Zschimmer & Schwarz

Synthetic Ester Selection for High-Performance Industrial Lubricants and Metalworking Fluids

lexolube
synthetic esters

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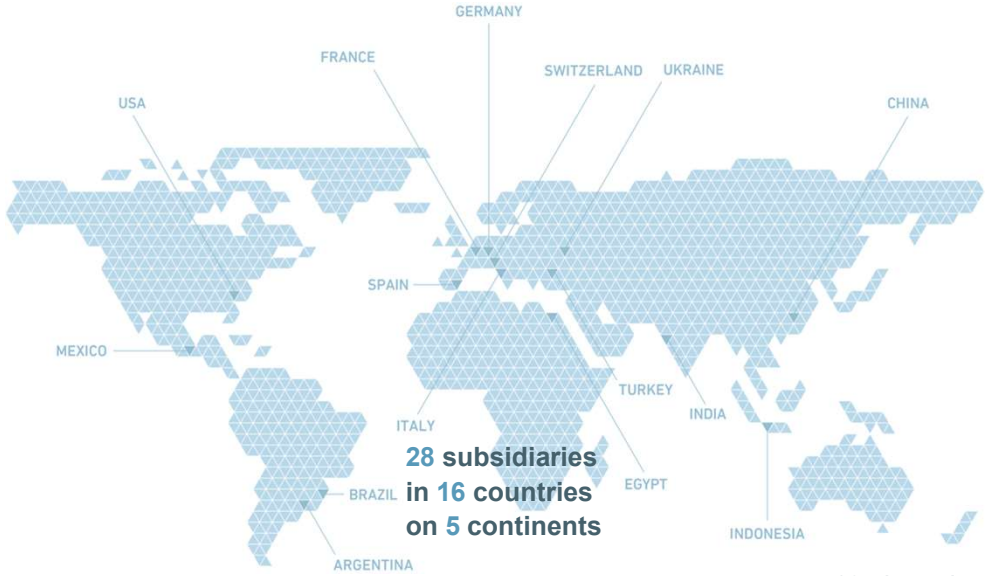
UNITI- 2023

ZSCHIMMER & SCHWARZ

Zschimmer & Schwarz – Company Profile

Key figures 2022

Turnover	€M 834
Number of employees	1,568



- Ceramic Auxiliaries
- Leather Auxiliaries
- Textile Auxiliaries
- Fibre Auxiliaries
- Personal Care
- Cleaning Specialties
- Industrial Specialties
- Paints & Coatings
- Lubricants

1894

Foundation of the company in Chemnitz, Germany

1909

First in-house production

1959 - 2019

New company headquarters in Oberlahnstein & Rapid growth and increasing globalisation

2019

125th anniversary and construction of new company headquarters

2020

Restructuring of business divisions

What are synthetics?

- Synthetic is a marketing term that signifies higher performance and generally denotes the base oil is made by chemical synthesis
- The American Petroleum Institute (API) defines 4 categories of hydrocarbons used in lubricants

	Base Oil Category	Sulfur [%]		Saturates [%]	Viscosity Index	Total Production [%]	Relative Cost
Mineral	**Group I (solvent refined)**	> 0.03	and/or	< 90	80 to 120	46	1
Mineral	**Group II (hydrotreated)**	< 0.03	and	> 90	80 to 120	47	1.05
Mineral	**Group III (hydrocracked)**	< 0.03	and	> 90	> 120	3	1.5
Synthetic	**Group IV**	PAO Synthetic Lubricants				2	2.5 to 3
Synthetic	**Group V**	All other base oils not included in Groups I, II, III or IV				1.6	5 to 10+

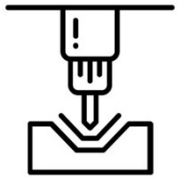
From: https://www.machinerylubrication.com/Read/618/new-lubes

Base Stock or Lubricity Additive

Does the application require performance that a petroleum oil cannot deliver?

- Biogenic content
- EcoLabel compliance
- Biodegradability
- VGP/VIDA aquatic safety
- Incidental Food Contact
- Fire resistance
- High VI for energy efficiency

Is friction reduction required as part of the antiwear and extreme pressure additive package?



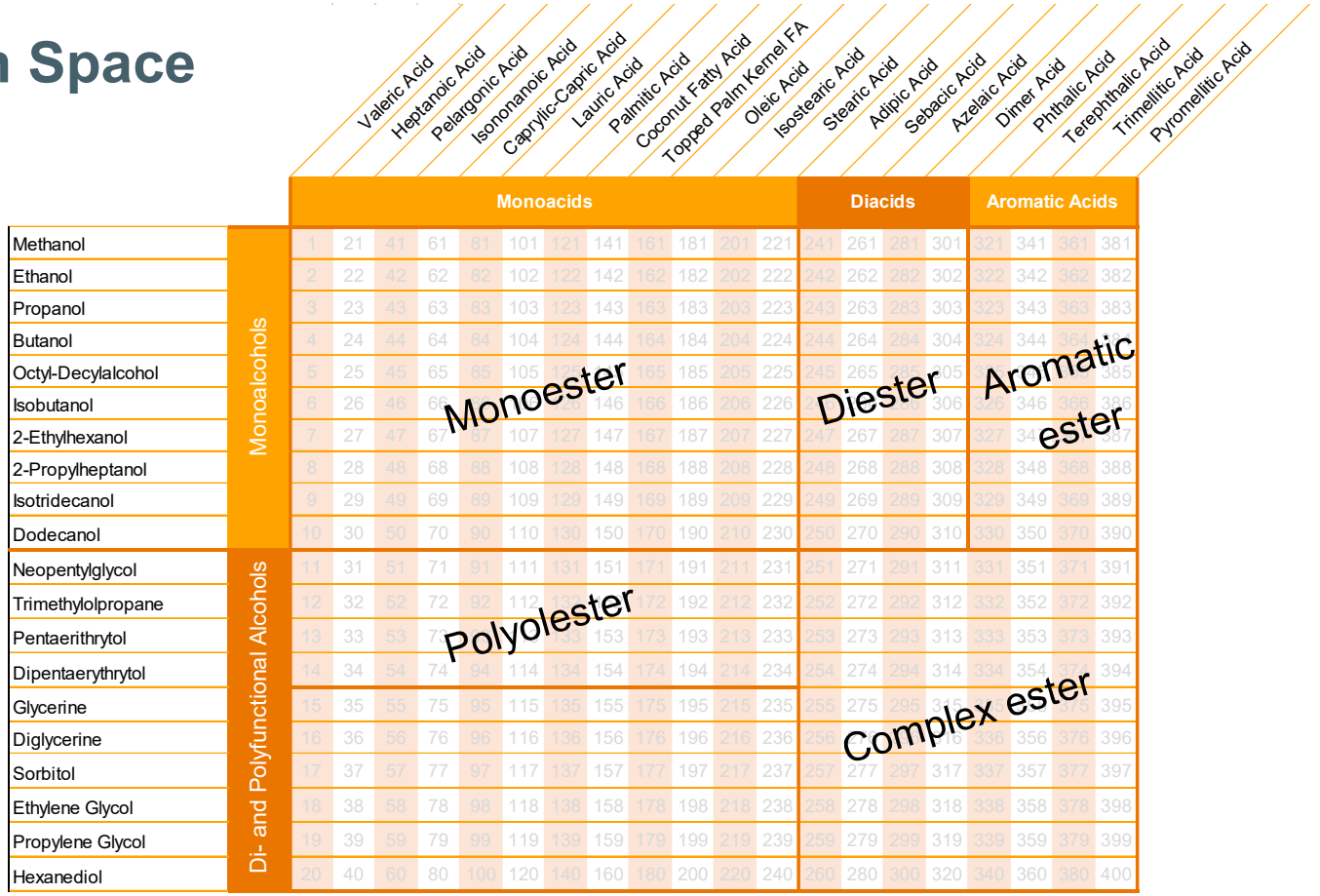
– Metal Forming
  - Rolling
  - Stamping

– Metal Removal
  - Cutting
  - Grinding

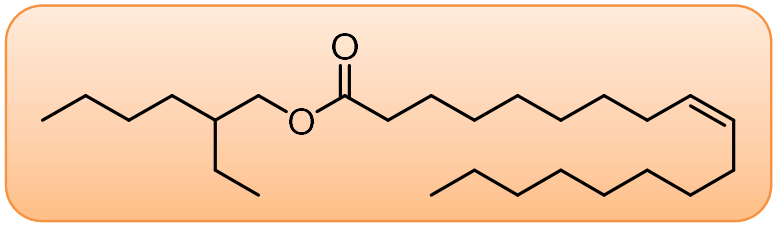
Esters are unique

- The ester bond structure links an organic acid and alcohol
  - Very good control of the molecular structure
- Many starting materials available - many possible combinations
- Permanent dipole moment of 1.7 Debye
  - More polar than hydrocarbons
- Choose the feedstocks based on the demands of the application
- Esters are designed to be fit for purpose

Huge Solution Space



Monoesters

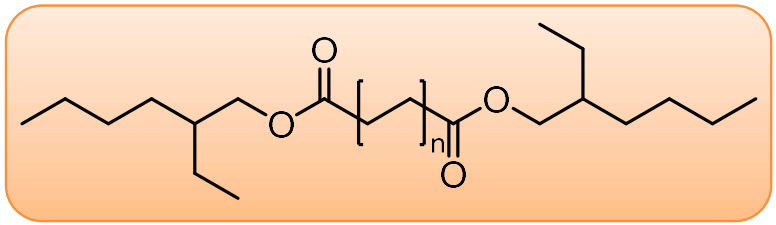


Typically made from natural fatty acids and mono-alcohols

- **60 – 90% renewable carbon**
- **biodegradable**
- **Low viscosity**
- **Low odor and colour**
- **Excellent lubricity**
- **Environmentally and Worker friendly**

- **Metalworking**
- **Textile lubricants**
- **Aerosol products**
- **Adjuvants**
- **Biobased lubricants**
- **HX1 grades available**

Diesters

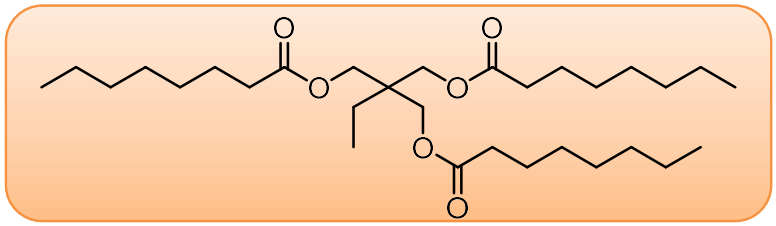


Two ester groups derived from dibasic acid + alcohols

- Typically no biobased content
- biodegradable
- Low viscosity
  (2-5 cSt at 100°C, ISO VG 10-22)
- Low volatiliy
- Excellent cold flow, wide temp. range
- Oxidative stability

- Engine oils
- Compressors oils
- Hydraulic fluids
- Grease
- Bearings
- Seal swell additives

Polyol esters



Stabilized at the β-carbon

- **many are biobased**
- **biodegradable**
- **higher viscosity (2-25 cSt at 100°C, ISO VG 15-320)**
- **Low volatiliy**
- **High Flashpoint**
- **Oxidative stability**

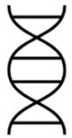
- **Compressor oil**
- **Fire resistant hydraulic fluids**
- **Oven Chain oils**
- **Aviation turbine engine oils**
- **Gear oils**
- **HX-1 products available**

Complex esters

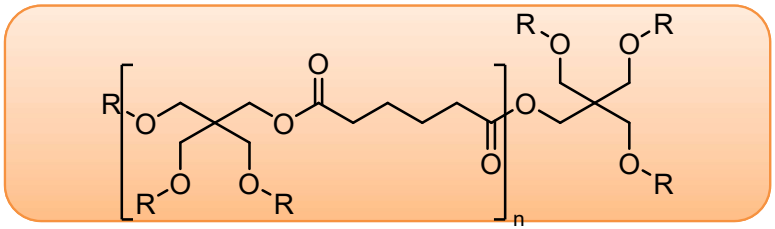
- Can be biobased

- Can be biodegradable

- Very high viscosity possible



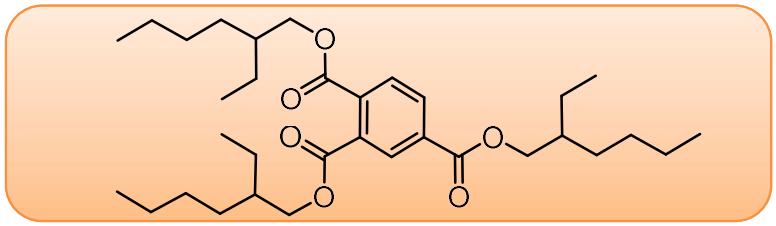
- Low volatility/High Flashpoint
- High Viscosity Index
- Antiwear/Extreme pressure



Capped polymeric ester

- Compressor oil
- Gear oils
- Grease
- Thickening
- Metal protection
- HX-1 products available

Aromatic esters



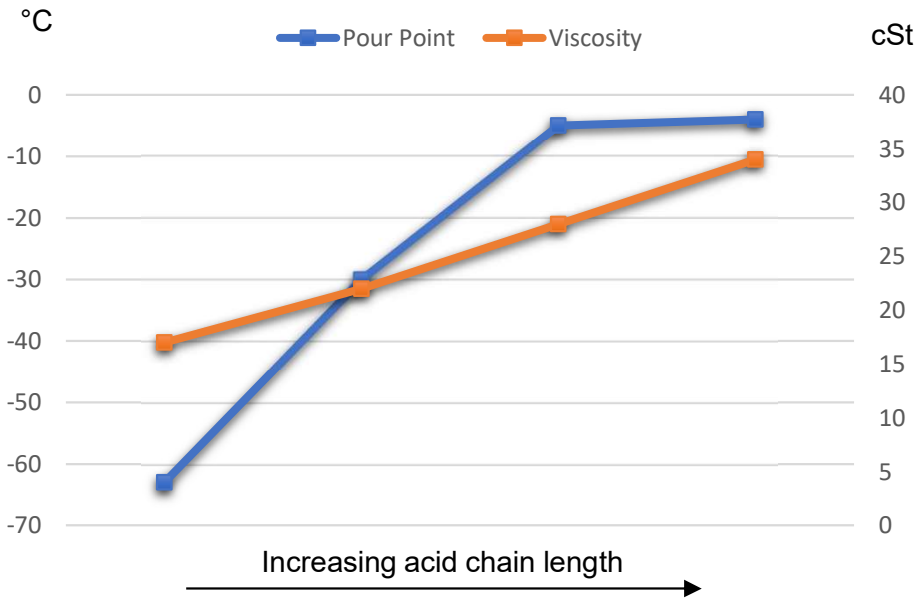
Made from aromatic anhydrides and mono-alcohols

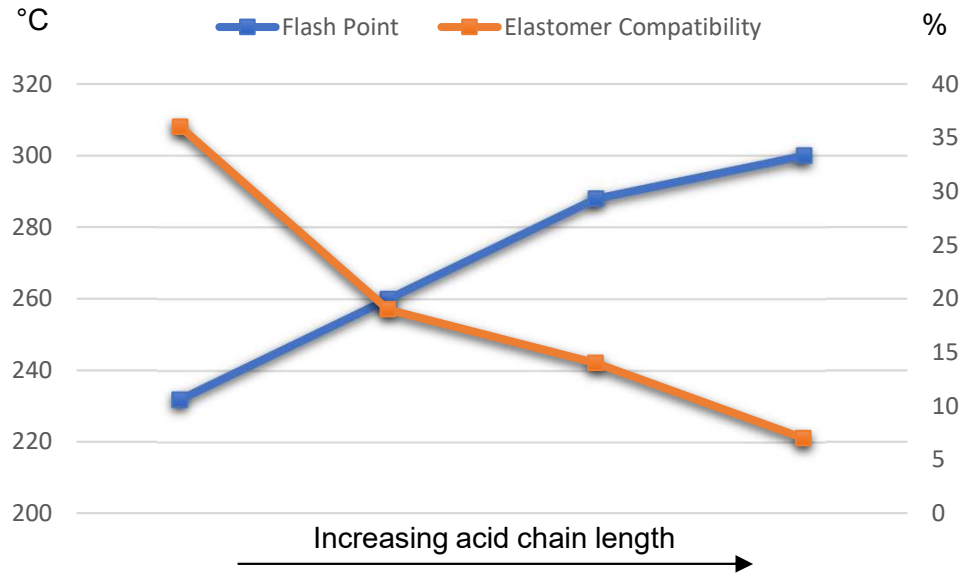
- **Not biobased**
- **Can be biodegradable**
- **High viscosity**
- **Low volatility/High Flashpoint**
- **Reduced varnish deposits**
- **Stable against oxidation & hydrolysis**

- **Compressor oil**
- **Gear oils**
- **Grease**
- **Oven chain lubricants**
- **Plasticizers**

Not always synergistic effects

- There is not the one fits all solution…





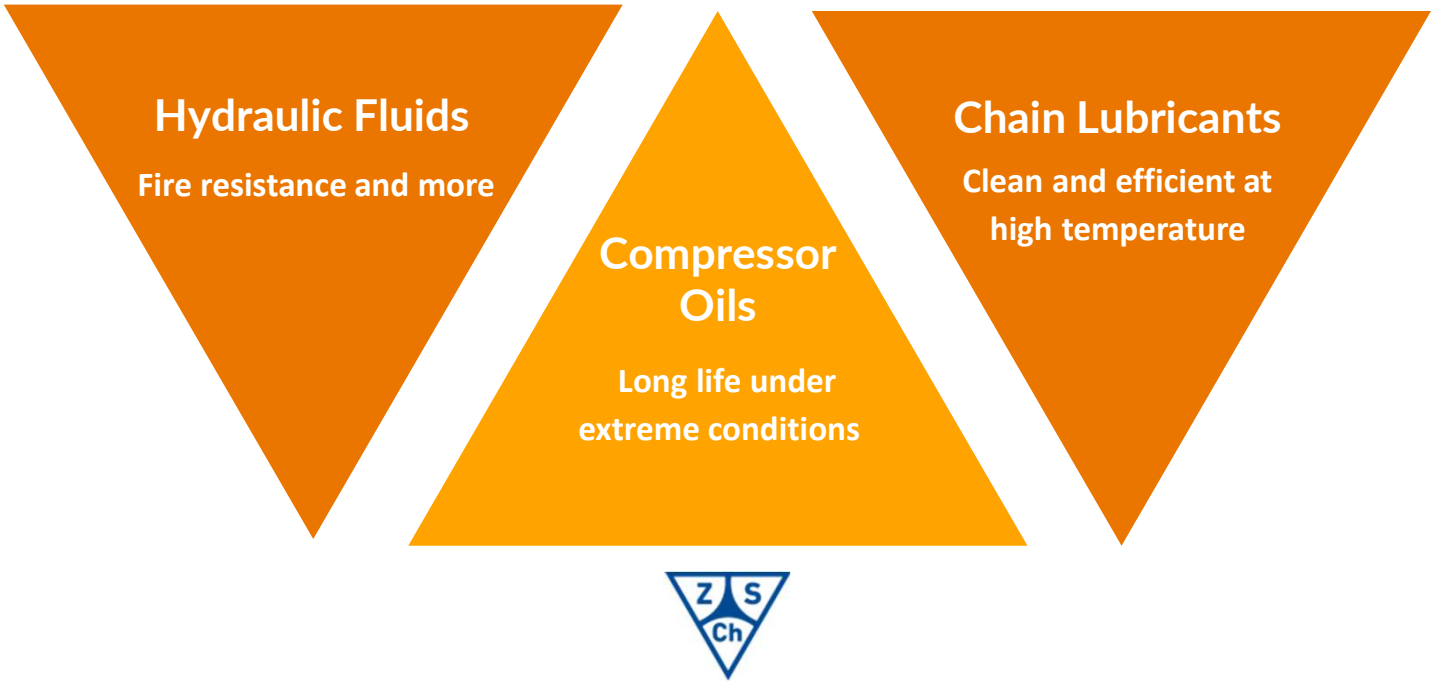
… properties need to be balanced to the intended application

Esters are used to formulate the highest performance fluids

- Hydraulic fluids
- Oven chain oils
- Grease
- Compressor fluids
- Transformer oils
- Metalworking fluids
- Environmentally sensitive applications
- Engine oils
- Transmission fluids
- Gear oils
- Drilling mud lubricants
- H1 Food Grade lubes
- Fiber finish lubricants
- Jet turbine engines
- Dielectric Coolants

Designed for Diverse Applications

- Synthetic Esters can be designed to perform under the specific conditions the application demands
- Work with an expert to make sure you have the right tailor-made ester for the job



Hydraulic Fluids

- **Low sludge - clean, long life**
- **High viscosity index - energy efficient**
- **Environmentally friendly**
- **Marine (VGP/VIDA), mining, forestry, agriculture**
  - Biobased, biodegradable esters
- **Fire Resistant- FM Approved/HFD**
  - Polyol ester oleates
- **Food processing plants**
  - NSF H1 Polyol ester-based fluids

Performance under pressure

Hydraulic Fluids

Ester based HF ISO 46	ASTM	Typical
Flash point	D-92	320°C
Fire point	D-92	360°C
Pour point	D-97	-40°C
Viscosity index	D-2270	210
FZG gear test	D-5182	Stage 12
Vane Pump Test	D-2882	<5 mg wear
Copper Corrosion	D-130	1a
Rust prevention A/B	D-665	Pass
Biodegradability (OECD)	301B	Readily

Data courtesy Zschimmer & Schwarz

High performance,
Factory Mutual fire resistant,
Environmentally friendly,
H1 (Use in food plants)

FM APPROVED

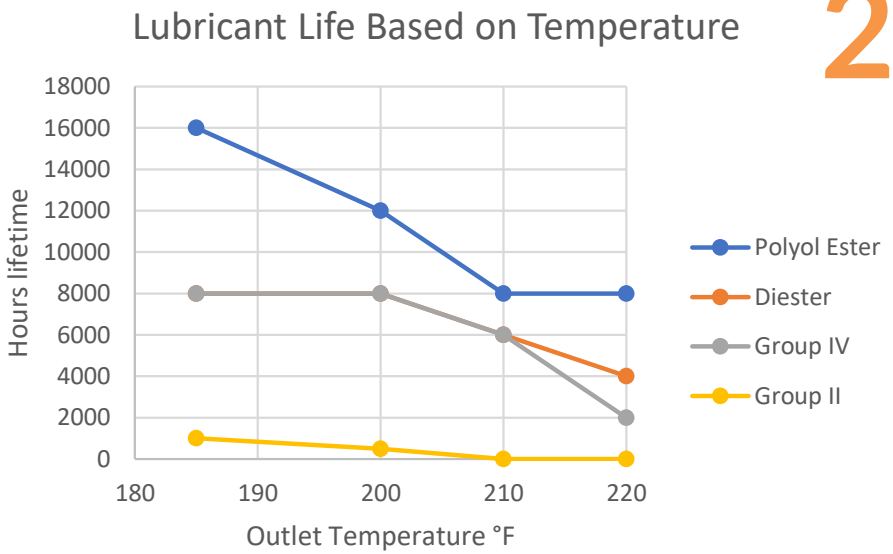
Photo courtesy US Navy

Compressor Lubricants

- **Low volatility - less lubricant carryover**
- **Low varnish - no sticking valves or deposits**
- **Compatibility with HFC refrigerants**
- **Reciprocating and rotary vane compressors**
  - Diesters for lubricity and solvency
- **Rotary screw and centrifugal compressors**
  - Polyol esters for oxidation stability
- **Food processing applications**
  - NSF H1 polyol ester-based fluids

Reliability and long life

Compressor Lubricants



Graph courtesy Ray Thibault, Consultant

2X

Polyol Esters can give double the life of other synthetics in compressor applications

20 hours at 260°C/500°F

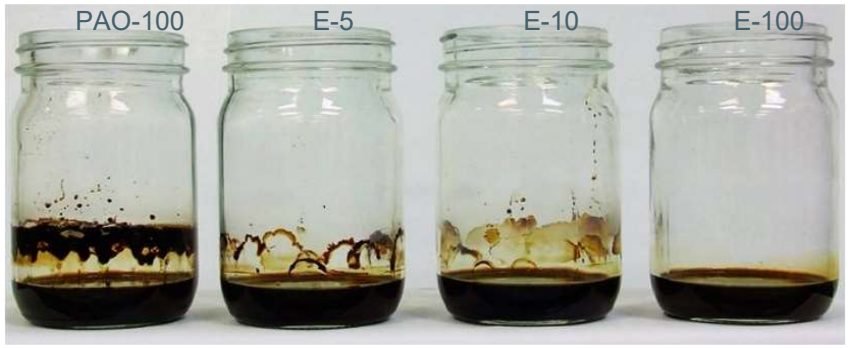


Photo courtesy Zschimmer & Schwarz

Oven Chain Lubricants

- **Low volatility- long relubrication intervals**
- **Low varnish- links move freely**
- **Surface lubrication- thin film wear prevention**
- **Industrial oven chains**
  - POE/aromatic esters optimum clean
- **Bakery tunnel ovens**
  - H1 POE for clean and safe lubrication
- **Food conveyors**
  - Biobased H1 POE- synthetic vegetable oil

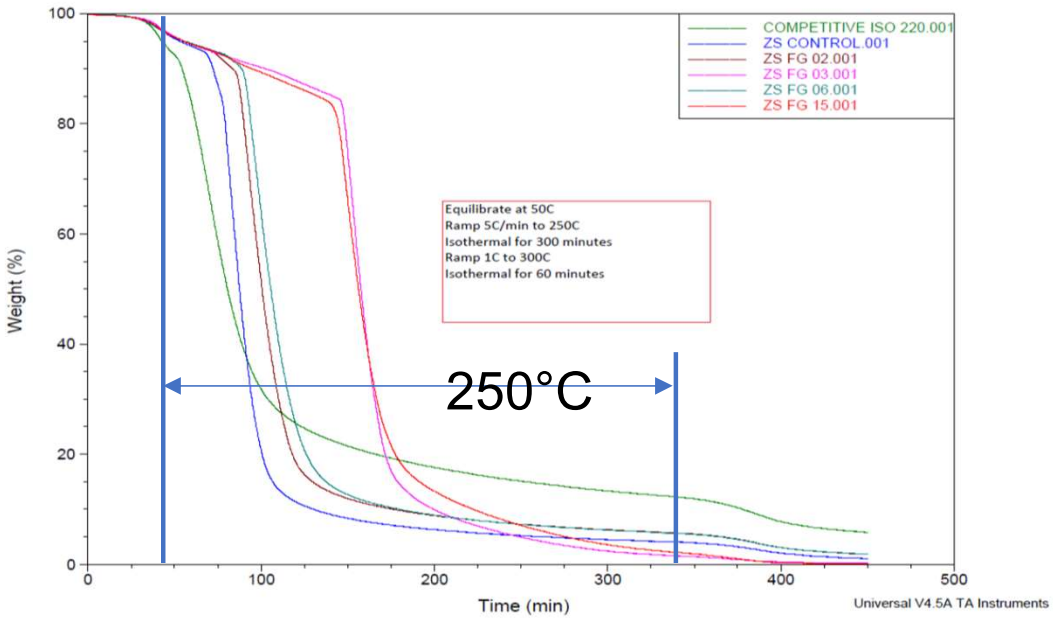
Oven Chain Lubricants

200°C+

Esters are the best option for high temperature chains

89 hours at 240°C/464°F

TGA Isothermal 6 hours at 250°C



Environmentally acceptable lubricants (EAL)

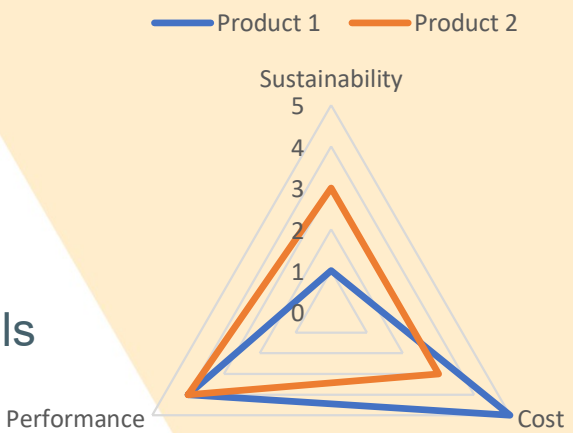
- Synthetic Esters are environmentally friendly
  - Marine
  - Mining
  - Forestry
  - Agriculture
  - Transformers
  - Wind turbines
- Performance is as good or better than petroleum oils

- Most esters meet USA EPA Marine (VGP) Vessel General Permit standards

- Many esters are renewable, sustainable, and have USDA BioPreferred status

- Wide variety of synthetic esters on LuSC list achieve EU Ecolabel status

Synthetic Ester Design Considerations



- Determine critical application performance requirements
  - **Low cost** – Oleates, natural fatty acids, commodity raw materials
  - **High viscosity** – Dipentaerythritol, complex esters
  - **High viscosity index** – Linear structures, long chain fatty acids
  - **Thermal stability** – Polyols, branched acids, fully saturated components
  - **Biodegradability** – Natural fatty acids, less branching
  - **Food contact** – Ingredients with detailed information on toxicity, NSF listed

- Build the ester from components that will give the desired properties

Thank you.

For More Information Visit:

ZSLubes.com

zschimmer-schwarz.com

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