Bio-Based and Recycled Content Polyols

Product Brochure

Emery Oleochemicals

Pioneering natural-based innovations for 175 years

Emery Oleochemicals is a leading solutions provider in renewable-based specialty chemicals with global operations spanning Asia, Europe and the U.S. Dedicated to providing customers with best-in-class products derived from natural sources, we pride ourselves on having a diverse portfolio known for its performance, economics, and environmentally responsible properties.

Guided by an inventive spirit that goes beyond providing high performance solutions, we are able to assist your business cope with the challenges of markets that are going greener by the day. Our combined strengths in cutting-edge research, technology, and development and in-depth knowledge and understanding of markets and customer needs, allow us to expand the boundaries of science and advance sustainable solutions. Our competitive advantage is translated into a wide-ranging portfolio of target markets including Eco-friendly Polyols, Agro Green, Bio-Lubricants, Green Polymer Additives, Home and Personal Wellness and OleoBasics.

Working with customers to build a resource-efficient way of life makes us your preferred natural-based chemical solutions partner.

Your preferred partner in sustainable polyurethanes

Ep
Eco-Friendly Polyols

Transforming market needs into innovative products through our EMEROX® renewable and INFIGREEN® recycled content polyols, our Eco-Friendly Polyols are poised to provide the polyurethanes industry with custom solutions providing value-added performance benefits that can be integrated economically into sustainable products and processes.

Creating polyols that enhance your formulations and end-products to go beyond performance requirements, optimize processing parameters, and be environmentally responsible. These are excellent raw materials for use in the manufacture of insulation, furniture, automotive applications, major appliances and coatings, adhesives, sealants & elastomers (CASE).

Overview

EMEROX® and INFIGREEN® polyols provide our customers, formulators and end-users with enhanced performance properties, increased efficiencies, and sustainability, and are excellent raw materials for use in the manufacture of polyurethane foams for building and construction, furniture and bedding, automotive applications, major appliances, packaging foams and coatings, adhesives, sealants, and elastomers (CASE) applications.

Spurred by our solutions orientation for an evolving polyurethanes industry, we work closely with customers to develop sustainable chemistry that offers long-term value and performance comparable to or better than existing petrochemical technology.

Our innovation is focused on creating customizable solutions that can be integrated economically into a variety of polyurethane applications where performance and sustainability are essential.

For polyurethane systems, sustainability is a significant challenge. It continues to be important to consumers and is increasingly specified by Original Equipment Manufacturer (OEMs).

Today, the majority of the available rapidly renewable (bio-based) content polyols are based on modified natural oils (NOPs, or natural oil polyols) which are more difficult to engineer to a specific application than its petrochemical equivalent. The challenge is even greater for recycled content polyol solutions where commercial options are limited. Until now.




EMEROX® and INFIGREEN® Polyols for versatility and innovations in sustainable polyurethanes

Emery Oleochemicals in 2015, made its mark as the world's first industrial-scale facility capable of using scrap foam as feedstock to manufacture a new range of sustainable polyols marketed under the INFIGREEN® trade name.

By leveraging Emery Oleochemicals' proprietary feedstock ozonolysis technology, the company is well-positioned to provide performance bio-based polyol solutions - marketed under the EMEROX® trade name.

Combined, our bio-based and recycled content polyols offer wide-ranging solutions suited for multiple industries and applications, such as building and construction, insulation, automotive, furniture and bedding, major appliances, packaging, and coatings, adhesives, sealants and elastomers (CASE).

We offer our customers unique, value-added and sustainable polyol products that address key performance and environmental issues while also reducing the amount of scrap foam sent to landfills.

EMEROX® Polyols

Engineered for Performance and Sustainability

- Based on rapidly renewable feedstock.
- Performance for flexible and rigid foams, CASE applications.

INFIGREEN® Polyols

Making Urethane Recycling a Reality

- Chemical recycling of polyurethane foam.
- Designed to address the recycle needs of the polyurethane industry.

EMEROX® Polyols

EMEROX® polyols are based on renewable azelaic (C_9 dibasic) acids produced via Emery Oleochemicals' ozonolysis technology (Figure 1). Emery Oleochemicals' ozonolysis technology and process was developed in the 1950s to produce azelaic and pelargonic acid (C_9 dibasic and C_9 monobasic acid respectively) from oleic acid and is a well-established large-scale commercial production process.

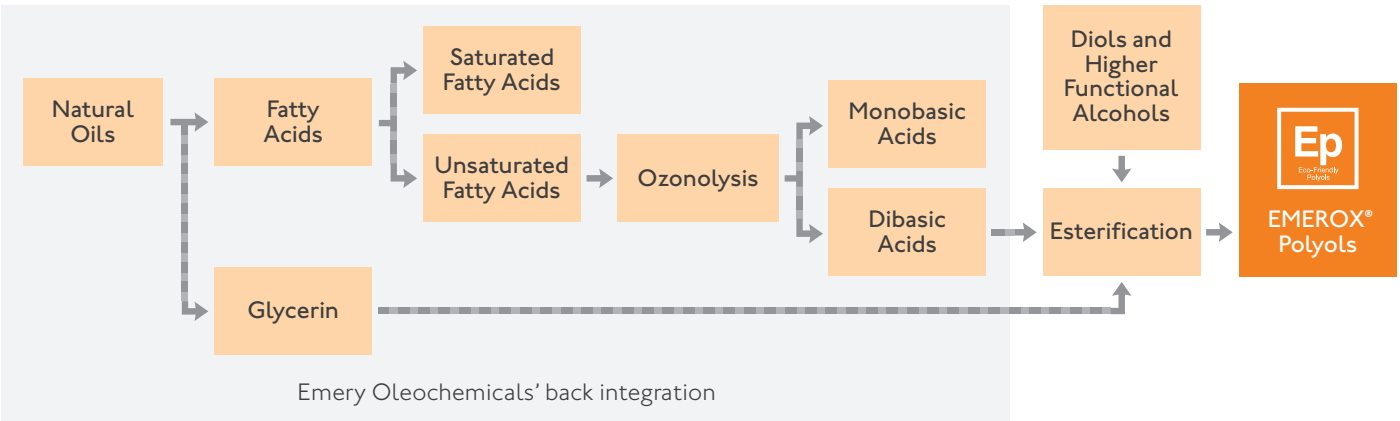


Figure 1: Process flow chart of EMEROX® polyols. Gray box demonstrates Emery Oleochemicals' long history and consistency with this process, including our back integration and unique process technology. The esterification process allows for the design freedom to customize value-added solutions for our customers and partners while combining the benefits of our long history, consistency and quality.

EMEROX® Polyols

The process starts with natural oils that are split into glycerin and fatty acids. The fatty acids are separated into saturated (e.g., stearic) and unsaturated (e.g., oleic) fatty acids. Oleic acid is a C_{18} mono functional acid with an unsaturation between the C_9 and C_{10} position. When reacted with ozone, the unsaturation is cleaved, forming acid groups on both sides of the unsaturated site. The result is a mix of monobasic and dibasic acid compounds, which are separated and further purified.

The dibasic acid streams from the ozonolysis process are converted to EMEROX® polyols by reaction with diols, glycerin, or higher functional alcohols via esterification. The benefit is that, while there is high bio-based content from these feed streams, the chemist has all the polyol structure design freedom typical of a petrochemical ester polyol. This allows for bio-based polyols that can be better optimized for specific application needs than typical NOP or bio-based polyols. Further, the ozone process is robust over a broad range of high unsaturation content natural oils and eliminates the seasonality that can be present in more traditional NOP polyols.

Engineered for performance and sustainability. Without compromise.

EMEROX® Polyols are first of its kind renewable polyols produced via Emery Oleochemicals' proprietary ozonolysis technology, and its unique characteristics include:

- **Engineered for performance** like a petrochemical product and sustainable through its use of rapidly renewable natural oils
- **Versatile chemical structure** enables product development from linear to highly branched, and a broad range of molecular weights and viscosities
- **Good reactivity** high to moderate reactivity (primary and/or secondary hydroxyl groups)
- **Cost-effective replacements** for petroleum-based polyols and available for rigid / flexible foams and CASE application
- **Renewable content** typically in the 70 - 100% range. USDA BioPreferred® approved products
- **Custom EMEROX® Polyol** solutions can be developed for your unique product needs

EMEROX® polyols are well suited for a broad range of applications:

- **Rigid foams:** high hydroxyl number/highly branched polyols
- **Flexible foams:** low hydroxyl number/slightly branched polyols
- **CASE** (Coatings, Adhesives, Sealants, Elastomers): low to high hydroxyl / linear to branched polyols

Value-adding through renewable solutions, certified BioPreferred®

EMEROX® polyols have bio-based content typically in the 70-100% range, an ideal fit in our pursuit to cutting-edge innovations. Backed by our drive in sustainable product stewardship, Emery Olechemicals participates in the certification process with the U.S. Department of Agriculture's (USDA) BioPreferred® program. A voluntary labeling initiative for bio-based products, it certifies that the product meets the USDA bio-based content standards. In receiving the certification for selected EMEROX® products, our customers are assured of the bio-based claims and are empowered in making informed purchasing decisions, relevant to their own product development and sustainability agenda.

DID YOU KNOW...

EMEROX® polyols offer a high level of design freedom and can replace petroleum-based polyols, typically at higher substitution rates than other renewable polyols. Research also shows that EMEROX® polyols often provide improved performance over soy polyols.

The following products have earned the USDA BioPreferred® program's Certified Biobased Product label:

	TYPICAL PROPERTIES			
PRODUCT	HYDROXYL VALUE mg KOH/g	VISCOSITY (25°C)	BIO-BASED CONTENT (%)	DESCRIPTION AND RECOMMENDED APPLICATION
EMEROX® Polyol 14001	50	2400	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 99%	• Slightly branched Polyol for Flexible Slab (Conventional, Memory) and Molded Foams • Secondary hydroxyl
EMEROX® Polyol 14050	50	9000	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 80%	• Branched Polyol for Flexible Slab (Conventional, Memory) and Molded Foams, CASE • Primary hydroxyl
EMEROX® Polyol 14055	50	5000	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 80%	• Slightly Branched Polyol for Flexible Slab (Conventional, Memory) and Molded Foams, CASE • Primary hydroxyl
EMEROX® Polyol 14250	345	270	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 69%	• Linear Polyol for Rigid Foams, CASE • Primary hydroxyl
EMEROX® Polyol 14270	355	2000	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 98%	• Highly Branched Polyol for Rigid Foams • Provides good foam flow and excellent properties
EMEROX® Polyol 14275	375	2500	USDA CERTIFIED BIOBASED PRODUCT PRODUCT 99%	• Highly Branched Polyol for Rigid Foams, with Catalytic Activity

For more information on USDA BioPreferred® visit www.biopreferred.gov

INFIGREEN® Polyols

This multi-award winning approach to recycling polyurethane foam is a first of its kind aromatic polyether/ester polyol and consists of a range of products manufactured via glycolysis of polyurethane scrap (Figure 2).

The INFIGREEN® process starts with polyurethane foam scrap. The scrap can be either rigid or flexible foams based on either ether or ester chemistry, and as a general rule it is best to use a scrap grade that is similar in structure to the grade of foam one intends to produce from the resultant polyol. The glycolysis product is further worked to remove any residual solids that may have been introduced into the foam scrap stream and the hydroxyl value is adjusted to meet an application specification.

Closed Loop: Your material – back to you

Of particular interest is the potential for closed loop processing of a foam producer's scrap. Depending on the grade and application, foam production can have high yield loss. There is a keen interest in the industry to find methods of reintroducing the scrap foam back into the foam process, especially for difficult to rebond grades of foam. In the closed loop process, the foam producer's scrap is converted back to polyol and returned for reprocessing into the foam manufacturing process. With closed loop processing, your own chemistry is returned back to you and issues of variability and formulation change are minimized.

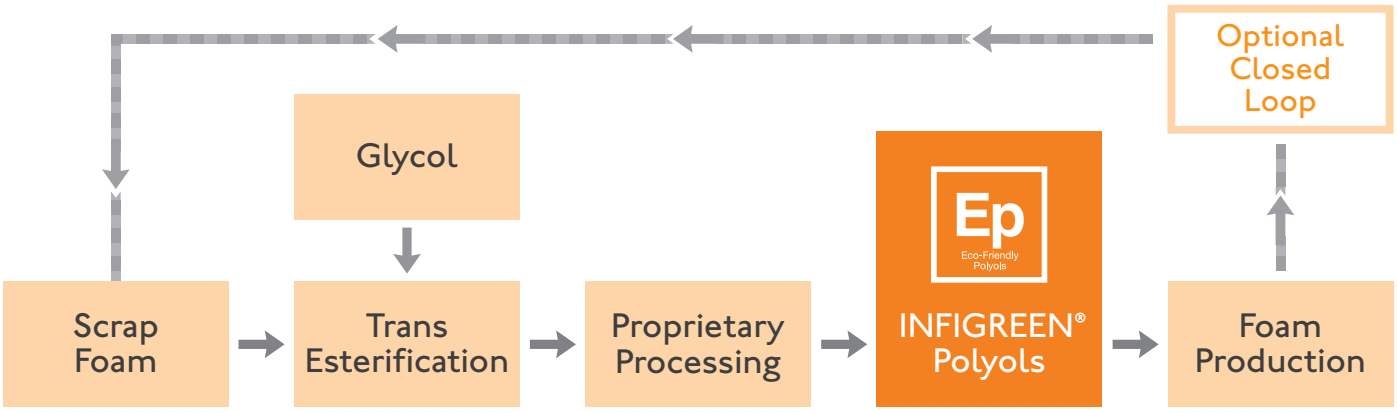


Figure 2: Process flow chart of INFIGREEN® recycled content polyols.

INFIGREEN® polyols are well suited for a broad range of flexible and rigid foam applications, and this first of its kind aromatic polyether/ester polyols is produced via Emery Oleochemicals' proprietary chemical process that uses scrap polyurethane as the key raw material. Its unique attributes include:

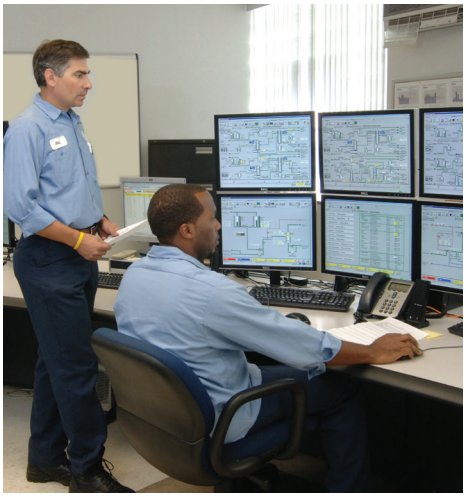
- **Versatile chemical** formulation with a range of molecular weights and viscosities possible
- **High to moderate reactivity**, depending upon the application requirements
- **Cost-effective replacement** for petroleum-based polyols for rigid and flexible foams
- **Broad feedstock capabilities** with the use of many types of scrap polyurethane foam for custom tailored solutions
- **Closed-loop processing** for best performance, sustainability goal measurement and economics

DID YOU KNOW…

INFIGREEN® polyols are a higher valued, environmentally responsible solution for its ability to use scrap polyurethane foam. Offering quantifiable environmental stewardship for postindustrial foam, INFIGREEN® provides an alternative to landfilling for difficult to rebond scrap.

	TYPICAL PROPERTIES		
PRODUCT	HYDROXYL VALUE	VISCOSITY (25°C)	RECOMMENDED APPLICATIONS
INFIGREEN® 100	170	3000	• Flexible slab • Molded foams • Memory foams • Conventional foams
INFIGREEN® 300	290	4000	• Flexible slab • Molded foams • Memory foams
INFIGREEN® 420A	385	1100	• Injected pour-in-place foams • Rigid/semi-rigid foams
INFIGREEN® 420R	395	1100	• Pour-in-place foams • Rigid/semi-rigid foams • Reduced reactivity
INFIGREEN® 429	380	1500	• Pour-in-place • Spray Foams • Rigid foams *(More crosslinking and catalytic behavior)*
INFIGREEN® 500	395	2000	• Pour-in-place • Spray Foams • Rigid foams

Specialty Ester Facility, Cincinnati



Located in Cincinnati, Ohio, the Emery Oleochemicals site spans over 140,000 sqm (35 acres) and has been operational since 1885. Our new bio-based and recycled content polyols plant designed for polyurethane applications was commercialized in 2015.

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