BIOBLEND™
High Performance BioBased Lubricants

October 2014

<u>BioBlend White Paper</u>:

BioBlend 2013 VGP-EAL Compliance Position Paper

The revised 2013 Vessel General Permit *(VGP)* went into effect 12/19/13 as a mandate passed down by the Environmental Protection Agency *(EPA).* The 2013 VGP provides a statement to the marketplace on the expanding & important role of bio-lubes, demonstrating a forward step is being made to back environmental claims with scientific testing. The final 2013 VGP is a complex document with one significant revision tied directly to lubricants:

- ✓ The 2008 VGP revision said EAL's ***'should'*** be used
- ✓ The 2013 VGP revision says EAL's ***'must'*** be used

Vessel Applicability

The 2013 VGP applies to all non-recreational vessels 79 ft. *(and greater)* in length that enter U.S. waters, defined as within 3 miles of a U.S. coast *(salt water and/or fresh water coasts or shorelines).*

> ***Excerpt from 2013 Vessel General Permit Section 1.2.1 General Scope of this Permit***
> ***<u>1.2.1 General Scope of this Permit</u>***
> This permit is applicable to discharges incidental to the normal operation of a vessel identified in Part 1.2.2 into waters subject to this permit. These waters are "waters of the United States" as defined in 40 Code of Federal Regulations (CFR) §122.2 (extending to the outer reach of the 3 mile territorial sea as defined in section 502(8) of the CWA). This includes all navigable waters of the Great Lakes subject to the jurisdiction of the United States. Recreational vessels as defined in section 502(25) of the CWA are not subject to this permit. Such vessels are not subject to NPDES permitting under section 402 of the CWA, and are instead subject to regulation under section 312(o) of the CWA. EPA expects that most vessels seeking coverage under this permit will be greater than 79 feet in length; however, commercial fishing vessels and other nonrecreational vessels less than 79 feet are also eligible for permit coverage under this permit or those vessels may seek coverage under EPA's small Vessel General Permit (sVGP), as available and appropriate. If auxiliary vessels or craft, such as lifeboats, rescue boats, or barges onboard larger vessels require NPDES permit coverage, they are eligible for coverage under this permit and are covered by submission of the NOI for the larger vessels. For purposes of recordkeeping, inspections, and reporting, auxiliary vessels may be considered as part of the same entity as the larger vessel. Nothing in this permit shall be interpreted to apply to a vessel of the Armed Forces as defined in section 312(a)(14) of the CWA.

Clarification on Applicability (Salt Water vs. Fresh Water … Coast vs. Shore)

It's easy to misinterpret the actual intent of the EPA's 2013 VGP regarding vessels operating in *'salt water'* versus vessels operating in *'fresh water'*. The VGP applies to ships entering U.S. waters *(within 3-miles)* from the Atlantic Ocean, Pacific Ocean or the Gulf of Mexico. What is often misunderstood is that the 2013 VGP also applies to vessels operating in *'fresh water'* within the U.S. The CWA definitions make it clear the 2013 VGP includes ***'waters of the U.S.'***; the five Great Lakes, the St. Lawrence Seaway and any river you can navigate.

> ***<u>Applicable Excerpts: 'Clean Water Act, Section 502 General Definitions'</u>***
> (7) The term **"navigable waters"** means the waters of the United States, including the territorial seas.
> (8) The term **"territorial seas"** means the belt of the seas measured from the line of the ordinary low water along that portion of the coast which is in direct contact with the open sea and the line marking the seaward limit of inland waters, and extending seaward a distance of three miles.
> (9) The term **"contiguous zone"** means the entire zone established by the United States under article 24 of the Convention of the Territorial Sea and the Contiguous Zone.
> (10) The term **"ocean"** means any portion of the high seas beyond the contiguous zone.

2013 VGP Requirements: Requires an Environmentally Acceptable Lubricant *(EAL)* to be used in all applications with the potential for an *oil-to-sea interface*, unless it is deemed *technically infeasible.*

EAL: EAL covers substances deemed acceptable for discharge by ships, tugs, etc. in U.S. waters. EAL refers to lubricants that are: Biodegradable, Minimally Toxic and Not Bioaccumulative.

Unless they are deemed *technically infeasible,* EALs must be used for a permit *(the VGP)* to be valid. If a ship is boarded for inspection, that ship must provide evidence of using an EAL in all *oil-to-sea* applications *(i.e.* evidence meaning a *VGP Compliance Declaration Certificate as provided by the lubricant manufacturer)*:

- ✓ BioBlend provides ship-owners a *VGP Compliance Declaration Certificate* – which serves as documentation that BioBlend EALs meet the 2013 VGP requirements.
- ✓ Ship operators must also document all oil-to-sea applications where it's *technically infeasible* to use EALs.

Oil-To-Sea Interface: Applies to any equipment where seals/surfaces may release oil into the sea. Since the VGP applies to vessels in both salt and fresh water, per CWA Section 502 oil-to-sea must be interpreted as oil-to-water. BioBlend EALs meet the VGP requirements and are VGP compliant in applicable oil-to-sea/oil-to-water interfaces.

Technically Infeasible: OEM's can certify it's *'technically infeasible'* to use an EAL in their specific equipment application. In this case ship operators can be challenged to get certificates from the OEM's stating that it is technically infeasible to use an EAL in the equipment they manufacture, as installed in the vessel. If the ship is boarded the ship operators must be able to present a certificate that they are using EALs in all applications where the potential for an oil-to-sea interface exists - and in all applications where it has been deemed technically infeasible to use an OEM, the ship operator must have a certificate from the OEM stating as such. There are additional *'technically infeasible'* reporting requirements spelled out in the 2013 VGP guidelines.

NOTE: *In some applications ships can wait to make EAL changes until their next dry-dock, which leaves 'some' compliance time in critical applications where EAL lube changes require dry-docking, like many stern tube lube applications.*

EAL Overview as per the Final 2013 VGP

TABLE 1: 2013-VGP Applications with Potential for an Oil-to-Sea Interface

Potential Lube Discharges - Critical	***Potential Lube Discharges – Other***
Controllable Pitch Propellers	Paddle Wheel Propulsion
Thruster Hydraulic Fluids	Thruster Bearings
Stern Tubes	Stabilizers
Rudder Bearings	Azimuth Thrusters
Fin Stabilizers	Propulsion Pod Lubrication
	Wire Ropes
	Any deck equipment with water contact when at sea
	Immersion equipment *(i.e. dredges, grabs, etc.)*

Excerpt from 2013 Vessel General Permit Section 2.2.9

2.2.9 Controllable Pitch Propeller and Thruster Hydraulic Fluid and Other Oil-to Sea Interfaces Including Lubrication Discharges from Paddle Wheel Propulsion, Stern Tubes, Thruster Bearings, Stabilizers, Rudder Bearings, Azimuth Thrusters, Propulsion Pod Lubrication, and Wire Rope and Mechanical Equipment Subject to Immersion

The protective seals on controllable pitch propellers, azimuth thrusters, propulsion pods, rudder bearings, or any other oil-to-sea interfaces must be maintained in good operating order to minimize the leaking of hydraulic oil or other oils. The vessel owner/operator must not discharge oil in quantities that may be harmful as defined in 40 CFR Part 110 from any oil-to-sea interface. If possible, maintenance activities on controllable pitch propellers, thrusters, and other oil-to-sea interfaces should be conducted when a vessel is in drydock.

Minimize maintenance activities on stern tube seals when a vessel is outside of drydock. If maintenance or emergency repair must occur on stern tubes or other oil-to-sea interfaces which have a potential to release oil in quantities that may be harmful as defined in 40 CFR Part 110, appropriate spill response equipment *(e.g., oil booms)* must be used to contain any oil leakage. Operators of the vessel must have ready access to spill response resources to clean up any oil spills.

After applying lubrication to wire rope and mechanical equipment subject to immersion, wire ropes, and other equipment must be thoroughly wiped down to remove excess lubricant unless doing so is deemed unsafe by the Master of the vessel.

All vessels must use an EAL in all oil to sea interfaces, unless technically infeasible. *'Environmentally acceptable lubricants'* means lubricants that are *'biodegradable'* and *'minimally-toxic'* and are *'not bioaccumulative'* as defined in Appendix A of this permit. For purposes of requirements related to EALs, technically infeasible means that no EAL products are approved for use in a given application that meet manufacturer specifications for that equipment, products which come pre- lubricated *(e.g., wire ropes)* have no available alternatives manufactured with EALs, products meeting a manufacturers specifications are not available within any port in which the vessel calls, or change over and use of an EAL must wait until the vessel's next dry-docking.

If a vessel is unable to use an EAL, you must document in your recordkeeping documentation consistent with Part 4.2 why you are unable to do so, and must report the use of a non-environmentally acceptable lubricant to EPA in your Annual Report. Use of an environmentally acceptable lubricant does not authorize the discharge of any lubricant in a quantity that may be harmful as defined in 40 CFR Part 110. EPA recommends that all new build vessel operators endeavor to use seawater-based systems for their stern tube lubrication to eliminate the discharge of oil from these interfaces to the aquatic environment.

TABLE 2: 2013 VGP Criteria for Lubricant Classification as an EAL

As defined in Appendix A of the 2013 VGP, there are three criteria for a product to be classified as an Environmentally Acceptable Lubricant (EAL)

EAL Criteria	*EPA Recognized Testing*	*Comment*
Readily Biodegradable	- OECD 301 A-F, 306, and 310 - ASTM 5864 - ASTM D-7373 - OCSPP Harmonized Guideline 835.3110 - ISO 14593:1999	> 60% means 'biodegradable' under this standard *(28 day test)*
Minimally Toxic	- OECD 201, 202, and 203 for acute toxicity *testing (ISO/DIS 10253 for algae, ISO TC147/SC5/W62 for crustacean, and OSPAR 2005 for fish, may be substituted)* - OECD 210 and 211 for chronic toxicity testing	Safe for contact with skin, non-carcinogenic
Not Bioaccumulative	- The partition coefficient in the marine environment is log KOW <3 or >7 using test methods OECD 117 and 107 - Molecular mass > 800 Daltons - Molecular diameter >1.5 nanometer - BCF or BAF is <100 L/kg using OECD 305, OCSPP 850.1710 or OCSPP 850.1730 - Field-measured BAF - Polymer with MW fraction below 1,000 g/mol is <1%	Calculated Value

2013 VGP - Section 2.2.9

All vessels must use an EAL in all oil to sea interfaces, unless technically infeasible. "Environmentally Acceptable Lubricants" means lubricants that are "biodegradable" and "minimally-toxic" and are "not bioaccumulative" as defined in Appendix A of the permit.

2013 VGP - Appendix A (*definitions)*

Environmentally Acceptable Lubricants (EALs): "Environmentally Acceptable Lubricants" means lubricants that are "biodegradable" and "minimally-toxic," and are "not bioaccumulative" as defined in this permit. For purposes of the VGP, products meeting the permit's definitions of being an "Environmentally Acceptable Lubricant" include those labeled by the following labeling programs: Blue Angel, European Ecolabel, Nordic Swan, the Swedish Standards SS 155434 and 155470, Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR) requirements, and EPA's Design for the Environment (DfE).

Biodegradable / Not Bioaccumulative: Regarding environmentally acceptable lubricants and greases, biodegradable means lubricant formulations that contain at least 90% (w/w (weight in weight concentration)) or grease formulations that contain at least 75% (w/w) of a constituent substance or constituent substances (only stated substances present above 0.10% shall be assessed) that each demonstrate either the removal of at least 70 percent of dissolved organic carbon, production of at least 60 percent of the theoretical carbon dioxide, or consumption of at least 60 percent of the theoretical oxygen demand within 28 days. Acceptable test methods include: Organization for Economic Co-operation and Development Test Guidelines 301 A-F, 306, and 310, ASTM 5864, ASTM D-7373, OCSPP Harmonized Guideline 835.3110, and International Organization for Standardization 14593:1999. For lubricant formulations, the 10% (w/w) of the formulation that need not meet the above biodegradability requirements, up to 5% (w/w) may be nonbiodegradable (but not bioaccumulative) while the remainder must be inherently biodegradable. For grease formulations, the 25% (w/w) of the formulation that need not meet the above biodegradability requirement, the constituent substances may be either inherently biodegradable or non-biodegradable, but may not be

bioaccumulative. Acceptable test methods to demonstrate inherent biodegradability include: OECD Test Guidelines 302C (>70% biodegradation after 28 days) or OECD Test Guidelines 301 A-F (>20% but <60% biodegradation after 28 days).

> ***NOTE:*** *An excerpt from the European Ecolabel standards, one of the approved programs mentioned above, "Data on bioaccumulation must be submitted if the substance is not ultimately nor inherently biodegradable". Several testing methods are available to determine the bioaccumulation potential of a non-biodegradable substance: molecular mass > 800 Daltons, molecular diameter >1.5 nanometer, means the partition coefficient in the marine environment is log KOW <3 or >7 using test methods OECD 117 and 107, BCF or BAF is <100 L/kg, using OECD 305, OCSPP 850.1710 or OCSPP 850.1730, or a field-measured BAF, or a polymer with MW fraction below 1,000 g/mol is <1%.*

Minimally-Toxic: "Minimally-Toxic" means a substance must pass either OECD 201, 202, and 203 for acute toxicity testing, or OECD 210 and 211 for chronic toxicity testing. For purposes of the VGP, equivalent toxicity data for marine species, including methods ISO/DIS 10253 for algae, ISO TC147/SC5/W62 for crustacean, and OSPAR 2005 for fish, may be substituted for OECD 201, 202, and 203. If a substance is evaluated for the formulation and main constituents, the LC50 of fluids must be at least 100 mg/L and the LC50 of greases, two-stroke oils, and all other total loss lubricants must be at least 1000 mg/L. If a substance is evaluated for each constituent substance, rather than the complete formulation and main compounds, then constituents comprising less than 20 percent of fluids can have an LC50 between 10-100 mg/L or a no observed effect concentration (NOEC) between 1-10 mg/L, constituents comprising less than 5 percent of fluids can have an LC50 between 1-10 mg/L or a NOEC between 0.1-1 mg/L, and constituents comprising less than 1 percent of fluids can have an LC50 less than 1 mg/L or a NOEC between 0-0.1 mg/L.

Not Bioaccumulative: "Not Bioaccumulative" means -

- The partition coefficient in marine environments is log KOW <3 or >7 via test methods OECD 117 and 107,
- Molecular mass > 800 Daltons,
- Molecular diameter >1.5 nanometer,
- BCF or BAF is <100 L/kg, using OECD 305, OCSPP 850.1710 or OCSPP 850.1730,
- Field-measured BAF,
- Polymer with MW fraction below 1,000 g/mol is <1%.

The Relationship between Biodegradability, Toxicity and Bioaccumulation: While the toxic impact a lubricant might have on the environment and its associated microorganisms and higher species as that lubricant biodegrades is relatively straight-forward to understand and quantify, what's not so easy to quantify is the rate at which the lubricant and its components bioaccumulate and impact the survival rate of a variety of varying aquatic and sediment microorganisms and species, including humans. Persistent bioaccumulative chemicals are distributed throughout the United States, with biological species and sediments serving as both a sink and a reservoir for these chemicals.

The U.S. EPA and other regulatory agencies are frequently required to interpret the environmental significance from laboratory and field studies. Decisions that require the interpretation of bioaccumulation data are complicated by numerous factors, including variability in chemical bioavailability due to seasonal and physicochemical conditions. It is no longer sufficient to know only whether chemicals accumulate because bioaccumulation itself is not an effect, but a process.

Regulatory managers must know whether the accumulation of chemicals is associated with, or responsible for, adverse effects on the aquatic ecosystem and human health. Another complicating factor is that EPA programs have different mandates, often requiring different applications and uses of bioaccumulation data. The two main approaches to bioaccumulation model development are:

(1) An empirical approach in which laboratory or field data are interpreted to calculate parameters such as bioaccumulation factors (BAFs) and biota-sediment accumulation factors (BSAFs).
(2) A deterministic modeling approach that employs kinetic or equilibrium models in which the mechanistic aspects of bioaccumulation are considered and usually referred to as food web models.

Empirical models include bio-concentration factors, BAFs, BSAFs, food chain multiplier, and theoretical bioaccumulation potential. Mathematical models or food web models can be grouped into two categories - equilibrium-based and kinetic approaches. Equilibrium models are usually referred to as "dynamic" because absolute thermodynamic equilibrium between contaminant concentrations in biota, water, and sediments is rarely reached in a natural setting. Thus, the equilibrium-based models assume steady-state conditions between organisms and the environment. In contrast to equilibrium-based models, kinetic models describe bioaccumulation

as the net effect of rate processes (uptake and loss of contaminant). General assumptions of kinetic models include constant uptake rate(s), instantaneous mixing within the compartment(s), and a negative exponential depuration process for all compartments. A newer bioaccumulation assessment tool currently being evaluated for its utility is the critical body residue approach. The critical body residue approach links body burdens in an individual organism to toxicological effects in that organism. Considerable interest exists in using the above tools to identify sediment concentrations associated with threshold tissue concentrations that are protective of aquatic organisms or their predators, including humans.

BioBlend and the Final 2013 VGP

A Historical Perspective on the Bio-based Lubricants Revolution: The evolution of modern equipment during the industrial revolution demonstrated that base oils alone didn't cut it … lube performance requirements gave rise to the lube additive market. When bio-lubes were first introduced to the market about 20 years ago, early promoters used oil additives designed to maximize the performance of petroleum base oils, not vegetable base oils. This proved to be a disaster, giving early bio-lubes a bad performance reputation.

Then along came bio-technology. We all recognize the advancements made in our lifetimes with bio-technology, applying to everything from bio-genetic advancements in seed technology … to bio-lubes. The bio-technology field is literally changing the way we live and how we view the world, and its global resources. Similar to the manner in which bio-technology is revolutionizing the world economy, advancements made in the bio-lubes arena is light-years ahead of where it all started. Today, the lubricants world is redefining the way bio-lubes work and perform in the marketplace, and in the case of BioBlend, delivering performance results that are nothing short of phenomenal.

Whether you produce petroleum, synthetic, or bio-based lubricants, the same basic formula applies: ***Base Oil(s) + Additive(s) = Finished Lube(s)***

When it comes to bio-based lubricant development BioBlend engineers' performance first, accomplishing this using renewable, bio-based, enviro-minded base oils, with additives meeting current and recognized definitions of biodegradability, while being minimally toxic and not bioaccumulative. Today, BioBlend is redefining the way bio-lubes work and perform in the marketplace … delivering results that are nothing short of phenomenal. When it comes to performance we often say: ***"BioBlend lubricant technologies are optimized to perform equal-to or better-than competitive, conventional petroleum lubricants, and at a comparable price, and by the way … they're biodegradable, minimally toxic and not bioaccumulative."*** Marketers of conventional petroleum lubricants simply can't make this claim … period.

BioBlend's VGP Strategy

1. Provide products with proven performance & protection.
2. Market technologies founded on sound and verifiable environmental principles.
3. Deliver bio-lube solutions that work, delivering bottom-line operating profitability enhancements to all stake-holders.

TABLE 3: 2013 VGP-Compliant BioBlend EAL Technologies

General Applications	*Typical Product*	*BioBlend EAL Products*
Stabilizers	**Hydraulic Fluid**	BioFlo AW32/AW46/AW68 BioFlo AWS32/AWS46/AWS68 BioFlo HEES32/HEES46/HEES68
Hydraulic Systems *(Systems, Doors, Ramps)*	**Hydraulic Fluids**	BioFlo AW32/AW46/AW68 BioFlo AWS32/AWS46/AWS68 BioFlo HEES32/HEES46/HEES68
Thrusters	**Gear Oil**	BioGear EP100/EP150/EP220
Azimuth Thrusters	**Gear Oils** **Hydraulic Fluid**	BioGear EP100/EP150/EP220 BioFlo AW32/AW46/AW68 BioFlo AWS32/AWS46/AWS68 BioFlo HEES32/HEES46/HEES68

Stern Tubes	**Stern Tube Lube**	BioFlo STL68/STL100/STL150
Multi-Purpose Grease & Wire Rope Lube	**Grease**	BioGrease HD1/HD2 BioGrease GP00/GP0/GP1 SynGrease XT
Winches & Cranes	**Gear Oil** **Cable Lube**	BioGear EP100/EP150/EP220 BioLube C&C 32P/46P
General Purpose Lube & Penetrating Oil	**Multi-Purpose Oil**	BioBlend MPO *(aerosol or bulk)*

BioBlend EAL Compliance Declaration: BioBlend has determined that the EAL technologies illustrated in TABLE 3 meet the Vessel General Permit definition for being Environmentally Acceptable Lubricants. A compliance certificate is available directly from BioBlend, upon request.

Things to remember when selecting EALs:

- ✓ EAL lube compatibility with existing lubes.
- ✓ EAL lube compatibility with existing seal materials.
- ✓ EAL lube changeover procedures & requirements.

BioBlend Consideration Points:

- ✓ The inherent friction reducing qualities of the bio base oils used by BioBlend lower application temperatures, enhancing equipment reliability and extending equipment life.
- ✓ BioBlend offers biodegradable technologies that are minimally toxic and not bioaccumulative.
- ✓ BioBlend products will not biodegrade in the application while in-service. You need air, water and micro-organisms found in the ground and/or water to start, and complete, the biodegradation process.
- ✓ BioBlend is compatible with most petroleum based products, and the most popular marine seal types.
- ✓ BioBlend products have incredibly high VI - correlating to less viscosity change with temperature changes.
- ✓ BioBlend products are '*polar'.* This affinity for metal delivers excellent metal wetting capabilities thereby providing superior lubricity via a mechanism most petroleum and synthetic lubes can't deliver.
- ✓ BioBlend product usage supports most corporate sustainability, green and carbon reduction objectives.
- ✓

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BioBlend Renewable Resources, LLC made their lubricant debut in the field in 2001. Since then, we've continued our bio-lubes innovation quest expanding our product line to include not only the most advanced biobased lubricant technologies available, but also food grade and synthetic lubricants. BioBlend's goal is to provide environmentally responsible products and solutions to a wide range of industries. Our customers come to us from every corner of the earth and in every industry: drilling, mining, construction, agriculture, marine, food processing, government, and many more.

The BioBlend team has a wealth of experience in lubricants, manufacturing, and distribution. The company also has the venture capital backing of Archer Daniels Midland (NYSE: ADM) and Quest Technology Ventures.

- ✓ *Made in the United States of America*
- ✓ *Renewable*
- ✓ *Readily Biodegradable*
- ✓ *Sustainable*
- ✓ *Performance Driven*
- ✓ *Cost Competitive*

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