

Discover **COPPER**

Copper Connects Life.™

Edition #13

Copper Ions Keep Roofs Clean

Homeowners spend lots of time and money keeping insects, rodents and other assorted vermin at bay and out of their houses. But one familiar pest — *Gloeocapsa magma* — does its dirty work outside the home, up on the roof. *Gloeocapsa* is an airborne algae with a taste for limestone, a common component of asphalt roof shingles. The by-product of this unique appetite is ugly black streaks that can build up and completely discolor a roof in just a few years. One way homeowners are meeting this challenge is through the use of asphalt shingles containing algae-resistant copper roofing granules.

According to Frank Stilley, president and owner of Amstill Corporation, a Houston-based contracting firm, “Many homeowners are more likely to replace a badly streaked roof than clean it, even if the roof hasn’t reached its full service life.” Shingle manufacturers estimate that approximately 80 percent of all roof replacements are caused by this pest. *Gloeocapsa* can end up costing homeowners thousands of dollars they may not need to spend.

WHEN ALGAE ATTACK

How does *Gloeocapsa* infect a roof? Typically, reproductive spores are blown there by the wind. Birds, squirrels and other small animals also act as spore carriers. Algae prosper where nutrients, moisture and heat are present, and a sun-warmed, rain-dampened asphalt roof is a perfect host environment. In addition, the porous limestone on shingles absorbs moisture, encouraging growth. Once a colony establishes itself, the algae form a

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Got Copper (In Your Diet)?

How important to your health is copper? Could it reduce the risk of osteoporosis and slow the rate of bone loss, or lower the incidence of cardiovascular disease, or reduce pregnancy complications?

Copper’s role in our daily diet is becoming a focus of research into the causes and prevention of degenerative diseases related to aging. Because the average age of the U.S. population is increasing — as the Baby Boom generation moves into and beyond middle age — information regarding proper copper consumption has become a growing concern.

“Lack of copper is a significant health risk,” says Carl Keen, Ph.D., chair of the Department of Nutrition and professor of Nutrition and Internal Medicine, University of California at Davis.

As an element found in thirteen key enzymes in the body, says Keen, “copper is essential for prenatal development, bone growth and strength, helping to fight off cell damage and for transport and absorption of iron.” Enzymes create reactions within cells, such as converting sugars into energy, and are critical for bodily function.

COPPER DEFICIENCY ISSUES

Humans need copper to develop firm skin, bones and other connective tissues like cartilage and ligaments. The presence of copper is espe-

cially important in enzymes that form strong bonds (called cross-links) within collagen and elastin, which support and add resilience to connective tissues.

Copper’s role in forming strong tissue is the reason it is used in treating osteoporosis. “Marginal copper deficiency is seen by some scientists as a risk factor for the development of osteoporosis, which makes sense because of the need for cross-linking in bone tissue,” Keen says. “Evidence suggests modest copper supplements reduce the rate of bone loss.”

“Because vascular tissue also needs healthy cross-links, copper deficiency may contribute, in some people, to cardiovascular disease,” he adds.

Copper is also necessary to create antioxidant enzymes that remove excess “free radicals” in the body. Free radicals are unstable atomic ions destructive to cells. Researchers believe these particles damage human DNA, which controls cell growth, and that heart and lung diseases, cataracts and the general wear and tear associated with aging may all be linked to excess free radicals.

Because copper can offset this process, it is regarded by scientists as a potential ally in the war on cancer. However, as Keen notes, “It is premature to say that copper deficiency contributes to cancer. Research in this area is ongoing.”

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Many of the different foods that are rich in copper

Vegetarians generally get ample copper from their diet. However, when foods and vegetables are processed, they lose some of their beneficial nutrients and metals, says Keen.

The correct amount of daily copper intake depends on a person's age and reproductive status. The Recommended Dietary Allowance (RDA) for copper established by the National Academy of Sciences is 0.9 mg per day for men and women between the ages of 19 and 70. A daily intake of 1.0 mg for pregnant women and 1.3 mg, for nursing mothers is recommended. Children between 9 and 18 need only 0.7 mg to 0.89 mg per day, and younger children need even less.

BALANCE IS IMPORTANT

Research also points to the importance of balancing the amounts of metals used by the body. "Without copper, iron cannot be properly converted to its usable form and absorbed by the body," explains Keen. "Too much zinc inhibits the body's ability to absorb copper." According to the National Academy of Sciences, a proper daily balance for adults is 0.9 mg of copper (male and female), 8 mg (male)/18 mg (females 19-50) of iron, and 8 mg (female)/11 mg (male) of zinc.

Ingesting more copper will not help you more. "If you have enough, taking extra will not provide additional benefits," says

Keen, adding that getting too much copper in one's diet is unlikely. "I wouldn't worry about copper toxicity — it doesn't occur too much. I'd worry more about copper deficiency."

Approximately one-third of the copper used in our bodies is found in skeletal muscle tissue, another third in the brain and liver and the remaining amount in bone and other tissues, according to Northwestern University's Feinberg School of Medicine.

WHY ALL THE ATTENTION NOW?

Nutritionists now realize that the accepted wisdom fifteen years ago — that the amount of copper we got from food was adequate — is no longer the case. There is growing acceptance that marginal copper deficiency is a risk factor in pregnancy complications and damage from free radicals.

Also, today we expect our diet to do more for us. People used to want the nutrients found in foods and supplements to ensure that they weren't vitamin-deficient. "The new nutrition has to do with reducing the risk of developing chronic diseases associated with age. It's a different paradigm," notes Keen.

"Evolutionarily, we died earlier. Now we're trying to find the optimal diet for people in their fifth, sixth, seventh and eighth decades of life." **Cu**

WHAT IS ENOUGH?

Copper-rich foods include grains, nuts and seeds, organ meats such as liver and kidneys, shellfish, dried fruits, legume vegetables like string beans and potatoes, chicken and some unexpected and delightful sources such as cocoa and chocolate.

"Roofs" continued

dark, protective covering to shield it from the sun's ultraviolet rays. The black streaks that appear are actually multiple layers of dead algae cells that build up over time.

Many people consider *Gloeocapsa* to be only an aesthetic issue. However, prolonged contamination can affect a roof's longevity. Limestone granules provide a protective barrier atop the shingles. As the algae consume the limestone, this barrier diminishes, creating a risk of premature shingle failure. *Gloeocapsa* also absorbs heat, causing roof surface temperatures to rise. A hotter roof means a greater load on the air-conditioning system and higher costs to cool the home.

COPPER SAVES THE DAY

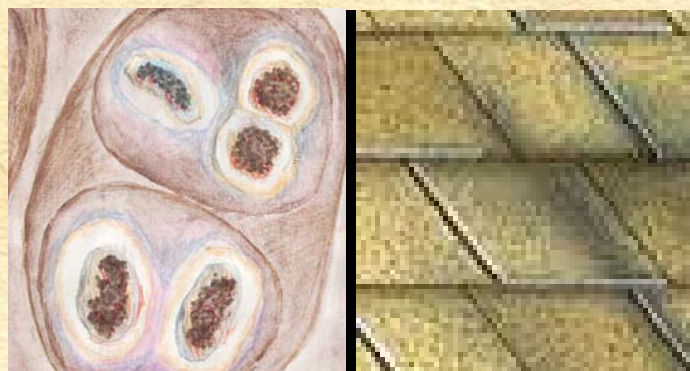
One way homeowners are meeting this challenge is through the use of asphalt shingles containing algae-resistant copper granules. Copper's ability to resist and even destroy harmful organisms is well known. Since ancient times, people have stored drinking water in copper vessels to prevent disease, while marine biologists today rely on metallic copper sulfate to treat and kill algae blooms. Current research into copper's biocidal properties indicates it could provide a practical way to help control the cross-contamination of antibiotic-resistant microbes.

Asphalt roof shingles with copper-oxide ions entered the marketplace a decade ago. Moisture slowly leaches these oxides out of porous ceramic granules, forming a layer of algae-killing cop-

per over the shingles. Depending on the product, this continual leaching process can protect a roof from algae for up to 30 years.

Most asphalt shingle manufacturers offer algae-resistant products in a variety of colors and sizes. While initially more expensive, they help maintain a roof's visual appeal and aesthetic value and may offset the cost of cleaning a roof every few years, which averages \$500 for a single-family home.

Proponents believe it is just a matter of time before copper-granule shingles become the industry standard for homebuilders in areas where *Gloeocapsa* is a problem. According to Amstill's Frank Stilley, "Contractors are realizing that they can benefit the consumer by making algae-resistant shingles standard on their homes, rather than an upgrade option." **Cu**



Gloeocapsa Magma

Asphalt shingles contaminated with the algae

Heating and Cooling “Green” With Copper

Over the past decade, the green building movement has grown from a small grassroots initiative to a major influence in building and design. Designers are increasingly required to develop more energy-efficient and environmentally acceptable plumbing, piping and HVAC systems for residential homes and commercial businesses. As a result, builders are taking a more critical look at the systems and materials they incorporate into their projects and designs.

Those intent on building green must take a broad view of life-cycle assessment into account when choosing one material or building product over another. A true assessment goes well beyond initial cost, and even beyond the narrow definitions of USGBC LEED ratings, and consider the overall impact of a product or material on the environment over its useful lifetime.

Copper may be considered the “greenest” of all materials used in plumbing, heating and cooling systems. It can improve the sustainable nature of homes and help commercial buildings achieve green building certification through such attributes as durability, heat transfer efficiency and its ability to be recycled while retaining its key physical properties. By some estimates, as much as 80 percent of all copper that has ever been mined and recovered is still in use today.

One important aspect of green design is controlling waste. Waste in design includes not using key elements to their full capability. Waste can come in many forms, such as wasteful use of electricity and resources as well as operating inefficiencies. With copper, there is little or no waste. All scrap is reclaimed and, in many cases, reused for building projects in one form or another. Recovered copper scrap is a vital raw material in copper plumbing products.

Builders have long relied on the versatility of copper. It is specified for use in most commercial plumbing, and is used extensively as a tubing material in HVAC systems. In addition, it offers several attributes that make it ideal for fire sprinkler systems.

One system for green builders to consider is closed-loop direct-exchange (DX) geothermal heating and cooling. DX systems incorporate copper tubing to effectively harvest the earth’s thermal energy for heating and cooling. The system

consists of a heat exchanger connected to a network of small-diameter copper tubing buried into the ground. The ambient, constant warmth of the earth is transferred to a heat transfer fluid that circulates through the tubing then back into the building via heating coils and air handlers. In most cases, buildings with DX systems do not require a supplemental furnace or air compressor for heating and cooling.

Water heating is one of the largest energy expenditures for any building or home, but heating water through conventional methods can be energy-intensive and ultimately wasteful. Solar heat exchangers, a highly efficient alternative that absorbs thermal energy from sun (an unlimited free resource) and transfer it to water in the home’s storage tank, can be constructed from a variety of metals and some conductive polymers. However, copper is preferred because of its thermal conductivity and excellent resistance to corrosion. This is critical, as these systems are constantly exposed to the elements and can be located in harsh environments.

Hot water recirculating systems that rely on copper tubing for efficient fluid transfer are also gaining in popularity. These systems not only increase energy efficiency, they help to conserve water as well. The most efficient systems are designed to operate only when needed, so energy is not required to circulate water all of the time.

Another option for green plumbing systems is radiant heating that uses copper to circulate water or a heat transfer fluid. Unlike more conventional hydronic or forced-air heating methods, radiant heat systems radiate energy directly to an area’s objects and its inhabitants. Because this is a more efficient way to transfer heat, a building can achieve a level of comfort and warmth at a lower overall temperature, saving energy and reducing heating costs.

Builders intent on embracing the green building movement must consider a variety of alternatives to traditional heating and cooling methods. Copper, as one of nature’s few renewable finite resources, offers a number of assets to help builders increase efficiencies and reduce energy expenses. **Cu**



Copper pipe and tubing is 100% recyclable

A Copper Dollar in Your Pocket

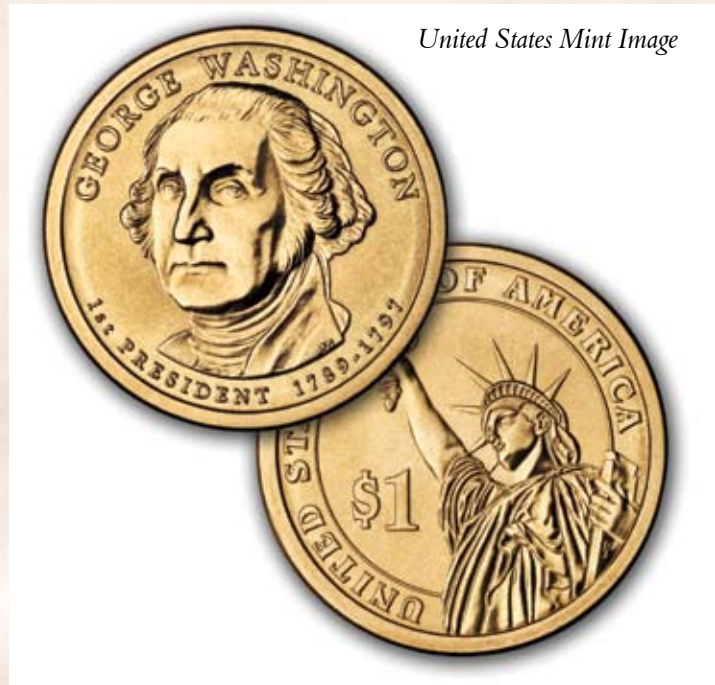
Following the popular 50 State Quarters Program that debuted in 1999, the U.S. Mint introduced in February a new series of one dollar coins, made primarily of copper, that honor the country's deceased Presidents. Although previous dollar coins bearing the likenesses of Susan B. Anthony and Sacajawea failed to catch on with consumers, the government is betting the public will welcome the new Presidential coins.

Four coins will be circulated each year in the order that each President served. The series, which begins with George Washington and includes the late Gerald Ford and Ronald Reagan, is scheduled to run through 2016. If any of the four current living Presidents dies before then, their images would be added to the list and the series extended. Each of the 39 coins features a unique image of the Statue of Liberty on its reverse side.

The \$1 Presidential coin contains 88.5 percent copper, 6 percent zinc, 3.5 percent manganese and 2 percent nickel. This is the same composition as the Sacajawea dollar, and it carries the same electronic signature, enabling its use in vending machines, tollbooths and fare collectors as well as retail commerce. Copper's durability has made it an ideal choice for use in all circulating U.S. coins, which are designed to last for decades.

According to U.S. Mint spokesperson Carolyn Fields, "Congress designed the \$1 coin program to give Americans coins they will enjoy using and collecting over time. At the same time, general use of the Presidential \$1 coin is expected to increase use of all dollar coins as Americans become more familiar with using them."

It costs the federal government hundreds of millions of dollars annually to replace worn and unusable one-dollar paper bills. A recent report from the Government Accounting Office estimates a savings of \$500 million dollars per year if the bills are replaced by dollar coins.



United States Mint Image

The first \$1 Presidential coin featuring George Washington

For more information on the \$1 Presidential coin series please visit the U.S. Mint at www.mint.gov. **Cu**

Building Better Bridges

A new type of steel is changing the way bridges are built, thanks to the addition of a tiny percentage of copper. In a novel process, copper is combined with iron at the molecular level to produce an exceptionally durable material. This modern alchemy results in an alloy that is easier to weld, more resistant to corrosion and weathering, and almost 40 percent stronger than commonly used structural steels.

While some alloys such as Architectural Bronze or Cor-Ten steel earn easy-to-remember monikers, to date, the steel-copper alloy is known only by its technical designation, ASTM A 710 Grade B High Performance Steel. Illinois recently became the second state to put the material to use by specifying it for bridge construction in the town of Lake Villa. Some 500 tons of the material went into the 430-foot bridge.

According to Timothy W. Martin, secretary of the Illinois Department of Transportation (IDOT), "Not only is this steel strong, tough and easy to fabricate, but it withstands the elements better than typical steel, meaning it doesn't have to be painted. This makes construction easier and will significantly reduce long-term maintenance costs." Martin estimates IDOT saved \$300,000 by not having to paint the bridge.

Illinois was so pleased with its bridge that it recently applied to have the steel-copper alloy designated as the standard for bridge construction throughout the United States. If it wins the approval of the American Society for Testing and Materials (ASTM), and American Association of State Highway and Transportation Officials (AASHTO), all bridges here and elsewhere may one day contain an important copper component. **Cu**



New copper alloys are poised to change the face of building bridges

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:

American Society for Testing and Materials (ASTM) — <http://www.astm.org>

Presidential \$1 Coin Program — [http://www.usmint.gov/mint_programs/\\$1coin/](http://www.usmint.gov/mint_programs/$1coin/)

3M Algae Resistant Roofing Systems (Copper Ion Shingles) —

http://solutions.3m.com/wps/portal/3M/en_US/IMPD/Roofing-Solutions/Products/Scotchgard-Algae-Resistant/

National Academy of Science — <http://www.nas.edu>

Green Building Solutions — <http://www.greenbuildingsolutions.org>