



# Does This Stuff Really Work?

**Soybean-based biodiesel vs. regular diesel fuel—we do a real-world, real-boat wring out.**

**By Capt. Bill Pike • Photos by Martin H. Simon**

When I first came up with the notion of modifying a modern recreational vessel so I could do a side-by-side performance comparison between plain ol' diesel fuel and the environmentally friendly, vegetable-based stuff getting so much press these days, the idea didn't seem that complicated. I mean, how tough could it be? All I had to do was find a boat, install a temporary bladder-type tank in her

cockpit, cross-connect the tank with the existing fuel system via valves and fuel hoses, and hook up the *PMY* test gear. Right?

Not quite. When I started playing with the project's preliminaries several months ago, I quickly struck a big, fat snag.

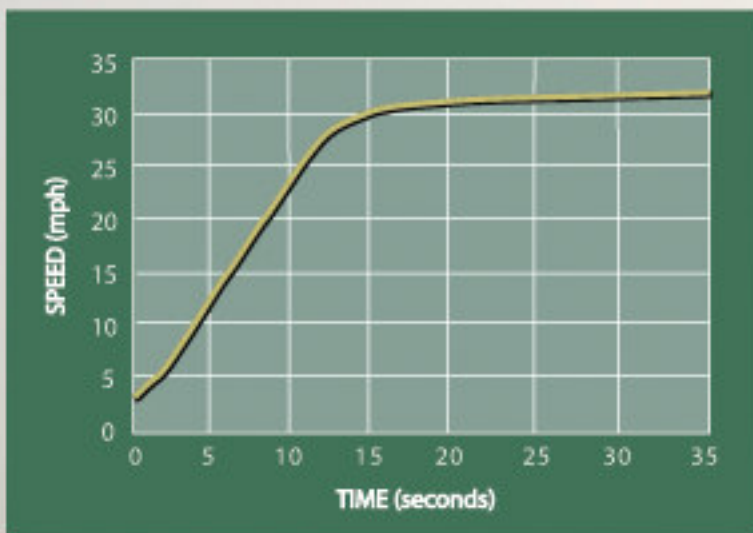
Oh, I know. Scads of upbeat stories about fuels made from vegetable oils or animal fats are appearing on TV and in news-

**Glacier Bay  
3470 Ocean  
Runner  
operating  
with regular  
#2 diesel fuel**

RPM	MPH	(KNOTS)	GPH	MPG	(NMPG)	SM RANGE	NM RANGE	DECIBELS	TRIM (DEGREES)
600	6.0	(5.2)	1.0	5.95	(5.17)	1,607	1,397	66	0.0
1000	8.7	(7.5)	2.9	2.98	(2.59)	805	700	71	1.0
1250	9.7	(8.4)	4.6	2.10	(1.82)	566	493	73	3.5
1500	10.6	(9.2)	8.8	1.20	(1.04)	324	281	77	5.5
1750	13.7	(11.9)	13.3	1.03	(0.90)	278	242	78	6.0
2000	18.4	(16.0)	17.4	1.05	(0.92)	285	248	80	6.5
2250	22.7	(19.7)	21.9	1.04	(0.90)	280	243	82	5.0
2500	26.2	(22.8)	26.7	0.98	(0.85)	265	230	83	5.0
2750	29.8	(25.9)	33.1	0.90	(0.78)	243	211	85	4.5
2950	32.1	(27.9)	39.4	0.81	(0.71)	220	191	87	4.0



Most experts agree that biodiesel's easy on the environment.



These acceleration curves indicate a smooth, steady transition to plane, thanks in part to the high-pressure, common-rail technology of our fully electronic Cummins QSB380 HO's.

\* Acceleration based on an average of 4 reciprocal runs.

papers and magazines these days. I've read many of them myself. They tout virtues like resource renewability; reduced dependence on foreign oil; speedier biodegradation after spills; increased lubricity for decreased engine wear; increased safety due to lower flash points; and reduced emissions. Additionally, marine-related programs and publications often add stuff about water taxi and other fleet-type operations that are going great guns on either B100 (100 percent biodiesel) or some blend of B100 and regular diesel that offers the above benefits at proportionately diminished levels.

But the marine business is a conservative one, particularly when we're talkin' dollars, cents, and warranties. In fact, few if any engine manufacturers today will warrant their products once biodiesel enters the picture (see "Warranty Fuzziness,"

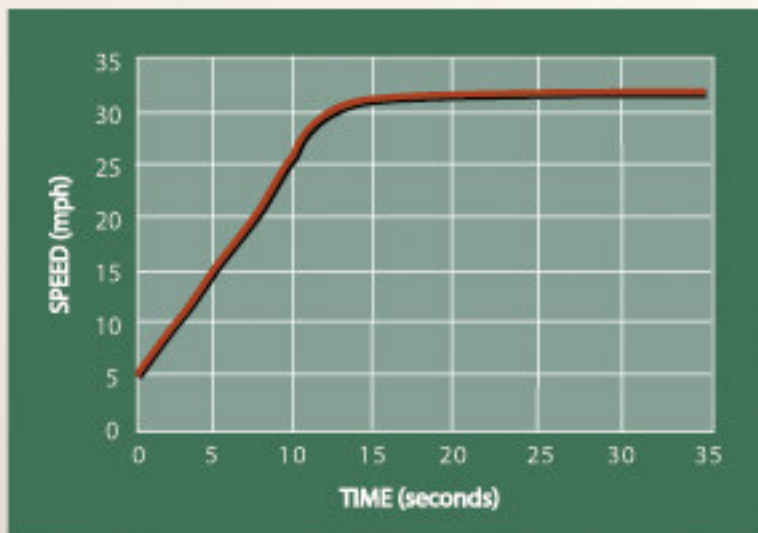
this story), and that's not likely to change soon, considering the scarcity of solid, field-tested data. So I wasn't real surprised when a warranty-related problem surfaced just days after I'd begun organizing my wring out. Here's what happened.

Although Glacier Bay Catamarans, which builds efficient, displacement-type powercats, had valiantly agreed to make a diesel-powered 3470 Ocean Runner available for testing (see "Fast Track," this story) as well as temporarily install an extra fuel system so we could operate on two fuels without contaminating either, the company was worried about warranty, understandably. What if a mechanical problem occurred? What if it proved catastrophic? Who'd pony up \$90,000 for two french-fried diesels?

Good questions, of course. And after many phone calls and

RPM	MPH	(KNOTS)	GPH	MPG	(NMPG)	SM RANGE	NM RANGE	DECIBELS	TRIM (DEGREES)
520	6.1	(5.3)	1.0	6.37	(5.54)	1,719	1,495	66	0.0
1000	8.6	(7.5)	2.9	3.02	(2.62)	815	708	71	1.0
1250	9.9	(8.6)	4.5	2.20	(1.91)	594	517	74	3.5
1500	10.8	(9.4)	8.8	1.23	(1.07)	331	288	77	6.0
1750	14.7	(12.7)	13.0	1.13	(0.98)	304	265	78	5.5
2000	19.3	(16.7)	17.4	1.11	(0.96)	299	260	81	6.0
2250	23.2	(20.2)	21.6	1.07	(0.93)	290	252	82	5.0
2360	26.4	(23.0)	26.2	1.01	(0.88)	272	237	83	5.0
2750	29.8	(25.9)	33.1	0.90	(0.78)	243	211	85	4.5
2950	32.1	(27.9)	39.3	0.82	(0.71)	220	191	86	4.0

**Glacier Bay  
3470 Ocean  
Runner  
operating  
with B20  
biodiesel fuel**



Because inconsistencies arise when coordinating radar-gun activation with throttle advancement, starting speed for the biodiesel curve is slightly higher than it is for the regular diesel curve.

\* Acceleration based on average of 4 reciprocal runs.

**TEST ENGINES:** 2/375-hp Cummins MerCruiser Diesel QSB380 HO diesel inboards w/ 2 fuel systems  
**TRANSMISSIONS/RATIO:** ZF (V-drive)/1.64:1  
**PROPS:** 22x22 Acme 3-blade bronze  
**CONDITIONS:** temperature (with heat index): 112°; humidity: 97%; wind: variable, light; sea: less than 1'; load: 110 gal. #2 diesel fuel and 30 gal. biodiesel for portion of test featuring regular diesel fuel; 97.1 gal. #2 diesel fuel and 30 gal. biodiesel for portion of test featuring biodiesel fuel; 4 persons onboard for regular diesel fuel test; 3 persons onboard for biodiesel fuel test; and 100 lbs. gear. Speeds are two-way averages measured w/ Stalker radar gun. GPH taken via SmartCraft fuel monitoring system. Range: 90% of advertised fuel capacity. Decibels measured on A scale. 65 dB is the level of normal conversation.

## Emissions Comparison

To help us do a complete biodiesel vs. regular diesel wring out, Cummins MerCruiser agreed to gather emissions data on our two test fuels as burned in a 375-bhp QSB380 HO diesel—the same engine in our test boat but temporarily installed in a dynamometer in one of the company's test cells at its Charleston headquarters. Here are the results:

- NOx (oxides of nitrogen):** 3.1% higher for B20
- HC (hydrocarbons):** 10% lower for B20
- CO (carbon monoxide):** 14% lower for B20
- PM (particulate matter):** 14% lower for B20

These findings closely parallel data published by the National Biodiesel Board. Smog and ozone-forming NOx emissions generally increase with biodiesel fuel (topping out at approximately ten percent for B100), but all other parameters decrease substantially. Moreover, and in keeping with the data we recorded, CMD found that brake-specific fuel consumption and maximum rated power were virtually identical.

—B.P.

much corporate-level consultation, Cummins MerCruiser Diesel (CMD), one of Glacier Bay's suppliers, came up with the answer. "We're onboard with the project," affirmed CMD president Scott Patrohay. "The resulting data will be useful to us as well as to your readers."

Patrohay added that Cummins would cover all potential warranty claims, even catastrophic ones. It would send assistant chief engineer Mike Abraham to the test site on test day to both monitor engine performance and lend a hand. It would gather emissions data on our two test fuels by running them in a test cell at CMD headquarters in Charleston, South Carolina, using an engine that was identical to the two 375-hp Cummins MerCruiser Diesel QSB380 HOs on our Glacier Bay. And it would blend a so-called B20 mixture (20



Folks hanging around the marina on test day asked, "Are your test engines special in any way?" Nope, we replied, while lugging test fuel to the boat.



**Above:** Chris Butler (with hat and sunglasses) and Lady's Island Marina manager Joe Nilles look on while Abraham (right) and the author top off fuel jugs. **Right:** Abraham and the author top off the bladder tank onboard our test boat.

percent biodiesel and 80 percent regular diesel) for usage at the *PMY* test site as well as in the test cell at Charleston. While numerous vessels are presently using B100 with reported success around the world (see "Earthrace Saga," this story), B20 is currently more quality-controlled and more generally accessible. We deemed it the best sort of biodiesel for a wring out.

Test day dawned hotter than hell, as if to underscore the gloom of global warming. The National Weather Service heat index for our testing venue—Beaufort, South Carolina—was predicted to peak near 112°F. At eight o'clock in the morning, Abraham pulled into the sweltering parking lot of Lady's Island Marina in a CMD pickup truck with tank of B20 in the back. Chris Butler of Butler Marine, Glacier Bay's local dealership, arrived almost simultaneously, and so did *PMY* photographer Martin Simon and me.

We set to work immediately, offloading B20 into five-gallon jugs and lugging them to our 3470, *Smooth Ice*. As the morning wore on, folks hanging around at the marina began exercising their curiosity. I explained that *PMY* had purchased a drum of soy-based B100 for \$4.13 per gallon from West Central, a bulk distributor in Ralston, Iowa; that CMD had converted the stuff into B20 in Charleston; that B20 was obtainable at many gas stations in South Carolina and indeed across much of the country; and that "the warranty thing" and other issues should be investigated well before





# Fast Track

## GLACIER BAY 34

**O**ur Glacier Bay Catamaran's 3470 Ocean Runner was a solid performer regardless of which fuel her two 375-bhp CMD QSB380 HO diesel inboards burned. Top speeds were the same, a sporty 32.1 mph, and although running attitudes peaked near six degrees coming out of the hole, visibility was always good, the elevated express-style helm being the explanation.

Sound levels (see test data, this story) were fairly high because our extra fuel system necessitated leaving the engine-room hatches open. Tracking was excellent, and there was negligible outboard lean in higher-speed turn. Given the calm conditions during our wring out, I couldn't gauge the rough-water handling of our 3470.

Our instrument panel was uncomplicated and easy to read, with savvily laid-out (optional) electronics from Simrad, SmartCraft gauges, controls for the Lenco electric trim tabs (which I didn't need to use after determining they worked), and a Vetus windshield-wiper control. Below decks, finish was top-shelf. The galley is small but efficiently outfitted, there's a separate shower stall, and the mattresses in the two staterooms are innerspring-type Handcrafts. A Clarion AM/FM stereo/CD player at the helm, with speakers below decks as well as above, rounded out the ample complement of creature comforts.

The 3470 is a real, kick-back-and-go-for-it cruising machine, and she's comparatively fast, too.

—B.P.

Glacier Bay Catamarans ☎ (360) 794-0444. [www.glacierbaycats.com](http://www.glacierbaycats.com).

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### SPECIFICATIONS

**Length overall:** 34'0"

**Beam:** 13'3"

**Draft:** 3'8" (maximum at cruise load)

**Weight (dry):** 18,700 lbs.

**Fuel capacity:** 300 gal.

**Water capacity:** 60 gal.

**Steering:** Teleflex Sea-Star hydraulic

**Controls:** Teleflex electronic

**STANDARD EQUIPMENT** | piggy w/ roller, 6/water-tight compartments w/ Johnson bilge pumps, Force 10 stove, Nova-Kool refrigerator, Sharp convection-type microwave oven, Handcraft innerspring mattresses, 6/1ster-stale bathtubs (4 showers, 2 hoses), 11-gal. Seaward stainless steel water heater, 2/10-cu-ft. fishboxes, bait-grip center w/ 47-gal. bait tank, electric MSD

### OPTIONAL EQUIPMENT ON TEST BOAT

Simrad electronics; helm tower w/ hardtop and controls; 3.8-KW Fockler Panda genset, 18,000-Btu Marine Air A/C

**Price as tested:** \$564,118 (approx.)

pumping B20 into a diesel-powered vehicle.

We did the wring out on the Beaufort River over a period of three hours. During that time a slowly ebbing tidal current remained unchanged, and the wind stayed variable and light. There were four of us onboard for the first, regular-diesel-fueled portion of the test but just three stayed onboard for the

second, B20 portion. Fuel load for the B20 portion was also a bit lighter due to the consumption during the earlier regular-diesel runs. Taking into account the hefty 18,700-pound dry displacement of the 3470, however, we calculated the difference in test-boat weights—regular vs. biodiesel—at just 250 pounds, giving only a slight advantage to the latter fuel.



**Above left:** Our 3470 featured a comfy, queen-size Handcraft innerspring mattress in the port stateroom. **Above right:** The full galley offers numerous ventilation-enhancing louvered-leak doors.

Results were intriguing. Performance differences between the two fuels were so small (see test data, this story) as to be immeasurable with *PMY*'s test equipment. Basically, we got the same speeds, the same fuel burns, and the same acceleration curves, disregarding operator-error-generated differences in starting speed. Butler and I drove the 3470 with both fuels coursing through her mains, and neither of us could quantify any handling differences whatsoever. B20's only distinction was its total lack of smoke and smell! We were all big-time impressed.

## Earthrace Saga

New Zealander Peter Bethune, a one-time oil-exploration engineer now solidly into 100-percent biodiesel-powered propulsion, is betting he can break the world record for circumnavigating the globe in a powerboat. He figures *Earthrace*, his wave-piercing trimaran, can do the job and then some, thanks to a set of off-the-shelf 540-hp Cummins MerCruiser QSC8.3-540 diesels, a superslippery running surface, and a 2,500-gallon fuel capacity that should provide a range of 3,000 nautical miles.

At presstime Bethune had just arrived with *Earthrace* on the West Coast, having crossed the Pacific from Hawaii in seven days (at cruise speeds of 15 to 20 knots) using B100. When we caught up with him in Vancouver, British Columbia, he told us the trip had gone slicker than soybean oil. "We had to work out a few issues with the steering system and the ballast tanks, but...except for the wake-boarding we did in the midst of the Pacific, the trip was quite uneventful."

After touring ports around the world, including Miami for the 2007 Miami International Boat Show, touting the virtues of biodiesel and *Earthrace*, Bethune and his crew will make their record-breaking attempt next spring.

Bethune's an interesting guy. During his years as an oil-exploration engineer in the North Sea and later along the coast of North Africa, he told *PMY*, it was common knowledge that the world's oil reserves would dry up in approximately 50 years and natural gas ones in approximately 75. "Such numbers didn't sit that easy with me at the time," he added, "and they still don't."

His interest in alternative fuels began to grow soon after he left the oil business, mostly thanks to alternative fuels research he undertook while he was enrolled in an MBA program in Sydney, Australia. Toss in weekends and holidays spent boating, fishing, and diving along the coast of Australia, and you



**Above:** *Earthrace* is a B100-powered 78-foot trimaran with carbon fiber and Kevlar laminates and engine air intakes atop her "wings" to facilitate breathing in the wave-piercing mode. **Below:** *Earthrace*'s proposed around-the-world route.



begin to get the point of the *Earthrace* project. Bethune's on a mission: to break the around-the-world speed record set by Cable & Wireless in 1998 and, in the process, help save the planet. —B.P.

# Warranty Fuzziness

If you peruse the policy statements of diesel-engine manufacturers on biodiesel usage, you're likely to come away scratching your head at their near-identical language. On the one hand, most manufacturers officially state that the use of biodiesel does not affect their materials and workmanship warranties. On the other, they also officially state that problems resulting from the use of it are not defects of workmanship and/or materials and therefore will not be covered under warranty.

"All this is pretty confusing," says Tom Verry of the National Biodiesel Board, "especially to the public at large. In fact, about the only advice I

can give the individual boat owner who wants to burn biodiesel is go to his engine dealer and talk it over with him—see what he says."

Don't expect a positive response, however. Most dealers will turn thumbs-down on biodiesel, according to Verry, at least where an individual customer's concerned. He hastens to add, however, that fleet operations fielding many vessels and therefore swinging lots of business a given dealer's way will fare much better because of their increased financial clout. "Most of these guys will get good warranty coverage for biodiesel right now," Verry explains.

The good news? With help from manufacturers like Cummins and others, several regulatory agen-

cies are addressing standardization issues that currently muddy the waters for biodiesel blends in the marketplace and keep manufacturers from getting fully onboard with the fuel. At presstime *PMY* asked a major engine manufacturer (other than Cummins) if biodiesel will ever win full acceptance within the marine-diesel community. "Absolutely," said the rep, who asked to remain unidentified. "All the engine manufacturers are doing right now is waiting for and working toward sufficient standardization to ensure the availability of good, high-quality fuel. Then biodiesel's gonna take off—and the whole warranty thing'll be history." —B.P.



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**Above:** Butler takes the helm while the author wields a radar gun and CMD's Abraham records performance data. **Left:** Abraham and the author evince considerable test-related nervousness during the actual switch over from regular diesel to B20—two new Cummins electronic diesel engines hung in the balance! **Below:** Fuel testing in torrid 112°F temperatures calls for constant, Gatorade-infused, electrolyte replenishment.

Sure, biodiesel's got its drawbacks at present, things like a reported six-month shelf life; the tendency of high concentrations to break down rubber fuel hoses and gaskets on older engines; availability problems; and the aforementioned warranty issues. But engineers are developing shelf-life-extending additives; modern engines from Cummins and others typically have synthetic gaskets and hoses that won't break down; availability's on the rise; and the marine industry's stance on warranties may change as standardization solidifies and the cost of regular diesel skyrockets.

More testing is needed, of course. A one-day wring out of one boat is not definitive, especially when shelf life and other stumbling blocks may surface only after lengthier periods. Nevertheless,



right now, I'd say B20 works! In the real world. On real boats.

We proved it. 🍷

**Butler Marine** ☎ (843) 522-9461. [www.butlermarineinc.com](http://www.butlermarineinc.com).

**Cummins MerCruiser Diesel** ☎ (843) 745-1400. [www.cummins.com](http://www.cummins.com).

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