

Hurricane Sandy in 2012 left hundreds of damaged and destroyed boats in its wake.



The Fiberglass Dilemma

Is there an alternative to landfill endings for old hulls?

When Texan Pat Zagar moved his boat salvage business three years ago, he had to find a way to dispose of the 200 hulls stored on his property. "I'm in the boat recycling business, and I could not find a place that would

take the fiberglass," says Zagar, 57, of Houston, who dismantles boats for parts and sells them. So he dumped them into a landfill, where the fiberglass will sit for years. It cost him \$40,000 to trash more than 1,100 tons of hull material.

"We do the environment a good turn by getting these boats out of the water, getting them out of people's backyards," says Zagar, who started salvaging boats in 2008 after Hurricane Ike roared through Galveston, causing \$200 million in damage to boats alone.

Cleaning up the waters and shoreline "is a good thing," he says. "Taking the hulls to the dump is a bad thing, but I can't see any other way to do it right now."

He says he could have bought a machine for \$100,000 to grind pieces of fiberglass hulls into small glass fibers and powdered resin, then tried to sell the material as an additive to virgin fiberglass in some manufacturing processes or to make pilings, fence posts, manhole covers, boardwalk planks, parking stops and other wood substitutes.

But Zagar says the market for recycled fiberglass is too small and fragmented, and the price for recycled fiberglass is too low to justify trying to recycle it.

He's better off dumping the hulls for \$35 a ton. He has a 17-foot hull and three more 30- to 40-foot hulls — all stripped and at the end of their useful lives — and they'll probably end up in the dump, too. "I'd love to see a use for them, but there isn't, to my knowledge," he says. "It's all about dollars and cents."

Filling The Landfills

Recycling fiberglass hulls has been a concern to retired naval architect Eric Sponberg for nearly two decades. In an article he wrote for *Professional BoatBuilder* magazine in 1999, Sponberg, of St. Augustine, Florida, says it probably will take a generation to make real progress in recycling fiberglass boat hulls in this country.

"It's been nearly a generation now, and we've not seen any progress," Sponberg says. "The problem is not going away. We've got



Recycling fiberglass is one solution, but some say the market for recycled glass is too small to justify the costs.



The need to recycle end-of-life hulls will become even more urgent as U.S. landfills reach their capacities.

“What’s the cheapest way to get rid of a boat?” Sponberg asks. “Abandon it along the side of a canal or at the back of a marina.”

In Florida alone there are an estimated 1,500 abandoned or derelict boats, says Phil Horning, the state’s derelict boat program administrator. The 275 derelict boats in the state’s active case file will probably cost \$3.5 million to clean up. Extrapolating from those figures, cleaning up the entire mess probably will cost more than \$20 million. As the derelicts are cleaned up, they probably will be broken up, loaded onto a roll-off dumpster and trucked to the nearest landfill, he says.

There are about 12 million registered boats in the United States and 6 million in Europe, most of them fiberglass. A 2007 report by the International Council of Marine Industry Associations estimates that a well-kept fiberglass boat easily can last 50 years, during which time it likely will change owners several times. But “even the best-constructed craft someday will have to end its life,” the report notes.

Then what? In Europe, where vacant land is scarce and the state recycles cemetery plots — in Greece, survivors rent a space for their loved one for three years, then move the body to a communal osuary — profligate use of landfills for waste disposal is becoming unsupportable. Just before the Marine Equipment Trade Show in Amsterdam last November, Quaynote Communications and Yachtmedia hosted a day-long conference, “The Future of Yacht Recycling.”

European Solutions

Europeans seem to be making headway in dealing with the problem. In a report about the conference, organizers said:

- A network of 52 yacht disposal points, where vessels are turned in so they can be cleaned, dismantled and turned over to a recycling company, has been operating along the French coast since 2009 under the umbrella of the French Nautical Industries Association. It has handled about 4,000 boats.
- Sweden, Norway, Denmark, Spain and Japan also are recycling fiberglass hulls, and the Netherlands has several companies offering yacht disposal services. One of them dismantles a boat every day, on average.
- Disposal prices range from \$325 for a small dinghy to \$2,400 for

a 52-foot fiberglass yacht and \$1,635 for a typical 32-foot boat. About 30 percent of the cost is to transport the boat to the disposal yard.

- Boat owners see recycling as an option, but the cost appears to be a deterrent. Owners accept just 10 percent of the quotes for scrapping end-of-life boats.

- Conferees heard that taxpayers might have to foot the bill for some end-of-life disposals. There also was discussion about the industry developing a scheme for raising money for boat disposal, perhaps by charging a fee that is incorporated into the sales price whenever a boat is transferred to a new owner.

- The most feasible technology for recycling fiberglass for now seems to be a mechanical one: shredding the material into particles and combining it with other materials or resins to create a new composite for use in a new product.

Researching Fiberglass Recycling

One of the biggest challenges to recycling fiberglass hulls in the United States is that generally landfills still are willing

to find a way to take these end-of-life hulls out of the stream of commerce and get them back into the stream of commerce” — recycle and reuse the fiberglass instead of trashing it.

Even disposing of a hull in a landfill can be problematic. Often the owner of an end-of-life boat can’t afford the disposal fee, which can be \$95 to \$100 a ton or \$5 a foot, plus the cost of transporting the boat or, if it’s sunk, thousands more to raise it.

Florida Initiative Is A Good Start

Although it hasn’t figured out how to keep “end-of-life” boats out of the landfill, Florida is working on getting these eyesores out of circulation and, where possible, keeping older boats from falling into irreversible disrepair and becoming derelict.

The state now has a category of boat called “at-risk.” “If an officer sees a vessel that has indications that it may become derelict in the near future, he leaves a notification for the owner,” says Phil Horning, Florida’s derelict boat program administrator.

That notification — and a letter mailed to the registered owner — lists the indicators that the boat is falling into serious disrepair. If the owner corrects the deficiencies and notifies the officer, the boat is taken off the “at-risk” list.

But owners who do nothing could face a criminal misdemeanor charge and revocation of their registration privileges. If the boat has to be removed, the owner is liable for that cost, as well — as much as \$10,000 to \$15,000, if it’s in the water — and could face more fines.

Horning’s office has submitted a 2016 budget request allowing Florida counties to keep an as yet undetermined percentage of the boat registration fees they collect and earmark the money for cleaning up derelict boats. Borrowing from a program in California, Monroe County (the Florida Keys), where derelicts are a big nuisance, is set to begin a five-year pilot program in 2017 that will allow owners to apply to turn their old boats in to the county for disposal in the landfill at no cost to the owner.

“The county pays for it,” Horning says. “It [helps] people who don’t have the means to do the right thing” — that is, dispose of the boat properly instead of abandoning it in a canal. “Hopefully this will be a preventive program that will decrease the cost of distressed vessel removal,” he says.

to accept hulls and at a price that makes this option more economical than recycling. "Most states have sufficient space for dumps where you can throw away an old boat hull," says Dennis Nixon, professor and director of the University of Rhode Island's Sea Grant.

That soon may end in Rhode Island, which has only enough space in its landfills to dump for 23 more years. Then it will have to start using out-of-state dumps. Nixon says other states soon will ask the same question as Rhode Island: "What can we stop putting into our landfills?" Fiberglass hulls?

Working with the state's marine businesses, Sea Grant is putting together a request for proposals for a "modest grant" to come up with innovative ideas for recycling fiberglass — hulls and scraps from marina, boatyard and boatbuilding operations — and for developing a market for the recycled material. "It's a start," Nixon says.

Most of the research has involved three fiberglass-recycling technologies.

- Incineration, or "thermal oxidation," burns organic material in the resin to create heat for other purposes, such as making steam to power turbines, but incineration produces air pollution and leaves ash, which ends up in the landfill, says Sponberg.

Typically fiberglass resin "contains only 25 to 30 percent organic material, so its heat content is low, and its ash content is high," he says in his 1999 article "Recycling Dead Boats" for *Professional BoatBuilder*.

- Pyrolysis — heating the material in an inert atmosphere to recover the polymer as an oil — prevents combustion and minimizes air pollution, says Kyle Bartholomew, author of the 2004 article "Fiberglass Reinforced Plastics Recycling" for the Minnesota Technical Assistance Program.

The fiber is recoverable using this technology, but the extreme heat can damage the fibers, and the recovered oil can be used as fuel or to regenerate chemicals in the resin, Bartholomew says.

- The use of chemicals that separate the resin from the fibers. The fibers retain most of their original strength with this method, but it typically requires granulating the scrap, which reduces fiber length, and it involves using potentially hazardous solvents, according to Bartholomew.

Like pyrolysis, chemical recycling is capital-intensive, so it's not much of an option for a small operator.

In 2011 Norwegian researchers reported developing a chemical process that separates polyester from fiberglass and makes about 80 percent of the original material available for reuse, but hurdles remain: ensuring that the raw material is clean and successfully separating the fiberglass from core material. Norway is eyeing this process as a way of eventually recycling fiberglass hulls.

- Mechanically grinding fiberglass into loose fibers and powdered resin and using the recycled material to replace as much as 35 percent of the fiberglass in new products. Eco-Wolf, of Edgewater, Florida, has machines that grind fibers to a length of 1/8 inch to 1 inch, depending on the manufacturer's desires. One of its machines grinds 800 pounds of fiberglass an hour, and a larger one grinds 1,700 to 1,800 pounds an hour, says Eco-Wolf sales manager Bruce Ogilvy.



Recycled fiberglass can be used in the manufacture of a variety of products, from pilings to boardwalk planks.

Ogilvy's sales pitch: "Why pay the landfill to take your waste when you can recycle it, use it to manufacture a product and turn the waste fiberglass into a moneymaker?"

Ogilvy says anyone with the vision to develop a market for the repurposed fiberglass can incorporate the recycled material into a variety of products: fence posts, boardwalks,

manhole covers, pots for plants, stepping-stones and parking stops.

Sounds sensible, but Ogilvy says there are at least two challenges. There must be enough large recycling centers around the country that will take in enough scrap fiberglass and dismantle enough fiberglass hulls to give manufacturers a reliable source of recycled fiberglass and a large enough market for recycled products to support those recycling centers.

"It's going to take someone with the foresight to see that this raw material is just lying around waiting for someone to do something with it," he says.

It's a chicken-or-egg kind of problem. Boat salvager Zagar says he would buy that \$100,000 fiberglass grinder, but it won't turn a profit unless he has a market for the recycled fiberglass. He says that market does not exist now.

In Port Angeles, on Washington's Olympic Peninsula in a region where aircraft and superyacht builders and their suppliers manufacture and use a lot of carbon-fiber composites, the port is building a \$4 million Compos-

ite Recycling Technology Center with federal, state and local grant money.

Washington's aerospace and recreational industries — yacht, bicycle, snowboard, skateboard, swim fin, fishing rod — plus automobile and wind turbine industries "are dumping 2 million pounds of waste fiberglass a year into landfills," says Jennifer States, the port's director of business development. "We are working with the producers. We hate that all that carbon fiber goes into the landfill."

The region also needs to find jobs for people put out of work by lumber mill closings. The mills were high-technology operations, so the recycling center will be a good fit for them, she says. The center will develop in phases, first recycling frozen, uncured carbon fiber composite waste from the plant, then cured carbon fiber composite materials, and in a third phase other types of composites, including fiberglass.

"The challenge with fiberglass right now is its [resale value], which is a lot lower than carbon fiber," she says.

Carbon fiber recycling already is making

inroads in yachting. Teaming with aircraft maker Boeing, Oracle Team USA, winner of the 2013 America's Cup, has enlisted Carbon Conversions, of Lake City, South Carolina, to recycle *USA-71*, a boat built for the 2003 Cup regatta, and repurpose 7,000 pounds of carbon fiber from it in a mold for a next-generation raceboat. The carbon fiber was recovered in a geothermal plant and shipped to Oracle Team USA's supplier, Core Composites, for the repurposing.

Boeing is working with the U.K.'s University of Nottingham and Carbon Conversions to recycle composites in its 787 Dreamliners, which are 50 percent composites by weight.

Meanwhile, in Rhode Island, Sea Grant's Nixon is hoping his request for proposals will help find some combination of technology and entrepreneurial savvy that can profitably recycle fiberglass hulls, and he hopes it will be sooner rather than later.

"In Jamestown, where I live, it's almost like a zoning rule that you have to have an abandoned boat in your backyard," he says.

What's the alternative right now? Landfilling them. ■