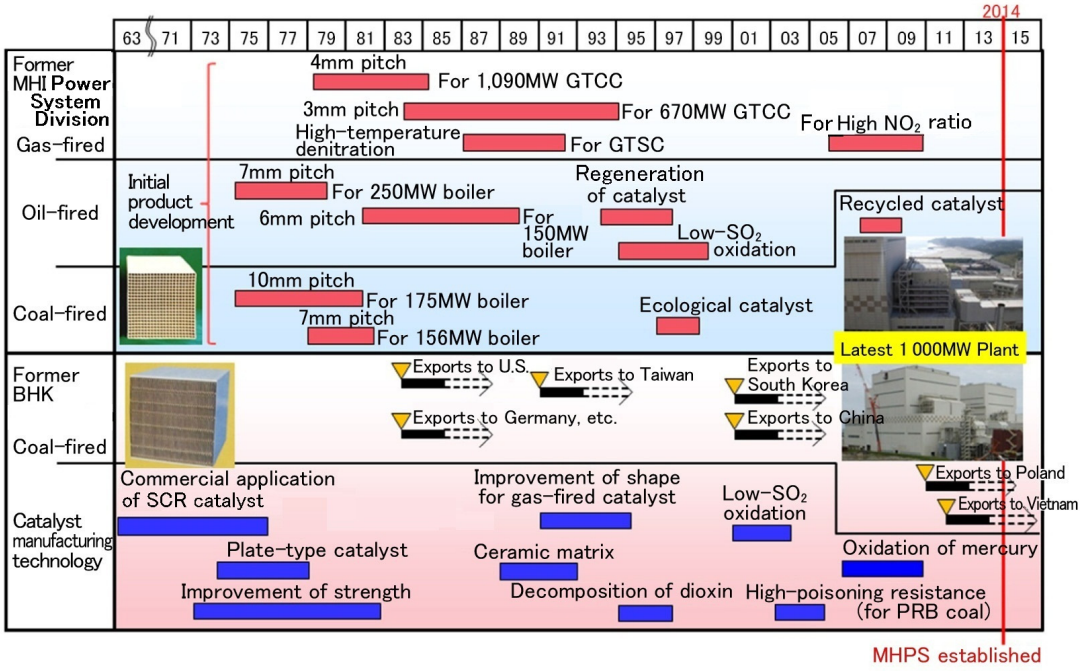
## 1. Introduction

MHPS is a leading company in the thermal power system and environmental technology areas. In the environmental technology field, MHPS not only designs, manufactures, installs and commissions SCR system for thermal power plants, but also manufactures SCR catalysts, which are key component of SCR system. The company is also one of the few manufacturers in the world that has advantages both in SCR system and catalysts.

## 2. Product development overview

MHPS, as shown in **Table 1**, started to develop SCR catalysts in the 1960s, commercialized its first SCR system for thermal power plants in 1977 – the earliest anywhere in the world – and now provides SCR system or catalysts to no less than 1,700 facilities. Based on a multitude of operational achievements in the past, we are in pursuit of development to meet customer needs, thereby expanding our product lineup.

**Table 1 History of SCR catalyst development**



# 3. Product lineup outline

## 3.1 Examples of SCR system application

To mitigate nitrogen oxide (NOx) emissions from various thermal power plants including coal-fired, gas turbine combined cycle (GTCC), gas turbine simple cycle (GTSC) and petroleum coke (PC)-/heavy oil-/other low quality solid fuel-fired types, SCR system suitable for each thermal power plant is applied.

**Figure 1** shows a schematic of SCR system. SCR system is in some cases installed in a brand-new thermal power plant under construction, while in other cases it is retrofitted to reduce nitrogen oxide emissions under the intensified environmental regulations over thermal power plants in operation or as part of environmental preservation measures, and we can respond to both cases with our products. MHPS is also capable of dealing in SCR system installation projects at home and abroad. We have recently received orders from Polish and Spanish electric power companies for the retrofit of such system.

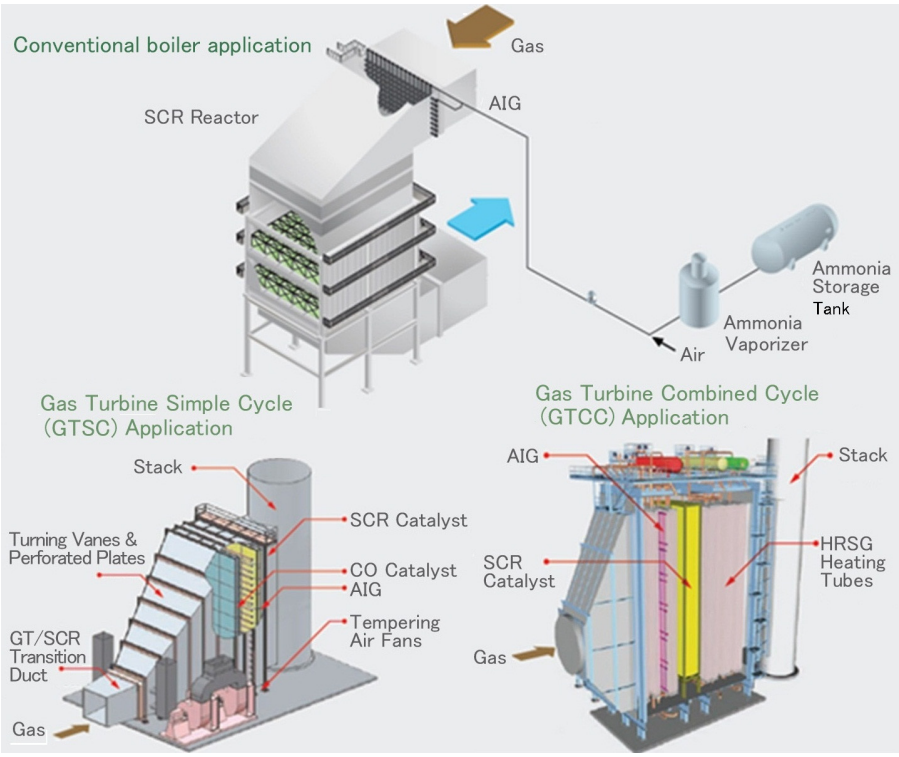



**Figure 1 SCR system schematic**

## 3.2 Characteristics of SCR catalysts

Most SCR catalysts are roughly divided into plate-type, honeycomb-type and corrugated catalysts, of which MHPS mainly adopts plate and honeycomb types (**Figure 2**) in consideration of the fuel used, system configuration, conditions for utilization, customer needs, etc

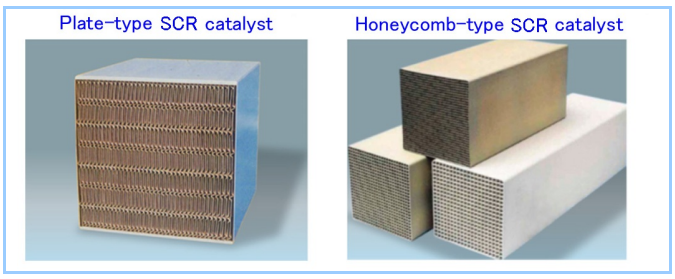



**Figure 2 SCR Catalyst**

## 3.3 High-performance/high-value added in SCR catalysts

(1) Mercury oxide catalyst (TRAC®)

Under the regulations for mercury and other toxic substances in the U.S. (MATS: Mercury and Air Toxics Standards) and the international Minamata convention on mercury, it is necessary to reduce the amount of mercury emitted from power plants. Accordingly, the

adoption of a system that oxidizes mercury at the denitration catalyst section into soluble mercury halide and then collects it by wet desulfurization equipment at a later stage is being considered. Hence, MHPS developed a mercury oxidation catalyst (TRAC®) which oxidizes mercury efficiently at the denitration catalyst section as shown in **Figure 3**, and is now delivering the catalyst mainly to the U.S. market, where mercury emission regulations have intensified.

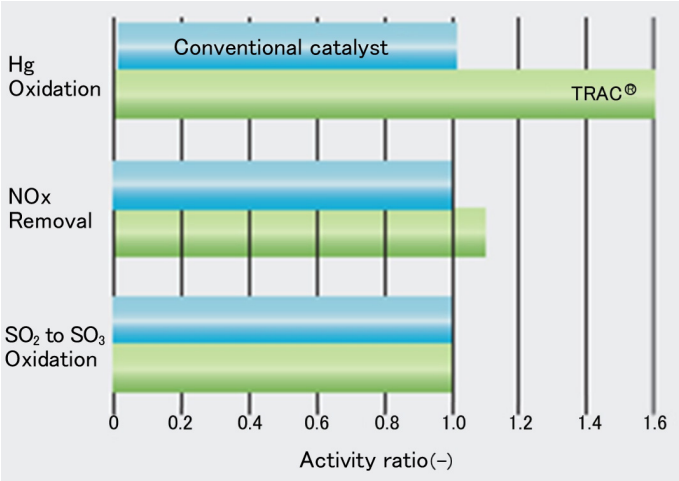



**Figure 3 Characteristics of Mercury Oxidation Catalyst (TRAC ®)**

(2) High-performance/low-$SO_2$ oxidation catalyst

For customers who desire a low-$SO_2$ oxidation rate catalyst in plant operation, we developed a catalyst that can achieve a low $SO_2$ oxidation rate while optimizing catalyst composition, as well as maintain high activity in terms of denitration (**Figure 4**). MHPS has thus far delivered this type of catalyst to plants at home and abroad mainly in the U.S., Europe and Asia (China, South Korea and Taiwan).

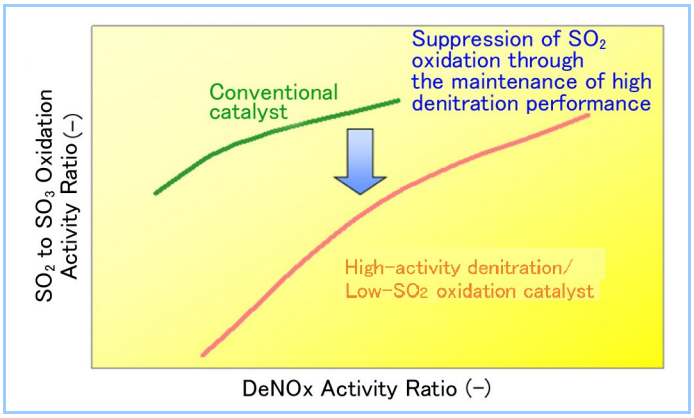



**Figure 4 Characteristics of high-performance denitration/ low-$SO_2$ oxidation rate**

(3) Recycling of catalyst

As part of catalyst material recycling, MHPS is engaged in the development of technology to recycle spent catalysts. In terms of the recycling method, MHPS recycles catalysts to meet customer needs through processes such as water-washing spent catalysts and coating catalytic component ([1] ecological catalysts), reshaping once-powdered spent material into a grid pattern and coating catalytic component ([2] recycled catalysts), washing spent catalysts with a chemical solution to be reprocessed ([3] new-type cleaned catalysts), or instead of bringing spent catalysts back to the processing factory, renewing them on-site ([4] on-site renewed catalysts).

(4) High performance catalyst in case of high $NO_2$ ratio

When a gas turbine starts up or is low-loaded, exhaust gas from the turbine tends to contain NOx with high $NO_2$ content. If the ratio of $NO_2$/NOx increases, denitration performance decreases; so MHPS has developed a high performance catalyst in case of high

$NO_2$ ratio for which the performance can be prevented from performance degradation even if the ratio of $NO_2$ increases (**Figure 5**). MHPS has delivering it to plants at home and abroad as SCR system for high performance denitration in case of high $NO_2$ ratio.

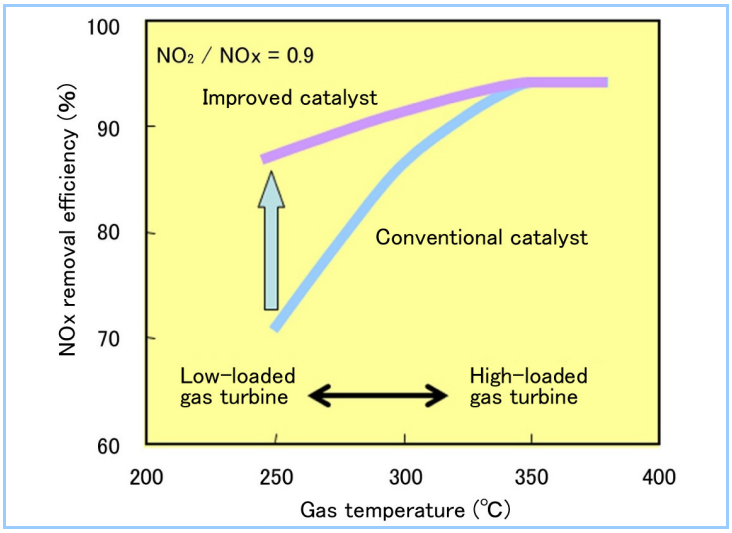



**Figure 5 Characteristics of catalyst for high $NO_2$ ratio**

(5) High temperature SCR catalyst

SCR system, if installed in a simple-cycle gas turbine power facility to supply emergency power, is required to have high denitration performance over the high temperature range because of lack of heat recovery system in front of the SCR system. In response, MHPS has successfully come up with a high temperature SCR catalyst that suppresses the decomposition of ammonia on catalyst to provide sufficient denitration performance at high temperatures up to 530°C, and the latest application of high-temperature SCR system was in 2012 (**Figure 6**).

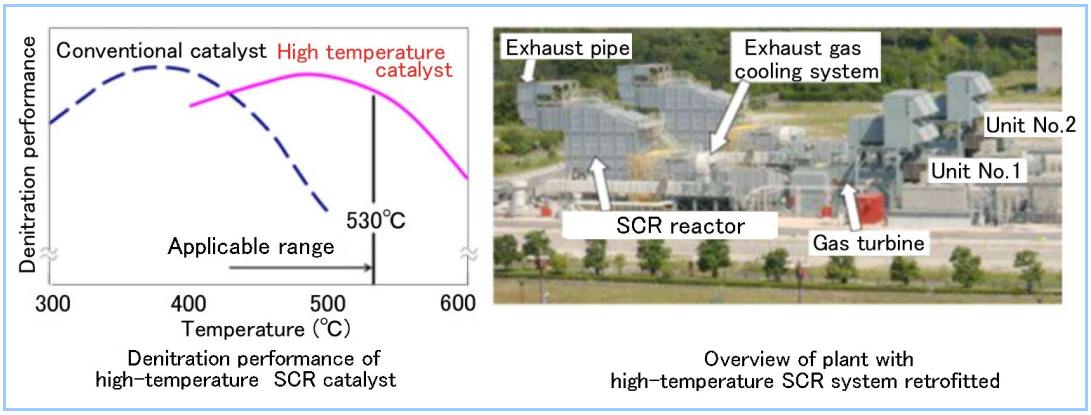



**Figure 6 High-temperature SCR system outline**

(6) Low-$SO_2$ oxidation catalyst for low quality solid fuel

Exhaust gas from high-sulfur content petroleum coke, heavy oil and other low quality solid fuel-firing boilers incurs an increase with time in the rate of $SO_2$ oxidation at SCR catalyst section, and such an increase must be suppressed in plant operation. This is why MHPS has developed an low quality fuel-purpose low-$SO_2$ oxidation catalyst capable of suppressing the increase in the rate of $SO_2$ oxidation through the surface treatment of the SCR catalyst, thereby expanding our product lineup.

## 4. Conclusion

MHPS proposes global environment-friendly solutions to the reduction of nitrogen oxides to meet customer needs by merging SCR system design technologies and expertise of Babcock-Hitachi K.K and the former thermal power division of Mitsubishi Heavy Industries, Ltd.