GPS SPOOFING: SCIENCE FICTION OR SCARY NEW REALITY FOR YACHTING? page 12

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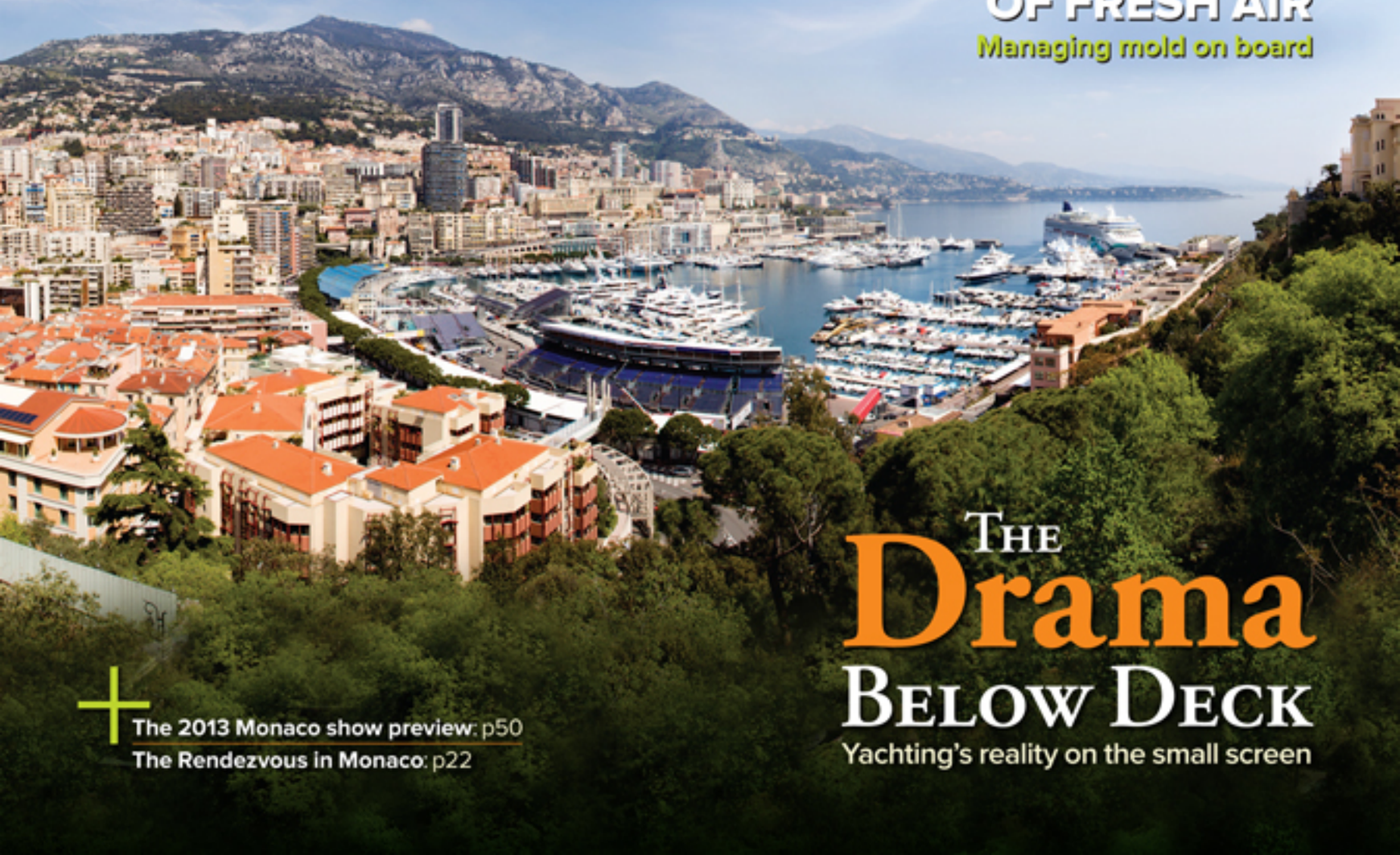

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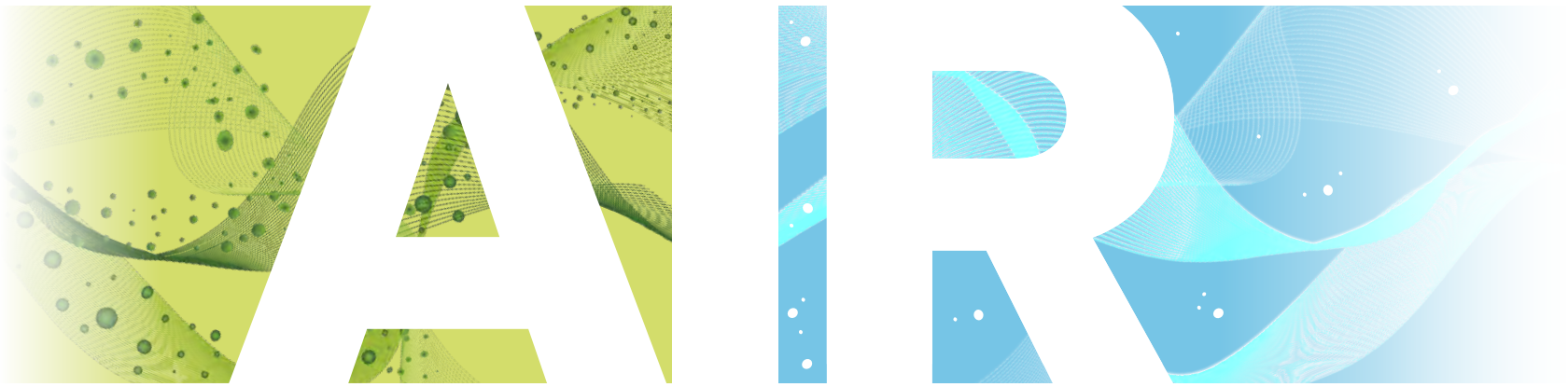


MOLD ON BOARD CAN CAUSE SERIOUS HEALTH ISSUES, AND LET'S NOT FORGET THE COSTLY DAMAGE TO THE VESSEL AND ITS PRICELESS FURNISHINGS. PREVENTION IS KEY TO A HEALTHY YACHT AND HEALTHY CREW.

BY RICHARD BOGGS

RALPH WALDO EMERSON PROBABLY DIDN'T HAVE YACHTS IN MIND when he wrote "Live in the sunshine, swim the sea, drink the wild air…" but if he had the opportunity to experience a few days on a modern charter yacht, he might have reconsidered one of his other musings; "The wonder is always new that any sane man can be a sailor."

A yacht at sea is usually surrounded by the wildest and freshest air, so air quality problems are not as great as might be experienced at home or in a shoreside office. However, yachts are susceptible to some problems not typically found in terrestrial installations.

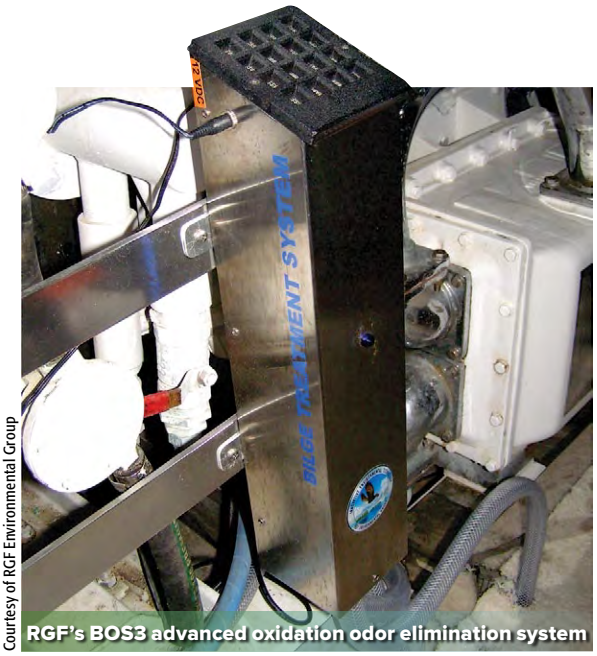
A schematic diagram of a modern superyacht's heating, ventilation and air conditioning (HVAC) system can resemble a map of the London Underground. Unfortunately, a yacht's ductwork and air handlers are rarely as easily accessible. A general lack of crew awareness of the health risks attributed to bacterial and fungal contamination, compounded with the difficulty of access to air handlers and ventilation ducting, may contribute to a lack of maintenance that can lead to respiratory illness or aggravate existing allergies.

The Problem with Mold

Mold (often called mildew) is probably the single greatest threat to the condition of a yacht's interior and the health of guests and crew. Molds are denizens of the biological kingdom of fungi, the organisms that help provide us with truffles, beer, Champagne, bleu cheese, soy sauce and antibiotics, among other useful products and services. Life without molds would be very unpleasant; molds are nature's recycling SWAT team and reduce dead organic material to its basic chemical components. But even the best families can include a few ne'er-do-wells, and many molds are well represented in that group.

Mold and fungi can grow anywhere. Any organic material in a warm, moist location provides an ideal environment for a passing spore to blossom into a carpet of multi-hued, toxin generating mycelium. Preventing the growth of mold is very difficult, but not impossible. With regular cleaning and filter replacement, most of the problems attributed to mold in a yacht's air-conditioning and ventilation system can be controlled before mold spores and toxins lead to odors, costly damage and serious health issues.

Most molds are harmless to humans and are non-parasitic, only becoming a problem when they are in the wrong place. Unlike all other respiratory



Courtesy of RGF Environmental Group

RGF's BOS3 advanced oxidation odor elimination system

pathogens, except anthrax, only mold can exist outdoors and enter a yacht through its ventilation system. Some molds can cause respiratory infections, and because they don't cause secondary contagious infections, only the person who inhales the spore is affected.

Our problem with mold is that it doesn't differentiate between old fruit, priceless paintings, leather upholstery and Mrs. Owner's Manolo Blahniks. Molds thrive in warm and humid conditions and reproduce by expelling millions of microscopic spores as small as one micron — about one quarter the size of a normal dust particle. Mold spores can survive harsh environments, such as hot, dry conditions that do not support normal mold growth. Although there have been recent efforts to debunk the theory, one plausible explanation for "King Tut's Curse" is the existence of viable Aspergillus mold spores that lay dormant for nearly 4,000 years within Tut's tomb. As recently as 1973, 10 of the 12 scientists who opened the tomb of Polish King Casimir IV succumbed to toxins produced by *Aspergillus flavus* spores that riddled the 500-year-old remains.

We don't have to open a royal tomb to stir up a cloud of mold spores. They are everywhere. The highest concentrations of molds, like yachts, can be found in the lower latitudes. Regions where summer winds raise clouds of dust from dry soil can lift large quantities of mold spores that may be carried great distances offshore. Dust storms originating in the Sahara Desert produce some of Florida's most spectacular sunsets, but they also transport viable microbes, including mold spores. According to NASA and U.S. Geological Survey studies, Florida receives nearly seven million tons of microbe-laden African dust annually. It requires only a few spores to enter the ventilation system of a yacht to lead to widespread contamination.

Stop the Invasion

Filtration is the first line of defense against an invasion of mold. Air inlet screens and filters should be maintained religiously. Even the relatively coarse woven filters commonly used on intakes will capture a significant percentage of mold spores. If the highest degree of protection can be fitted, either at the design stage or during a refit, High-Efficiency Particulate Air (HEPA) filters will capture virtually all mold spores in addition to bacteria and viruses. American government standards require a HEPA filter to retain at least 99.97 percent of particles down to a size of 0.3 microns. EU standards provide a range of retention from 99.75 percent up to 99.9999 percent.

Keeping mold spores outside the boat is relatively easy compared to dealing with those that have established a homestead inside the air handlers and ventilation ducts. Molds require moisture to grow. Chilled water circulation piping, air handlers and condensation drains are all sources of moisture and should be carefully inspected for mold growth. If any signs of mold are found, the area must be thoroughly cleaned and sanitized to eliminate further spread of both mold and its spores.

Chlorine bleach is frequently recommended for cleaning and sanitizing ventilation components. Chlorine is a powerful oxidizer and is highly effective at killing bacteria and fungus on hard, non-porous surfaces such as metal or glass countertops, but it does not penetrate porous materials deeply enough to destroy the mycelia or roots and, like a weed, will quickly regenerate.

Commercial air-conditioning supply firms and cleaning product suppliers that cater to mold remediation and "restoration" contractors sell highly effective products for emergency and routine ventilation system cleanup. There are several "natural" products that use thyme oil

RESOURCES

ARW Maritime
www.arwmaritime.com

Beard Marine
www.beardmarine.com

Dometic
www.dometic.com

Elite Marine AC
www.elitemarineyachts.com

Heinen & Hopman Engineering
www.heinenhopman.com

Matthew's Marine AC
www.matthewsmarineac.com

Nautic Air
www.nautic-air.com

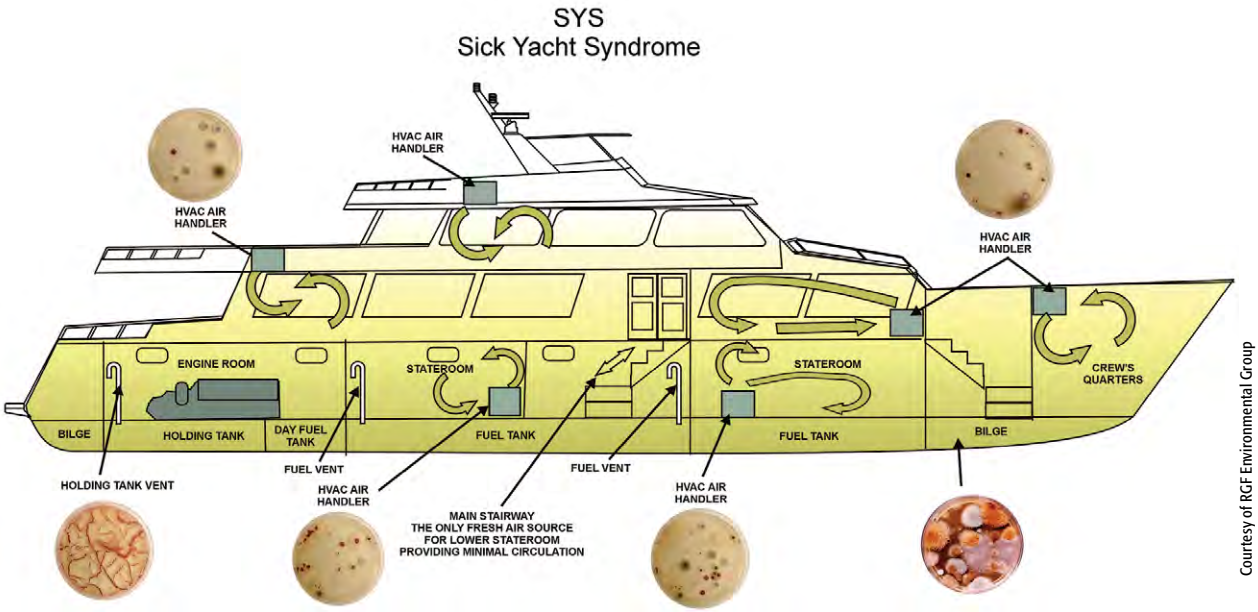
N.R. Koeling
www.nrkoeling.nl

RGF Environmental Group
www.rgf.com

Thomas Marine Systems
www.thomasmarinesystems.com

Tropical Marine Air Conditioning
tropicalmarineairconditioning.com

Voda Marine Services
www.vodamarine.com



Courtesy of RGF Environmental Group

and other plant essentials as a base that are reported to be highly effective, yet completely non-toxic to humans.

Clogged air-handler drains are epidemic, and the root cause of many mold and odor problems.

"It is rare to not find mold growing on and around air handlers on yachts," explained one well-known Fort Lauderdale large-yacht surveyor. "Because filters are often installed in very difficult to reach locations, they don't get changed regularly, and some of them are installed so that it is practically impossible to service them." It is imperative that drains are always open to prevent collection of standing water or even worse, overflow to irrigate the fields of Aspergillus and Cryptococcus that inevitably follow.

Because so many people are exposed at the same time, cruise ships are infamous for outbreaks of illnesses attributable to mold spores and bacteria, and the construction and operating conditions of most yachts provide identical breeding grounds for airborne transmission of the same infections. We have all heard of the "sick building syndrome," but rarely think of large yachts as being at risk of contracting what Ronald G. Fink, president of West Palm Beach-based RGF Environmental Group, calls the "sick yacht syndrome."

Fink stretched and converted a Broward motor yacht to create a 33.5-meter showcase for RGF Environmental's range of air- and water-treatment technologies, which include his trademarked PHI photocatalytic oxidizer units. Photocatalytic oxidation (PCO) systems use ultraviolet light acting on a metallic catalyst, such as titanium dioxide, to produce a hydroxyl radical, or hydroxide ion. This is the same stuff that makes hydrogen peroxide, oxygen and ozone such effective weapons against many biological pathogens. Hydroxyl radicals are even produced naturally in the body by macrophages, the specialized cells that are dispatched to the scene of infection or viral attack.

While PCO is a somewhat controversial method of eliminating mold spores and airborne pathogens because ozone is generated in small amounts as a byproduct, it has been proven to be a highly effective means of eliminating many airborne pathogens and volatile organic compounds (fumes and smells). Supporters of the technique point out that the concentration of ozone produced is very low and with a half-life of around 30 minutes in normal conditions…a short-lived problem.

The Crew Solution

Given the pervasive nature of mold, mildew and bacterial contamination of a yacht's ventilation system, what measures can crew take to reduce the risk of an airborne invasion that seems to be all but impossible to avoid?

The best answer might be found in your local library, not just in a book on the shelves, but from the organizations that help preserve the networks of libraries and museums that maintain very large collections of materials that are ideal breeding grounds for mold. Experts in the library collections preservation business suggest a three-step approach to remediation and prevention of mold damage that is equally applicable to yachts of any size.

Modify the environment: If relative humidity can be maintained between 40 and 60 percent, mold growth is stopped in its tracks. Operate the HVAC system in a mode that maintains the lowest possible relative humidity. Keep air circulating constantly; turning air handlers on and off allows spores to settle on damp coils then reproduce wildly when the temperature rises. Install portable dehumidifiers if the HVAC system must be secured, and leave lighting on. Mold doesn't like light, especially daylight — ultraviolet light is a stake through the heart of a mold organism. If

Courtesy of RGF Environmental Group

RGF's 33.5-meter Broward *Envision*

possible, install PCO units in ducts or ultraviolet lights to illuminate filters and air-handler coils.

Clean: Use personal protective equipment to avoid breathing spores or contaminating your clothes while cleaning ducts and air handlers. Wear a dust mask, surgical style gloves and perhaps even a Tyvek suit left over from the last refit. Wipe, brush and vacuum air handler coils and all accessible areas of the HVAC system that are exposed to air flow. Avoid using a shop-vac unless it can be fitted with a HEPA filter. The engineer's wet vac will just blow spores around and create larger problems in a few weeks. As mentioned earlier, most remediation experts now advise against the use of chlorine or sodium hypochlorite-based mildew stain removers, so read the label carefully. Obtain and carefully read the material safety data sheet (MSDS) for any fungicide or cleaner before using it within the confines of a yacht. Some cleaners may be more dangerous than the problem you're trying to eliminate. The library collections experts recommend wiping with ethanol or grain alcohol — it's a highly effective (not to mention very flammable) biocide, it evaporates quickly and leaves no residue or lingering smell. One of the more potent brands of vodka will do nicely, too.

Monitor: Once you have removed as much contamination as possible, keep a regular and continuous watch of the affected areas. It only takes a few mold spores to produce another outbreak. Make sure that filters are replaced before they clog and reduce air circulation. Include professional duct cleaning in the next refit and if outbreaks seem to be a common occurrence, call in the pros to perform a more intensive search for the source of the spores.

Drinking the "wild air" doesn't mean we have to breathe in the wildlife as well. ***DW***