Down River

The Navy's 'flex-fuel fleet' starts with RCB-X

Written by: **Eric Tegler** on December 31, 2010

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Sailors assigned to Riverine Group 1 stand their post aboard a Riverine Command Boat (Experimental) (RCB-X) as the boat conducts test runs at Naval Station Norfolk. The RCB-X was powered by an alternative fuel blend of 50 percent algae-based and 50 percent NATO F-76 fuels to support the Secretary of the Navy's efforts to reduce total energy consumption on naval ships. U.S. Navy photo by Mass Communication Specialist 2nd Class Clifford L. H. Davis.

In October, Naval Sea Systems Command (NAVSEA) put some power behind Secretary of the Navy Ray Mabus' drive for a "Green Strike Group" demonstration by 2012 and the deployment of a "Great Green Fleet" running entirely on alternative fuels by 2016.

The power emanated from the twin diesels that propel the RCB-X or Riverine Command Boat – Experimental. The Navy is evaluating RCB-X for future use with the Naval Expeditionary Combat Command. The 49-foot platform is being used for a variety of experimental purposes, including the initial test and scale-up of marine biofuels. On Oct. 22, NAVSEA ran a "full-power" biofuel demonstration of the RCB-X at Hampton Roads.

The fuel in question is a 50/50 mix of algae-derived biofuel and NATO F-76, which forms a blend of hydro-processed renewable diesel, also known in industry as "HR-D." The blend is considered a "drop in replacement" to standard shipboard fuel and, in that sense, mimics the drop-in aviation fuels the services are testing in the F/A-18 Hornet, A-10 Thunderbolt and SH-60 Sea Hawk.

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"It won't make any difference from the boat's standpoint whether it's operating with F-76 one day and refuels with a 50/50 blend a week later, then is refueled with petroleum again," says Gregory Toms, NAVSEA's Fuels/Lubricants Technical Warrant Holder. "That's the criterion for the development of these fuels, to be a complete drop-in. The logistics trail, whether it's supply ships or shoreside, there's no noticeable difference. The fuel should be completely transparent."

The alternative-fueled RCB-X conducts full power maneuvers while being followed by Riverine Command Boat (RCB-1) at Naval Station Norfolk. U.S. Navy photo by Mass Communication Specialist 2nd Class Clifford L. H. Davis.

HR-D is essentially what is called a "second generation" biofuel. It does not include water, which is incompatible with shipboard fuel systems, and does not have the limited serviceable life (about six months) of biofuels. A blended hydro-processed renewable diesel fuel ensures that the integrity of existing fuel systems is not compromised.

The algae portion of the blend is grown in Riverside, Pa., by Solazyme, a San Francisco-based synthetic biology firm that announced a contract with the Defense Logistics Agency (DLA) to supply 150,000 gallons of its algae-based fuel in September. Solazyme grows algae in large vats and extracts oils for applications including cosmetics, food, and fuel.

The company's patented process requires no sunlight and uses sugar as a feedstock. The process is similar to fermentation, Toms explains; the algae matures and has water removed on site. The dry algae is then packaged and sent to the Midwest, where oil is extracted and shipped in its raw state to Texas. There, it's refined and processed like any other oil. This raw or "neat oil" is then sent to NAVAIR at NAS Patuxent River, Md., where it's blended with F-76 to create the HR-D blend. There are considerable similarities between 100 percent algae fuel and F-76, Toms points out. The algae fuel is somewhat less dense than F-76, so on a weight basis it has a higher energy content. However, on a volume basis (as with most liquid alternative fuels) the energy content is slightly less.

The blend is entirely sourced from within the United States. The production process is expensive (the blend is estimated to cost approximately $60/gallon) and the volumes are still quite small, Toms acknowledges. "But, we're capturing CO2 during the algae growing process. So it's a much cleaner production process which doesn't emit as many greenhouse gases as a fossil fuel."

And thus far, the blend is working well.

"It performed as we had anticipated," Toms confirms. The operators of RCB-X said they couldn't tell any difference between using F-76 and the 50/50 algae blend."

In fact, the RCB-X achieved 44.5 knots during the full power test, above the craft's rated 43 knots. NAVSEA is still evaluating additional test data, but the RCB-X's diesel power plants appear to have produced their maximum 1700 horsepower without major issues.

That's a promising sign, since the RCB-X test is only the second in a series of evaluation/demonstrations NAVSEA intends to run, proving the biofuel blend in progressively larger and different types of power plants. The first demonstration was actually carried out in July of this year using a seven meter Ribcraft inflatable boat with a 250-horsepower diesel engine.

Rear Adm. Philip Cullum, director of the Energy and Environmental Readiness Division, left, and Rear Adm. Michael P. Tillotson, commander of Navy Expeditionary Combat Command, show the alternative fuel blend of 50 percent algae-based and 50 percent NATO F-76 fuels during a press conference at Naval Station Norfolk. The fuel was demonstrated by the Riverine Command Boat (Experimental) (RCB-X) to support development of the Secretary of the Navy's efforts to reduce total

"We started small," Greg Toms relates, "and we're gradually working our way up through larger engines. The RCB-X is the second in this series of demonstrations. We decided to use RCB-X because it was available at Fort Monroe [Va.] and it's an experimental platform for R&D purposes. We weren't specifically trying to look at differences between RCB-X and RCBs. We needed a platform to get some data with quickly."

NAVSEA's biofuel testing generally follows two tracks – land based or "fit-for-purpose" laboratory testing and shipboard demonstrations. The former ensures that whatever biofuel blend is being considered meets F-76 specifications.

"We want to just slightly modify that [F-76] specification so we can allow this algae fuel to be used in the future," Toms explains. The algae blend must have highly similar thermal and storage stability, lubricity, and corrosion qualities to F-76 if it is to be a successful drop-in.

energy consumption on naval ships. U.S. Navy photo by Mass Communication Specialist 2nd Class Gregory N. Juday.

"We have a long history with petroleum. We've been operating ships with diesels and gas turbines for a long time so we have a historical database. We don't have that with algae fuels so we need to know how they're going to perform. Fit-for-purpose testing provides us with the information to ensure that the blend performs like petroleum does. We also need to make sure that if there is a fire on ship, it can be fought with the same equipment and expertise that sailors currently have."

The land-based testing will prepare the way for a number of platform demonstrations in 2011 Toms adds.

"We have other tests ongoing, including the Cummins QSB [diesel] engine which is being done in a controlled environment, so we'll be able to get data to see how well the fuel matches up from a performance standpoint. There are other demonstrations, including one using a [Yard Patrol Boat] at the U.S. Naval Academy next year. We plan on looking at an LCAC [Landing Craft Air Cushion] in the spring to summer time frame. That will be our first operation of a [biofuel blend-powered] gas turbine on a boat. In February 2012 we'll be testing [the blend] on a [Self Defense Test Ship]. All of these shipboard tests will support the drive to the demonstration of a carrier battle group and ultimately, sailing a bio-fueled fleet in 2016."

Not surprisingly, the Navy has a huge inventory of different sizes and types of diesel engines and various turbines. Testing the algae blend in all of them is simply impractical, but the results from selective power plant testing can be extrapolated, Toms says.

"We've talked to the different tech warrant holders here at NAVSEA and gotten their buy-in on which engines they'd like to see tested. We've asked them – if the performance meets the specification on those engines, can they extrapolate [the results] to other engines? So we've gotten a [collaboratively] compiled list of engines that we will be testing. On the gas turbine side we've really only done land-based testing with the Rolls-Royce 501K-34. Again, we've had discussions with the tech warrant holders and they've said that if the fuel meets the performance requirements for that engine, they envision it to be acceptable on the propulsion side."

As for the cost of biofuel, Toms emphasizes that the Navy is qualifying various blends so they can be used, but not driving the market. Industry will ultimately decide which products are produced and distributed.

"These companies are looking at how they can improve efficiencies and reduce costs. The raw materials cost is a consideration right now. The algae is grown with a feed source that is sugar and sugar-type products. So the cost of the fuel is very high, but it has come down drastically in the last year. We're hopeful that it will continue to drop as [developers] continue to improve their performance. There will be [favorable] economics when they get into large scale production."

Though algae is the prime ingredient in the blend NAVSEA is testing to F-76 specifications, Toms agrees that it is quite similar to the camelina seed blend NAVAIR is testing in aircraft and that there is potential crossover.

"In the long term we envision that the alternative fuel could come from either of these sources or additional sources. It's a family of fuels that we're looking at."

Likewise, a scenario in which an RCB-X or other craft sorties with tanks full of conventional diesel, performs a portion of its mission, and is refueled with a bio blend before continuing on fits well with the Navy's vision of a Flex-Fuel Fleet, Toms agrees.

"Absolutely. The Navy travels all over the world, and petroleum will be available in some places and we envision that an alternative fuel would be available in other places. It won't make any difference whether [a ship] is getting F-76 or biofuel X or biofuel Y. As long as they're meeting our specifications, that's all we need."

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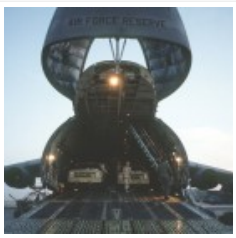

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