

The Hidden Environmental Hazards of Compact Fluorescent Lights (CFLs)

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Generally, our articles deal with "big picture" issues related to cleaning and restoration contractors, so some readers may be wondering what compact fluorescent bulbs have to do with our industry. The reality is that cleaning and restoration contractors are increasingly called on to diagnose and resolve health hazards from a variety of environmental concerns including mold, sewage, infectious agents, soot/smoke, and chemicals. In addition, restoration contractors build back damaged homes and commercial buildings to a pre-loss condition and in doing so make many recommendations and choices in regards to the products that are used in such restored structures. Therefore, it is imperative that as leaders in our industry we clearly understand the risks associated CFLs because they are so commonly recommended and installed, yet pose hidden dangers to both cleaning and restoration work crews and building occupants.

A Brief Primer on Compact Fluorescent Bulbs

Because of the emphasis over the last few years on switching from incandescent bulbs to CFLs for energy efficiency, most individuals are familiar with the twisty tube shape of compact fluorescent bulbs. The CFLs are a modern advancement of the traditional fluorescent lights that have been used in commercial structures since the 1940s. The standard fluorescent light has a separate ballast that controls the energy provided to the bulb(s) in that fixture. The compact fluorescent light combines the ballast and bulb into one piece by substituting electronic controls at the base of the bulb for a traditional ballast. As such, CFLs can be screwed into standard light sockets that are not wired to a ballast.

However, compact fluorescent bulbs have some drawbacks even when compared to the traditional fluorescent tubes. The control mechanism on many CFLs must have a steady power source to operate properly and, therefore, cannot be used with dimmer switches. Improper replacement of standard bulbs with compact fluorescent bulbs in lights with dimmer switches has already been documented as the source of a number of serious fires. (Consider the irony, as well as the liability, of a restoration company that specializes in putting burned buildings back together installing the bulb and switch combination that led to a serious fire.)

CFLs are not designed to be turned off and on frequently. The electronic control at the base the bulb is designed for a certain number of on/off cycles, so the lifespan of a CFL may be reduced by up to 85 percent if it is switched off and on frequently. This makes them a poor choice for fixtures that are controlled by motion sensors. Even something as simple as the position of the bulb can dramatically impact its performance and lifespan. Screwing a CFL into a ceiling socket, particularly a can light with limited air circulation, will dramatically reduce its lifespan as the heat from the bulb rises and damages electronics in the base.

The chief advantage of fluorescent over incandescent bulbs, whether traditional or compact fluorescent, is that the lights burn cooler and use less electricity to produce the same amount of light. Still, they have several drawbacks, including higher upfront cost for each bulb, a warm-up time to get to full intensity, and difficulty of operation in cold temperatures. Of primary concern to the cleaning and restoration contractor is that all fluorescent bulbs have some level of mercury in them. Even green tipped bulbs that are considered to be ecologically friendly have mercury, just a smaller amount than the traditional bulbs. In commercial fluorescent tubes the mercury content ranges from 3.5 to 4 milligrams per tube for a low mercury bulb compared to a standard fluorescent bulb with 8 to 14 milligrams of mercury per tube. Despite their smaller size compact fluorescent lights can contain mercury levels as high as 18 milligrams per tube, although the average is around 5 milligrams. Currently the lowest recorded level is 0.9 milligrams of mercury per CFL tube.

Environmental Contaminant and Neurotoxin

The mercury in a fluorescent bulb can be released as both dust and vapor if the light is broken. This heavy metal is dangerous to people and animals and easily migrates through the environment in the air, water, and soil. Mercury is persistent in the food chain and "bio accumulates" in living organisms—meaning that its toxicity level increases as it moves up through the food chain. Numerous media outlets have reported on data taken from a Stanford University research report that indicates that the amount of mercury in one standard CFL "is enough to contaminate up to 6,000 gallons of water beyond safe drinking levels." A separate EPA funded study found that improper disposal of 200 average CFLs (at 5 mg of mercury each) or 71 standard commercial fluorescent tubes (at 14 mg of mercury each) deposited in a 20-acre lake is enough to contaminate the fish and make them unfit to eat.

Breaking the bulbs inside buildings where there is less dilution from outside air makes the situation worse. Measurements have consistently shown that breaking a single bulb in an average sized bedroom can result in mercury vapor levels 300 times higher than the EPA's recommended long-term exposure level. Although the mercury level will dissipate over time, carpeting acts as a trap for the contaminant. This was confirmed by a study conducted by the Maine Department of Environmental Protection which noted that despite following EPA cleanup guidelines their researchers were unable to remove mercury from carpet. Even more sobering was their assessment that later agitation of the carpet, such as by young children playing, created hazardous localized concentrations of mercury in the air close to the carpet—even weeks after the initial breakage.

Proper Cleaning Techniques

These studies on the difficulty of removing residue from broken fluorescent bulbs should give cleaning and restoration contractors pause. Accidental breakage of a fluorescent light, whether a standard tube in a commercial building or a CFL in a house, requires a response from your crew well beyond a broom and dust pan. At a minimum professional restoration contractors should be following the EPA guidelines for cleaning up broken fluorescent bulbs.

The EPA has produced a detailed three-page series of recommendations for the cleanup of fluorescent bulbs, which was updated in January 2011 and can be found at <http://epa.gov/cfl/cflcleanup.pdf>. Admittedly, that document is designed for homeowners rather than professional contractors, but its focus makes it even more important for contractors. Think of the potential liability if a professional cleaning or restoration contractor broke a fluorescent bulb during their work and then did not even follow the EPA cleanup recommendations to which nonprofessionals are supposed to adhere. So what does the Environmental Protection Agency advise in regards to cleaning up broken fluorescent bulbs? Their latest recommendations include such items as:

- Evacuating the area
- Isolating the room where the breakage occurred and shutting off the HVAC system
- Opening windows and leaving them open for several hours after the cleanup as well as opening them and leaving them open during subsequent regular cleaning of the same area
- Throwing away any clothes or bedding that has come in direct contact with the mercury from the bulb as attempts at laundering just spread the contamination
- Scooping up as much debris as possible using cardboard or duct tape
- Sealing glass fragments and dust in a glass jar with a tight fitting lid
- Damp wiping in lieu of vacuuming unless a vacuum is absolutely necessary to pick up residual pieces of glass
- Throwing away the vacuum bag after cleaning the area, and continuing to replace the bag "the next several times" the area where the breakage occurred is vacuumed
- Confirming that all debris, vacuum bags, etc. Are properly recycled as required by federal and state regulations

Even utilizing cleaning methods that are not available to the typical homeowner, such as HEPA vacuums and truck mounted hot water extraction systems, the cleanup of broken fluorescent bulbs poses a dilemma for contractors in regards to the use of personal protective equipment. Because of the fact that the bulb residue is a serious contaminant for people and the environment, it is my recommendation that contractors require the use of suits and respirators for such cleanups. It is important to remember that an N-100 filtering face piece, which is so common for work in the cleaning and restoration industry, would *not* be adequate protection for cleaning up fluorescent bulbs as special respirator filters are necessary to trap mercury vapor.

An Ongoing Debate about Rules and Regulations

There has been a push to move to fluorescent lights as a way to save energy, to the point that many countries have passed laws that limit or ban incandescent light bulbs. The United States and Canada followed many European nations with rules that are leading to the phase out of incandescent bulbs from last year (2012) to 2014. However, concerns about environmental pollution from broken fluorescent bulbs in homes and bulbs improperly disposed of in landfills have caused one country, New Zealand, to backtrack on its push toward CFLs. Multiple bills have been passed in the U.S. House of Representatives to adjust the standards to allow market

forces to determine if incandescent bulbs should be replaced. The rationale for these bills always notes numerous drawbacks to compact fluorescent lights, including some of the pollution and cleanup issues discussed above. Because of the current political make-up of the Senate, the House bills are never adopted as law, and as a practical consequence higher wattage incandescent bulbs are becoming harder and harder to find at your local grocery and big box stores.

Another concern listed by the representatives urging a reassessment of CFLs was a warning that the compact bulbs can overheat and smoke. Although not detailed in the Congressional press release this hazard that often occurs toward the end of the bulb's service life is significant from a health as well as a safety standpoint. The fire danger of certain types of CFL bulbs is magnified because as they degrade bulbs without an internal fuse will melt or smoke until power is turned off. Numerous studies have shown that as CFLs overheat when they are reaching a burnout stage they create an acrid plastic-smelling smoke that contains a number of carcinogens. Even more alarming are the recent studies (including a carefully controlled study in England released in April of this year) that point toward many CFLs releasing small amounts of nasty chemicals such as phenol, naphthalene, and styrene every time they are switched on. With cleaning and restoration professionals handling more and more indoor air quality cases and dealing with sensitized individuals, recommending or utilizing products that can be contributing to poor air quality rather than improving it can have serious consequences.

More Reasons for Concern

There are at least two other health concerns with CFLs of which cleaning and restoration contractors should be aware. When light is produced in both incandescent bulbs and compact fluorescent bulbs it is emitted over a range of frequencies that span the visible as well as invisible spectrums; therefore, both types of bulbs are known to emit ultraviolet rays (UV) as well as visible light. However, there is significant medical concern that CFLs produce more UV rays than other types of lights, particularly as they age. Several years ago the British Health Protection Agency (HPA) cautioned that CFLs emit UV radiation that is beyond acceptable safety levels. They explain that tube fluorescent bulbs have diffusers that filter the UV radiation. Compact fluorescent light bulbs do not have these diffusers; hence, people using CFLs are exposed to UV radiation.

For this reason people with certain health conditions can be harmed by prolonged or close exposure to CFLs. Reactions have been reported to range from disabling eczema-like reactions, to light sensitivities that can increase the risk of skin cancer. In fact, Health Canada, the Canadian equivalent of OSHA, released a report on CFLs that stated:

Although the amount of UV emitted by CFLs poses no problem for the average person, some people are extremely sensitive to UV and may be affected by the amount of UV produced by CFLs. Those who have Lupus or another auto-immune disease and certain skin conditions can be sensitive to the UV from CFLs, in the same way they would be sensitive to sunlight and other light bulbs that emit UV. If

you believe you are suffering from symptoms related to UV, you should consult your health care provider.

The report went on to mimic recommendations made by other European countries such as Sweden and Switzerland which advise individuals to stay at least 12 inches away from CFLs when they are operating. Health Canada goes on to warn that if bulbs are closer than 12 inches exposure should be limited to no more than three consecutive hours.

Ultraviolet radiation is not the only byproduct of CFLs. The bulbs produce both electric and magnetic fields (EMFs), as all electrical appliances do. A March 2010 Swiss study, undertaken for the Federal Offices of Health and Energy, found that EMFs from CFLs can induce electric currents in the body, which, above a certain frequency, can stimulate the nerves and muscles. This data matches with previous Swedish studies that reported a significant percentage of the population exposed to greater EMFs reported symptoms ranging from joint stiffness, chronic fatigue, headaches, tinnitus, problems related to respiratory, gastric, skin, sleep and memory, to depressive tendencies, to Alzheimer's disease.

Finally, it should also be noted that all fluorescent bulbs, whether traditional or compact, produce light that flickers. Fluorescent bulbs are designed to emit this flickering light in frequencies that are beyond those detectable by the normal human eye. Still, in some cases the flicker in the lighting caused by deteriorating ballasts, bulbs, or controls on CFLs creates a hum that can be heard or variations in light intensity that can be seen. These problems quickly lead to eye strain, headache, and more serious problems; but even if the CFL is operating properly many individuals have reported that they and/or their pets were bothered by them. This is likely due to the fact that the CFLs operate at frequencies at which the flickering is visible than do traditional fluorescent bulbs. Therefore, animals and people with sensitive eyes can be adversely affected, with reports of health effects such as headaches and depression from the use of CFLs.

What Does It All Mean?

For cleaning and restoration contractors the introduction of new materials, processes, and equipment need to be evaluated for their impact on the safety and health of both work crews and clients. The use of compact fluorescent bulbs as recommended replacements during restoration work should be subject to that same scrutiny in order to avoid problems later on down the road. At a minimum, professional contractors should understand the immediate health risk associated with improperly installed CFLs and broken bulbs. They should add the appropriate safety equipment to their inventory (respirator filters that screen out mercury vapor), as well as detailed cleanup procedures for any fluorescent bulbs that need to be addressed as part of the restoration process or that are broken by employees during work. In the long run, the many environmental hazards associated with CFLs might mean that a different type of energy efficient bulb may end up in the long run dominating the market, reducing the risk to contractors and occupants alike.