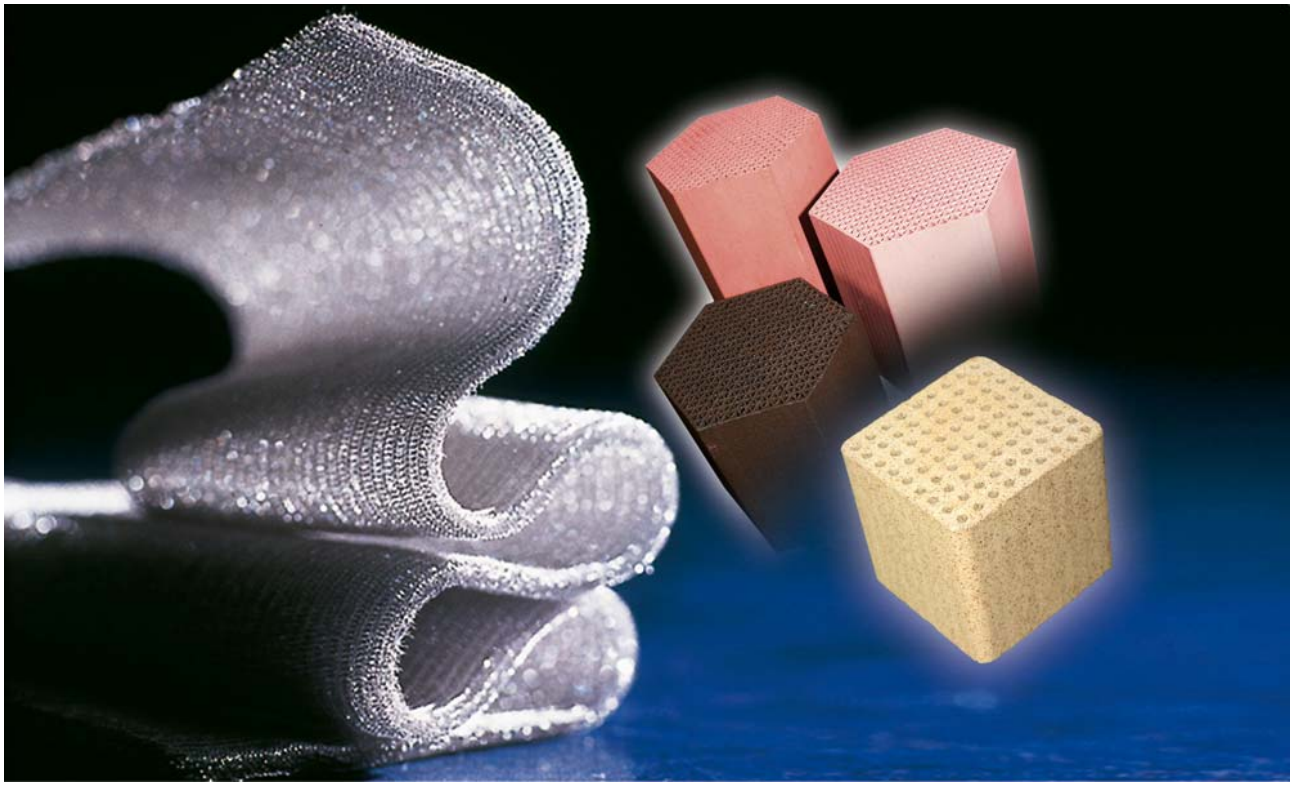
umicore
Platinum Engineered Materials

Umicore's MKS Modulares Katalysator System™:
Strategies for reduction of precious metal inventory in nitric acid production



Ever since ammonia is oxidised to yield nitric acid ("Ostwald process") the catalyst has been consisting of pure precious metals: originally starting with woven Pt gauzes only, whereas today mainly knitted PtRh catalyst gauzes and Pd catchment gauzes are operated.

The steadily increasing economic and ecological demands – and here especially the tremendously rising prices for Pt, Rh, and Pd – towards today's ammonia conversion processes do substantially trigger the necessity for more sophisticated products, better conceptional solutions and more comprehensive considerations than ever before.

Hence the producers of catalyst products for the Ostwald process need to distinctly change their mindsets and are forced to refocus their activities from former (raw) materials suppliers towards system providers today. The division Performance Catalysts of our business line Platinum Engineered Materials wants to highlight how their MKS Modulares Katalysator System™ complies with this challenge:

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1. Flat-bed knitting technology based catalyst gauzes

In contrast to conventional production of standard gauzes this technology allows us to manufacture each gauze individually in any desired modification (knitting type, diameter of gauze and wire, density, alloy composition). Hence a catalyst pack that is designed for a specific burner can be manufactured within very short time, and can easily be modified as well. This flexibility based on our broad gauze portfolio is unique in the market. Besides, it allows to extend the lifetime of the catalyst pack to a maximum.

2. Concepts for gauze re-use

During many years of intensive research on kinetics and chemical reactions on the catalyst surface the most crucial aspects for the catalyst technology – alloying, wire drawing, surface formation – could be optimised. Consequently we perfectly know about the influence of alloy types and compositions on the mechanism of primary and secondary reactions during ammonia conversion (adsorption, chemisorption, desorption processes and nature of fragments on the wire surface) and the impacts on the formation of surface structure and catalyst performance.

With this knowledge we have developed concepts for partial gauze re-use in following campaigns that do dramatically lower the PGM installation weight in the second campaign.

3. Getter Technology

Minimizing net losses of Pt and Rh has recently gained increased attention regarding the tremendous costs of Pt and Rh compared to the price of Palladium. Here we offer a highly sophisticated catchment technology that was originally developed by umicore. This technology reflects the strong correlation between recovery rate, gauze position and operating conditions and allows to identify the best economic solution for each individual case. The getter function itself is based on the continuous mechanism of surface regeneration and hence allows to recover up to 85% of each getter gauze weight of the Platinum primary losses. This way we can easily adjust the desired overall process recovery rate at the best economically feasible ratio.

4. Engineering

This means to finetune and/or to modify the process conditions in a given reactor to reach the maximum performance. Catalyst gauzes will not be able to achieve the best possible results in case they are lacking the perfect environment. Here we take care of providing this condition which is as important as the catalyst itself.

Process Simulations - Making the reaction visible: by means of computational fluid dynamics (CFD) umicore has developed a wide range of model calculations for any type of burner and pressure setup and can nowadays quite easily simulate even difficult and highly complex burner setups including filter systems, distribution plates and other specific features of the burner design. This way we can detect weak points of the process and develop strategies and perspectives to tackle these problems together with our customers.

According to the findings analysed by our simulation tools we can offer different engineering elements to comply with specific issues like calculation of distribution plates, defined and targeted pressure control above and below the catalyst system, or the installation of our ceramic systems.

5. Ceramic Honeycombs: our new MultiComb product families

Non-uniform gas flow distributions considerably limit the economy of the ammonia oxidation process as they do have negative impacts on precious metal losses, catalyst lifetime and oxidation selectivity.

The moulded ceramic honeycombs of the MultiComb DynamicLine do generate a well defined pressure drop below the gauze pack in order to ensure a uniform adjustment of the gas flow distribution and thus generate a homogeneous and excellent process.

The MultiComb DynamicLine has already achieved substantial benefits in a number of industrial runs with savings in PGM inventory of up to 20% installation weight and increased campaign lengths of up to 20%.

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The reduction of N_2O emissions in the nitric acid industries will considerably contribute to comply with the targets of the Kyoto Protocol. Umicore – as one of the world's largest manufacturers of automotive catalysts – has developed a tailor-made catalyst technology for the ammonia oxidation process by taking advantage of this internal synergy. This new non-precious metals based honeycomb system assures the selective decomposition of N_2O pollutants into environmentally harmless gases. Reduction rates depend on the process characteristics and amount up to 90% of the emissions under comparable conditions without nitrous oxide catalyst.
This concept of honeycomb catalysts for N_2O abatement with well defined structures and geometries is expressed in the MultiComb GreenLine and forms our basis for the next development step: a comparable catalyst with a selectivity for ammonia oxidation that will be able to replace a part of the PGM based catalyst gauze pack. Savings of about 40% of the PGM inventory should be considered as realistic estimations.
Both product lines, MultiComb DynamicLine and GreenLine are available in various shapes and geometries as well as in different porosities. They can easily be installed, possess a very high thermo shock resistance (usage at least for 2 campaigns), are totally inert towards the process itself and are completely based on materials that are not containing any precious metals.

Making use of the MKS toolbox means to cooperate with the technology leader for ammonia oxidation catalyst systems:

- Competent combinations of excellent products & sophisticated services along with a strong engineering focus
- Unique solutions due to maximum flexibility based on the modular approach & special knitting technology (no standard offers - unless desired)
- Strong short-term adaptability to frequently changing requirements due to wide portfolio of tools
- High degree of transparency (no black box offers) enabling a joint learning experience
- Long lasting experience in catalyst applications due to internal synergies with other divisions like Automotive Catalysts
- Proximity to our markets due to reliable & competent local partners forming a global network
- Solid financial background of a well recognized and strong global player

With this comprehensive approach we strive for Process Excellence: providing the maximum possible process performance to our clients by shared objectives means to sustainably achieve savings in

- Financing costs
- Capital employed
- Material costs
- Energy costs
- Labour costs
- Emissions
- Any other resource that is precious (Time, Efforts)

And furthermore will generate key process characteristics like

- Efficiency (Productivity)
- Stability (Sustainability)
- Safety.

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