

**high performance  
additives**

**BIOEXTEND**  
high performance additives

## Innovations in High-Performance Additives . . . Eastman BioExtend™ 30 for Biodiesel

### Eastman BioExtend™ 30

- Outstanding Antioxidative Power at Low Concentrations
- Dual Antioxidative System for Increased Performance
- Ready-to-Use Solution with Excellent Miscibility in Biodiesel
- Excellent Protection Against Metals Contamination



**EASTMAN**

## How Does Eastman BioExtend™ 30 Work?

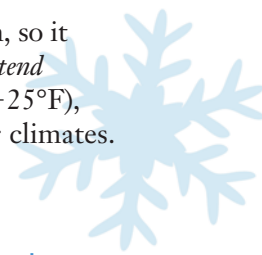
Eastman's antioxidant solution for biodiesel, Eastman BioExtend™ 30, is a dual functionality system. It combines one of the most effective antioxidants with a chelating agent, both of which are known to be effective in vegetable oils. The proprietary solvent system ensures excellent miscibility with the biodiesel. The key steps in the mechanisms for the oxidation process, initiation and propagation, are significantly slowed by *BioExtend*. The synergistic effect observed in the combination of a powerful antioxidant and chelator results in better oxidation inhibition.

The outstanding antioxidative power of *BioExtend* can be seen by comparing the OSI obtained with *BioExtend* in various vegetable oils/blends with the OSI obtained using the same amount of common antioxidants, BHT, BKF, and DTBP. In rapeseed, rapeseed/soy and rapeseed/soy/palm matrixes, *BioExtend* provides 20% to 400% longer OSI than the other antioxidants (see graph below).

## What Makes Eastman BioExtend™ Different?

While all antioxidants aim to address the same concern and extend the shelf life of biodiesel, they do not perform equally. *BioExtend* is highly effective at a low concentration—making it an ideal choice to meet European standards and the U.S. suggested oil stability index (OSI) standards. Unlike other antioxidants, *BioExtend* is a dual system, acting in the initiation phase as well as the propagation phase, and, therefore, is highly efficient in slowing the oxidation process.

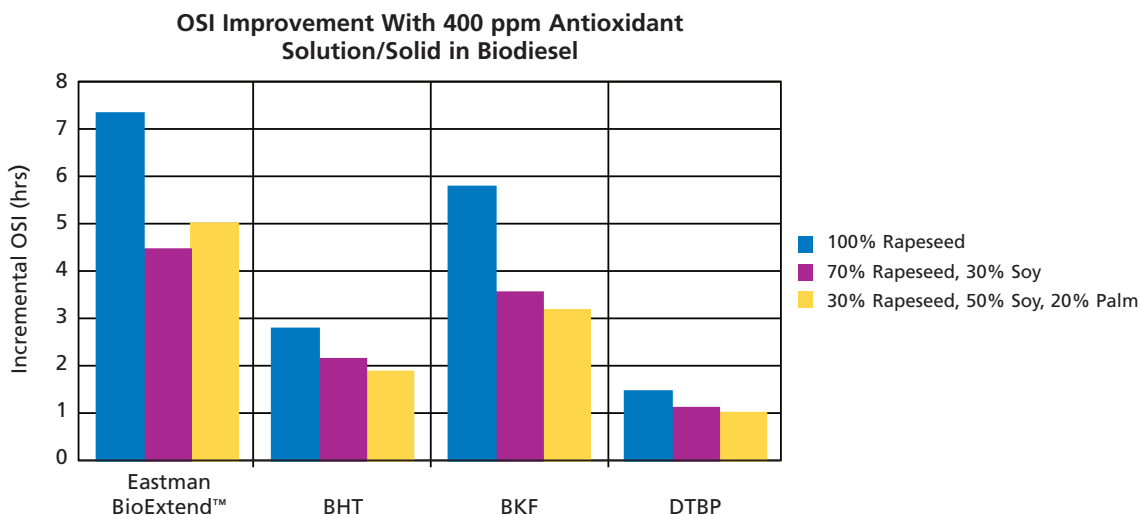
Furthermore, *BioExtend* is a liquid solution, so it is unnecessary to premix before use. *BioExtend* remains a liquid at low temperatures ( $< -25^{\circ}\text{F}$ ), making it easy to use and store in cooler climates.



## How Do Metals Affect The Oxidative Stability of Biodiesel?

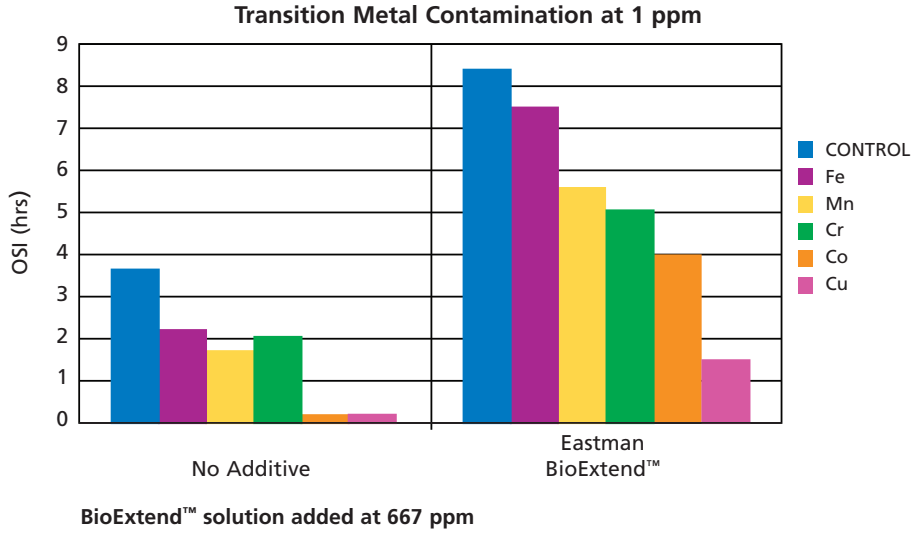
Biodiesel oxidation can be caused by many factors, including metal contamination. While oxidation cannot be completely prevented, the process can be significantly slowed by the use of antioxidants. The presence of metals in biodiesel results in acceleration of the free radical oxidation due to a metal-mediated initiation reaction which renders any antioxidant addition much less effective. A variety of possible sources of metal contamination include materials of construction, hard water, and the biodiesel production process itself, which typically uses a metal catalyst.

The presence of these metals typically depresses the oxidative stability of the biodiesel, as measured by the induction period in the OSI determination. Metal ions can act as catalysts in the initiation phase of the oxidation process. Some metals only modestly affect the OSI, while others have a dramatic effect. In particular, the transition metals can cause a deleterious effect on OSI. The “No Additive” portion of the second graph shows suppression of the OSI in a soy biodiesel sample when transition metals such as iron, manganese, chromium, cobalt or copper are present at only 1 ppm. The incorporation of a metal chelator in *BioExtend* provides protection to the biodiesel by partially sequestering the metal, thus stalling the initiation reaction. The dramatic improvement in OSI on addition of *BioExtend* is seen in the Eastman BioExtend™ portion of the graph.



Low Concentration

Excellent Stability



of the graph.

## Is Eastman BioExtend™ Easy to Use?

*BioExtend* is extremely easy to use. It is formulated as a high concentration of antioxidant, along with a metal chelator in a low viscosity solvent blend. This solvent blend ensures excellent miscibility with biodiesel, requiring minimal mixing. The resulting solution is stable at low temperatures, and the components remain in solution even at low temperatures (<math>-25^{\circ}\text{F}</math>). The viscosity of the solution is amenable to conventional pumping systems without further dilution and allows the solution to be dosed directly from the container, potentially eliminating the need for additional storage tanks for the additive.

$$+ \frac{1}{3} \begin{matrix} \text{outstanding antioxidant} \\ \text{effective chelating agent} \\ \text{superior antioxidative power} \end{matrix}$$

## Eastman and Antioxidants . . .

From food to cosmetic markets, Eastman has produced innovative antioxidants for more than 50 years, including a variety of easy-to-use solutions. Eastman has leveraged these years of experience and its expertise in our exploration of the biodiesel market. The introduction of *BioExtend* 30 is another example of Eastman's drive to develop innovative antioxidant solutions.



# EASTMAN

## **Eastman Chemical Company Corporate Headquarters**

P.O. Box 431  
Kingsport, TN 37662-5280 U.S.A.

Telephone:  
U.S.A. and Canada, 800.EASTMAN  
(800.327.8626)  
Other Locations, (1) 423.229.2000  
Fax: (1) 423.229.1193

www.eastman.com

## **Eastman Chemical Latin America**

9155 South Dadeland Blvd.  
Suite 1116  
Miami, FL 33156 U.S.A.

Telephone: (1) 305.671.2800  
Fax: (1) 305.671.2805

## **Eastman Chemical B.V.**

Fascinatio Boulevard 602-614  
2909 VA Capelle aan den IJssel  
The Netherlands

Telephone: (31) 10 2402 111  
Fax: (31) 10 2402 100

## **Eastman (Shanghai) Chemical Commercial Company, Ltd. Jingan Branch**

1206, CITIC Square  
No. 1168 Nanjing Road (W)  
Shanghai 200041, P.R. China

Telephone: (86) 21.6120.8700  
Fax: (86) 21.5213.5255

## **Eastman Chemical Japan, Ltd.**

AIG Aoyama Building 5F  
2-11-16 Minami Aoyama  
Minato-ku, Tokyo 107-0062 Japan

Telephone: (81) 3.3475.9510  
Fax: (81) 3.3475.9515

## **Eastman Chemical Asia Pacific Pte. Ltd.**

#05-04 Winsland House  
3 Killiney Road  
Singapore 239519

Telephone: (65) 6831.3100  
Fax: (65) 6732.4930



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