

BASF

We create chemistry

**We create chemistry for
a sustainable future.**



01. The Oleochemical Difference

BASF recognizes the growing shift from petroleum to oils and fats as chemical raw materials. For over 50 years, BASF has been a leading global supplier of catalysts for oleochemical applications and their technologies. As BASF, we have the resources to help companies meet and exceed challenging quality, environmental, and governmental standards with solutions tailored to their specific needs in their markets to give them a competitive advantage and make them more successful.

With the resourceful imaginations of over 650 research scientists and engineers for various catalyst technologies, **we create working solutions, make processes more efficient, and deliver superior performance for your oleochemical process.**

1.1 Cutting-Edge Technologies for a Progressive Future

BASF offers a comprehensive portfolio of catalysts that covers a wide range of oleochemical processing needs. In addition to existing products, our research and development team is continuously designing new technologies for the markets.

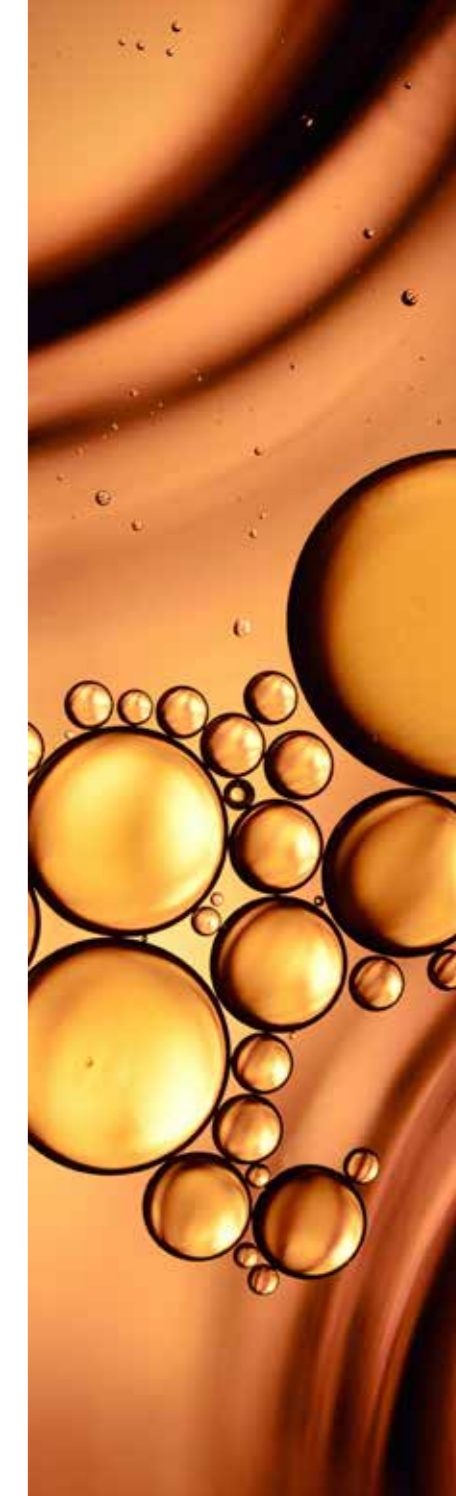
- Hydrogenation of fats & oils and fatty acids
- Ammoniation–Dehydration of fatty acids to fatty nitriles
- Production of fatty alcohols and fatty amines
- Conversion of glycerol to propylene glycol (MPG)

1.2 Choosing the Best Product for your Process

BASF provides catalysts for an array of renewable feedstock processing technologies including powders and droplets for slurry phase reactors as well as tablets and extrudates for fixed bed applications. This includes, but is not limited to:

- Copper Catalysts (powders, tablets, and extrudates)
- Nickel Catalysts (fixed bed, powders and droplets)
- Alumina Catalysts (extrudates and tables, including ring-type geometries)
- Precious Metal Catalysts
- Zinc-based catalysts

Let BASF assist you in selecting the right catalyst for your application.



02. Markets we serve

BASF offers a broad product portfolio of nickel, copper and alumina catalysts for the oleochemical industry that produces a variety of industrial and end consumer products:



2.1 Fats and Oils Hardening

Nickel Droplets: Catalytic Hydrogenation

BASF provides a variety of catalysts that optimize oil and fatty acid hydrogenation. BASF's Nysosel® catalysts are effective, nickel-based precipitated catalyst powders on proprietary supports, coated in fully hydrogenated vegetable oil and formed into pastilles for ease of handling. Since hydrogenated fats and oils are mainly used in edible applications BASF produces to all relevant food regulations accordingly. Beside being a very demanding application with regard to regulatory aspects it is also very ambitious considering the multitude of feedstock used and variety of products ranging from shortenings to coating fats. We have just the right catalyst for every feedstock and application ranging from high selectivity/low-transformation for partial hydrogenation to high activity for cost efficient full hydrogenations.



Did you know that our Nysosel® 880 has the highest nickel efficiency on the market?

It combines a high cost efficiency due to its low nickel content with an extraordinary performance.

Nysosel® Catalysts: Edible Oil Hydrogenation

Product	Ni	Type	Application	Activity	Selectivity
Nysosel®800	16.5	Standard	Full hydrogenation of a wide variety of oils and fats	High	High
Nysosel®645	21.5	Selective	Partial or full hydrogenation, e.g. to minimize saturates	Good	Very high
Nysosel®820	21	High-durability	Partial or full hydrogenation of feedstocks containing trace impurities like sulfur	Good	High
Nysosel®880	11.5	Low Nickel	Full hydrogenation of a wide variety of oils and fats	Very high (based on Ni content)	High
Nysosel®210	18	Sulfur-promoted	Hydrogenation with high selectivity for transomers	Good	High

On demand all Nysosel® products for the hydrogenation of triglycerides can be coated with RSPO certified palm oil.

2.2 Hydrogenation of Fatty Acids

Highly Robust Catalysts with Low Nickel Soap Formation

BASF offers a comprehensive line of Nysofact® catalysts for hydrogenation of fatty acids. Nysofact® products are effective, nickel-based precipitated catalyst powders on proprietary supports, coated in fully-hardened vegetable oil and formed into pastilles for ease of handling.

These nickel catalysts have high activity and excellent filterability and are especially suited to applications requiring full hydrogenation of fatty acids from animal, marine, or vegetable origins. Our fatty acid catalysts of the Nysofact® family show an excellent resistance against Nickel leaching in an acid environment, help to reduce Nickel soap formation and accordingly Nickel contamination of your product.

Catalysts for Fatty Acid Hydrogenation

Product	Metal (wt%)	Type	Application	Activity
Nysofact® 120	Ni (22%)	Standard	Hydrogenation of a wide variety of fatty acid feedstocks	High
Nysofact® 117	Ni (17%)	Low Nickel	Full hydrogenation of wide variety of oils and fats	Very high (based on Ni content)
PM on carbon powder	Pd (5%)	Standard	Hydrogenation of a wide variety of fatty acid feedstocks	Very high at 130–150 °C
PM on carbon powder	Pd (4%)	Low Pd	Hydrogenation of a wide variety of fatty acid feedstocks	Very high at 130–150 °C

Alternatively, precious metal powder catalysts can be used which deliver several potential advantages. Due to the high acid resistance of precious metals, no metal removal or post treatment is needed after catalyst filtration. Compared to Ni catalysts, the activity of precious metal-based catalysts is significantly higher at lower process temperature. Consequently, precious metal-based catalysts can be used at a 10 to 20 times lower metal loading, requiring lower initiation temperatures (80–100 °C) while full activity is reached at 130–150 °C. Under these conditions, exceptionally low iodine values as low as 0.1 can be obtained without difficulty. Finally, catalyst re-use will further reduce the catalyst consumption by 50 to 70%.

The latest innovation in this field are low metal containing catalysts which maintain the high activity per kg of catalyst used. With this new innovation, the metal loading in the reactor can be lowered by an additional 20% further reducing the cost of use of precious metal-based catalysts.



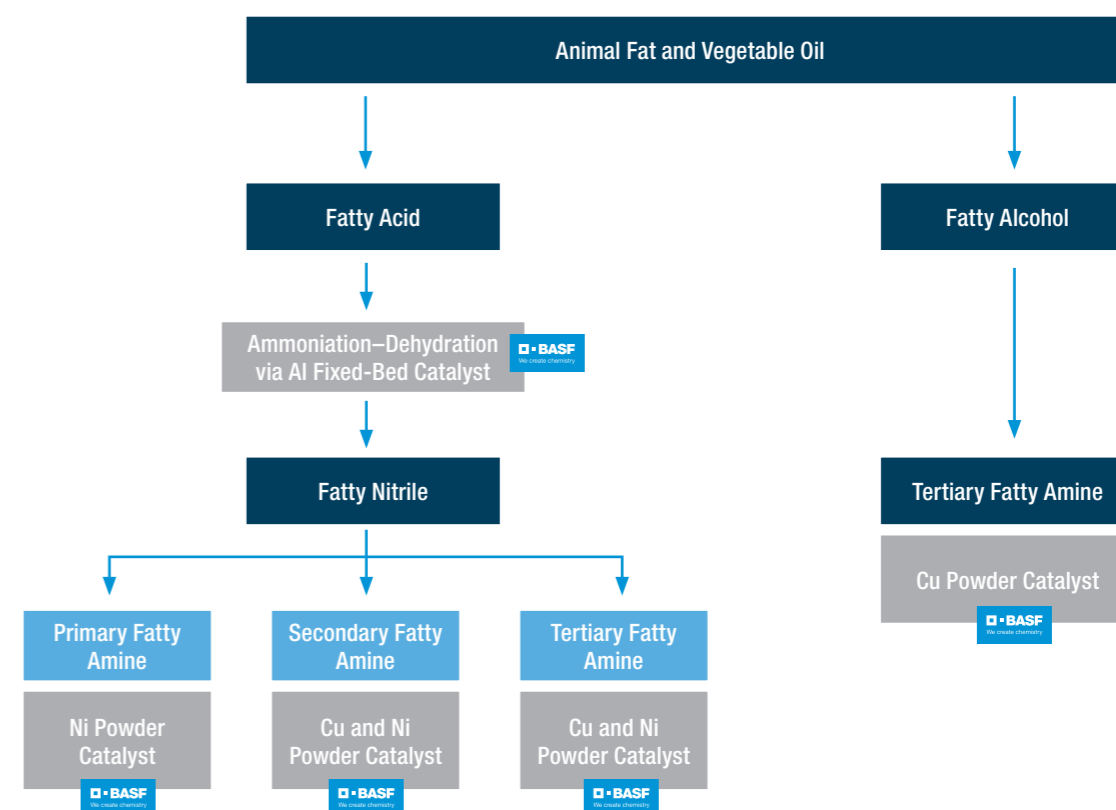
2.3 Fatty Nitriles and Fatty Amines

Production of fatty nitriles and fatty amines from renewable resources represents an attractive pathway to highly specialized chemicals for a broad variety of applications. BASF's extensive portfolio of Ni and Cu powder catalysts offers multiple commercially proven solutions for our customers slurry phase processes to produce fatty amines. BASF offerings cover the whole value chain from the animal fat and vegetable oil to the fatty amine, either via the fatty nitrile or fatty alcohol route. The field of amines is very complex, and our catalyst makes the difference when you are influencing your selectivity to primary, secondary or tertiary amine and if you want to saturate them or rather leave them unsaturated. BASF's portfolio helps you to steer your process in the desired direction. BASF is the one-stop shop for all fatty amine applications.

You are also looking for a fatty alcohol catalyst? You can find more information on our catalysts for this application in this brochure under fatty alcohol.

Did you know that BASF is the sole supplier for secondary fatty amine coated catalysts for the hydrogenation of nitriles?

The secondary fatty amine coating allows a safe and healthy powder catalyst handling whilst the coating is not polluting your product.



2.4 Fatty Alcohols

Oils to Fatty Alcohol: A Catalytic Process

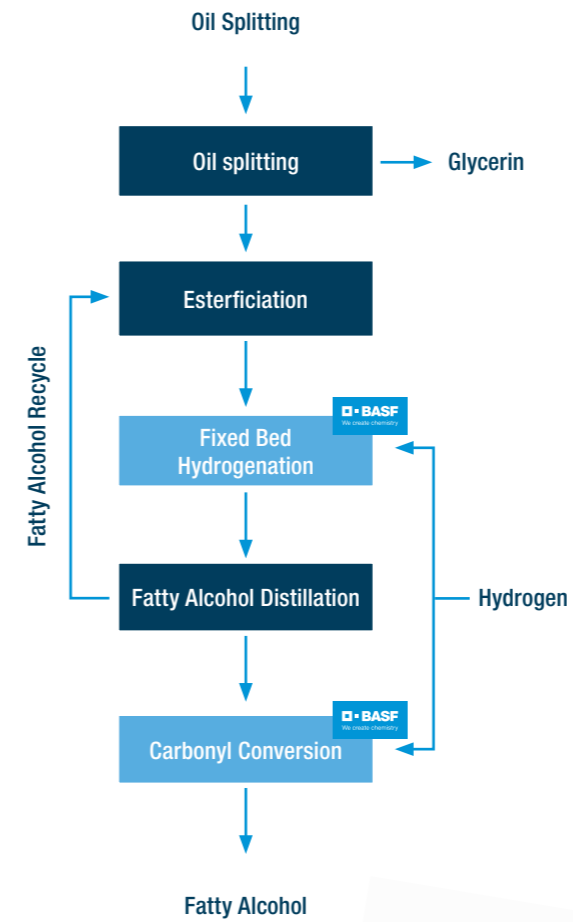
Natural source fatty alcohols are produced from plant sources such as palm and coconut trees, using triglyceride oil raw materials. In a series of processing steps, the oils are converted into fatty esters which are catalytically hydrogenated into fatty alcohols. BASF provides a comprehensive product line of copper- and nickel-based catalysts for the fatty alcohol processes.

High-Pressure Processes for Production of Fatty Alcohols

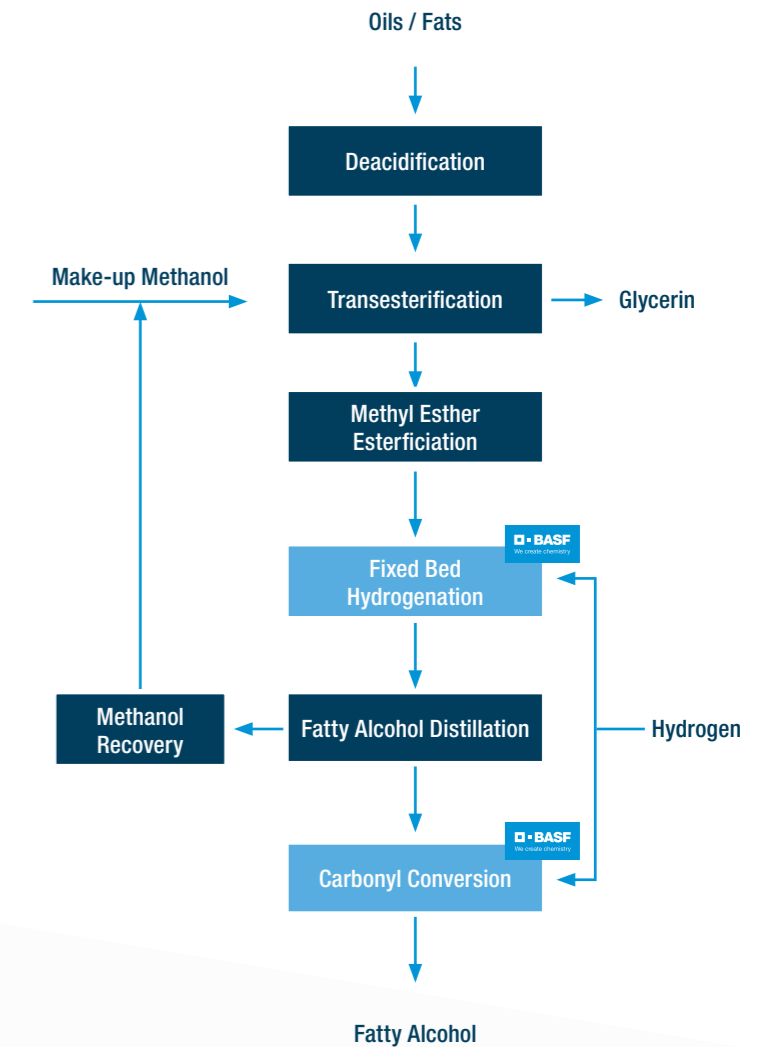
BASF offers proprietary Cu and Ni fixed bed catalysts for fatty alcohol production in liquid phase with proven track record for reliable operation at multiple plants. Catalysts of choice for the core hydrogenation step are tailored Cu-based fixed bed catalysts while Ni fixed catalysts are preferred in the downstream section for the conversion of carbonyls. Catalysts are available in extrudate or tablet form. The extrudates offer lower density for lower cost-of-fill and better mass transfer properties, while tablets offer better physical integrity.

Ni and Cu catalysts are available unreduced (requires activation at user site) or pre-reduced under optimal conditions at BASF and stored in alcohol for quicker start-up and shorter turnaround times.

Wax Ester Route



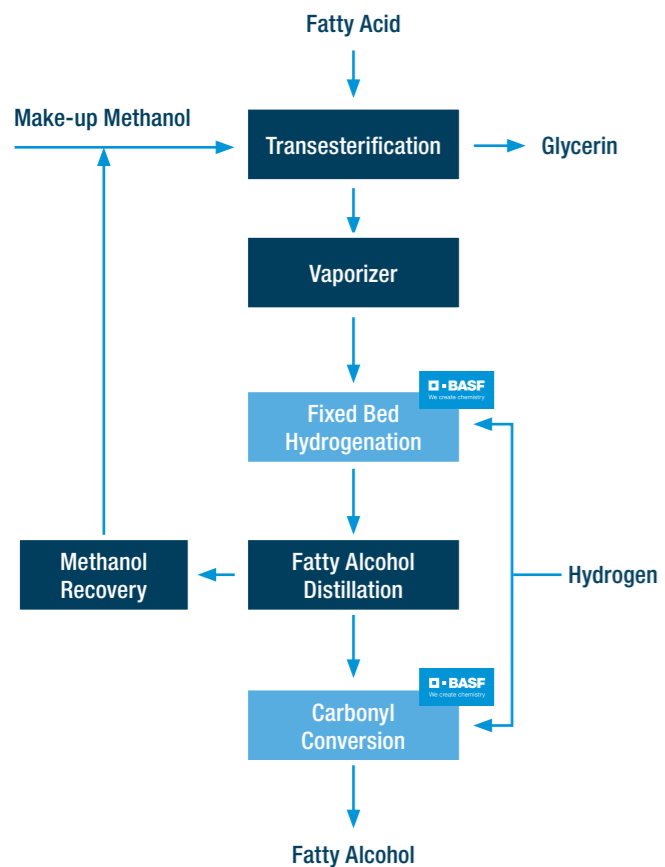
Methyl Ester Route



Vapor Phase Processes for Production of Fatty Alcohols

BASF recently developed a new Cu-based catalyst for the hydrogenation of methyl esters in vapor phase. The new product BASF product offers high conversion, excellent selectivity to desirable products and low selectivity to paraffins while demonstrating high resistance towards free acids present in feed which significantly improves catalyst lifetime.

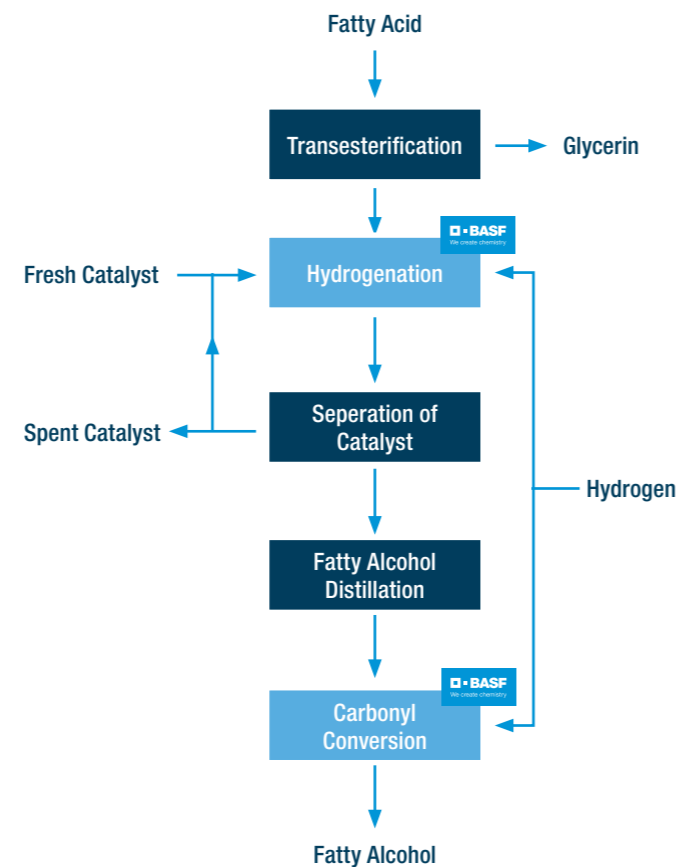
BASF Ni fixed catalysts are preferred in the downstream section for the conversion of carbonyls.



Slurry Phase Production of Fatty Alcohols

An alternative process to the fixed-bed hydrogenolysis of fatty esters is the production of fatty alcohol via a high pressure continuous slurry process. BASF offers a variety of Cu powder catalysts that have been commercially proven over many years. The broad portfolio consisting of various Cr-containing and Cr-free powder catalysts allows a tailored product selection which properly addresses the technical requirements of your process, i.e. catalyst separation and attrition.

BASF Ni fixed catalysts are preferred in the downstream section for the conversion of carbonyls.



2.5 Unsaturated Fatty Alcohols

Unsaturated fatty alcohols are highly specialized active surfactants because of the high reactivity of the double bond and its convenient characteristic to add other molecules to the alcohol or even to produce a branched high molecular weight alcohol which is based on renewable material.

BASF offers as well highly specialized Zinc-based fixed-bed catalysts for the production of unsaturated fatty alcohols from fatty acids. The unique selectivity of BASF's catalyst allows to hydrogenate the carbonyl group to an alcohol while maintaining a high selectivity towards the double bond product.

2.6 Glycerin to (Bio) Propylene Glycol

The oversupply of glycerin derived from production of biodiesel or fatty alcohols resulted in significant decrease in prices and made glycerin a low-price commodity limiting the outlets and margins for glycerin producers. Bio Propylene Glycol as a new outlet for glycerin is an attractive bulk chemical in a fast-growing market and offers multiple benefits to producers and has applications in many different industries, such as urethanes, polyester resins, food and beverage processing and deicing/antifreeze agent.

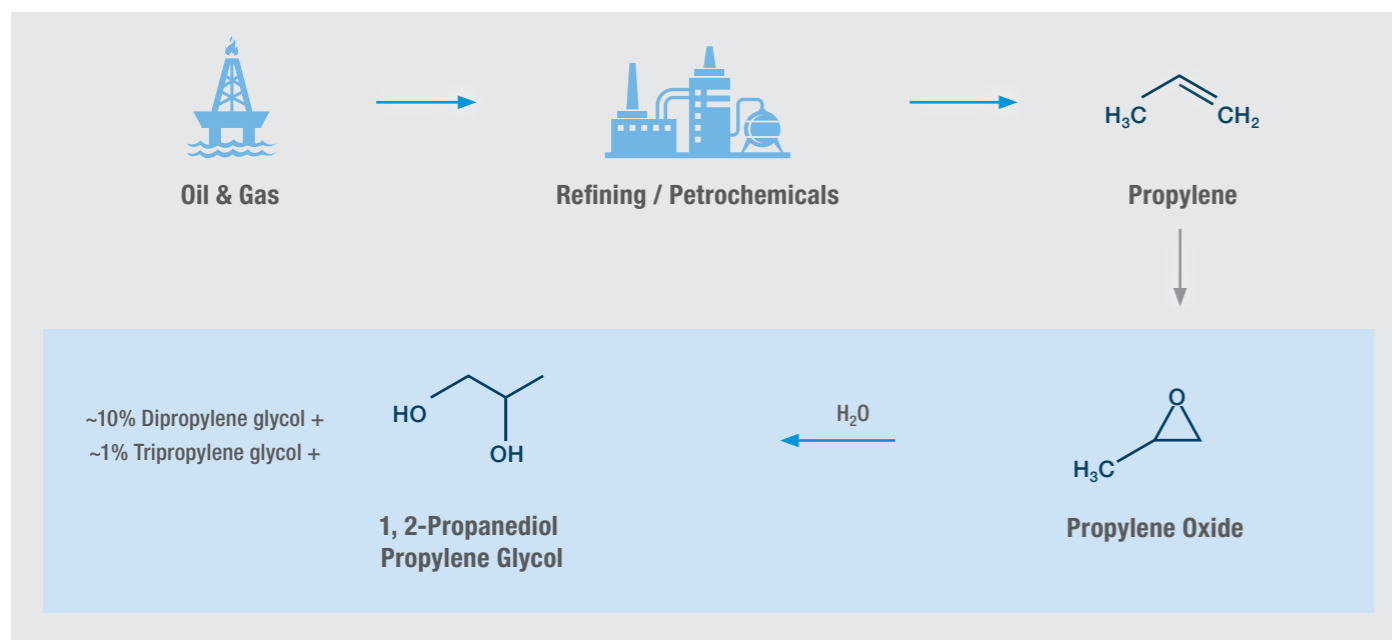
Bio Propylene Glycol represents an attractive alternative to conventionally produced propylene glycol from glycerin which does not rely on petroleum as raw material and offers an environmental advantage.



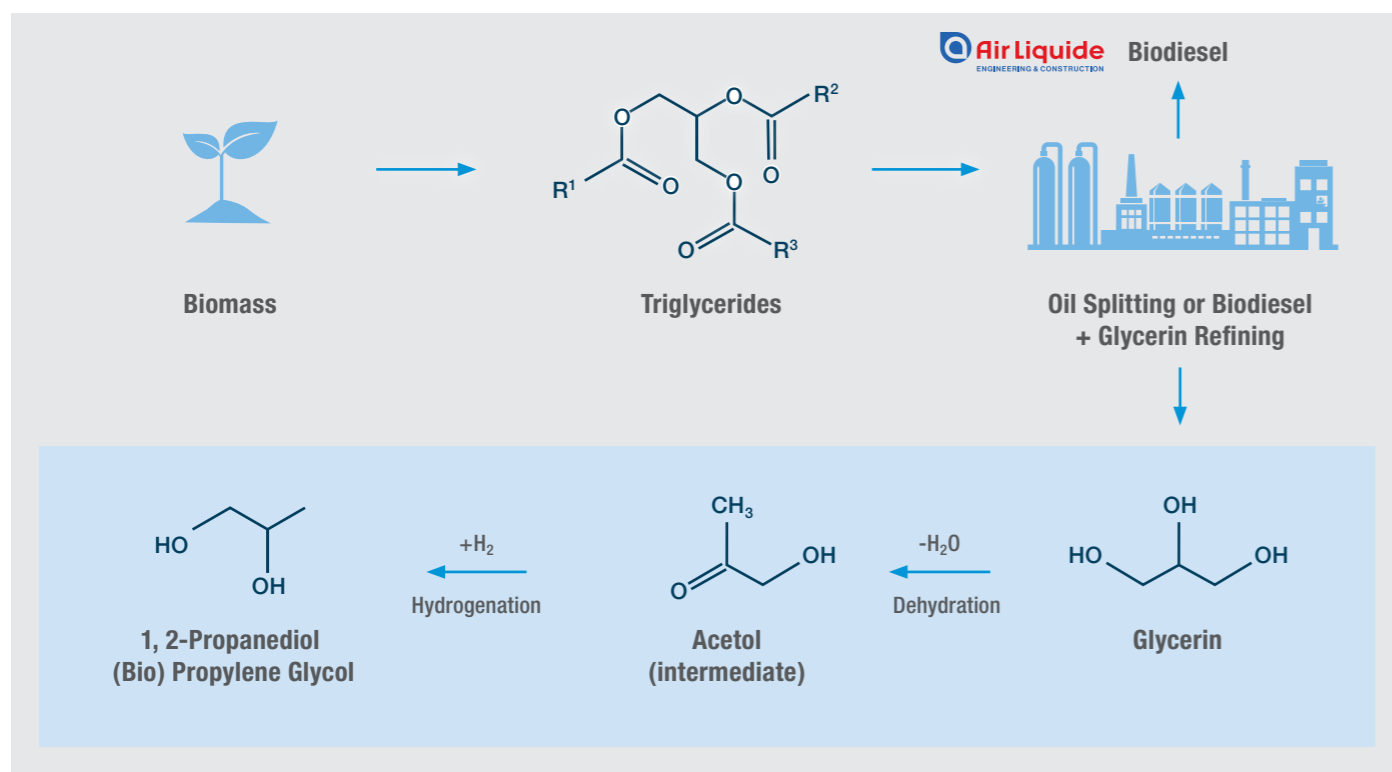
Looking for options to upgrade your glycerin business?

Do you want to improve your value chain carbon footprint and develop into a bio refinery?

Conventional route via petroleum-based propylene oxide



New Bio-based Route using Glycerin



BASF teamed-up with Air Liquide Engineering & Construction, a market leader providing superior technology solutions for the world's oleochemicals producers, to license the commercially proven BASF technology for hydrogenolysis of Glycerol to Bio Propylene Glycol. Glycerin is hydrogenated at very high conversion and selectivity in liquid phase with a proprietary BASF copper catalyst. The conversion to Bio Propylene Glycol is taking place in two serial fixed bed reactors and at temperatures between 175 to

195 °Celsius and at a pressure of 75 or 200 bar. The crude product is then further purified downstream in a two-column distillation to produce propylene glycol with a technical grade of more than 99.5% purity. Pharma grade Bio Propylene Glycol is possible to produce depending on feedstock quality. The technology for production of Bio Propylene Glycol is commercially proven and successfully operating since 2012. Glycerin is hydrogenated in liquid phase with a proprietary BASF copper catalyst.

03. Quality and Services

3.1 Technical Service

BASF's advanced oleochemical catalysts are backed by the best technical support in the industry. In addition to providing recommendations for activation/handling procedures, we provide:

- On site start up assistance (upon request)
- Analysis service for spent catalysts
- Technical product data sheets
- Consultation with technical experts
- Catalyst selection recommendations
- Catalyst samples (upon request)
- Custom catalyst capabilities
- Joint collaboration on projects

3.2 Exceptional Manufacturing for Superior Quality Products

BASF's meticulous manufacturing process controls particle size, porosity, and many other essential catalyst properties.

Adsorbent Properties

- Acidity level
- Moisture content
- Surface area
- Ion exchange capacity

Catalyst Properties

- Metal content
- Crush strength
- Bulk density
- Promoter addition

3.3. Quality Certification

- All products are manufactured at sites with ISO 9001 certification
- Adsorbent bleaching clays are FEDIOL compliant
- Nickel hydrogenation catalysts are "Non-Animal Protein" and IFS certified
- Kosher and Halal certificates are readily available for all products upon request



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Americas

BASF Corporation
25 Middlesex/Essex Turnpike
Iselin, New Jersey, 08830, USA
Phone: +1-732-205-5000
Fax: +1-732-205-7725
Email: catalysts-america@basf.com

Asia Pacific

BASF (China) Company Limited
300 Jiang Xin Sha Road
Pudong, Shanghai 200137
P.R. China
Phone: +86-21-2039 1311
Fax: +86-21-2039 4800-2549
Email: catalysts-asia@basf.com

Europe, Middle East, Africa

BASF Nederland BV – Catalysts
P.O. Box 19, 3454 ZG
De Meern
The Netherlands
Phone: +31-30-666 9211
Fax: +31-30-6669340
Email: catalysts-europe@basf.com



About Us

BASF's Catalysts division is the world's leading supplier of environmental and process catalysts. The division offers exceptional expertise in the development of technologies that protect the air we breathe, produce the fuels that power our world and ensure efficient production of a wide variety of chemicals, plastics and other products, including advanced battery materials. By leveraging our industry-leading R&D platforms, passion for innovation and deep knowledge of precious and base metals, BASF's Catalysts division develops unique, proprietary solutions that drive customer success.

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