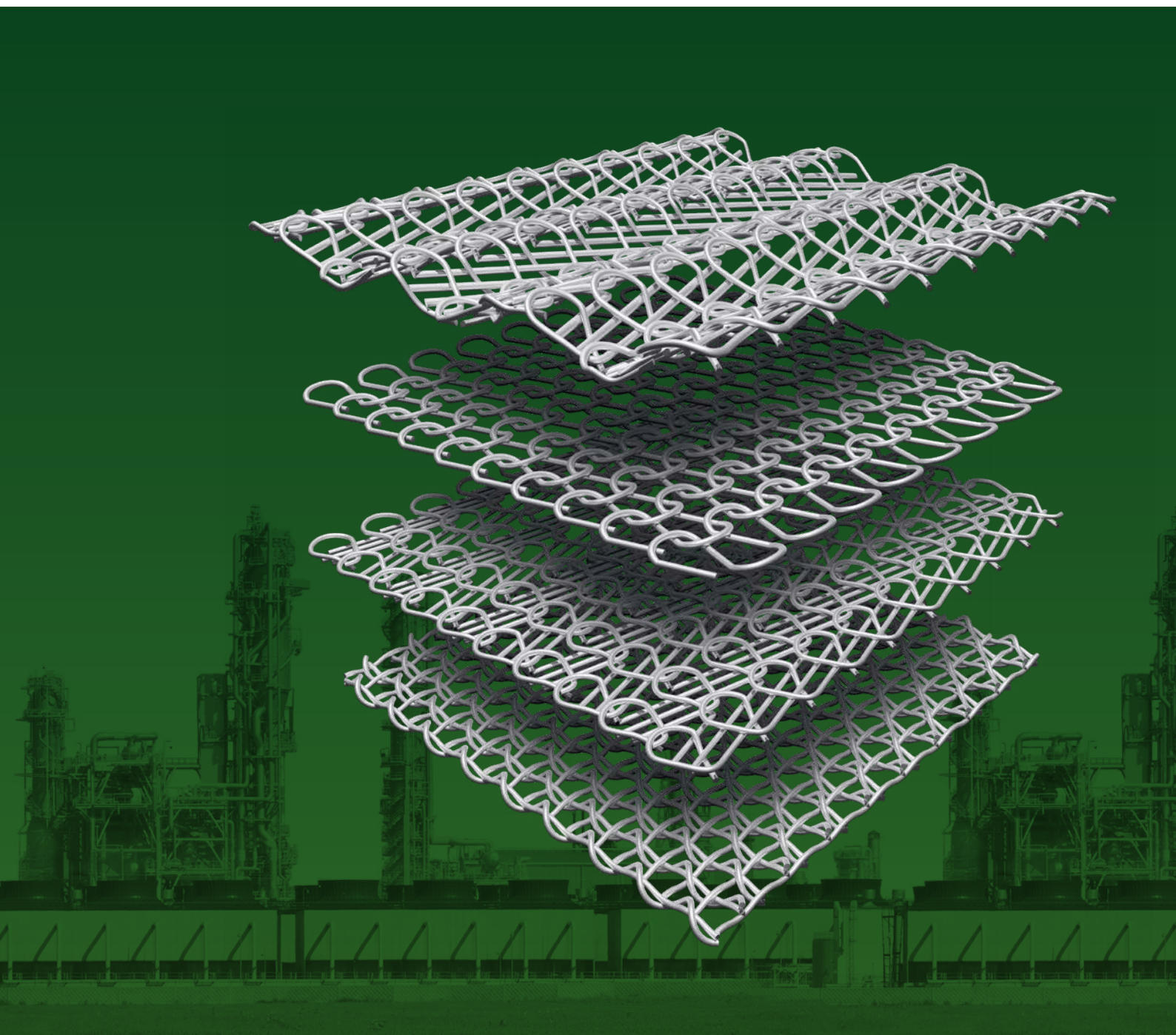




Tailored Catalytic Gauze Architectures

Engineered for Your Process – Optimized for Performance

YOUR GLOBAL PARTNER FOR CATALYTIC GAUZZES

As an expert in platinum group metals, Heraeus is an industry leader in the production of catalytic gauzes and is dedicated to providing products and services for this industry. Close collaboration with customers throughout the entire product life cycle enables continuous improvement and optimal outcomes. Customers are regarded as partners, with a strong focus on building long-term relationships and developing a deep understanding of their needs to ensure high level of service and support.



Catalytic gauzes from Heraeus

PRECIOUS METALS LOOP FOR CHEMICAL CATALYSTS

PRECIOUS METALS SOURCING & LOGISTICS SERVICES



CATALYST RECOMMENDATION AND SUPPLY



RECYCLING & REFINING



INDUSTRIAL APPLICATION OF CATALYST

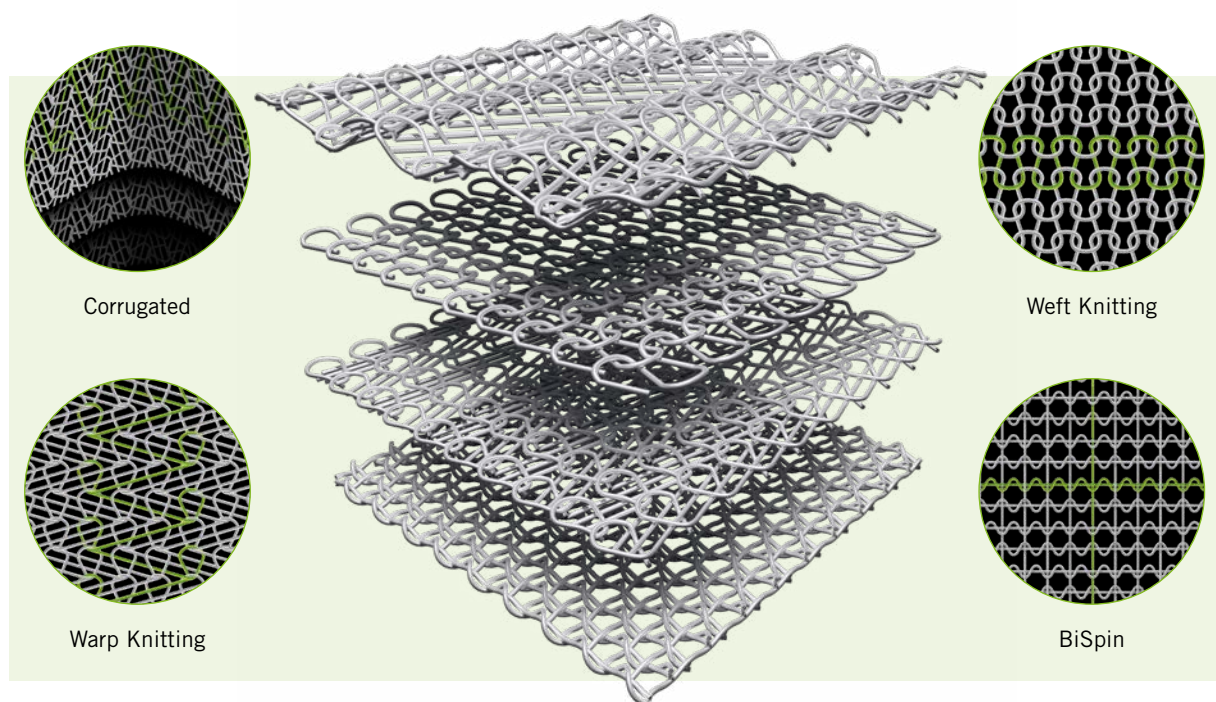


PRODUCT PORTFOLIO

Heraeus' systems are based on varying physical parameters and metal alloys in different gauze layers. The gauzes of these catalytic systems are made up of fine wires which are knitted to create 3D structures. They are tailored according to operating conditions of a specific plant and to market requirements perceived by the customer.

FLEXIBLE CUSTOMIZATION

Heraeus supports customers in selecting an optimized catalyst configuration, alloy, and gauze structure for their specific process requirements. A broad manufacturing portfolio, including weft knitting, warp knitting, and BiSpin technology, enables highly customized catalyst solutions.



FTC FLEX SYSTEM

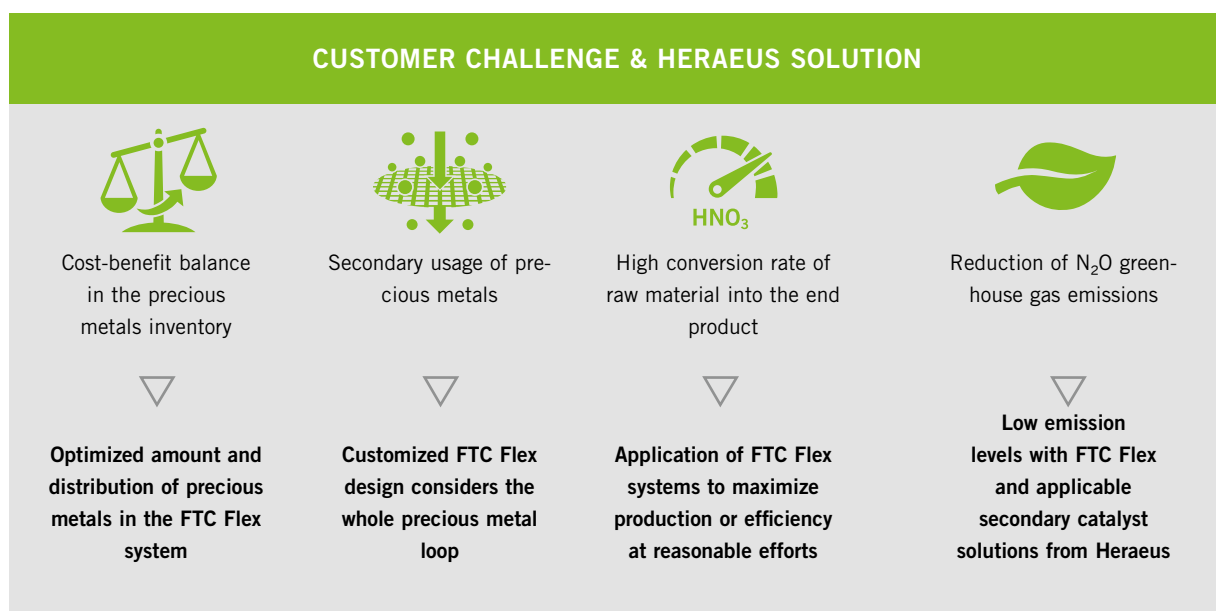
The Heraeus "Functional Total Control (FTC) system" is a concept for the catalytic oxidation of ammonia. Using computer models like Computational Fluid Dynamics (CFD), a fully integrated package is designed to save money for the customer.

Based on extensive application expertise, optimized catalyst systems can be designed to maximize process performance and meet specific customer objectives.

By studying the catalyst reaction kinetics, the gas flow dynamics, and the changes of catalyst micro-surfaces during the operating time, Heraeus was able to improve the gauze systems, which are known today as FTC Flex.

FTC Flex leverages all established manufacturing technologies within a single platform. This capability provides exceptional design flexibility and enables the development of innovative gauze structures tailored to individual operating conditions.

**THE HERAEUS “FUNCTIONAL TOTAL CONTROL (FTC) SYSTEM”
HELPS TO TACKLE FOLLOWING COMMON OBSTACLES:**



CORRUGATED SYSTEMS

Heraeus has extensive experience with the global use of corrugation in high pressure nitric acid reactors. With the wave-like shape of the corrugated gauzes, an increased surface area is obtained, which allows a gauze design with lower pressure drop and therefore with a higher production capacity.

- Surface area for reaction increased by up to 30% compared to flat gauze systems
- Lower pressure drop and therefore increased production capacity

With lower pressure drop, additional catchment layers can be added which will lead to significantly lower metal losses and operating costs. It is also possible to modify primary catalyst layers to increase campaign length.

AVOIDING N₂O EMISSIONS

When ammonia is oxidized to produce caprolactam, ending up in nylon fibres, or nitric acid for fertilizers and explosives, the process releases N₂O into the atmosphere as a byproduct. This greenhouse gas has 273 times the global warming potential of carbon dioxide and is therefore a major factor in global warming. More than 65 million tons of nitric acid are produced around the world annually, with an estimated 500,000 tons of nitrous oxide generated as a byproduct – equivalent to the carbon dioxide emissions from over 60 million mid-sized cars.



Agricultural tractor applying fertilizer to a wheat field.



Large drill rig prepares boreholes for explosives in a quarry.

Heraeus has developed primary and secondary catalytic solutions, which reduce N₂O emissions by 90%. For further information on gauze systems and secondary catalysts for N₂O reduction, Heraeus experts are available to provide support and advice.

OUR SERVICES AND TECHNICAL SUPPORT

Heraeus provides solution offerings backed by extensive experience in process performance and deep technical expertise. A commitment to continuous improvement is realized through close collaboration with customers before, during, and after product use. Dedicated technical support helps optimize processes, while rapid on-site assistance ensures effective response in emergency situations.

SERVICES

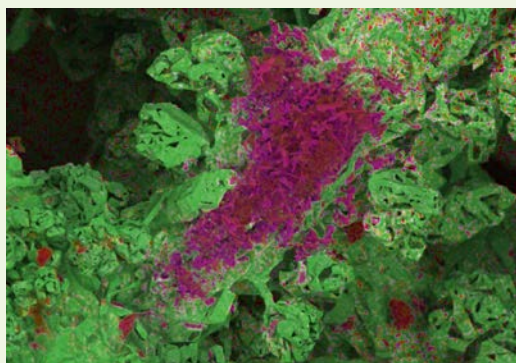
PLANT CLEANING

In modern plants, substantial amounts of precious metal catalysts are retained in the heat recovery train, and large quantities of precious metals can be recovered from spent heat exchangers. Also, there are various non-destructive cleaning methods which enable the recovery of precious metals during normal plant turnarounds or stoppages, while also improving heat transfer and plant throughput.

METAL MANAGEMENT AND LEASING

Heraeus offers not only the physical precious metal cycle but also a comprehensive precious metal management service.

- 24-hour worldwide trading and acquisition of precious metals
- Precious metal handling via customer metal accounts
- Financing models available to the customer include leasing or buying precious metals



Surface analysis of used gauzes
(200-fold magnification. Green = Pt; other colors = impurities)



Analytical facilities

REFINING OF USED GAUZE SYSTEM

As specialists in the handling of spent precious metal catalysts, Heraeus uses state-of-the-art technologies to pretreat, sample, and refine valuable materials and ensure high return rates. The reclaimed precious metal can be used again for the manufacture of new gauzes, reducing the demand for primary precious metals.

TECHNICAL SUPPORT

PROCESS OPTIMIZATION IN CUSTOMER PLANTS

In order to ensure process optimization, Heraeus offers the option to perform a run evaluation on the production campaign. Numerous process performance data are monitored in a standardized data bank. After each campaign, the process parameters are evaluated and, if necessary, methods of improving performance are demonstrated and conducted. These can include: Increasing conversion efficiency and/or production capacity, reducing metal losses, increasing campaign length, reducing N_2O emissions. This is a stepwise approach to process performance improvement, in collaboration with the customer.

INVESTIGATION REPORTS

Samples of used gauzes are taken and analyzed for contamination on the surface of the gauzes. Contaminants can include: Catalyst poisons, carbon layers and Rhodium Oxide formation. The results of the investigation are summarized in an investigation report with the goal of reducing the amount of contamination and therefore increasing conversion efficiency. A wide range of advanced investigation techniques is routinely employed. The most commonly used technique is Scanning Electron Microscopy (SEM) in conjunction with Energy Dispersive X-Ray Analysis (EDXA). With these methods the morphology of the catalyst and the composition of surface contaminants can be quickly investigated on small scale samples.

- In more demanding situations, other techniques such as Auger Electron Spectrometry (AES) and Secondary Ion Mass Spectroscopy (SIMS) can be used for surface analysis and sub-surface profiling.
- These methods are further supplemented by bulk material analysis techniques such as X-Ray Fluorescence Analysis (XRFA) and directly and inductively Coupled Plasma Optical Emission Spectrometry (DCP and ICP-OES).

INSTALLATION OF GAUZE SYSTEMS INTO THE BURNER TOGETHER WITH THE CUSTOMER

TROUBLESHOOTING

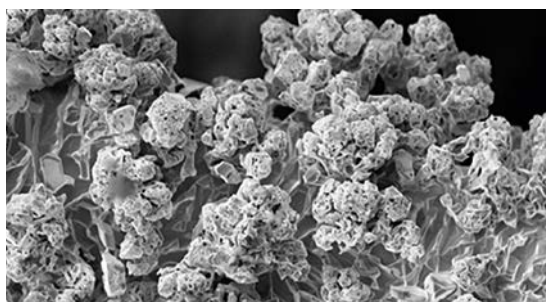
Heraeus provides a troubleshooting service to customers in addition to the use of its products and services. This service includes consultations by phone or on-site and is aimed at solving any problem which may occur like performance loss and increasing N₂O emissions.

TEST FACILITIES FROM COOPERATION PARTNER INSTITUTE INS PULAWY

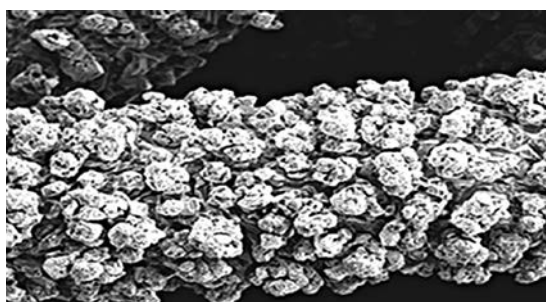
At the pilot plant from partner institute INS Pulawy, Heraeus has the opportunity to test FTC gauzes and N₂O abatement catalysts under specific process conditions on a pilot scale. This pilot plant gives the customer an additional tool for improving the performance of their process.

ENGINEERING SERVICE

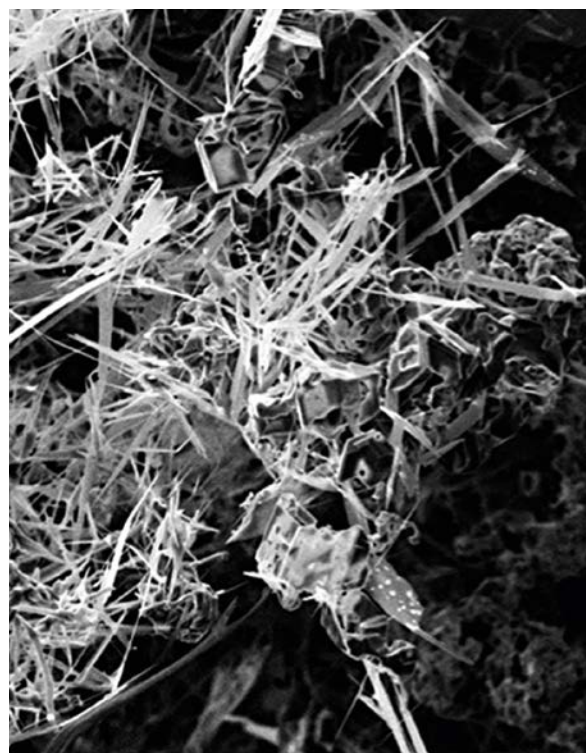
Heraeus has partnerships for reviewing all equipment related to the reactor and the catalyst basket with an experienced team. If necessary, a CFD simulation of the flow distribution in the burner is conducted. After basic and detailed engineering drawings, the necessary equipment/parts are manufactured and shipped to customer's site. Then, for example, a new basket is installed/assembled into the burner so that the necessary amount of N₂O abatement catalyst can be installed to reach the N₂O abatement regulations.



Gauze without Rhodium Oxide



Cauliflower structure of Heraeus FTC gauzes



Gauze with Rhodium Oxide

COMPLIANCE

The Heraeus stringent supply chain policy ensures sourcing of metals from legitimate and ethical sources. All of our recycling and refining facilities are ISO 9001 and 14001 certified to Quality

and Environmental Management Standards. They are authorized for treatment and storage of hazardous and non-hazardous waste containing precious metals.

WORLDWIDE PRESENCE

A global footprint spanning Germany, the United States, India, and China enables production within customers' customs borders and the delivery of on-site technical support, ensuring consistent quality standards worldwide.



ABOUT HERAEUS PRECIOUS METALS

Heraeus Precious Metals is one of the world's leading players in the precious metals industry.

As part of the Heraeus Group, the company covers the value chain from trading to precious metals products to refining and recycling. It has extensive expertise in all platinum group metals as well as gold and silver.

With about 2,500 employees at 11 sites worldwide, Heraeus Precious Metals offers a broad portfolio of products that are essential for many industries such as the automotive, chemicals, semiconductor, aerospace, pharmaceutical and hydrogen industry.

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