

## Biocea™: The Sustainable Additive for High Performance Environmentally Acceptable Metalworking Fluid Formulations

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**Biosynthetic® Technologies** has developed a revolutionary new class of high-performance bio-based additives for metalworking fluids, called Biocea™. These novel sustainable additives use the patented estolide technology and are biobased, biodegradable, non-bioaccumulative, and non-toxic. Biocea additives deliver superior lubricity, film strength, biostability, hydrolytic stability, oxidation stability, and increased polarity on both ferrous and non-ferrous alloys. They are derived from natural oils and improve the overall quality of formulated metalworking fluid. Biocea additives can result in increased productivity, reduced waste and down time, and lower cost in your overall manufacturing operation.

### EAL Market Drivers

According to a recent Kline and Company report, the global finished lubricants market in 2019 was 40.5 million tons, of which bio-lubricants accounted for less than 1% at 350,000 tons. The report stated that there are untapped growth opportunities, considering the low penetration of bio-lubricants

demand in some key country markets. The U.S. is one of the fastest growing country markets, with uptake of bio-lubes expected at about a 4% CAGR from 2019 to 2024 (*Kline and Company, August 5, 2020*). Compare that to the global lubricants market, which according to Reportlinker, is expected to witness a downfall in 2020 with a negative growth of 0.95% (*Reportlinker, May 7, 2020*). In June 2020, Genomatica reported that “Despite setbacks from the pandemic, demand for bio-lubricants should continue to grow faster than the overall global lubricants market”. To leverage the pending growth of the biobased lubricant and metalworking fluid markets, lubricant manufacturers can convert their traditional formulations into environmentally acceptable EAL offerings and capitalize on growth patterns.

### Novel Technology

Biocea utilized Biosynthetic Technologies’ patented estolide technology. Estolides are a class of unique biobased additives with a variety of uses in lubricant applications.

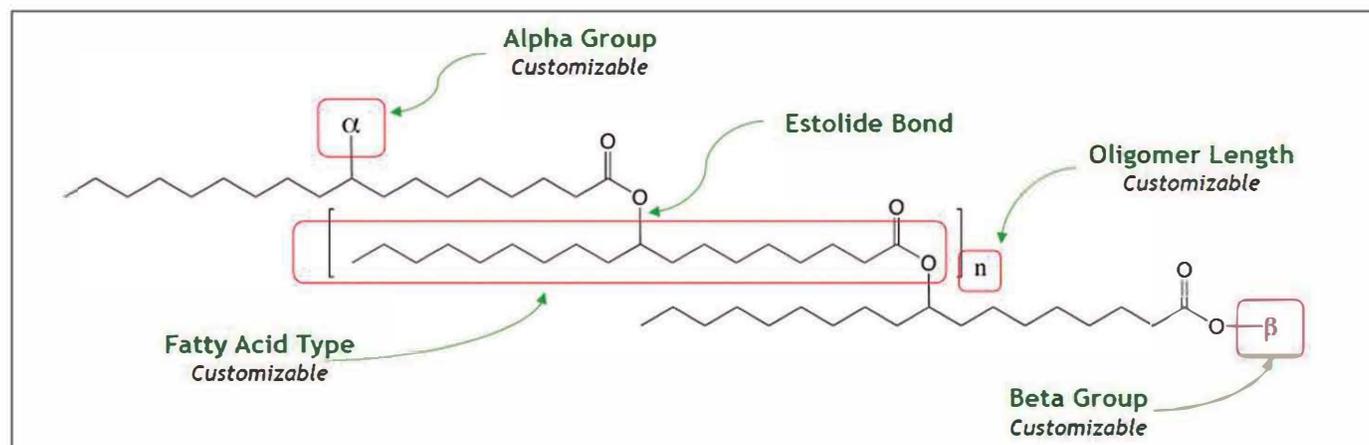
Their oligomeric structure contains fatty acid repeat units, with secondary ester linkages on the alkyl backbone. *Below, please find the general structure.*

Functional groups (denoted as  $\alpha$  and  $\beta$ ), oligomer length ( $n$ ), and the fatty acid feedstock can all be altered in order to achieve desirable performance properties for any particular application. In addition, their environmental compatibility allows them to be used in widespread industry applications.

### Features and Benefits

Our patented Biocea additives deliver superior performance in metalworking fluid applications such as:

- Unparalleled lubricity
- Provide superb wear protection
- Are free of restricted chemicals
- Vegetable derived
- Excellent hydrolytic stability
- Natural detergency
- Improves overall operations in terms of uptime
- Minimizes safety risks
- Reduces overall formulation cost



- Meet the national chemical inventory requirements
- Increases operational efficiency
- Reduces cost related to maintenance
- Are REACH registered
- HX1 certified
- Show no signs of dermal irritation
- Naturally low foaming

### Technical Performance Data

Biosynthetic Technologies' Biocea additives provide excellent lubricity, film strength and improved tool life, when compared to other PAO additives. In addition to superior oxidative stability Biocea additives provide excellent wear protection as well as industry leading hydrolytic stability. Below, please find the ranking for the leading metalworking fluid additives performance features, and see how Biocea additives outperform the most commonly used additives available in the market today (see Figure 1).

### Environmental Performance Data

Biocea additives are manufactured with consideration for the environment, health and safety (see Figure 2). They provide the sustainable answer for environmentally acceptable metalworking fluids. Biocea are renewable carbon based and provide:

- High Biodegradability
- Low Bioaccumulation
- Low Toxicity
- High Bio-Content
- Rapid Breakdown
- No dermal irritation
- Low Environmental Risk
- Reduced Risk to Wildlife

Biocea additives have been evaluated through a revolutionary new method known as the CADRE Method. This is a new innovative modeling software used to safely determine skin sensitization concerns without requiring any animal testing. Biocea additives show no signs of dermal irritation or allergic

sensitization. The lack of odor and skin irritation make these additives extremely suitable for metalworking fluid applications while promoting a safe work environment.

### Applications

Biocea additives are used in a variety of Metalworking and metal forming fluid formulations for all 4 major classes of metalworking fluids: straight oil, soluble oil, semi-synthetic, and synthetic metalworking fluids. Biocea additives can be used as high performance lubricity additives, that meet (and often exceed) the technology requirement needed in modern machining techniques. These novel Biocea additives are considered to be the best biobased choice for multi-purpose or general-purpose applications in neat oils, soluble oils, and semi-synthetic fluids. They have good solubility in all base oils, and are the easiest to emulsify into water-based chemistries (see Figure 3).

Figure 1

Performance Feature	Pentaerythritol Ester	Synthetic Ester	TMPTO	Biocea™ I	Biocea™ II	Biocea™ III
Lubricity	✓	✓	✓	✓	✓✓	✓✓✓
Film Strength	✓	✓	✓	✓✓	✓✓✓	✓✓✓
Anti-Wear	-	-	-	✓✓	✓✓✓	✓✓✓
Improved Tool Life	✓	✓	✓✓	✓✓	✓✓✓	✓✓✓
Increased Polarity	-	✓	-	✓	✓✓	✓✓
Hydrolytic Stability	-	✓	-	✓✓✓	✓✓✓	✓✓✓
Molecular Weight	420.6*	295.04*	927.5*	455	1462	2680

\*Numbers are based on industry averages and final numbers for individual products may vary. Results listed in table may vary. Optimum blends can be created to maximize performance.

Figure 2

Environmental Properties	Method	Biocea™ I	Biocea™ II	Biocea™ III
Biodegradability	OECD 301B	88%	79%	76%
Bio Content	ASTM D6866	68%	86%	94%
Toxicity				
Alga Toxicity EC50	OECD 201	>1000 mg/L	>1000 mg/L	>1000 mg/L
Daphnia Toxicity EC50	OECD 202	>1000 mg/L	>1000 mg/L	>1000 mg/L
Fish Toxicity EC50	OECD 203	>1000 mg/L	>1000 mg/L	>1000 mg/L
Bacteria Toxicity EC50	OECD 209	>1000 mg/L	>1000 mg/L	>1000 mg/L

Figure 3

Additive	General Machining	Cutting and Grinding	Forming
Biocea™ I	✓✓	✓✓✓	✓
Biocea™ II	✓✓✓	✓✓✓	✓✓
Biocea™ III	✓	✓✓	✓✓✓

\*Results may vary. Optimum blends can be created to maximize performance by application.

**Specialty Castor Derivatives**

In addition to Biocea additives, Biosynthetic Technologies offers other castor derived high-performance fluids that are natural and sustainable. Our extensive bio-based product line is specifically formulated to match formulator needs and to provide solutions to the distinct challenges in the metalworking fluid market. Biosynthetic Technologies offers the following castor derivatives in their metalworking product line.

is to make sustainability a point of difference for our business, and we are confident that this strategy will generate even greater benefits for the environment in which we operate, the people that we work with and the communities we are part of. Biosynthetic Technologies is committed to sustainability and clearly focused on the responsible use of natural resources in our daily business. We understand that health, environmental awareness and traceability play just as large

tensive R&D team is here to help in the creation of tailor-made ingredients to meet your specific formulation needs.

**About Biosynthetic Technologies**

Biosynthetic® Technologies manufactures a revolutionary new class of biobased synthetic compounds called Estolides that are made from organic fatty acids found in various bio-derived oils. These highly functional biosynthetic oils have numerous uses in lubricant, automotive, marine, pharma and personal care applications and can be used as the primary base oil of a formulation, a component of a base oil co-blend, or even as an additive. In addition to their high-performance properties, these renewable oils are biodegradable and nontoxic. Biosynthetic Technologies strives to make their mark on the world by delivering innovations for a sustainable future. For more information about Biosynthetic Technologies, please visit [www.biosynthetic.com](http://www.biosynthetic.com) and follow us on LinkedIn or contact me directly at [jmackey@biosynthetic.com](mailto:jmackey@biosynthetic.com).

Biosynthetic Technologies Product Name	Industry Equivalent
BT-PRA30	Polymerized Lubricant 30
BT-PRA40	Polymerized Lubricant 40
BT-PRA50	Polymerized Lubricant 50
BT-PRA100	Polymerized Lubricant 100
BT DES	Di Ethylhexyl Sebacate
BT BHI	Bis-Hydroxyl
BT DSS	Di-Sodium Sebacate

These castor derived products perform exceptionally well in a variety of functions, and often represent formulation improvements that offer greater product uniformity and cost savings.

a role for consumers as quality and efficacy. Biosynthetic® Technologies is aware of its responsibility in this business and sustainability. As such, our manufacturing facility is operating with a NEGATIVE carbon footprint!

**Sustainability and Carbon Footprint**

At Biosynthetic Technologies, we understand the importance of sustainable manufacturing practices. As such sustainability through innovation is a main driver of our company’s mission. We are constantly looking for ways to minimize the negative impacts on the environment while conserving energy and natural resources. Our objective

**Formulation Assistance**

At Biosynthetic Technologies, we believe in the importance of offering superior technical support and customer service to our clients. We work closely with our partners to understand their needs and challenges and determine the best solutions to keep your businesses running smoothly. Our ex-

*The information in this document relates only to the named product. The user is solely responsible for all determination regarding any use and any process. Typical properties depicted on this document are average values only and do not constitute a specification. Minor variations that do not affect product performance are to be expected during normal manufacture, and at different blending locations. Product data is subject to change without notification.*

**Registration and Certification**

At Biosynthetic Technologies we hold the appropriate certifications and registrations to certify our products do not only deliver on performance and quality but are also compliant with national and international requirements. Our Quality Assurance team stays current on the ever-evolving regulations as new legislation is passed and implemented in the industry. Our continuous improvement culture drives us, building upon our solid foundation of quality principles ensuring we meet or exceed customer expectations. All our castor oil derivatives have sales approval for US (EPA, Canada (CEPA), and Europe (REACH). Currently, we proudly maintain the following certifications for all products:



# WHERE SUSTAINABILITY MEETS PERFORMANCE

Biosynthetic® Technology has developed a revolutionary new class of high-performance additives for the use in metalworking fluids, called **Biocea™**. These unique additives are **biobased**, **biodegradable**, **non-bioaccumulative**, and **non-toxic**.

**Unparalleled Lubricity**

**Superb Wear Protection**

**Vegetable Derived**

**TSCA Compliant**

**Excellent Hydrolytic Stability**

**HX1 Certified**

**Improved Total Cost of Operations**

**REACH Registered**

**Exceptional Natural Detergency**

**Minimize Safety Risks**

**Reduce Overall Formulation Cost**

**Reduce Cost of Maintenance**

**Free of Dermal Irritation or Allergic Sensitization**

**Naturally Low Foaming**



**BIOSYNTHETIC®**  
TECHNOLOGIES

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