California Professional Divers Association...BMP Committee

Divers Hull Cleaning
Best Management Practices
Certification Manual

Hull Coatings

I. ANTI-FOULING PAINT SYSTEMS (4 BASIC GROUPS)

a. LEACHING TYPE (vinyl: pro-line 1088) considered a hard paint
b. SEMI-ABLATIVE (modified epoxies: Interlux Ultra-coat) hard paint.
c. ABLATIVE/SLOUGING (co-polymers: Interlux CSC) soft paint
d. BIOCIDE FREE/NON-TOXIC (Aqua-ply M., Ceram-Kote) very hard.

II. PRIMARY FUNCTION: REPEL GROWTH OF MARINE ORGANISMS

a. Bacterial microfilm (appear in the first week)
b. Algae film slime (grows rapidly in weeks 2-3)
c. Invertebrates (warm water, appear as early as 2 weeks) i.e. Tubeworms

III. BIOCIDES (2 KINDS: CHEMICAL/METAL OR ORGANIC)

a. The active ingredients in bottom paint that repel organic growth
b. They are a primary concern in reducing pollution in the water (metal kinds)
c. Copper: (cuprous oxide) most commonly used biocide in bottom paints today, registered with EPA this biocide is targeted for reduction. One of our primary objectives is to reduce copper loading in the bays.
d. Irgarol: organic biocide, Used as a co-biocide with cuprous oxide to lower the amounts of copper in paints.
e. Econea: organic biocide. Can be used as a primary invertebrate biocide
f. Zinc: (pyrithione or zinc oxide) commonly referred to as zinc omidine or ZnPt

IV. LEACHING TYPE (VINYLS AND SEVERAL MODIFIED EPOXIES)

a. Leaching: process allows toxins to bleed out of resin in a controlled manner. The toxins are in the form of a dissolved biocide, if you listened to the previous topic you know what a biocide is/does.
b. The leaching types are usually hard paints the vinyl's being the hardest.
c. Tough, smooth, and extremely durable - can be sanded out of water to a finish of very low friction. A popular choice of competitive sailors.
d. Very strong solvents in paint make them incompatible with most other bottom paints when over coating.
e. Modified Epoxies- some are leaching type and considered a hard finish. Very easy to apply, the most compatible paint for over coating, also very durable and expensive.
f. Semi-ablative paints can also be considered a leaching type some may differ depending on their chemical make-up.

V. ABLATIVE/SLOUGHING PAINTS

a. Co-polymer paints, soft paints, not very durable
b. These paints are impervious to air which makes them a good finish for the boater who frequently takes his/her boat in and out of the water.
c. Biocide release is uncontrolled, resulting in inconsistent longevity.
d. Difficult to clean with out removing excessive amounts of paint (recommend divers refrain from cleaning ablative paints.)
e. Good seasonal paint (not recommended for multi season use)
f. These paints bleed the most toxins and pigment into the bays.

VI. BIOCIDE FREE NON-TOXIC PAINTS

a. These boats are easily fouled, and require frequent cleaning.

b. Most can be aggressively cleaned (rock hard), not silicon.
c. Extremely durable, some last up to five years
d. Some of these finishes are non porous and double as a blister blocker.
e. Very expensive to apply (still cost prohibitive for many boaters)
f. SILICON - easily fouled, but very slippery larger organisms have difficulty adhering to surface. Must be cleaned often and handled with a delicate touch do not use abrasive techniques. Very expensive. System has been reported to add up to 10% additional hull speed to boat.

VII. OUTLAWED PAINTS IN CALIFORNIA

a. Any paint exceeding 330 VOC limit.
b. All paints containing TIN

BOTTOM PAINT OBJECTIVES

1. Understand biocides and their function
2. Know the different types of bottom paints and their properties
3. Know which paints are legal in Southern California and why
4. Know the difference between biocide free paints and toxic paints. - Be able to give examples of each.
5. Have an understanding of growth accumulation in relation to a bottom paint's age.

EXISTING TYPES AND THEIR PROPERTIES

1) HISTORY

a. copper sheeting
b. lead
c. mercury, cyanide, arsenic, cyan pepper
d. tributyl tin
e. cuprous oxide

2) PAINTS DIVIDED BY STRATEGIES

a. leaching
b. ablative & sloughing
c. non-toxic

3) STAGES OF MARINE GROWTH

a. bacterial biofilm
b. algae film "slime"
c. invertebrates "hard growth"

4) COMPONENTS

a. resin
b. pigment
c. solvent
d. biocide

5) BINDERS (CHARACTERISTICS & PROPERTIES)

a. vinyl - leaching
b. epoxy - ablative/leaching
c. copolymer - ablative
d. water - ablative
e. polyurethane - non-toxic
f. teflon - non-toxic (additive)
g. silicone - non-toxic
h. ceramic - non-toxic
i. acrylic - non-toxic (additive)

6) BIOCIDE (CHARACTERISTICS & PROPERTIES)

a. cuprous oxide
b. tributyl tin

c. cuprous thiocyanate
d. ciba irgarol
e. taramysen (additive)
f. biolux

7) CHOICE CONSIDERATIONS

a. durability
b. resistance to growth
c. preparation
d. cost

8) BRAND NAMES (CHART)

a. Pro-Line
b. Interlux
c. Pettit
d. West
e. Woolesy
f. Devoe

9) TERMS

a. sloughing
b. ablative
c. matrix
d. rosin-based
e. resin-based
f. binder
g. solvents
h. diatoms
i. solids
j. leaching
k. hard coatings
l. soft coatings
m. self-polishing
n. soluble coatings

NEW TYPES OF HULL PAINTS ON THE MARKET

1. Aquaply - Sound Specialty Coatings
2. Captain Biox - Kansai Coatings
3. Cerama-Marine - Cerama-Tech International
4. Ceram-Kote - Freecom Inc.
5. Easy On Bottom Wax - Easy On Products
6. Easy Spray Bottom Coating , Aluminum Boat Performance Wax - Natural Marine Products
7. Exsil 2200 - GE Silicone Division
8. Marineeskin - Marineskin Inc.
9. No Foul Paints - E-Paints Inc.
10. MegaGuard - Kiss-Cote
11. SealCoat
12. SI 560 - CSL Silicone
13. Teqmar Antifoul - Lehmann Pacific Industries
14. Veridian - Interlux Yacht Finishes
15. WC 15E - 21st Century Coatings
16. Wearlon - Decora
17. Miracle Cover

Several new companies are now manufacturing Zinc and Econea bottom paint:
Blue Water
Pettit Paints
Interlux
Epaint
Sea Hawk Paints

OUTLAWED BOTTOM COATINGS

All Tin Based Products with the exception of Aluminum Stern Drives with proper permitting and applicator license.

EXISTING TYPES OF ANTI-FOULING PAINTS AND THEIR PROPERTIES

Contrary to popular conception, development of anti-fouling coatings is a science and can become complicated and sometimes confusing. The function of anti-fouling paint is to repel the attachment of fouling. With this in mind, it becomes obvious that anti-fouling compositions bear only a superficial resemblance to other paints. This discussion is intended to equip the diver with the knowledge and terminology necessary to carry on an intelligent conversation with his customers concerning bottom coatings. Knowledge of what the terms presented herein is the first step in choosing the anti-fouling paint that’s right for your customers boat.

Any boat that remains in a marine environment for any period of time will be colonized by marine growth, including algae, grasses, sponges, polychaetes, barnacles, mussels, and more. To prevent or slow this fouling, boat owners apply antifouling coating. There are three stages of hull fouling associated with marine growth: bacterial biofilm, which is microscopic and plugs the pores of paints; algae film "slime" which further plugs the pores, interferes with water flow across the hull and provides a good footing for the third stage; and invertebrates, the "hard growth", which causes significantly higher friction as boats move through the water. Such friction, or drag, increases the fuel cost for powerboats and slows sailboats. In addition, hard growth penetrates the surface of the paint, which contributes to the degradation of the paint.

Over the years many different treatments have been tried to deal with the fouling problem. There are reports of ships being treated dating from the fifth century BC, though no specific details of what was used. By the fourth century AD, copper or lead sheeting was used and copper sheeting can still be found on occasion. Poisons such as arsenic and sulfur mixed with wax or tar was also used. The basic principle of coating a vessel's bottom with material that dissolves slowly and releases toxic substance or biocide is still the fundamental approach used in anti-fouling treatments today. Lead-base paints fortified with copper and other biocides were used very early in recreational boating. As successful as lead-based paints were in controlling sub-waterline growth for long periods of time, it was determined by the EPA that the boating community had no charter to saturate tidal waters with lead-based toxins.
Lead bottom paints were summarily pronounced illegal. Mercury, arsenic, and cyan pepper were legally added to paints. Cyanide was illegally used as an additive as well. In response to the outlawing of lead, mercury, and arsenic, the marine industry introduced a new class of anti-fouling bottom paints based on tributyl tin or TBT in conjunction with cuprous oxide. The EPA then decided that, though considerably less destructive than lead, the TBTs were still overstepping boating's charter by emanating unacceptable levels of toxins. In December 1988, Tributyl tin was banned in California for boats less than 82 feet. TBTs may only be used over aluminum and must be applied by a certified applicator. Tributyl tin will be phased out worldwide by 2008. The primary active anti-fouling agent today is cuprous oxide. Cuprous oxide is now targeted for reduction in California.

This discussion will cover the strategies employed, the components and their properties, the characteristics of different types of components, and the choice considerations to help an owner decide which paint to use. A glossary of terms is also included at the end of this section. Unfortunately, there is no way of describing the different surfaces so the diver could recognize them. This will have to come through experience and an occasional conversation with your customers about their paint.

STRATEGIES

There are two basic strategies most commonly employed in today's anti-fouling coating and a third that is beginning to hit the market in the experimental stages. The two most common are the ablative or sloughing and the leaching. These two rely on toxins to slow or retard the fouling. The newer strategy is the “non-toxic.” The non-toxic coatings rely on a hard or slick surface that organisms cannot easily attach to or can be removed from the surface without degrading the coating.

ABLATIVE OR SLOUGHING - Through carefully placed progressive chemical decay, the surface of ablative bottom paint is designed to constantly erode and fall away. In doing so, it automatically removes parasitic growths or organisms that attempt to attach to it. These paints work in much the same way that a bar of soap would if it had a biocide mixed uniformly throughout the bar. As the film's surface dissolves, helped by the boat’s motion, the surface layer is washed off, and a fresh surface is exposed. Ablative coatings are resin-based paints. A sort of quasi-ablative paint is the soft sloughing-type, rosin-based bottom paint. Much softer, it is simply worn off by the boat's motion. The main distinction between ablative and sloughing paints are that the latter is uncontrolled, whereas ablative paints are controlled by the matrix of the resins.

LEACHING - Leaching is the process that allows the toxins to bleed out of the resin in a controlled manner. Water slowly diffuses through the insoluble film, dissolving the particles of biocide. The dissolved biocide then diffuses out the surface. As the outermost particles of the biocide dissolve, they leave holes within the film’s interior. This allows water to permeate deeper; dissolving the biocide that lies deeper within the film. The toxins restrict or impede the growth of organisms through the life of the toxin. As the available toxins diminish, the growth rate of the fouling increases.

NON-TOXIC - Available non-toxic coatings seek to take advantage of “foul-release” properties; that is, organisms can attach but are easily released off the hull. By definition, it’s very difficult to make a “non-toxic” biocide, nevertheless some also use a FDA approved biocide that acts as an irritant.

Photo Reactive – Photo reactive or photo degradation is a process by which the coatings toxins can be released by exposure to sunlight. The result is that the toxins in the coating will also be released along with a form of ablative properties that keep the surfaces layers free of fouling growth. Zinc based coatings are characteristic of this type coating strategy.

COMPONENTS

Anti-fouling paint is simply a coating that holds a biocide on a boat bottom. They are most often resins or other film-forming vehicles. Resins bind the coating ingredients together and affect major properties including the biocide release rate and hardness. There are four basic components that typically form anti-fouling coatings.

PIGMENT - Provides the color of the coating and affects its thickness property.

SOLVENT - Affects the viscosity that determines application characteristics. If the paint uses an organic solvent such as naphtha, toluene, or acetone, it is called an “oil-based paint.” And if it is water-thinned, it’s called a “water-based paint” (even though the “base” in neither type consists of oil or water). Anti-fouling coatings are also subject to air quality compliance. The evaporation of the solvent affects drying speed and release of VOCs (Volatile organic compounds). The oil-based solvents are a source of air pollution. This is the reason so many paints are outlawed in California, which only allows 330 grams per liter in Southern California and 340 grams per liter VOCs in the rest of the state. To meet VOC criteria, water-based coatings were introduced.

BIOCIDE - The compound used to combat fouling. Many biocides used in anti-fouling coatings are based on metals. Most recreational vessel anti-fouling coatings use copper compounds, including cuprous oxide, copper thiocyanate or metallic copper. Other biocides commonly used as additives or boosters include tributyl tin, zinc compounds, ciba irgarol, seanine-2 11, thiocyanate, tetracycline, and organic chemical compounds such as econea. Biocides are a source of water pollution.

BINDERS

Binders provide the body of the coating, which holds everything else together. There are some additives, which are added to the binders to fortify them and are included in this group. The binder acts as a reservoir for biocides which eventually becomes depleted, and all toxic anti-fouling coatings will fail when the concentration of biocide falls below the critical level necessary to deter larval attachment.

EPOXY: Epoxy esters are sometimes found, however epoxies which have been modified to bind better with cuprous oxide or other biocides is the most common binder used in anti-fouling paints for recreational use today. One-part epoxy resins dry to a tough, hard, reasonably smooth finish. They have good color stability and cure by evaporation. The solvents have less volatile concentrations, keeping the paint from attacking old coatings. Thus, they can be applied over the existing coating. They are durable and resist abrasion, adhere tenaciously to bare hulls and other finishes. However, they require higher levels of biocides to compete with some other binders, they are moderately difficult to remove when worn out, gradually lose effectiveness out of water and are not as smooth or quick-drying as some types of paint. Epoxies employ a combination of ablative and leaching strategies.

COPOLYMER: A commonly used ablative binder encapsulates each particle of biocide in it. It is impervious to air, so the paint doesn't lose as much of its effectiveness as other coating, when boats are hauled and re-launched. It is however, effected by U/V

light, as are all bottom paints. They continue to work as long as paint remains on the hull. Since there is no build up of the spent coating, they are reasonably easy to re-coat. Some of the disadvantages are that scrubbing removes paint and shortens life span; thicker coats are required which adds weight and expense. Copolymers are not as smooth or quick drying as some other paints. They do, however, smooth as they are used.

VINYL: These paints offer a tough, smooth, extremely durable finish that resists abrasion and scrubbing. They can be burnished to create a hull surface with extremely low friction. They have strong solvents, which are incompatible with copolymer or rosin based paints. They are a leaching type paint in the true sense of the word.

***ROSIN BASED*:** Sloughing paints are the least expensive of the anti-fouling paints. They are easy to apply and easy to sand and remove. They flake off in a less controlled fashion than ablatives, so they do not provide protection that's as consistently reliable. Since rosin binders are much softer and more permeable, they are best suited for slower boats with limited time in the water. Sloughing paints are too soft to survive much scrubbing and they quickly lose effectiveness when exposed to air.

SILICONE: Silicone-based, coatings offer excellent foul-release properties, but do not create a tough coating. They are notoriously fragile and manufacturers are working on toughening them. Because they are so fragile, silicone coatings may be damaged during routine activities, such as cleaning or launching. Organisms do not adhere well to silicone coatings; they are easily removed without tough scrubbing or the use of coarse pads. Thus, cleaning may be more frequent, but quicker. Its slippery nature causes handling problems for yards. This coating may increase speed as much as 10%. It is expensive.

CERAMIC: Ceramic-based coatings readily foul, but in contrast to silicone-based coatings they can be aggressively scrubbed without threatening the coating. If cleaning is not done regularly, organisms may be especially difficult to remove. Like silicone-based coatings they must be cleaned more often. Power scrubbing best cleans ceramic. The life span of this coating may be as much as 10 years. In addition, since it is non-porous, water will not penetrate to the hull, so it acts as a blister-blocker.

TEFLON (Additive): Teflon is a booster additive to thin film paints (usually copolymers), which drastically cuts surface friction. The thin film with its aggressive solvents, dry quickly, so multiple coats can be applied in the same day. It can be burnished to create an extremely low-friction hull surface and there is no thick buildup to remove when re-coating. They are incompatible with most other finishes, requires frequent re-coating because they are thin and gradually lose effectiveness out of water.

ACRYLIC (Additive): Acrylic resins are used as an additive for some ablative paints.

BIOCIDES

Biocides used in anti-fouling coatings are grouped into two different categories, metals and organic. The “metals group” comprises the primary concerns to the water pollution problem. Up to a point, it is logical to gauge the toxicity longevity and effectiveness by how much and how strong biocide they contain. However the true measure of their effectiveness is in the composition, matrix, and thickness of the coating - not how much they contain, but how efficiently they release it to combat fouling.

COPPER: Copper is by far the most common of the biocide used for recreational boating. Its most common form is Cuprous Oxide, however some paints will use copper powder, copper flakes, and cuprous thiocyanate. Cuprous oxide-based anti-fouling coatings are currently registered with the State of California Environmental Protection agency. It has been targeted for reduction in this State. The shortcomings of copper based anti-foulants is that some diatoms can thrive in this setting by producing a mucous layer (slime) in response to heavy metal poisoning. This shortcoming has increased the need for biocide additives, some of which will be discussed latter in this section. This slime layer is problematic because it can clog the paint's pores, thus preventing copper from leaching, and it provides a substrate for further colonization of larger organisms.

Zinc: Zinc coatings are becoming more popular as an alternative to copper. Zinc coating are primarily ablative photo reactive coatings. Most paints strategies use a softer matrix that tends release its coatings pigments when wiped. These coating are of great concern to the state because they are still a heavy metal become toxic to sea life if used as copper is today. Manufactures claim short term toxicities in water column and thus creates an environmental benefit. Studies are still pending but it is clear zinc coatings are a viable alternative as formulators increase the performance of the latest products

TIN: Although outlawed (in most cases) it may be found on aluminum boats or outdrives. Tin is found in the form of tributyl tin. It contributes to a hard long lasting coating. It is effective against algae as well as hard growth.

IRGAROL: Irgarol is used as a co-biocide in at least 5 coatings, approved by the State of California. Using this as a booster biocide is considered a way to lower the necessary amount of copper in anti-fouling paints. It is an organic algaecide additive.

Econea: As a metal-free antifouling agent, ECONEA claims are that it is an excellent invertebrate repellent and does not accumulate in the marine environment due to:
• An extremely short hydrolytic half-life in seawater(3 hours and 15 hours depending on water temperatures
• Rapid aqueous photolysis
• Rapid degradation in freshwater and marine environments
• A strong tendency to partition and bind to soil/sediment
Combined with the fact that its degradation products are biodegradable, ECONEA May be an excellent choice for protecting both boat hulls and the marine environment.

SEA-NINE OR KATHON: These two are the same formula. This co-biocide has a conditional approval by the Federal Government. It has been use in Europe. This biocide is also considered as a way to lower the necessary amounts of copper. It is an organic algaecide additive.

BIOLUX: An additive used by Interlux

TETRACYCLINE: Sold separately as an additive under the brand name “Compound X.” This additive is a fungicide, which many people like to add to their paints.

CHOICE CONSIDERATIONS

Durability is a large factor since yard haul-outs are expensive. Sloughing paints are the less expensive, however, sloughing and some copolymers are single season paints. Consequently, they are only popular for boats that come out of the water for the winter. Other copolymers with additive to fortify them are multi-seasonal. The durability of copolymer paint is a function of the mil thickness of the coating; therefore if the customer wants longer life more coats can be applied. Copolymers are not recommended for use on trailerable boats since the coating will wear off where the boat sits on the cradle. Also, they are not suitable for boats that do not leave the slip or are too slow to erode the surface unless they are cleaned regularly. Modified epoxies and vinyl are very durable. Silicone coatings have shown to be about as durable as epoxies and vinyl. Provided due care is taken during cleaning and handling they must be cleaned often and gently. Ceramic coatings show promise of lasting as much as 10 years. They must be cleaned often and may be cleaned aggressively. Water-based paints have been criticized for poor durability and the manufacturers are working to improve their quality.

The effectiveness of the resistance to growth plays a large role in the decision process. Because of legal constraints, cuprous oxide is used in almost all epoxies, vinyl, and copolymers. The matrix and the thickness of the coating determine the effectiveness and persistence of the biocide. Since most paints on the market today use the same biocide, control of the release rate is the key element in bottom paints effectiveness. If the release rate is too low for the particular set of conditions the anti-fouling action will not be adequate. If the release rate is too high, the paint will not last long enough to make its use practical. Release rates can be affected by a host of external factors such as boat speed, water temperature, and how often the boat is used. Manufactures design their paints for a particular set of conditions. For this reason, some paints are better in some circumstance than others. Silicone and ceramic coatings have no resistance to growth; consequently, they must be cleaned more often.

To the recreational boater, the economics of non-toxic coatings are very different from that used to make decisions regarding conventional anti-fouling. Financial differences between non-toxic coatings and cuprous oxide coatings may include initial cost, hull preparation, longevity, maintenance, fuel efficiency, and engine load. In conventional anti-fouling paints, the initial cost is a primary factor. The cost of the paint weighted against the longevity and effectiveness. The required cost of the bottom preparation if changing to another coating also plays a large roll. See compatibility chart. In non-toxic coatings, the overall costs and environmental considerations may play a larger roll. As regulative pressure grows these differences may only be academic.

GLOSSARY OF TERMS

ABLATIVE - A type of anti-fouling paint that is designed to shed at a determined rate while the vessel is in motion, thus releasing paint and growth into the water.

BINDER - The resins that hold the other ingredients together.

DIATOMS - See Phytoplankton

FILLERS - Consists of the biocide and the pigments.

HARD COATINGS - Oil-based paints, which include most “vinyl”, “Epoxy” and “Co-polymer” antifouling paints, have a vehicle, which is a hard resin dissolved in a solvent. Once the solvent evaporates a film of hard resin remains.

LEACHING - The process used by non-soluble anti-fouling paints with a matrix - the materials in which the biocide is enclosed or embedded.

NON-SOLUBLE - Do not dissolve in water. Vinyl and epoxies are in this category. They slowly diffuse through the insoluble film.

PHYTOPLANKTON - Tiny marine plants that form the base of aquatic food chains. They derive energy from sunlight and are generally the first organisms to attach to boat hulls. Examples include: diatoms, cyanobacteria, and dinoflagellates.

RESIN-BASED - Natural resins are extracted from wood as sap. Synthetic resins have replaced natural resins.

ROSIN-BASED - a sap obtained from several varieties of pine trees. Used as a binder for sloughing paints.

SELF-POLISHING - See ablative

SLOUGHING - A soft coating which allows the surface to erode in an uncontrolled manner.

SOFT COATINGS - A soluble coating used in sloughing or ablative paints in the past. Newer copolymer coatings can be quite hard and many no longer fall into this category.

SOLIDS - The remaining part of the coating after the solvents have evaporated.

SOLUBLE COATINGS - referred to in paint manufacturers’ ads as “ablative,” “Co - Polymer,” “self-polishing,” or “sloughing” paints - uses resins that slowly dissolve in the surrounding seawater.

SOLVENTS - A Substance that reduces the viscosity of the ingredients to a brushable or sprayable liquid.

U/V'S - Ultra-Violet light given off by the sun.

WATER-BASED PAINTS - the binder is dissolved in a small amount of organic solvent and dispersed in water as tiny droplets. When the paint dries, the water evaporates, allowing the individual droplets to coalesce, or flow together. The paint then continues to dry with the evaporation of the solvent as if it were an oil based paint.

NEW TYPES OF BIOCIDE FREE HULL PAINTS ON THE MARKET

It would be nice if we could report that the future promises a whole new generation of low-cost, long-lasting, more-effective, environmentally-friendly, anti-fouling bottom paints. *We cannot*. The future will most likely hold compromises to achieving all these qualities. One thing for sure is that they will be more environmentally friendly. That being said, there are some exciting new prospects being tried throughout the world. A look at these new products may give you some insight into future.

1) AQUAPLY M: SOUND SPECIALTY COATINGS
It is a non-solvent epoxy replacement for toxic antifouling bottom coating for pleasure boats. It provides a fast, hard, and slippery surface. It contains neither VOCs, nor metals. Aquaply M is as slippery as silicone coatings.

2) CERAMA-MARINE: CERAMA-TECH INTERNATIONAL
It is a non-toxic water-based vinyl acrylic coating that complies with the strictest federal, state, and local VOC regulations. It cures to a super hard finish that will remain impervious to outside elements.

3) CERAM-KOTE: FREECOM INC.
Ceram-Kote 54 is a highly modified epoxy resin, which has a heavy load of ceramic particles. It is tough with very high adhesion that provides a surface that barnacles and marine growth cannot penetrate. Short-term marine growth can be removed with power scrubbers. It is not an anti-fouling coating. It is low in VOCs. Light marine vessels have shown an increase in service speed and reduced fuel consumption.

4) MIRACLE COVER: Miracle Cover, used primarily as graffiti covering for commercial applications, was offered to boaters as a test coating in Jan 2000. It base is silicon and water making it an ideal surface for racing sailboats and vessel that need to achieve maximum hull speed. It is believed that because of the lack of drag, fuel efficiency is increased. The silicon base means that durability is questionable and regular 14 to 21 day hull cleanings are a must.

REFERENCES

1) California Sea Grant - Jul 2000
2) Port Supply Catalog - 2000
3) Powerboat Reports - Apr 1992
4) www.yachtpaint.com/USA/usersguide
5) www.yachtingnct.comlgear/bottom finishes
6) www.cerarna-tech-int.corn/in Co
7) www.cerarn-kote.comirnarine

CONTACTS

1) Stan Susman – Interlux Paints
2) Bill Roberts - Shelter Island Boat Yard (619) 222 0481
3) Marlan Hoffman-California Professional Dives Association 619 534 5041
4)Barth Hudiburgh- SEA HAWK PAINTS (619) 231 2313 Pager (619) 290 3187

HULL COATING QUESTIONS

1. Bacterial micro-film appears when?

a. four weeks after cleaning
b. three weeks after cleaning
c. as early as one week after cleaning
d. six weeks after cleaning

2. The component in an anti-fouling bottom paint that controls or repels growth levels is?

a. the matrix
b. the biocide
d. resin
e. pigment

3. Soft bottom paints are usually of the ABLATIVE or SLOUGHING type.

a. TRUE
b. FALSE

4. There are two basic kinds of biocides found in bottom paints, circle both of them.

a. Chemical or metal
b. Organic
c. Vinyl
d. Tributyl-tin

5. The process which allows toxins to bleed out of a bottom paint is known as?

a. Sifting
b. Impregnation
c. Leaching
d. Leaking

6. Which of the following is not a type of bottom paint

a. Semi-ablative
c. Biocide-free
d. Leaching type
e. Polyester

7. Biocide free bottom paints are loaded with toxins, and therefore do not need to be cleaned very often.

a. TRUE
b. FALSE

8. Which kind of bottom paint is the most environmentally safe?

a. modified epoxy
b. vinyl
c. ceramic
d. water base

9. Pick the most common kind of bottom paint used in California

a. vinyl
b. self sloughing
c. silicon
d. modified epoxy

10. Silicon bottom paints are a good alternative to toxic paints because they are relatively inexpensive and easy to apply.

a. TRUE
b. FALSE

11. Tributyl-tin is the most effective of the biocide-free paints on the market.

a. TRUE
b. FALSE

12. Irgarol is currently being used as a co-biocide with cuprous oxide and is an organic biocide

a. TRUE
b. FALSE

13. The maximum V.O.C. level that may be used in bottom paints in Santa Barbara is?

a. 400
b. 390
c. 330
d. 360

14. Zinc Paints are Photo Reactive

a. TRUE
b. FALSE