

An Overview of Recent Trends in Lighting Technology

Akash Gowda LV¹, Ashwini M¹,

Chandan G¹, Sindhu V¹

¹UG Scholars

Department Of Electrical Engineering University
Visvesvaraya College Of Engineering Bangalore University
K.R.Circle, Bengaluru-563101

Maheshan C M²

²Assistant Professor Department Of Electrical
Engineering

University Visvesvaraya College of Engineering Bangalore
University

K.R.Circle, Bengaluru-563101

Abstract -This paper presents an overview of recent advances and trends in indoor as well as outdoor lighting technology. Energy efficient lighting and its conservation is more concern in recent years. This can be achieved through the usage of energy efficient lamps at home, schools, colleges, hospitals, research organizations, businesses and public places. In this paper an overview of different types of bulbs used at different places is discussed with respect to wattage, lumen, lux, efficacy, lifespan, color rendering index. The implication of this study reveals to use energy efficient lighting to save energy as well as save environment.

Keywords—Lumen, Lux, Life span, Wattage, efficacy , CRI, Efficiency, Optical Characteristics

I. INTRODUCTION

Lighting or brightening depicts the manner in which a region is made known to the natural eye through either common or counterfeit light. Regular light radiates either from the sun, stars or fire. The force of these sources shifts as indicated by the hour of day and the area. Right now counterfeit light sources can be utilized as an enhancement or substitution of common light.

Counterfeit light is comprised of trend setting innovation that takes after regular light (daylight). It has changed human culture. It liberates us from obscurity and permits us to light our homes and networks. Counterfeit light is commonly handily controlled to accomplish the necessary lighting result. The light can be expanded or diminished, coordinated, engaged and shaded. This permits lighting to make a scope of impacts as indicated by the necessities of a space. The lighting framework has a significant effect on the light quality and lighting vitality utilization. Ordinarily the lighting framework can be isolated into two sorts: indoor lighting and open air lighting. In this paper, the different sorts of counterfeit light sources are quickly clarified with their qualities [1].

Albeit counterfeit lighting can make a decent compositional light condition, fake light sources depend on a huge sum traditional vitality, which causes design lighting to involve a colossal piece of building vitality utilization. Lighting power devours 17% of intensity the State lattice every year and expends 1.7 million barrels of oil for every day. Along these

lines we should utilize counterfeit lighting and pick reasonable light source to diminish the vitality devoured by lighting under the state of fulfilling a decent design light condition. The goal of this paper is to guarantee the vitality effective lighting to spare vitality just as spare condition.

II. INDOOR LIGHTING

Without proper lighting interior architecture cannot be experienced to the fullest. Good lighting assures a warm, inviting and functional atmosphere in your home. Hence selection of proper lighting is the key element in interior design. Some of the most common indoor light bulbs are incandescent bulbs, which look like a traditional light bulb. Generally, the input for these bulbs is either 40W or 60W. But there are other kinds of indoor light bulbs as well, such as CFLs and LEDs. Keep in mind that the wattages listed for the CFLs and LEDs correspond to the 40W incandescent bulb. This means that for a lamp that takes a 40W incandescent, you could also use a 9W CFL or a 7W LED. This will allow you to easily compare the bulbs to one another.

A. Incandescent Bulbs



Figure 1.Incandescent bulb

The glowing light has had a similar plan for more than a long time since Thomas Edison developed it! It delivers light when a slender wire called a tungsten fiber is warmed by power going through it making it so hot that it begins to shine brilliantly. This discharges a great deal of warmth and the bulbs get hot to the touch, which means this bulb is wasteful. Numerous nations, including the United States, are right now passing enactment prohibiting the offer of these lights since they are so wasteful [2].

The characteristics of 40 watts incandescent bulb are shown below.

TABLE II.1
General Data of Incandescent Bulbs

Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
40	290	100	1000-2000	12.6	1.9

B. Fluorescent and CFL Bulbs



Figure 2. T5 linear fluorescent tube



Figure 3. CFL light bulb

Glaring lights utilize an extraordinary idle gas and a powder covering within their bulbs to create lights. The electrical flow pushes through the gas and energizes its molecules. After each cycle the ions discharge their vitality in little blasts, which at that point hit the particles of the powder covering [3]. The covering ions respond similarly, however the vitality they discharge is in reality light. This procedure utilizes power proficiently.

Minimal Fluorescent Light bulbs (CFLs) are unquestionably more proficient than the standard brilliant bulb. CFLs work by running power through gas inside the loops, energizing that gas, and delivering light. There is a covering on the spirals, which makes this light white. These bulbs don't get close to as hot as the brilliant bulbs [4]. The specifications of fluorescent and CFL bulbs are shown below.

TABLE II.2
General Data of Fluorescent and CFL Bulbs

	Wattage	Lumen	CRI	Lifespan in hours	Efficacy in lm/W	Efficiency
Fluorescent lamp	8	400	60	7,500	110	15.6%
CFL	9	500	80	10,000	57	7-10%

C. LED Bulbs



Figure 4. LED bulb

In contrast to radiant and CFL bulbs, LED bulbs have moved into the innovative age. LEDs that produce white light work in a somewhat muddled manner and their innovation won a Nobel Prize in Physics in 2014! While these are the most effective bulbs to date, they are not without issues. In spite of the fact that the light they produce looks white, recall that white light contains all the shades of the rainbow [5].

LEDs contain a ton of blue light, a lot of which can effectively affect human well-being and untamed life. Some specifications of 7w LED bulb are shown below.

TABLE II.3
General Data of LED Bulbs

Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
7	500	100	25,000	320	40-50

III. OUTDOOR LIGHTING

Open air lights (Outdoor) are typically not quite the same as those bulbs utilized inside in light of the fact that they should be a lot more splendid and last more. There are various sorts of lights utilized outside, and they each have advantages and disadvantages.

A. Halogen Bulbs



Figure 5. Halogen bulb

Halogen bulbs are frequently found in homes as spotlights or floodlights, in vehicles as headlights, or at sports fields as arena lights. These bulbs work likewise to a brilliant bulb by running power through a tungsten fiber. Not at all like the brilliant, there is halogen gas inside the bulb. At the point when the tungsten consumes off the fiber, the gas re-stores it back onto the fiber to be reused. Halogen bulbs last any longer

than glowing, yet these bulbs are a lot more brilliant and consume a lot more sultry than customary radiant bulbs [6].

TABLE III.1
General Data of Halogen Bulbs

Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
53	920	100	1,500	17.7	2.6

B. Metal Halide Bulbs



Figure 6. Metal halide bulb

Metal halide lights are usually utilized in streetlights, parking area lights, and arena lights. They are extremely brilliant and add to a ton of light contamination. They are genuinely effective. They produce exceptionally white light and have great shading version, implying that objects under these lights look their genuine nature [7].

TABLE III.2
General Data of Metal Halide Bulbs

Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
250	21,250	65	24,000	90	12

C. Low and High Pressure Sodium Vapour Bulbs



Figure 7. Low Pressure Sodium Light Bulb



Figure 8. High pressure sodium vapor lamp

The low weight sodium (LPS) light works likewise to the HPS light. Rather than creating white light (all the shades of the rainbow), LPS lights produce only yellow light. While this light is genuinely productive, it takes a few minutes for the bulb to turn on. The light is extremely yellow-orange. This

yellow light makes objects it is enlightening look an alternate shading or dark.

The high weight sodium light (HPS) is the most generally utilized road light all through the world. It creates light by running power through a blend of gases, which delivers light. The light itself is favored on the grounds that it requires little support. These lights are genuinely effective. They require a long time to turn on totally and produce a yellow-orange sparkle [8].

TABLE III.3
General Data of Sodium Vapor Lamps

	Wattage in watts	Lumen	CRI	Lifespan in hours	Efficacy in lm/W	Efficiency in %
LPS	20	3,022	-44	50,000	151	15-29
HPS	150	16,000	21	24,000	90	12-22

D. Low and High Pressure Mercury Vapour Lamps



Figure 9. Low pressure mercury vapor lamp diagram



Figure 10. High pressure mercury vapor lamp

Low weight mercury fume lights are an exceptionally proficient wellspring of UV light, especially short frequency UV light (254nm and 185nm). Regularly called germicidal or ozone assimilation lights, they are truly steady light sources. These kinds of lights are accessible in ozone creating and without ozone quartz, with an assortment of phosphors. Force supplies are likewise accessible for every light.

A mercury fume light is a high-pressure, electric circular segment release light that gives extraordinary enlightenment over a chose scope of frequencies. Lights that transmit light by the entry of electric flow through a gas are called gas-release lights. These lights were first presented during the 1930s [9].

TABLE III.4
General Data of Mercury Vapor Lamps

	Wattage in watts	Lumen	CRI	Lifespan in hours	Efficacy in lm/W	Efficiency in %
Mercury Vapor lamps	250	12,500	45	24,000	35-65	75-90

E. LED Street Lamps



Figure 11. LED Street light

Driven advances have grown quickly lately and these bulbs are currently being incorporated into outside lighting arrangements. While the vitality investment funds are critical, LEDs produce a ton of blue light, a lot of which can effectually affect human well-being and untamed life [10].

TABLE III.5
General Data of LED Street Bulbs

Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
120	17,180	≥70	50,000	143	40-60

i. Phosphor-Converted Amber (PCA) LED Street Lamps:



Figure 12. PCA LED street lamps

PCALEDs have just been available for as far back as not many years. They utilize next to no vitality and have great shading version, however are still rather costly. A few urban areas have just introduced these lights on their roads.

ii. Narrow-Band Amber (NBA) LED Street Lamps:



Figure 13. NBA LED street lamp

Thin band golden (NBA) LED Street lights are a shiny new innovation. Instead of producing all the shades of the rainbow and a great deal of blue light, they discharge for the most part in the yellow. They despite everything have great shading version, implying that they don't make things look dim like LPS lights do [11]. Since this innovation is so new, these bulbs are not generally accessible and in that capacity, are as yet costly. They are extremely productive.

IV. RESULTS AND DISCUSSION

TABLE IV.1
Comparison of Various Lighting Technologies (Bulbs)

Type of Bulb	Wattage in watts	Lumen	CRI	Life Span in hours	Efficacy in lm/W	Efficiency in %
Incandescent	40	290	100	1000-2000	12.6	1.9
Fluorescent	8	400	60	7,500	110	15.6
CFL	9	500	80	10,000	57	7-10
LED	7	500	100	25,000	320	40-50
Halogen	53	920	100	1,500	17.7	2.6
Metal Halide	250	21,250	65	24,000	90	12
Low pressure sodium lamp	20	3,022	-44	50,000	151	15-29
High pressure sodium lamp	150	16,000	21	24,000	90	12-22
Mercury Vapor lamps	250	12,500	45	24,000	35-65	75-90
LED street Lamp	120	17,180	≥70	50,000	143	40-60

From the TABLE IV.1 obviously all the lighting advances for example different bulbs utilized in late market have various qualities. Each of the luminaires have their own usefulness and various applications. Where the force utilization matters most at that point LED bulbs are utilized as they expend less

force and are more proficient than different lights. In this way, LED's are utilized broadly in neighborhoods [12].

The Street Lights likewise assumes a significant job in lighting the urban communities and towns during the evening time. There are distinctive lightning methods for those and typical family bulbs can't be utilized for those applications.

V. CONCLUSION

Using a suitable and most efficient bulb for an application is must. Usage of non-suitable bulbs may lead to more energy consumption, early breakdown of the bulb or even may cause fault or inefficient lighting system.

In this paper discussions are done with respect to Wattage, Lumens, CRI, Efficacy, Efficiency and an Average life span of various bulbs. This helps one to select a suitable bulb for their applications. Different bulbs varying characteristics for example LED consumes less power, Incandescent bulb brightness is more than other bulbs and many more. And studying about these things are very important as they give full insight about lighting design.

It tends to be inferred that utilizing a reasonable light for a specific application or need is important. As this prompts sparing more vitality and the expense of establishment of a lighting plan and furthermore maintains a strategic distance from wasteful lighting framework which may prompt early breakdown of bulbs, loss of intensity, sporadic brilliance and so on which isn't alluring.

REFERENCES

- [1] F. Grum, "Artificial light sources for simulating natural daylight and skylight," *Applied optics* 7 (1), 183-187, 1968.
- [2] Dan MacIsaac, Gary Kanner, and Graydon Anderson, "Basic Physics of the Incandescent Lamp (Lightbulb)," December 1999.
- [3] Askari Mohammad Bagher, "A detailed review on types of lamps and their applications," January 2016.
- [4] A Bouwnegt, "Compact fluorescent lamps," *Journal of the illuminating engineering society* 11 (4), 204-212, 1982.
- [5] Siddha Pimpalkar, James S. Speck, Steven P. DenBaars and Shuji Nakamura, "Prospects for LED lighting".
- [6] Olive Entwistle, "Lamphead for tungsten-halogen lamps," United States Patent, September 1970.
- [7] John F Waymouth, "Metal halide lamps," *Proceedings of the IEEE* 59 (4), 629-633, 1971.
- [8] Schmidt Kurt, "High pressure sodium vapor lamp," US Patent 3,248590, 1966.
- [9] Hanns E. Fischer, Stolberg, "High pressure mercury vapor discharge lamp," April 1989.
- [10] DR Nuttall, R Shuttleworth, G Routledge, "Design of a LED street lighting system," *IET Digital library*, 2008.
- [11] [7] Illuminating Engineering Society of North America (IESNA) – "Lighting Handbook"
- [12] Sohel Uddin, Hussain Shareef, Azah Mohamed, M A Hannan and Khodijah Mohamed, "LEDs as Energy Efficient Lighting Systems: A Detail Review" – 2011 IEEE Student Conference on Research and Development 978-1-4673-0102-2/11/\$26.00 ©2011 IEEE 468.