Heraeus

CATALYTIC SYSTEMS FOR CYANIDE INDUSTRY

Global partner for catalytic gauzes

YOUR GLOBAL PARTNER FOR CATALYTIC GAUZES

Of all the industrial-scale cyanide production methods, the Andrussow process is the most important and the most frequently used production route. A preheated mixture of ammonia, methane and air is passed through a platinum-based gauze catalyst at a temperature of about 1100 °C.

Regardless of what product the cyanide is later converted into (methyl methacrylate, polyamide, methionine, sodium cyanide, etc.), Heraeus catalyst gauzes are always the best choice to run the cyanide synthesis with the highest possible yield. As an expert in platinum group metals, Heraeus is industry-leading in catalytic gauzes and focuses its activities on providing products and services for this industry.

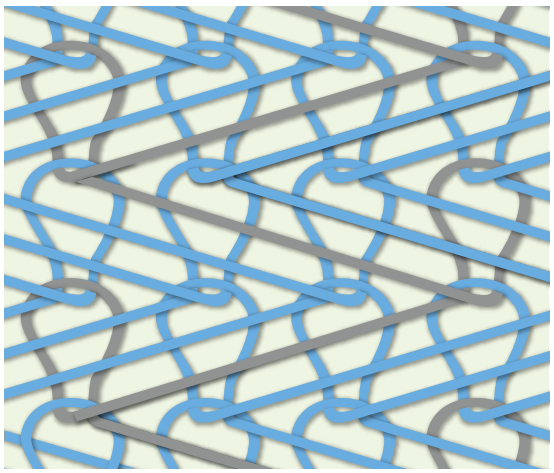
By working closely with our customers throughout the life cycle of their product, we achieve constant improvement for their benefit and best outcome. Our customer is our partner. We value long-term relationships and know our customers well in order to serve them in the best possible way.

HERAEUS CATALYST GAUZES FOR CYANIDE PRODUCTION

All Heraeus gauze catalysts for hydrogen cyanide synthesis are manufactured using extremely fine wires of a platinum group alloy. Due to the very high operating temperature during the process, the rhodium content must be sufficient to ensure adequate mechanical strength. Other alloying elements such as iridium that would give high strength at elevated temperatures are not acceptable, as unwanted side reactions would be favored which lead to lower process yields.

KNITTED GAUZES

Knitted gauzes improve mechanical flexibility compared to the more rigid and crack-susceptible woven gauzes. Knitted gauzes also have a more open structure that offers lower shadowing of the wire surface and a lower tendency to fuse.



Warp knitting

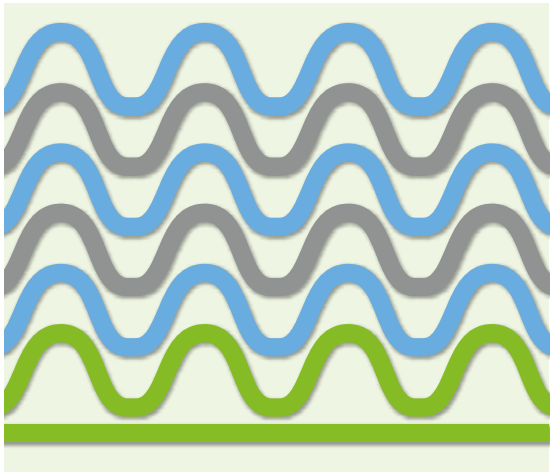
LOW FUSION PACKS

Heraeus has developed low fusion packs especially for the cyanide process. These packs are constructed specifically to hinder the fusion of individual wires, which can occur due to unusually high process temperatures or in the presence of gas impurities. This type of pack is becoming ever more widely used in the cyanide industry.

CORRUGATED SYSTEM

The Heraeus development of corrugation and profiling technology is a major leap forward, offering the following advantages:

- Up to 40 % reduction in specific load per unit area
- Considerably extended campaign durations



Corrugated

REACTION MECHANISM

Once the reactants have reached the catalyst surface, the HCN synthesis reaction is extremely rapid. The speed of the overall reaction is therefore only limited by the mass transfer of the reactants through the boundary layer that surrounds each wire.

As conditions of thermodynamic equilibrium are not achieved in the HCN synthesis, the selectivity of the reaction is completely governed by kinetics. The secret of a good catalyst gauze with high selectivity lies in the chemistry of the alloy and the gauze structure.

The microstructure of the catalyst gauze needs to be designed in a way that allows fast mass transfer through the boundary layer. In addition to this a homogeneous density over the entire reaction area is extremely important to allow an even gas distribution throughout the reaction zone.

CONTAMINATION

There are three possible sources of catalyst contamination: the process gases, the reactor construction materials and the purity of the catalyst itself. During our production process, we pay particular attention to the purity of materials used in the catalyst gauzes. This ensures that the process gases flow only through high purity material from day one. The process gases themselves are responsible for the vast majority of contamination problems.

Consequences of contamination include mechanical degradation of the catalyst structure, deactivation due to shadowing effects and loss in selectivity. Iron is the most significant impurity in HCN production. It is present in the ammonia in the form of submicron particles transported by the process gas.

Iron causes cracking of ammonia and disproportionation of CO, which leads to a loss of the expensive feedstock (ammonia and natural gas), higher NOx emissions and carbon formation on the gauzes. Heavy hydrocarbons have a severe impact on catalyst performance. The resulting increased rate of carbon deposition limits the mass transfer efficiency on the catalyst surface. The higher the molecular weight of the hydrocarbons, the greater is the tendency for hydrocarbon cracking to occur, resulting in further carbon formation. The carbon can diffuse into the alloy where it creates a solid solution. This leads to alloy embrittlement, wire cracking and increased mechanical losses.

Sulphur is a common impurity in natural gas. It drastically affects the catalyst structure, because sulphur lowers the melting point of the alloy and leads to fusing of the wires and reduction in active surface area.

The impact of contamination depends on surface concentration and not on bulk concentration. For fully soluble contaminants such as iron, the impact on catalytic properties depends on the balance between the rate of surface deposition and the rate of diffusion into the bulk.

Special attention has to be paid to preventing pollution during the start-up period. Contamination during start-up hinders the important crystal structure development in the first days of operation and leads to lower process yield throughout the remainder of the campaign.

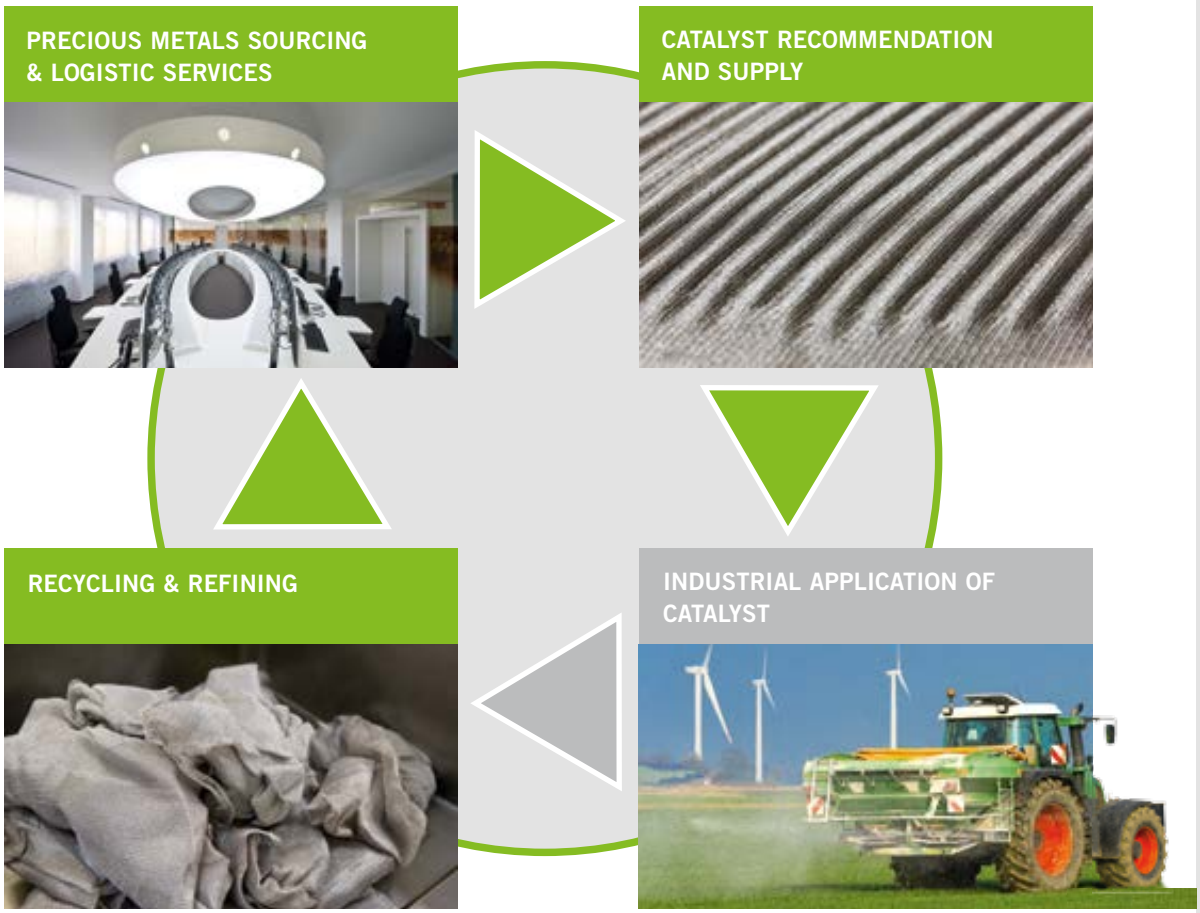
ACTIVATION

Heraeus offers a special surface activation process for catalyst gauzes which improves the recrystallisation of the gauze surface in the reactor. Gauzes will thus reach their maximum efficiency in a shorter time, increasing general efficiency and reducing the production costs per ton of acid produced.

ANALYSIS

Reasons for unexpectedly low process yields are often extremely complex. Heraeus offers diverse analysis techniques which allow us to zero in on the specific problem areas. Customers can provide us with a representative sample of the used catalyst pack. If you would like Heraeus to carry out an analysis, please contact us for instructions on how to take samples.

OUR PRECIOUS METALS LOOP FOR CHEMICAL CATALYSTS



OUR SERVICES AND TECHNICAL SUPPORT

Heraeus is your partner for a complete solution. Thanks to our long-standing experience in process performance, we can offer a wealth of knowledge. It is our goal to achieve constant improvement through close cooperation with our customers before, during and after the use of our products. We assist the customer with technical support to optimize processes and are quick to respond to their site in emergency situations.

SERVICES

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

Analytical facilities

REFINING OF USED GAUZES SYSTEM

As specialists in the handling of spent precious metal catalysts, we offer the fastest possible precious metal recovery with the highest yield. The reclaimed precious metal can be used again for the manufacture of new gauzes.

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. 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 or increasing campaign length. 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. We routinely use a wide range of powerful investigation techniques. Themost 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 and reliably 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).

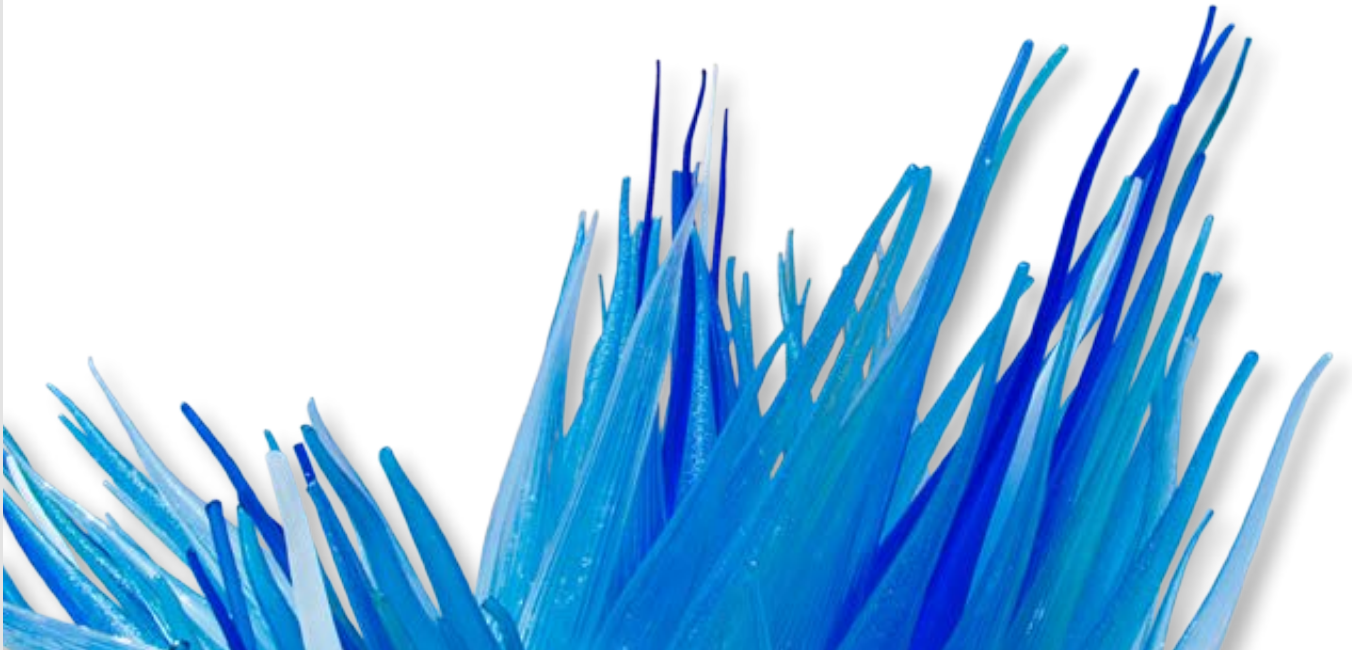
INSTALLATION OF GAUZE SYSTEMS INTO THE BURNER TOGETHER WITH THE CUSTOMER

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.

COMPLIANCE

For our customers, Heraeus is a trusted partner that clears the path for environmental protection, regulatory compliance and resource conservation. Our stringent supply chain policy ensures sourcing of metals from legitimate and ethical sources. All of our major production facilities comply with governmental, federal, state and municipal laws and regulations and are ISO 9001 and 14001 certified to Quality and Environmental Management Standards.



WORLDWIDE PRESENCE

With our global positioning in Germany, the US, India and China, we are able to produce within our customers' customs borders, and provide on-site technical support – with the same quality all over the world.

Our global locations

ABOUT HERAEUS

Heraeus, the technology group headquartered in Hanau, Germany, is a leading international family-owned company formed in 1851. With expertise, a focus on innovations, operational excellence and an entrepreneurial leadership, we strive to continuously improve the businesses of our customers around the world.

The Global Business Unit **HERAEUS PRECIOUS METALS** is a leading provider of precious metals services and products. We combine all activities related to our comprehensive expertise in the precious metals loop – from trading to precious metals products to recycling.

We are one of the world's largest refiners of platinum group metals (PGMs) and a leading name in industrial precious metals trading. Our precious metals products are used in a wide variety of industries, including the chemical, pharmaceutical, glass, electronics and automotive industries. We offer top quality solutions and products based on many years of experience and technical expertise. We are a reliable development partner for our customers and find the best solutions for their requirements.

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