

LIFE SCIENCES & FINE CHEMICALS

Evonik Catalysts.
Let's make a difference.





**EVONIK
CATALYSTS**

Let's make
a difference

- 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.



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- 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





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 2021:

15 billion

ACTIVE IN OVER:

100 countries

EMPLOYEES: more than

33,000

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 catalytic processes 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® Metalyst® MC Purocel®	Durocel® MONCAT™	KALCAT™ Noblyst®
Industrial & Petrochemicals	Aerolyst® Durocel® KALCAT® MONCAT® Peroxcel®	Chlorocel™ Dynocel® Maxcel™ Noblyst® Polycel	Dryocel® Hydrocel® Metalyst® MC Octolyst® Specialyst®
Refining & Re-Refining	Catalyst Regeneration Presulfurization Chlorocel® Dynocel® Purocel™	Excel® Rejuvenation UltraCAT® Preactivation Dryocel® Fluorocel™	actiCAT & actiCAT Shield® CatGuard® Durocel® Maxcel™
Polyolefins	Catlyen®	Dynocel®	Polycel



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.”

BUSINESS MODELS

We have built our business models around your needs in relation to catalyst solutions. There are two business models; the product and the project business.

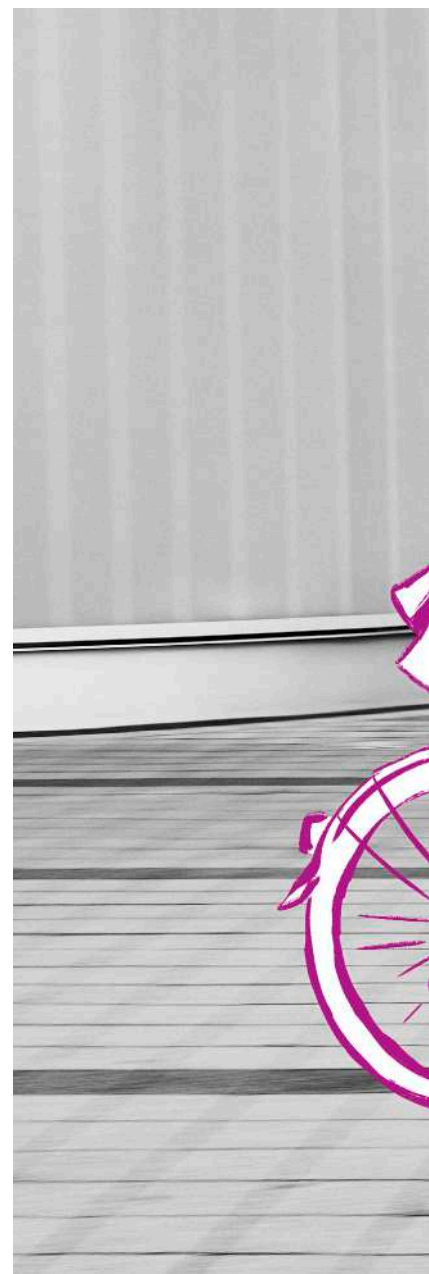
PRODUCT BUSINESS

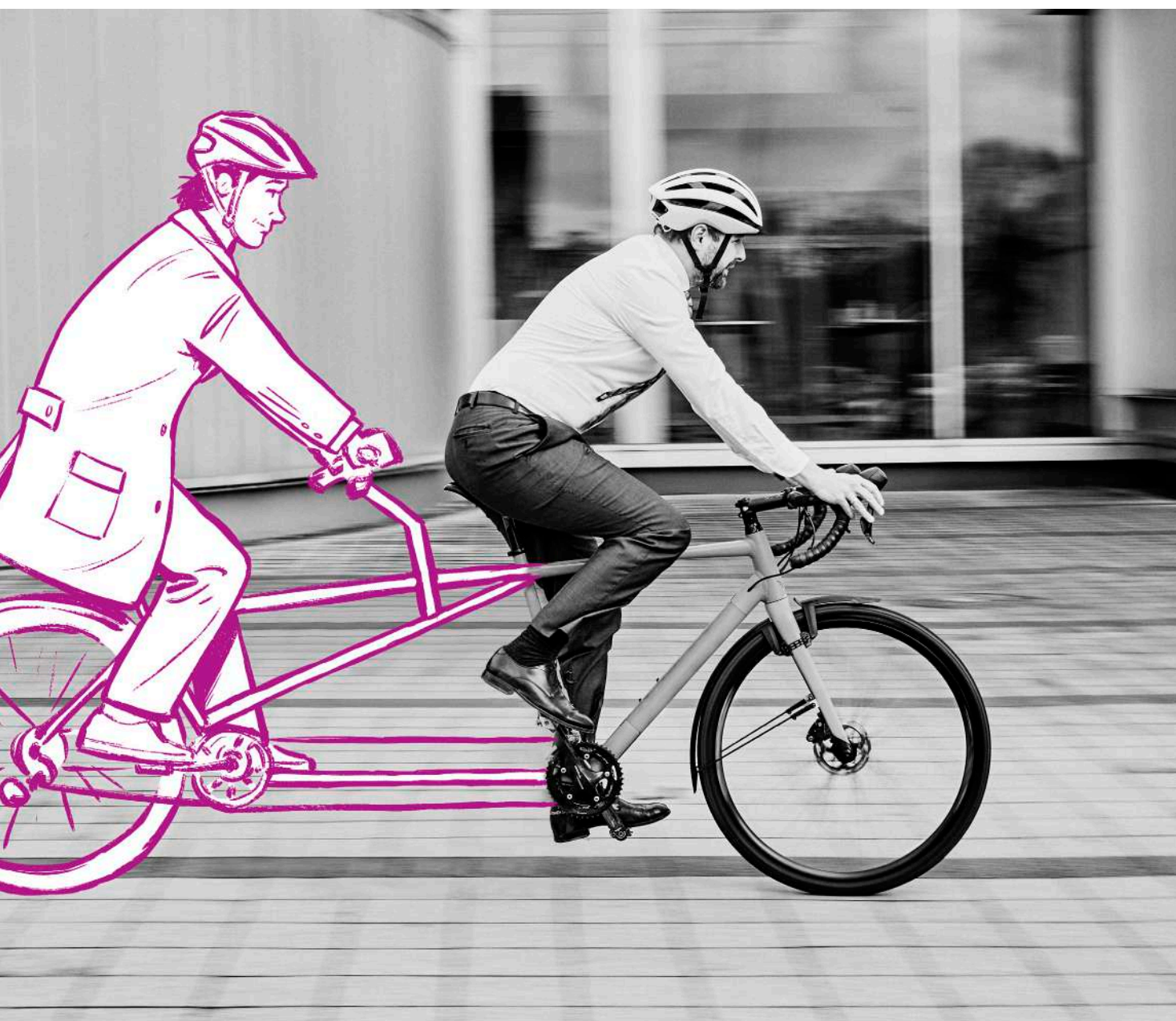
- Products from our portfolio
- Evonik proprietary products and production know-how
- Ready to use

PROJECT BUSINESS

Catalysts that are customized in close cooperation with the customer

True partnership for optimized catalyst solutions





In both business models, we leverage our core competencies. We are creative in finding new solutions and are open to ideas that are not obvious. We specialize in scaling up and producing sophisticated catalysts on a commercial scale.

Our core competencies:

- Designing robust, high performance catalysts
 - Producing in commercial quantities
 - Delivering on our promises
 - Professional project management
-

INTRODUCTION TO 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 agrichemicals. 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.

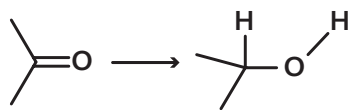
With the ability to fine-tune selectivity, activity and filterability with unparalleled precision, regardless of

the application, Evonik is the right partner to deliver catalysts that contribute tangibly to value creation.

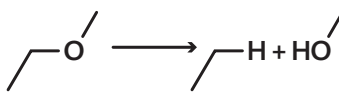
Throughout the process, sustainability concerns motivate us to continuously improve our products and practices. By enhancing both the efficiency and yields of your chemical processes, our catalysts help to produce a larger quantity of the desired product in a shorter period of time, making a difference in reducing energy and resource consumption.



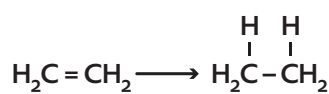
REACTION TYPES



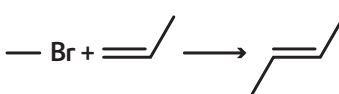
Hydrogenation of C=O bonds



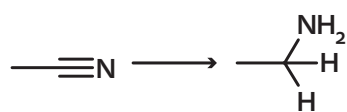
Hydrogenolysis



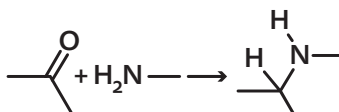
Hydrogenation of CC bonds



CC coupling



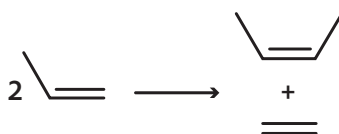
Hydrogenation of CN bonds



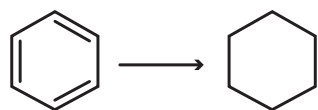
Reductive alkylation/amination



Hydrogenation of nitro groups



Metathesis



Hydrogenation of aromatics

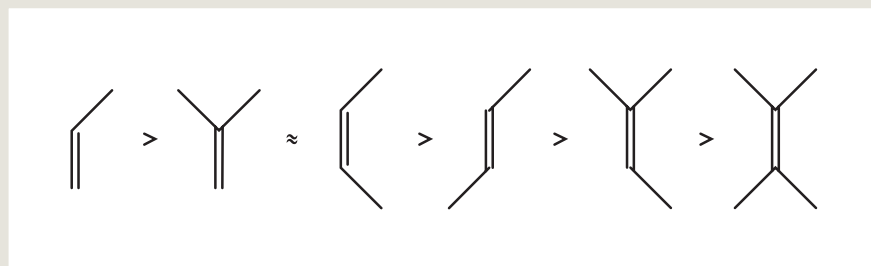


Dehydrogenation/oxidation

HYDROGENATION OF C=C BONDS

The most reactive functional groups towards hydrogenation are CC multiple bonds. An isolated CC double bond is the most readily hydrogenated func-

tional group. Looking at the six reactions below, the reactivity decreases from the reaction on the left due to steric influence at the double bonds.



Principal susceptibility of different double bond types to hydrogenation with group VIII metals

The principal susceptibility of different double bond types to hydrogenation with group VIII metals is shown in the graphic above.

The hydrogenation of CC double bonds is usually carried out at fairly low tempera-

tures and hydrogen pressure using various metal catalysts. Therefore it is a useful reaction for the synthetic chemist.

The principal hydrogenation activity of group VIII metals for double bonds can be seen in the graphic below.

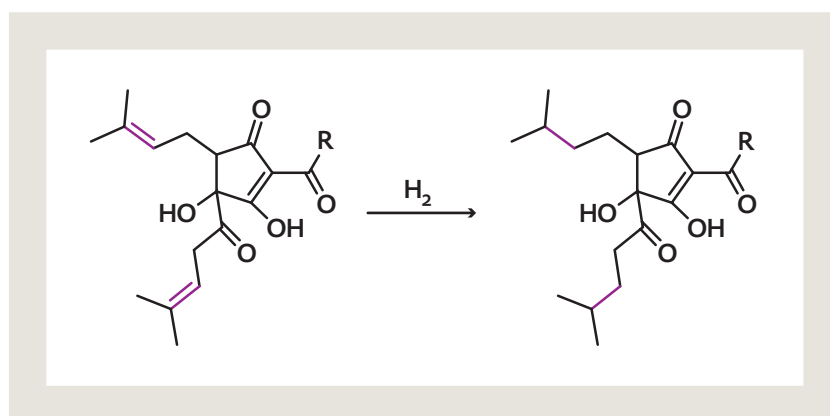




Highly selective hydrogenations

Selectivity is sometimes more important than activity, particularly in life science and fine chemicals applications, where often precious metal catalysts, such as Evonik's Noblyst® P series, are applied. Tailored catalysts are required, especially when other reducible groups are present nearby or in conjugation with the double bond to be hydrogenated.

For example, a palladium on carbon catalyst from Evonik's Noblyst® P1000 series can be used for the hydrogenation of hops to make the beer more resistant to UV light.



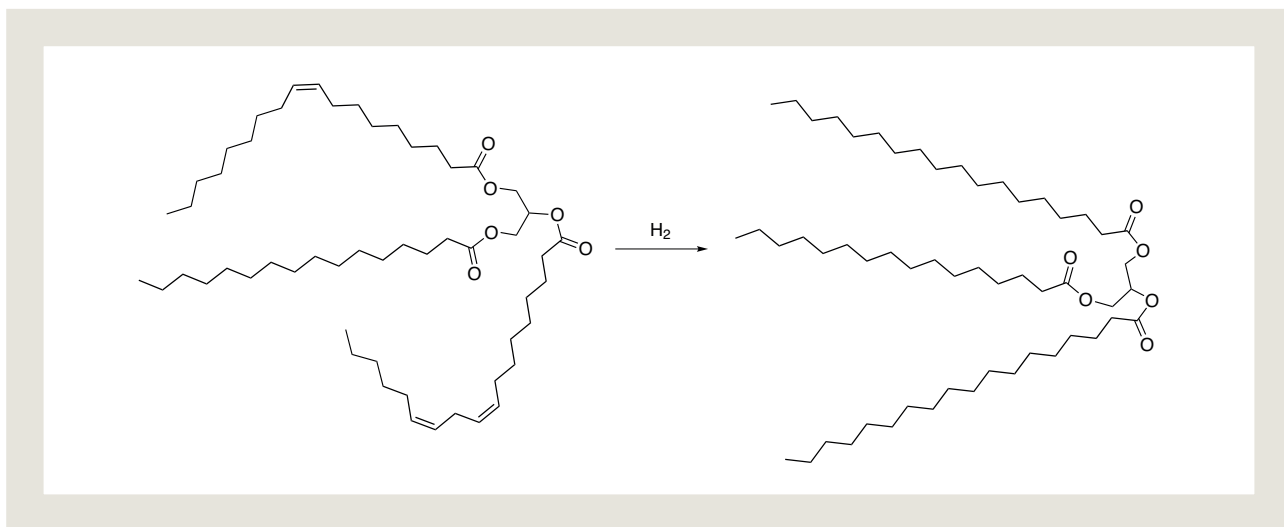
Hydrogenation of hops bitter acids

Evonik provides many customized precious metal catalysts from its Noblyst® P portfolio and also a wide range of activated base metal catalysts. For selective hydrogenation of CC

triple bonds to the corresponding olefins a Lindlar catalyst such as Noblyst® P8059 or lead-free alternatives are available.



The full hydrogenation of an unsaturated triglyceride



Edible oils can be hydrogenated and at times used in combination with other modification methods (e.g., interesterification, fractionation, glycerolysis and physical blending) for:

- Plasticized fats including margarines and spreads
- Shortenings used in pastries and cakes
- Ice cream and confectionery products
- Chocolate coatings and cocoa butter alternatives
- Dairy fat replacements such as non-dairy coffee creamers and whiteners
- Food emulsifiers
- Imitation cheese products
- Cooking fats such as ghee and vanaspati
- Oxidative stability enhancement and increased shelf life for foods

EDIBLE OIL HYDROGENATION

Edible oils are mainly vegetable and sometimes animal oils, that have been refined and modified to remove undesirable impurities in order to make them suitable for human consumption. Some of these processes include plant extraction or animal rendering, degumming, caustic refining, bleaching, deodorization and hydrogenation. Edible oils are hydrogenated in the form of triglycerides (please see reaction scheme on the left) to produce either fully hydrogenated oils (FHO) that are used for food

preparation or for interesterification with unsaturated oils to produce "trans fatty acid (TFA) free" functional foods with the desired melting points and textures. It is important to have final IV values that are as close to zero as possible for FHO to avoid problems with unwanted trans fatty acids (TFA) in food. Evonik's oils and fats catalysts are very capable to reach the desired levels of saturation and therefore are the preferred catalysts for FHO.





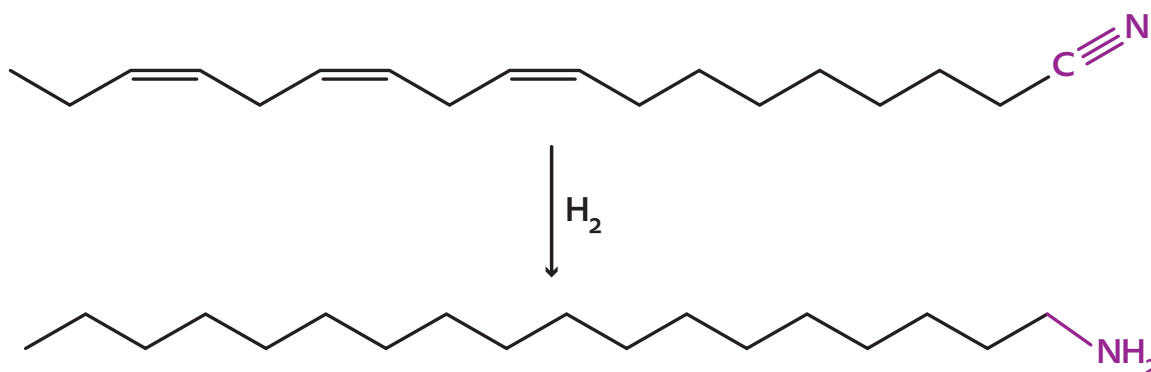
HYDROGENATION OF C=N BONDS

Fatty amines are nitrogen derivatives of fatty acids, olefins, or alcohols prepared from natural sources, fats and oils, or petrochemical raw materials. Commercially available fatty amines consist of either a mixture of carbon chains or a specific chain length from C-8 to C-22. The amines are classified as primary, secondary, or tertiary depending on the number of hydrogen atoms of an ammonia molecule replaced by fatty alkyl or methyl groups.

Important commercial products are prepared using fatty amines as reactive intermediates. Fatty amines and chemical products derived from the amines are used in many applications such as fabric softeners, oil field chemicals, asphalt emulsifiers, petroleum additives, mining, and others.

Commercially available fatty amines are most frequently prepared from naturally occurring materials by hydrogenation of a fatty nitrile intermediate to the corresponding primary amine. Evonik Industries offers Metalyst™ MC 111, an activated nickel metal catalyst, that is particularly well suited to the special needs of fatty amine production. Furthermore a unique droplet technology provides a water free, easy to handle Raney-type catalyst embedded in a solid fatty amine, e.g. Metalyst™ MC 111 DSA.

Nitrile to primary amine is also an important transformation for the production of agrochemicals and pharmaceutical intermediates where Noblyst® P1000 type catalysts are utilized.

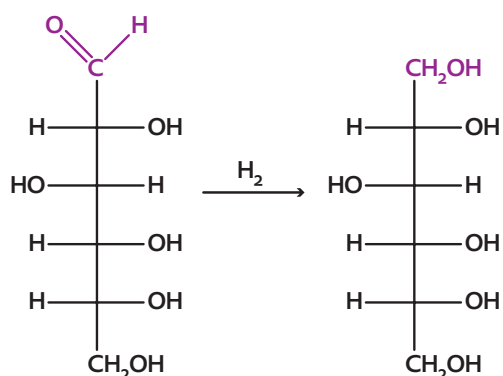


Full hydrogenation of linolenic acid nitrile to the corresponding amine

HYDROGENATION OF C=O BONDS



Carbonyl compounds are readily hydrogenated to alcohols under mild conditions with platinum catalysts preferably in acidic media, while rhodium or ruthenium catalysts work best under neutral or basic circumstances. Palladium catalysts are not usually applied for these reductions, however they have proved useful in the selective hydrogenation of aromatic carbonyl groups to methyl. Carbonyl groups are also hydrogenated with base metals such as Ni, Cu, and Co. Although the base metals tend to require higher hydrogen pressures, they provide economically suitable alternatives to the precious metals, particularly for large volume reactions. Promoters typically enhance the activity and selectivity of both precious and base metal catalysts. The types and amounts of promoters can be optimized for the desired reaction.



Hydrogenation of glucose to sorbitol

Sugar polyols

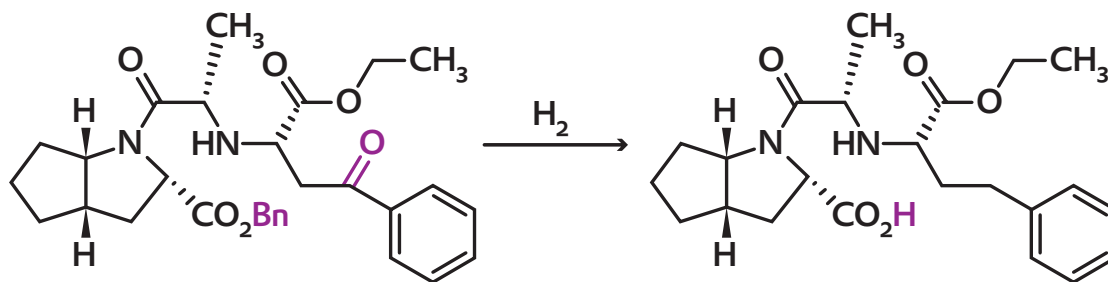
Sugar alcohols, often just described as polyols, are carbohydrates where the carbonyl group of the corresponding sugar has been reduced to a primary or a secondary hydroxyl group.

Polyols are used in a wide range of applications, such as food, oral care or pharmaceuticals. They are industrially manufactured by hydrogenation of sugars using either a nickel or ruthenium catalyst.

Evonik offers different molybdenum promoted activated base metal catalysts that are tailored to the raw materials and the production technology of the customer. Metalyst™ MC 813 is a standard catalyst for sorbitol manufacturing with high activity, selectivity and very good filterability. Suitable ruthenium on carbon catalysts for sugar hydrogenation are available from Evonik such as Noblyst® P3060.

Pharmaceuticals

In the manufacturing of active pharmaceutical ingredients (APIs) selectivity is the major challenge. Since often multi step synthesis are required to get to an API, a good yield in each step is essential for the commercial success of a synthesis route. An example is the selective hydrogenation of an aromatic carbonyl to methylene in the synthesis of Ramipril using Evonik's palladium catalyst Noblyst® P1076.

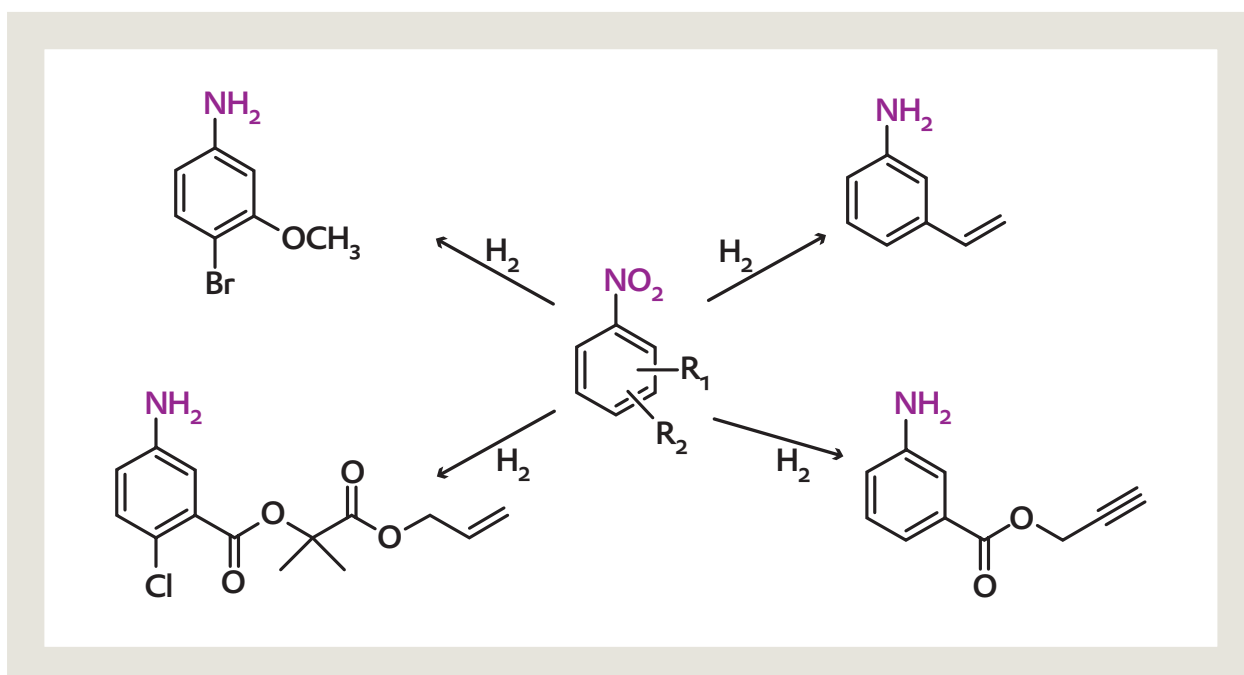


Synthesis of Ramipril

HYDROGENATION OF NITRO GROUPS

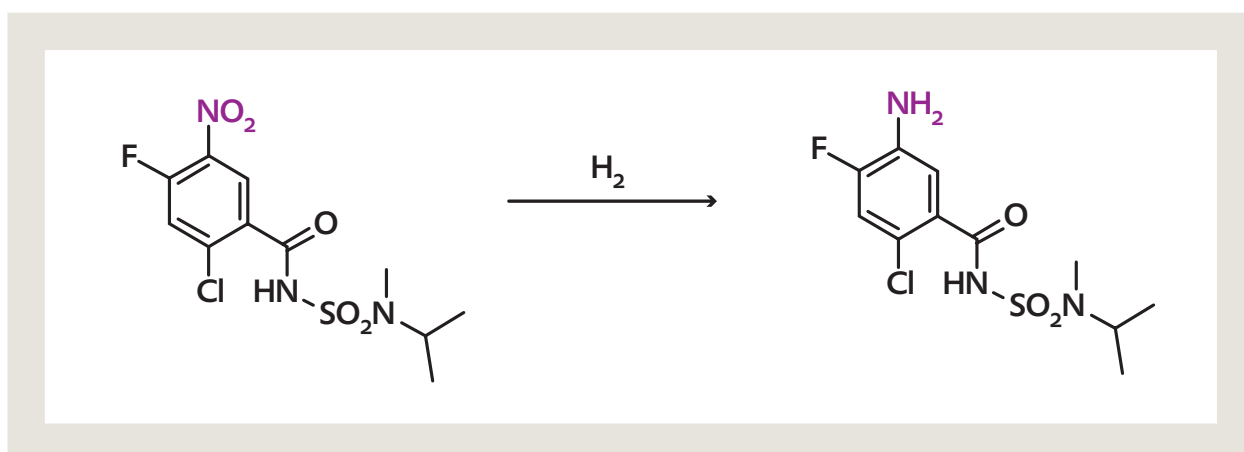
The reduction of aromatic nitro groups is widely used in the chemical industry for the production of aromatic amines. The reduction is carried out preferably in the presence of heterogeneous catalysts. The nitro group is stepwise reduced to the amine group through nitroso and hydroxylamine

intermediates, the so called Haber mechanism. Palladium on activated carbon or activated base metal catalysts are the catalyst of choice for both the hydrogenation of aliphatic and aromatic nitro groups.



If other functional groups are present on the aromatic system, for example, in the hydrogenation of halonitrobenzenes, other solutions are preferable. Platinum on carbon catalysts from the Noblyst® P2000 series are able to decrease the level of dehalogenation, which can be further reduced by promoters in selected cases. In selected cases promoters can further reduce the level

of dehalogenation. Noblyst® P8000 series offers promoted catalysts containing copper, iron or vanadium as a modifier. Additional modification with hypophosphoric acid leads to a catalytic system that tolerates functional groups like carbon-carbon and carbon-nitrogen double and triple bonds, halogens and carbonyl groups.



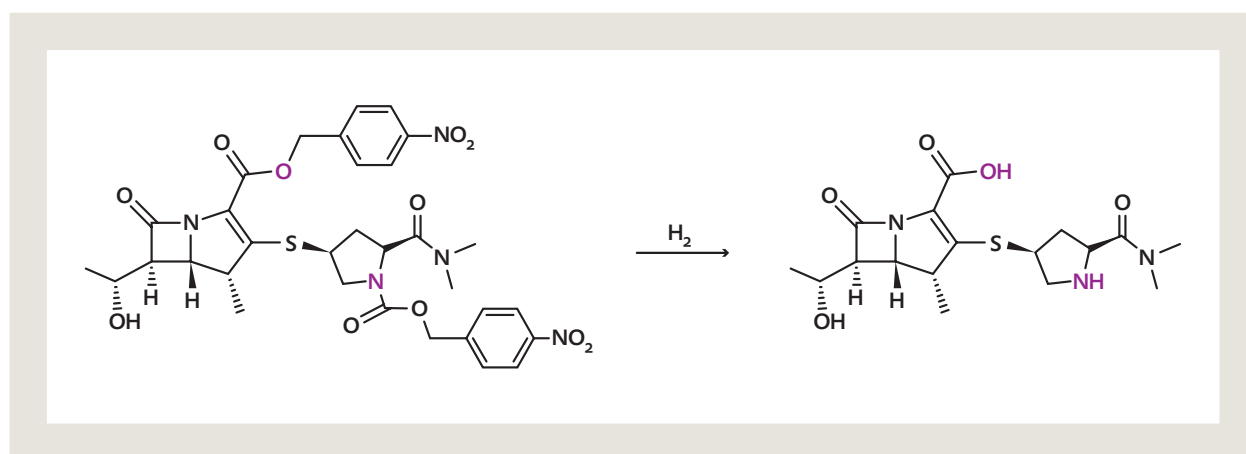
Example of hydrogenation of an agrochemical intermediate with a vanadium modified platinum catalyst.



HYDROGENOLYSIS REACTIONS

Catalytic hydrogenolysis consists of breakage of various bonds such as C–O, C–N, C–Hal, C–S, and C–C with hydrogen. Catalytic hydrogenolysis reactions, especially removal of functional groups play an important role in the production of pharmaceutical compounds. Those deprotection reactions applied on an industrial scale involve the cleavage or hydrogenolysis of O- and

N-benzyl protective groups, and N-Cbz (Z) protective groups. Palladium on carbon from the Noblyst® P1000 series works well for most deprotection reactions, and typically achieve excellent results under mild reaction conditions. Such catalysts can be also used for hydrodehalogenation reactions.

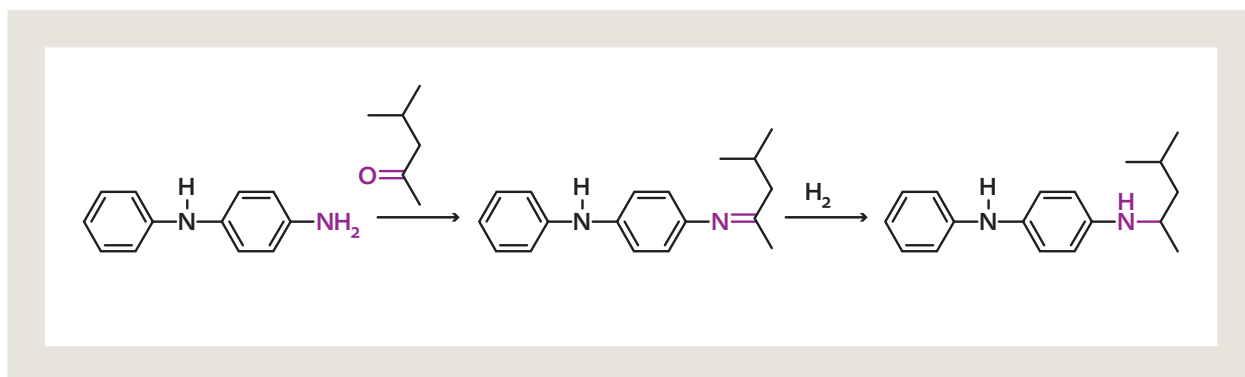


This example shows the deprotection with palladium on carbon catalyst in carbapenem synthesis.

REDUCTIVE ALKYLATION

Reductive alkylation is an effective method to synthesize secondary and tertiary amines from primary amines and hence commercially practiced for the synthesis of a variety of fine and specialty chemicals. These include corrosion

inhibitors such as the derivatives of cyclohexylamine, rubber chemicals such as N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylene-diamine, active pharmaceutical intermediates, dye intermediates, and pesticides.



Synthesis of N-(1,3-dimethylbutyl)-N'-phenyl-p-phenylene-diamine – a compound that protects rubber from ageing - by reductive alkylation

The production is usually carried out in batch processes using heterogeneous catalysts at pressures of 5-35 bars and temperatures of 50°C to 150°C. A selection of suitable catalysts from the Noblyst® P1000 series (palladium on carbon), Noblyst® P2000 catalysts (platinum on carbon) or Metalyst™ MC series are available. Instead of the amines, the respective nitro compounds can also be used and converted in situ to the corresponding primary amines, which are subsequently alkylated to higher alkylated amines.

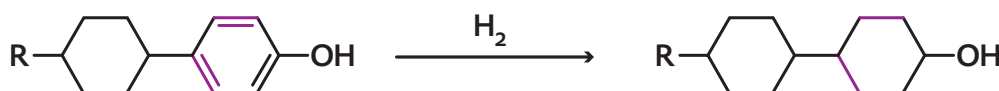
Sometimes catalysts are modified with sulfur, which decreases the formation of side products and reduces the risk of metal dissolution.

When ammonia is reacted with a carbonyl compound under similar conditions, the reaction is called reductive amination and the product is a primary amine. The catalyst requirements depend strongly on the application and the process conditions.





HYDROGENATION OF AROMATICS



Hydrogenation of phenols to cyclohexanols

The hydrogenation of aromatic and heteroaromatic rings is often used for the production of specialty chemicals and polymers. Hydrogenation of aromatic systems require more severe reaction conditions than the hydrogenation of other functional groups, which means that most often those functional groups are hydrogenated first. Supported rhodium and ruthenium catalysts are the most active catalysts for the ring hydrogenation of benzene to cyclohexane.

Phenols can be hydrogenated to cyclohexanols or cyclohexanones. Substituted cyclohexanols are important intermediates for LCDs, fragrances and pharmaceuticals. Noblyst® P3061 and Metalyst™ MC 113 are preferred catalysts for these kinds of conversions.

Other important ring hydrogenations are the hydrogenation of anilines to cyclohexylamine and the reduction of heteroaromatic compounds.

The reduction of pyridine to piperidine can be performed under very mild conditions using 1-4 bars hydrogen at room temperature in the presence of palladium or platinum catalysts. Pyrrole can be hydrogenated to pyrrolidine with activated nickel catalysts (Metalyst™ MC series) or with Noblyst® P1000 or Noblyst® P2000 catalysts under those conditions.

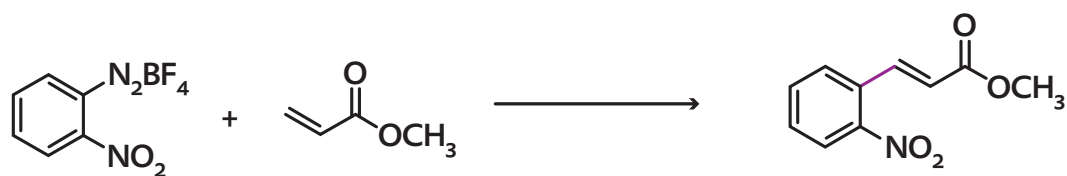




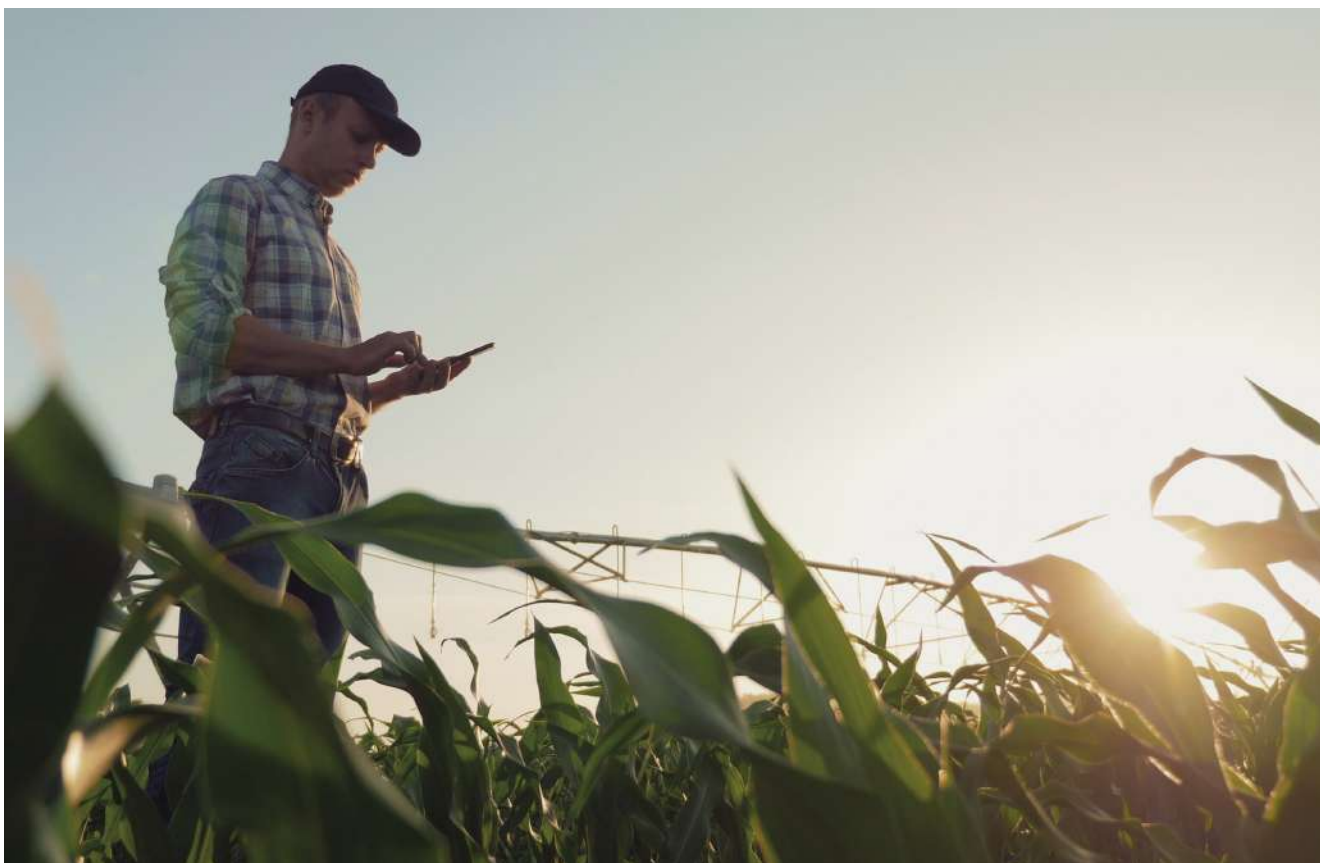
CC COUPLING REACTIONS

For CC coupling reactions typically homogeneous catalysis has been widely accepted. However, there are some major drawbacks in regard to metal contamination of the final product and metal recovery also being seen as a challenge. Heterogeneous catalysts with palladium on activated carbon are an alternative since the metal is precipitated on the

activated carbon and the catalyst can be recovered by filtration. Heck (see example below), Suzuki-Miyaura and Sonogashira coupling reactions can be carried out with palladium on carbon catalysts such as Noblyst® P1076, Noblyst® P1086 or Noblyst® P1089.



Heck-Matsuda coupling of an arenediazonium salt with an acrylate, catalyzed by a heterogeneous palladium on carbon catalyst

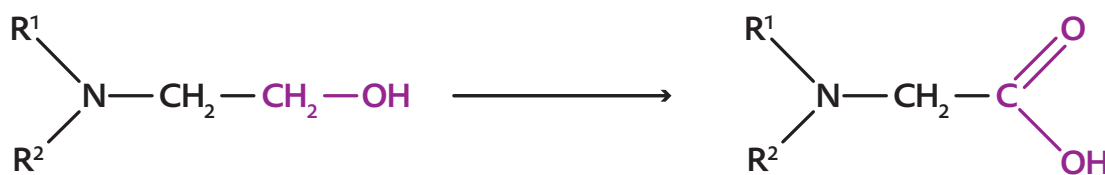


DEHYDROGENATIONS AND OXIDATIONS

Dehydrogenations

Amino carboxylic acids can be obtained by the oxidative dehydrogenation of the corresponding amino alcohols. Those products are important intermediates in the synthesis of agrochemicals and feed additives.

The reaction is typically carried out with a copper catalyst in aqueous media at temperatures ranging from 50 °C to 200 °C.

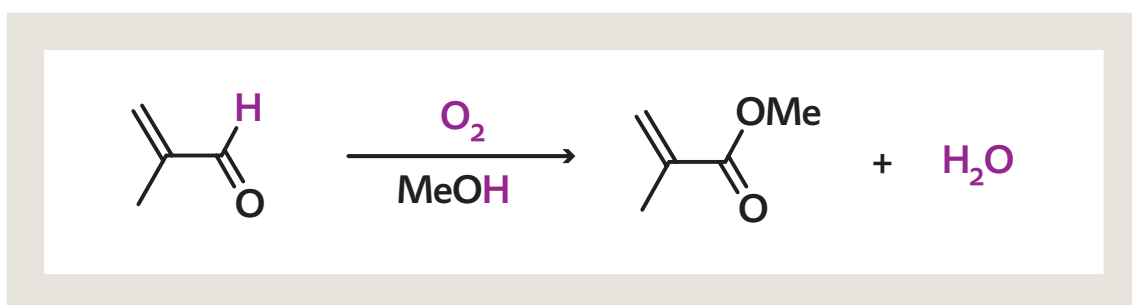


Oxidation

Precious metal powder catalysts enable the oxidation of alcohols and aldehydes in the slurry phase. Most often water is used as a solvent due to safety reasons. Oxidation reagents are either oxygen or hydrogen peroxide.

Good reaction monitoring is essential to prevent overoxidation and metal leaching. The most common modifiers are lead and bismuth which increase both activity and selectivity, and finally prevent catalyst deactivation caused by leaching of the precious metal.

When water is replaced by alcohol as a reactant and solvent, carboxylate esters are obtained by the reaction of aldehydes with oxygen in the presence of a lead modified palladium catalyst.



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 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.

Samples

Evonik offers single samples for precious metal powder catalysts (Noblyst® P) and activated base metal catalysts.

Sample kits are also offered and are an efficient way to enhance your internal R&D efforts. With several samples and useful application information in one convenient location it is an efficient way to select a catalyst and screen for a project. If you run low on sample quantities, replacements can easily be provided.

There are three standard sample kits for Noblyst® P which can be ordered directly from Evonik or through Strem Chemicals, Inc. (www.strem.com).

- The Pharma kit - 12 catalysts
- The Selective Hydrogenation kit - 6 catalysts
- The Palladium kit - 6 catalysts

In case you are sharing appropriate details of your project, we are pleased to create a custom design sample kit with catalysts samples selected to fit your individual needs.

High Throughput Preparation and Screening Services

Evonik offers extensive technical support, using high-throughput experiments and catalyst optimization to rapidly identify the most suitable catalyst with the optimal performance for your particular application.

Services

Whichever model you choose, all the products come embedded in service packages. Trained staff in every region of the world provides you with the highest levels of technical service.

We also provide custom packaging, help you with the safe and correct handling of our products, and tailor our logistics to your specific needs.

www.evonik.com/catalysts



CUSTOM CATALYSTS

Over the last two decades the demand for custom specific catalysts has increased dramatically. When the need for a custom catalyst arises, we leverage our core competencies in the context of a project. 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 and operate 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

Catalyst and process needs to be developed; close interaction between you and Evonik

Custom design

Catalyst needs to be developed for existing commercial application

Custom manufacturing

Catalyst lab recipe exists, but has not yet been produced commercially

Toll manufacturing

Catalyst and manufacturing process is well defined

Characteristics of a project

- A confidentiality agreement protects each party's intellectual property rights and allows a free flow of information.
- A collaboration agreement defines the scope and goals of the project and the commercial conditions.
- By definition, all projects run on an exclusive basis.

How you benefit from custom catalyst projects

- Allows you to concentrate on your core business
- Provides you with a skilled partner for developing and scaling up of catalysts
- Access to sophisticated catalyst manufacturing equipment
- Offers greater flexibility in the use of catalyst types and quantities
- De-bottleneck your own catalyst production



PRECIOUS METAL MANAGEMENT

Evonik has built an extended service package around precious metal recovery and precious metal management. Our services help you to optimize the logistics, purchasing and financing of the precious metals you need.

Precious Metals - Sales & Leasing

Evonik supports your supply chain by either selling or leasing the required amount of precious metal for your order. In cooperation with an established network of metal refiners, banks and traders worldwide, we can close your precious metal loop locally.

Purchasing

- Spot market orders
- Fixing orders (London fixing plus location charges)
- Limit orders
- Split orders
- Forwards

Please note:

Securities are necessary, e.g. a bank guarantee.

Financing

- Bridge leases
- Long-term leases
- Sell and lease-back transactions
- Forwards

By consolidating your metal demands we are able to offer competitive precious metal prices, leasing conditions and metal shipping/transfer services.

Precious Metals Related Services

To find comfortable precious metal management solutions, we provide precious metal related services such as:

- Precious metal hotline
- Market statistics
- Cooperation with precious metal firms that have outstanding reputations
- Logistics for precious metal transactions
- Transfers
- Swaps
- Physical shipments
- Determination of the precious metal demand in the precious metal cycle
- Critical (minimum) demand
- Future demand

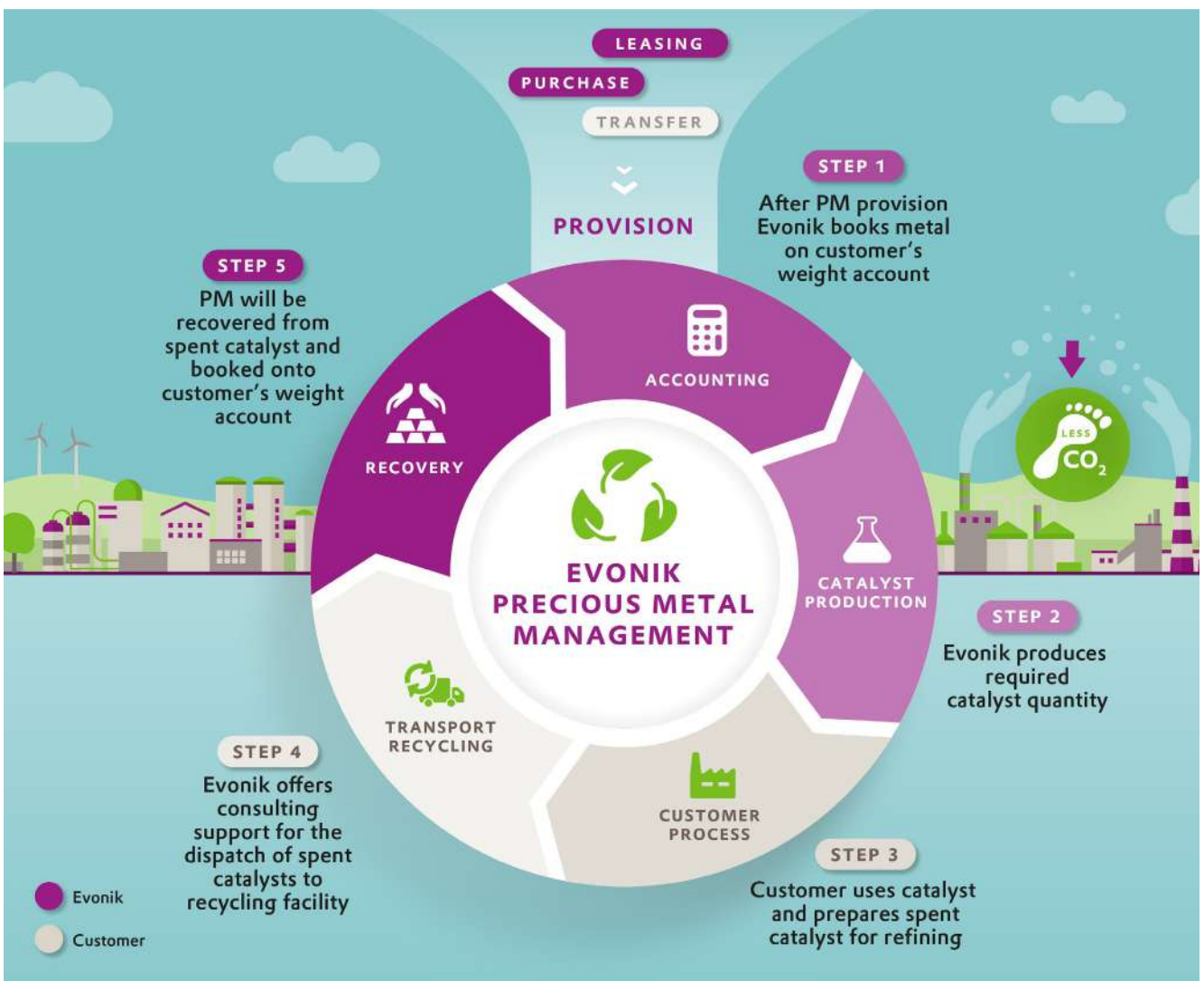


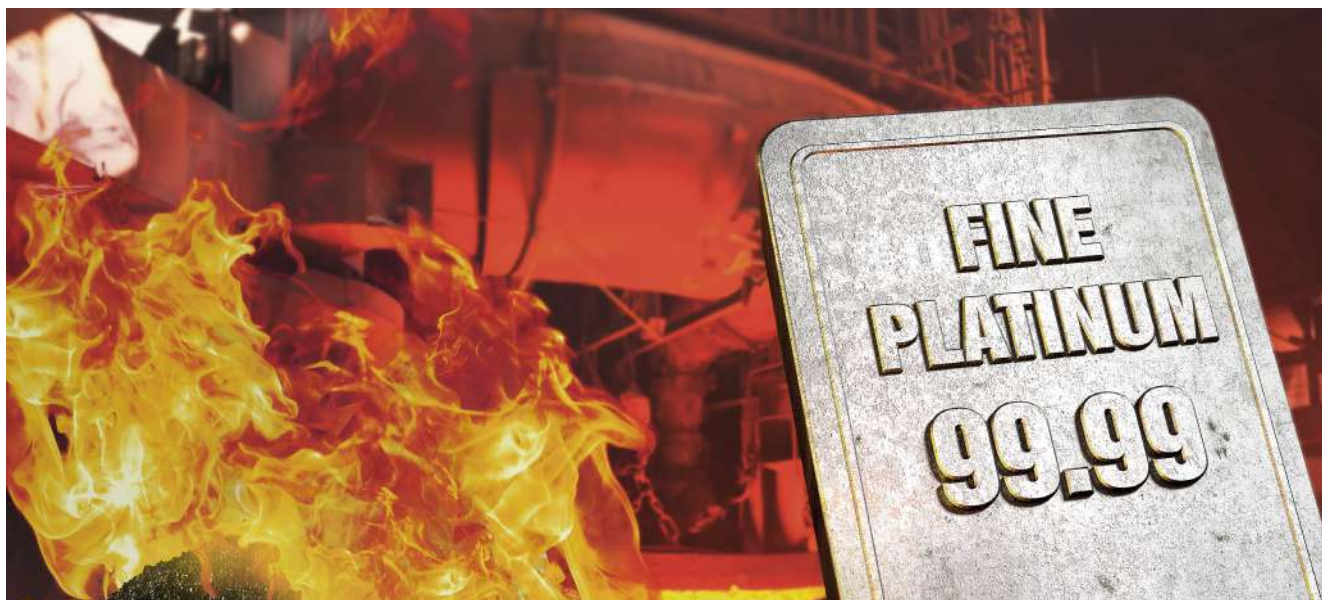
PRECIOUS METAL REFINING

Evonik's catalyst solutions and closed metal loop services help you achieve your sustainability targets while contributing towards a circular economy, as recycled metal has a significantly lower carbon footprint than a metal from primary sources.

Spent catalysts containing precious metals are sent to a metals refinery where the precious metal is extracted from the catalyst. The catalyst is destroyed in this process.

The metals refinery produces solutions of precious metal salts that are subsequently used in the production of fresh catalysts. This recycling minimizes precious metal losses. Evonik takes care of the entire precious metal cycle, from management of the precious metal account to coordination of refining activities. This process is transparent to the customer, for whom Evonik is simply a convenient one-stop service point for all his refining needs.





SPENT CATALYSTS

Legislation requires the sender of spent catalysts to obey national and international transportation regulations and traffic laws for residual materials and waste. It must be checked, for example, if the residual chemicals in the spent catalyst need to be classified as hazardous or dangerous goods. If necessary, special regulations and permits for packaging and transportation may be required.

The spent catalyst should:

- Be thoroughly washed and steamed and delivered moist with water but solid for handling and shall not contain any excess liquid.
- Not be self combustible.
- Be marked according to international transportation laws and packed in 60, 120 or 200 l steel or plastic UN-approved drums with metallic lid or in approved pails. Authorization to use other packaging must be agreed to in advance of a shipment.
- Be shipped together with a copy of the completed and signed questionnaire, "Information on Spent Precious Metals Catalyst", and a Material Safety Data Sheet (MSDS). Furthermore send the completed questionnaire 10 days in advance of dispatch if possible, but in any case before dispatch of shipment.
- Be separated from all materials that are not spent catalyst, but would be combustible, for example, cloths and filters. These materials shall be cleaned and disposed at the customers' site or if included because of precious metal content, they must be packed and labeled separately. Additional cost or any change in conditions involved with the processing of these special materials will be passed on to the customer.
- Be packed and sent freight prepaid and insured (DDU, Delivered Duty Unpaid, incl. Declaration T1).

Please refer to our detailed [Delivery Provisions for Spent Precious Metals Containing Catalysts](#) available upon request from your local sales or customer service contact.



EVONIK RECEIVES
a sample of the spent
catalyst for the initial
analysis

RECEIPT OF SPENT NICKEL
after both parties agree on
the initial value of the spent
catalyst

SPENT NICKEL CATALYST REFINING

In alignment with our commitment towards the environment Evonik has a dedicated facility for recovering nickel from spent catalyst. Evonik purchases your spent catalyst based on the percentage of nickel, where the higher concentrations of nickel receive a higher percentage of nickel LME.

The best results are achieved when the spent catalyst residue contains 10 % or more of nickel. This service allows the customer to effectively dispose of the spent catalyst, while recovering some of the nickel value. The availability of this service depends on the local laws and regulations of the customer.

Please contact your Evonik representative for further details.

BASE METAL MANAGEMENT

In addition to refining, Evonik takes care of base metal purchasing and financing and associated services. We are well aware of the implications of base metal prices on the overall economic viability of the catalytic

process. Therefore, we can offer tailored solutions for integrated metal management and can help you select the cost optimization approach that's right for you.



* London Metal Exchange; www.lme.com



PACKAGING

The standard packaging consists of steel drums with a capacity of up to 200 liters (55 gallons) with two polyethylene inner liners. Approved (UN-1A2) air release valves are incorporated into the lid as required. Our products are also supplied in big bags.

We also provide custom packaging, help you with the safe and correct handling of our products and tailor our logistics to your specific needs.

MSDS

Material Safety Data Sheets

Material Safety Data Sheets (MSDS) can be obtained from your local sales representative 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, 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.

OTHER BROCHURES

Additional Services

For access to more of our publications please contact your local sales manager or visit our website at www.evonik.com/catalysts

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EVONIK OPERATIONS GMBH
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