Behind the Green Door: Biodiesel Promise Fraught With Drawbacks

Ralph Lewis, CEO – Newport Fuel Solutions, Inc.

Ralph Lewis is the CEO at Newport Fuel Solutions, Inc.

Mr. Lewis served as Technology Transfer and Public Information Specialist with Shell Oil and eventually, as Vice President Technical with Power Research Inc for over 32 years.

+1 832 627 7499
ralphl@newportfuelsolutions.com
www.newportfuelsolutions.com

As the great British scholar Samuel Johnson wrote in 1775, "The road to hell is paved with good intentions."

Seeking to carve out a niche in the marine fuels market, biodiesel manufacturers are now touting many positive benefits to the IMO, charterers and ship owners regarding biodiesel capability to significantly reduce emissions in response to new IMO directives – a prime target being CO2 emissions.

Seems reasonable. After all, engine emissions testing of biofuels over decades has established that the various biodiesel fuel formulations typically have high ignition quality and generate fewer unburned hydrocarbon, particulate and carbon monoxide (CO) emissions. As they are composed mostly of fatty acid methyl esters (FAME), some may also provide good lubrication to fuel delivery systems.

Promising. Right? But the devil is in the details.

CO2 Reduction?

Whether derived from plant or animal sources, biofuel has anywhere from 8-to-11 percent less energy value than conventional diesel fuel thanks to lower carbon content. In a comprehensive 2002 review of biodiesel emissions testing on a range of diesel engines under stringent EPA test standards, the US Environmental Protection Agency evaluated the performance of several biodiesel fuel blends and compared the results to those from conventional diesel fuels.

The EPA study reported fuel efficiency loss with biodiesel ranged from 4.6-to-10.6 percent – a reflection of the reduced energy value of the fuel. While the EPA reported that particulate and carbon monoxide emissions were reduced with biodiesel, it was evident that CO2 emissions were yet another story, as the study concluded the following:

"It also appears that biodiesel may actually increase emissions of CO2 relative to conventional diesel fuel. However, this potential increase is small (~1%), and it is unlikely to be discernable in-use given the variability in each of the components (density, H/C ratio, and energy content). These results suggest that there would likely be no measurable difference between biodiesel and conventional diesel in terms of exhaust CO2 emissions."

Since then, numerous organizations have conducted extensive biodiesel emissions studies under EPA protocols – the very same protocols proscribed by Marpol Annex VI. Little has changed. These studies continue to verify that the use of biodiesel, whether as a blended fuel or in a 100 percent form, has a negligible effect on CO2 emissions. These studies were conducted on a myriad of engine types – two-stroke, four-stroke, medium and high speed. Regardless of the variables – CO2 was very slightly higher in some cases, very slightly lower in others.

One study that would seem to contradict the hundreds of valid studies conducted over the past 20 years under accepted testing protocols, is one conducted by EXXONMOBIL on a Stena Bulk tanker – claiming a whopping 40 percent reduction in CO2. Yet the engine was not tested under the EPA or Marpol Annex VI standard. No emissions were actually monitored by any onboard test equipment.

Rather, the claimed reduction was "calculated" on an "energy basis', states the company in fine print in their promotional circular for the fuel. Doubtless a computer model, like the one used by those who predicted in 1979 that the world's coastal cities would be underwater by the year 2000.

Increased NOx Emissions

These emissions tests over the past two decades under the standard ARB/EPA test protocol (also the Marpol VI engine test protocol), have conclusively demonstrated that use of biodiesel increases NOx emissions anywhere from 7-to-12 percent. The reason? Biodiesel typically has a much higher oxygen content than conventional fuels. The EPA review reported a 10 percent average increase of NOx.

Technically, any vessel using a biodiesel fuel in an emissions control area (ECA) under Marpol Annex VI would likely fail to be in compliance with the IMO's own NOx limitation standard. Under the statute – vessel owners opting for a biodiesel fuel may be required to conduct onboard emissions testing under standard – and highly expensive – mandated testing protocols.

And there is another risk. Biodiesels are composed of fatty acid methyl esters. FAME is often used as the main component in lubricity additives as it has excellent lubricity properties. But there is a risk of overuse. Some studies by oil companies and pump makers have shown that certain FAME based lubricity additives can result in severe cylinder bore polishing long term.

Deterioration in Storage

Biodiesel blended fuel on board? Better use it up in a hurry – at least by the end of the month. Components of biofuel can be animal or plant-based, or both. In time, these organic structures, like any former living things, will decompose, especially when exposed to heat and oxygen. Many acids are formed – capable of quickly corroding fuel delivery systems.

One of the worst of these products of decomposition is carboxylic acid. Why is this bad?

In the early 2000s, four vessels operating in the US Pacific Northwest suddenly experienced very dense smoke emissions within the same week, alarming authorities, who then issued costly citations. Samples of the fuel were sent to the British Petroleum UK test facility for analysis. The culprit was carboxylic acid, discovered in the fuel at only 400 ppm. When burned, carboxylic acid smokes like an old coal-fired furnace.

All these vessels had been bunkered by the same supplier within just a few days of each other. Investigation revealed that the supplier had adulterated the fuel with a copious supply of biodiesel which had been decomposing.

Biofuel Production Increases CO2 Emissions

A final consideration – one that might mean the death knell for biodiesel long-term, not just in commercial shipping, but worldwide. Researchers have discovered that biofuels are not at all net neutral when it comes to CO2 emissions. In fact, the methodologies of biodiesel production are directly responsible for adding significant amounts of CO2 to the atmosphere.

This was the conclusion in a 2016 study undertaken by the University of Michigan. The study is based on USA Department of Agriculture data evaluating the rapid increase in farmland in recent years devoted to the great expansion of corn and soybean crops used to produce biofuels. Just since 2005, biofuel production in the US grew from 4.2 billion gallons to 14.6 billion gallons in 2013.

Of course, these crops absorb CO2. Yet they did not absorb nearly enough to offset the CO2 generated in their production. In many cases, these croplands were developed from forested areas – woodlands that absorb much higher levels. Then you have massive diesel fuel consumption and subsequent CO2 emissions from crop planting and harvesting equipment. When corn is fermented to create biofuel, additional CO2 release is generated. Turns out that planting food to manufacture fuel is not such a good idea after all.

"When it comes to the emissions that cause global warming, it turns out that biofuels are worse than gasoline," said researcher John DeCicco. "So, the underpinnings of policies used to promote biofuels for reasons of climate have now been proven to be scientifically incorrect."

DeCicco added, "Policymakers should reconsider their support for biofuels. This issue has been debated for many years. What's new here is that hard data, straight from America's croplands, now confirm the worst fears about the harm that biofuels do to the planet."

Nowhere is the physical harm of the biodiesel push more evident than in the wholesale destruction of rainforests in Malaysia and much of Southeast Asia where palm oil is harvested – the source of most biodiesel sold in Europe. Out of sight, out of mind. Right?

European Union rule makers seem oblivious to the fact that the development of palm oil plantations in the region has resulted in more than 87 percent of deforestation over the past decade - and there is more to come. Thousands of indigenous people have been displaced and left homeless. And as expansion continues for the cheapest source of biodiesel, even Indonesia's famous Tanjan Putting national park – a sanctuary for many endangered species – is threatened.

Of course, when vast areas of rainforest are removed – so is the source for CO2 absorption. The forests are burned, casting a dark layer of smoke over the areas. Then the remaining scorched earth is drained before planting. The peat on the former forest floor dries and oxidizes releasing even more CO2 into the atmosphere – all so Europeans can feel good about so-called "sustainability" – and politicians can continue to virtue signal as "green" advocates.

Shipowners need not be complicit. Slow steaming, unlike biodiesel, is thoroughly proven to make significant reductions in CO2. The many technical problems of biodiesel – acid forming deterioration, fuel system corrosion, NOx increase, tank bacterial growth and seal failures – are avoided altogether.

Besides, marine equipment manufacturing companies have been diligently developing shipboard CO2 capture technologies which have already been proven highly effective in onshore applications. Alfa Laval, partnering with the Japanese shipowner NMRI, successfully demonstrated the technology shipboard just last year on auxiliary generators in port, and is working to scale up the technology for sea trials in the near future. Very likely in a few short years these CO2 scrubbers will be mandated through IMO rulemaking, relegating the biodiesel approach to yet another failed promise.

Meanwhile, if vessel owners have no choice from charterers but to bunker biodiesel blended fuels – the many handling challenges of these unstable fuels can be resolved in short order. Newport Fuel Solutions manufactures two refinery grade, 100 percent concentrated products which keep these fuels highly stable in storage, preventing bacterial growth, inhibiting corrosion and fuel degradation. Onshore operators of biodiesel tanks who have no choice but to use the fuel under certain mandates have long applied these Newport technologies to overcome the extreme storage and handling problems of these fuels.

First of these is **NP-FOT** – a refinery grade, amide/amine dispersant which inhibits oxidation of biodiesel and prevents the deterioration which leads to corrosion. This antioxidant chemistry has also proven to be a highly effective anti-corrosion tool – gently coating interior spaces for protection against moisture and acids that are often generated by biodiesel.

Since most biodiesel blends have a tendency to loosen and displace fuel system sludge deposits – which in turn can result in plugged filter and purifiers – **NP-FOT** prevents the problem altogether by working as a "peptizing" agent. **NP-FOT** seeps deeply into the fuel and migrates on a molecular level to separate materials and distribute them throughout the fuel mixture – downsizing particle size while spreading them out in an evenly balanced, colloidal suspension. This also helps to minimize the hazard of chemical contamination.

Another major issue with biofuel is potential infestation of bacteria – which feed off the fuel at the fuel water interface. Although not technically a microbicide, **NP-FOT** prevents this condition by first, emulsifying phase moisture into the fuel – preventing such an interface – then literally dissolving and dispersing any bacterial growth that heretofore may have been present before treatment.

The second product, **NP-HFO** has almost identical capabilities as **NP-FOT**. The difference is that **NP-HFO** has an additional series of amines and antioxidants to counter deterioration in long-term storage of six months or more. Both chemistries elevate thermal stability – providing the most effective deposit control system available – the same chemistries applied by global refineries for the same purpose in onshore fuels. This makes either product extremely useful in the event a vessel opts for slow steaming.

To summarize, in decades of emissions testing under stringent EPA protocols, biofuels have shown no capability to effect CO2 emissions. NOx emissions, immediately more damaging, are increased – the primary reason why the State of California refuses to certify biodiesel as a "clean fuel". Biofuel production methods not only withdraw massive areas from food production, planting and harvesting methods coupled with mass deforestation contribute significantly to global CO2 emissions. As always, it comes back to money – free money to those who develop and grow the soy, corn, palm trees and other plants from which biofuels are derived.

But nothing is free. More than 60 countries provide subsidies to producers. Prices have dramatically escalated in recent years in tandem with those for food. Meanwhile whole ecosystems are destroyed, and low-income populations go increasingly hungry with food price escalation. Meanwhile, we all pay and pay dearly, all in the wholly false narrative of "green energy".

As Frances Seymour of the Center For Global Development concludes, "The bottom line is that biofuel subsidies in rich countries are bad for development by increasing the costs of food and driving tropical deforestation even while failing to reduce the emissions that cause climate change. In addition, they set a bad example for developing countries to follow."