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Senate Committee on Environment and Natural Resources
Oregon State Capitol
900 Court St. NE Room 347
Salem, Oregon 97301

RE: Senate Bill 19, updates descriptions and allowed quantities of oxygenates in gasoline for sale at wholesale or retail in this state.

Dear Committee Members,

Bombardier Recreational Products (BRP US, Inc.) the maker of Evinrude outboard marine engines appreciates the opportunity to express our opposition to Senate Bill 19 which modifies descriptions and allowed quantities of oxygenates in gasoline for sale at wholesale or retail in the State of Oregon.

Over the last five years, BRP has lead comprehensive research into second generation biofuels such as biobutanol and its compatibility with marine engines and boats. Butanol as an oxygenate, when blended at 16.1 volume percent with gasoline is a tremendously valuable biofuel and is compatible with gasoline marine engines and boats. In fact, **the National Marine Manufacturers Association and the entire recreational marine industry approved the use of biobutanol fuel blends up to 16.1 volume percent in gasoline.** The industry backs this up by including warranty statements coving the use of biobutanol fuel blends in marine products.

Supported by the U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy and Argonne National Laboratory, BRP Evinrude has been integral to a five-year comprehensive testing program, which included the American Boat and Yacht Council, the National Marine Manufacturers Association and other boat and engine manufacturers across the industry.

The comprehensive multi-year testing program included measurements of gaseous and particulate engine exhaust emissions, combustion analysis, cold start, runability, durability, fuel storage assessment and more. The research program included many engine technologies from engine and boat manufacturers, including 4-stroke carbureted and fuel-injected outboard

Ski-Doo
Lynx
Sea-Doo
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engines, conventional 2-stroke carbureted outboard engines, sterndrive engines and direct fuel injection outboard engines.

The years-long test program accumulated thousands of marine engine and boat test hours and results indicate that biobutanol blends of as much as 16.1 percent can be used in marine engines and boats without a deterioration of engine or boat performance. There were no engine durability or exhaust emission failures throughout the test program.

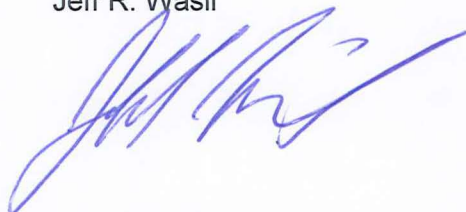
Butanol fuels do not phase-separate in the presence of water meaning butanol is more stable in open-vented fuel tanks such as the ones used in recreational boats. Butanol also contains an energy content closer to that of gasoline, so for the same biofuel percentage, butanol will result in better fuel efficiency. Moreover, butanol raises the octane rating of gasoline and lowers carbon monoxide emissions as it contains 2.7 to 3.5 oxygen by weight when blended at up to 16.1 volume percent in gasoline.

Enclosed is a biobutanol fact sheet assembled for the recreational marine industry. Please also reference marinebiobutanol.net for additional information including some of the peer-reviewed studies and industry approval event in Washington, DC

I encourage you to include biobutanol as a valuable and viable option for gasoline oxygenates. Biobutanol is an approved commercially available next-generation biofuel that is available for purchase today. There has been great feed-back from consumers that are using biobutanol fuel blends and it would be very disappointing to limit the availability of this excellent biofuel from the great state of Oregon.

Sincerely,

Jeff R. Wasil



Engineering Manager -
Emissions Compliance & Regulatory Development

FACT SHEET

EMISSIONS AND OPERABILITY OF GASOLINE, ETHANOL, AND BUTANOL BLENDS IN RECREATIONAL MARINE APPLICATIONS

The National Marine Manufacturers Association (NMMA) and the American Boat and Yacht Council (ABYC) under the direction and guidance of the US Department of Energy and Argonne National Laboratory have been engaged in a four-year program to evaluate the performance of recreational marine engines and vessels operated on biologically produced butanol fuel¹. With known issues associated with ethanol fuels and the ongoing push toward higher quantities of ethanol such as E15, the marine industry has come together to evaluate an advanced biofuel with properties more suited for the marine environment than ethanol.

Biobutanol contains nearly 90% of the energy content of gasoline compared to 67% for ethanol. A higher energy content means that 16.1 vol% biobutanol (Bu16) is equivalent to the energy content of 10 vol% ethanol (E10). Both Bu16 and E10 contain the same oxygen by weight, and both raise octane when blended into gasoline. **Biobutanol is particularly interesting to the marine industry as it is significantly more resistant to phase separation than ethanol. It is also**

less corrosive to fuel system component materials such as fuel tanks, fuel hoses, primer bulbs, gaskets and o-rings when compared to ethanol².

Lack of phase separation and low solvency means that biobutanol could be transported in the existing pipeline distribution infrastructure, minimizing the need for truck and rail transportation, which is required for ethanol³. When added to gasoline, biobutanol lowers the Reid Vapor Pressure (RVP) of the finished gasoline blend which results in lower evaporative emissions and allows for a less costly gasoline blend stock.

Several years of engine and vessel testing performed through a collaborative industry effort conducted on many different engine technologies and boats, along with US Coast Guard testing have confirmed the compatibility of biobutanol fuel blends with marine engines and vessels. The major tests performed during this testing program and conclusions are highlighted in this fact sheet.

TEST PERFORMED

- Gaseous and particulate engine exhaust emissions (regulated and non-regulated)
- Green house gas emissions (GHG)
- Combustion analysis
- Cold start
- Power and performance
- Runability
- Winter storage
- Oil tribology and lubricity
- Exhaust gas temperature
- Stoichiometric air/fuel ratio (Lambda)
- Field engine and vessel performance
- Full useful life endurance/durability
- Engine tear down and component inspection

TYPES OF FUELS TESTED

- E10 (10 vol% ethanol – control fuel)
- Bu16 (16.1 vol% biobutanol)
- Tri-fuel blend (8 vol% isobutanol, 5 vol% ethanol and 87 vol% gasoline)
- Indolene (non-oxygenated certification fuel)

ENGINE TECHNOLOGIES TESTED

- Electronic fuel injection four-stroke outboards
- Carbureted four-stroke outboards
- Open-loop (CARB 3-star) SD/I and PWC engine
- Closed-loop (CARB 4-star) SD/I engines
- Conventional carbureted two-stroke outboard
- Direct fuel injection two-stroke outboards

ENGINE BRANDS TESTED

- BRP – Evinrude and SeaDoo
- Mercury
- Volvo-Penta
- Yamaha
- Tohatsu
- Indmar
- OMC – Johnson
- Honda

MAJOR CONCLUSIONS

Laboratory, endurance, and field testing results on boats and engines indicate no discernable difference in power, performance, runability, emissions or durability between E10 and biobutanol test fuels (Bu16/Trifuel blends).

All test engines remained below EPA and CARB emissions standards for HC+NOx and CO. Exhaust emissions comparisons between E10 and biobutanol test fuels were virtually the same on all engines tested. No significant emissions differences between E10 and biobutanol test fuels were found regardless of engine technology.

Full useful life engine tear-down and inspection on pistons, cylinder heads, cylinder bores, intake/exhaust valves, intake/exhaust ports, connecting rods and rod bearings indicate similar wear between the E10 control engines and Bu16 test engines. No unusual wear, carbon build-up or durability issues were observed with either fuel during the 350 hour (equivalent 10 year useful life) testing.

No engine runability, engine durability, or engine/boat performance issues were experienced during the test program. All engines and boats performed well throughout the test program.

Engine startability performed at two different temperatures indicates similar seconds to start and pulls to start at 75°F between E10 and Bu16 test fuels. At 30°F, data indicates a slight advantage in startability for biobutanol fuels.

Friction, wear and scuffing tests performed on engine oils suggest that E10 and Bu16 fuels present in the oil result in a slight friction reduction but a noticeable reduction in scuffing load compared to a non-oxygenated test fuel. There were no major differences between the load carrying capacity of the oil with either E10 or Bu16 fuels.

The comprehensive data collected during this multi-year test program suggests that biobutanol blends up to 16.1 vol% can be used in recreational marine engines and boats without deterioration of engine/boat performance, emissions characteristics, durability or runability. Moreover, butanol blends up to 16.1 vol% may mitigate many fuel related issues experienced with ethanol fuels, primarily related to phase-separation and corrosion.

¹DOE Annual Progress Reports – Emissions and Operability of Gasoline, Ethanol, and Butanol Blends in Recreational Marine Applications – marinebiobutanol.net

²Kass, M., Theiss, T., Janke, C., Pawel, S., et al “Compatibility Study for Plastic, Elastomeric, and Metallic Fueling Infrastructure Materials Exposed to Aggressive Formulations of Isobutanol-blended Gasoline” Oak Ridge National Laboratory, 2014

³Wasil, J., McKnight, J., Kolb, R., Munz, D. et al., “In-Use Performance Testing of Butanol-Extended Fuel in Recreational Marine Engines and Vessels,” SAE Technical Paper 2012-23-0011, 2012, doi:10.4271/2012-32-0011.

Biobutanol FAQ

Q: What is biobutanol and how is it made?

Biobutanol is a four-carbon alcohol produced from renewable, plant-derived energy sources in a fermentation process similar to beer and wine production. Biobutanol can be produced using existing ethanol feedstocks, such as corn and sugar beets, or advanced feedstocks (cellulosic biomass) such as crop residues, wood residues, dedicated energy crops, and industrial and other wastes. Biobutanol delivers more renewable energy content than ethanol while remaining compatible with current vehicles, boats, and infrastructure.

Q: Why interest in biobutanol for recreational marine engines?

The congressionally-mandated US Renewable Fuels Standard (RFS) requires 36 billion gallons of renewable fuel to be blended into the gasoline supply by 2022. Methods to increase renewable fuels in the gasoline supply have primarily focused on ethanol and higher ethanol blends such as E15. Recreational marine industry reports show significant damage to marine engines using ethanol E15 fuels. Recognizing the issues associated with higher ethanol blends such as E15, the recreational marine industry has explored biobutanol fuel blends with very promising results. The approval of biobutanol fuel blends up to 16.1 vol percent (Bu16) for marine engines and boats positions the industry as a proactive leader in identifying renewable fuels that are more compatible with recreational marine engines and boats.

Q: How is biobutanol different from bioethanol?

Biobutanol has several characteristics which distinguish it from ethanol, making biobutanol an attractive gasoline bio component. For example:

- Biobutanol is compatible with existing recreational boats and refueling infrastructure at levels significantly higher than ethanol, overcoming the impending ethanol blendwall.
- Biobutanol is substantially less susceptible to phase separation in the presence of water than ethanol which means biobutanol behaves similarly to conventional non-ethanol gasoline when water is introduced to the boat fuel tank.
- Biobutanol has an energy content that is closer to gasoline, so consumers face less of a compromise on fuel economy at higher blend ratios. At 16.1 vol% in gasoline (Bu16), biobutanol has the exact same energy content of 10 vol% ethanol fuels (E10).
- Biobutanol is well-suited for current boat and engine technologies. It does not require boat builders or engine manufacturers to compromise on performance to meet environmental regulations.

Q: Has biobutanol caused any damage to recreational boats or engines?

No. Based on thousands of engine and boat test hours, extensive industry testing and published research reports, biobutanol fuel blends up to 16.1 vol percent (Bu16) resulted in no engine failures, no engine runability issues and no boat performance issues.

Q: Does an engine have to be altered to use biobutanol?

No. Biobutanol fuel blends up to 16.1 vol percent (Bu16) were rigorously tested in standard marine engines and boats with no alterations to the engine or fuel system.

Q: Can biobutanol be used in an old engine?

Yes. Biobutanol fuel blends up to 16.1 vol percent (Bu16) have been tested in a variety of recreational boats powered by many different engine technologies including fuel injected four-stroke outboards, two-stroke direct fuel injection outboards, catalyst based stern-drive and inboards, non-catalyzed inboards, carbureted four-strokes, and conventional carbureted two-stroke engines.

Q: Will my boat perform differently with biobutanol?

Based on thousands of hours of testing both in the laboratory and on water, boat and engine performance is transparent between fuels such as E10 and biobutanol fuel blends up to 16.1 vol percent (Bu16). Biobutanol fuel blends behave more similarly to conventional non-ethanol gasoline, particularly when water is introduced into the boat fuel tank.

Q: Is there any significant difference in fuel economy or other operating factors that I should expect when running my boat with biobutanol fuel blends?

Thousands of hours of testing on marine engines operated both in the laboratory and operated in boats on the water indicate no negative impact on fuel economy as compared to E10. More importantly, Biobutanol does not phase separate in the presence of water which is a very desirable property, particularly when used as a biofuel blend for recreational boats. Fuel phase separation with ethanol fuel blends such as E10 is a very common source of boat and engine related issues. Phase separated fuels can quickly deteriorate fuel system components and can lead to catastrophic engine failure. Biobutanol fuel blends up to 16.1 vol percent (Bu16) behave similarly to conventional non-ethanol gasoline, in its resistance to phase separation, making biobutanol an excellent biofuel for recreational boats when compared to E10.

Q: Are there any different maintenance requirements in a boat using biobutanol fuel blends?

No. Comprehensive material compatibility studies indicate that biobutanol fuel blends up to 16.1 vol% (Bu16) are compatible with a variety of fuel system components typical of recreational boats. In fact, research has shown biobutanol fuel blends to be more compatible with fuel system components than ethanol. Coupled together with desirable properties including resistance to phase-separation in the presence of water and thousands of hours of successful marine industry testing means that biobutanol (Bu16) is a biofuel better suited for recreational marine engines and boats.

Q: What is the difference between biobutanol, isobutanol and n-butanol?

Biobutanol is a description for biologically produced butanol which can include isobutanol and n-butanol. Isobutanol and n-butanol are similar (same energy content and resistant to phase separation) but isobutanol has a higher octane rating than n-butanol making it more attractive for blending with gasoline. Both n-butanol and isobutanol have been evaluated in internal combustion engines.

Q: Who is involved in the recreational marine biobutanol testing program?

Biobutanol research is supported by the US Department of Energy, Office of Energy Efficiency and Renewable Energy coordinated through Argonne National Laboratory. There is participation across the industry from engine manufacturers as well as the National Marine Manufacturers Association (NMMMA), the American Boat and Yacht Council (ABYC) and the United States Coast Guard (USCG).

Q: How many companies are working on commercializing biobutanol?

There are many companies currently working on commercializing and developing biobutanol as a building block for renewable chemicals and/or use as a biofuel in internal combustion engines. The marine industry does not endorse any specific biofuel company, but rather is focused on biofuels that indicate compatibility with recreational marine engines.

Q: Where can I purchase this fuel?

Large scale availability of biobutanol fuel blends will take some time. However, marine industry approval of biobutanol fuel blends up to 16.1 vol percent (Bu16) for marine engines and boats as an alternative to ethanol will encourage its market expansion by providing marine fuel distributors, retailers and consumers with the confidence that this is not only a suitable, but a more compatible fuel for boats. Approval for the use of Bu16 blends is an important first step in securing a biofuel that is compatible with recreational boats and engines, particularly when the damaging effects of higher ethanol blends such as E15 are widely known.

Q: Will biobutanol fuel blends up to 16.1 vol percent (Bu16) be available in different octane ratings?

Yes, the existing fuel grade structure will remain applicable to biobutanol fuel blends.

Q: What is (or what will be) the relative price of biobutanol fuel blends vs. conventional gasoline?

Biobutanol production technology is being developed to compete against current market gasoline fuel costs

Q: With today's lower gas prices, why are we interested in biofuel alternatives like biobutanol?

Gasoline blended with oxygenated compounds like biobutanol is required in many parts of the US by EPA regulations in the Clean Air Act for reducing air pollution. In addition, a biofuel that is more compatible with recreational boats and engines such as biobutanol is key to realizing important goals of the Renewable Fuels Standard such as US energy security, rural and agricultural job growth, and greenhouse gas reduction.

Q: Are there any other aspects of Bu16 that need further investigation?

Long term fuel storage, in the marine environment, has been an issue both in boats and in fuel storage tanks. As we have seen, E10 created even more storage issues as compared to E0. The marine engine manufacturers will continue to work with the Biobutanol suppliers to determine the long range storage characteristics of Bu16 and work to develop best practices for storage of this fuel with the suppliers.

Q: How can I learn more?

More information can be found on the following websites -- US Department of Energy Alternative Fuels Data Center and the Marine Biobutanol Research webpage:

http://www.afdc.energy.gov/fuels/emerging_biobutanol.html
<http://marinebiobutanol.net>



SERVICE BULLETIN

Date: December 19, 2015

No. 2015-13(S)

MODELS: All Evinrude® Outboards

SUBJECT: Biobutanol Blended Fuel (Bu16)

Bulletin Revision Information

Revision Letter	Purpose / Changes	Date
-	Original Bulletin	December 19, 2015

Biobutanol Blended Fuel (Bu16)

Biobutanol is a four-carbon alcohol produced from renewable, plant-derived energy sources in a fermentation process similar to beer and wine production. Biobutanol delivers more renewable energy content than ethanol while remaining compatible with current vehicles, boats, and infrastructure. Biobutanol does not phase separate in the presence of water like ethanol and is less corrosive to fuel system components such as fuel tanks, fuel fittings and fuel hoses.

BRP has approved the use of biobutanol blended fuel (either isobutanol or n-butanol) in all Evinrude outboards. Use of biobutanol blended fuel will NOT void the warranty of Evinrude outboards.

Biobutanol blended fuel (Bu16 - up to 16.1% by volume) has been approved for use by the National Marine Manufacturers Association (NMMA®).

Refer to the correct Operator's Guide or Service Manual for specific fuel requirements.

Fuel Requirements

⚠ WARNING

Gasoline is extremely flammable and highly explosive under certain conditions. Improper handling of fuel could result in property damage, serious injury or death.

Always turn off the outboard before fueling.

Never permit anyone other than an adult to refill the fuel tank.

Do not fill the fuel tank all the way to the top or fuel may overflow when it expands due to heating by the sun.

Remove portable fuel tanks from the boat before fueling.

Always wipe off any spilled fuel.

Do not smoke, allow open flames or sparks, or use electrical devices such as cellular phones in the vicinity of a fuel leak or while fueling.

Recommended Fuel

Use unleaded gasoline with an AKI (R+M)/2 octane rating of 87, or an RON octane rating of 90.

Fuel blending varies by country and region. Your outboard has been designed to operate using the recommended fuels; however, be aware of the following:

- The boat's fuel system may have different requirements regarding the use of alcohol fuels. Refer to the boat's owner guide.
- Ethanol and methanol blended fuels attract and hold moisture which may lead to fuel phase separation and can result in engine performance problems or engine damage.
- Use of fuel containing alcohol above the percentage specified by government regulation can result in the following problems in outboard engines and fuel system components:
 - Vapor lock or fuel starvation
 - Starting and operating difficulties
 - Deterioration of rubber or plastic parts
 - Corrosion of metal parts
 - Damage to internal engine parts
- Inspect for fuel leaks or other fuel system abnormalities if you suspect the presence of alcohol in gasoline exceeds the current government regulation limits.

Use in North America

NOTICE

Do NOT use fuel from fuel pumps labeled E85. Never experiment with other fuels.

The use of unleaded gasoline containing alcohol above the percentage specified by government regulations is not recommended.

Use of fuel labeled E15 is prohibited by U.S. EPA Regulations.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit, P/N 174176, is strongly recommended.

Use Outside North America

The use of unleaded gasoline containing alcohol above the percentage specified by local government regulations is not recommended.

Use of a boat mounted water separating fuel filter, such as Fuel Filter Kit, P/N 174176, is strongly recommended.

Biobutanol Fact Sheet

See the following pages for the attached **Biobutanol Fact Sheet**.