

# ALGAE

## THE GROWING PROBLEM

BY KRISTEN AMMERMAN

“What are you going to do about that black stuff on your old roof?” a friend asked me this summer after viewing the new addition to my home and comparing its pristine, clean shingles to the adjacent, original, 10-year-old roof.

“What is that stuff?” I asked.

“I think it’s mold,” he replied.

“What can you do?” I shrugged.

“You’re the one who works for the roofing people,” he said. “Find out.”

So over the next few weeks, in the course of my job as director of publications for RCI, I asked a few of the consultants I routinely deal with about the “black stuff” on my roof. I got some interesting and varied suggestions (some being unprintable), but the most ultimately enlightening (and frustrating) one came from *Interface*’s senior editor and my friend Lyle Hogan, RRC, FRCI, PE: “You’re a reporter, aren’t you?”

Forced, reluctantly, to find my own answers, I did some research. Eventually, I had enough information to write a novella along the lines of “Attack of the Spore.” But I figured it might be more productive to share what I learned with our readers, homeowner-to-homeowner, if you will.

First of all, the black streaks aren’t molds or fungi, they are actually algae: *Gloeocapsa Magma*, to be precise. Knowing what they are doesn’t make them easier to deal with. Homeowners want the unsightly stains off their homes and their steep-sloped commercial buildings. In some areas

of the country, homeowners’ and condominium associations actually require algae’s periodic removal, although asphalt shingle manufacturers claim they are not damaging, in and of themselves. Nonetheless, an estimated 50% of new residential roofs are installed not because they are leaking or worn out – but for aesthetic reasons.<sup>1</sup> And algae were listed in a 1994 survey as the number one aesthetic problem associated with asphalt shingles.<sup>2</sup>

The problem is, algae spores are blown in by the wind, and they will come back to roost on those very same roofs once again. Before the last cleaning has been paid for out of the condominium maintenance fee account, the creatures’ dead, dark cells will once again begin to form those telltale streaks on the roof. And once there, heat, humidity, and plenty of food allow them to thrive.

There is argument in the roofing community over whether the simple presence of algae on roofs actually compromises the roof’s integrity. Removal itself, many argue, can actually cause deterioration of the roof covering to the point where it will have to be replaced due to loss of functionality, regardless of algae presence.

### GROWING PROBLEM?

Why does this infestation appear to be multiplying throughout the country like kudzu across the south? One theory blames the newer, heavier fiberglass asphalt shingles now being produced. Shingles were formerly made of asphalt-saturated felt made from scrap cotton rags and wood chips. But synthetic textiles eliminated the cotton rag market, and manufacturers switched to

heavier, more wind-resistant fiberglass shingles made with limestone fillers.<sup>3</sup> Algae love limestone; they eat it for breakfast, lunch, and dinner.

The proliferation of suburbia and its mushrooming subdivisions, where wind can easily spread algae spores from roof to roof, is also blamed. The staining is first exhibited on the damper, north side of the roof.<sup>4</sup> Many suggest that overhanging trees should be cut to slow the creatures’ growth, but even without the added dampness associated with shady areas, algae, once present, will flourish.

*Gloeocapsa Magma* survives and thrives on roofs without the apparent presence of nourishment and in spite of harsh climatic conditions because it has developed a dark pigment to protect itself from ultraviolet rays.<sup>5</sup> It is this same outer sheath sur-

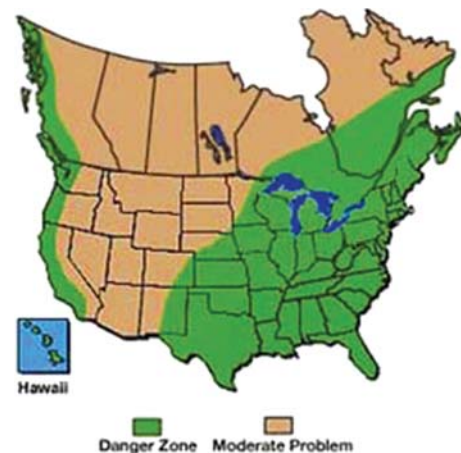


Figure 1: Algae are seen on roofs in over 80% of the U.S. – anywhere there is sufficient humidity. (Map by 3M.)

rounding individual cells that gives it the visually arresting black color that stains roofs.<sup>6</sup> Under low-light conditions, the algae are actually blue-green, from the cyanobacteria division of the Eubacteria kingdom.<sup>7</sup>

*Gloeocapsa* also hold on tightly to fiberglass shingles by secreting a material that helps them to grip. They are fed by an ability to absorb carbohydrates via photosynthesis, nitrates via atmospheric nitrogen, and trace nutrients from dust and dirt settling upon them.<sup>8</sup> Calcium carbonate in asphalt shingles is also considered a food by these voracious creatures.<sup>9</sup> Because of their hardy characteristics, algae blooms have flourished and migrated to less and less humid environments and created a “growing” problem worldwide (See *Figure 1*.)

### DO THEY DO DAMAGE?

There is some disagreement over whether the growth of algae on roofs is merely aesthetically unpleasing or if it is destructive. A huge industry has grown in pace with this epidemic - a roof-algae-destroying, sealing, removing, and preventing industry; and each group has its point of view.

Tim Carter, nationally syndicated newspaper columnist on building issues, says “the green and black algae, in my opinion, are not harmful to the actual roofing material because they do not develop roots.”

The Canadian Asphalt Shingle Manufacturers' Association (CASMA) is adamant: “The staining caused by the algae is in no way indicative of a shingle defect... and has never been shown to seriously harm the shingle or [to] significantly shorten the life of the roof.”<sup>10</sup>

Companies selling products to combat the scourge, however, disagree. The roof cleaning industry is thriving. Information distributed by these companies and those who supply them with materials urge owners to “clean it immediately!” They say that algae “eat away the base of the shingle and expand and contract with the outside temperature. This growth and movement is [sic] said to loosen the granules, creating premature granule loss and dramatically shortening the life” of the roof.<sup>11</sup> They also frighten owners with the threat of “fungus spores” in and around the home, affecting those who are allergic.

RSI, a roof cleaning service in the Bahamas that claims 80% of the homes there are infested with roof algae, ominously warns:

*“These organisms are fast growing by nature and will spread from the*

*roof into the interior... structure. This area then becomes an excellent incubator for them to flourish due to its darkness and warmth. The organisms will then continue to spread, finding their way into your inner sanctum like a thief in the night; hiding in interior walls, under sinks and cabinets, and around water heaters. They then attack your beloved children and pets by way of allergic reactions such as sinusitis and asthma, along with other respiratory problems.”<sup>12</sup>*

On cedar shakes and shingles, algae is said to lead to moss growth.<sup>13</sup> Moss is destructive to cedar shakes because it uses the wood for food and hinders drying, so it is simultaneously consumed while rotting. Some companies claim that algae can lead to moss growth on asphalt and fiberglass shingles as well. The growth of the moss, they claim, can lift granules.<sup>14</sup>

Besides the obvious aesthetics and the unproven harm algae might do to a roof, its darkening stains, particularly on light-colored shingles, can arguably raise building temperatures and, therefore, cooling costs.

Numerous approaches have been employed, to varying degrees of success, in an attempt to solve the roof algae problem. These are detailed below.

### CLEANING

Cleaning a roof of algae can be attempted in many ways. Unfortunately, each has its drawbacks.

#### Power-washing

Do not try this at home. The power of high-pressure-released water is awesome. The National Roofing Contractors Association (NRCA), the Asphalt Roofing Manufacturers Association (ARMA), and countless industry experts warn that (in the words of ARMA) “high pressure washing systems for algae removal should not be used.” The mineral granule surfacing that protects the asphalt from ultraviolet radiation could be seriously compromised by power-washing.

#### Chlorine Bleach

Applying a solution of chlorine bleach is perhaps the easiest and least costly cleaning method. ARMA notes solutions recommended by shingle manufacturers may vary and depend on the amount of discoloration.

Generally, bleach is diluted in water at about a 10% solution and sprayed “gently”

onto the roof. Commercial-grade mixes of sodium hypochlorite (liquid pool chlorine) are available at building material stores and may be applied with a garden sprayer. The bleach should be allowed to sit for only five minutes before it is rinsed off; otherwise, it may cause damage. Any subsequent applications of cleaner must be applied to a dry roof; a damp surface will not provide full effect.<sup>16</sup>

One writer advises, “There is some concern regarding the use of chlorine-based products on asphalt roofs. Household bleach can damage asphalt due to its high sodium content... The sodium causes an electrochemical reaction that reduces the elasticity of the asphalt, leading to stiffness, brittleness, and curling of the shingles.”<sup>17</sup> Bleach can also dye the original color of wood shakes as well as speed up corrosion of metal gutters and downspouts.<sup>18</sup>

Other downsides to cleaning with bleach are that its effectiveness is short-lived and it is environmentally hazardous. Efforts must be taken to protect plants, animals, and people on the ground and nearby. Experts warn to spray the ground with water where run-off or spray-over may occur prior to treating and again after rinsing the roof.

#### Oxygenated Bleach

Oxygenated bleach (sodium percarbonate) is a solid form (usually powder) of hydrogen peroxide bonded with natural soda ash to produce products such as Oxy-Boost and Stain Solver. These products are activated by water, whereupon oxygen is released, providing cleaning and stain removal. These products must be left on longer and kept damp. It is best to work with oxygenated bleach in the cool part of the day because the roof surface must be kept wet with the solution for up to 45 minutes to achieve best results. If it is attempted in direct sunlight, the solution will evaporate too quickly. These mixtures are not as potentially damaging as chlorine bleach by itself.<sup>19</sup>

#### Sodium Hydroxide

Sodium hydroxide (lye) is an effective degreaser and has been used to clean roofs. Such cleaners are gentler on the surrounding landscaping than bleach but are nonetheless toxic, and great care must be employed by both the applicator and anyone with whom the lye comes in contact. Sodium hydroxide is also tough on asphalt shingles, capable of causing granule loss, and even dissolving roofing nails.<sup>20</sup> It re-

quires heavy rinsing (never using greater than 100 pounds per square inch of pressure without expecting considerable granule loss). Most lye-based products have been removed from the market and are not recommended by environmentalists.

### Trisodium Phosphate (TSP)

For years, this compound was used in clothes and dishwashing detergent, until the early 1970s, when the damage phosphates could do to the environment was recognized. TSP can still be purchased in its purest form, however. Trisodium phosphate can damage many metal and painted surfaces and stain wood.

Apply TSP with a brush or sponge or spray it on. Normal dilutions of this compound range from 1/2 cup of TSP to 2 gallons of warm water; to 1 cup TSP to 3 quarts for "ridiculously heavy duty cleaning." (Savogran Co.)<sup>21</sup>

All accounts agree this is a dangerous chemical and can cause eye damage and burn unprotected skin. Wear protective clothing and eye protection when applying it. Foliage also is in danger and should be soaked with water before and after application in its vicinity, vendors warn.

### Mixes

CASMA suggests "lightening" algae discoloration with a mix of chlorine, TSP, and water. The shingle manufacturing association suggests one part chlorine bleach to three parts water to 1/4-cup TSP. The organization also suggests working from a ladder or "walkboard" to avoid walking on the slippery shingles. It notes that repeated applications may be required "every few years" because of the likely recurrence of algae blooms.<sup>22</sup>

### Proprietary Products

Some roof-cleaning product manufacturers also promote application of additional products they say will keep the roof cleaner and "protected" longer. There are proprietary cleaners that blend fungicides and polymers that are designed for bi-yearly application. GreenClean, JOMAX, Anti-Growth, Roof-a-Cide, Safer's De-Moss, Shingle Guard™, and Shingle Coat™ are but a few.

### Sealers

Even clay and concrete tile roofs are subject to Gloeocapsa, and there are products on the market that claim they "penetrate the surface and prevent the algae,

mold, and mildew from growing," while actually "strengthening the structure of the tile." Enviroseal Corporation makes Roof-Guard 102™, a patent-pending acrylic formulation for cement and clay unglazed tile roofs. It offers a seven-year warranty for "elimination of algae, mold, and mildew build up." Its Roof-Guard 101™ is made for shingle roofs and claims to "increase adhesion of granules to asphalt shingle surfaces, thereby increasing ultraviolet protection." The company warrants the roof for "five years from date of purchase for mold, mildew, algae, and granule loss."<sup>23</sup>

The effects of cleaners or sealants are temporary, requiring repeated applications as early as six months later. Many cleaning companies and homeowners' associations recommend reapplication every 6-18 months in order to maintain the appearance of the roof. This can lead to premature aging of the roof from caustic chemicals and accelerate the natural erosion of the roof materials, according to numerous sources. The additional foot traffic or use of washers and tools can

also cause damage. Many homeowners in Florida (a largely infested area) now expect to replace their roofs after only 12-15 years rather than 25-30, simply because of the damage caused by repeated cleaning.<sup>24</sup>

To avoid repeated cleanings, some preventive measures can be employed.

### METAL INHIBITORS

Anyone who has studied stains on roofs has noted the area below metal flashings or galvanized steel roof vents where it appears to be algae-free. That's because algae hate metal even more than they like limestone. One way to stop algae from growing is to arrange for the roof to be periodically bathed in metal "drippings," so to speak.

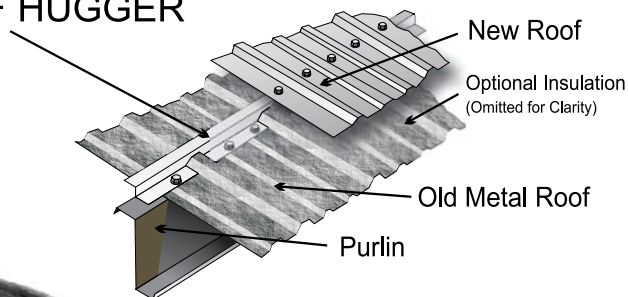
Figure 2: This roof, on a golf course clubhouse in South Africa, shows that Gloeocapsa Magma is as much at home in Africa as North America. Also note the effect of the copper flashing around the chimney. (Courtesy, Michael Rosenthal, Durban, South Africa.)



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Figure 3: The Scotchgard™ Algae Resistant (AR) Roofing System from 3M for asphalt shingles, shown on the home on the left, combines a defined percentage of 3M copper granules with 3M standard colored granules to help provide effective protection against algae growth. Algae have stained the untreated shingles of the house on the right. (Courtesy of 3M.)

### Copper and Zinc Strips

In order to effect this “poisonous,” metal-bathing experience, some recommend zinc or copper strips or wires be placed at the ridge of the roof. When rain hits the ridge, it carries the zinc or copper carbonate down over the shingles, serving as a wash and preventing algae from getting a foothold.

Tim Carter suggests installing 6- or 7-inch-wide, 10-foot-long strips of copper. Using a metal brake tool, “put a 20-degree bend one-half inch from the edge on one of the long sides of the copper strip” to eliminate the crimps caused by cutting copper with tin snips. Then, slide the unbent edge under the last full course of shingles at the top of the roof “so that the bent edge and 4 inches of copper are exposed” to the elements.<sup>25</sup>

What if one has no bending tools? A homeowner from Portland, Oregon, writing to a newspaper columnist, touted the placement of pennies on the roof to inhibit moss and algae growth. He suggesting using two or three per linear foot, slipped under the edge of shingles near the top of the roof or stuck in place with a dab of silicone caulk.<sup>26</sup> This adds new meaning to the phrase, “raining pennies from heaven.”

Z-Stop by Wespac uses the same basic concept of copper strips but with zinc,

packaged specifically for the purpose of stopping algae growth. Its 50-foot long zinc strips, about 2-1/2-inches wide, are claimed to be effective for “20+ years.”<sup>27</sup> A building owner can have the strips nailed on both sides of the ridge, and they are said to be effective on all types of shingles or tiles except for Spanish tiles (due to their shape). Other providers are ZincShield® and Save-time Corporation. Many of these ready-made products come as kits, complete with fasteners.

Those who espouse the use of copper over zinc say it works for a longer period of time and blends in with the roof when it begins to oxidize (of course, that would depend on the original color of the shingles). Another argument against zinc is the “blooms” or white spots said to result from the build-up of zinc oxide.<sup>28</sup>

Those who prefer zinc say copper and galvanized metals may leave an offensive discoloration. Ready-made zinc strips for this purpose seem to be more common than copper equivalents. It is said that both types of strips can stain siding, but the stains are easily removed unless they're on very old or porous vinyl siding.

A pamphlet published by the city of Seattle, however, cautions homeowners to “Avoid copper- and zinc-coated roofing materials. Copper production is energy-

intensive and extremely polluting. Additionally, copper leaches from roofs, eventually finding its way into creeks, lakes, and the Puget Sound - where it is toxic to aquatic life. It also renders rainwater unsuitable for landscape uses. Galvanized steel's protective zinc layer helps prevent rusting by continuously releasing zinc from its surface, where it is carried away by rain. Like copper, zinc is toxic to aquatic life.”<sup>29</sup>

### Metal ridge vents

Air Vent and others make ridge vents that contain zinc alloys that act as algae-icides when it rains.

### Metal-infused washes

Some companies offer products intended to be diluted with water and sprayed on roofs like cleaners but that contain metal ions intended to act as algae inhibitors. LiquidZinc® is one. These products are usually color-free formulas used to coat the roof. But like the cleaners mentioned earlier, they must be reapplied every 12 - 18 months.

### Metal-infused granules on shingles

Chemists studied the *Gloeocapsa* invasion in this country as early as 1967.<sup>30</sup> Scientists at 3M, searching for a poison cocktail that could be delivered to algae before it even got a toehold on a roof, eventually dis-

covered that dew, present across the entire roof for up to 12 hours a day, could work to naturally and evenly disperse metal ions if they were already present in shingles. This, they argued, would more evenly distribute the desired lethal poison than simple reliance on the “wash-down” effect necessitated by strips or ridge vents.

The company focused on copper ions rather than zinc because studies showed copper ions to be ten times more toxic than zinc against algae similar to *Gloeocapsa*. It is also cheaper and more easily colored than zinc.<sup>31</sup> Scientists developed a base rock mineral that is first coated with a ceramic overcoat containing cuprous oxide. Then a seal coat that allows consistent release of the copper is applied (this can also be colored to produce various blends). 3M's granules are called the Scotchgard™ AlgaeBlock system. “A 10 percent uniform blend of copper granules with standard granules is necessary to ensure a minimum of 10 years of algae resistance,” they claim.<sup>32</sup>

The chemical company didn't get into the shingle-making business, however; instead, it began selling its granules in 1993 to shingle manufacturers who use them in their manufacturing process.<sup>33</sup>

Divergent shingle manufacturing companies, such as Owens Corning, CertainTeed, GAF, etc., use the Scotchgard™ system in their products. Manufacturers of these shingles currently offer 10-, 15-, and 20-year warranties against algae stain. The shingles typically cost \$4 to \$5 more per square than standard shingles, but their cost is typically justified by subtracting eventual cleaning costs for shingles not protected with the process.

In a brochure targeted to roofing contractors, 3M says, “Research has demonstrated that consumers will pay a price premium for asphalt shingles with Scotchgard™ Algae Resistance. As a roofing contractor, you can earn an additional \$300-\$500 per average roof by recommending that your customers purchase asphalt shingle brands with the Scotchgard™AR System.”<sup>34</sup>

#### SUMMARY

*Gloeocapsa Magma* - that ugly “black stuff” on our roofs, appear to be here to stay. Steep-sloped roofs will continue to be increasingly vulnerable to colonization by the algae as they spread ever-wider throughout the globe, causing unsightly

and perhaps damaging effects. Numerous cleaning strategies provide varying levels of effectiveness but are temporary, requiring multiple applications that can further compromise the integrity of roofing materials. Installation of metal strips and vents may provide protection but may result in “spotty” coverage. Copper- and zinc-embedded shingles seem to offer reasonable protection, but add cost to the roof. The first such shingles installed are now reaching their teen years. Only time will tell if their effectiveness will provide a long-term weapon to combat the dreaded *Gloeocapsa Magma*. ☒

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## “GREEN” Schools Touted in Report

“Greening America’s Schools; Costs and Benefits” is a report commissioned by several organizations and intended to answer the question, “How much more do green schools cost, and is greening schools cost effective?” Written by Gregory Kats, it was paid for by the American Federation of Teachers, the American Institute of Architects, the American Lung Association, the Federation of American Scientists, and the U.S. Green Building Council.

The national review of 30 green schools built in 10 states from 2001 to 2006 concludes that green schools cost less than 2% more than conventional schools, or about \$3 per square foot above the average national school construction cost of \$150/sq ft. But they provide financial benefits that are 20 times as large, it says.

The report claims that financial savings are about \$70/ sq ft – 20 times as high as the cost of going green (*Table A*). Only a portion of these savings accrues directly to the school. Lower energy and water costs, improved teacher retention, and lowered health costs save green

schools directly about \$12/sq ft, about four times the additional cost of going green. For an average conventional school, building green would save enough money to pay for an additional full-time teacher. Financial savings to the broader community are significantly larger, and include reduced cost of public infrastructure, lower air and water pollution, and a better educated and compensated workforce. Most cost data were obtained from school architects, with energy data culled from building performance and design modeling.

The AIA reports, “With over \$35 billion projected to be spent in 2007 on K-12 construction, the conclusions of this report have far-reaching implications for future school design.”

In December 2006, USGBC was scheduled to release its LEED for schools program. Sub-

jects addressed include acoustics, master planning, mold prevention, and joint use of facilities. The program launch is supported by a full set of tools tailored to schools: a reference guide, workshop, and LEED online with credit templates. For more information on the LEED for Schools program, go to [www.usgbc.org/leed](http://www.usgbc.org/leed).

For the complete green school report, visit [www.cap-e.com/ewebeditpro/items/059F9819.pdf](http://www.cap-e.com/ewebeditpro/items/059F9819.pdf).

**Table A: Financial Benefits of Green Schools (\$/sq ft)**

Energy	\$9
Emissions	\$1
Water and Wastewater	\$1
Increased Earnings	\$49
Asthma Reduction	\$3
Cold and Flu Reduction	\$5
Teacher Retention	\$4
Employment Impact	\$2
<b>TOTAL</b>	<b>\$74</b>
<b>COST OF GREENING</b>	<b>(\$3)</b>
<b>NET FINANCIAL BENEFIT</b>	<b>\$71</b>