Acid Scavengers

Lubricant additives for increased lubricant lifetime

Cargill®

A company with **constant growth** and development

160,000 employees

With more than **155 years** of experience

165 billion annual revenue

Working in 70 countries

Energy Technologies

The home of base oil and additive technologies

Bioindustrial

Performance Specialties

Energy Technologies

- **Synthetic esters**
- **Organic friction modifiers**
- **Vegetable oils**
- **Polyalkylene glycols**
- **Crude oil production enhancers**
- **Isostearic acids**

Expoxide lubricant acid scavengers

A fusion combining our strongest pillars

Speciality chemical **expertise**

A powerful business

Vast and integrated **capabilities**

To serve you with the **highest quality** solutions:

Products delivering great performance

- 40 years of lubrication expertise
- Well known, trusted brands

High level of global technical expertise

- Knowledgeable and experienced technical experts
- Global, dedicated sales team

Supply security

- Investments in business and production capacity
- A globally scaled, mature company

Overview

Cargill epoxides

- Cargill epoxide acid scavengers offer performance benefits in ester base oils. They allow the formulator to create lubricants that last longer with much higher resistance to hydrolysis or oxidation
- Cargill acid scavengers are especially useful in formulations that will be used at elevated temperatures or where there is a risk of water contamination. They can also be utilized in ester-based formulations where there is a potential for acid degradation.
- They help to neutralize oxidation and hydrolysis reaction products, stopping the increase in acid value and extending oil drain intervals.

Suitable for use in lubricants for

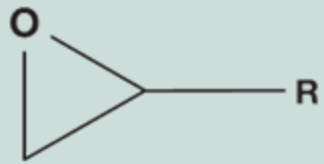
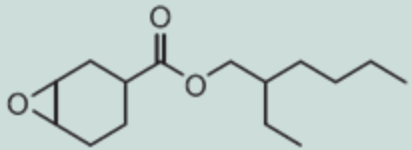
Hydraulics

Gears

Compressors

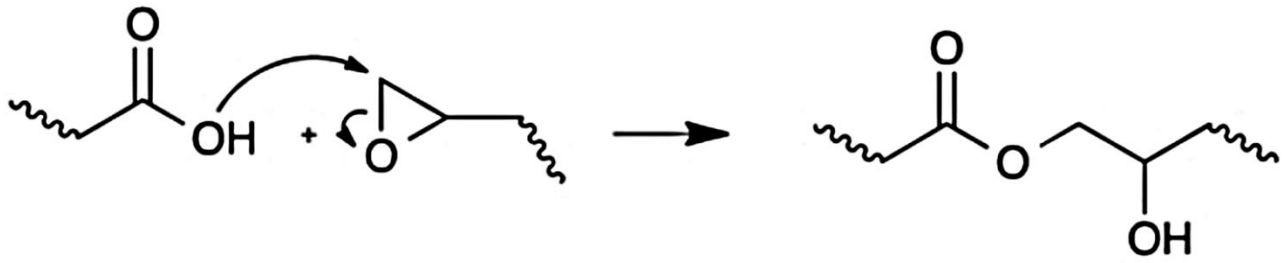
Turbines

Physical properties

Testing	Units	Acid scavenger (AS) 16 *Linear epoxide*	Acid scavenger (AS) 68 *Branched epoxide*
Chemistry	-	Epoxidized olefin	2-Ethylhexyl cyclohexene carboxylate epoxide
Kinematic viscosity at 40˚C	cSt	5.3	7.4
Kinematic viscosity at 100˚C	cSt	1.81	1.92
Viscosity index	-	120	-
Pour Point	ºC	17	-58
Oxidation induction time (ASTM D8206)	Minutes	84	595
-	Structure		

Mechanism of action

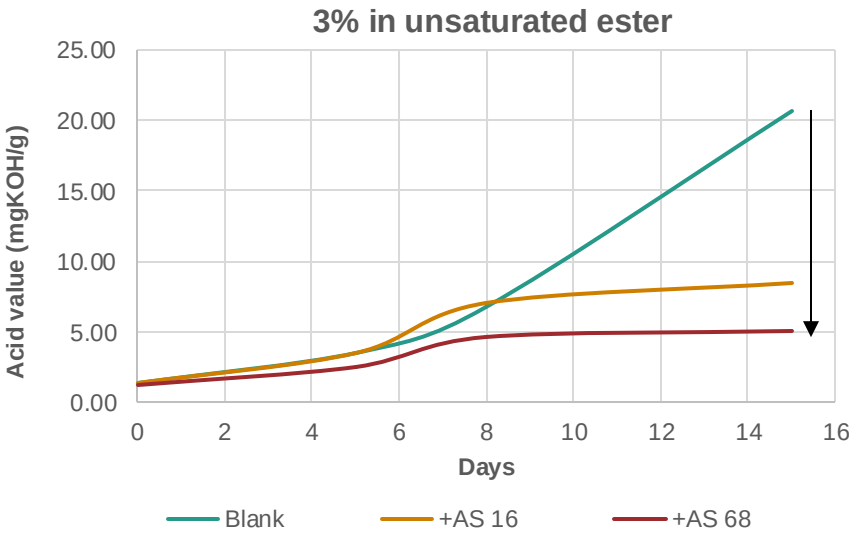
- Ring structure from epoxide
- Breaks the bond as it is under strain and reacts with acid
- This neutralises free fatty acids from the mechanism of hydrolysis



Acid scavengers in synthetic esters at 3% treat rate

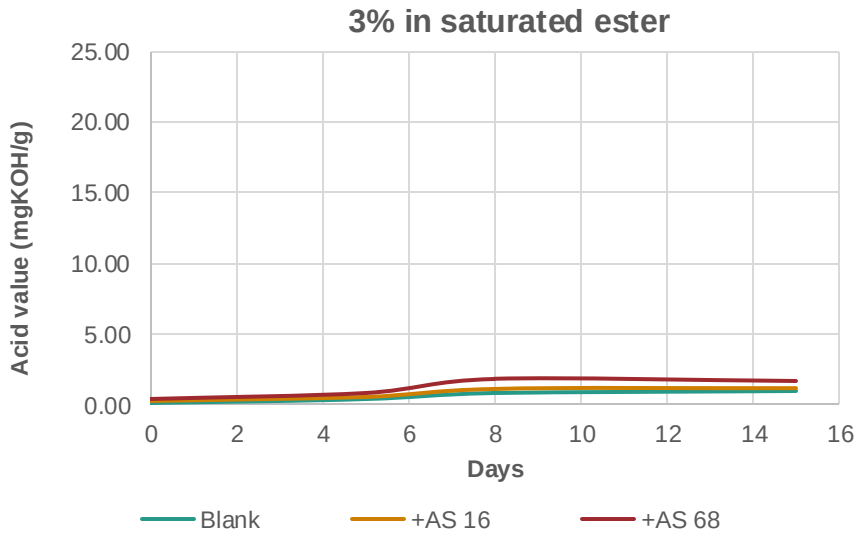
Hydrolysis: Synthetic esters

Swedish standard (SS 155181) (90°c)



After 15 days, an unsaturated ester treated with **AS 68** had an acid value **75% lower** than the untreated ester.

Over the same time, **AS 16** offered a **59% improvement**

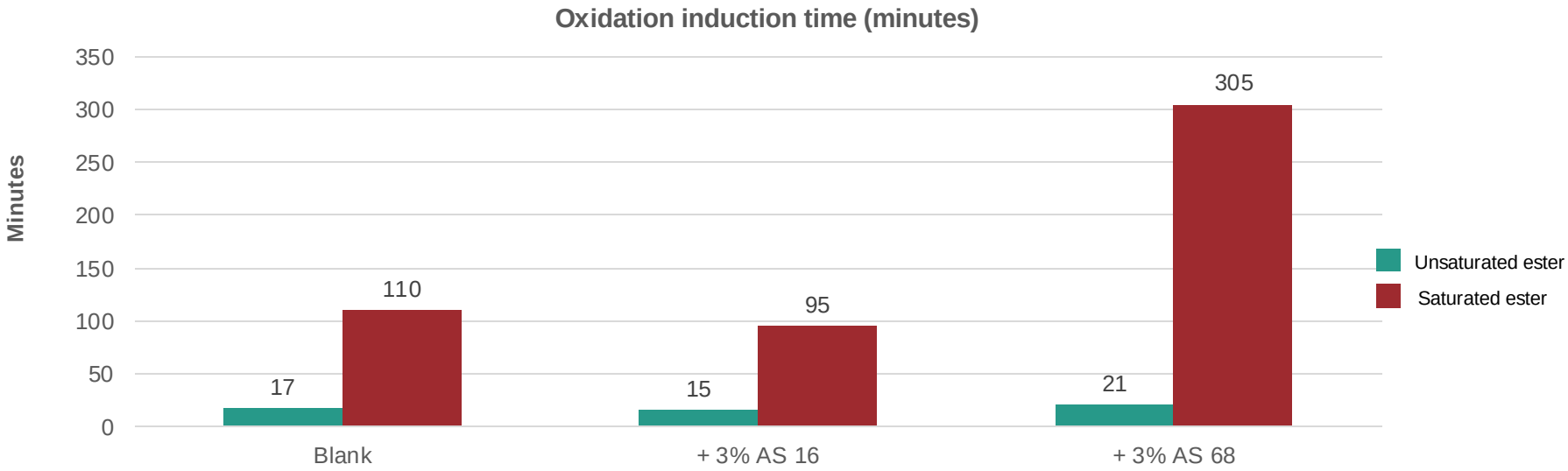


After 15 days, there was no significant difference in the acid value for a saturated ester treated with either product

No additive pack

Oxidation stability: Synthetic Esters

ASTM D8206*



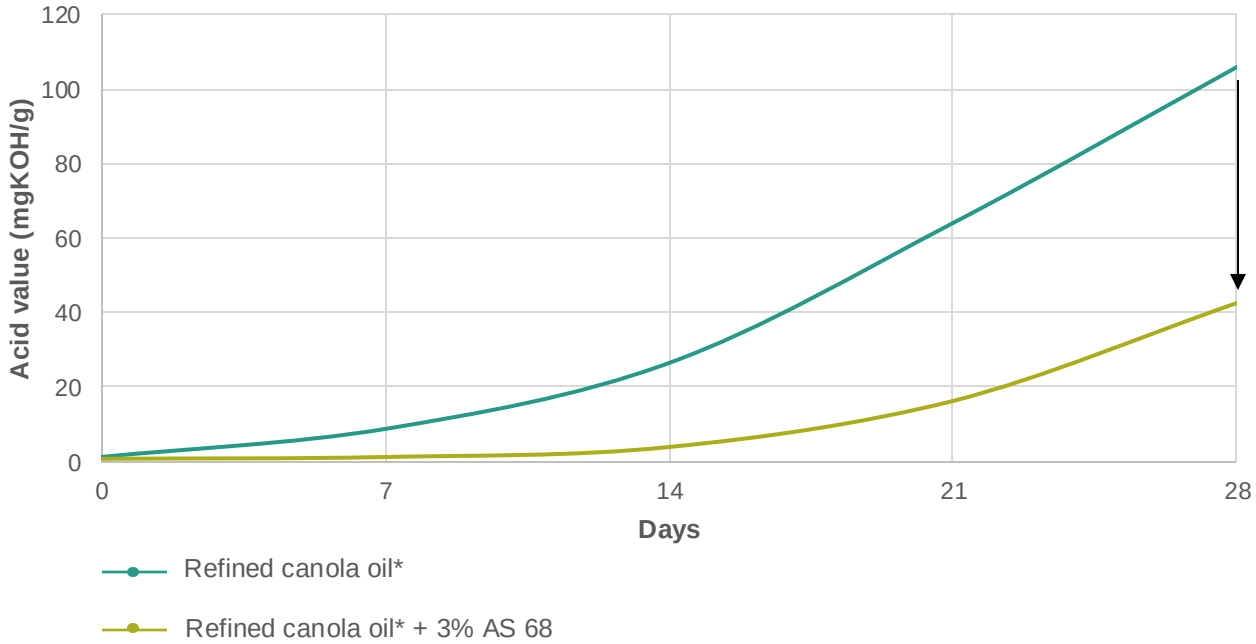
3% AS 68 improves oxidation induction time by 73% vs. an untreated saturated ester.
AS 68 does not improve the oxidation stability of unsaturated esters.

No additive pack

Acid scavengers in natural esters

Hydrolysis: Natural ester

Swedish standard (SS 155181) (90°c)



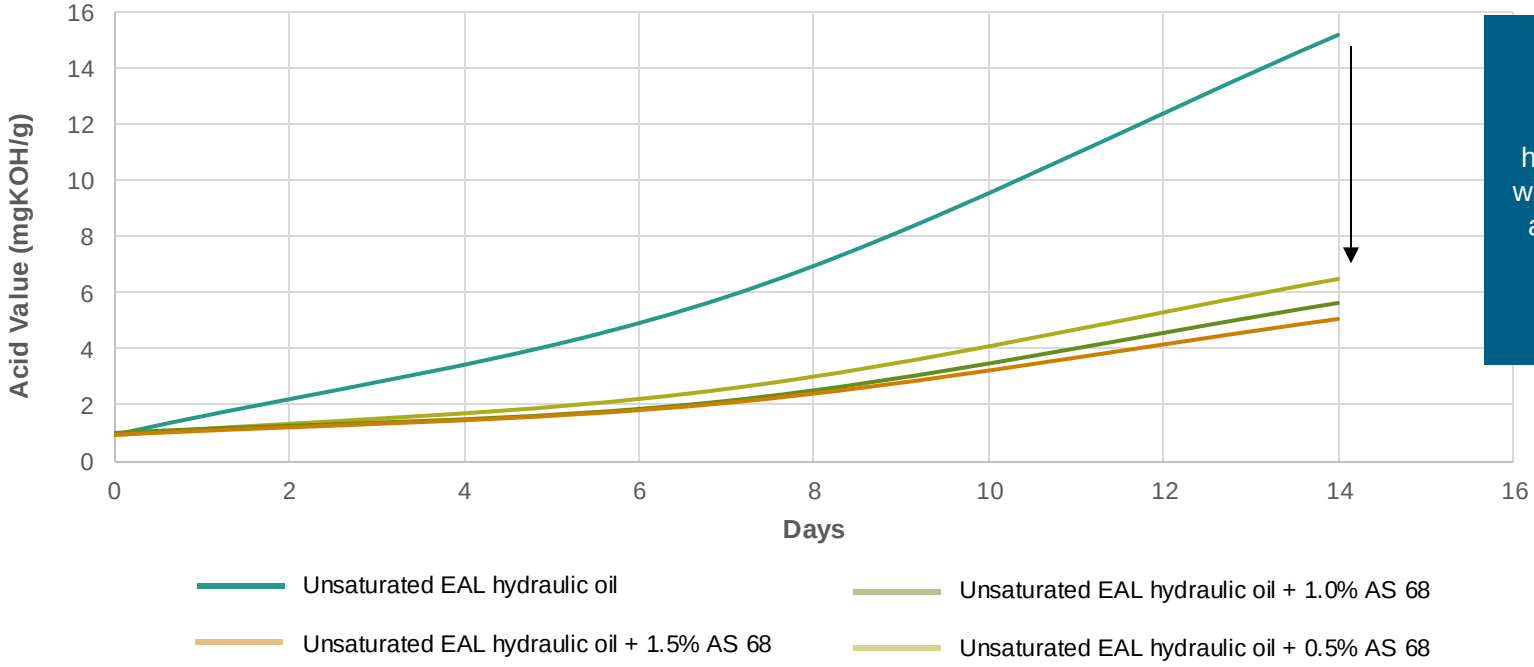
AS 68 significantly reduced the acid value of refined canola oil that had been formulated with an EAL hydraulic add-pack

After 28 days, AS 68 reduced the acid value by 60% vs. an untreated canola oil

Acid scavengers at ≤ 1.5% treat rate

Hydrolysis: EAL unsaturated hydraulic oil

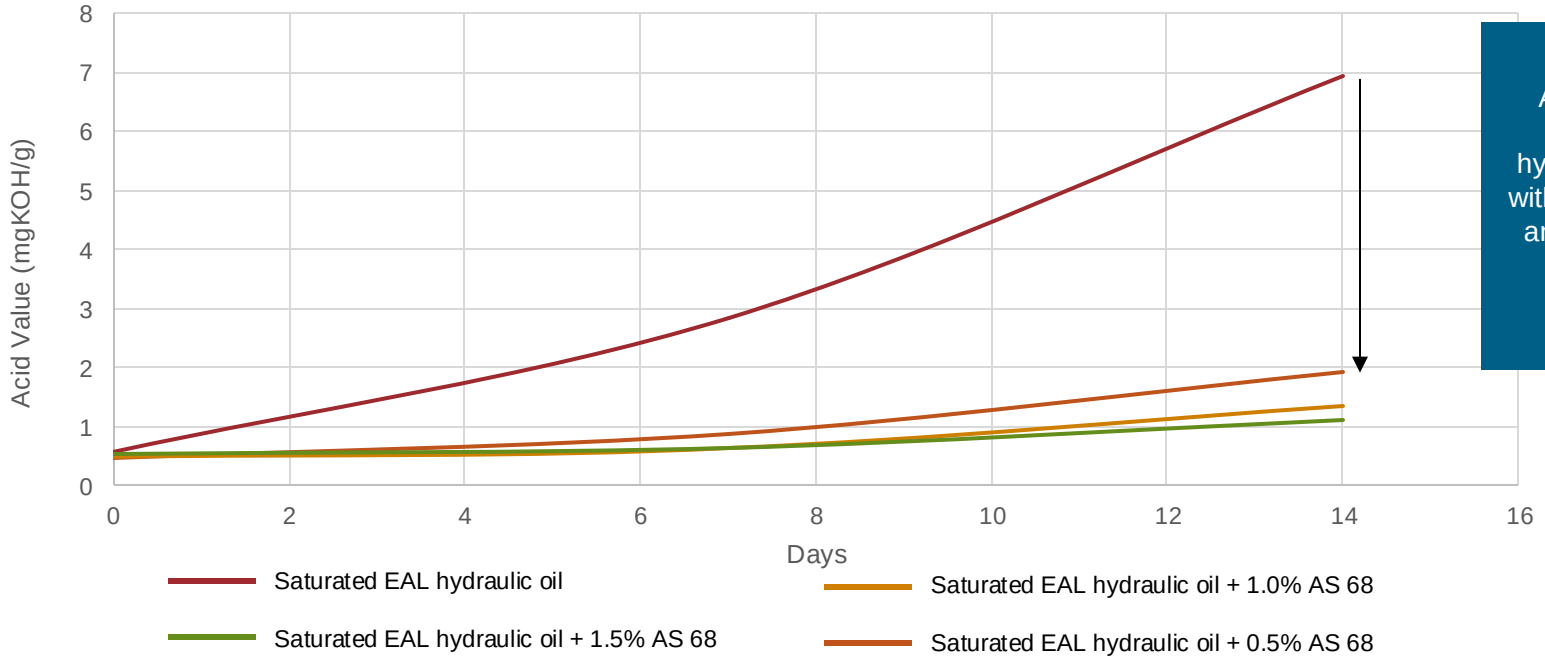
Swedish standard (SS 155181) (90°c)



After 2 weeks, an unsaturated EAL hydraulic oil treated with 0.5% AS 68 had an acid value 57% lower than the untreated ester

Hydrolysis: EAL saturated hydraulic oil

Swedish standard (SS 155181) (90°c)

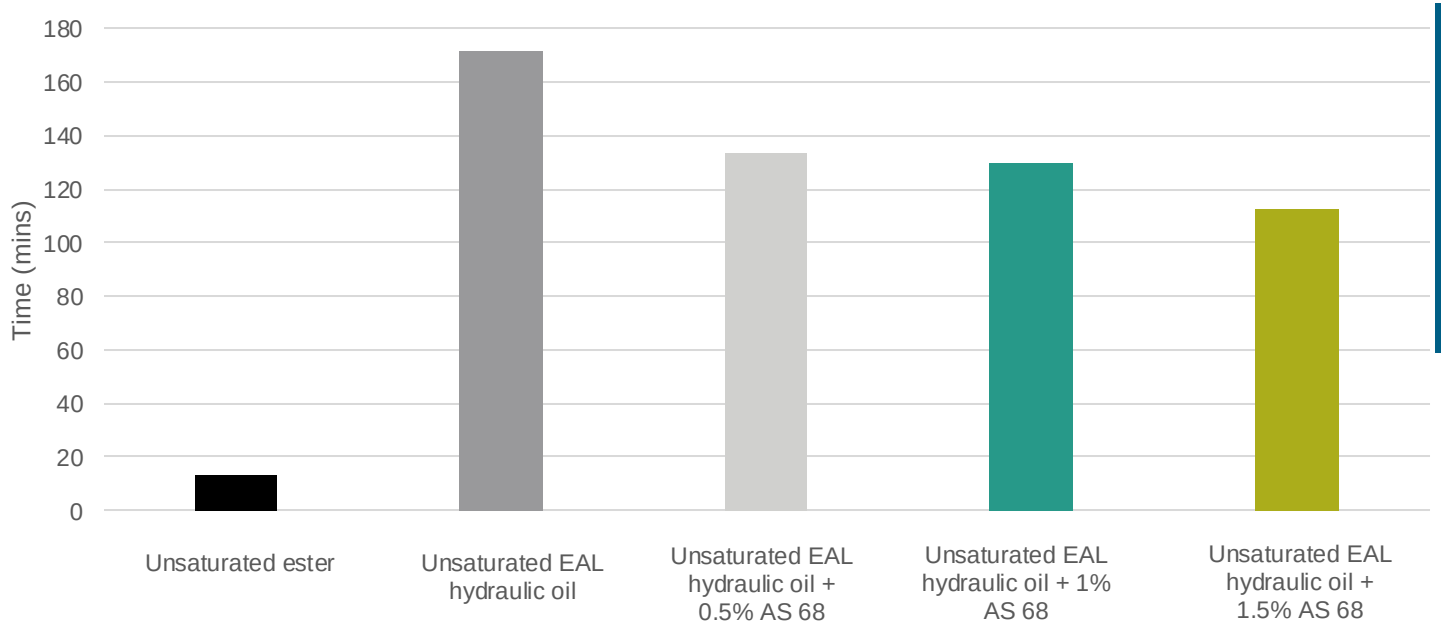


After 2 weeks, a saturated EAL hydraulic oil treated with 0.5% AS 68 had an acid value 72% lower than the untreated ester

With an EAL hydraulic- specific add-pack

Oxidation stability: EAL unsaturated hydraulic oil

ASTM D8026 – OIT Rapidoxy 160°C 10% O_2 Consumption

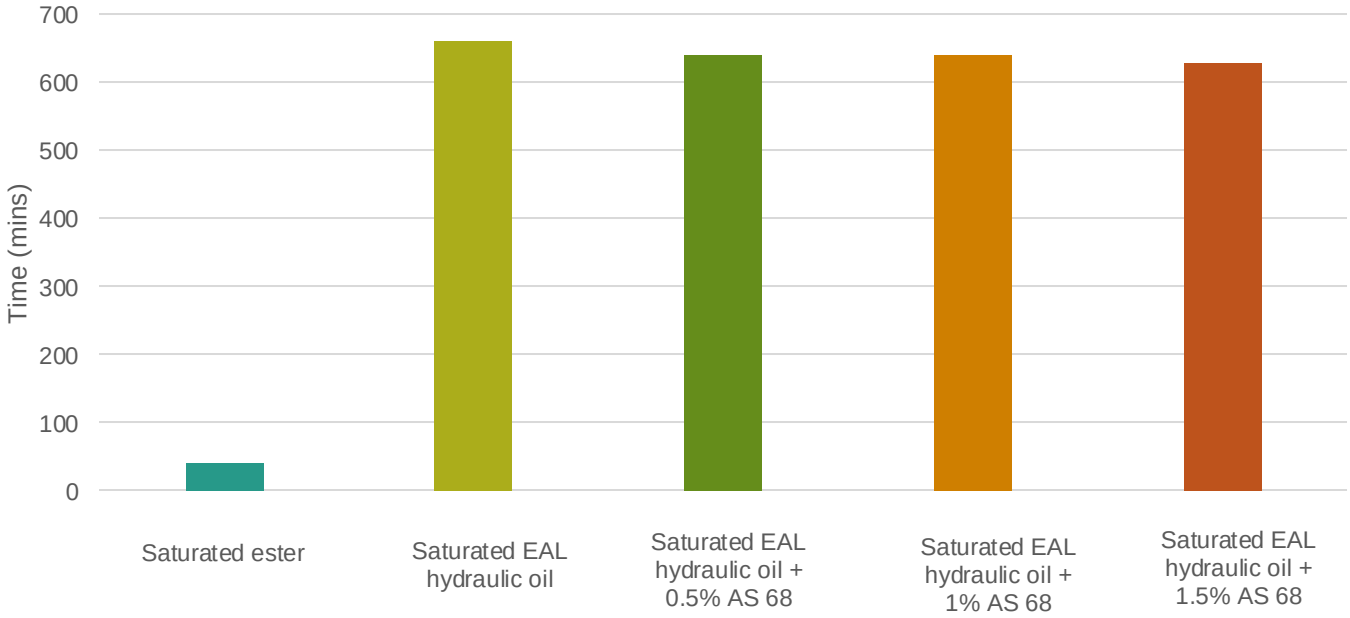


In an unsaturated hydraulic oil, oxidation stability is not significantly affected by the addition of AS 68

With an EAL hydraulic- specific add-pack

Oxidation stability: EAL saturated hydraulic oil

ASTM D8026 – OIT Rapidoxy 160°C 10% O_2 Consumption



In a saturated hydraulic oil, oxidation stability is not significantly affected by the addition of AS 68

With an EAL hydraulic- specific add-pack

Summary

- All lubricants suffer from aging and in challenging operating environments, these lubricants are at higher risk of hydrolysis or oxidation.
- In this presentation we have discussed two epoxides that when formulated into either saturated and unsaturated ester-based lubricants, reduce the effect of hydrolysis and oxidation and so mitigating the effect of acid degradation.
- Even at treat rates as low as 0.5%, we have demonstrated the ability of the products to significantly reduce the increase in acid value in the Swedish standard hydrolysis test with an EAL hydraulic add-pack. We have also demonstrated no harms in the ASTM D8026 Rapidoxy test.
- Natural esters, such as canola also benefit from this effect.
- By careful optimisation of the formulation, these epoxides can be used to improve fluid life without additional labelling.

Thank you for your attention
We are happy to answer your questions

Energy_technologies@cargill.com

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