Men's Health

HEALTH RISKS FROM FLUORESCENT LIGHTBULBS

Uncle Sam's Not-So-Bright Solution

Soon the switch from inefficient incandescent bulbs to power-saving ones like CFLs will be complete, and America will be conserving countless kilowatts of power. So what if a little radiation and mercury are part of the bargain?

By Bryan Smith, Photographs by Claire Benoist

"IT'S NOT ROCKET SCIENCE," MIRIAM RAFAILOVICH, PH.D., is saying, perhaps sensing my distress after she'd peppered me with rapid-fire tech talk at her lab at Long Island's Stony Brook University. "Here, look. You can see it."

She holds up one of those spirally CFLs—compact fluorescent lights, the bulbs that have been crowding out incandescents on store shelves. "There," says the materials engineering researcher. "And there. And, oh my, look at that. Wow."

Sure enough, it doesn't take Stephen Hawking to spot a series of hairline cracks in the coiled glass tubing, along with one hole the size of a small beauty mark. "We found the same thing in every bulb we bought," Rafailovich says.

Last year, Rafailovich's research team at Stony Brook conducted a series of experiments showing that these innocent-looking fissures allowed ultraviolet rays to leak out. And leak not just a little of UV radiation but enough to cause skin damage akin to what a day at the beach sans sunscreen might yield. The UV toll on unshielded eyes could be even worse: You may as well be gazing straight at a solar eclipse, she says.

It's the reason she keeps CFL bulbs far away from her at home, only using them in ceiling fixtures. And more important, it's why she's deeply concerned about a little-discussed but profoundly impactful switch already occurring for U.S. consumers. (You can replace your lightbulbs at home, but **your office is a different story**.)

As Rafailovich speaks, I become keenly aware of the fluorescent light shining on me from the tubes overhead. Such illumination has always seemed a little harsh to me but certainly not harmful—hardly noticeable, in fact. As I soak in what she's telling

me, I flick a glance at the white glow and wonder.

THE UNITED STATES HAD NOT EVEN TURNED 35 WHEN AN English chemist named Humphry Davy made a discovery as profound as the caveman's first flame: He "created" light by connecting two wires to a battery and placing a charcoal strip between the wires. The light glowed white-hot as the juice from the battery flowed through it.

A practical use for Davy's invention would not appear for another 70 years, when Thomas Edison, building on decades of hit-and-miss science, created the modern lightbulb by placing a carbon filament in an oxygen-free glass lamp. Edison's first bulb stayed lit for almost 14 hours-a marvel at the time. Improvements to the discovery, including the replacement of carbon filaments with tungsten, continued through the decades until the bulb lit lamps all over the world. The one nagging problem, however, was that the technology wasted—and still wastes—vast amounts of energy.

And so, on a parallel track with the development of the incandescent bulb, other scientists tinkered with fluorescents. Instead of utilizing a glowing filament, the fluorescent light employs an integrated device called a ballast to produce an electric current that passes through a vapor mix of mercury and argon, exciting the molecules and producing ultraviolet rays. These rays strike the phosphor coating on the bulb, which then gives off visible light. The fluorescent tube as we know it today, the one shining down on cubicles around the world, took far longer to perfect than Edison's famous invention did. But by the 1970s, these lights had not only come of age but also were mostly replacing the less efficient incandescents in stores, offices, workshops, and plants around the country.

The next step was to create a compact version of this tubular light source. It needed to be about the size of a standard incandescent and to fit into the same screw-based socket. Bending the tubes into the now familiar coil shape solved the problem, and the CFL was born.

In recent years, nations around the world, dazzled by the potential energy savings, have begun phasing out inefficient incandescent bulbs. Canada, Australia, and members of the European Union all either have stopped making the old bulbs or plan to stop soon. The United States started its own process in 2007, when Congress passed the Energy Independence and Security Act. After 2011, 100-watt incandescent bulbs were no longer being manufactured. On January 1 of this year, 75-watt bulbs followed suit. In 2014, any remaining inefficient incandescents, 60-watt and 40-watt, will fade to black for good.

CFLs seem superior in virtually every way. Take the energy savings. Replacing the old bulbs with the new ones will reduce consumer energy bills by $ 13 billion a year (or $ 100 per household) and save 30 power plants' worth of energy annually once the law is fully implemented, according to the Natural Resources Defense Council (NRDC). True, CFLs cost a little more up front, but the difference in cost is recouped in energy and longevity savings. A compact fluorescent, for example, can last an estimated 10,000 hours; its traditional incandescent counterpart lasts less than 1,500 hours. According to an estimate from the Arlington Initiative to Reduce Emissions, CFLs can save at least six times their purchase price over a 5-year period.

"If you care about the environment or simply about saving money, CFLs are the superior choice compared with the inefficient incandescent lightbulb," says Noah Horowitz, a senior scientist with the NRDC. "If all the sockets that still have incandescents were converted to CFLs, we could save as much electricity each year as that consumed by all the homes in Texas."

Good for the planet, good for the wallet. What's not to like?

BATHED IN A RED SOLUTION CALLED CELL-GROWTH MEDIA, the human skin tissue cells swimming in the petri dish look as if they've already suffered a sunburn. Rafailovich's research partner at Stony Brook, Tatsiana Mironava, Ph.D., slips the glass dish onto a foil-wrapped box the size of a large toaster and then places the box just under a slinky-shaped CFL shaded by the green glass hood of a standard banker's desk lamp.

It's the same experiment Rafailovich and her team carried out last spring to gauge how much UV radiation was being absorbed by human skin cells and whether any damage resulted. She also measured how long it took to reach the "Threshold Limit Value"—the amount of UV radiation exposure considered safe over an 8-hour period, according to the American Conference of Governmental Industrial Hygienists.

Rafailovich tested cells under nine bulbs purchased randomly at area stores. In each case the bulbs "far exceeded" the threshold, she says. It took one bulb just 42 seconds to reach the amount of UV radiation allotted for an 8-hour period.

"That means that if you sit under that bulb for 8 hours, you're going to get a thousand times more than you can really tolerate," she says.

Indeed, Rafailovich says her study reveals that the response of healthy skin cells to

UV rays emitted from CFLs "is consistent with damage from ultraviolet radiation." As with excessive sun exposure, that could make the cells more susceptible to mutation and even cancer. By contrast, under incandescent light of the same intensity, the skin cells sustained no damage.

The EPA admits that the bulbs emit such rays but says the levels are low and the filtering effect of the glass further minimizes damage for all but the most sensitive skin types. "The vast majority of people do not suffer from such UV or visible light sensitivities," notes the website for Energy Star (a partnership between the EPA and the U.S. Department of Energy), to which an EPA spokesperson referred me when I asked about the bulbs. (The agency didn't respond to any of my further requests for comment.)

Yes, says Rafailovich, in a perfect world—one in which you have a fresh bulb that has not been shipped from Asia, shoved on the store's rack, and handled by a consumer—the EPA is probably correct. "I am sure the bulbs they test when they're just off the assembly line may be perfectly safe," she says. "And maybe that one bulb has been treated gently so the phosphor doesn't crack."

But of the dozens of bulbs the Stony Brook researchers examined, every one had imperfections that allowed ultraviolet radiation to escape. "Most compact fluorescents have cracks in the phosphor coating, probably due to the fact that the coating is brittle and has trouble making the tight bends required to make these bulbs compact," says Mironava.

The long overhead fluorescent tubes that illuminate so many of America's offices and garages pose far less risk: Because they're straight rather than tightly twisted into slinky shapes, far fewer are subject to flaws.

"The take-home message is that CFL bulbs are fragile," Mironava says. "The phosphor coating is easily damaged, and possibly dangerous amounts of UV are being emitted."
In addition to the potential skin damage—which Rafailovich says is "exactly like being in the sun"—looking directly at a CFL can be harmful. Without anything to protect the pupils, the radiation "goes straight to the retina," she says. (**Go here** to see more risks from LED lights.)

She and other experts acknowledge that much of the problem can be solved simply by keeping the CFLs at a distance. But what to do about bedside and living room lamps? "That's the problem," Rafailovich says.

Magda Havas, Ph.D., an associate professor of environmental and resource studies at Trent University in Ontario, agrees that compact fluorescents come with question marks that could conceivably turn into cancer concerns. "There are quite a few concerns," she says. "I'm a staunch environmentalist, but I also care about human health. I wouldn't give one up for the other."

NOT LONG AFTER CFLS BEGAN APPEARING in stores and homes, red flags arose about their mercury content, prompting recommendations to dispose of dead bulbs at special collection locations rather than dumping them in the trash. But supporters of CFLs—which include the EPA and environmental groups like the NRDC, along with government regulatory agencies in Canada, Europe and Australia—say the amount is so minuscule that consumers needn't worry.

"Today's CFLs contain 2 to 3 milligrams of mercury, which is equivalent to the size of a pen point," the NRDC's Horowitz says. What's more, "although incandescents do not contain mercury, they result in much greater amounts of mercury emissions than CFLs." Because CFLs are so much more efficient, they demand far less energy from mercury-spewing power plants than do incandescents. According to a 2010 Energy Star fact sheet, the net lifetime emissions for mercury is higher for incandescent bulbs than for CFLs.

And yet, of the two types of bulbs, it's CFLs that the EPA seems most worried about consumers breaking, even going so far as to issue a 21-step set of instructions for what to do in the event you break one. Start by evacuating the room for 5 to 10 minutes. Then shut off the central forced-air heating/air-conditioning. Gather materials you need for the cleanup, including stiff paper or cardboard, sticky tape, damp paper towels, and a glass jar with a metal lid or sealable plastic bags.

But why all the hazmat-level precautions, especially if the mercury levels are as insignificant as Horowitz claims? Because with an incandescent, a broken bulb makes a mess, but with a CFL, it makes mercury vapors. In a 2012 study, a team of researchers at the Aristotle University of Thessaloniki in Greece found that when a CFL cracks open, harmful levels of mercury vapor—a neurotoxin with numerous potential damaging effects—can linger some 4 hours afterward. "Indoor air concentration of mercury vapor may exceed toxicological thresholds of concern such as the acute Reference Exposure Limit (REL) for mercury vapor set by the Environmental Protection Agency of California," the study authors noted.

"If you clean them up properly, there is no problem, I agree," says Denis Sarigiannis, Ph.D., who led the study. "But what happens if you don't? What happens if you try to clean them up and don't follow the proper procedure?" How

many people are really going to follow all those instructions—and the additional list of proper recycling techniques? The EPA recommends recycling, but if you can't, it suggests sealing the bulbs in a plastic bag and placing them in the trash. That's a lot of trust to put in a plastic bag.

These are concerns shared by Trent University's Havas. "Most people don't know how to clean up the mess, and they often do the wrong thing," she says. "They bring out a vacuum cleaner and use bare hands to pick up the glass shards, and that's about the worst thing you can do." As the EPA points out, vacuuming may spread a cloud of mercury. And touching the glass with your hands can contaminate them with residual mercury—if you put one of those hands in or near your mouth, you're directly ingesting a neurotoxin.

The lack of knowledge isn't simply confined to home users. "I've been in stores where they collect these lightbulbs to be recycled, and I've looked in the bins and found broken bulbs there," Havas says. "I've been told that when the truck comes to pick them up that the handlers just throw the bulbs in the back of the truck."

The problem isn't malice, she says, but ignorance. "They just don't get it. They haven't been educated that the reason these bulbs are being recycled is to prevent the glass from breaking so the mercury can be recaptured."

"That is the real issue," says Sarigiannis. The potential energy savings are great with CFLs, he concedes. "I'm not against that. What I am against is not putting any word of caution on the package. For instance, say, 'If the bulb breaks, make sure you ventilate first.' It's a very simple thing."

IF SIMPLY USING CFLs CARRIES HEALTH RISKS, you can only imagine the peril that's posed to the people who manufacture them. Unfortunately, you don't have to imagine—and neither do they.

Over the past decade, hundreds of workers at lighting factories in China, where most CFLs are made, have suffered mercury poisoning, says a 2009 article in the *Sunday Times* in London. It noted that a medical journal published by China's health ministry "describes [a] compact fluorescent lightbulb factory in Jinzhou, in central China, where 121 out of 123 employees had excessive mercury levels. One man's level was 150 times the accepted standard."

Perhaps it's no surprise that the manufacturers themselves don't seem worried about the dangers—to their workers or to consumers. In fact, even after Rafailovich's research was published online, the following statement appeared in a National Electrical Manufacturers Association press release: "Based on current

knowledge, the levels of UV radiation emitted by CFLs are acceptably low."

More perplexing is the position of the EPA and the NRDC. Why does the government—and what is sometimes one of its most vocal critics—continue to insist that the lamps are safe despite the claims of studies suggesting otherwise? Why is there no push to examine the engineering of the bulbs and redesign them so they don't sustain the kinds of cracks and holes discovered by Rafailovich's team? Could it be that these groups are blinded by the light of nationwide energy savings to the detriment of individual safety?

Havas believes so. "I think they want to justify it because we all want to be environmentally conscious," she says. "I'm an ecologist. I care very much about the environment. I recognize the importance of our carbon footprint. But you don't want to have a technology that is causing harm at the same time. And this is causing harm to people."

When I ask if she uses fluorescent bulbs in her home, the researcher laughs. "Not one," Havas says. She has created a stockpile of incandescents, she says, and will hold out as long as she can. "Until we get a lightbulb that is energy efficient, safe for the environment, and free of adverse health effects, it seems ludicrous to use them."

BACK AT RAFAILOVICH'S LAB, MIRONAVA carefully places the scarred CFLs back into a plastic bag, one by one, and then stores the bag on a shelf. The human tissue cells are still cooking under the banker's lamp like little sunburn victims, to be examined later for possible damage.

The demonstration over, the two scientists take a last look around. Then, as we leave, they turn off the kinder, gentler fluorescent lights that shine down on the work area.

http://www.menshealth.com/health/health-risks-fluorescent-lightbulbs