Bio-lubricants for marine vessels and auxiliary equipment: a better return on investment

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Page 15: Don Gregory, Gulf Oil Marine
Page 26: Ian Nielsen, RSC Bio Solutions
Page 33: Gazpromneft company information

#marinelubricants
Biosynthetic Technologies is a highly innovative company, dedicated to the development of a bio-based alternative to Petroleum Base Oils.

**Our Vision**
To deliver Innovative Solutions for a Sustainable Future.

**Our Mission**
To be the Premier Synthetic Base Fluid Supplier Across a Variety of Specialty Markets.
Independent Leader in Biosynthetic and Sustainable Solutions

- Have solved the major weaknesses of EAL base-oils
- Manufacture of estolides and other sustainable, high-performance petroleum alternatives and specialty oleo derivatives
- Extensive experience in product and process improvement
**Biobased Synthetic Estolides Raise the Base of Performance**

**Synthetic Variations**
- Use of different fatty acid feedstocks
- Oligomerization ($n$)
- Unique functional groups ($a, b$)

**Performance Focus**
- Increased or reduced viscosity
- Improved cold temperature properties
- Increased or decreased polarity
- Improved oxidative stability
### Technical Performance

- High Oxidative Stability
- Hydrolytic Stability
- High Viscosity Index
- Low Volatility
- Natural Detergency
- Longer Lasting
- Increased Safety
- Fewer Additives Needed
- Increased Stability
- Less Maintenance

### Environmental Performance

- High Biodegradability
- Low Bioaccumulation
- Low Toxicity
- High Bio-Content
- Rapid Breakdown
- Low Environmental Risk
- Reduced Risk to Wildlife
- Renewable Carbon Based
Biosynthetic Base Oils for Marine Lubricants

- EAL Base Oils to meet or exceed the performance requirements of Euro Ecolable and the 2013 US Vessel General Permit (VGP)
- Suitable for the manufacture of synthetic gear oils, hydraulic fluids, stern tube oils, greases, etc.
- Can be used as the primary base oil, a component of a base oil co-blend, or even as an additive.
- Provide excellent wear protection for shipboard equipment and will safeguard equipment from rust and corrosion.
- Prototype formulations meet ISO 15380, DIN 51517-3, China GB CKD
Marine Applications

Biosynthetic Base Oils can be used to make the following marine lubricants and more:

• Gear Oils
• Hydraulic Oils
• Greases
• Compressor Oils
• Bearing

In addition, they have environmental benefits including:

• High renewable content,
• Biodegradability, and
• Non-bio accumulative nature

Estolides have excellent performance in the areas of:

• Oxidative stability,
• Hydrolytic stability,
• Evaporative loss (volatility),
• Viscosity Index, and
• Wear protection
Base Oils

BIO-BASED

BT4
ISO 22
68%
(ASTM D6866)

BT22
ISO 150
86%
(ASTM D6866)

BT75
ISO 680
94%
(ASTM D6866)
Carbon Negative Manufacturing

Raw Materials

Manufacturing Impact

Material Handling

Manufacturing Process

Sustainable Agriculture

For each 1 MT of BT Product, 9.16 Tons of CO2 is absorbed.

Non-GMO Products

Castor crops are sustainable both from an Environmental and Social Analysis:
- Farmland not suitable for competing food crops
- Crop can be harvested multiple times in a single planting

Fields, crushing, processing, and shipping locations are integrated in a small geographical region to minimize transportation effects on CO2 use.

Primary Production Facility Energy produced from:
- Wind Farm
- Boilers utilizing spend Castor Cake from Oil Crushing

Lifecycle study conducted by Gujarat Agriculture University, Dantiwada and Kadam Environmental consultancy laboratory, Baroda, India. A full life cycle assessment report can be delivered upon request for CO2, Water, NOx, SOx, COD, and TDS impacts from production.
## Wide Range of Certifications and Registration

![Certification Logos](image)

<table>
<thead>
<tr>
<th>Product</th>
<th>US Approval</th>
<th>Canada Approval</th>
<th>Europe, REACH Approval</th>
<th>Environmental Claims</th>
<th>Food Contact</th>
</tr>
</thead>
<tbody>
<tr>
<td>BT4</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ 68% Biocontent</td>
<td>✓ HX-1 InS</td>
</tr>
<tr>
<td>BT22</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ 86% Biocontent</td>
<td>✓ HX-1 NSF</td>
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<tr>
<td>BT75</td>
<td>✓</td>
<td>✓</td>
<td>✓</td>
<td>✓ 94% Biocontent</td>
<td>✓ HX-1 NSF</td>
</tr>
</tbody>
</table>
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Website
www.biosynthetic.com

Blog
www.biosynthetic.com/media
A CASE FOR SWITCHING TO EALs

Regulatory Aspects (Mandatory)
Will continue to grow more stringent over time

Greater Environmental Stewardship (Voluntary)
Sustainability initiatives within a company that have real benefits.

Performance Benefits
WHAT MAKES AN EAL LUBRICANT?

NOW!

- Readily biodegradable
- Minimum eco-toxicity
- Non-bioaccumulating
- Preferred bio-sourced

• Regulatory Drivers
• Corporate responsibility
"ARE ALL EALs THE SAME?"

**ISO CLASSIFICATIONS**

- **HETG**
  - Hydraulic Environmental Triglycerides

- **HEES**
  - Hydraulic Environmental Ester oil Synthetic*

- **HEPG**
  - Polyalkylene glycol Base (i.e. polyglycol)

- **HEPR**
  - Hydraulic Environmental PAO and Related product

* Most commonly used. Huge variation
## OXIDATION STABILITY

Un-additivated

<table>
<thead>
<tr>
<th>ISO Class</th>
<th>Oil Type</th>
<th>Oxidation time (mins)</th>
</tr>
</thead>
<tbody>
<tr>
<td>HETG</td>
<td>Vegetable Esters</td>
<td>&lt; 30</td>
</tr>
<tr>
<td>HEES</td>
<td>Oleochemical <strong>Unsaturated</strong> Esters</td>
<td>&lt;30</td>
</tr>
<tr>
<td>HEES</td>
<td>Oleochemical <strong>Saturated</strong> Esters</td>
<td>&gt; 180</td>
</tr>
<tr>
<td>HEES</td>
<td>Petrochemical Esters</td>
<td>&gt; 200</td>
</tr>
<tr>
<td>HEPG</td>
<td>Polyalkylene glycols</td>
<td>&lt;30</td>
</tr>
<tr>
<td>HEPR</td>
<td>PAO / ‘New’ PAO</td>
<td>&gt; 120</td>
</tr>
</tbody>
</table>

- Rapidoxy – static oxidation tester (ASTM 7545)
- Sample ~ 5mls
- Pressure vessel charged with $O_2$ at 700 kPa
- Temperature maintained at 140°C
- Test completed when $O_2$ pressure drops by 10%
HYDROLYTIC STABILITY
Includes commercial additive pack, Test method (RR1006)
CONCLUSIONS & TALKING POINTS

EALs are a viable and effective option for lubrication

Not all EALs are the same!

HETG, HEPG, HEPR, HEES?
If HEES:
• Mono, Di or Polyol?
• Complex or Polymer?
• Bio or Petro based?

Careful oil selection is paramount

Film Forming Behaviour
Oxidation
Hydrolytic Stability

DESired EFFECTS

ELIMINATE ENGINEERING ISSUES

REDUCE OIL DEGRADATION

MINIMISE RISK OF EQUIPMENT FAILURE
Bio-lubricants: A better return on investment
23rd November 2020
Bio-lubricants?

Derived from animal or vegetable sources

BASE OILS

- Various vegetable oils such as Palm, Cannola, Caster, Corn, Soya, Peanut & many more
- Normally highly processed to remove unwanted compounds & inherent performance shortcomings
- Blended oils such as synthetic diester and canola (rapeseed) oil to improve characteristics

ADDITIVES

- Limited options to achieve bio-degradability
- Surfactants from the amine family is one source of animal derived additives
- Usually higher cost than for the standard mineral oil additive systems
Derived from synthesis of usually petro-chemicals

- **BASE OILS**
  4 Huge range of synthetic base oils
    - Di-esters,
    - Poly-alpha-olefins
    - Poly-glycols
    - Etc..
    - May be blends of different chemistries to impart necessary performance

- **ADDITIVES**
  4 Limited availability of additives if bio-degradability is a key performance factor
Advantages & Disadvantages

Bio-lubricants

4 Potentially higher sustainability
4 Biodegradable
4 Non-toxic
4 Do not bio-accumulate
4 Highly polar hence excellent lubricants
4 High viscosity index & sometimes viscosity

8 Often highly water sensitive – poor hydrolytic stability
8 Poor thermal & oxidative stability
8 Poor cold flow properties
8 Usually lower allowable operating temperatures
8 Seal swell or seal shrinkage risks
8 High cost

WHAT ABOUT THE ADDITIVES?
Advantages & Disadvantages

Synthetic-lubricants

- Required for specific applications
- Consistent molecular structure
- Often extended lifetime
- May have outstanding base oil durability
- May be bio-degradable & extended bio performance properties

- Very high cost
- Base oil properties tailored for specific applications
- Usually very rapid failure at end of lifetime
- Seal swell or seal shrink risks
- Poor additive solubility
- Often incompatible with other base oils

WHAT ABOUT THE SYNTHESIZED PETROLEUM BASE OILS?
Changeover

- Check suitability of formulation for the application
- Check compatibility with previous lubricant
- Drain out & if possible, purge or manually clean system
- Remove all residues of previous lubricant
- Ensure system is moisture free & dust/dirt free
- Change lubricant filters prior to re-filling
- Ensure any potential sources of external contaminants are eliminated
- Label system denoting the applied formulation/product name
- Ensure lubricant is recorded in PM for periodic UOA

POOR CONVERSION

Circle Leaking seals
Smiley face Plugged filters, high operating pressures
Smiley face Higher than normal wear
Smiley face High operating temperatures - rapid lubricant degradation
4. Ensure the formulation is suitable for the system materials
   - Seals, hoses and other non metallic & metallic components
   - Routinely monitor operating temperatures, pressures and flow rates
4. Ensure oil change interval is observed
4. Apply UOA at recommended running or elapsed time intervals in accordance with PDS
   - Free water content
   - Oxidation
   - Acid number
   - Particle contamination
   - FTIR
4. If in doubt consider an oil change
Thank you
Bio Lubricants

Solve Smarter
US EPA VGP Definition

WHAT IS AN EAL?
Enviromentally Acceptable Lubricant

- READILY BIODEGRADABLE
  > 60% in 28 Days
- MINIMALLY TOXIC
- NOT BIOACCUMULATIVE

Additional Things to Consider

Beyond what the EPA defines as an EAL, we also consider renewability, or biobased carbon content, Non-sheening characteristics and overall safety for workplace environment.
THE EVOLUTION OF EALs

According to the international ISO Standard, there are 4 different types of EALs, and they vary greatly on performance.

- **HETG**
  - TRYGLYCERIDES
  - AKA Vegetable Esters

- **HEPG**
  - POLYALKYLENE GLYCOLS
  - AKA polyglycols or PAGs

- **HEES**
  - SYNTHETIC ESTERS
  - Both saturated and unsaturated types

- **PAO + HEPR**
  - POLYALPHAOLEFINS
  - OTHER SYNTHETIC HYDROCARBONS
Each type of hydraulic fluid is characterized by the chemical composition of its base oil.
### Not All EALs Are the Same

Each type of base oil imparts key performance properties to the lubricant.

<table>
<thead>
<tr>
<th>Base Oil Type</th>
<th>Hydraulic Fluid Type</th>
<th>Oxidation Resistance</th>
<th>Water Resistance</th>
<th>Superior Lubricity</th>
<th>Broad Seal Compatibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRIGLYCERIDE</td>
<td>HETG</td>
<td>★★★★★</td>
<td>★★★★★</td>
<td>★★★★★</td>
<td>★★★★★★★★</td>
</tr>
<tr>
<td>POLYALKYLENE GLYCOL</td>
<td>HEPG</td>
<td>★★★★☆</td>
<td>★★★★★</td>
<td>★★★★☆</td>
<td>★★★★☆★☆★</td>
</tr>
<tr>
<td>SYNTHETIC ESTER</td>
<td>HEES</td>
<td>★★★★☆</td>
<td>★★★★☆</td>
<td>★★★★★</td>
<td>★★★★☆★☆★</td>
</tr>
<tr>
<td>PAO &amp; SYNTHETIC HYDROCARBON</td>
<td>HEPR</td>
<td>★★★★★</td>
<td>★★★★☆</td>
<td>★★★★★</td>
<td>★★★★☆★☆★</td>
</tr>
</tbody>
</table>
MAXIMIZING ROI

SUPERIOR TECHNOLOGY OFFERS LONG TERM VALUE

LESS LUBRICANT CONSUMPTION
- Longer changeout intervals
- Better miscibility = less flushing

MAINTENANCE COST REDUCTION
- Spills treated more leniently
- Longer maintenance intervals

INCREASED UPTIME
- Works with NBR seals
- Superior lubricating, less equipment wear

INCREASED BRAND PERCEPTION
- Reduced PR risk
- Position yourself as a leader and innovator
LET’S DO THIS TOGETHER

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IAN NIELSEN

INIELSEN@RSCBIO.COM
Get in touch! I can’t wait to find the best solution with you

RSCBIO.COM
Check us out and learn more
Gazpromneft Ocean brand, Technical Service PLUS, Global Supply Chain and Professional Team are indivisible parts of “Details that make it work” philosophy. Its essence is in the fact that the quality of each detail determines the efficiency of the whole mechanism - whether it is a single vessel or the entire marine business.

**New Generation Lubricants**

Gazpromneft Ocean is a new generation marine lubricants brand. Fifteen (15) engine oils meet actual industry requirements:

- reduce friction
- cool engine details
- protect engine details from corrosion
- protect engine details from combustion products

Gazpromneft Ocean oils keep their properties for a long time to extend service life.

Gazpromneft secondary grades lubricants range includes more than 30 grades of compressor, gear, hydraulic, turbine, and heat transfer oils, greases, and coolants. Each liquid engineered to provide excellent performance and reliability. Their efficiency is proved by the Russian Arctic and the Far East conditions, where navigation is carried out at extreme temperatures up to -45 °C.

**Global Supply Chain**

We develop a global supply chain to establish the most comfortable environment for our customers and for their business to expand more efficiently.

Production of Gazpromneft ocean oils organized at 2 own plants and 6 partner blending sites in Europe and Asia. All kinds of operations from the delivery of base components and additives to the plant till the product shipment to vessels are carried out under the 100% quality control.

Today Gazpromneft Ocean oils are available in more than 400 ports worldwide with short notice that does not exceed 3 days for port hubs.

**Marine Dedicated Team**

Our team consists of 100% dedicated marine professionals are aware of what operating at sea means.

High-accuracy, high-efficiency and highly-qualification of technical team specialists are the key features to the smooth work of all business operations.
Professional Lubricant Service PLUS unites onboard and onshore analyses, online Personal Accounts and experts’ advices.

It gives our customers a vital insight on equipment and used oil condition, and helps to adjust the Vessels Maintainance Plan to be one step ahead of potential premature downtime and keep running smoothly.

Portable testing laboratories allow to fulfill prompt onboard diagnostics according to 5 main lube properties and to monitor used oil conditions.

Independent onshore laboratories in both Europe and Asia give a deep insight on oil and equipment’s condition according to 11 properties for engine oils and 7 properties for hydraulic and gear oils.

Online Personal Accounts bring analyses results right on your fingertips in forms of tables and dashboards to visualize changes.

Experts advices is a strong support for you lubrication strategy decisions. More than 150 consultations were successfully held during 2020.

The complex enables to monitor changes in equipment condition and helps to prevent mechanism breakdowns in real time mode.

Online reports from the certified independent laboratories allows you to manage lubricants as easy and fast as never before. Now you can track changes and find out potential issues prior they effect on your equipment.

User friendly
- Intuitive and simple interface;
- Clear lists of vessels and used lubricants.

Effective
- Reports can be downloaded to your PC or any gadget;
- Access to the reports from either office, vessel or plane.

Manageable
- Marine experts recommendations;
- Reports can be delivered extra via e-mail [up to 3 addresses].

Powerful
- Easy and fast access to all the old reports allows to identify trends;
- Ability to create graphs of change.