EVONIK CATALYSTS

Let’s make a difference

EVONIK
Leading Beyond Chemistry

EVONIK CATALYSTS Think globally and act locally

- As independent catalyst and adsorbents manufacturers and experts, we are your long-term, solution-oriented, trustworthy partner, for off-the-shelf products or joint development projects.

CONTENTS

- We offer a complete solution: from products to technology to services; from the production of fresh materials to refining and rejuvenating spent catalysts; and from development, to scale-up, to commercial-scale production.
- We think globally and act locally. Working with Evonik means you have direct access to our regional technical and commercial organizations. Our experienced experts strive to respond quickly with high-quality tailored solutions for your specific topic.
- We are a purpose-driven, sustainable, and innovative business, transforming catalyst features into value drivers for the benefit of our customers and the environment. We can help you significantly reduce energy and resource consumption by improving your current process or develop new solutions from scratch.

YOUR PARTNER FOR CHEMICAL CATALYSTS

With more than 80 percent of all chemical products manufactured using catalytic processes, catalysts are the number one value generator in the chemical industry. We know they are at the very heart of your processes. If you are looking for an experienced and reliable catalysts partner, then look no further. Together we will find the best solution to suit your needs. As an international leading provider of catalytic technologies, we serve the markets:

- Life Sciences & Fine Chemicals
- Industrial & Petrochemicals
- Refining & Re-Refining
- Polyolefins
- Biodiesel

EVONIK INDUSTRIES AT A GLANCE…

Evonik is one of the world leaders in specialty chemicals. Profitable growth and a sustained increase in the value of the company form the heart of Evonik's corporate strategy. Its activities focus on the key megatrends health, nutrition, sustainability and globalization. Evonik's customers benefit from its innovative products and integrated technology platforms. Evonik is active in over 100 countries around the world. As part of Evonik Operations GmbH, the Business Line Catalysts lives up to the principles of resource efficiency. Our products enable and continuously improve production efficiency.

SALES 2022:

18.5 billion

ACTIVE IN OVER:

100 countries

EMPLOYEES: more than

34,000

EVONIK IS A MEMBER OF

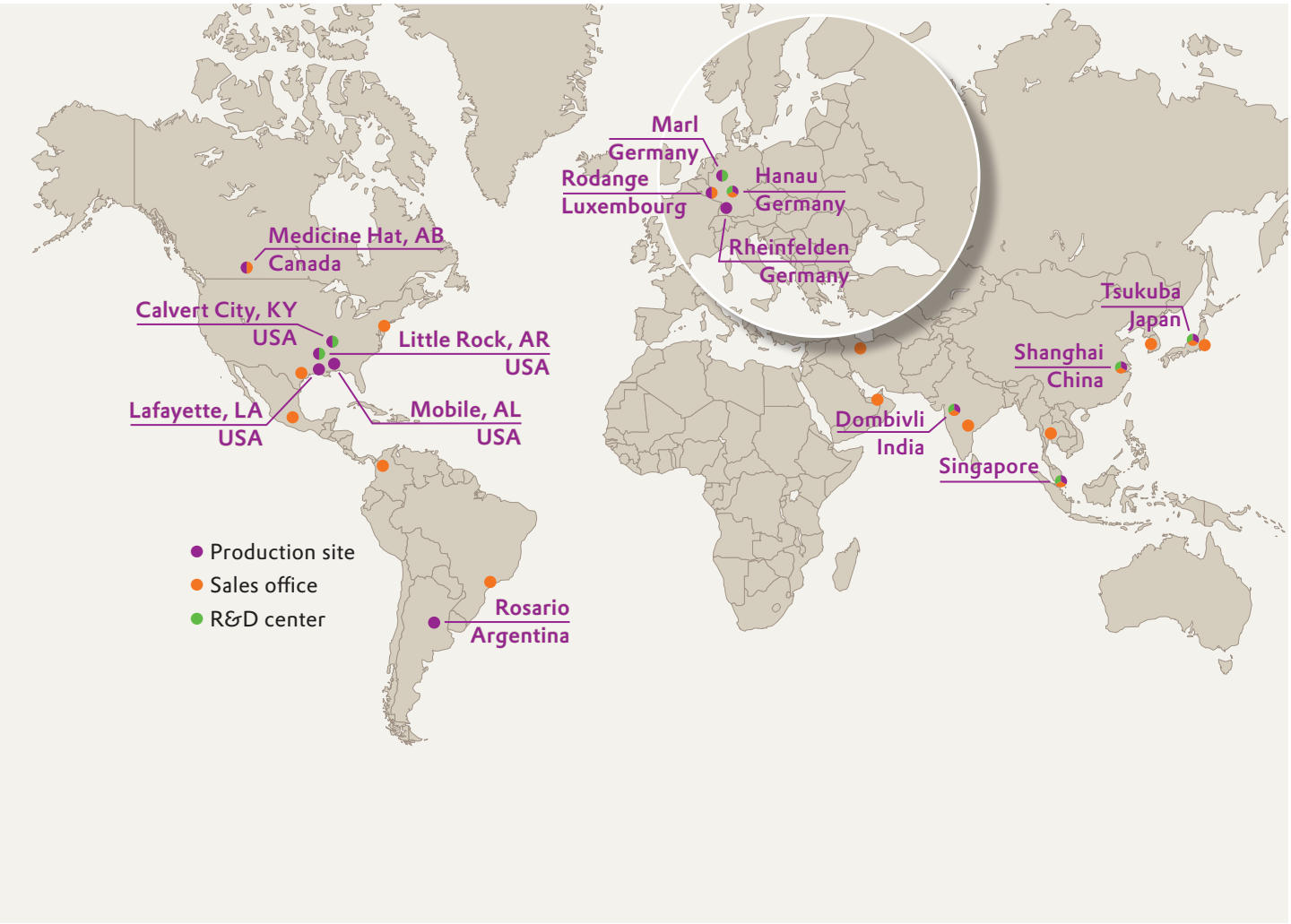
- the European Catalyst Manufacturers Association (ECMA)
- the Catalyst Manufacturers Association of Japan (CMAJ)
- the Synthetic Organic Chemical Manufacturers Association (SOCMA)
- the Drug, Chemical & Associated Technologies Association (DCAT)
- the American Chemistry Council (ACC)
- the Catalysts Society of Japan (CSJ)

MARKETS & BRANDS

Today, Evonik has several major brands for adsorbents and heterogeneous catalysts and catalyst technologies under one roof. This diverse portfolio of catalysts gives us the flexibility to find the most cost-efficient solution for your needs. With its catalysts for batch, semi-batch and continuous processes, Evonik serves the following markets:

Market Segment	Brands and Solutions		
Life Sciences & Fine Chemicals	Chromatocel®	Durocel®	KALCAT®
	Metalyst® MC	MONCAT®	Noblyst®
	Purocel®		
Industrial & Petrochemicals	Aerolyst®	Chlorocel®	Dryocel®
	Durocel®	Dynocel®	Hydrocel®
	KALCAT®	Maxcel®	Metalyst® MC
	MONCAT®	Noblyst®	Octolyst®
	Peroxcel®	Polycel®	Specialyst®
Refining & Re-Refining	Catalyst Regeneration	Excel® Rejuvenation	actiCAT® & actiCAT Shield® presulfurization
	Chlorocel®	UltraCAT® Preactivation	CatGuard®
	Dynocel®	Dryocel®	Durocel®
	Purocel®	Fluorocel™	Maxcel®
Polyolefins	Catylen®	Dynocel®	Polycel®
Biodiesel	NM30	KM32	

GLOBAL PRESENCE



OUR MISSION

"We provide tailor-made catalyst solutions based on in-depth understanding of customer processes. We broaden our product portfolio and expand our production capacities serving new demands in emerging markets and applications."

LIFE SCIENCES & FINE CHEMICALS

Life Sciences are helping to improve the quality and standard of living with applications including care specialties, feed and food, pharmaceuticals, edible oils and the agricultural industry.

Fine chemicals are used as starting materials for specialty chemicals. The latter are obtained either by direct formulation or after chemical/biochemical transformation of intermediates to active substances. With the ability to fine-tune selectivity, activity and filterability with unparalleled precision, regardless of the reaction type, Evonik is the right partner to deliver catalysts that contribute tangibly to value creation. Throughout the process, sustainability concerns motivate us to continuously improve our products and practices.

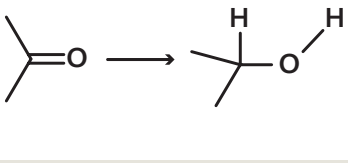
By enhancing both the efficiency and yields of your chemical processes, our catalysts help to produce a larger quantity of the desired product in a shorter period of time, making a difference in reducing energy and resource consumption.

EVONIK PROVIDES:

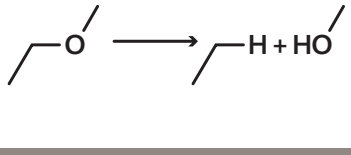
A portfolio of

- Heterogeneous catalysts for many reaction types
- Global presence for close customer proximity
- Early involvement of Evonik's catalyst experts ensuring successful identification of high-performance catalysts

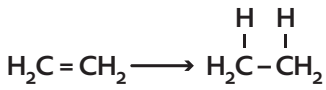
REACTION TYPES



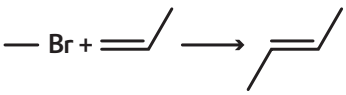
Hydrogenation of C=O bonds



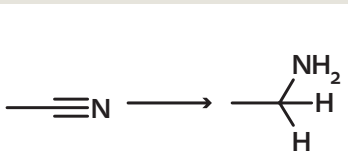
Hydrogenolysis



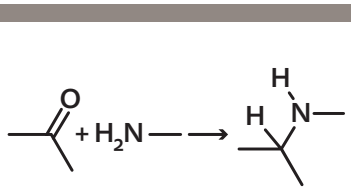
Hydrogenation of CC bonds



CC coupling

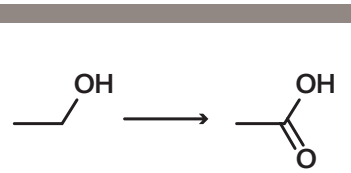


Hydrogenation of CN bonds

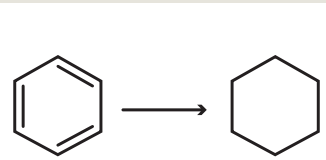


Reductive alkylation/amination

Hydrogenation of nitro groups



Dehydrogenation/oxidation



Hydrogenation of aromatics

INDUSTRIAL & PETROCHEMICALS

Changing markets, innovative technologies and the availability of new raw materials are always posing new challenges but also offering fresh opportunities to the chemical industry.

With Evonik's catalyst experts you have proficient and experienced support at your side. The range of catalysis solutions for the Industrial & Petrochemicals market segment is as extensive and varied as the market itself. Evonik is in a position to actively support the development of catalysts right from the initial concept.

In addition, thanks to many years of experience in scaling-up catalysts, Evonik can efficiently take catalyst recipes developed by customers to full commercial production. With innovative custom-designed catalysts, customers receive specially tailored – and thus the best possible – solutions.

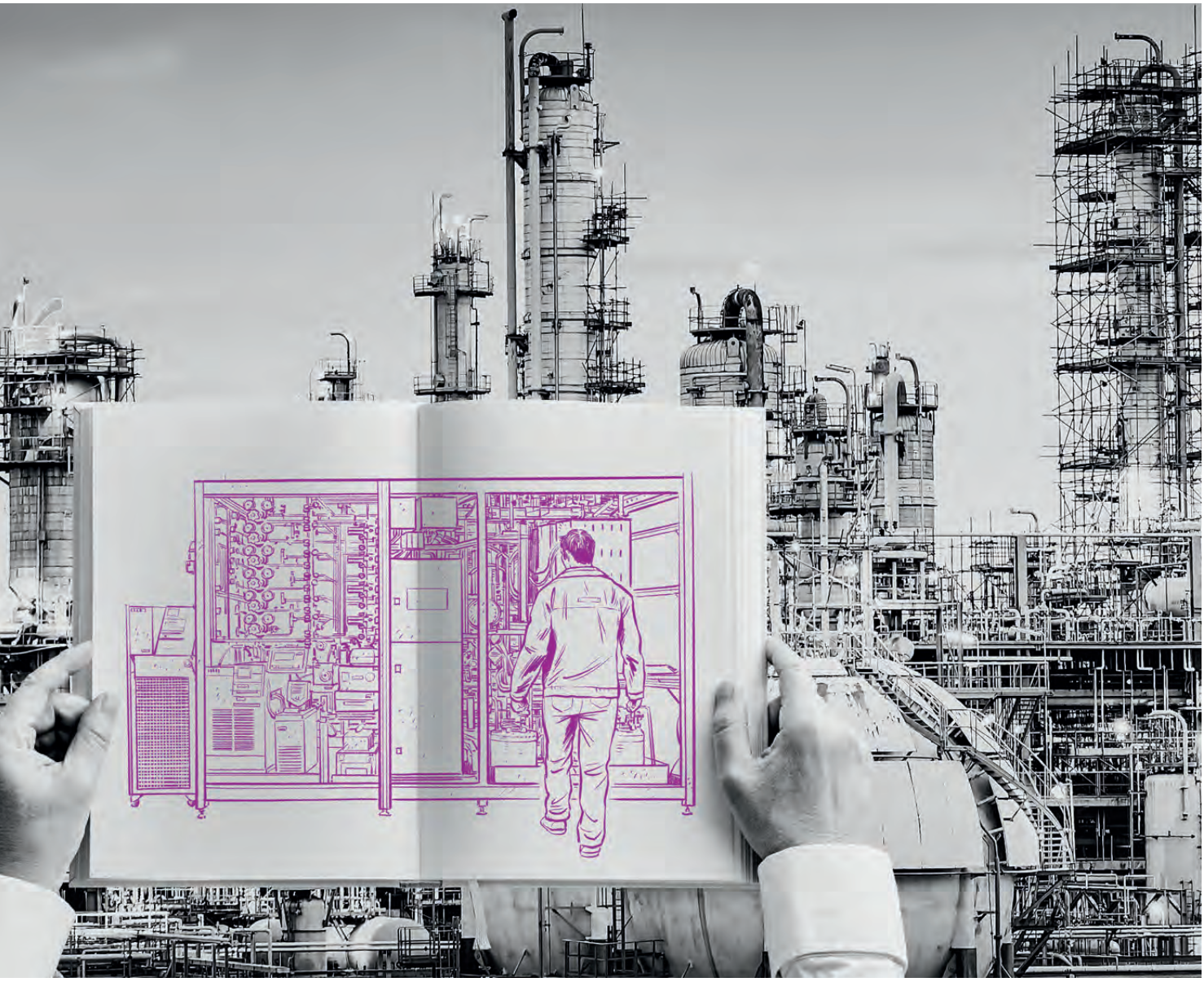
For many existing processes Evonik can offer drop-in solutions based on proprietary catalysts with global references.

Petrochemicals

Evonik's Petrochemicals customers can avail of specially developed proprietary catalysis solutions for applications such as selective hydrogenations of dienes or acetylene in aliphatic, aromatic or aliphatic-aromatic compounds. In the area of oxidation reactions Evonik has developed highly selective catalysts, which can be tailored to required activity, thus fitting to specific plant design. Technology platforms offering lab test facilities, constant product development and in depth technical support complete our value solution approach.

SELECTED APPLICATIONS

Vinyl acetate monomer (VAM)
Alpha-methylstyrene (AMS)
C_3 /C_4 Olefins (Propylene, 1-Butene, MTBE)
Vinyl chloride monomer (VCM)



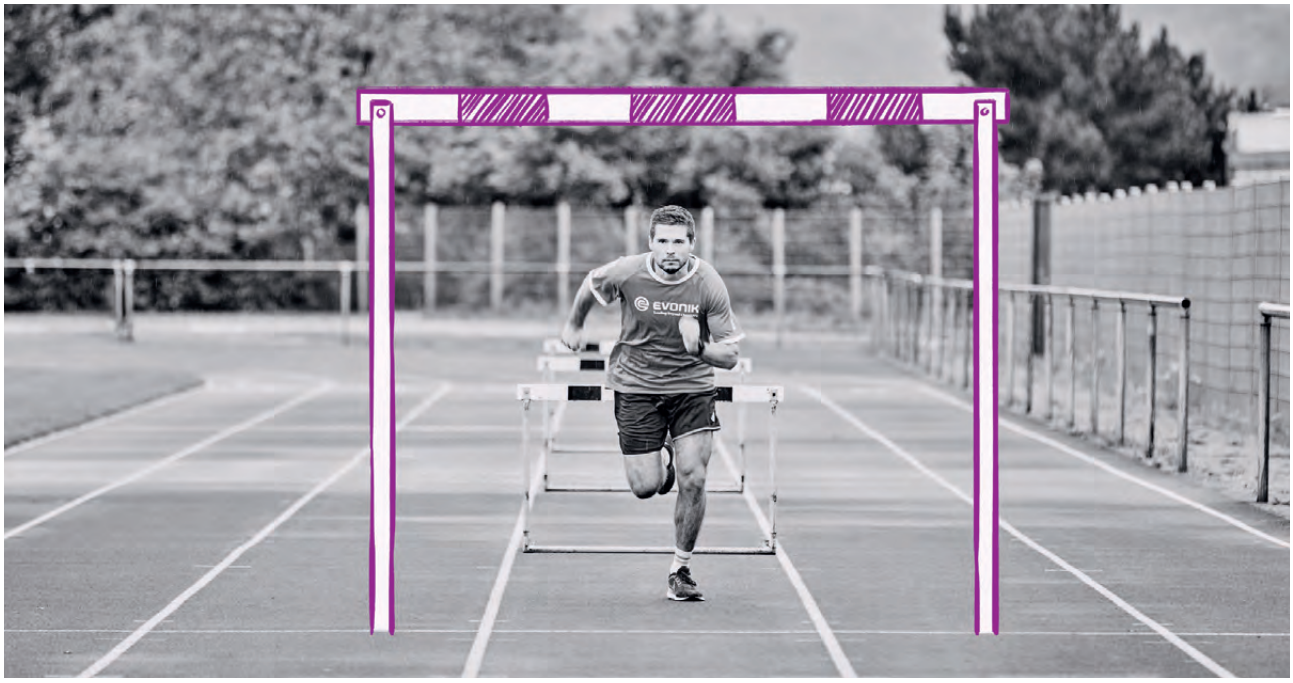
Industrial Chemicals

As in petrochemical applications, exclusively developed catalysts are used here to meet the most varied requirements of our customers in industrial chemicals. Catalysts offered contain a broad spectrum of materials, such as precious and non-precious metals as active components, often supported on substrates with customized acidity or basicity.
Increasing the efficiency of the process by means of an optimal combination of activity, selectivity and catalyst service lifetime is a prerequisite for value creation.

SELECTED APPLICATIONS

Caprolactam
1,4-Butanediol (BDO)
Propylene oxide
Toluenediamine (TDA)
Hexamethylenediamine (HMDA)
Aniline
Fatty acid hydrogenation
Stearic acid

POLYOLEFINS



Polyethylene (PE) and polypropylene (PP) have come to be the most important polymers in the world: in 2016, the quantities produced for both plastic materials together amounted to more than 160 million tons; the estimated worldwide capacity for both polymer classes amounted to more than 205 million tons. Ziegler-Natta (ZN) catalysis, for which Karl Ziegler and Giulio Natta were awarded the Nobel Prize for chemistry in 1963, is still widely used today. In PE production, it is used in 50 percent of all cases and in the production of PP, more than 95 percent of the time. Our Catylen® family of products are key components of the Ziegler and ZN catalysts; although they are used in very small amounts, they have a profound influence on the ultimate properties of the polymers.

The Evonik Catylen® D series offers the broadest selection of silane donors in the industry. In addition, the availability of various packaging options as well as mineral oil dilutions means that Evonik's product offering can accommodate virtually all commercial polypropylene processes in use today. For catalyst precursors, Evonik's ability to tailor the particle size parameters of the Catylen® S family of products helps to ensure that the catalyst producer can obtain the proper raw material for the desired polyolefin application.

Polypropylene

Polypropylene (PP) is a thermoplastic polymer made by polymerization of propylene. It is used in a wide variety of applications including food packaging, ropes, textiles, plastic parts and reusable containers of various types, laboratory equipment, loudspeakers, automotive components and polymer banknotes.

Polyethylene

Polyethylene (PE) is a thermoplastic polymer made by polymerization of ethylene. It is used in a wide variety of applications where blow molding, injection molding or extrusion coating can be applied. Polyethylene is the most common polymer and is produced on a multi-million ton scale annually.

For more information please scan the QR code or visit us at: evonik.com/catalysts

FROM RENEWABLE FEEDSTOCKS TO BIODIESEL

Transesterification

Feedstocks from vegetable oils, as well as animal fats consist of triglycerides, which are the combination of the trivalent alcohol glycerol with three fatty acids. However, the molecular structure of these feedstocks in their pure form recludes their use for conventional combustion diesel engines. The key is to replace the trivalent glycerol with three monovalent methanol molecules. This transforms the viscous feedstocks into a fuel with excellent flow characteristics: biodiesel. And all it takes is a simple chemical reaction called transesterification, which involves methanol and a small quantity of an alkaline catalyst.

Here, sodium methylate 30 % solution in methanol (NM30) and potassium methylate 32 % solution in methanol (KM32) from Evonik have become the industry's preferred choice. The feedstock quality determines the efficacy and cost-efficiency of these catalysts. To prevent undesired side effects, such as soap formation, or increased catalyst consumption, the crude feedstock should be refined to reduce water and free fatty acid (FFA) content. In addition to biodiesel, transesterification also yields glycerol as a valuable by-product for the pharmaceutical and cosmetics industry.

REFINING & RE-REFINING

Refining

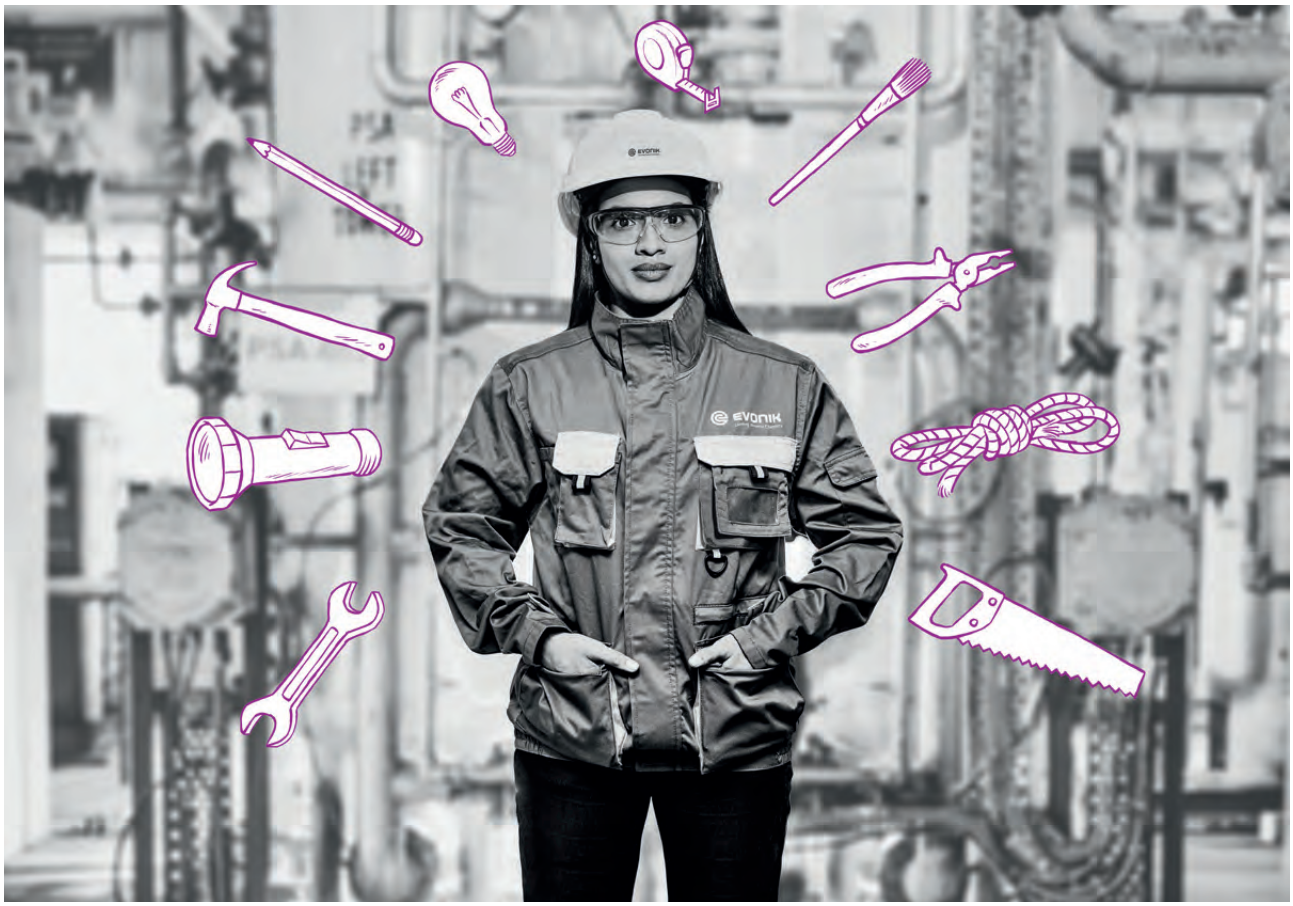
Sustainability is a strategic focus for today's refining industry. Working together, Evonik can help global refiners to reduce operational costs while maximizing profitability and environmental commitment in their applications. We build long-term trustful partnerships which contribute to our customers' success.

With facilities in the USA, Canada, Luxembourg, and Singapore, Evonik has a global presence and is able to serve refining and petrochemical industries with products and services wherever they are located.

Evonik has been dealing with the circular economy for 40 years resulting in the reduction in the need to extract virgin natural resources, minimizing waste and lowering the carbon footprint of catalytic manufacturing processes.

Evonik's preactivation technology, a "ready-to-use" solution, enables introducing early cracked feedstocks after start-up, resulting in time and cost savings.

Through the regeneration or rejuvenation of catalysts, Evonik helps its customers to be more cost efficient and meet circular economy goals. Catalyst reuse contributes to environmental sustainability and bottom-line economic improvements in the refining industry.



Re-refining

Re-refiners process used oil from the automobile and other industries – which cannot be disposed of via landfill – and clean it for reuse. This approach meets circular economy objectives, as the oil can be returned to producers who can blend it with virgin oils. Evonik offers various solutions for the polishing step in the re-refining process which are economical and effective depending on the feed quality, throughput and product quality required.

For the re-refining of used oil to make it suitable for re-use, Evonik offers hydrotreating catalysts, adsorbents and technology for the final polishing step which will help to reduce the carbon footprint.

Bauxite based polishing Unit (Rocket)

For the polishing step in re-refining processes, Evonik offers a bauxite based polishing unit to help re-refiners produce the desired quality of base oil.

Evonik's multi-column Rocket technology polishing system is the most suitable solution for small to medium scale re-refiners with a smaller carbon footprint. The system is modular and expandable to meet quality and throughput requirements, simplifying construction, transportation, and installation – meaning a higher volume of purification can take place.

This skid mounted modular unit helps re-refiners to process distilled oil to produce base oil meeting the quality of group II. The unit uses activated bauxite as the media to improve color and odor of the oil. As bauxite is reactivated for a few hundred cycles, it helps re-refiners to contribute towards circular economy. Due to lower re-fill and disposal cost, the overall investment for this unit is very low.

Hydrotreating

Alternatively, hydrotreating of distilled oils helps re-refiners to produce base oil meeting the quality of group II plus. Evonik offers a comprehensive portfolio of regenerated, rejuvenated or fresh surplus catalysts in combination with CatGuard® metal traps and inert bed supports for hydrotreating units. Using this, re-refiners can reduce their catalyst costs by 50% compared to fresh catalysts.

A hydrotreating unit can help re-refiners to achieve best results in terms of quality (HDS & HDM) and higher throughput.

EMPLOYEES AT EVONIK

People first for over 175 years

People are at the heart of everything we do at Evonik. Every one of our 34,000+ global team is an individual with different talents, different ideas, different beliefs and different needs. We encourage and support that diversity because a mix of skills, personalities and cultural experiences produces a much more creative result.

That diversity of creative drive is particularly appropriate for Evonik Catalysts because we develop solutions for a wide variety of markets that require catalysts that are as individual to the chemical process they enable as the people who develop them.

Since 1847 Evonik is an enabler in specialty chemicals. Today around 950 colleagues are working for the business line Catalysts, they are our biggest value creator and the true driving force behind the innovation and success we achieve together They represent more than 50 countries and so bring experience and understanding from nearly every region of the world.

We look for knowledgeable, talented individuals from every part of the world and encourage a team chemistry that produces remarkable results. We strive to create a workplace environment that is engaging and stimulates creativity and dedication since 1957.

Our values are: trust, performance, speed and openness. We believe that true leadership is about enriching people's lives. It is about inspiring people and spreading knowledge as well as sharing passion. We like to create an environment where anyone can achieve anything.

#Humanchemistry

The Evonik work philosophy extends outside the company, so we embrace the diversity of markets we operate in and work hard to create the same human chemistry between us and our customers.

AWARD WINNING

Our people-focused approach has achieved great results, not just for our customers, but also for the company itself. Evonik has won multiple awards for its employment and employer practices in different regions around the world. These include the HR Excellence Award in Singapore, European Excellence, Leading Employer Award for women in Alabama, and Top Employer Award in China.

In Germany, Evonik is rated in the top 1 percent of employers in the chemicals sector.

FINDING THE RIGHT CATALYST

With our long history in the development and production of catalysts, we have accumulated considerable expertise and built up a large portfolio of proprietary catalysts. Most of our products have been tailored for many challenging catalytic reactions. Therefore, our portfolio may already contain a suitable catalyst for your process.

To identify this catalyst we can use either classical sampling and testing in your laboratories or our parallel rapid screening equipment. When the need for a custom catalyst arises, we leverage our core competencies in the context of a project.

Custom Catalysts

Over the last two decades the demand for custom specific catalysts has increased dramatically. We are creative in finding new solutions and are open to ideas that are not obvious at first glance. Evonik specializes in scaling-up and producing sophisticated catalysts on a commercial scale. A robust and stable production process is crucial to all catalysts, and we know how to design this. The best catalyst in the laboratory is of no use if it cannot be produced in commercial quantities. Reliable, delivering on our promises, our professional project management with cross-functional teams makes the project flow smoothly. We are never complacent about our achievements and continually strive for constant self-renewal in our business processes for your benefit.

Project Categories

Joint development	Custom design	Custom manufacturing	Toll manufacturing
Catalyst and process needs to be developed; close interaction between you and Evonik	Catalyst needs to be developed for existing commercial application	Catalyst lab recipe exists, but has not yet been produced commercially	Catalyst and manufacturing process is well defined

MSDS

Material Safety Data Sheets

Material Safety Data Sheets (MSDS) can be obtained from your local sales representative, on our website under **https://catalysts.evonik.com/en/catalyst-brands** or from:

Evonik Operations GmbH
Postcode 713/303
Product Safety Department
Rodenbacher Chaussee 4
63457 Hanau-Wolfgang
Germany
sds-im@evonik.com

ESHQ

Environment, safety, health and quality

As a subscriber to the Responsible Care® program and other ESHQ initiatives, Evonik is committed not only to delivering quality products and services but also to maintaining high health, environmental, safety and security standards in the operation of its plants and distribution of its products. Our sites have ISO 9001 and ISO 14001 certification, and all our US sites are certified in accordance with the RC 14001 standard. Certain products are also Halal and Kosher certified. We take pride in promoting the principles and practices of Responsible Care® by sharing experiences and offering assistance to others who produce, handle transport or dispose of our products. **More information about Evonik and its commitment to responsibility can be found at: corporate.evonik.com/en/company/environment/management-system**

Responsible Care®

Responsible Care® is the global chemical industry's voluntary initiative, which commits companies, national chemical industry associations and their partners to an ethical framework towards safe chemicals management and performance excellence. Launched in 1985, Responsible Care® activity has since extended beyond chemicals manufacturing to other activities, especially those associated with the safe use and handling of products along the value chain. Find more information under: **cefic.org/responsible-care**

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