COMPACT FLUORESCENT LIGHT BULB ENVIRONMENTAL, HEALTH AND POWER ISSUES

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Compact fluorescent lamps (CFLs) are about five times more efficient than tungsten incandescent lamps at turning electrical power into light. This has resulted in support for replacing common incandescent lamps with CFLs to save energy and reduce the lighting footprint. CFLs produce light when an electric current is driven through a tube containing argon and a small amount of mercury vapor to generate an invisible ultraviolet light that excites a fluorescent coating (the phosphor) on the inside of the tube, which then emits longer wavelength visible light. Over time, however, there have been a number of issues that have been raised regarding the use of CFLs. This paper will briefly describe some of these issues and also address potential solutions for those issues.

Issue 1: Mercury

Typically, CFLs contain approximately 4 mg of mercury, which is a cumulative poison. If not disposed of properly, they can end up in landfills where breakage is almost inevitable, releasing their mercury and toxic phosphors and creating high local concentrations with the potential to contaminate water supplies. In an office or home, a bulb may also be broken and release mercury vapor and phosphors into the surrounding air. Toxic effects may include damage to the brain, kidney, and lungs with symptoms ranging from sensory impairment (vision, hearing, speech) to disturbed sensation and lack of coordination.

Issue 2: Strobing or Pulsing

Fluorescent lamps run on alternating current. They also need a pulse of high voltage and heated filaments at either end to start the electrical discharge that lights them. After that, the current must be limited externally, otherwise high flow volume would burn them out. Once started, the current flows through the tube as a smooth sine wave at 50 Hz in Europe and 60 Hz in America. This makes the light flash on and off with each half cycle (i.e. 100 or 120 times a second). To reduce the strobing effect, some CFLs incorporate a *switched-mode power supply* in the base of the lamp that rectifies the AC from the mains to convert it to DC and then chops it electronically into a series of sharp rectangular alternating pulses, which then light the lamp. The new frequency is usually about 40 kHz and the gaps between pulses are extremely short such that the relatively slow response of the phosphors can fill them to reduce strobing or pulsing.

Some symptoms from strobing or pulsing have been recorded to include dizziness, nausea, tinnitus (ringing or buzzing in the ears), headaches and various skin disorders. Strobing and pulsing can also aggravate the conditions of many sufferers of ADHD, migraines and epilepsy.

Issue 3: Light Spectrum

The color of a lamp’s light is usually described by its color temperature, the temperature to which a metal would have to be heated to produce that specific color. For example, a “warm” white lamp has a color temperature of around 2700 degrees Kelvin (Celsius + 273), whereas natural noon daylight is somewhere between 5000° and 6000°K. The ability to match colors under a specific light results in a color rendering index, with daylight being rated at 100. CFLs typically do not have a high color rendering index and the quality of the light is not full spectrum. Full spectrum light is often attributed to better color rendition, whereby colors such as purple actually look purple, making it desirable in salons and retail stores.

Issue 4: Low Power Factor

Power Factor is defined as the ratio of real (working) power to apparent (total) power. As the power factor approaches 1, or 100% working power, the reactive (nonworking) power approaches 0. Reactive power must be released in some way other than the real work of the load. Typically reactive power is released as heat and electromagnetic radiation. A power factor of 1 or "unity power factor" is the goal of any electric utility company because if the power factor is less than 1, they have to supply more current to the user for the same amount of work. In so doing, they incur more line losses and the load as well as the wiring must compensate for the release of the reactive power through heat or radiation. Poor quality CFLs often have very low power factor that allows pulses to leak back into the mains wiring and contribute to "dirty electricity". This can influence the power factor of the electricity throughout the entire system. These CFLs typically have a power factor range of 40% to 60% (0.40 to 0.60). Low power factor CFLs must also use more mercury to excite the phosphors, so accordingly, higher power factor means less mercury usage and more electricity delivered to the lamp to be converted into light. This also means CFLs with high power factor use less electricity overall, produce less heat and release less radiation due to this higher efficiency.

Issue 5: Electromagnetic Radiation and Electrosensitivity

The pulses created by CFLs with low power factor also contain harmonics (multiples of the original frequency) that can extend well into the radio frequency spectrum, consisting of hundreds of sharp spikes up to hundreds of millivolts high, superimposed on each cycle of the 120 volt mains supply. These sharp magnetic spikes can penetrate deep into the human body, generating electrical voltages proportional to their rate of change. The rapid rise and fall times of these magnetic pulses can give relatively massive and potentially damaging voltage spikes both in living cells and across their membranes.

People who are affected negatively by weak electromagnetic fields in this way are described as being electrosensitive, or as suffering from electromagnetic hypersensitivity. The symptoms of electrosensitivity are many and varied and not everyone suffers in the same way or to the same degree. Some of the effects are on the brain and nervous system and often become apparent

Issue 5: continued

during or shortly after exposure. Potential symptoms include dizziness, tinnitus, pins and needles, sensations of burning, numbness, fatigue and headaches. Longer-term effects include skin disorders, digestive tract problems and an increased tendency to allergies and multiple chemical sensitivities.

The Satic Solution:

Satic has addressed these CFL-related issues by developing a series of exceptional lighting products using Satic's proprietary full-spectrum quantum photon technology and superior ballast design. The marriage of these two technologies creates an unprecedented eco-lighting system that has the following advantages:

- Longer life compared to any other half-bridge fluorescent lamps, greatly reducing replacement costs and landfill
- Power factor between 92% and 95% (0.92 and 0.95) according to independent 3rd party evaluations, which means less heat and greater efficiency
- Less mercury content due to high efficiency and high power factor
- Simulated "natural" light, increasing spectrum density for true bright light and natural color rendering, with a color temperature above 5000°K
- No flicker, pulse or strobe, resulting in less distraction, fatigue, eye strain and headaches due to an advanced ballast design
- Total harmonic distortion of less than 3%, creating a sinusoidal waveform that does not leak harmonics or lower the power factor of other circuits and electrical services
- Sound rated A for silent, buzz-free operation
- High reliability factors exceeding 99.9%
- Less energy consumption - up to 85% more energy efficient than incandescent lamps and up to 45% more energy efficient than standard magnetic ballasts

Contact Information:

For more information on the Satic lighting products or Satic's line of Global Energy Saver solutions, please contact:

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References:

B.C. Hydro. Power Factor. The GEM Series. October 1989.

Brown, Jerrod. Satic Pulse CFL Lamps: 3rd Party Power Verification. Eco JAB Enterprises, 2011

Goldsworthy, Andrew. Compact Fluorescent Lamps (CFLs) - What you need to know about low energy lighting. 2008 http://www.mastsanity.org/index.php?option=com_content&task=view&id=233&Itemid=1

U. S. Department of Energy. Motor Challenge Sourcebook. 1996 Edition.