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Naturally Antimicrobial, Copper May Also Improve Air Quality

Healthy HVAC Systems Is Goal of New Research

Seafarers have known for generations that copper plates and paints prevent algae and barnacles from growing on their boat hulls. Today, the heating, ventilation and air conditioning industry may be learning a similar lesson.

Copper and copper-rich alloys not only repel marine growth, they are also naturally antimicrobial. Bacteria and viruses—germs, in common language—simply can't live for long on copper-based surfaces. As a result, medical researchers and scientists have begun to focus on the germ-fighting ability of these metals.

An area of special interest to these researchers is heating, ventilation and air-conditioning (HVAC) systems, which provide a moist, dark, closed environment that can be a breeding ground for mold, mildew and bacteria.

Many residential and virtually all commercial buildings rely on HVAC systems to heat, cool, ventilate, clean, humidify or dehumidify their indoor air. Passenger cars and public transportation systems have similar "climate control" systems.

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Mankind's "Alloy" in the War Against Bacteria

Copper battles disease on common touch surfaces

Long before the advent of modern medicine and the scientific discovery of germs, ancient healers recognized that copper had medicinal powers.

Egyptians used copper to sterilize drinking water and wounds. Hippocrates, a fifth-century B.C. Greek who led the development of the Hippocratic Oath taken by doctors, treated open wounds and skin irritations with copper. The Aztecs applied copper to heal sore throats. And the Romans catalogued numerous diseases for which copper could be used as a treatment.

These antimicrobial uses of copper and copper-based alloys throughout history have led to today's efforts to determine the effectiveness of the metals in stemming infectious disease—a problem of growing concern in healthcare facilities. The U.S. Centers for Disease Control and Prevention (CDC) estimates that infections acquired in U.S. hospitals affect some two million individuals each year, resulting in nearly 100,000 deaths annually at a cost of \$30 billion.

Studies sponsored by the Copper Development Association (CDA) and the International Copper Association (ICA) have shown that uncoated copper and copper alloys can eradicate common disease-causing bacteria such as *E. coli*, *Streptococcus* and *Staphylococcus*. Copper and copper alloy surfaces, including brass and bronze, have even proven effective against Methicillin-resistant *Staphylococcus aureus* (MRSA), one of the more virulent strains of antibiotic-resistant bacteria associated with hospital-acquired infections.

In laboratory studies at the University of Southampton, U.K., MRSA was eliminated on brass surfaces in 4.5 hours and on pure copper in just 1.5 hours. Brass surfaces also wiped out an often-deadly strain of *E. coli* in less than two hours. On stainless steel, which is typically used for touch surfaces in hospitals, the pathogens can survive unabated for more than 30 days. The studies also show that the higher the copper content of the alloy, the more quickly bacteria die.

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APPROVAL PENDING

In the United States, health claims must be verified, approved and registered by the Environmental Protection Agency (EPA). To obtain registration, CDA has submitted substantial documentation to support the laboratory results. Upon approval of this application by EPA, copper will become the first and only metal to be granted approval to make human health claims.

In hospital and healthcare facilities, the first lines of defense against the spread of infection are hand-washing and routine sterilization of surfaces, particularly those that are frequently touched or in close proximity to patients. These "touch surfaces" include door and furniture hardware, bed rails, intravenous (IV) stands, medical monitoring equipment, faucets, sinks and work tables. Unfortunately, disinfectants and antimicrobial coatings work only for short periods before wearing off or losing their germ-killing potency. Identifying and employing surface materials—such as copper and its alloys—that provide continual antimicrobial protection, accommodate the demands of everyday use, and require minimum maintenance, may help reduce cross-contamination.

Congress recently approved funding for clinical trials to determine the effectiveness of copper touch surfaces in hospital environments. This research, under the direction of the U.S. Department of Defense, will be conducted at Memorial Sloan-Kettering Cancer Center in New York City, the Medical University of South Carolina and the Ralph H. Johnson VA Medical Center, both in Charleston, South Carolina. A series of three trials will determine how well natural copper, brass and bronze surfaces mitigate infectious microbes, decrease cross-contamination and ultimately help reduce the incidence of hospital-acquired infections in patients.

Not unlike those ancient men of medicine who discovered copper's innate healing ability through trial and error, modern scientists are re-examining this marvelous metal as a defense against murderous 21st century maladies. If they succeed, the warm glow of copper and its alloys could again become mankind's dependable shield in our ongoing battle against illness, infection and disease. **Cu**

Copper Roof Crowns Historic Saratoga Track Renovation

New shine and sparkle restored to Victorian-era architectural jewel

Every August since 1864, the oldest operating racetrack in the country, Saratoga Race Course, has drawn betting fans, vacationers, celebrities and the elite echelons of high society by the thousands to this woody whistle-stop in upstate New York.

They come to watch the ponies run, of course, but also to celebrate the sheer spectacle of racing that revolves around this glamorous, whitewashed, Victorian-era architectural icon. This year, a \$1.3 million improvement program put some much-needed sparkle back into America's crown jewel of racetracks, with lavishly renovated horse barns and interior appointments befitting a betting palace of this stature—all capped off with a shining new 10,000 square-foot copper clubhouse roof.

Maintaining the track's fabled photogenic appearance was the highest priority throughout the renovation. "The integrity of the architecture and the historical character were paramount," explained Saratoga Facility Manager Charles Wheeler, of the New York Racing Association (NYRA). When it came to replacing the aging clubhouse roof, he added, "Copper was the only material on the list. There really was no other option."

The NYRA, which has operated the historic site for more than a half century, kicked off the 139th summer racing season with the debut of the completed renovation, a project that has added new features as well as more flare to the venerable racetrack. Aside from the renovated roof and horse barns, race fans now enjoy such modern amenities as hot water in all the restrooms, along with 37 new covered television-viewing areas that allow visitors to keep an eye on the action when not at trackside.

The contractor for the clubhouse roof, WeatherGuard Roofing of Schenectady, NY, had little difficulty meeting the challenge—despite the age and overriding importance of the site, and the absolute necessity of retaining the structure's Victorian charm while modernizing it.

"It went extremely well," said Steve Bradt, WeatherGuard's project manager. Bradt agreed with the NYRA's choice of copper for the roof as "necessary for the historic preservation of Saratoga."

The roof replaced an existing copper roof of ancient but indeterminate age that was beyond repair. The new roof, which is composed of multiple 16-ounce-weight solid copper panels, was fabricated onsite from materials produced by Revere Copper Products of Rome, NY, and supplied by Admiral Building Products, also located in New York.

With track attendance already surpassing expected numbers this season, Saratoga Race Course continues to be a major attraction for vacationers from the region and across the country. While the recent improvements might not be the most important reason for visiting, according to many who have seen the change, it certainly adds to their enjoyment.

"People were ecstatic when they saw some of the improvements around the facilities," Wheeler said. "It's really been quite rewarding." **Cu**



A new copper roof covers the back clubhouse at Saratoga Race Course. Copper was specified to help maintain the structure's historic appearance.

“Naturally Antimicrobial” Continued from page 1

Copper—in the form of pipes, tubing, cooling fins and other parts and equipment—has been a critical component of these systems since they were invented. In recent years, however, less-expensive aluminum and plastic components, which have no inherent antimicrobial properties, have replaced many copper HVAC parts. This has raised concerns that the conditioned air we breathe at home, at work and in public spaces could actually be making us sick.

VERIFIABLE EVIDENCE

Research by Professor C. William Keevil at the University of Southampton, U.K., has demonstrated that copper alloys are naturally antimicrobial and effective against a wide range of pathogens. Recently, preliminary data from the university also showed that brass surfaces reduce the amount of *Aspergillus niger* (black mold) found on them by about 99 percent within six hours, while aluminum surfaces have virtually no effect on the organism.

As evidence of copper’s antimicrobial effectiveness accumulates, the use of this ancient metal in HVAC systems is being re-examined from a fresh new perspective.

The Department of Defense, through the U.S. Army Medical Research and Materiel Command, recently awarded a congressionally funded contract to study the antimicrobial effects of copper components in

HVAC systems. This multiyear research project will be carried out in laboratories, medical facilities and military bases.

One reason for the DoD’s keen interest: Last year a certified independent laboratory undertook the most rigorous experimental testing of copper alloys ever attempted, which provided concrete evidence of copper’s antimicrobial properties. To verify the results, the International Copper Association (ICA) and the Copper Development Association (CDA) funded an additional series of controlled experiments by a U.S. Environmental Protection Agency-approved test center. The ICA and CDA goal is to gain acceptance from the EPA to make human health claims related to the antimicrobial properties and use of copper alloys.

EVAPORATOR ODOR

The verification that copper and brass possess antimicrobial properties is exciting news, but what does it mean to the HVAC industry?

Automotive industry research has shown that moisture condensing on a vehicle’s air-conditioner evaporator traps dust and creates an environment where microorganisms thrive. These bacteria and mold form a “slime-layer,” or biofilm, that is a focus of investigation by scientists who study the natural ecologies of bacteria.

The researchers have learned that by inhibiting biofilm growth in climate control systems, unpleasant odors can be eliminated. And if copper substrates prevent microbe growth, biofilms can’t form. Consequently, using copper alloys in climate control systems could be effective in eliminating not only bad odors, but also the unhealthy atmosphere created by the presence of mold spores and bacteria.

LOOKING AHEAD

The antimicrobial properties of copper and copper alloys are now firmly established on a foundation of quantified experimental results. However, these extraordinary properties are just beginning to be fully appreciated and applied to the development of products and systems that can control microorganisms in the environment.

The Department of Defense research now underway hopes to demonstrate that harmful bacteria and fungi can be eliminated or effectively reduced by replacing aluminum and steel HVAC components with parts made of copper or copper alloys. These studies are just a first step in clarifying how copper’s naturally antimicrobial ability can not only contribute to improved indoor air quality, but also to creating a more healthful human environment in hospitals, homes and public spaces—and anywhere germs thrive. **Cu**

Research has shown that moisture condensing in air conditioning systems can create an environment where microorganisms thrive. High-efficiency air handling systems (inset) with naturally antimicrobial copper components not only improve vehicle engine output and cooling, they also help to inhibit mold and bacteria growth. Studies are underway to demonstrate the effectiveness of copper systems in commercial air conditioning as well.



Cu Newsbriefs

A Penny for Your Tongue

Copper scraper stops bad breath before it starts

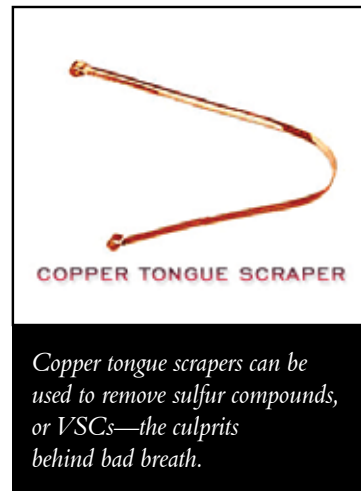
Got mint? If not, a quick application of copper can put the brakes on bacteria that cause bad breath. But you won't find this breath-saver at a checkout counter.

According to a study in the *Journal of Clinical Periodontology*, bacteria on your tongue break down food debris into volatile sulfur compounds, or VSCs—the culprits behind stinky breath. The study recommends tongue scraping as the most effective way to remove the compounds and improve bad breath.

Many tongue-scraping devotees use naturally antimicrobial copper scrapers, which are considered to be more comfortable

on the tongue and do a better job than brushes or plastic scrapers. Although this practice may not permanently stop bad breath, studies have shown that bacteria build-up is significantly less when tooth brushing is followed by a vigorous tongue scraping.

Copper tongue scrapers are available on many health, dental and yoga Web sites, and are sold through Amazon.com and eBay. Among yoga disciples, daily cleaning with an unalloyed copper scraper is considered beneficial to maintaining the body's elemental balance, or *kapha*. **Cu**



Copper Under the Microscope

Is it alive? That was a question some scientists asked themselves when they observed copper particles swimming like a school of fish under the microscope.

When physicists Narayanan Menon and Vijay Narayan agitated tiny copper rods (4.5 mm long, 0.8 mm in diameter) in a liquid-filled container, the rods mysteriously aligned themselves and began moving in the same direction, resembling schools of fish. Only copper rods with pinched ends, shaped like rolling pins, exhibited the unique swarming motion. An earlier experiment with cylinder-shaped rods did not prompt the same reaction.

While the study does not indicate that copper is alive, it may provide insight into similar behavior in living organisms that travel in swarms, schools and flocks. The scientists speculate that if copper, an inert material, behaves in such a fashion, swarming may also occur in nature without any thought or conscious motivation.

Research is now being conducted with other objects having a "rolling pin" shape. Another physicist, Martin van Hecke, reportedly observed swarming, swirling and spontaneous grouping while experimenting with rice grains.

Menon plans to continue his research with copper because the characteristics of the metal provide reproducible results. Some day, such research may prove useful in the production of powders and glass. **Cu**

Copper and Pregnancy

Copper is an essential trace element for your hair, skin and bones, as well as your central nervous and cardiovascular systems, immune and reproductive systems, and even gene transcription. It's also an enabler, helping the human body to use other minerals, such as iron.

But while copper is needed to transport iron from red blood cells into your body, too much iron can inhibit the body from using much-needed minerals—including copper. Similarly, too much zinc inhibits the body's ability to absorb copper.

According to a recent study in *BJOG: An International Journal of Obstetrics and Gynecology*, pregnant women who take iron supplements have a greater risk of zinc and copper deficiency, which can lead to high blood pressure and smaller baby size.

The study suggests that in order to receive a recommended 2 to 3 milligrams of copper and 27 milligrams of iron per day, pregnant women would be better off skipping supplements altogether and obtaining the minerals through a properly balanced diet. **Cu**



A recent study suggests pregnant women should obtain the daily recommended amount of copper and iron in their diet through properly balanced nutrition.

RESOURCES

This edition of Discover Copper is also available online at www.copper.org and at www.homeplanningnews.com.

For more information on the topics mentioned in this newsletter go to:

BJOG: An International Journal of Obstetrics and Gynecology — www.blackwell-synergy.com/loi/BJO

Journal of Clinical Periodontology — www.ingentaconnect.com

Centers for Disease Control and Prevention — www.cdc.gov

International Copper Association, *CuproBraz* Executive Report — www.cuprobrzealliance.com

Journal of Hospital Infection — www.sciencedirect.com