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Gelcoat Hull Cleaner – Algae Remover for Boats

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Request
We use an acid hull cleaner to remove algae from our fiberglass boats. Are these types of cleaners safe for the environment? If not, are there better options?

Recommendation
Strong acid cleaners are not the best choice for the aquatic environment or for personal safety. In addition to being directly toxic to marine life, these cleaners may contain unlisted active ingredients that accumulate in the environment and cause further harm. The Clean Water Act and laws in many states prohibit discharge without a permit of materials that could adversely affect the aquatic environment, so, if you decide to use acid cleaners, be careful to keep them away from the water.

Choosing cleaning products wisely will enhance personal safety and limit the environmental consequences of accidental runoff from washing. While many marine cleaning products promote themselves as "green" or "eco-friendly," no consistent standards regulate the use of these terms. When possible, buy products with a green certification you know and trust, or products designed with environmental concerns in mind, such as those of the Environmental Protection Agency's (EPA) Design for Environment program.

Consider these practices to minimize the environmental impact of cleaning your boat:
- Start with mechanical cleaning with scrub pads or brushes safe for the fiberglass gelcoat.
- When water isn't enough, use green-certified cleaners with non-toxic ingredients.
- Strong acid cleaners are not likely to be accepted by most green certifiers. If the application requires acid cleaners, use the lowest effective acid concentration and select brands with non-toxic additives.
- Keep in mind that if a cleaner requires significant personal-protection equipment during use, it is almost certainly bad for the environment.
- When using *any* chemical cleaner, collect the wash and rinse liquids for safe disposal. This is especially important if the washing occurs near lakes, rivers or wetlands.
- It may be better to do your washing over a porous, grassy surface rather than a paved or impermeable surface. This will keep accidental spillage from flowing to surface waters as runoff or through drains.

Background
Due to a lack of suitable facilities, an Oregon boat club stores their boats in the water rather than in a dry environment. Over time, the build-up of algae and scum on the hulls and pontoons increases boat drag and the effort needed to paddle these human-powered craft. The problem worsens with boat age, as UV exposure damages the gelcoat outer surface of the fiberglass and increases the size and number of pores in the surface coating. The gelcoat pores provide a foothold for debris and algae. While brushes can remove the bulk of the algae, mechanical action and ordinary detergent cleaners do not remove the algae trapped in pores (1).

Marinas and boating centers offer a wide range of cleaner types, for general cleaning, rust removal, hull cleaning, etc., and products specific to surface-type, targeting aluminum, chrome, fiberglass or wood. Hull

cleaners are designed to remove stains from rust and metal salts, oily residues, natural substances (e.g., tannins), and biological growth (e.g., algae) (2).

How do these cleaners work?
Most commercial fiberglass hull cleaners contain one or a combination of acids, among them hydrochloric acid, phosphoric acid, and oxalic acid. An article in a recent boating magazine reviewed and tested 22 commercial hull cleaners (2). With the exception of one "non-toxic, no acid" product, all of the cleaners contained one or more of the acids mentioned above.

According to users, acid cleaners are fast, effective, and reduce the rate of algae re-growth by eliminating the algae trapped in gelcoat pores (1). The acids work in two ways: 1) acids lower the pH, which changes rust and metal salts to a form that dissolves and rinses away, and 2) acids chemically attack organic matter like algae. In some cases, cleaners include other ingredients, such as surface active agents (surfactants), that aid in penetrating pores and helping to lift and carry-away oily residues and particulate matter. Though acid cleaners are quite strong, and provide good cleaning action, they do not harm the gelcoat layer that otherwise might be easily damaged by harsh abrasive cleaners.

Are acid marine cleaners safe to apply?
While acid marine cleaners are safe for fiberglass, personal safety during acid application is a major concern. For most brands, the acids are at high concentration and, given their corrosive nature, the manufacturers recommend wearing gloves and safety goggles during use. Applying a gel cleaner is likely safer than a liquid (less splattering potential) and it is best to avoid use of acid spray cleaners in windy outdoor locations.

In addition to reading the label, information on the chemical contents of cleaners and their health effects can often be found on an MSDS (material safety data sheet). These should be provided by the manufacturer and either packaged with the product or made available at the retailer or on a company website. The MSDS should show the active ingredients, potential safety hazards, and information on managing spills or accidental human exposure (3). Unfortunately, these MSDS's can be difficult to read, ingredients are often not listed, and their accuracy is poorly policed. Furthermore, while required for industrial products, MSDS's are not required for household products, though, with a little digging, you can find them for most marine cleaning products.

For the acid cleaners mentioned above, it is essential to have available plenty of fresh water and baking soda to neutralize splashes, spills, or wind-blown spray (4). Strong hydrochloric acid solutions may emit fumes that can irritate or injure eyes and airways. Many cleaners also contain oxalic acid (sometimes called ethanedioic acid) that, while a somewhat weaker acid, is a strong poison if ingested (5). While these acids are used routinely and safely in many applications and are common ingredients in household cleaners, radiator cleaners, etc., they should be respected for the damage they can do through accidental or careless human exposures.

Are marine acid cleaners safe for the environment?
Any of the acids in these cleaners could do serious harm if released to the environment. Concentrated acid solutions are immediately toxic to almost all life. Even a small amount of a strong acid, like hydrochloric acid, can significantly change the local chemistry of soil or water to a degree that damages or kills soil or aquatic organisms.[1] Cleaners with phosphoric acid are a potential source of phosphate pollution and regulatory agencies have given special attention to eliminating phosphates from waste streams due to their effect on promoting algae growth and the subsequent environmental damage. Of the common cleaning acids, oxalic

[1] For example, by lowering the pH (increasing the acidity), acid rain increases the amount of dissolved aluminum in surface waters. Acid cleaner residues added directly to surface waters would act in the same way. While some fish may tolerate the acid-induced pH change, the increased aluminum may be directly toxic (16).

acid is environmentally the "least hazardous" according to EDF's *Scorecard* ranking of chemical health hazards (6).[2]

For one-time acid spills, the local environment will recover over time, depending on the degree of mixing (stagnant waters suffer more than flowing streams) and natural soil and aquatic healing processes.[3] More serious environmental damage can come from the non-acid active ingredients found in some cleaners. In the magazine rating of cleaners mentioned above, the best performer contained nonylphenol ethoxylate, or NPE. The EPA reports that NPE's and their breakdown products are toxic to aquatic life and persist in the environment (7).[4] This is particularly alarming when you consider the language of product labeling. NPE's *biodegrade*, but the main breakdown product is *more* toxic than the starting chemical molecule (8).

Are there better choices for marine cleaning?

A green cleaning approach begins with some simple principles in nearly all applications. Water and mechanical work, with the appropriate tools (brushes, scrub-pads) can accomplish a lot. Cleaning more frequently will minimize the opportunities for algae and contaminants to get out-of-hand.

If mechanical cleaning action is not sufficient, choose cleaners wisely and use them sparingly. While many products are labeled "biodegradable" or "environmentally friendly," there are no widely accepted standards that regulate the use of these terms, and as discussed above, the ability to biodegrade does not necessarily render a cleaning chemical safe for the environment (9). When choosing a cleaning product, it is important to identify the active chemical ingredients. Read the label; ask for and read the MSDS information. Use the label information or the internet to identify manufacturers. Call and ask manufacturers why their product is "eco-friendly." Consult green cleaning or chemical safety internet resources for more information (a list is given in the *Resources* section below).

Governments and regulatory agencies have been working in a number of areas to limit pollution by cooperating with suppliers to improve cleaning product design. The EPA's Design for Environment (DfE) program creates partnerships with manufacturers and formulators to produce products "whose ingredients, when compared to conventional formulations, are less toxic, less persistent (i.e., they biodegrade faster), less bioaccumulative (i.e., they do not tend to build up in living tissue—human or animal)—and whose ingredient byproducts have similar beneficial characteristics" (10). A number of other green cleaning chemistry guidelines have been established in the United States, Canada and abroad. The EPA's Design for Environment website has a listing of *some* of the chemicals targeted for reduction or elimination in these standards, see Table 1 below (11).

Only one marine *hull* cleaner is listed on the EPA's DfE website (12).[5] As the formulation has not been disclosed, it is unclear as to how effective it would be at removing algae. PPRC recommends maximizing mechanical cleaning methods and spot cleaning first, then using cleaners with the lowest effective acid concentration and the fewest additional additives. Some experimentation will be required to find the best mix of cleaning methods and the type and amount of cleaning chemicals.

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[2] Based on toxicity and persistence. The Environmental Defense Fund's Scorecard website contains human and environmental hazard rankings for a range of chemicals based on independent data sources, including the EPA (14).

[3] For example, many natural bodies of water contain significant alkalinity that will buffer or reduce the impact of a local acid spill, but this should not be used as a justification to discharge waste.

[4] For products like boat cleaners, the EPA has raised the standard for its surfactant screen to address the potential of immediate contact with aquatic life. Any ingredients (including surfactants, preservatives, solvents, etc.) that have aquatic toxicity values <1 mg/L are not allowed in DfE-recognized direct release products (15).

[5] Calls to the supplier (West Marine) indicate that this product will be available for sale in February 2009.

Regardless of which cleaning product you choose, special care must be taken when working around lakes, streams, and wetlands. According to government and regulatory sources, the Clean Water Act and state regulations prohibit the dumping or release without a permit of any agents that would alter the normal marine environment.[6] For example, in Oregon, the water quality law states that "… no person shall: (a) Cause pollution of any waters of the state or place or cause to be placed any wastes in a location where such wastes are likely to escape or be carried into the waters of the state by any means" (13). The by-products of any cleaning activity should be collected and properly disposed. This is also true for "green" cleaning products.

Think ahead when planning your cleaning location. Spills are always a possibility, so it may be best to clean over grass or porous surfaces where accidental spills can receive at least some minimal natural filtering and processing before reaching the water table or surface waters. Cleaning over pavement or directly on the dock risks runoff to surface waters or storm drains that lead to the water.

Organization	Prohibited Substances	Limited Substances
EPA-DfE	Alkylphenol ethoxylates (APEOs) Carcinogens (known, probable, or possible) Ethylene Glycol Ethers Chorine Bleach Inorganic phosphates	Highly corrosive chemicals Highly combustible chemicals Volatile organic compounds (VOCs)
USA-GreenSeal	Ethylene diaminetetraacetic acid (EDTA) Nitrilotriacetic acid (NTA) Chlorine bleach Sodium hypochlorite Nonylphenol ethoxylate (NPE) Petroleum-based solvents	Phosphates VOCs
Canada-EcoLogo	Phosphates APEOs EDTA NTA Halogenated organic solvents Butoxy-ethanol Carcinogenic chemicals	VOCs
EU-EcoLabel	APEOs EDTA NTA Quaternary ammonium compounds Glutaraldehyde Sensitizing substances Acute oral toxicity chemicals	Phosphorous Phosphonates VOCs Petroleum oil Biocides

Table 1. Examples of compounds controlled in guidelines for green cleaners. These guidelines are for general cleaning compounds and may be less-restrictive for industrial or special purpose cleaners (11).

Conclusions

Common acid-based marine hull cleaners are likely to contain chemicals that are dangerous both to users and to the environment. Choosing the lowest effective acid concentration and cleaners without toxic additives will reduce these risks. New, environmentally preferable hull cleaners will be available in 2009, but PPRC cannot predict their effectiveness against algae.

[6] Sources contacted for this effort, included the Washington and Oregon Clean Marina programs and the Washington State Department of Ecology and the Oregon Department of Environmental Quality.

When using any marine cleaner, it is important to keep wash and rinse liquids away from surface waters where they are likely to be directly toxic to local aquatic life. Without a permit, it is also illegal to discharge the by-products of any cleaning operation into surface waters. While government and regulatory agencies naturally pay more attention to large polluters than to small ones, the collective impact of the behavior of thousands of individual boat owners can be substantial.

For some boaters, it may be possible to perform maintenance at state-permitted boat yards or to trailer boats to commercial car washes, where by-products of washing are sent to sanitary sewers or treated appropriately on-site. Green cleaning may require a little more effort, but by making better choices, we can minimize our impact on the environment and help preserve the quality of our recreational waters.

Additional Notes

- These recommendations are *not appropriate for cleaning hulls with anti-fouling paint*. Even simple scrubbing of painted hulls could release highly toxic materials.
- Improving gelcoat maintenance, for example, regular waxing or treatment with a UV protectant, may slow or limit pore damage and limit access for algae. Further investigation is required on this issue.
- The acid cleaners discussed here are suitable for gelcoat, but would damage aluminum and other metals and painted surfaces. Be sure to check the compatibility of any cleaner for your boat materials.
- Similarly, be sure to use acid-compatible gloves and tools (e.g., scrub pads, brushes).
- It is not safe to mix cleaners, especially acid cleaners, without specific information on the potential for dangerous chemical reactions. For example, never mix strong acids with bleach.
- Powder and gel formulations of acid cleaners are available. These may be less likely to spread or drip, and may be more visible in use due to their consistency or because of added colorants. Knowing where the cleaner has been applied will enhance safety and help prevent overuse.

Resources

Alternative cleaner information

EPA's Environmentally Preferable Purchasing Program: http://www.epa.gov/epp/pubs/products/cleaning.htm
Greenseal provides environmental certification for a wide-range of consumer products: http://www.greenseal.org/
Consumer Reports Greener Choices: http://www.greenerchoices.org/products.cfm?product=greencleaning&page=RightChoices
The European Union's EcoLabel program: http://ec.europa.eu/environment/ecolabel/index_en.htm

Personal safety data for common cleaning products (available by brand, type, etc.)

The U.S. Department of Health and Human Services maintains a large database of information for household cleaning product safety: http://householdproducts.nlm.nih.gov/index.htm

Environmental hazards of cleaning chemicals

Women's Voices for the Earth have produced a variety of documents on hazards of household cleaners as well as their own ratings of manufacturers: http://www.womenandenvironment.org/newsreports/issuereports
Green Media Toolshed's *Scorecard* website is a good source of technical information on the environmental hazards associated with individual chemicals: http://www.scorecard.org/chemical-profiles/

Clean Boating

Oregon Clean Marina Program – a program for certifying *marinas*, but Oregon's program includes boater education materials: http://www.boatoregon.com/OSMB/Clean/index.shtml
Puget Soundkeeper Alliance – Affiliated with Washington State's Clean Marina Program: http://www.pugetsoundkeeper.org/ or http://www.cleanmarinawashington.org/

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