FLUORESCENT LAMPS AND THEIR ALTERNATIVE

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Abstract: Artificial lighting systems are undergoing transitions these days. Suitable light sources must be chosen in households and other dwelling places. Proper choice is important, as many criteria must be taken into consideration. Although Compact Fluorescent Lamps (CFLs) and Light - Emitting Diode (LED) Lamps are more energy-efficient than incandescent lamps (ILs), they have some risk factors for environment and people. The lack of disposal mechanism of the discarded and used-up lamps is another matter of concern, which needs urgent attention.

Index terms: Fluorescent Lamps; Compact Fluorescent Lamps; Light - Emitting Diode

Introduction

Lighting is very important whether it be any type of house, apartment, or any other building, and it costs a significant share of total electricity consumption. Requirements of lighting differ and also different light sources have different light properties. Therefore, choosing suitable light sources is very important. Artificial lighting systems are moving from incandescent lamps (ILs) to compact fluorescent lamps (CFLs) and recently to Light - Emitting Diode (LED) lamps. Each have its own peculiarities, advantages and disadvantages. While taking into account which should be chosen, many criteria should be considered. These are, environmental and personal safety, sustainability, expense, efficiency, quality, waste disposal, and the like. In addition to enhancing energy efficiency, conservation and sustainability policies should focus on the development of technologies that will reduce hazardous ingredients or components in lighting products without compromising their performance and useful lifespan (Lim et al.2013). In this paper mainly a discussion about the fluorescent lamps in general, Compact Fluorescent Lamps (CFLs) and its alternative, the Light - Emitting Diode (LED) lamps is taken up.

Fluorescent Lamps

Since their inception in 1930s, fluorescent lamps have found to gain popularity in offices, schools and large industries, but not in domestic areas because of their huge dimensions (Bouwknegt, 1982). Later on, size reduction of these lamps resulted in the widespread use of popular CFLs almost in all settings including domestic areas. Fluorescent and other mercury-containing lamps are generally much more energy efficient and longer lasting than incandescent and other equivalent forms of lighting. Compact fluorescent lamps (CFLs) help in power-saving. But their mercury content damages the environment and human health if broken lamps are not properly disposed. It is well known that mercury is a very potent neuro, nephro- and immunotoxic substance which provides no physiological benefit (Bose-O'Reilly et al. 2010). Mercury is essential to a fluorescent bulb's ability to emit light. Mercury containing lamps other than CFLs are, HID lamps, metal halide lamps, ceramic metal halide lamps, high-pressure sodium lamps, mercury vapour lamps, neon lights, and mercury capillary lamps widely used in the silk-screen process, CD/DVD printing and replication, medical manufacturing, bottle or cup decorating, and coating applications.

Cold cathode fluorescent lamps (CCFLs)are a variation on fluorescent tubes but have a small diameter which are used for backlighting in liquid crystal displays (LCDs) for a wide range of electronic equipment, including computers, flat-screen TVs, cameras, camcorders, cash registers, digital projectors, copiers and fax machines. They are also used for backlighting instrument panels and entertainment systems in automobiles. CCFLs operate at a much higher voltage than conventional fluorescent lamps and so there is no need for heating the electrodes. Mercury content is similar to that of other fluorescent lamps. LED lighting that contain no mercury are becoming available at prices that can compete with CFLs which is a good alternative for the latter (Bell et al. 2014).

Compact Fluorescent Lamps (CFL)

Compact Fluorescent Lamps (CFL) typically consists of a glass tube filled with low- pressure mercury vapour and inert gases, such as argon and krypton, and phosphour coating on the inside wall of the tube, an electronic ballast, and a metal end (Li and Jin, 2011). Fluorescent lamps use mainly mercury as the source of ultraviolet radiation for the production of visible light. The excited mercury atoms produce short-wave ultraviolet light, which then causes phosphour to fluoresce, producing visible light.The CFLs rapidly replaced the traditional incandescent bulbs.

Reports on neuro behavioural and other health hazards in fluorescent lamp factory workers are also there (Abdel-Rasul et al. 2013). CFL manufacturing factory workers may have mercury bio- accumulation from occupational exposure (Liang et al. 2015) and consumption of locally grown rice, as reported from China. Mercury content of Compact fluorescent lamps (CFLs) varies with manufacturers and brands, and also differs in different countries (Li and Jin 2011). Indian CFLs are quite high in their mercury content, the average per unit being 21.21 mg. In the European Union, it is restricted to 5 mg. Indian market has a potential to produce 400-500 million pieces of CFLs per annum and about 8.5 tonnes of mercury leach into environment from CFL bulbs in India (Toxics Link 2011).

CFL Waste Disposal – The major issue

Careless dumping and accidental breakage of CFLs released enormous amount of mercury both indoor and outdoor and posed a serious issue (Salthammer et al. 2012). Energy saving CFLs are now posing an alarming risk due to its unethical disposal in the environment. The spent fluorescent lamps will eventually break and release the contained mercury into the solid waste stream and the environment. Broken CFLs if not properly handled, will contaminate the soil in and around the dumping site and then proceed to other ecosystems. It is estimated that one-third of the mercury release occurs during the first eight hours of breakage (Aucott et al. 2003). According to the same authors, discarded bulbs could release 3-8 mg of mercury over two weeks, and therefore tons of mercury could be released to the environment from millions of CFLs discarded carelessly. Broken CFLs if not properly handled can contaminate the soil in and around the waste dumping site, further proceeding to other ecosystems (Harikumar et al. 2011)

Light - Emitting Diode (LED) lamps

Now LED light sources are much preferred in homes and offices because of their luminous efficiency and many other positive features, and has almost replaced incandescent bulbs and fluorescent lamps in most parts of the world. The LED lamps offer a different solution to the direct conversion of electrical energy into visible light (Di Mauro et al. 2017). There are different types of LED lamps, depending on the chemical components that are used. For example, gallium arsenide, gallium phosphide and the like. The choice of the type of semiconductor determines the light intensity produced (Lim et al.2013). The constant improvement of the LED technology has produced dramatic increases in terms of luminous efficiency, emission spectrum, intensity, lifetime, cost, and reliability. Their popularity is due to their good performances, enhanced energy savings in comparison to incandescent lamps, easy control of brightness and colour, and a long lifetime. The exploitation of the light emitting diode (LED) into the development of bulb lamps will considerably reduce the energy consumption and therefore ensures sustainable development. The LED lamps offer best electrical characteristics and photometric performances compared to those of the CFL ones. This is because of lower harmonic distortion into the mains and the good behaviour in case of varying voltage on the supply source. LED lamps also have other advantages as these do not contain toxic substances, like mercury, and therefore do not represent critical environmental problems. If higher cost is brought down, LED lamps are the best. In large-scale industrial facilities LED lighting products lowers the maintenance costs (Mauro and Raciti,2014).

Discussion and Conclusion

Although CFLs and LEDs are more energy-efficient than incandescent bulbs, they have more metal-containing components, which is a risk factor for adverse environmental impacts, especially with regard to their disposal after the end of their useful life (Lim et al.2013). According to these authors, both CFL and LED bulbs are hazardous, due to excessive levels of lead (Pb), copper and zinc. The incandescent bulb is not reported hazardous. The former two have higher resource depletion and toxicity potentials than the latter, but have higher life span. High mercury and other metal content of compact fluorescent lamps (CFLs) can cause havoc to the environment and human health when manufactured, broken, or disposed carelessly (Aucott et al. 2003; Abdel-Rasul et al. 2013; Liang et al. 2015). Study by Toxics Link, New Delhi, suggests that Government initiatives should be there to regulate mercury content of CFLs and mercury management at manufacturer and consumer levels. The lack of disposal mechanism of the discarded and used-up lamps is a matter of concern. Therefore, a lamp recycling unit (LRU), for the environmentally sound collection and transport, treatment, recycling and disposal of used CFLs from the consumers, may be set up. The Bureau of Indian Standards (BIS) may formulate the standards for mercury consumption and dosing. The consumer instead of throwing used lamps in the general trash, must hand them over in a properly packed manner to an individual or a collection agency (Toxics Link, 2011). Light Emitting Diode (LED) that contain no mercury are becoming available at prices that can compete with CFLs which is a good alternative for the latter (Bell et al. 2014).

CFLs, though help in power-saving, their mercury and other hazardous metal components can cause havoc to the environment and human health. Initiatives to put a limit to mercury dosing in Indian CFLs, environmentally sound mercury management at the manufacturer and consumer levels and proper disposal of spent lamps at the government level may be made. LED may be popularised instead of CFL.

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