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AN **stle** PUBLICATION | NOVEMBER 2014



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The Use of Estolides to Produce High Performance Motor Oils

By **Jakob Bredsguard**, Chief Technical Officer, Biosynthetic Technologies

Typical Estolide Structure

Estolides are a class of synthetic high-performing compounds derived from renewable sources.

Estolide Properties

Property	Unit	Method	7cSt (Typical)	15cSt (Typical)
KV at 100°C	cSt	D 445	7.2	14.9
KV at 40°C	cSt	D 445	35.3	101.3
Viscosity Index	-	D 2270	173	154
Pour Point	°C	D 97	-18	-18
Cloud Point	°C	D 2500	-15	-15
Flash Point	°C	D 92	280	300
Fire Point	°C	D 92	300	305
Iodine Value	mg I2/100 g	EN 14111	< 5	< 5
Specific Gravity (15.5°C)	-	D 4052	0.898	0.907
Evaporative Loss (NOACK)	wt%	D 5800	1.9	<1.9
Acid Value	mg KOH/g	D 664	< 0.10	< 0.10

High Oxidative Stability

- Increased oil longevity

Low Volatility

- Low evaporation rates
- Safer in high temperature applications

High Viscosity Index

- Minimizes change in viscosity with change in temp
- Less viscosity modifier required

Excellent Hydrolytic stability

- Increased oil longevity
- Good for applications where risk of water contamination is high

Natural Detergency

- Keeps equipment looking clean and new

Biodegradability

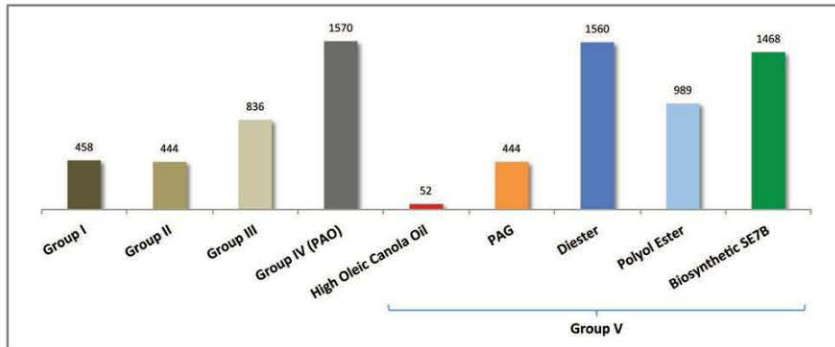
- Rapidly breaks down once released into the environment

Bio-content

- Made from renewable carbon
- Reduce dependence on petroleum products



Oxidative Stability

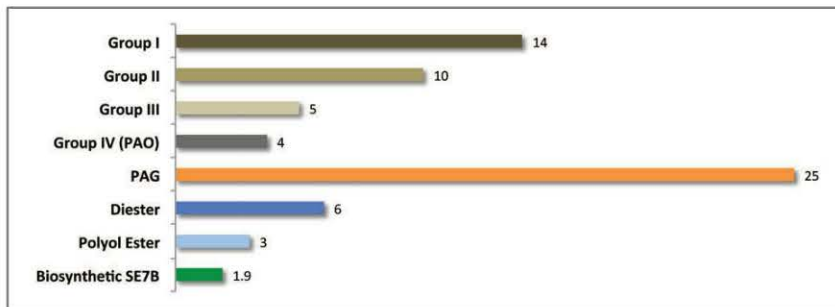


Biosynthetic 7 cSt Estolide (SE7B) Compared to Common Similar Viscosity Base Oils (6 to 8 cSt)

ASTM D2272, RPVOT (minutes)

Notes: Base oil samples are additized with 1% antioxidant (1:1 wt/wt aminic/phenolic blend).

Evaporative Loss



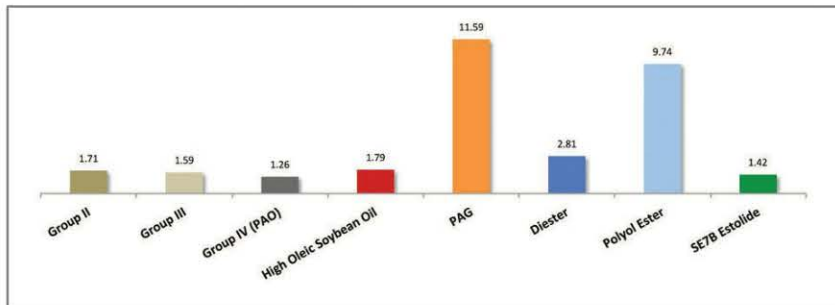
NOACK of Biosynthetic 7 cSt Estolide (SE7B)

Compared to Common Low Viscosity Base Oils

ASTM D5800 (wt%)

Notes: (1) Base oil samples are unadditized.

Hydrolytic Stability

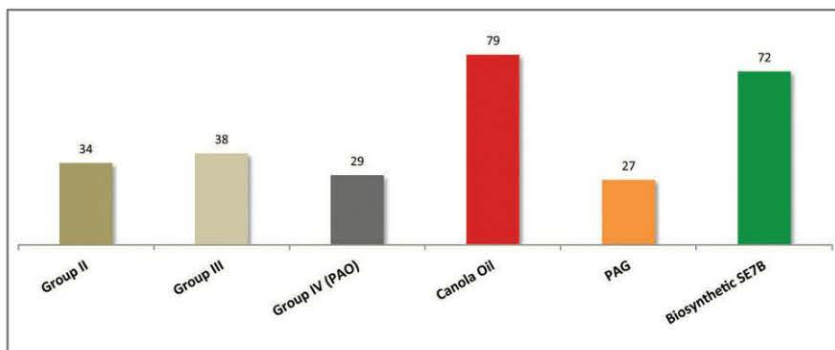


Biosynthetic 7 cSt Estolide (SE7B) Compared to Common Similar Viscosity Base Oils (6 to 8 cSt)

Modified ASTM D2619, Water Acidity Increase at 144 Hours (mg KOH/g)

Notes: (1) Base oil samples are unadditized.

Biodegradability



Biodegradability of Biosynthetic SE7B Compared to Common Low Viscosity Base Oils

OECD 301 (% Degraded in 28 Days)

Notes: Base oil samples are unadditized.

PCMO API SN ILSAC GF 5

Formulation Makeup

Viscosity Grade	SAE 5W-30 mass %	SAE 5W-20 mass %
DI Package	13.350	13.350
Viscosity Modifier	3.500	2.000
Biosynthetic Estolide (SE7B)	35.000	35.000
4 cSt Group III	22.950	48.150
6 cSt Group III	25.200	1.500

DI package and VM provided by Infineum International Limited.

PCMO Formulation

General Analysis

Viscosity Grade	SAE 5W-30	Limits
TBN D2869	8.6	-
KV at 100°C	9.68	9.3 to < 12.5
KV at 40°C	54.16	-
HTHS, mPa-s	3.2	≥ 2.9
CCS at -30°C, cP	6370	≤ 6600
MRV at -35°C, cP	27800	≤ 60000
MRV at -35°C, Yield Stress	No Yield Stress	No Yield Stress
NOACK, wt%	8%	≤ 15%

Other Applications

Estolides are now used by many major oil companies in a wide number of applications including:

- Motor Oil
- Hydraulic Fluid
- Grease
- Various Marine Applications
- Dielectric Fluid
- Metalworking Fluid
- And many others.

Conclusion

Estolides are a high-performing biosynthetic that offer an environmentally acceptable base oil option without giving up performance and in fact support efforts to further improve the quality of lubricants used in automobiles.

With Questions Please Contact:

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Engine Cleanliness

Field Trial Details

- 150,000 mile (241,402 km) taxi cab field trial under severe stop and go conditions in Las Vegas Nevada, USA
- First 100,000 miles (160,934 km) ≈ 84% estolide with additives
- Last 50,000 miles (80,467 km) ≈ 42% estolides, 42% GpIII, and additives
- Reference Oil – Minimum Quality GF-5 oil
- Typical drain interval 2 to 3 times recommended mileage
- Vehicle – Taxi Cab, Chevy Impala, 3.5 liter V6
- **Engines run on estolide-based formulations had far less varnish**



BIOSYNTHETIC™ BASE OIL



ILSAC GF-5 API SN RESOURCE CONSERVING

Using Biosynthetic Base Oils, Biosynthetic Technologies has successfully completed all testing requirements for certification of its 5w20 and 5w30 passenger car motor oil formulations.

THE CLEANEST ENGINE POSSIBLE AND A CLEANER ENVIRONMENT

ENVIRONMENTAL BENEFITS



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