Environmental Building News™
The Leading Newsletter on Environmentally Responsible Design & Construction
A Publication of BuildingGreen, Inc. www.BuildingGreen.com Volume 16, Number 8 · August 2007

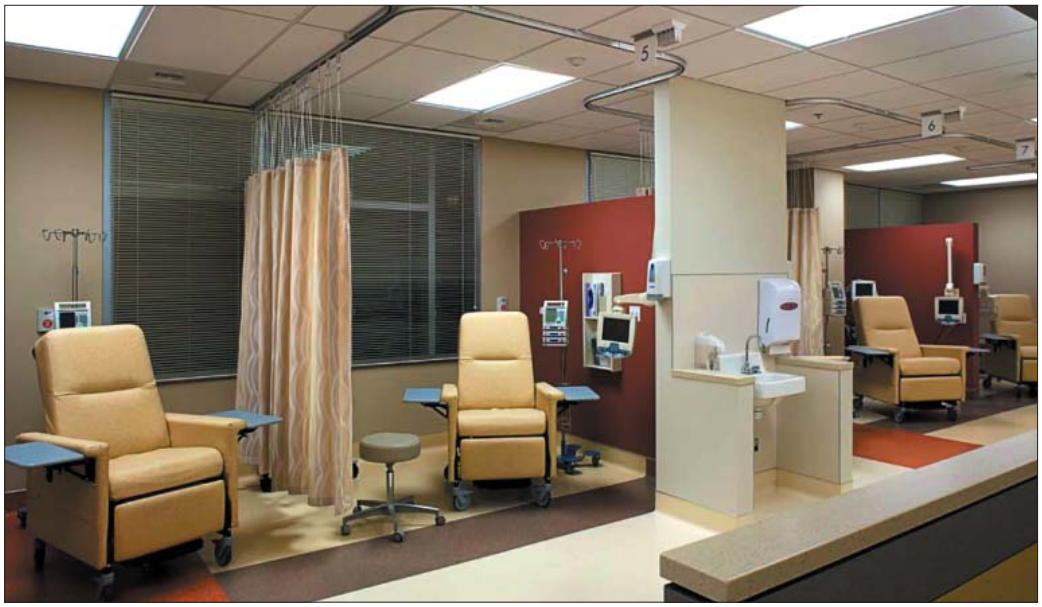
Antimicrobial Chemicals in Buildings
Hygiene or Harm?

FEAR OF INFECTION IS HARDLY A new phenomenon, but it seems to have risen to a fever pitch in recent years. Modern medicine appeared to have all but conquered infectious disease decades ago—but in the last three decades our society's confidence in that victory has unraveled. Diseases like AIDS, anthrax, "mad cow disease," severe acute respiratory syndrome, antibiotic-resistant tuberculosis, and bird flu have perplexed and challenged the medical establishment, and popular culture and the press have seized on reawakened fears of uncontrollable diseases, reporting on health emergencies around the globe with ever greater fervency.

The market for antibacterial lotions, soaps, and wipes has exploded, and antimicrobial compounds are now common in other consumer items like shampoos, deodorants, shoes and apparel, and food-preparation and storage items, despite widespread evidence that these compounds often don't work as advertised. But now even our buildings are getting in on the trend. The use of chemicals in building products, especially to kill mold, is centuries-old, but antimicrobial chemicals are proliferating in heretofore rarely seen places: furniture, flooring, wallcoverings, textiles, countertops, sunshades, doorknobs and pushplates, ductwork, and caulking.

To say that cultural fears are driving these trends would be simplistic, however. In buildings, mold growth has long been known to compromise the structural

(continued on p. 11)



The oncology infusion unit in Kaiser Permanente's Modesto Medical Center in Modesto, California, designed by Lionakis Beaumont Design Group, includes impervious, cleanable surfaces and accessible handwashing stations. Photo: John Swain Photography

In This Issue

Quote of the month:

"Masco is the brains and GE is the muscle."

Joseph Lstiburek, Ph.D., P.Eng. of Building Science Consulting on the collaboration between two industry giants

(page 4)

Environmental Building News

Executive Editor · *Alex Wilson*
Editor · *Nadav Malin*
Managing Editor · *Tristan Roberts*
Associate Editor · *Allyson Wendt*
Associate Editor · *Mark Piepkorn*
Consulting Editor · *Jessica Boehland*
Editorial Intern · *Rachel Navaro*
Art Director · *Julia Jandrisits*
Research Director · *Jennifer Atlee*
Marketing Director · *Susan Way*
Outreach Director · *Jerelyn Wilson*
Director of Online Services · *Jim Newman*
Web Developer · *Kelly Lucas*
Circulation Manager · *Charlotte Snyder*

ENVIRONMENTAL BUILDING NEWS (ISSN 1062-3957) is published monthly by BuildingGreen, Inc. *EBN* does not accept advertising. Subscriptions are $99/year. Outside North America add $30. Periodicals postage paid at Brattleboro, Vt. and at additional mailing offices. POSTMASTER: Send address changes to *Environmental Building News*, 122 Birge St., Ste 30, Brattleboro, VT 05301.

Editorial & Subscription Office
122 Birge St., Suite 30, Brattleboro, VT 05301
802-257-7300 · 802-257-7304 (fax)
ebn@BuildingGreen.com · www.BuildingGreen.com

Printed on New Leaf Opaque paper, 100% post-consumer, process chlorine free with soy-based inks. FSC certified.

mail@BuildingGreen

CFLs Aren't Perfect

Thank you for your recent article on light bulb bans [see *EBN* Vol. 16, No. 4]. It was well documented and had good points about the value of improving incandescent lamps rather than banning them. Incandescent lamps still have their place in some situations, and it would make no sense to replace every incandescent bulb with a compact fluorescent lamp (CFL), since CFLs don't like to be switched on and off. If CFLs don't get three to five hours of operation at a time, they will burn out within a year, causing customers to doubt their energy-saving potential. In addition, we have to specially dispose of the lamps, and they require more energy to produce than incandescent lamps.

You have the ability to draw the attention of the public, manufacturers, and sales companies and should educate the public on the correct use and disposal of CFLs and on which situations are appropriate for the use of CFLs.

Stefan Bernath, Energy Coordinator
Alberta Infrastructure and Transportation
Edmonton, Alberta, Canada

Editors' response:

Indeed, Mr. Bernath is correct that switching CFLs on and off does shorten lamp life, but his conclusion that they need a three- to five-hour on-cycle to maintain a reasonably long life does not appear to be correct. Robert Clear, a staff scientist at Lawrence Berkeley National Laboratory, told *EBN* that it has been difficult to get data on this question, but a 1998 study of electronically ballasted CFLs found a 20% reduction in lamp life if the on-time was reduced to one hour. With significantly shorter on-times, the lamp life is dramatically reduced: with 15-minute on-time cycling, lamp life dropped 70% and with five-minute on-time lamp life dropped 85% (which brings the lamp life close to that of incandescent light bulbs). "This suggests that you should consider replacing incandescents with CFLs in any application where the lamp is on an average of [at least] about 10 minutes per start," said Clear. He added that "every switch cycle is equivalent to about 6 minutes of lamp life. This means that you should turn a CFL off if you think it won't be turned on again for another five minutes or so." This approach should also maximize electricity and cost savings. We strongly agree with Mr. Bernath's point about the need for safe disposal of CFLs due to the mercury content.

Readers Support Renewables Over Carbon-Intensive Nuclear

In Alex Wilson's editorial in the June 2007 issue [*EBN* Vol. 16, No. 6], he was careful to point out that "the *heat source* in nuclear power plants does not emit greenhouse gases" (my emphasis). This simplification distorts the true emissions picture, as shown in an analysis performed by Jan Willem Storm van Leeuwen and Philip Smith of carbon dioxide (CO_2) production during the fuel production cycle and decommissioning of nuclear power plants. (The article, along with a rebuttal and response, can be found at www.stormsmith.nl.)

With fuel from the highest-grade soft uranium ores (1% uranium by mass), the amount of CO_2 emitted by fuel processing for operating a nuclear plant for 20 years and decommissioning the plant is the same as that emitted by operating a gas-fired

power plant for seven years. As ores are depleted, and the percentage of uranium in them declines, the CO_2 emissions of fuel processing increase. Total CO_2 emissions from the nuclear plant will thus increase over time. When the available ore depletes to 0.01% uranium, the total emissions of the nuclear plant are about equivalent to those of operating a gas-fired plant over 20 years—about the safe useful life of a reactor. And ore quality is declining steadily and will decline faster if more nuclear plants are built. So nuclear plants are *not* carbon neutral, by any considered analysis. When we reach the time when only the lowest grade ores are available, nuclear power becomes a "carbon loser" compared with natural-gas-fired generation.

Storm van Leeuwen and Smith, you, and I all reach the same conclusion—significant investment in efficiency and renewables is critical. But it is very important to dispel the myth that nuclear energy does not emit CO_2.

A further, perhaps more subtle, reason to avoid further nuclear power is the increased militarization of our society that is required to accompany the production, transport, use, storage, and disposal of such a highly dangerous material.

Andy Shapiro
Energy Balance, Inc.
Montpelier, Vermont

I strongly agree with Alex Wilson's position on nuclear power. We have four reactors in Virginia, with plans in the works for building another reactor on the North Anna site, about 40 miles from Richmond.

This is a critical time in history. We must turn away from fossil fuels and nuclear power. Let's go full force toward renewables and conservation.

Karl Bren, Founder
Green Visions Consulting
Richmond, Virginia

What's Happening

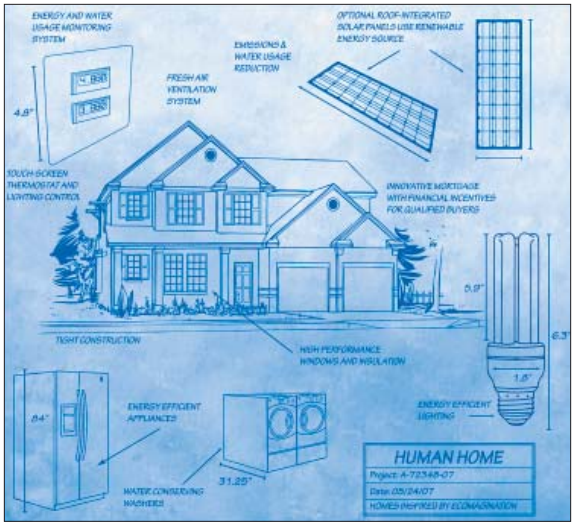
GE and Masco Team Up on Homebuilder Program

In an effort to provide homebuilders and residential developers with a single package that combines high-performance products with advanced building-science principles, industry giants General Electric (GE) and Masco have recently teamed up to merge their existing green programs—GE's Ecomagination with Masco's Environments for Living (EFL)—into one Ecomagination Homebuilder Program.

EFL (see *EBN* Vol. 12, No. 7) will continue operation on its own, but builders eligible to be EFL-certified may also opt to enter the Ecomagination Homebuilder Program, which offers participants items not available through EFL alone, including an Ecomagination mortgage and a utility-monitoring and energy-management wall panel, GE's SmartCommand Dashboard. This last item exemplifies the difference between the Ecomagination Homebuilder Program and EFL; while EFL is strictly performance-based and brand-neutral, the Ecomagination Homebuilder Program requires builders to use certain GE products in the lighting, appliance, and energy-management product categories.

A longtime product manufacturer, Masco created subsidiary Masco Contractor Services (MCS) in the 1990s and now claims to provide some form of product or service to more than half the houses built in the U.S. In 2000, MCS created EFL, offering guaranteed space-conditioning loads and thermal comfort for buildings meeting minimum performance specifications. EFL standards include a tight building envelope, mechanical ventilation, air-pressure balancing, and moisture management. Parent company Masco will soon take over management of EFL, but program developers say they will maintain the program's performance-based structure despite Masco's involvement in product manufacturing.

Meanwhile, with its launch of Ecomagination two years ago GE has put a greater focus on offering cleaner technologies, products, and services. GE says that homes built to Ecomagination Homebuilder Program standards would be anticipated to achieve at least 20% fewer household emissions of greenhouse gases and pollutants, at least 20% household energy savings, and at least 20% savings on household indoor water usage. As Jeff Renaud, director of Ecomagination, told *EBN*, "Now, in addition to the building envelope, [builders] will look at lighting, appliances, energy management, water fixtures, and solar power," which, he said, creates a "broader performance objective" than EFL standards alone.



Ecomagination Homebuilder Program addresses whole-house energy load while promoting use of GE products. Photo: GE

Dave Bell, national sales manager for MCS, concurred: "We [at MCS] have historically been all about the building envelope. With GE, we can address the whole house load and essentially provide a whole-house energy program."

"We view this as a marriage of great technology and marketing on our side and great building science and execution infrastructure on their side," said Renaud, discussing GE's interest in working with Masco. Rick Davenport, vice president of marketing for MCS, agreed, explaining that although GE is a commanding force for product development and marketing, "what we have that they lack is homebuilder infrastructure." Davenport also noted that, from Masco's perspective, "GE brings a level of credibility necessary for this aspect of the industry."

David Wax, CEO of the architectural design and energy-consulting firm Independence Energy Homes, commended the collaboration but said he'd "like to see them push their energy efficiency goals harder, from 20% to 30% or 40%." He also said that while he recognized the value of the program's prescriptive checklist for production builders, he hesitated to fully embrace it, commenting that checklists "tend to strangle innovation." Joseph Lstiburek, Ph.D., P.Eng., founder of Building Science Consulting and a primary developer of EFL's construction specifications, said, "I think [the collaboration] is a logical and natural extension of EFL's program. Masco is the brains and GE will be the muscle."

– Rachel Navaro

For more information:

GE Ecomagination Homebuilder Program
Fairfield, Connecticut
203-373-2547
www.ge.ecomagination.com

Masco Contractor Services
Daytona Beach, Florida
386-763-7638
www.eflbuilder.com

Updated Guide Shows the Way to Cost-Effective Energy Optimization

In July 2007 the New Buildings Institute (NBI) released its Advanced Buildings *Core Performance Guide*. The guide describes a series of energy-efficiency measures, selected by NBI using a comprehensive energy-modeling exercise, as the most cost-effective ways to achieve 20%–30% energy savings in buildings throughout the U.S. This guide supplants the Advanced Buildings *Benchmark*, originally published in 2003, which has been used by participating utilities as the basis for providing financial incentives to customers that implement energy conservation measures. *Benchmark* was also cited by the U.S. Green Building Council (USGBC) in its LEED Rating System as a means by which buildings could qualify for an energy optimization credit without energy modeling. The new *Core Performance Guide* is updated to the 2004 version of ASHRAE Standard 90.1 and simpler in structure, with a refined set of criteria based on more sophisticated and extensive energy simulations.

The release of *Core Performance* was well timed, given USGBC's June 2007 announcement of a new requirement in LEED that all projects earn at least two energy optimization points (see *EBN* Vol. 16, No. 7). With this requirement in effect, the Advanced Buildings *Benchmark* is no longer relevant in LEED. At press time USGBC had not yet ruled on how many points would be awarded to projects following *Core Performance*, but "we have a strong argument for two points, and a pretty strong argument for three," said Mark Frankel, technical director at NBI and author of the guide. "Of the 186 permutations of building types, prototype systems, and climate zones, only three—all retail buildings in humid climates—are below 20% energy savings," Frankel noted. LEED requires a 17.5% energy cost reduction from the ASHRAE 90.1-2004 baseline to earn three points, and 21% to earn four.

The other option for achieving energy optimization points in LEED without undertaking energy modeling, based on ASHRAE's Energy Design Guide for Small Office Buildings, provides four points but is restricted to office buildings up to 20,000 ft^2 (2,000 m^2) in size. The *Core Performance* measures apply specifically to office, retail, education, and public assembly buildings between 10,000 ft^2 (1,000 m^2) and 70,000 ft^2 (7,000 m^2) in which glazed areas do not exceed 40% of gross wall area. Most of the measures themselves, especially the ones affecting building-envelope performance, are applicable in larger buildings as well, according to Frankel.

There are two sets of criteria in *Core Performance*: the first addresses design process strategies, and the second addresses the building's envelope, lighting, and mechanical systems. Based on energy modeling, "these required criteria are predictably significant in every climate," says Frankel. A third section lists additional energy-saving measures that NBI recommends considering, even though they are not cost-effective in all circumstances. *Core Performance* is not a complex model for projects seeking to achieve exemplary energy performance, but rather "simple guidelines for use on simple buildings to do a much better job than they are currently doing," according to Frankel. "We're just trying to show how state-of-the-shelf technology can get you much better buildings than are required by code."

– Nadav Malin

For more information:

New Buildings Institute
White Salmon, Washington
509-493-4468
www.advancedbuildings.net

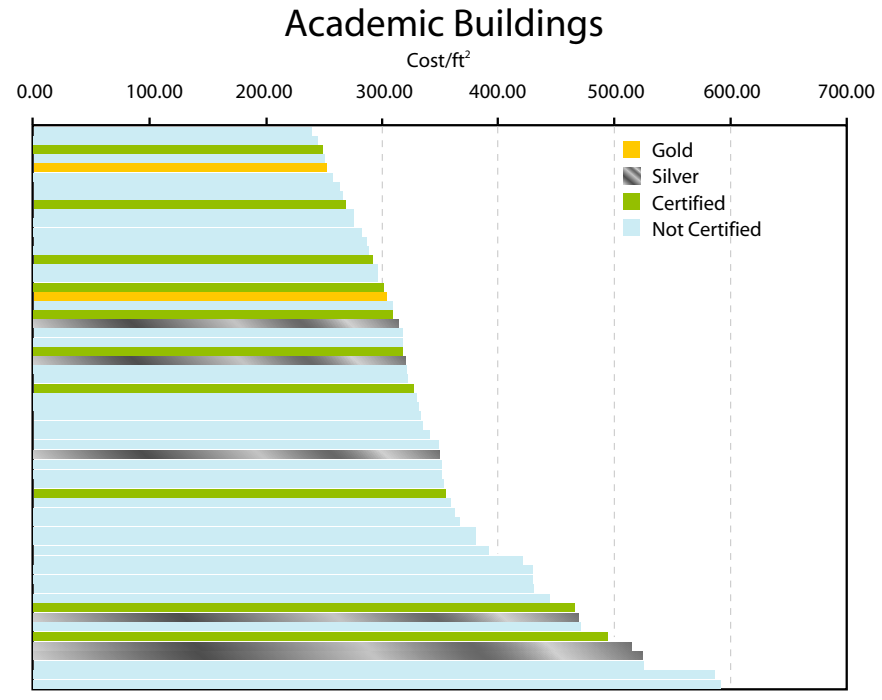
Report Says Green Still Doesn't Drive Building Cost

Having updated their influential 2004 study of the cost of green building [see *EBN* Vol. 13, No. 8] with new data, Lisa Fay Matthiessen and Peter Morris of Davis Langdon still come to the same conclusion. There are so many huge cost factors in construction that it is not possible to detect any statistically significant difference between the cost of green and non-green buildings, they report in "Cost of Green Revisited," released in July 2007. Based on an analysis of the budgets for 221 projects, of which 86 were pursuing some level of LEED certification, the report concludes that "buildings cannot be budgeted based on averages," leaving open the question of whether, for any given building, a green agenda affects its cost.

To reduce the potential variables involved, the authors adjusted building cost figures to eliminate the effects of timing (changing prices based on market factors) and location. Within the set of green buildings that they analyzed, the authors found that how green goals were achieved had a bigger impact on cost than the ultimate level of performance. For example, they encountered a number of LEED Silver buildings that cost more than comparable LEED Gold buildings, largely because the Silver-rated buildings were more likely to use expensive technologies such as photovoltaics to achieve energy points. A greater concern for climate-change impacts, however, is the finding that many of the projects minimized their investment in energy-conserving strategies and failed to exceed the minimum energy performance requirement, in spite of the evidence that, with integrated design, good energy performance is achievable within a conventional budget.

Also included in the reports is a credit-by-credit analysis of the feasibility and costs associated with achieving LEED points, including descriptions of the design approaches and technologies most often employed for each credit. This analysis was updated to reflect changes instituted with LEED for New Construction version 2.2. The report concludes with a short section on how to budget for green buildings; not surprisingly, it advocates a comprehensive budget model from the earliest design phases. This section fleshes out the philosophy embodied in these tidbits: "The key point to remember is that sustainability is a program issue rather than an added requirement. … The first question in budgeting should not be 'How much more will it cost?' but 'How will we do this?'"

– Nadav Malin



This graph from "Cost of Green Revisited" shows the cost per square foot of 60 academic buildings—classrooms, computer labs, and faculty offices on higher education campuses across the country. The 17 LEED projects that are either certified or pursuing certification are distributed widely in the mix.

For more information:

Lisa Matthiessen
Davis Langdon
www.dladamson.com/USA/Research/ResearchFinder/2007-The-Cost-of-Green-Revisited/

Newsbriefs

San Francisco to Mandate Environmental Standards for Private-Sector Buildings—A spokesperson for San Francisco's Department of Environment confirmed that chances were very good that legislation would be enacted to formalize recommendations put forth in a June 2007 report by the Mayor's Task Force on Green Building. Following the proposed recommendations, large commercial and high-rise residential buildings, both new and renovated, would be required to satisfy LEED Certified standards immediately, and LEED Gold standards by 2012. Also by 2012, smaller residential buildings would have to satisfy the introductory level GreenPoint Rated standards. Various incentives will be made available for buildings that exceed the standards. Following committee hearings on issues such as the fiscal impact of the ruling, San Francisco's combined city and county legislative body could pass an ordinance enabling Mayor Newsom to sign it into law as early as January 2008. If legislation is enacted according

to the report's recommendations, San Francisco will be on a path to having the nation's most rigorous environmental building standards. See www.sfenvironment.org (under Quicklinks, click on "Green Buildings Task Force Report") and www.builditgreen.org/greenpointrated/ for more information.

Merchandise Mart Pursuing LEED—With more than 4.2 million square feet (39,000 m²), Chicago's Merchandise Mart is the largest commercial building in the world. As owner of the building, Merchandise Mart Properties (MMP) already employs some green practices, such as recycling waste and using cleaning products with low levels of volatile organic compounds (VOCs). MMP is now pursuing certification for the 77-year-old building through the U.S. Green Building Council's LEED for Existing Buildings rating system. To achieve certification, MMP plans to adopt a purchasing policy emphasizing products with recycled and low-VOC content, update its construction standards to include green practices, increase the energy efficiency of equipment throughout the building, and implement green guidelines for events held in the building, among other strategies. MMP will also work with its tenants who wish to achieve certification in the LEED for Commercial Interiors rating system. MMP began documenting its compliance with LEED standards in July 2006 and hopes to achieve certification by November 2007.

Carbon-Neutral Products Approved for LEED Innovation Point—In a July 16, 2007 ruling for the LEED for Commercial Interiors Rating System, the U.S. Green Building Council endorsed the use of carbon-neutral products to achieve an innovation point. Both the original query, which was submitted in June of 2006, and the eventual ruling contain extensive qualifications and restrictions on this path to an innovation point. The query clarifies that emissions from all phases of a product's life cycle—not just emissions from the manufacturing plant—must be offset and that the carbon-neutral status must be certified by an independent third party. USGBC's ruling includes a list of acceptable programs and protocols for accounting for carbon offsets and notes that, because the carbon-trading industry is evolving so rapidly, the requirements are subject to change.

The largest commercial building in the world, the Merchandise Mart in Chicago will soon be submitted for LEED-EB certification. Photo: Merchandise Mart Properties, Inc.

Waste Management Offers Fluorescent Recycling—One of the largest waste collection and recycling companies operating in the U.S., Waste Management, Inc., has acquired an existing business, LampTracker, which offers a mail-back recycling program for fluorescent lamps. The company sells special containers for collecting and shipping fluorescent tubes, compact fluorescent lamps, and other items containing mercury. To protect the lamps from breaking and limit mercury exposure, the packaging consists of a small box wrapped with a mercury vapor barrier inside a larger box. When the box is full, the client ships it to LampTracker, which recycles the lamps; the cost of the packaging materials includes shipping and recycling fees. Federal and state laws require businesses to properly dispose of any equipment containing mercury; although such disposal can occur in a hazardous waste landfill, the U.S. Environmental Protection Agency strongly encourages recycling fluorescent lamps. More information is available at www.wmlamptracker.com.

House of Representatives to be Carbon Neutral—A report released in June 2007 details plans to move the U.S. House of Representatives to carbon-neutral operation by the end of 2008, to reduce energy consumption in House facilities by 50% from 2006 levels by 2017, and to "make House operations a model of sustainability." The initiative, headed by Speaker Nancy Pelosi (D–CA) and Majority Leader Steny Hoyer (D–MD), calls for the House to achieve carbon neutrality by purchasing electricity from renewable sources, purchasing

carbon offsets on the Chicago Climate Exchange, and switching the fuel for the Capitol power plant from coal to natural gas. The funding for these steps is outlined in an appropriations bill passed by the House and currently making its way through the Senate. In addition to these steps, the report outlines strategies for reducing energy consumption in the House by using more energy-efficient equipment in buildings and improving the efficiency of the Capitol power plant; legislation to fund these actions has yet to be introduced. The full report is available at www.speaker.gov (click on "greening the capitol").

SIPs Accepted into Residential Code—Until recently, builders using structural insulated panels (SIPs) had to work with an architect or engineer to prove the technique was equivalent structurally to those spelled out in the International Residential Code. In May 2007, the International Code Council (ICC) adopted prescriptive specifications and installation details for SIPs into the code, eliminating the need for this extra engineering. The specifications describe material requirements for SIPs as well as construction details for single- and double-story buildings. Written by the Structural Insulated Panel Association and APA - The Engineered Wood Association, the specifications were originally rejected by ICC but were later accepted after changes were made to expand the number of materials that can be used in the foam core of SIPs. The specifications are published in the 2007 supplement to the code, which is available at www.iccsafe.org/cs/codes/2007-08cycle/2007Supplement/.

Third-Largest Solar Power Plant Goes On Line—Nevada Solar One, a 64-megawatt solar-thermal power plant in Boulder City, Nevada, became fully operational in June 2007. The plant, among the largest in the world, features parabolic-trough mirrors that focus sunlight on tubes filled with a synthetic oil, heating it to over 700°F (370°C). The hot oil flows to a central plant, where it passes through a heat exchanger, generating the steam that drives a turbine to create electricity. The energy produced on the 300-acre site will power about 15,000 average homes and will be delivered primarily during peak demand times—summer afternoons and evenings. Acciona Solar Power is online at www.acciona.com; for more on parabolic-trough collectors, see *EBN* Vol. 13, No. 5.

The Nevada One solar power plant, located in Boulder City, Nevada, is the third-largest plant in the world, providing 64 MW of electricity. Photo: Acciona Solar Power

Design Guide for IAQ in Development—Six organizations have joined forces to create a design guide focused on indoor air quality (IAQ) in nonresidential buildings. The U.S. Environmental Protection Agency initially decided to fund a design guide and reached a cooperative agreement with the American Society of Heating, Refrigerating, and Air-Conditioning Engineers. A memorandum of understanding, signed in May 2007, brought four other organizations onto the project: the U.S. Green Building Council, the Building Owners and Mangers Association, The American Institute of Architects, and the Sheet Metal and Air-Conditioning Contractors' National Association. Slated for release in 2009, the guide, which will be followed by a professional development course, will describe an integrated process for achieving good IAQ in buildings.

USGBC Hits 10,000-Member Mark—The U.S. Green Building Council (USGBC) announced in July 2007 that it had reached a total of 10,000 member companies, signaling large growth in the previous year. The 2007 figure represents a growth of 2,800 members over 2006 numbers; USGBC gained a total of 4,800 members between 2002 and 2006. Member companies include architects, manufacturers, engineers, facilities managers, trade associations, and other building professionals. More information on USGBC membership is available at www.usgbc.org/membership/.

New Energy Star Specification for Home Plans—The U.S. Environmental Protection Agency (EPA) is currently drafting a new specification for home plans called Designed to Earn Energy Star. EPA expects to complete the specification by the end of 2007, after two rounds of comments from stakeholders. The current version of the specification requires home plans to be accompanied by information on the energy efficiency of mechanical systems, windows, lighting fixtures, and the building envelope, among other home features. Once the specification is complete, architects and designers will be able to sign a partnership agreement with EPA that will allow them to use the Energy

Star logo on plans for houses that meet the specifications. Those interested in the program should contact Zak Shadid, operations coordinator for the Energy Star Homes program, at shadid.zachary@epa.gov or visit www.energystar.gov/homes/.

Treated Wood Susceptible to Rot, Says Study—A study published in *Forest Products Journal* in June 2007 found that wood treated with copper azole or alkaline copper quaternary compound (ACQ) to both aboveground and ground-contact levels is prone to damage from brown-rot fungi. Both chemicals were introduced to replace chromated copper arsenate for residential use several years ago (see *EBN* Vol. 15, No. 8) and together are the current industry standard. Test samples treated with both chemicals lost 20%–60% of their mass due to rot; the study concludes that wood treated to current standards may not be adequately protected. While gathering samples for the study, researchers found that wood treated to higher-retention ground-contact levels was not available at many lumberyards, suggesting that many consumers are using lower retention treated wood in ground-contact applications, creating even greater risk for rot.

New Version of Cradle to Cradle Certification Program Released—McDonough Braungart Design Chemistry (MDBC) has released a draft of the version two criteria for its Cradle to Cradle (C2C) product certification program. The most significant changes to C2C, which certifies an array of consumer and building products based on MBDC's environmental philosophy, are a new "Basic" level of certification and increased stringency for the previous entry level, Silver. According to MDBC's Jay Bolus, the intent behind the new level is to show manufacturers that "you're in the game but there are some things in your product that we find unacceptable at Silver, Gold, and Platinum levels." Bolus also noted that Gold has become more achievable through a reduction in renewable energy requirements. A comment period is expected to run through summer 2007. For more information, see *EBN* Vol. 16, No. 2, and www.c2ccertified.com.

Canadian Building Organizations Abandon Cross-Promotion Plan—The Canada Green Building Council (CaGBC) and the Building Owners and Managers Association of Canada (BOMA Canada) have discontinued negotiations towards a cooperative relationship. According to Nancy Grenier, manager of communications for CaGBC, the two organizations had been pursuing a relationship in which they would promote each others' products: CaGBC's LEED rating systems and BOMA Canada's GoGreen and GoGreen Plus certification programs. CaGBC's LEED systems are currently focused on new construction, with most existing building certifications going to BOMA's programs or to the U.S. Green Building Council's LEED for Existing Buildings rating system. GoGreen was developed by the British Columbia chapter of BOMA Canada, and GoGreen Plus is BOMA's implementation of the Green Globes assessment tool for existing buildings. While CaGBC fully supported GoGreen Plus as a robust, third-party-verified certification system for existing buildings, said Grenier, it had some reservations about GoGreen, and the two organizations could not come to agreement on the issue. Both parties agreed to end the negotiations and will look for other ways to collaborate on green building issues.

Awards & Competitions

"Building a Sustainable World" Winners Announced

The Royal Institute of British Architects USA (RIBA–USA) has announced the winners of its international design competition "Building a Sustainable World: Life in the Balance." The competition asked entrants to conceive self-sustaining communities that respond to the challenges of global climate change (see *EBN* Vol. 15, No. 9). More information on winning entries and finalists is available at www.riba-usa.org/competitions/.

• First prize went to **Vakabauta Village**, an urban housing project in Suva, Fiji, designed to be self-sustaining by Toby Kyle, Chris Cole, and Kamineli Vuadreu of Fiji. The project addresses the needs of low-income people currently living in temporary housing within the city and includes a bamboo grove on the site, used to both create green space and generate revenue for residents.

• **Boonah Two Development**, located about 60 miles (100 km) inland from the east coast of Australia, won second prize. Developed by Gall and Medek Architects of South Brisbane, Australia, and Team DES of Crows Nest, Australia, the 50-year plan for the small city of Boonah incorporates agricultural production areas and renewable power generation.

• Third prize went to Wallace Roberts Todd, LLC, of Philadelphia, for **Urban Kidney Project—Revitalizing Forgotten Bottom**. The project addresses a post-industrial waterfront neighborhood of Philadelphia (known as Forgotten Bottom) that is both polluted and economically depressed. The project team created a neighborhood redevelopment plan centered on a restored wetland located on a brownfield site.

– Allyson Wendt

Product News & Reviews

TerraClad Rainscreen Cladding

TerraClad is a terra cotta rainscreen cladding panel for commercial building façades. Made by Boston Valley Terra Cotta, a 115-year-old company near Buffalo, New York, TerraClad panels have hollow profiles and are installed on engineered aluminum tracks that provide a vented space behind the panels.

Terra cotta has been used in the building industry for hundreds of years—especially as roofing tile, floor tile (often referred to as Mexican tile), chimney lining, and as exterior cladding materials. A ceramic material fired at a relatively low temperature (Boston Valley fires at about 2,300°F, [1,260°C]), terra cotta can be glazed or left unglazed, depending on the performance and aesthetic needs.

From an environmental standpoint, terra cotta is an attractive material. It is produced from natural, inorganic materials, primarily clays, that are abundant and widely distributed—Boston Valley sources 42% of its raw materials from within 500 miles of its plant. It is inert, with no offgassing after firing is complete. It is noncombustible without requiring the addition of flame retardants. It is durable—TerraClad carries a 50-year-plus life expectancy, according to the manufacturer, and is engineered to survive freeze-thaw cycles. And it is 100% recyclable back into new terra cotta. According to Sheri Carter, AIA, of Boston Valley, the company sends its terra cotta scrap and overruns to Maryland Refractories (located in Ohio), where it is ground and shipped back to Boston Valley for reuse as the primary constituent in the product. Boston Valley could also recycle panels taken off buildings, though, as TerraClad is a new product, this has not been done. "Our TerraClad panels should never contribute to a landfill," said Carter, who added that Boston Valley has begun examining the life cycle of its entire product line (which also includes an exterior sunshading system).

While fired at a lower temperature than stone-fired porcelain, terra cotta *does* take significant energy to produce, and significant energy is involved in shipping the finished materials. According to Gretchen Kraus, vice-president for sales, Boston Valley uses state-of-the-art, high-efficiency kilns that use less energy than the continuous-firing brick kilns used by some manufacturers. On the materials side, Carter said that the company has had some setbacks. Boston Valley used to recycle all of its plaster casts (used in fabricating custom terra cotta architectural elements in historic renovations and repairs), but the company that was taking their plaster stopped accepting it because of contaminants from the form-release agents.

In addition to terra cotta being an environmentally attractive material, the TerraClad rainscreen product offers building-performance benefits. Rainscreen cladding is an effective way to shed moisture and allow venting of the exterior wall assembly, preventing moisture penetration and improving building durability (for more on rainscreen benefits, see *EBN* Vol. 12, No. 7). Boston Valley has developed a simple and effective aluminum mounting system for TerraClad panels. This not only provides for rapid installation but also facilitates deconstruction without damage to the panels.

John Addonisio, a New York-based contractor who installed TerraClad

TerraClad is a hollow, fired-terra cotta exterior rainscreen panel for commercial buildings that is installed on an aluminum mounting system.

on a commercial brick structure retrofit, said TerraClad "looks fantastic and really sharp" and that once a crew figures out how to work efficiently with the mounting system, installation runs smoothly. "It's one of the best [rainscreens] out there," he told *EBN*. Addonisio said that the cost of TerraClad is comparable to that of precast concrete panels, although adding waterproofing behind TerraClad as part of the rainscreen assembly "might make it a bit more."

TerraClad is the only U.S.-made terra cotta rainscreen product, though similar products are produced in Europe and available in North America. These include Faveton back-ventilated ceramic façade panels and mounting systems available from Pohl (www.pohlusa.com).

Boston Valley TerraClad is custom-manufactured for each project, with panels available up to 5' (150 cm) in length, though 30"–38" (76–97 cm) is more common. A dozen through-body colors are available.

– Alex Wilson

For more information:

Boston Valley Terra Cotta
Orchard Park, New York
888-214-3655; 716-649-7490
www.bostonvalley.com
www.terraclad.com

SierraPine Bets on Phenolic Particleboard

SierraPine, which manufactures the Medex, Medite II, and Arreis lines of architectural fiberboards and moldings made of recycled and recovered wood free of added urea-formaldehyde, has begun producing particleboard using a phenol-formaldehyde (phenolic) binder rather than the conventional urea-formaldehyde (UF) binder. The new particleboard, called Encore, is made with 100% recycled wood fiber from sustainable forestry operations and produced at SierraPine's facilities in Georgia, California, and Oregon.

Encore can be used in any application where typical particleboard is used, such as casework, countertops, and stair treads. It carries Scientific Certification System (SCS) and Environmentally Preferable Product (EPP) certification, is approved for CHPS Section 01350, and complies with CARB Phase II regulations. The product is comparable in constitution and cost to Roseburg's SkyBlend (see *EBN* Vol. 14, No. 9); output from the Springfield, Oregon, plant, however, is a stronger, M3-rated panel meeting ANSI A208.1-1999 standards. While these phenolic-resin panels are made with binders that contain formaldehyde, they do not release as much of the toxic compound as panels made with urea-formaldehyde binders, and they qualify for use in the LEED Rating System's composite wood credit.

– Mark Piepkorn

For more information:

SierraPine, Ltd.
Roseville, California
800-676-3339
www.sierrapine.com

Carnegie Introduces Surface iQ Wallcoverings

The wallcovering company Carnegie, maker of Xorel and other non-PVC wallcoverings, has introduced a line of polyethylene wallcoverings with an affordable price of $22.50 per yard ($24.20/m; net wholesale rate). The Surface iQ line, manufactured by Len-Tex Corporation, has been available directly from the manufacturer since 2005. Carnegie's offerings include seven new patterns in a range of colors.

Surface iQ fabrics use only nonhalogenated, natural-clay fire retardants and are available with optional microperforations, recommended in humid climates, to reduce the risk of trapping moisture behind the wallcovering during the cooling season. Surface iQ passes the California Section 01350 indoor air emissions test and uses a non-arsenate antimicrobial additive as well as water-based inks free of heavy metals and chlorine. A standard cellulose and polyester backing is adhered to the textured polyethylene face, so the product installs with a standard vinyl wallcovering adhesive.

– Nadav Malin

For more information:

Carnegie
Rockville Center, New York
800-727-6770
www.carnegiefabrics.com

Len-Tex Corporation
North Walpole, New Hampshire
603-445-2342
www.surfaceiq.com

Photo: Carnegie

Carnegie's new polyethylene wallcoverings, Surface iQ, use natural-clay fire retardants and water-based inks, and are available with microperforations to reduce moisture build-up.

Antimicrobial Chemicals in Buildings *(from page 1)*

integrity of buildings, and research over the last decade has increased concerns about mold's effects on indoor air quality. Providing sanitary conditions in homes and commercial buildings alike has become a greater focus in preventing the spread of disease-causing pathogens. Hospitalization is a leading cause of *death* in the U.S.; among other hazards, infections acquired during hospital treatment kill more than 80,000 people annually (nearly twice the number of people killed in automobile accidents), leading to strong interest in antimicrobials from healthcare facilities.

Some of these infections are caused by "superbugs," pathogens that have developed resistance to multiple antibiotics used in medicine. (Antibiotics differ from antimicrobials in being specifically medicinal in nature and often being based on compounds derived from fungi and bacteria that are capable of killing fellow microbes.) Similar concerns associated with widespread use of antimicrobials suggest that bacteria could evolve resistance to them, becoming more deadly. The inherent toxicity of antimicrobial compounds—many of which are pesticides—also raises concerns that treatments to prevent disease could cause other problems.

This article examines applications of antimicrobials in buildings, asking whether they are warranted, and looking at how antimicrobials work. It also explores health and safety concerns and suggests ways to make buildings more hygienic, with or without antimicrobials.

Microbes—and Antimicrobials

The Freedonia Group, a market research firm, projects that U.S. demand for disinfectant and antimicrobial chemicals will increase 5% annually to $930 million in 2009, up from $730 million in 2004. Those dollar figures represent growth in sales from 238 million pounds (108 million kg) in 2004 to 273 million pounds (124 million kg) in 2009. This growth is spread across several categories, with paints and coatings accounting both for the greatest volume compared with other categories, such as plastics and healthcare, and some of the strongest growth. Another product category, copper-based biocides, most commonly used as wood preservatives, accounted for another $245 million in sales in 2005, according to Freedonia, and shows similarly strong growth. (For more on protecting wood from insects and mold, which is not discussed in this article, see *EBN* Vol. 15, No. 8).

Bacteria

The growth and spread of these chemicals pales, of course, in comparison with microbes, which are much more widespread and can proliferate much faster in a given environment. Bacteria typically require moisture, a food source, and adequate warmth. One environment providing those factors in abundance is the human body: scientists have estimated that 500 to 1,000 species of bacteria live on and inside us, with ten times as many bacterial cells as human cells. Most of those bacteria live in the large intestine, where they help us digest food.

Humans require the same things in their environment as bacteria—moisture, food, and warmth—so we tend to create ideal bacterial habitats all around us. Furthermore, humans frequently move around in bacteria's environments touching ourselves, each other, and many other surfaces along the way—creating many ways for bacteria, viruses, and other microbes to spread.

Mold

Fungi are distinct from bacteria: they inhabit separate taxonomic kingdoms, and some of the best known fungi and bacteria are adversaries: the *Penicillium* mold, which kills and inhibits the growth of some bacteria, was the first modern antibiotic. However, fungi can interact with humans and the environment in similar ways to bacteria, leading to some similar problems.

Photo: Andy Mattern, Artimbo.com

American Clay Earth Plaster, shown with a troweled finish in this bathroom, has inherent mold-inhibiting properties, according to the company, because it naturally releases moisture.

Of greatest concern in terms of the built environment are molds, which grow on and decompose organic material, including wood, paper, and cloth. Dirt, which usually contains a high proportion of organic material, also offers a home to mold, allowing it to grow on surfaces that would otherwise not support it, such as concrete, glass, and metal. Mildew is a form of mold, as is the foggy substance that frequently grows on the outside of windows.

Whether mold exposure causes widespread health problems is a largely unresolved scientific question (see more in *EBN* Vol. 10, No. 6). Summing up the evidence in a 2002 paper that remains relevant today, building scientists Nathan Yost, M.D., Joseph Lstiburek, Ph.D, P.Eng., and Terry Brennan wrote, "Most people are not affected by exposure to mold, unless they are exposed to a lot of mold. Unfortunately, we are not quite sure what 'a lot of mold' means." Mold's decomposition and despoliation of building materials poses practical and aesthetic concerns. Prevention of mold growth in interiors is an important goal—can antimicrobials help?

Antimicrobials

In order to be effective against microbes that are as ubiquitous and small as mold and bacteria, antimicrobial substances need to be similarly ubiquitous in distribution and have properties making them effective at the cellular level.

The Microban brand of antimicrobial products offers an example of how antimicrobials are incorporated into products and how they work, as well as how they cause health and environmental concerns. Microban International, based in North Carolina, develops antibacterial formulations for product manufacturers. Wayne Swofford, head of research and development for Microban, explained that Microban antimicrobials typically will be "durably incorporated into whatever product is going to be used or sold. The specific type of antimicrobial is going to vary based on the end use and the matrix you're putting it into," he said. Incorporating Microban into a product allows the microbial to provide "continuous action, versus periodic treatment of that surface," said Swofford.

In building products, Swofford said, antifungal protection is usually a top priority, leading Microban to use products including pyrethiones, isothiazolinones, and azoles. Microban frequently incorporates triclosan and has become best known for that chemical. Triclosan, found in toothpastes, mouthwashes, and soaps, as well as numerous other hygiene products, apparel, and interior finishes, works by inhibiting various bacterial functions. At the lower concentrations typical for building products, triclosan is a biostat, or an inhibitor of growth in bacterial populations; it works by interfering with the synthesis of fatty acids, which are needed for building cell membranes.

Environmental Risks

Although a chemical like Microban offers clear benefits—continuous, targeted treatment for bacteria in infection-prone situations—numerous medical and environmental groups have raised questions about risks. These groups warn about health and environmental risks from antimicrobials, including antimicrobial resistance, and exposure, both direct and mediated through the environment.

Antimicrobial resistance

Bacterial resistance to antibiotics is a well-established problem in public health. *Staphylococcus aureus*, for example, is the main bacterium responsible for staph infections and a range of diseases, many of them fatal. *Staphylococcus* developed resistance to penicillin in 1947, four years after penicillin was first mass-produced. Staph bacteria resistant to multiple antibiotics have since developed and become common. This history contributes to widespread fear, articulated by the American Medical Association and others, that bacteria targeted by antimicrobials could adapt and develop resistance to those chemicals, as has happened in medicine with antibiotics.

Resistance to silver

Silver is a powerful antibacterial, and it is commonly used in medical settings as well as in building materials. Silver kills bacteria by interfering with their cell membranes, causing internal fluids to be released and allowing entry of the silver, which can then kill the bacterium in several ways, including binding with proteins and killing enzymes. Milliken uses a silver-based antimicrobial on all of its carpeting, and silver is an option in ductwork, washing machines, and mobile phones, among other applications.

Silver also provides a case study in antimicrobial resistance. According to Simon Silver, Ph.D., professor of microbiology at the University of Illinois-Chicago, bacteria resistant to silver appear regularly, as many as a few times a year in different places, and "highly resistant" bacteria have also appeared at times, including in the 1970s in a Boston burn ward. In that case, following three deaths from resistant *Salmonella* bacteria, the ward was closed and intensely cleaned, eliminating the problem. The saving grace in these cases is that, for whatever reason, neither the silver-resistant bacteria nor the genes responsible for their resistance seem to have spread.

Although not discounting the danger entirely, Silver argues that use of silver in buildings isn't likely to cause antimicrobial resistance. He says that the metal has been commonly used

for so long in applications where it contacts bacteria, including dental fillings, jewelry, food utensils, and photography, that its new uses in buildings are relatively minor.

Nonetheless, especially since bacterial resistance to silver has been shown to occur, the risk should be properly disclosed, an action at least one manufacturer appears not to take. Ginger Merritt, vice president of worldwide marketing and sales for Agion Technologies, makers of silver-based antimicrobial AgION, told *EBN* that "silver works in three ways. … Over time the microorganism can learn its way around one mechanism. With three it's unlikely if not impossible."

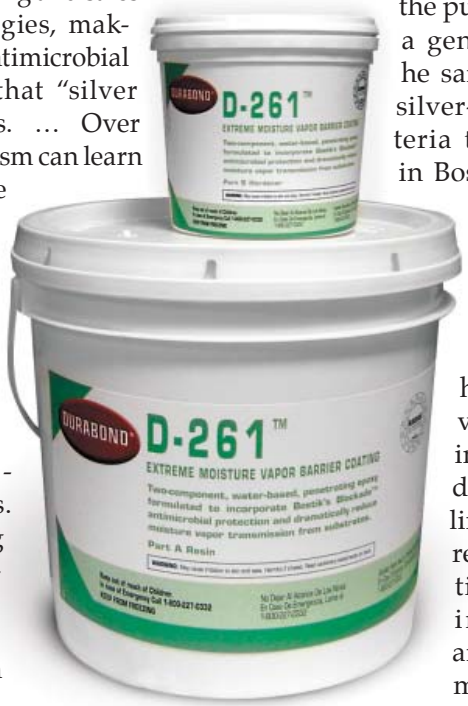


Photo: Courtesy Bostik, Inc.

This Bostik coating, incorporating AgION antimicrobial silver, is applied to freshly poured concrete prior to installation of floorcovering to prevent moisture transmission.

The past emergence of silver-resistant bacteria shows that Agion may be underrepresenting the risks. Moreover, according to Silver, "The mechanism of resistance has nothing to do with the mechanism of action." That is, bacteria don't have to "learn their way around" multiple mechanisms of attack to form a counterattack. Bacteria resist silver by binding it to the outside of their cells, or pumping it out as fast it enters, said Silver.

Another danger that is frequently underplayed by manufacturers touting the safety of their own antimicrobials is cross-resistance. "Microbes package their resistances on little pieces of DNA called plasmids," said Silver. "With that package a bug will gain resistance to a whole bunch of different things." Bacteria can also exchange those plasmids with each other, potentially spreading resistance. In addition to the gene-packaging issue contributing to cross-resistance is the possibility that a mechanism for resistance could apply to multiple chemicals, said Bernie Weisblum, M.D., professor of pharmacology at the University of Wisconsin–Madison. "One common way of expressing resistance is for the bacterium to pump [the antimicrobial] out, and some of the pumps may have a general activity," he said. Indeed, the silver-resistant bacteria that appeared in Boston were also resistant to ten other antibiotics, Silver said.

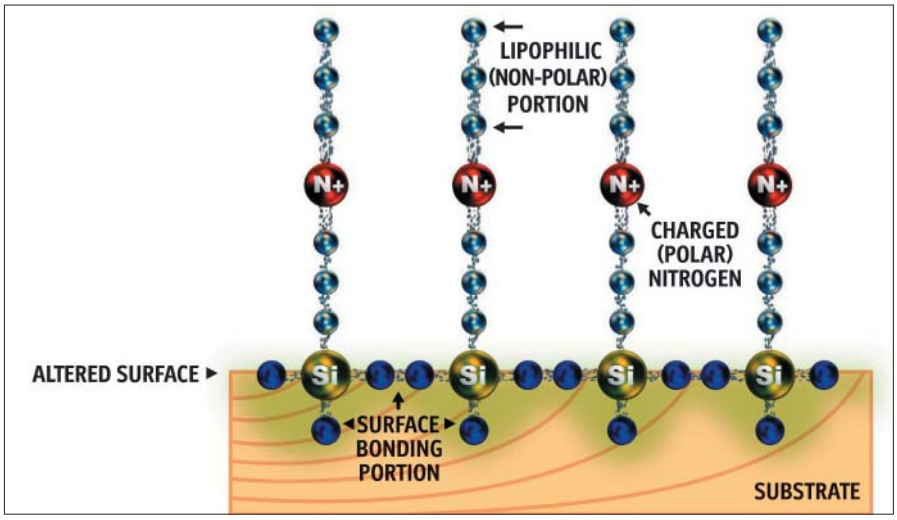
Even with this history of silver resistance in bacteria, evidence doesn't link instances of resistance to antimicrobial use in buildings, and other common antimicrobial chemicals remain unlinked to resistance. Stuart Levy, M.D., a professor of microbiology at Tufts University who has studied antimicrobial resistance, said that concerns remained, particularly with chemicals that leave residues. "That leaves out alcohols, peroxides, and bleaches but leaves in those compounds that contain triclosan, triclocarbon, and QACs [quaternary ammonium compounds]," he said. "The volatile compounds do their killing immediately and leave no residual substance to allow other bacteria to become trained to be resistant," Levy explained.

Exposure hazards

The factors that make antimicrobials effective—including their toxicity and their need to be fairly durable—can make them hazardous to people and the environment. Here we briefly examine several common compounds—silver, triclosan, and zinc pyrithione—and their potential hazards.

Silver: Proponents of the use of silver, like Agion's Merritt, call it a "naturally occurring chemical." Others, meanwhile, call it a "toxic heavy metal." They're both technically correct, requiring us to carefully sort out hype from reality. Silver has been used in medicine for decades, and, while doctors should take care not to overuse it, most scientists would probably agree with microbiologist Silver when he told *EBN* that "silver's toxicity for humans is very little and only in a few situations." According to Silver, a *sterile* wound will heal faster using bandages not impregnated with silver. However, those bandages protect wounds from the very real risk of infection—ultimately leading to faster healing, especially for burns and other severe wounds. An additional concern is that antimicrobial silver is ultimately released to the environment, where it could disrupt aquatic life, including bacterial populations. However, there has so far been little evidence to support this fear.

Triclosan: Triclosan is relatively nontoxic to humans and other mammals, in part because humans synthesize fatty acids with a process different from that used by targeted bacteria. However, triclosan appears to be very persistent in the environment: a 2002 study by the U.S. Geological Survey found triclosan in 58% of the natural waters it tested that year. In addition to its possible role as an endocrine disruptor, as one study has shown in frogs, triclosan can convert to a potentially toxic



Duraban offers an antimicrobial coating for a variety of surfaces using quaternary ammonium compound. The chemical works by using a positively charged molecule with a carbon-chain "sword" to attract and impale bacteria, which have negatively charged cell walls. Although the compounds are relatively nontoxic, some experts worry that bacteria could develop resistance to them through constant exposure. Rendering: Duraban LLC

dioxin when exposed to sunlight, according to a 2003 study (see *EBN* Vol. 12. No. 7). Triclosan also appears to be bioaccumulative, so additional problems could emerge as it becomes more widespread and studied in more contexts.

Zinc pyrithione: Zinc pyrithione is primarily a fungicide with some antibacterial properties. It is common in anti-dandruff shampoos and in building products as a mildewcide and algaecide in paints and wet-applied adhesives (where it has become more common as solvent-based adhesives have been replaced by waterborne formulations, in part because of air-quality concerns from solvents' offgassing). In higher doses zinc pyrithione is acutely toxic to humans, but at the doses present in building materials—doses much lower than those in shampoos, according to industry sources—it does not appear to be toxic.

Effectiveness Unproven

While many antimicrobials appear to be relatively safe to occupants, whether they are effective is another question. The immediate efficacy of antimicrobials in killing microbes is not a matter of debate: the U.S. Environmental Protection Agency (EPA) requires companies registering pesticides to show that they work in a given application. However, it's not as clear that antimicrobials remain as effective in real-world applications as they are in lab tests, or that their use creates overall benefit.

Healthcare authorities skeptical

Antimicrobial products are prevalent in healthcare settings, providing an arena to evaluate their effectiveness. So far, healthcare authorities have found a lack of supporting evidence and have adopted a precautionary approach. One report, "Guidelines for Environmental Infection Control in Health-Care Facilities," published by the federal Centers for Disease Control and Prevention (CDC) in 2003, offers one of the most exhaustive examinations to date of the evidence for and against the use of antimicrobial compounds in interiors.

Discussing clothing, linens, and mattresses treated with antimicrobials, the CDC report concludes, "No evidence is available to suggest that use of these products will make consumers and patients healthier or prevent disease. No data support the use of these items as part of a sound infection-control strategy." The report came to this conclusion despite extensive evidence it cited for potential contamination of linens and beds, particularly wet mattresses. But the agency recommends simply following cleaning and sanitizing procedures, and removing damaged mattress covers and mattresses from service.

The CDC report provides another case study, taking a closer look at carpeting (see also *EBN* Vol. 16, No. 6). "Several studies have documented the presence of diverse microbial populations, primarily bacteria and fungi, in carpeting," it reports, going on to say that "new carpeting quickly becomes colonized, with bacteria growth plateauing after about four weeks. Vacuuming and cleaning the carpeting can temporarily reduce the numbers of bacteria, but these populations soon rebound and return to pre-cleaning levels." The report notes that bacterial contamination tends to increase with higher levels of activity and that soiled, damp carpeting provides ideal conditions for bacteria and fungi to proliferate.

Despite all this, "only limited epidemiologic evidence demonstrates that carpets influence health-care-associated infection rates in areas housing immunocompetent patients," or patients with healthy immune systems, the report concludes. If, as the report concludes, there is no link between infection rates and carpets, then one would expect carpets treated with antimicrobials to have little positive impact. The report makes this point, noting that "treated carpeting has not been shown to prevent the incidence of health-care-associated infections in care areas for immunocompetent patients."

Regulations from the U.S. Occupational Safety and Health Administration (OSHA) and EPA further

suggest that there is not a significant difference between how carpets with and without antimicrobial treatment fare in real-world use. The antimicrobial effect that chemicals provide at the surface of a material as it comes in contact with an infected substance does not extend throughout a substance spilled on the material, especially a viscous, potentially infectious fluid like blood or sputum. An OSHA ruling speaks to this crucial gap in effectiveness. OSHA requires that in occupational settings, following contact with potentially infectious substances, equipment and surfaces be cleaned and disinfected. However, the EPA has not approved a test protocol for how a chemical could be shown to disinfect carpeting, and therefore pesticides registered as disinfectants apply only to hard surfaces, not to carpeting. (EPA distinguishes between *antiseptics*, *sanitizers*, *disinfectants*, and *sterilizers*, which are increasingly effective in killing microbes in a given application.) OSHA has noted that because EPA-registered pesticides, including all of those used as antimicrobials in carpet, cannot disinfect carpet, it follows that carpet cannot be disinfected following contamination.

Researchers at Kaiser Permanente, the nonprofit managed-care giant, came to a similar conclusion as the CDC authors in a December 2006 memorandum, "Evaluation of Antimicrobial Property Claims in Finishes and Fabrics." Analyzing how infectious diseases are transmitted, the memo notes that in a "chain" of transmission, one broken link prevents infection. Emphasizing that building environments can frequently be recontaminated, the report argues that handwashing by medical personnel is most effective in breaking the chain of transmission. Citing logic similar to OSHA's, the Kaiser memo also argues that mechanical cleaning with detergent and water is most effective in controlling contamination of surfaces. The memo further argues that antimicrobial treatments of surfaces are not effective in preventing airborne distribution of disease. The memo concludes, "Review of current scientific literature reveals no evidence that environmental surface finishes or fabrics containing antimicrobials assist in preventing infections."

What EPA registration means

The apparent disconnect between the skeptical approach of these health and safety authorities and the claims of manufacturers can be better understood through an examination of the EPA pesticide registration process.

In addition to ensuring that an antimicrobial product doesn't harm human health or the environment, among other requirements, EPA requires data from manufacturers demonstrating that the product is effective against targeted bacteria, fungi, or viruses. Most building products fall under EPA rules that limit manufacturers to claiming protection of the product from pests; expressed or implied public health claims are not allowed. For example, many water-based paints contain antimicrobials, usually to prevent mildew and algae growth on the paint while it is in the can or on a building. The benefit to the consumer is that the paint remains good to use and, after application, does not decay or discolor.

Claims often blur the line, however, in terms of whether antimicrobials simply protect the product or protect public health. Interface, for example, in a technical brief on Intersept, the antimicrobial it uses in all of its carpet tiles, emphasizes the "protection" Intersept offers to its products as a "microbial-inhibiting preservative." The same brief claims that by providing that protection, "Intersept protects the quality of the indoor environment"—which could be interpreted as a claim regarding public health. Daniel Price, Ph.D., director of microbiology for Interface, told *EBN* that "Intersept is there to protect the product," noting that Intersept protects a plasticizer in Interface's carpet tile backing that could be a fungal food source. Price also extended his argument into public health, however: "We make no health-related claims even though it stands to reason that if I'm not living an a mold-laden environment, I might be better off," he said.

Dennis Edwards, chief of the regulatory branch in the EPA's antimicrobials division, indicated that EPA frowns on this kind of marketing: "The claims have to be limited to the fact that the carpet has been treated to protect the carpet from stains and odors, or to keep it from breaking down," he said. "The articles don't need to be protected from diseases—people do," he added. (When asked why Interface linked Intersept to indoor environmental quality, Price emphasized Intersept's odor-preventing qualities.)

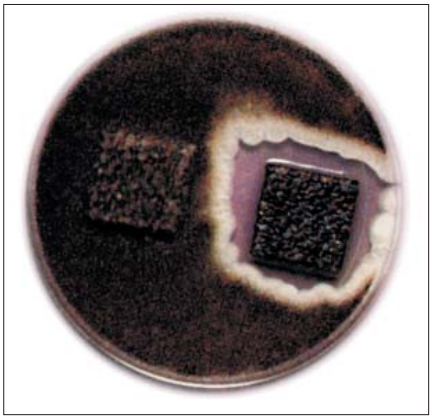


Photo: InterfaceFLOR

Interface uses images like this one to advertise the antimicrobial protection afforded by its use of Intersept, a registered pesticide, in its carpet tiles. With the two carpet samples spread with an agar solution and exposed to heat and humdity, the Intersept-treated carpet sample on the right does not grow mold.

Erica Stewart, a certified industrial hygienist, a project manager with

Kaiser Permanente, and a coauthor of Kaiser's memo quoted in this article, described what she has seen in antimicrobial product marketing: "What happens in marketing is that manufacturers conflate the antimicrobial label with claims that it will also prevent infection. When we've asked for studies, what we've actually received from manufacturers were testimonials, no actual well-designed studies."

Since EPA requires efficacy testing, those buying products with antimicrobials should at least be able to know that the product will be protected. That is likely true in most cases, but buyers should understand the difference between laboratory testing and the test of time in the real world. For example, while carpet antimicrobials may inhibit mold in petri-dish tests, that is no guarantee that they will inhibit bacteria in real-world situations, as the OSHA ruling indicates.

One problem is that a variety of testing methods may be used to evaluate antimicrobial performance. According to Elliott Horner, Ph.D., microbiology lab director at Air Quality Sciences, which promotes its own newer test method for mold inhibition, "Many of those tests are decades old and some of them are rather simplistic. They don't really give a good handle on how the product is going to perform," he said, noting that some of the tests "were developed for the technical people in the company to use on a comparative basis, to test a new formulation" and may be fairly subjective. He added, "Unfortunately very few organizations have attempted to correlate the predictiveness of these tests with service conditions."

The way those test results are often used in marketing contexts can also be misleading, argues Dobbin Callahan, manager of government markets for Tandus, a carpet manufacturer that has been critical of antimicrobial use. "Slathering agar solution [a common culture medium] on carpet and allowing it to grow under controlled heat and humidity proves only that agar solution grows mold and mildew under controlled heat and humidity," he said, describing a common test procedure. "It's not the carpet growing the mold, it's the agar. It's a non sequitur to conclude that carpet needs pesticides in order to perform well or for health reasons."

The CDC report makes a broader point about marketing to the public: "The 'antibacterial' label on household cleaning products, in particular, gives consumers the impression that the products perform 'better' than comparable products without this labeling, when in fact all household cleaners have antibacterial properties." In evaluating marketing claims of antimicrobial products, it is worth carefully evaluating what is being claimed, what is being implied, what is supported by evidence, and what testing or logic supports that evidence. Buyers may often find missing pieces at multiple levels.

Hygiene Without Pesticides

In sifting through claims to find products that meet their goals, those specifying or purchasing products can look to numerous products and designs without using antimicrobial pesticides. "My first pick is things that make life difficult for the colonizers," building scientist Terry Brennan told *EBN*, "for example, fiberglass-faced gypsum board or fiber-cement board used on walls and floors that are going to receive tile, or in rooms where dampness or regular sweating is expected."

Other products, in addition to not supporting mold or bacterial growth, offer some active protection against microbes without use of pesticides. Linoleum, for example, contains linseed oil, which continues to oxidize long after installation. On its website, Forbo claims that its linoleum offers bactericidal properties against a variety of microbes, including *Salmonella* and *Staphylococcus*. However, Marmoleum, Forbo's linoleum, would seemingly need to be registered to make bactericidal claims, but Scott Day, marketing administrator for Forbo North America, said that pesticide regulations do not apply to Marmoleum..

Clay plaster is another natural product that appears to offer inherent mold-inhibition. Recent tests by American Clay, makers of American Clay Earth Plaster, showed that panels with applications of the plaster did not support mold or fungal growth, even when held for an extended period in a warm, humid environment. Croft Elsaesser, president of American Clay, attributed the effect to clay's moisture-releasing properties: "Even though the clay holds moisture readily, given the opportunity to release that moisture it does that also," he said. Remaining moisture destroys mold and its habitat. Elsaesser said that American Clay had been using borax as an antifungal additive to its plaster, but eliminated it following these tests, which showed equivalent performance with or without the borax.

Hydrated lime, or calcium hydroxide, is an age-old building material that has been used around the world in mortar, whitewash, plaster, and many other more specialized uses. Lime-based products like whitewash have traditionally been applied periodically to walls and other surfaces both inside and outside, where they temporarily increase the alkalinity of the surface, killing microbes. However, lime is caustic, and its antimicrobial effect is quickly spent, limiting its use. One interior paint, Caliwel, manufactured by the Alistagen Corporation, encapsulates lime, registered with EPA as a pesticide, in the paint to

Improving Hygiene in Buildings

All of the following items apply especially to public buildings, where risks for infection and liabilities may be greater. Residential buildings, particularly where hygiene is a high priority, can also benefit from these tactics.

GENERAL PRACTICES	
Maintain cleaning equipment	Maintain vacuum cleaners properly to reduce risk of spreading contaminated dust, and use a HEPA filter. Wet cleaning equipment can become colonized by bacteria and serve as a population reservoir. Follow proper maintenance procedures.
Use green chemicals	Use less-hazardous cleaning chemicals, particularly when cleaning with machines, e.g., wet carpet cleaners, that can disperse chemicals into the air. Seek out chemicals with green certifications, e.g., Green Seal. Use cleaning chemicals as directed on the label, because the effectiveness of the product may depend on a certain concentration of the chemical and certain contact time.
Adopt a green cleaning policy	Articulate a cleaning policy focused around keeping surfaces clean, and ensure that it is implemented. Educate occupants on how to respond to a spill or contamination. Do not rely on antimicrobials as a substitute for cleaning and maintenance.
Encourage basic hygiene	Soap works by breaking down waxes and oils that protect bacteria, and it takes time to work. Educate occupants on the proper hand-washing technique: apply soap and hot water and vigorously rub for about 20 seconds, or as long as it takes to sing the ABC's. Studies show that in most situations, regular handsoap used in this way is more effective than antibacterial soap.
Take a clinical approach	If practicing clinical infection control, be clear on what microorganisms are being targeted, with what modes of transmission. For example, control airborne pathogens in operating rooms per American Society of Heating, Refrigerating, and Air-Conditioning Engineers research now underway focusing on air movement patterns.
DESIGN PRACTICES	
Design for cleanability	When possible, specify hard-surface flooring and other cleanable components like rounded corners and larger tiles, minimizing grout. (See *EBN* Vol. 14, No. 9 for numerous other strategies.)
Use carpet tile instead of sheet carpet	When using carpeting in areas of high risk for spills, e.g., patient-care areas in healthcare facilities or food-preparation areas, use carpet tile to facilitate easy replacement.
Design to keep buildings clean	Make design decisions to keep out dirt, which can harbor microbes. For example, use metal grates or track-off systems at building entrances (See *EBN* Vol. 10, No. 10). Make handwashing stations accessible and convenient.
Control moisture	Assiduously control moisture in buildings by preventing bulk water intrusion, providing capillary breaks in foundations, avoiding thermal bridging where condensation could occur, and maintaining low interior humidity. Maintain awareness of the building assembly's vapor profile to avoid trapped condensation. (See *EBN* Vol. 12, No. 7 for more.)
PRODUCT SELECTION	
Use passive protection	If microbial contamination is a concern for occupants, select products that will tend to not harbor microbes, e.g., by not providing a food source or a hospitable surface for growth.
Evaluate antimicrobial use	Especially in interior products that occupants and indoor air will be exposed to, e.g., carpets and furnishings, ask manufacturers if their products contain antimicrobials. If they do contain them, ask what chemicals are used and why they are needed. Request and evaluate evidence supporting efficacy and safety.
Distinguish health claims from product protection claims	EPA prohibits manufacturers from claiming that a product will offer health benefits unless the product itself is registered with EPA as a pesticide—and most building products are not. Watch for health claims—explicit and implicit—and evaluate whether they are being made on a scientific basis.
Clarify the need for antimicrobial products	Manufacturers finesse EPA rules by claiming that antimicrobials are present simply to protect their products, not the building or the consumer. With proper design and maintenance, however, products may not need that "protection."
Evaluate chemical safety	Use EPA registration numbers for pesticides used by manufacturers to investigate chemical safety. EPA evaluates safety when awarding registrations, but new studies may have emerged since registration that EPA has not taken into account. Also, toxicity deemed generally safe may be inappropriate for a given situation.
Exercise precaution	Remember that antimicrobials are designed to be toxic, at least to some organisms. Avoid using them unless there is a clear need.

The Sittris chair is designed for cleanability, with its silicone upholstery. A silver antimicrobial treatment is an option on textile versions of the chair. Photo: Sittris

release it over time, prolonging its antimicrobial properties for four to six years, according to the company, which markets the paint for healthcare applications.

Other companies promote new products offering an inhospitable surface for microbial growth. The Sittris series of products, launched in 2007 for the healthcare market by furniture maker Keilhauer, uses silicone-upholstered seating (the largest silicone components that have ever been made, the company told *EBN*) to provide a very cleanable surface that does not support microbial growth and is inherently flame-retardant. (A textile surface containing silver antimicrobial is also an option.) The seating is designed for patient comfort and cleanability in healthcare settings. As opposed to antimicrobial surfaces that it didn't find effective, the CDC report discussed earlier endorses the use of easily cleaned furniture, noting that it "reduces likelihood of disease."

Are Antimicrobials Needed?

At the root of many of the concerns about the safety of antimicrobials, including health problems from exposure and antimicrobial resistance, is the sense that they're not needed. Discussing antimicrobials in carpet, for example, Brennan said, "I don't think it's an advantage in carpet. You get the hazard from all phases of the pesticide and I don't think you get a lot of benefit." He added, "You might just get some benefit from [antimicrobials when] putting carpet on a basement floor," a moisture-prone situation, but, he said, "you don't get kisses for dumb booboos." In other words, a superficial solution to an avoidable problem is misguided.

The danger of infection from building surfaces should also be put in context. As the Kaiser memo points out, quoting an industrial hygiene textbook, "the most common source of infectious agents is the patient's own endogenous flora," or microorganisms within one's own body. The memo notes that these organisms usually don't harm us, and are often beneficial, but when our immune systems are weakened we can become susceptible. Care should be taken to ensure that indoor environmental quality is not needlessly compromised by poor moisture control, for example, but, says the memo, "For environmental surfaces to be a source of infection, typically the patient's immune system must be severely compromised."

We can expect to see more antimicrobials, however. "There's a market for it," said Ron Swindle of Milliken. "There's not always someone there to make sure that everything is spotless and perfectly maintained," said Microban's Swofford, adding, "They [antimicrobials] are a matter of convenience."

Countering those claims, microbiologist Levy said, "To most of us, the potential hazards of use far outcry any potential benefit." The potential for benefit *is* attractive: preventing rampant microbial growth in buildings is a worthy goal. But buyers should beware of products that claim too much, and, based on available evidence, many antimicrobial products may be oversold. If a manufacturer limits claims to protecting its own product, and there is a good reason to do so, it is likely on solid ground. A building product incorporating a pesticide and successfully making and defending a broader public health claim is harder to come by, however.

Asked if, as an industrial hygienist, she would listen to a pitch from a building product manufacturer making a public health claim backed up by studies, Kaiser's Stewart said she would. "I think there is potential," she said. "But we have to look at these claims very carefully to make sure that one solution doesn't create another problem."

– Tristan Roberts

For more information:

Centers for Disease Control and Prevention
"Guidelines for Environmental Infection Control in Health-Care Facilities"
www.cdc.gov/mmwr/preview/mmwrhtml/rr5210a1.htm

Kaiser Permanente
"Evaluation of Antimicrobial Property Claims in Finishes and Fabrics"
www.healthybuilding.net/healthcare/KP_Antimicrobial_Position_Paper.pdf

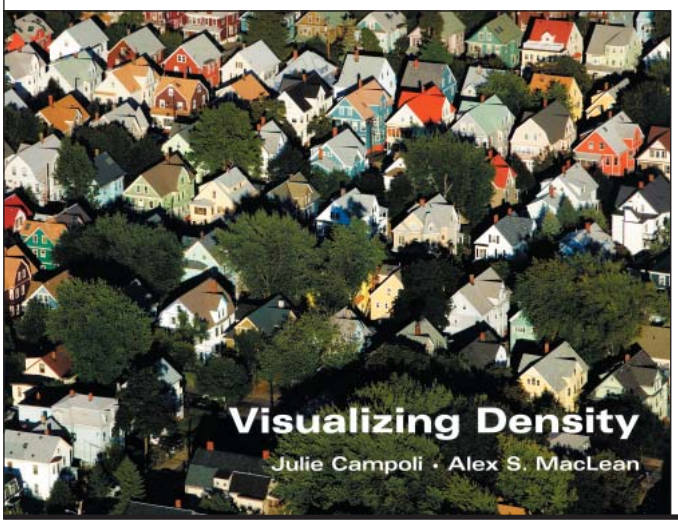
U.S. Environmental Protection Agency
Office of Pesticide Programs
www.epa.gov/pesticides/

From the Library

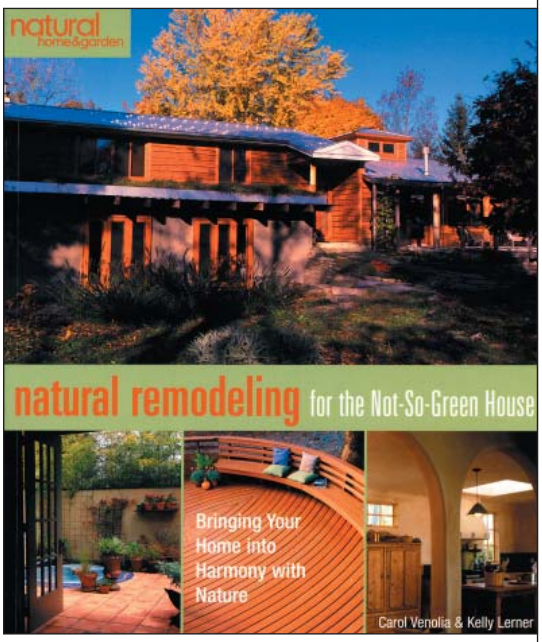
Briefly Noted

Biodiversity Planning and Design: Sustainable Practices (Jack Ahern, Elizabeth Leduc, and Mary Lee York; Island Press, 2006; 136 pages, $25)—Ahern, Leduc, and York look deeply at five landscape designs that promote biodiversity, offering a full case study of each project and an overall discussion of the issues. They find that planning for biodiversity in landscapes is an important goal that should be combined with other goals such as environmental education. Aimed primarily at landscape architects, the book includes a discussion at the end that is both pragmatic and thoughtful, leaving the reader, regardless of profession, with a firm sense of what can be done to protect biodiversity in our landscapes.

Visualizing Density (Julie Campoli and Alex MacLean; Lincoln Institute of Land Policy, 2007; 160 pages, $40)—Campoli, a landscape architect and land planner, and MacLean, an architect and aerial photographer, have created a visual study of housing density throughout the U.S. Starting with an essay on the benefits (and difficulties) of density, the authors explore various types of residential development, from low-density suburban sprawl to high-density, high-rise development. Aerial photographs accompany both the essay and an encyclopedic chapter on density patterns, and the "density catalog" offers pages of photographs organized by the number of units per acre. A companion CD-ROM and website offer readers the opportunity to share these powerful images with land planners, community leaders, and residents, helping make the argument for dense, multiuse development.



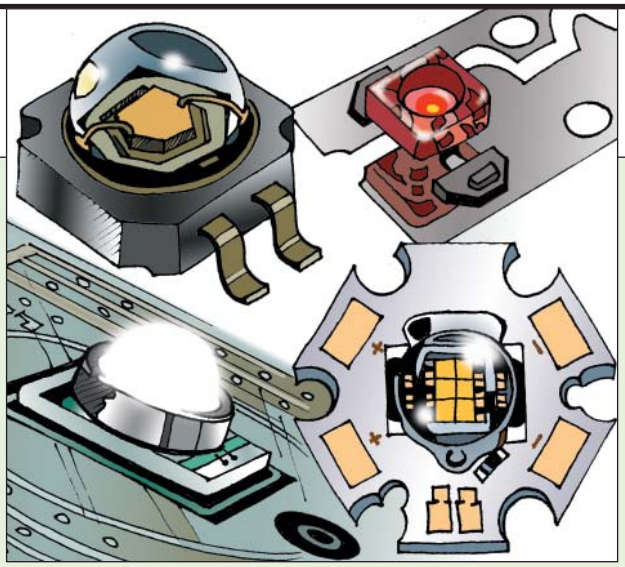
Roadmap for the Integrated Design Process (Busby, Perkins+Will and Stantec Consulting; BC Green Building Roundtable, 2007; 114 pages, free)—Starting with the premise that the integrated design process is necessary to the creation of high-performance buildings, this report approaches the process in two ways. The first part of the report is a summary of integrated design, offering those new to the process an overview of its objectives and benefits. The second part delves deeper, offering more detailed information for each phase of the integrated design process, including the possible roles and responsibilities of each design team member. This part of the guide offers tips for successful charrettes and meetings as well as benchmarks for each phase of the design process. Equally readable by novices and experienced integrated design practitioners, this report can help design teams align their expectations for the design process and provide needed guidance along the way. The report is available for download at www.greenbuildingsbc.com/home/newbuildings.aspx (click on "more resources" and then "other resources").



Natural Remodeling for the Not-So-Green House: Bringing Your Home into Harmony with Nature (Carol Venolia and Kelly Lerner; Lark Books, 2006; 280 pages, $25)—Designed for homeowners wanting to align their homes with their environmental goals, Venolia and Lerner's book is practical, easy to follow, and well illustrated. Going beyond energy efficiency and materials choices, the authors explore the connections between the homeowner, the home, and the ecosystem in which they exist. Several case studies demonstrate concepts and techniques, and possible strategies are divided into "low-hanging fruit" and "more advanced steps" to guide readers through smaller and larger projects.

BackPage Primer

Light-Emitting Diodes:
Chasing White Light



Light-emitting diodes (LEDs) use semi-conducting materials to turn electricity into light; electrons jump from one material to another, emitting photons as they travel. Different semiconductor materials create different colors of light: most white LEDs use indium gallium nitride (InGaN), which actually emits blue light. The blue light excites a phosphor coating on the lens of the diode, creating a yellow light that mixes with the blue and makes it look white to the human eye. Manufacturers also use closely placed red, green, and blue LEDs to deliver white light.

While LEDs use very little electricity, they also produce relatively small amounts of light. This light is highly concentrated and easy to focus, making it effective in some applications, such as task or display lighting. To use LEDs for area or ambient lighting, manufacturers collect multiple LEDs in a single fixture; getting enough output and an attractive color of light, however, has been challenging. Complicating matters, LEDs vary tremendously in quality; inexpensive LED lamps and flashlights tend to have inconsistent color temperature and light output.

When their light is effective, LEDs offer great potential for energy efficiency. Although current LED fixtures average 30–40 lumens per watt (lpw), the Solid-State Lighting Program at the U.S. Department of Energy (DOE) estimates that LED fixtures are capable of achieving an efficacy of 160 lpw. By comparison, incandescent lamps typically produce 10–18 lpw and compact fluorescent lamps (CFLs) 35–60 lpw. LEDs also have the significant advantage of not containing mercury, which is a disposal and breakage hazard in fluorescent and mercury-vapor lamps.

LEDs have long lives; a fixture can last for a projected 35,000–50,000 hours, compared to an incandescent lasting 750–2,000 hours and a CFL lasting 8,000–10,000 hours. In addition, LEDs rarely burn out totally (making them appealing in traffic signals and hard-to-reach locations), but their light output diminishes over time. DOE and industry representatives have defined the "useful life" of an LED as the time span over which it will produce at least 70% of its original light output.

Fixtures containing LEDs are becoming increasingly popular: colored plastic tubes containing LEDs have already widely replaced neon signs in new installations, and LEDs are now used in refrigerated display cases, where their directional light highlights products. LED fixtures for use in under-cabinet lighting and downlighting in living spaces are on their way to becoming cost-effective. As efficacies rise, costs decrease, and manufacturers get better at applying them to a variety of applications, LEDs should become an increasingly attractive option.

For more information:

"Full Line of Residential LED Lighting Arrives"
EBN Vol. 15, No. 7
U.S. Department of Energy Solid-State Lighting Website
www.netl.doe.gov/ssl/

Environmental Building News
122 Birge St., Suite 30 · Brattleboro, VT 05301

0708

A publication of BuildingGreen, Inc. · www.BuildingGreen.com