

Selection of Lighting System and Environment

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Abstract. Illumination sector shares nearly 30 % of total energy utilized in commercial, industrial and household. Inefficient and improper placement of lighting system results excessive energy consumption, air pollution and enormous discharge of carbon dioxide leading to global temperature rise and destruction to ecological systems. The conventional bulbs produce 90% of heat and large amount of carbon lighting by just one percent would eliminate the need for an average-sized power plant. Because 70% of electricity is produced from coal fired power plants and wastage of energy as heat contributes a lot to global warming. Reducing the electricity used for lighting by just one percent would eliminate the need of an average-sized power plant. With growing concern about climate change, governments around the world are looking for ways to reduce greenhouse gases and to reduce consumption of fossil fuels. One simple solution that has gained government support is phasing out energy inefficient light bulbs and replacing them with energy efficient ones. Keeping this in mind, in this paper, common lighting systems such as incandescent bulbs, fluorescent tubes and LED tubes are compared and their impact on environment is discussed. The comparison of lighting system is done on the basis of efficiency, lifetime, capacity, mercury emission, toxic material emission and their dispose off after usage. The paper discusses the importance of energy efficient use of lighting system while other aspects related to environment are also discussed.

Keywords: *Lighting, LED, CFL, Bulbs, Environment, Mercury Emission*

1. INTRODUCTION

Illumination system shares a major portion of the total loads in a home, office and building etc. Lighting accounts for a significant portion of the electricity used in the any country. In commercial buildings, about 30 percent of the total energy bill is for lighting, and in homes, about ten percent. Most of the artificial light, especially in residences, is produced by incandescent light bulbs, using the same technology developed in 1879 by Thomas Edison. These bulbs are surprisingly inefficient, converting up to 90 percent of the electricity into heat instead of light. If the country start using new lighting technologies, the electricity consumed to produce light would be reduced by 70 percent. This would reduce carbon dioxide emissions equivalent to removing one-third of the nation's cars (43 million) from the highways. Reducing the electricity used for lighting by just one percent would eliminate the need for an average-sized power plant. The conventional bulbs

produce 90% of heat and large amount of carbon dioxide. Because 70% of electricity is produced from coal fired power plants and wastage of energy as heat contributes a lot to global warming.

The accumulation of carbon dioxide is occurring at a rate more rapid than our planet's ecological systems can absorb. The planet's continual cycling absorption systems are overloaded with excessive carbon dioxide produced as a combustion by-product in all our modern energy demands. Each of us in dimmed consciousness has ignored global warming being amassed by our energy consumption. The results of inefficient and excessive energy consumption has been predicted by visionaries and scientists for over 50 years, but the symptom of global warming is now known to be occurring even more rapidly than was predicted. Our consumption of energy/electricity through inefficient energy appliances and lighting our business and homes, foster all forms of air pollution and enormous discharges of carbon dioxide leading to global temperature rise and the destruction of so many ecological systems already underway.

With growing concern about climate change, governments around the world are looking for ways to reduce greenhouse gases and to reduce consumption of fossil fuels. One simple solution that has gained government support is phasing out energy *inefficient* light bulbs and replacing them with energy *efficient* ones.

Keeping this in mind, in this paper the most commonly used lighting facilities and their impact on environment are discussed.

2. COMMONLY USED LIGHTING FACILITIES

(i) Incandescent Bulbs

Incandescent bulbs produce light by passing electricity through a wire inside the bulb. This wire is called a filament. When electricity flows through the wire, it gets very hot and glows, producing light. Incandescent bulbs use 90 percent of the electricity to produce heat and only ten percent to produce light. They are very inefficient in their use of energy. Therefore there is need of adapting some other alternatives for lighting purposes.

(ii) Fluorescent Lights

In fluorescent bulbs light is produced by passing electricity through a gas inside the bulb. The electrons in the gas molecules become more energetic and some escape. They bounce around and crash into the walls of the tube. The walls are painted with a special material that gives off light when the electrons hit it. The lumen efficiency of these bulbs is 60-70 lumens/watt.

(iii) Compact Fluorescent Lamps

These are extension of fluorescent lights and known as compact fluorescent lights (CFLs). These are four times as efficient as incandescent bulbs and last up to 13 times longer. Over the life of the bulbs, CFLs cost the average consumer less than half the cost of traditional incandescent bulbs for the same amount of light. In addition, CFLs produce very little heat, reducing the need for air conditioning in warm weather.

(iv) LED Lights

These days LED lights are introduced in the market. LED's are efficient and can save as large as 90% of the Energy spent by traditional Incandescent tubes/bulbs. LED is the most efficient since it completes almost all of the electrical energy into Light and very minimal amount of energy is dissipated. However a traditional light bulb spends more energy in heating than emitting light.

3. COMPARISON OF BULBS, CFL AND LED LIGHTS AND ENVIRONMENTAL ISSUES

As it is clear the energy conserved is energy generated because in India the maximum power demand is met from coal fired power plants. Which it self affects the environment very much and a source of carbon emission. To limit this, it is important to consider energy efficient, environment friendly lighting facilities.

The use of incandescent (filament burning) light bulbs is outdated and even in some countries like U.K it is totally banned from 2010. In these bulbs much of their energy consumed goes in heating a filament rather than producing light. Nine of these 100watt incandescent light bulbs glowing 8 hours per day for one year use approximately 2142 pounds of coal. The by-products of the coal combustion for their light produce 15 pounds of sulphur dioxide mixing in our planet's atmosphere that result in acid rain. A large quantity of 15.3 pounds of nitrogen oxide is also released which causes smog and acid rain. Nine incandescent filament-burning bulbs discharge 5556 pounds of carbon dioxide gases into atmosphere from the coal combusted for lighting these bulbs. These bulbs not only excessively heat their filaments in a poor ratio of energy to light, but they also heat up our planet by requiring four times more coal burning than other lighting technology available now.

These day's incandescent bulbs are replaced with CFL. Replacing one 100-watt incandescent with a CFL can save 600 pounds of coal reduce carbon dioxide emissions by 1,020 pounds; sulphur dioxide emissions by four pounds; nitrous oxide emissions by three pounds and mercury emissions by 40%. Compact florescent light bulbs (CFL's) are four times more efficient. They use one-fourth

the coal to produce the same light. They convert 75% of the electrical energy they use to light in contrast to filament heating in an incandescent bulb. Nine 100watt CFL's, for eight hours per day over a one year period, require only 538 pounds of coal to be burned, in contrast to 2142 pounds for the same wattage in nine 100watt incandescent bulbs. Only 3.75 lbs of sulfur and nitrogen oxide are released for the CFL's. Most critical to global warming is that these nine CFL bulbs reduce the amount of coal burned by 1604 pounds and that amount of coal's combustion byproduct, carbon dioxide, by 4167 lbs. Each household utilizing nine, 100watt CFL lights, for 8 hours per day for one year, reduces three quarter of a ton of coal burning annually and well-over two tons of the carbon dioxide emissions per year that is warming our planet so rapidly.

Economically, CFL's last 10-11 times longer than incandescent filament bulbs. (Incandescent bulbs have a lifespan that averages 750 hours, CFL's average 8000 hours) As consumers we may mindfully purchase technology that reduces damaging effects on our bodies, all life bodies and the planetary body, save natural resources because they last long, and save us money.

Lumens Comparison

The output lumens available are as

60 watts Incandescent = 20 watts CFL = 3.5 watts LED

Lifetime

The lifetime of an LED bulb is nearly 50, 000 hours (~6 years), when run continuously. This is insanely great as compared to 8,000 hours of CFLs and 1200 hours of Incandescent bulbs.

Time to Reach maximum Light

LEDs are instantaneous, taking only nano seconds. Incandescent takes order of 2-5 seconds. CFLs are slowest, taking upto 30 seconds to emit maximum lumens of energy.

Mercury Emission

Mercury is an element found naturally in the environment. Mercury emissions in the air can come from both natural and man-made sources. Utility power plants (mainly coal-fired) are the primary source of mercury that naturally exists in coal and is released into the air when coal is burned to make electricity. Coal-fired power generation accounts for roughly 40% of the mercury emissions in the some countries even in U.S and India.

Mercury is an essential ingredient for most energy efficient lighting products, including CFLs. It is the mercury that excites phosphors in a CFL, causing them to glow and give light. When electric current passes through mercury vapor, the mercury emits ultraviolet energy. When this ultraviolet

energy passes through the phosphor coating, it produces light very efficiently. Because mercury is consumed during lamp operation, a certain amount is necessary to produce light and achieve long lamp life.

The amount of mercury in the most popular and widely used in CFLs is minimal, ranging between 2.3 mg and 3.5 mg. That is lower than other CFLs on the market, which generally contain approximately 5 mg, roughly the equivalent of the tip of a ballpoint pen. No mercury is released when the bulbs are in use and they pose no danger to you or your family when used properly. By comparison, older home thermometers contain 500 milligrams of mercury and many manual thermostats contain up to 3000 milligrams. It would take between 100 and 665 CFLs to equal those amounts. CFLs are responsible for less mercury than standard incandescent light bulbs, and actually work to prevent mercury from entering air, where it most affects our health. The mercury in a CFL is no threat to the environment unless the glass is broken. The highest source of mercury in air comes from burning fossil fuels such as coal, the most common fuel used in India to produce electricity. A CFL uses up to 75% less energy than an incandescent light bulb and lasts up to 10 times longer. A power plant will emit 10mg of mercury to produce the electricity to run an incandescent bulb compared to only 2.4mg of mercury to run a CFL for the same time.

Toxic material

LEDs and CFLs are both environmental friendly as they do not have mercury.

Carbondioxide Emissions

Lower energy consumption decreases CO₂ emissions and hence LEDs do 451 pounds/year, CFLs 1051 pounds/year, and Incandescent does 4500 pounds/year.

Disposal of Lighting Facilities and its Affect on Environment

However, when mercury emissions deposit into lakes and oceans, they can transform into a highly toxic form that builds up in fish. Fish consumption is the most common pathway for human exposure to mercury. Pregnant women and young children are most vulnerable to the effects of this type of mercury exposure.

Because of the mercury, it is preferred and better for the environment to recycle CFLs. Never burn or incinerate CFLs (or any mercury or plastic containing materials). CFLs may be disposed in with the household trash.

Incandescent light bulbs contain lead at levels that exceed hazardous waste limits and are regulated as hazardous wastes because they contain toxic heavy metals. These bulbs are not yet recyclable, and burning or dumping them in landfills releases toxic elements that contaminate the environment. As the bulbs burn out and phase out, the amount of incandescent bulbs that require proper disposal grows. People are encouraged to safely store incandescent bulbs according to hazardous waste regulations to keep them in tact and out of landfills. While there is no such problem is with disposal of the LED lights.

4. CONCLUSIONS

The use of energy efficient lighting reduces the amount of coal, oil, and gas burned in power plants, as well as the amount of air pollutants released from power plants. Mercury is a common pollutant emitted from power plants burning coal, oil, or gas. High efficient LED/fluorescent lamps result energy savings. It is better to replace incandescent lamps or older fluorescent lamps with new LED lights which may require higher investment but finally results net reduction in mercury emissions and other pollutants which are adversely affecting the environment.

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