



Alternative Antifouling Strategies Sampler

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Copper antifouling paints are widely used to control fouling that slows sailboats and increases fuel consumption for powerboats. These pesticidal paints slowly leach copper from the hull to deter attachment and growth of fouling species. Copper, like zinc, tin, lead and mercury, is a metal and so will not break down over time. Thus, copper can accumulate in poorly flushed marina waters to levels that can harm marine life.^{1, 2, 3} As a result, boat owners are seeking alternative antifouling strategies that are more environmentally friendly than metals. An antifouling strategy typically combines a hull coating with a companion strategy, such as in-water hull cleaning, storing the boat in a slip liner or storing it out of the water.⁴ Nontoxic hull coatings, in particular, require a companion strategy to achieve fouling control.



In-Water Hull Cleaning Photo by Cesar Alvarez, UC SGEP

Boat owners will find a variety of hull coatings and companion strategies in this Sampler. Information is compiled from manufacturers' data; it has **not** been tested by University of California and inclusion does **not** constitute a recommendation or endorsement.

Boaters should be sure to take the following steps:

- 1) Consult experienced, local boat repair yards about performance, expected longevity and costs to prepare the hull and to apply hull coatings.
- 2) Also consult experienced, local in-water hull cleaning companies about frequency, ease and costs of cleaning and the expected longevity of hull coatings they are considering.
- 3) Ask boatyards and hull cleaners about pros, cons and special considerations for slick hull coatings.
- 4) Ask other boaters, boatyards, hull cleaners, and slip liner and boat lift companies about:
 - cost and suitability of particular hull coatings and companion strategies for one's own boat;
 - how the boat is used and where it is kept;
 - where the boat is likely to be taken on a trip;
 - climate, government regulations and hull maintenance services at home and away.

- 5) Ask the marina, yacht club or harbor manager if slip liners, boat lifts, in-water hull cleaning or particular hull coatings are permitted.

Invasive, hull-fouling species are particularly unwelcome. Such invaders have been carried from home to new locations where their predators, parasites and diseases are absent. They can multiply rapidly, creating problems for native marine life and structures; eroding shorelines; clogging intake pipes of cooling plants, irrigation and municipal water systems; and sometimes causing disease.⁵

Scientists have found that at least some invasive, fouling species can tolerate copper, suggesting that they may have a competitive edge over native species and that copper antifoulants may have become less effective in controlling them.^{6, 7} Copper-tolerant species may also provide habitat for copper-sensitive species on hulls with copper antifouling paints.⁸

Water quality problems and development of tolerance to copper antifoulants stem in part from the fact that they are widely used. Boat owners within a given marina or boat basin may want to consider how they can diversify, as a group, the products and practices that they use to control fouling. Decisions should be made in consultation with experienced, local boat repair yards, hull cleaning, slip liner and boat lift companies and harbor, marina or yacht club managers.



Boat Lift Photo by Scott Parker, UC SGEP

Scientists are studying environmentally friendly alternatives to metal antifouling paints. For example, some are re-engineering pharmaceutical compounds, some are experimenting with extracts from plants and marine life, and others are testing surface textures.⁹ Their research shows promise for the future.

All boaters with an interest in environmentally friendly boat maintenance may find this report useful. Boat owners who are subject to regulation of copper emissions from

antifouling paints, such as those in Shelter Island Yacht Basin of San Diego Bay,¹⁰ need alternatives now. Note that elevated copper levels have also been detected in boating areas of San Francisco and Monterey Bays, Santa Cruz and Santa Barbara Harbors, Marina Del Rey, Long Beach and Lower Newport Bay.¹¹

For publications with more information and references on antifouling, water quality, invasive species and copper tolerance please visit our website at <http://seagrant.ucdavis.edu>

ATTENTION: Alternative hull coatings are relatively new and experience with them is limited. Some coatings have remained on the market for several years; others have left the market since we published Samplers in 2002 and 2004.

INVESTIGATE PRODUCTS CAREFULLY! Ask manufacturers for independent product test reports and referrals to others who have purchased them in your area. Ask local boat repair yards and hull cleaning services which coatings have performed well, what maintenance is needed, and air and water quality regulations that may affect local availability of some coatings. Many alternative coatings require professional application; do not attempt to apply them yourself. Some are not compatible with others that may be on the hull and old coatings may need to be removed before the new coating is applied. Boat repair yards should obtain and follow manufacturers' instructions!

DISCLAIMER

The purpose of this report is to raise awareness of alternative antifouling strategies. The following information on products and practices is for educational purposes only. It does not constitute an endorsement or recommendation by the University of California or any organizations that helped to fund this publication. Information is compiled from manufacturers' data and correspondence and has not been verified by the authors. The boat owner is responsible for choosing a coating and companion strategy that are best suited for his or her boat, how it is used and where it is kept. Prices and other information were effective as of July 2007.

REFERENCES

1. California Regional Water Quality Control Board, San Diego Region. 2005. *Total Maximum Daily Load for Dissolved Copper In Shelter Island Yacht Basin, San Diego Bay*. Resolution No. R9-2005-0019. Basin Plan Amendment and Technical Report. February 9, 2005.
2. U.S. Environmental Protection Agency. 2002. *Total Maximum Daily Loads for Toxic Pollutants: San Diego Creek and Newport Bay, California*. U.S. EPA Region 9, San Francisco, CA.
3. California Regional Water Quality Control Board, Los Angeles Region. 2005. Draft Marina del Rey Toxic Pollutants TMDL. http://www.waterboards.ca.gov/losangeles/html/meetings/tmdl/tmdl_ws_marina_del_rey_wma.html
4. Johnson, L.T. and J.A. Gonzalez. 2004. *Staying Afloat with Nontoxic Antifouling Strategies for Boats*. California Sea Grant College Program Report No. T-054. 21 p.
5. Johnson, L.T., J.A. Gonzalez, C.J. Alvarez, M. Takada, A. Himes, S. Showalter and J. Savarese. 2006. *Managing Hull-Borne Invasive Species and Coastal Water Quality for California and Baja California Boats Kept in Saltwater*. California Sea Grant College Program Report No. T-061. 152 p.
6. Piola, R.F. and E.L. Johnston. 2005. Differential tolerance to metals among populations of the introduced bryozoan *Bugula neritina*. *Marine Biology* (Published Online, November 2005).
7. Mackie, J.A. 2003. A Molecular Analysis of Bryozoan Dispersal. PhD Thesis, Department of Zoology, University of Melbourne.
8. Floerl, O., T.K. Pool and G.J. Inglis. 2004. Positive interactions between nonindigenous species facilitate transport by human vectors. *Ecological Applications* 14:1724-1736.
9. Presentations at International Congresses on Marine Corrosion and Fouling in 2002 San Diego, California, USA and in 2006 Rio de Janeiro, Brazil.
10. California Regional Water Quality Control Board, San Diego Region. 2005. *Total Maximum Daily Load for Dissolved Copper In Shelter Island Yacht Basin, San Diego Bay*. Resolution No. R9-2005-0019. Basin Plan Amendment and Technical Report. February 9, 2005.
11. Singhasemanon, Nan. California Department of Pesticide Regulation, December 6, 2007 presentation to California Clean Boating Network and Linda Candelaria, Santa Ana Regional Water Quality Control Board, January 10, 2008 presentation to Interagency Coordinating Committee – Marinas and Recreational Boating Workgroup.
12. County of San Diego, Department of Agriculture Weights and Measures, Official Notice to Dock Masters and Marine Suppliers, April 20, 2007.



Slip Liner Photo by Jamie Gonzalez, UC SGEP

ATTENTION: Boat owners should work with boatyards and boatyards should contact coating manufacturers for details on hull preparation and application. Bottom coatings are regulated by various agencies. Please check with your local boatyard on any coating that interests you. Prices and other information were effective as of July 2007. Coating descriptions are based on manufacturers' information.

Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
EPOXY COATINGS • Early stages of fouling growth can be removed with high pressure washing or scrubbing • Provides fast, hard, slippery surface			
Creative Coatings Corporation Photo Finish Bottom Pro Epoxy based foul release coating \$89/gallon covers 30 foot boat with 1 coat http://creativecoatingscorp.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Clean every 10 days to once a month, year round depending on use and vessel location. Clean by hand with a Scotch-Brite® pad or mechanically with a soft rotary brush	Durable coating; coating has chemical, abrasion, and impact resistant qualities; smooth gloss texture	Minimum of 3 years with 2 coats
FUJIFILM Hunt Smart Surfaces Duplex Fouling Release System Epoxy anti-corrosion layer and silicone topcoat are interlocked by a thermoplastic elastomeric tie formula \$ Contact manufacturer for price Theoretical coverage for Surface coat and for Tie coat is 107 square feet/gallon @ 12 mils each coating www.fujihuntsmartsurfaces.com Manufacturer recommends stripping old copper paint before coating application.	Fouling will release at speeds as low as 8 knots; clean with soft bristle brush if boat is not used for extended period	Tie formula incorporating nano-technology is a synergy of three layers that creates superior adhesion and durability	Expectations of 5+ years; after 5 years if surface coat is worn and tie coat is in good shape, then surface coat alone can be re-applied for another anticipated 5 years of service
SeaLife™ Marine Products, Inc SeaLife™ High Build Epoxy Epoxy coating \$115/gallon covers 1574 square feet @ 1 mil and 315 square feet @ 5 mils www.sealifemarine.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Clean with any cloth or carpet-like material; do not scrape or use rough material that may cause coating failure	100% volume solids surface tolerant epoxy coating; UV resistant	Minimum of 2 years

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*Maintenance of coatings depends on vessel location and activity and diver availability. Generally coatings are more difficult to clean the longer the time between cleanings. In the San Diego area, divers recommend cleaning nontoxic coatings every 1 to 2 weeks in summer and 2 to 3 weeks in winter.

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Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
EPOXY COATINGS (continued)			
Sound Specialty Coatings Corporation Aquaply M® Two part epoxy coating \$280/2 gallons covers 450 square feet www.sscoatings.net Manufacturer recommends stripping old copper paint before coating application.	Hull maintenance will depend on location and boat use; use a soft cloth, pressure wash, soft brush or burlap to remove marine growth	Coating is slippery; use caution when placing boat in slings or on blocks; coating smooths out with wear	Up to 17 years

Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
CERAMIC-EPOXY COATINGS • Early stages of fouling growth can be removed with high pressure washing or scrubbing • Provides protection against corrosion, abrasion, blisters			
Freecom, Inc. CeRam-Kote 99M Ceramic-epoxy coating \$97.61/gallon covers 136 square feet with 2 coats at 5 mils each www.ceram-kote.com Manufacturer recommends stripping old copper paint before coating application.	Clean with a soft brush every 2 weeks in summer and every 3 to 4 weeks in winter according to local conditions	Epoxy-resin system with high concentration of micron-sized ceramic particles; abrasion and corrosion resistant; durable, slick coating	Has been used extensively in Southern California waters. Previous formulas of CeRam-Kote have lasted up to 10 years
Viking Performance Coatings, LLC Cerakote™ VPC-40G Ceramic-based self-flushing coating \$ Contact manufacturer for price Coverage 500-900 square feet/gallon www.vikingperformancecoatings.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Self cleaning with periodic boat use. Remove remaining bio-film with routine hull wiping using a soft cloth or sponge for continued effectiveness; cleaning frequency will vary and depends on growth conditions in local waters	Clear, slick, and flexible; nano-sized molecular structure provides tight, smooth surface; water/oxygen barrier prevents osmosis and is catalyzed by ambient humidity; UV protection above waterline. Cruisers, power and sail, use as bottom coating over paint or epoxy barrier coat for improved fuel economy. For racing, apply as a top coat over epoxy barrier coat	Approximately 2 years with location-appropriate, periodic hull wiping using only soft hull wiping materials such as a soft cotton cloth or sponge

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Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
SILICONIZED EPOXY/SILOXANE COATINGS <ul style="list-style-type: none"> • Hard, smooth, slippery surface to which fouling growth has difficulty attaching • Drag reduction decreases fuel consumption 			
Ecological Coatings, LLC Wearlon® Super F1-M Silicone epoxy water-based coating \$189/gallon covers 220 square feet @ 3.0 mils dry film thickness www.wearlon.com Manufacturer recommends stripping old copper paint before coating application.	Self cleaning with more usage; recommended for boats that are in frequent use	Caution: Foul release coating is slippery	2 to 3 seasons depending on usage; abrasion leads to more wearing
MicroPhase Coatings, Inc. PhaseCoat® Bare Bottom Polysiloxane modified epoxy coating \$329/gallon covers 150 square feet with one coat @ 10-12 mils wet thickness www.microphasecoatings.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Coating will develop a brownish hydrophobic/hydrophilic film under water that does not require cleaning; above water line wash with a hose or a very soft sponge or brush	Provides fast, slippery surface, with a slight sticky feel; designed for boats that sit for weeks at a time or move slowly; may be suitable for certain powerboats that are not used actively	1 to 2 seasons on most marine surfaces depending on vessel use
Oceanic Surfaces International, LLC ECO-5 Foul release siliconized epoxy coating \$250/gallon covers 150 square feet www.oceanicsurfaces.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Clean every 2 weeks with soft brush depending on water temperature; in cooler water clean once every 3 weeks	Can be applied over copper paint with proper surface preparation	Expected to last 8 years and guaranteed 5 years

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Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
SILICONIZED EPOXY/SILOXANE COATINGS (continued)			
SeaCoat Technology, LLC Sea-Speed™ G.C. Fluorinated siloxane foul release coating \$350/gallon covers 144 square feet www.seacoat.com Manufacturer recommends stripping old copper paint before coating application.	Should be maintained with regular cleaning if boat is not used for extended period; clean light fouling with soft carpet	Non-stick foul release coating; durable and highly abrasion resistant elastomeric film	Expected to last 7+ years
SeaCoat Technology, LLC Sea-Speed™ DTM Fluorinated siloxane foul release coating \$350/gallon covers 144 square feet www.seacoat.com Manufacturer recommends stripping old copper paint before coating application.	Should be maintained with regular cleaning if boat is not used for extended period; clean light fouling with soft carpet	Durable coating providing anti-corrosive protection; cures into highly abrasion resistant elastomeric film	Expected to last 7+ years

Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
POLYMER BASED COATINGS			
<ul style="list-style-type: none"> • Slippery surface is difficult for fouling growth to attach • Slick surface reduces drag and fuel consumption 			
Aurora Marine Industries, Inc. Aurora VS721™ Bottom Coat Foul release polymer coating \$39.99 per 450 mls covers 400 square feet www.auroramarine.com Manufacturer recommends stripping old copper paint before coating application.	Boat usage continuously cleans hull; stationary boats may be cleaned periodically with a sponge or deck brush; at end of season or when marine growth is present, pressure wash or scrub with deck brush	Caution: Coating is slippery; inert, clear, shiny barrier polymer coating; seals gel coat to prevent osmosis blisters; low surface tension creates an unsuitable host for attachment of marine growth which may increase speed, improve performance and reduce fuel consumption	Seasonal coating

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Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
POLYMER BASED COATINGS (continued)			
KISS Polymers, LLC MegaGuard® Ultra LiquiCote Foul release coating \$ Contact manufacturer for price 4 ounces covers 2000-4000 square feet www.kisspolymers.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Non-stick drag-reducing protective finish; use soft cloth for routine maintenance	Caution: Coated surfaces are slippery; improves performance by reducing drag (can be applied directly to hard smooth surfaces); reduces or eliminates corrosion	Depends on durability of underlying surface; lasts at least 1 to 2 years on most marine surfaces

Antifouling Strategy Product	Maintenance*	Coating Characteristics	Longevity
BOTTOM WAX			
• Barrier coat provides slick surface that reduces drag and fuel consumption			
Alex Milne Associates Ltd Easy On® Bottom Wax #5425 Foul release bottom wax coating \$31.49 per 450 mls covers up to a 24 foot power boat www.alexmilne.com www.marinetex.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Clean with sponge, abrasive white pad or stiff deck brush as required or when fuzz develops; can only be removed with high Ph stripper	Caution: Coating is slippery; coating becomes molecularly attached to the hull or existing antifouling; allow 12 hours to cure to soft movable surface before launch; apply thin overcoat each season	For full season fresh-water and intermittent saltwater use
Alex Milne Associates Ltd Natural Marine Easy-Spray #5430 Water-based foul release hull coating \$28.36 per 400 mls covers up to a 24 foot power boat www.alexmilne.com Manufacturer states coating can be applied over properly prepared copper antifouling paint.	Clean with sponge, abrasive white pad or stiff deck brush as required or when fuzz develops; can only be removed with high Ph stripper	Caution: Coating is slippery; coating becomes molecularly attached to the hull or existing antifouling; allow 12 hours to cure to soft movable surface before launch; apply thin overcoat each season	For full season fresh-water and intermittent saltwater use

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NONTOXIC ANTIFOULING COMPANION STRATEGIES	
<ul style="list-style-type: none"> • Because a nontoxic coating will not slow fouling growth, a companion strategy must be used. May not be allowed in some marinas. • A nontoxic antifouling strategy combines a nontoxic bottom coating with a companion strategy such as mechanical cleaning or the use of a slip liner or boat lift. 	
UNDERWATER HULL CLEANING SERVICES	Characteristics <ul style="list-style-type: none"> • Mechanical cleaning by hand or with power tools • Cleaning frequency and type of cleaning tool depends on water temperature, type of paint, frequency and speed of boat use • The use of Best Management Practices reduces the amount of pollution generated during cleaning operations
BOAT LIFTS Basta Marine Inc. www.gobasta.com HydroHoist® Boat Lifts www.boatlift.com Poly Lift of California www.polyliftofcalifornia.com ShoreMaster, Inc. www.shoremaster.com	Characteristics <ul style="list-style-type: none"> • Eliminates need for antifouling paints and underwater hull cleaning if boat is always returned to lift • Minimizes electrolysis and osmosis • Wide range of models available to fit a variety of boats and dock applications
SLIP LINERS	
<ul style="list-style-type: none"> • Eliminates need for antifouling paint and underwater hull cleaning if boat is always returned to liner. May not be allowed in some marinas. • Add freshwater or approved chlorine products to liner. See list approved by California Department of Pesticide Regulation on following page. 	
Armored Hull™ Boat Hull Shield™ Air-gate™ system lowers and raises with valve and hand pump so that lines or ropes are unnecessary \$2400 for 30 foot boat www.armoredhull.com	Characteristics <ul style="list-style-type: none"> • Free floating 6" PVC pipe filled with foam and stays rigid • Can be used on a mooring ball, needs no side support • Neutralize chlorine before opening airgate to empty water from liner • Outside of liner must be maintained once each season • Longevity of slip liner material is 7-10 years • Armored Hull builds to 60' currently for \$6,000 and is expanding to 120' in 2008
Bottom Liner® UV-inhibited vinyl coated liner with foam flotation collar \$1850 for 30 foot boat www.bottomliner.com	Characteristics <ul style="list-style-type: none"> • Secured to slip by light lines to protect boat bottom from fouling growth and electrolysis • Neutralize chlorine before releasing slip lines to empty water from liner • Longevity of slip liner material is 4 years • Lines that suspend liner may stretch and sag if outside of liner is not properly maintained once a year • Extends life of zinc anodes by 5 to 6 times

This report is intended to be an educational summary of various products and services to raise awareness of alternative antifouling strategies and to help boat owners learn about options. It does not constitute an endorsement or recommendation by the University of California or any of the organizations funding this publication. Information is compiled from manufacturers' data and correspondence and has not been verified by the authors. Boat owners must take responsibility for choosing the combination of coating and companion strategy best suited for their situation.

*Maintenance of coatings depends on vessel location and activity and diver availability. Generally coatings are more difficult to clean the longer the time between cleanings. In the San Diego area, divers recommend cleaning nontoxic coatings every 1 to 2 weeks in summer and 2 to 3 weeks in winter.

ATTENTION: Boat owners should work with boatyards and boatyards should contact coating manufacturers for details on hull preparation and application. Bottom coatings are regulated by various agencies. Please check with your local boatyard on any coating that interests you. Prices and other information were effective as of July 2007. Coating descriptions are based on manufacturers' information.

Chlorine Products Approved by California Department of Pesticide Regulation** for Use with Boat Slip Liners in California			
Active Ingredient: Sodium hypochlorite			
Product	Sodium Hypochlorite	Manufacturer/Distributor	Website
Dixichlor	10.0%	DPC Industries, Inc.	www.dxsystemsco.com
Dixichlor Max	12.5%	DPC Industries, Inc.	www.dxsystemsco.com
L A Chemchlor	12.5%	Los Angeles Chemical Company	www.lachem.com
Liquichlor	12.5%	Univar USA, Inc.	www.univarusa.com
Multi-Chlor	12.5%	Hasa Inc.	www.hasaindustrial.com
Freshchlor	12.5%	Hasa Inc.	www.hasaindustrial.com
Hasachlor	12.5%	Hasa Inc.	www.hasaindustrial.com
Sierra Pure Chlor	12.5%	Sierra Chemical Company	www.sierrachemicalcompany.com
Sierra Sanitizer	5.25%	Sierra Chemical Company	www.sierrachemicalcompany.com
Sunny Sol® 100 Plus	10.0%	JCI Jones Chemicals Inc.	www.jcichem.com
Sunny Sol® 150	12.5%	JCI Jones Chemicals Inc.	www.jcichem.com

Follow all label directions. *Approved products typically state: To control slime on boat bottoms, sling a plastic tarp under boat, retaining enough water to cover the fouled bottom area, but not allowing water to enter enclosed area. This envelope should contain approximately 500 gallons of water for a 14-foot boat. Add 18 oz. of this product to this water to obtain a 35-ppm available chlorine concentration. Leave immersed for 8 to 12 hours. Repeat if necessary. Do not discharge the solution until the free chlorine level has dropped to 0 ppm, as determined by a swimming pool test kit.*

****Reprinted with permission of County of San Diego, Department of Agriculture Weights and Measures, Official Notice to Dock Masters and Marine Suppliers, April 20, 2007¹²**

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