

We create
chemistry
that makes
renewable
love reliable.



 **BASF**

We create chemistry

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 oleochemical technologies. As part of BASF, we have the resources to help companies meet and exceed challenging quality, environmental, and governmental standards with solutions tailored to specific needs. With the resourceful imaginations of over 650 research scientists and engineers for various catalyst technologies, we create practical solutions, optimize processes, and deliver performance for your oleochemical requirements.

Cutting-Edge Technologies for a Progressive Future

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

- Hydrogenation of oils, fats, and fatty acids
- Production of fatty alcohols and fatty amines
- Adsorbent purification of fats and oils
- Biorenewable technologies
 - Optimal processing of biomass to biodiesel and chemicals



Choosing the Right Product for your Processing

BASF provides catalysts and adsorbents for an array of renewable feedstock processing methodologies. This includes, but is not limited to:

- Copper Catalysts (powders, tablets, and extrudates):
 - Fatty alcohol production, furfural hydrogenation, amination, etc.
- Nickel Catalysts (powders and droplets): Hydrogenation of fatty nitriles, edible oils, fatty acids, and carbonyl compounds
- Alumina Catalysts (tablets, extrudates, or ring-shaped):
 - Fatty nitrile production from fatty acids
- Precious Metal Catalysts
 - Fatty acid hydrogenation
 - Methylation to produce natural source vitamins from tocopherol raw materials
 - Carbohydrates hydrogenation
- Solutions to utilize the glycerol streams
 - Conversion of glycerol to monopropylene glycol (MPG)

Many of these products are available as powders for slurry applications and formed shapes for fixed bed process. Let BASF assist you in selecting the right catalyst for your application.





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-, zinc- and nickel-based catalysts for the fatty alcohol process.

Copper-based Catalysts

- For conversion of fatty methyl or wax esters into fatty alcohols

Slurry Processes

- Powders (copper chromite and promoted copper chromite type)
 - High activity
 - Optimized particle size (removal ease using standard equipment)

Fixed Bed Processes

Formed catalysts are used in fixed bed, continuous processes for fatty alcohol production. Fixed bed catalyst types include copper chromite or copper on silica and alumina supports. These catalysts are available unreduced (requires activation at user site) or pre-reduced and coated with fatty alcohol for quicker start-up and shorter turnaround times. Fixed bed catalysts offer:

- High conversion rates
- Long reactor bed life
- Resistance to feedstock impurities, such as acidity and sulfur compounds
- Excellent reaction selectivity to minimize hydrocarbon formation

Catalysts are available in extrudate or tablet form. The extrudates offer lower density for lower fill costs in fixed volume reactors, while tablets are more rugged for better physical integrity.



Nickel-based Catalysts

- For fixed bed hydrogenation of low levels of carbonyl compounds in fatty alcohol as a final purification step
- Available in extrudate or tablet form
- Pre-activated by reduction to optimum activity levels
- Passivated or coated with fatty alcohol for ease in handling

Zinc-based Catalysts

- For ester hydrogenation for production of unsaturated alcohols
- Available in tablet form





Catalytic Hydrogenation Using Nickel Droplets

BASF provides a variety of catalysts that optimize oil, fat, and fatty acid hydrogenation. BASF's Nysosel® catalysts are used for oil and fat hydrogenation, while Nysofact® catalysts are suitable for the complete hydrogenation of fatty acids from animal, marine, or vegetable origins. Both are effective, nickel-based precipitated catalyst powders on proprietary supports, coated in fully-hardened vegetable oil and formed into pastilles for ease of handling.

Nysosel® Catalysts: Edible Oil Hydrogenation

Type	Application	Activity	Selectivity
Standard	Full hydrogenation of a wide variety of oils and fats	High	High
Selective	Partial hydrogenation, e. g. to minimize saturates	Good	Very high
High-Durability	Partial or full hydrogenation of feedstocks containing trace impurities like sulfur	Good	High
Low Nickel	Full hydrogenation of a wide variety of oils and fats	Very high (based on Ni content)	High
Sulfur-Promoted	Hydrogenation with maximum isomerization of double bonds	Good	High



Creating a Practical Reaction

BASF offers a comprehensive line of Nysofact® catalysts for hydrogenation of fatty acids. These nickel catalysts have high activity and excellent filterability and are especially suited to applications requiring complete hydrogenation. Catalysts for fatty nitrile hydrogenation are also offered. These catalysts are available in secondary amine-coated droplets as well as reduced and stabilized powders. Proper choice of catalyst and reaction conditions help achieve product selectivities.

Nysofact® Catalysts: Fatty Acid Hydrogenation

Type	Application	Activity
Standard	Hydrogenation of a wide variety of fatty acid feedstocks	High
Impurity Resistance	Partial or full hydrogenation of feedstocks containing high levels of impurities	Good
Low Nickel	Full hydrogenation of a wide variety of oils and fats	Very high (based on Ni content)

Technical Service

BASF's advanced oleochemical catalysts and adsorbents 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)
- On-site technical seminars
- Custom catalyst capabilities
- Joint collaboration on projects



Enhancing the World of Biorenewables

Biorenewables can be categorized into biochemicals and biofuels.

Biofeedstocks include triglycerides (oils and fats), sugar, and cellulosic materials.

Biofuels, which include biodiesel and bioethanol, represent an environmentally-conscious source of energy.

Biofeedstocks

In addition to our hydrogenation catalysts and purification adsorbents, BASF offers a comprehensive line of catalysts for sugar-based chemical value chains, including the conversion of sugars to sorbitol. BASF is also actively pursuing R&D solutions for biomaterials in the chemical, pharmaceutical, and fuel markets.

Biofuels

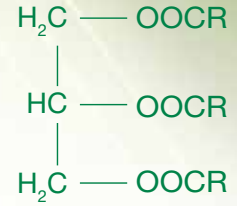
BASF offers catalytic solutions for processing biomass to biodiesel. For Fatty Acid Methyl Ester (FAME) production, BASF has developed a heterogeneous catalyst, which performs the catalytic transesterification process of converting triglycerides with methanol.

Other biofuel applications include:

- Special adsorbents materials to optimize biodiesel processes
- Catalysts to meet all the hydrogenation needs of biodiesel producers
- Additional solutions to utilize the glycerol stream of the FAME production [for example, the conversion of glycerol to monopropylene glycol (MPG)]



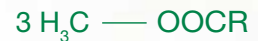
Catalytic Transesterification Process



Triglyceride



Glycerol



FAME
Biodiesel





Adsorbents for Purification of Fats and Oils

Trace impurities in vegetable, marine, and animal fats impact the color and stability of oils. Adsorbent bleaching clays are very useful in removing these impurities to improve appearance and flavor. BASF offers an extensive line of bleaching clay adsorbents produced from bentonite ore containing montmorillonite, as well as non-activated, surface neutral adsorbents for both purification and catalytic applications.

Purification Applications

- Bleaching of vegetable oils (soybean, canola, corn, sunflower, palm, etc.)
- Clay-catalyzed dimerization of fatty acids
- Catalytic application that require solid acid surface catalysis

The BASF Advantage for Purification

- Wide-range of particle sizes to fit all customer filtration requirements
- Different surface acidity levels
- High activity with the lowest clay dosages
- Optimal particle size for ease in conventional filtration equipment (pressure leaf or plate and frame filters)
- Optimize product bulk density and porosity for:
 - Ease in handling
 - Good pneumatic conveyance
 - Minimal oil retention in filter cakes
- Trace metals adsorption from triglyceride oils

Examples of Trace Impurities that Contaminate Fats & Oils

- Chlorophyll
- Carotenoid pigments
- Soaps
- Phospholipids
- Trace metals
- Oxidation compounds

Exceptional Manufacturing for Superior Quality Products

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

Adsorbent Properties

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

Catalyst Properties

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

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

About Us

BASF's Catalysts division is the world's leading supplier of environmental and process catalysts. The group 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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BF-10446 USL 03/16