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**TECHNOLOGY & COST ADVANTAGE OF COMPACT FLUORESCENT LAMP
Vs
INCANDESCENT LAMP IN JUPITER COMPONENT MAKERS INDIA Pvt.Ltd,
COIMBATORE**

By

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A PROJECT REPORT

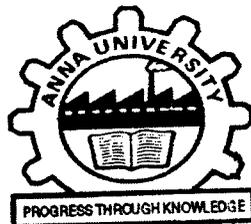
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In partial fulfillment for the award of the degree

of

MASTER OF BUSINESS ADMINISTRATION



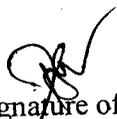
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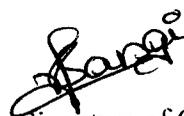


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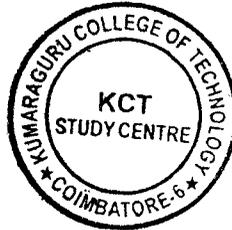
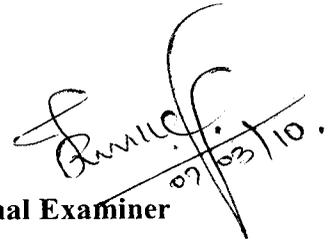
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ABSTRACT

The main objective of the project is to Study the Technology & Cost Advantage of Compact Fluorescent Lamp Vs Incandescent Lamp in Jupiter Component Makers India Pvt.Ltd, Coimbatore.

Jupiter component makers are one of the Leading manufacturers of Electronic components in Coimbatore.100% of the company products are exported to overseas customers.

This project report is very essential one for the comparison analysis of cost and technology advantages between various electric lamps particularly for Compact Fluorescent Lamps and Incandescent Lamps.

The incandescent light bulb or incandescent light globe is a source of electric light that works by incandescence (a general term for heat-driven light emissions, which includes the simple case of black body radiation). An electric current passes through a thin filament, heating it until it produces light. The enclosing glass bulb contains either a vacuum or an inert gas to prevent oxidation of the hot filament. Incandescent bulbs are also sometimes called electric lamps, a term also applied to the original arc lamps.

A compact fluorescent lamp (CFL), are energy saving lights, is a type of fluorescent lamp. Many CFLs are designed to replace an incandescent lamp and can fit into most existing light fixtures formerly used for incandescent. Compared to general service incandescent lamps giving the same amount of visible light, CFLs use less power, have a longer rated life, but have a higher purchase price. CFLs radiate a different light spectrum from that of incandescent lamps. Improved phosphor formulations have improved the subjective color of the light emitted by CFLs such that some sources rate the best 'soft white' CFLs as subjectively similar in color to standard incandescent lamps.

The company initiatives will improve the effectiveness of the usage of CFL lamps in the company.

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I must extend my sincere and heart full thanks to **Ms. S. Sangeetha, senior Lecturer, KCT Business School** who guided me and spent her valuable time whenever I needed her guidance.

I am also highly indebted to **Mr. Sajan Joseph George – Managing Director of M/s. Jupiter Component Makers India Pvt Ltd., Coimbatore** for his instantaneous permission to carry out the project in our company. I have to remember with a sense of gratitude the timely help and information provided by **Mr.Mathew John – Manager of M/s. Jupiter Component Makers India Pvt Ltd.,** for completing this Project. During typing the acknowledgement, I find several well wishers who helped me lot in successful completion of this project. I convey my sincere gratitude through this paragraph to **ALL GREAT MINDS.**

R.SENDHIL MURUGAN @ JAYA KUMAR

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CHAPTER 1

INTRODUCTION

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INTRODUCTION

1.1. RESEARCH BACKGROUND

Incandescent Lamps and CFLs are regularly and most commonly used Lamps in homes and industries. The main advantages of the CFL over Incandescent lamps are

- Less power consumption
- More light emission with lower rating than Incandescent lamps
- Smaller size
- No hum or buzzing
- Instantly turn on, with no flickering
- Cheaper price. Now very inexpensive, especially when compared with electricity costs.

Incandescent bulbs are made in a wide range of sizes and voltages, from 1.5 volts to about 300 volts. They require no external regulating equipment and have a low manufacturing cost, and work well on either alternating current or direct current. As a result the incandescent lamp is widely used in household and commercial lighting, for portable lighting, such as table lamps, car headlamps, flashlights, and for decorative and advertising lighting. Some applications of the incandescent bulb make use of the heat generated, such as incubators, brooding boxes for poultry, heat lights for reptile tanks, infrared heating for industrial heating and drying processes.

Compared to general service incandescent lamps giving the same amount of visible light, CFLs use less power, have a longer rated life, but have a higher purchase price. In the United States, a CFL can save over 30 US\$ in electricity costs over the lamp's life time compared to an incandescent lamp, and save 2,000 times its own weight in greenhouse gases. Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal. CFLs radiate a different light spectrum from that of incandescent lamps. Improved phosphor formulations have improved the subjective color of the light emitted by CFLs such that some sources rate the best 'soft white' CFLs as subjectively similar in color to standard incandescent lamps.

1.2. REVIEW OF LITERATURE

1.2.1. Introduction to Incandescent Light Bulb

The incandescent light bulb¹, incandescent lamp or incandescent light globe is a source of electric light that works by incandescence (a general term for heat-driven light emissions, which includes the simple case of black body radiation). An electric current passes through a thin filament, heating it until it produces light. The enclosing glass bulb contains either a vacuum or an inert gas to prevent oxidation of the hot filament. Incandescent bulbs are also sometimes called *electric lamps*, a term also applied to the original arc lamps.

Incandescent bulbs are made in a wide range of sizes and voltages, from 1.5 volts to about 300 volts. They require no external regulating equipment and have a low manufacturing cost, and work well on either alternating current or direct current. As a result the incandescent lamp is widely used in household and commercial lighting, for portable lighting, such as table lamps, car headlamps, flashlights, and for decorative and advertising lighting.

Some applications of the incandescent bulb make use of the heat generated, such as incubators, brooding boxes for poultry, heat lights for reptile tanks, infrared heating for industrial heating and drying processes, and the Easy-Bake Oven toy. In cold weather the heat shed by incandescent lamps contributes to building heating, but in hot climates lamp losses increase the energy used by air conditioning systems.

Incandescent light bulbs are gradually being replaced in many applications by other types of electric light such as (compact) fluorescent lamps, high-intensity discharge lamps, light-emitting diodes (LEDs), and other devices. These newer technologies give more visible light and less heat for the same amount of electrical energy input. Some jurisdictions, such as the European Union are in the process of phasing-out the use of incandescent light bulbs in favor of more energy-efficient lighting.

1. **Hughes, Thomas P. 2004. *American Genesis: A Century of Invention and Technological Enthusiasm*. 2nd ed. Chicago: The University of Chicago Press**

Incandescent light bulb

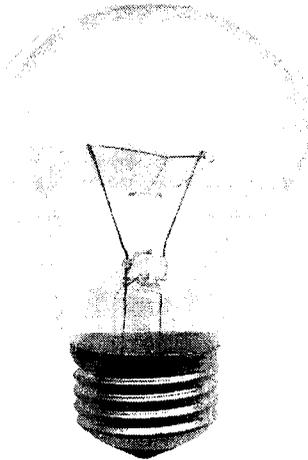


Fig.1.2.1.1.

1.2.2. Introduction to Compact Fluorescent Lamp (CFL)

A compact fluorescent lamp² (CFL), also known as a compact fluorescent light or energy saving light (or less commonly as a compact fluorescent tube [CFT]), is a type of fluorescent lamp. Many CFLs are designed to replace an incandescent lamp and can fit into most existing light fixtures formerly used for incandescent.

Compared to general service incandescent lamps giving the same amount of visible light, CFLs use less power, have a longer rated life, but have a higher purchase price. In the United States, a CFL can save over 30 US\$ in electricity costs over the lamp's life time compared to an incandescent lamp, and save 2,000 times its own weight in greenhouse gases. Like all fluorescent lamps, CFLs contain mercury, which complicates their disposal.

CFLs radiate a different light spectrum from that of incandescent lamps. Improved phosphor formulations have improved the subjective color of the light emitted by CFLs such that some sources rate the best 'soft white' CFLs as subjectively similar in color to standard incandescent lamps.

2. Mary Bellis (2007). "The History of Fluorescent Lights".

About.com. http://inventors.about.com/library/inventors/bl_fluorescent.htm

The compact fluorescent lamp

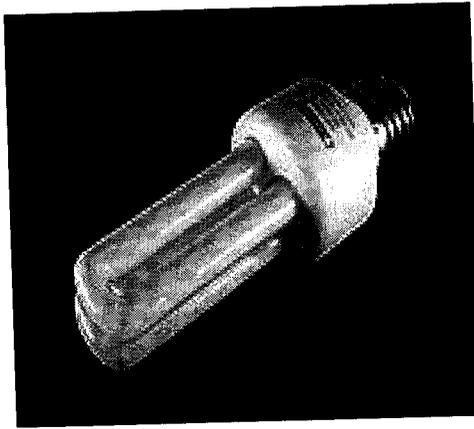


Fig.1.2.2.1.

1.3. Objectives of the study

The main objective of the project is Technology & Cost Advantage of Compact Fluorescent Lamp Vs Incandescent Lamp in Jupiter Component Makers India Pvt.Ltd, Coimbatore.

Secondary Objectives:

To study the Technology advantage on Various Criteria between Compact Fluorescent Lamp and Incandescent Lamp in Jupiter Component Makers India Pvt.Ltd, Coimbatore.

To study the cost advantage and savings of Compact Fluorescent Lamp over Incandescent Lamp in Jupiter Component Makers India pvt. Ltd, Coimbatore.

To suggest the customers about the best option of bulbs from this project study.

1.4. Scope of the study

The technology and cost advantages of Incandescent lamp Vs CFL study provides the effectiveness for various ratings and types of Incandescent lamps and CFL and the characteristics and advantages for the usage of Electrical energy with minimum power consumption and less cost and more efficient illumination levels for the various Electric lamps.

The company initiatives will improve the effectiveness of the usage of CFL lamps over Incandescent lamps in the company for future productions.

1.5. METHODOLOGY

1.5.1. Type of Study

This study describes the problems in utilizing in lamps and explores the opportunity for Fluorescent Lamps .Hence it is a exploratory research

1.5.2. Period of Study

Collecting several data's from different companies of manufacturing electric lamps.

1.5.3. Limitations

The study has the following limitations.

The study is based on Indian electrical specifications and not suitable for various foreign countries and the data's collected are secondary data's and are apply to the results of the study.

1.5.4. Sources of Data

The study is based on the secondary data. The data is collected from the following websites and various Lamp manufacturing companies, and are given below.

- Wikipedia Websites from Internet
- Philips
- Osram
- Vinverth (Jupiter Component Makers India Pvt. Ltd)
- Samson

Also the data was collected from the distributers of Electrical goods suppliers.

CHAPTER 2

ORIGIN OF LIGHT BULBS

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2.1 ORIGIN OF INCANDESCENT LIGHT BULBS

In addressing the question "Who invented the incandescent lamp?" historians Robert Friedel and Paul Israel list 22 inventors of incandescent lamps prior to Joseph Wilson Swan and Thomas Edison. They conclude that Edison's version was able to outstrip the others because of a combination of three factors: an effective incandescent material, a higher vacuum than others were able to achieve (by use of the Sprengel pump) and a high resistance lamp that made power distribution from a centralized source economically viable.

Another historian, Thomas Hughes, has attributed Edison's success to the fact that he invented an entire, integrated system of electric lighting. "The lamp was a small component in his system of electric lighting, and no more critical to its effective functioning than the Edison Jumbo generator, the Edison main and feeder, and the parallel-distribution system. Other inventors with generators and incandescent lamps, and with comparable ingenuity and excellence, have long been forgotten because their creators did not preside over their introduction in a system of lighting."

Original carbon-filament bulb

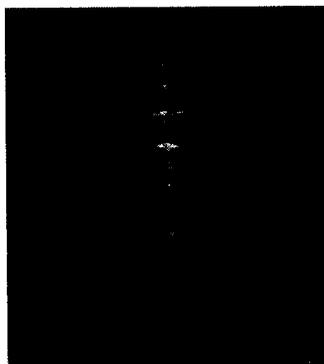


Fig.2.1.1.

2.1.1. Early pre-commercial research

In 1802, Humphry Davy had what was then the most powerful electrical battery in the world at the Royal Institution of Great Britain. In that year, he created the first incandescent light by passing the current through a thin strip of platinum, chosen because the metal had an extremely high melting point. It was not bright enough nor did it last long enough to be practical, but it was the precedent behind the efforts of scores of experimenters over the next 75 years. In 1809, Davy also created the first arc lamp by making a small but blinding electrical connection between two carbon charcoal rods connected to a 2000-cell battery; it was demonstrated to the Royal Institution in 1810.

Over the first three-quarters of the 19th century many experimenters worked with various combinations of platinum or iridium wires, carbon rods, and evacuated or semi-evacuated enclosures. Many of these devices were demonstrated and some were patented.

In 1835, James Bowman Lindsay demonstrated a constant electric light at a public meeting in Dundee, Scotland. He stated that he could "read a book at a distance of one and a half feet". However, having perfected the device to his own satisfaction, he turned to the problem of wireless telegraphy and did not develop the electric light any further. His claims are not well documented.

In 1840, British scientist Warren de la Rue enclosed a coiled platinum filament in a vacuum tube and passed an electric current through it. The design was based on the concept that the high melting point of platinum would allow it to operate at high temperatures and that the evacuated chamber would contain fewer gas molecules to react with the platinum, improving its longevity. Although an efficient design, the cost of the platinum made it impractical for commercial use.

In 1841, Frederick de Moleyns of England was granted the first patent for an incandescent lamp, with a design using platinum wires contained within a vacuum bulb.

In 1845, American John W. Starr acquired a patent for his incandescent light bulb involving the use of carbon filaments. He died shortly after obtaining the patent. Aside from the information contained in the patent itself, little else is known about him.

In 1851, Jean Eugène Robert-Houdin publicly demonstrated incandescent light bulbs on his estate in Blois, France. His light bulbs are on permanent display in the museum of the Chateau of Blois.

In 1872 A. N. Lodygin invented an incandescent light bulb. In 1874 he obtained a patent for his invention.

In a suit filed by rivals seeking to get around Edison's lightbulb patent, German-American inventor Heinrich Göbel claimed he developed the first light bulb in 1854: a carbonized bamboo filament, in a vacuum bottle to prevent oxidation, and that in the following five years he developed what many call the first practical light bulb. Despite a successful recreation of his lamp in 1882, Lewis Latimer demonstrated that the bulbs which Göbel had purportedly built in the 1850s, had actually been built much later, and found the glassblower who had constructed the fraudulent exhibits. In a patent interference suit in 1893, the judge ruled Göbel's claim "extremely improbable".

In North America, parallel developments were taking place. On July 24, 1874 a Canadian patent was filed by a Toronto medical electrician named Henry Woodward and a colleague Mathew Evans. They built their lamps with different sizes and shapes of carbon rods held between electrodes in glass cylinders filled with nitrogen. Woodward and Evans attempted to commercialize their lamp, but were unsuccessful. They ended up selling their patent (U.S. Patent 0,181,613) to Thomas Edison in 1879.

2.1.2. Commercialization

Carbon filament lamp

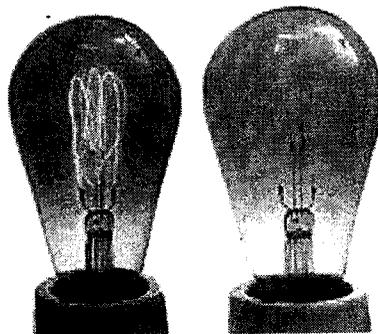


Fig.2.1.2.1.

Joseph Wilson Swan (1828–1914) was a British physicist and chemist. In 1850, he began working with carbonized paper filaments in an evacuated glass bulb. By 1860 he was able to demonstrate a working device but the lack of a good vacuum and an adequate supply of electricity resulted in a short lifetime for the bulb and an inefficient source of light. By the mid-1870s better pumps became available, and Swan returned to his experiments.

With the help of Charles Stearn, an expert on vacuum pumps, in 1878 Swan developed a method of processing that avoided the early bulb blackening. This received a British Patent No 8 in 1880. On 18 December 1878 a lamp using a slender carbon rod was shown at a meeting of the Newcastle Chemical Society, and Swan gave a working demonstration at their meeting on 17 January 1879. It was also shown to 700 who attended a meeting of the Literary and Philosophical Society of Newcastle on 3 February 1879. These lamps used a carbon rod from an arc lamp rather than a slender filament. Thus they had low resistance and required very large conductors to supply the necessary current, so they were not commercially practical, although they did furnish a demonstration of the possibilities of incandescent lighting with relatively high vacuum, a carbon conductor, and platinum lead-in wires. Besides requiring too much current for a central station electric system to be practical, they had a very short lifetime. Swan turned his attention to producing a better carbon filament and the means of attaching its ends. He devised a method of treating cotton to produce 'parchmentised thread' and obtained British Patent 4933 in 1880. From this year he began installing light bulbs in homes and landmarks in England. His house was the first in the world to be lit by a lightbulb and so the first house in the world to be lit by Hydro Electric power. In the early 1880s he had started his company.

Thomas Edison began serious research into developing a practical incandescent lamp in 1878. Edison filed his first patent application for "Improvement In Electric Lights" on October 14, 1878 (U.S. Patent 0,214,636). After many experiments with platinum and other metal filaments, Edison returned to a carbon filament. The first successful test was on October 22, 1879, and lasted 13.5 hours. Edison continued to improve this design and by Nov 4, 1879, filed for a U.S. patent for an electric lamp using "a carbon filament or strip coiled and connected ... to platina contact wires." Although the patent described several ways of creating the carbon filament including using "cotton and

linen thread, wood splints, papers coiled in various ways," it was not until several months after the patent was granted that Edison and his team discovered that a carbonized bamboo filament could last over 1200 hours.

Hiram S. Maxim started a lightbulb company in 1878 to exploit his patents and those of William Sawyer. His United States Electric Lighting Company was the second company, after Edison, to sell practical incandescent electric lamps. They made their first commercial installation of incandescent lamps at the Mercantile Safe Deposit Company in New York City in the fall of 1880, about six months after the Edison incandescent lamps had been installed on the steamer Columbia. In October 1880, Maxim patented a method of coating carbon filaments with hydrocarbons to extend their life. Lewis Latimer, his employee at the time, developed an improved method of heat-treating them which reduced breakage and allowed them to be molded into novel shapes, such as the characteristic "M" shape of Maxim filaments. On January 17, 1882, Latimer received a patent for the "Process of Manufacturing Carbons," an improved method for the production of light bulb filaments which was purchased by the United States Electric Light Company. Latimer patented other improvements such as a better way of attaching filaments to their wire supports.

In Britain, the Edison and Swan companies merged into the Edison and Swan United Electric Company (later known as Ediswan, which was ultimately incorporated into Thorn Lighting Ltd). Edison was initially against this combination, but after Swan sued him and won, Edison was eventually forced to cooperate, and the merger was made. Eventually, Edison acquired all of Swan's interest in the company. Swan sold his United States patent rights to the Brush Electric Company in June 1882. Swan later wrote that Edison had a greater claim to the light than he did, in order to protect Edison's patents from claims against them in the United States. In 1881, the Savoy Theatre became the first public building in the world to be lit entirely by electric lights.

U.S. Patent 0,223,898 by Thomas Edison for an improved electric lamp, January 27, 1880

In 1882, the first recorded set of miniature incandescent lamps for lighting a Christmas tree was installed. These did not become common in homes for many years.

The United States Patent Office gave a ruling October 8, 1883, that Edison's patents were based on the prior art of William Sawyer and were invalid. Litigation continued for a number of years. Eventually on October 6, 1889, a judge ruled that Edison's electric light improvement claim for "a filament of carbon of high resistance" was valid.

In the 1890s, the Austrian inventor Carl Auer von Welsbach worked on metal-filament mantles, first with platinum wire, and then osmium, and produced an operating version in 1898. In 1898 he patented the osmium lamp and started marketing it in 1902, the first commercial metal filament incandescent lamp.

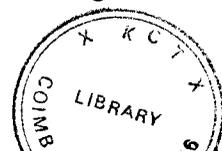
In 1897, German physicist and chemist Walther Nernst developed the Nernst lamp, a form of incandescent lamp that used a ceramic glower and did not require enclosure in a vacuum or inert gas. Twice as efficient as carbon filament lamps, Nernst lamps were briefly popular until overtaken by lamps using metal filaments.

In 1903, Willis Whitnew invented a metal-coated carbon filament that would not blacken the inside of a light bulb.

On December 13, 1904, Hungarian Sándor Just and Croatian Franjo Hanaman were granted a Hungarian patent (No. 34541) for a tungsten filament lamp, which lasted longer and gave a brighter light than the carbon filament. Tungsten filament lamps were first marketed by the Hungarian company Tungstam in 1905, so this type is often called Tungstam-bulbs in many European countries.

In 1906, the General Electric Company patented a method of making filaments from sintered tungsten and in 1911 used ductile tungsten wire for incandescent light bulbs. The tungsten filament outlasted all other types.

In 1913 Irving Langmuir found that filling a lamp with inert gas instead of a vacuum resulted in twice the luminous efficacy and reduction of bulb blackening. In 1924, Marvin Pipkin, an American chemist, patented a process for frosting the inside of lamp bulbs without weakening them, and in 1947 he patented a process for coating the inside of lamps with silica.



In 1930, Hungarian Imre Bródy filled lamps with krypton gas in lieu of argon. He used krypton and/or xenon filling of bulbs. Since the new gas was expensive, he developed a process with his colleagues to obtain krypton from air. Production of krypton filled lamps based on his invention started at Ajka in 1937, in a factory co-designed by Polányi and Hungarian-born physicist Egon Orowan.

By 1964, improvements in efficiency and production of incandescent lamps had reduced the cost of providing a given quantity of light by a factor of thirty, compared with the cost at introduction of Edison's lighting system

Consumption of incandescent light bulbs grew rapidly in the United States. In 1885 an estimated 300,000 general lighting service lamps were sold, all with carbon filaments. When tungsten filaments were introduced, there were about 50 million lamp sockets in the United States. In 1914 88.5 million lamps were used, (only 15% with carbon filaments), and by 1945 annual sales of lamps were 795 million (more than 5 lamps per person per year).

2.2. ORIGIN OF CFL

The parent to the modern fluorescent lamp was invented in the late 1890s by Peter Cooper Hewitt. The Cooper Hewitt lamps were used for photographic studios and industries.

Edmund Germer, Friedrich Meyer, and Hans Spanner then patented a high pressure vapor lamp in 1927. George Inman later teamed with General Electric to create a practical fluorescent lamp, sold in 1938 and patented in 1941. Circular and U-shaped lamps were devised to reduce the length of fluorescent light fixtures.

An early compact fluorescent lamp



Fig.2.2.1.

The modern CFL was invented by Edward E. Hammer, an engineer with General Electric, in response to the 1973 oil crisis. While it met its design goals, it would have cost GE about US\$25 million to build new factories to produce them and the invention was shelved. The design was eventually leaked out and copied by others. CFLs have steadily increased in sales volume. Development of fluorescent lamps that could fit in the same volume as comparable incandescent lamps required the development of new, high-efficacy phosphors that could withstand more power per unit area than the phosphors used with older, larger lamps.

CHAPTER 3

CONSTRUCTION METHODOLOGIES

CHAPTER 3

CONSTRUCTION METHODOLOGIES

3.1. CONSTRUCTION OF INCANDESCENT LAMP

Incandescent light bulbs consist of a glass enclosure (the envelope, or bulb) with a filament of tungsten wire inside the bulb, through which an electric current is passed. Contact wires and a base with two (or more) conductors provide electrical connections to the filament. Incandescent light bulbs usually contain a stem or glass mount anchored to the bulb's base which allows the electrical contacts to run through the envelope without gas/air leaks. Small wires embedded in the stem in turn support the filament and/or its lead wires. The bulb is filled with an inert gas such as argon to reduce evaporation of the filament.

An electrical current heats the filament to typically 2000 K to 3300 K (about 3100–5400°F), well below tungsten's melting point of 3695 K (6192°F). Filament temperatures depend on the filament type, shape, size, and amount of current drawn. The heated filament emits light that approximates a continuous spectrum. The useful part of the emitted energy is visible light, but most energy is given off as heat in the near-infrared wavelengths.

Three-way light bulbs have two filaments and three conducting contacts in their bases. The filaments share a common ground, and can be lit separately or together. Common wattages include 30–70–100, 50–100–150, and 100–200–300, with the first two numbers referring to the individual filaments, and the third giving the combined wattage.

While most light bulbs have clear or frosted glass, other kinds are also produced, including the various colors used for Christmas tree lights and other decorative lighting. Neodymium-containing glass is sometimes used to provide a more natural-appearing light.

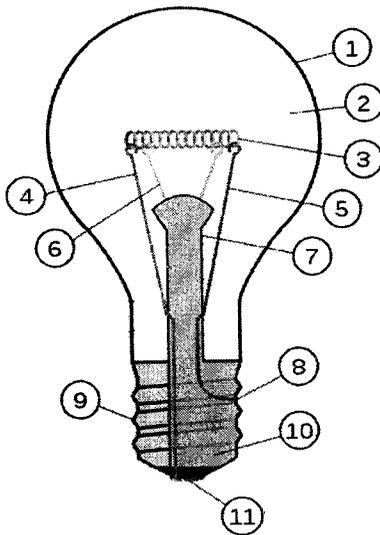


Fig.3.1.1 various parts of an Incandescent bulb

1. Outline of Glass bulb
2. Low pressure inert gas (argon, neon, nitrogen)
3. Tungsten filament
4. Contact wire (goes out of stem)
5. Contact wire (goes into stem)
6. Support wires
7. Stem (glass mount)
8. Contact wire (goes out of stem)
9. Cap (sleeve)
10. Insulation (vitrite)
11. Electrical Contact

Many arrangements of electrical contacts are used. Large lamps may have a screw base (one or more contacts at the tip, one at the shell) or a bayonet base (one or more contacts on the base, shell used as a contact or used only as a mechanical support). Some tubular lamps have an electrical contact at either end. Miniature lamps may have a wedge base and wire contacts, and some automotive and special purpose lamps have screw terminals for connection to wires. Contacts in the lamp socket allow the electric current to pass through the base to the filament. Power ratings for incandescent light bulbs range from about 0.1 watt to about 10,000 watts.

The glass bulb of a general service lamp can reach temperatures between 200 and 260 degrees Celsius (400 to 550 degrees Fahrenheit). Lamps intended for high power operation or used for heating purposes will have envelopes made of hard glass or fused quartz.

3.2 CONSTRUCTION OF CFL

The most important technical advance has been the replacement of electromagnetic ballasts with electronic ballasts; this has removed most of the flickering and slow starting traditionally associated with fluorescent lighting.

3.2.1. Parts of CFL

There are two main parts in a CFL: the gas-filled tube (also called bulb or burner) and the magnetic or electronic ballast. An electrical current from the ballast flows through the gas (mercury vapour), causing it to emit ultraviolet light. The ultraviolet light then excites a phosphor coating on the inside of the tube. This coating emits visible light.

An electronic ballast and permanently attached Lamp tube in an integrated compact fluorescent lamp.

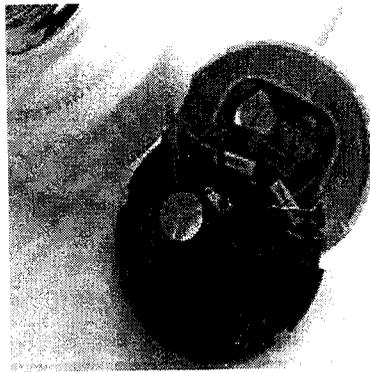


Fig.3.2.1.1.

Electronic ballasts contain a small circuit board with rectifiers, a filter capacitor and usually two switching transistors connected as a high-frequency resonant series DC to AC inverter. The resulting high frequency, around 40 kHz or higher, is applied to the lamp tube.

Since the resonant converter tends to stabilize lamp current (and light produced) over a range of input voltages, standard CFLs do not respond well in dimming applications and special lamps are required for dimming service. CFLs that flicker when they start have magnetic ballasts; CFLs with electronic ballasts are now much more common.

There are two types of CFLs: integrated and non-integrated lamps.

3.2.2. Integrated CFLs

Integrated lamps combine a tube, an electronic ballast and either an Edison screw or bayonet fitting in a single CFL unit. These lamps allow consumers to replace incandescent lamps easily with CFLs.

Integrated CFLs work well in many standard incandescent light fixtures, which lower the cost of CFL conversion.

Special 3-way models and dimmable models with standard bases are available for use when those features are needed.

The tubular-type compact fluorescent lamp (Integrated type)

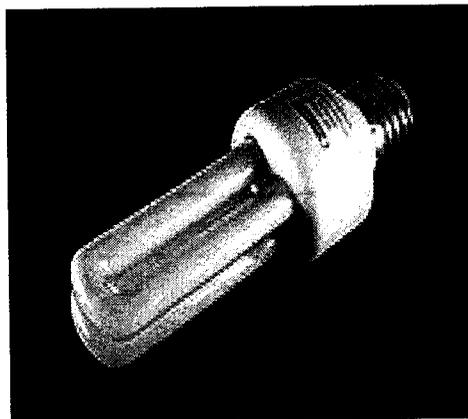


Fig.3.2.2.1.

A spiral-type integrated CFL (Integrated type)

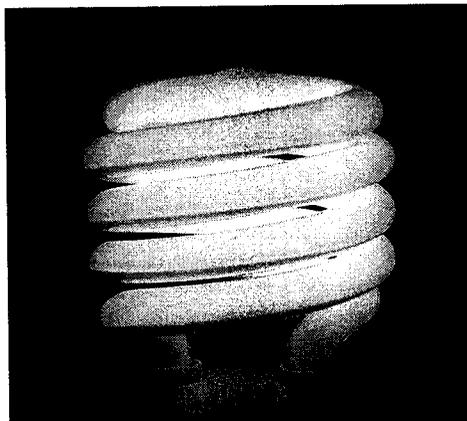


Fig.3.2.2.2.

3.2.3. Non-Integrated CFLs

There are two types of bulbs: bi-pin tubes designed for conventional ballasts and quad-pin tubes designed for electronic ballasts and conventional ballasts with an external starter.

The bi-pin tubes contain an integrated starter in the base, which obviates the need for external heating pins, but causes incompatibility with electronic ballasts.

There are different standard shapes of tubes: single-turn, double-turn, triple-turn, quad-turn, circular, and butterfly.

Since the ballasts are placed in the light fixture they are larger and last longer compared to the integrated ones, and they don't need to be replaced when the bulb reaches its end-of-life. Non-integrated CFL housings can be both more expensive and sophisticated.

Non-integrated bi-pin double-turn compact fluorescent lamp

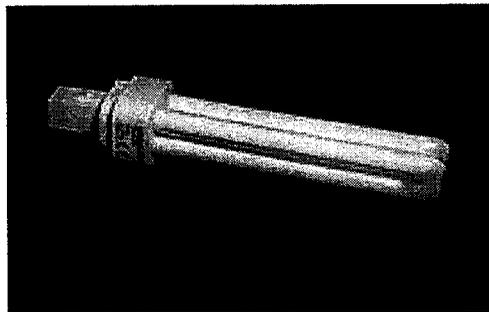


Fig 3.2.3.1.

Non-integrated electronic ballast for compact fluorescent lamps

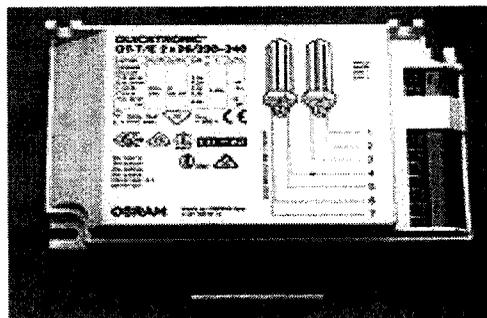


Fig.3.2.3.2.

CHAPTER 4

CHARACTERISTICS

CHAPTER 4

CHARACTERISTICS

4.1. CHARACTERISTICS OF INCANDESCENT LAMP

4.1.1. Electrical characteristics

Incandescent lamps are nearly pure resistive loads with a power factor of 1. This means the actual power consumed (in watts) and the apparent power (in volt-amperes) are equal. The actual resistance of the filament is temperature-dependent. The cold resistance of tungsten-filament lamps is about 1/15 the hot-filament resistance when the lamp is operating. For example, a 100-watt, 120-volt lamp has a resistance of 144 ohms when lit, but the cold resistance is much lower (about 9.5 ohms). Since incandescent lamps are resistive loads, simple triac dimmers can be used to control brightness. Electrical contacts may carry a "T" rating symbol indicating that they are designed to control circuits with the high inrush current characteristic of tungsten lamps. For a 100-watt, 120 volt general-service lamp, the current stabilizes in about 0.10 seconds, and the lamp reaches 90% of its full brightness after about 0.13 seconds.

4.1.2. Power

Incandescent light bulbs are usually marketed according to the electrical power consumed. This is measured in watts and depends mainly on the resistance of the filament, which in turn depends mainly on the filament's length, thickness, and material. For two bulbs of the same voltage, type, color, and clarity, the higher-powered bulb gives more light.

The table shows the approximate typical output, in lumens, of standard incandescent light bulbs at various powers. Note that the lumen values for "soft white" bulbs will generally be slightly lower than for standard bulbs at the same power, while clear bulbs will usually emit a slightly brighter light than correspondingly powered standard bulbs.

Table 4.1.2.1 Comparison of efficacy by power (120 Volt lamps)

Power (W)	Output (lm)	Efficacy (lm/W)
5	25	5
15	110	7.3
25	200	8.0
35	350	10.0
40	500	12.5
50	700	14.0
55	800	14.5
60	850	14.2
65	1,000	15.4
70	1,100	15.7
75	1,200	16.0
90	1,450	16.1
95	1,600	16.8
100	1,700	17.0
135	2,350	17.4
150	2,850	19.0
200	3,900	19.5
300	6,200	20.7

4.1.3. Physical characteristics

4.1.3.1. Bulb shapes, sizes, and terms

Incandescent light bulbs come in a range of shapes and sizes. The names of the shapes may be slightly different in some regions. Many of these shapes have a designation consisting of one or more letters followed by one or more numbers, e.g. A55 or PAR38. The letters represent the shape of the bulb.

The numbers represent the maximum diameter, either in eighths of an inch, or in millimeters, depending on the shape and the region. For example, 63 mm reflectors are designated R63, but in the U.S. they are known as R20 (2.5 inches). However, in both regions, a PAR38 reflector is known as PAR38.

Common shapes:

General Service

Light emitted in (nearly) all directions. Available either clear or frosted.

Types: General (A), Mushroom

High Wattage General Service

Lamps greater than 200 watts.

Types: Pear-shaped (PS)

Decorative

Lamps used in chandeliers, etc.

Types: candle (B), twisted candle, bent-tip candle (CA & BA), flame (F), fancy round (P), globe (G)

Reflector (R)

Reflective coating inside the bulb directs light forward. Flood types (FL) spread light. Spot types (SP) concentrate the light. Reflector (R) bulbs put approximately

double the amount of light (foot-candles) on the front central area as General Service (A) of same wattage.

Types: Standard reflector (R), elliptical reflector (ER), crown-silvered

Parabolic aluminized reflector (PAR)

Parabolic aluminized reflector (PAR) bulbs control light more precisely. They produce about four times the concentrated light intensity of general service (A), and are used in recessed and track lighting. Weatherproof casings are available for outdoor spot and flood fixtures.

120 V sizes: PAR 16, 20, 30, 38, 56 and 64

230 V sizes: Par 38, 56 and 64

Available in numerous spot and flood beam spreads. Like all light bulbs, the number represents the diameter of the bulb in 1/8ths of an inch. Therefore, a PAR 16 is 2" in diameter, a PAR 20 is 2.5" in diameter, PAR 30 is 3.75" and a PAR 38 is 4.75" in diameter.

Multifaceted reflector (MR)

HIR

"HIR" is a GE designation for a lamp with an infrared reflective coating. Since less heat escapes, the filament burns hotter and more efficiently. The Osram designation for a similar coating is "IRC".

4.1.3.2. Lamp bases

A 40 watt light bulb with standard E10, E14 and E27 Edison screw base

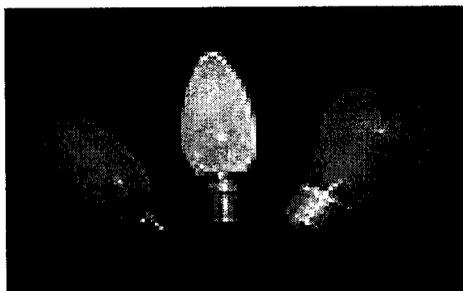


Fig.4.1.3.2.1.

Very small lamps may have the filament support wires extended through the base of the lamp, and can be directly soldered to a printed circuit board for connections. Some reflector-type lamps include screw terminals for connection of wires. Most lamps have metal bases that fit in a socket to support the lamp and conduct current to the filament wires. In the late 19th century manufacturers introduced a multitude of incompatible lamp bases. General Electric introduced standard base sizes for tungsten incandescent lamps under the Mazda trademark in 1909. This standard was soon adopted across the United States, and the Mazda name was used by many manufacturers under license through 1945. Today most incandescent lamps for general lighting service use an Edison screw or double contact bayonet base. Bayonet base lamps are frequently used in automotive lamps to resist loosening due to vibration. A bipin base is often used for halogen or reflector lamps.

Lamp bases may be secured to the bulb with cement, or by mechanical crimping to indentations molded into the glass bulb.

The double-contact bayonet cap on an incandescent bulb

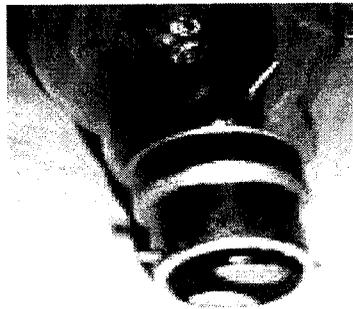


Fig. 4.1.3.2.2.

Miniature lamps used for some automotive lamps or decorative lamps have wedge-bases which have a partial plastic or even completely glass base. In this case, the wires wrap around to the outside of the bulb, where they press against the contacts in the socket. Miniature Christmas bulbs use a plastic wedge base as well.

Lamps intended for use in optical systems (such as film projectors, microscope illuminators, or stage lighting instruments) have bases with alignment features so that the

filament is positioned accurately within the optical system. A screw-base lamp may have a random orientation of the filament when the lamp is installed in the socket.

4.1.3.3. Voltage, light output, and lifetime

Incandescent lamps are very sensitive to changes in the supply voltage. These characteristics are of great practical and economic importance.

For a supply voltage V near the rated voltage of the lamp:

- *Light output* is approximately proportional to $V^{3.4}$
- *Power consumption* is approximately proportional to $V^{1.6}$
- *Lifetime* is approximately proportional to V^{-16}
- *Color temperature* is approximately proportional to $V^{0.42}$

This means that a 5% reduction in operating voltage will more than double the life of the bulb, at the expense of reducing its light output by about 20%. This may be a very acceptable trade off for a light bulb that is in a difficult-to-access location (for example, traffic lights or fixtures hung from high ceilings). "Long-life" bulbs take advantage of this tradeoff. Since the value of the electric power they consume is much more than the value of the lamp, general service lamps emphasize efficiency over long operating life. The objective is to minimize the cost of light, not the cost of lamps.

The relationships above are valid for only a few percent change of voltage around rated conditions, but they do indicate that a lamp operated at much lower than rated voltage could last for hundreds of times longer than at rated conditions, albeit with greatly reduced light output. The *Centennial Light* is a light bulb which is accepted by the *Guinness Book of World Records* as having been burning almost continuously at a fire station in Livermore, California, since 1901. However, the bulb is powered by only 4 watts. A similar story can be told of a 40-watt bulb in Texas which has been illuminated since September 21, 1908. It once resided in an opera house where notable celebrities stopped to take in its glow, but is now in an area museum.

In flood lamps used for photographic lighting, the tradeoff is made in the other direction. Compared to general-service bulbs, for the same power, these bulbs produce

far more light and (more importantly) light at a higher color temperature, at the expense of greatly reduced life (which may be as short as 2 hours for a type P1 lamp). The upper limit to the temperature at which metal incandescent bulbs can operate is the melting point of the metal. Tungsten is the metal with the highest melting point, 3695 K (6192°F). A 50-hour-life projection bulb, for instance, is designed to operate only 50 °C (90 °F) below that melting point. Such a lamp may achieve up to 22 lumens per watt, compared with 17.5 for a 750-hour general service lamp.

Lamps designed for different voltages have different luminous efficacy. For example, a 100-watt, 120-volt lamp will produce about 17.1 lumens per watt. A lamp with the same rated lifetime but designed for 230 V would produce only around 12.8 lumens per watt, and a similar lamp designed for 30 volts (train lighting) would produce as much as 19.8 lumens per watt. Lower voltage lamps have a thicker filament, for the same power rating. They can run hotter for the same lifetime before the filament evaporates.

The wires used to support the filament make it mechanically stronger, but remove heat, creating another tradeoff between efficiency and long life. Many general-service 120-volt lamps use no additional support wires, but lamps designed for "rough service" or "vibration service" may have as many as five. Low-voltage lamps have filaments made of heavier wire and do not require additional support wires.

Very low voltages are inefficient since the lead wires would conduct too much heat away from the filament, so the practical lower limit for incandescent lamps is 1.5 volts. Very long filaments for high voltages are fragile, and lamp bases become more difficult to insulate, so lamps for illumination are not made with rated voltages over 300 V. Some infrared heating elements are made for higher voltages, but these use tubular bulbs with widely separated terminals.

4.2. CHARACTERISTICS OF CFL

4.2.1. Lifespan

The average rated life of a CFL is between 8 and 15 times that of incandescents. CFLs typically have a rated lifespan of between 6,000 and 15,000 hours, whereas incandescent lamps are usually manufactured to have a lifespan of 750 hours or 1,000

hours. Some incandescent bulbs with long lifetime ratings have been able to trade voltage for lifespan, slightly reducing light output to significantly improve the rated number of hours.

The lifetime of any lamp depends on many factors including operating voltage, manufacturing defects, exposure to voltage spikes, mechanical shock, frequency of cycling on and off, lamp orientation and ambient operating temperature, among other factors. The life of a CFL is significantly shorter if it is only turned on for a few minutes at a time: In the case of a 5-minute on/off cycle the lifespan of a CFL can be up to 85% shorter, reducing its lifespan to "close to that of incandescent light bulbs". The US Energy Star program suggests that fluorescent lamps be left on when leaving a room for less than 15 minutes to mitigate this problem.

CFLs produce less light later in their life than when they are new. The light output decay is exponential, with the fastest losses being soon after the lamp is first used. By the end of their lives, CFLs can be expected to produce 70–80% of their original light output. The response of the human eye to light is logarithmic: Each f-number (or photographic 'f-stop') reduction represents a halving in actual light, but is subjectively quite a small change. A 20–30% reduction over many thousands of hours represents a change of about half an f-stop, which is barely noticeable in everyday life.

4.2.2. Energy efficiency

The chart shows the energy usage for different types of light bulbs operating at different light outputs. Points lower on the graph correspond to lower energy use.

For a given light output, CFLs use 20 to 33 percent of the power of equivalent incandescent lamps. Since lighting accounted for approximately 9% of household electricity usage in the United States in 2001, widespread use of CFLs could save as much as 7% of total US household usage.

4.2.3. Heating and cooling

If a building's indoor incandescent lamps are replaced by CFLs, the heat produced due to lighting will be reduced. At times when the building requires both heating and lighting, the heating system will make up the heat. If the building requires both

illumination and cooling, then CFLs also reduce the load on the cooling system compared to incandescent lamps, resulting in two concurrent savings in electrical power. Overall energy cost saving depends on the climate; increased heating energy demand offsets some of the lighting energy saved.

4.2.4. Efficacy and efficiency

A typical CFL is in the range of 17 to 21% efficient at converting electric power to radiant power based on 60 to 72 lumens per watt source efficacy, and 347 lumens per radiant watt luminous efficacy of radiation for a tri-phosphor spectrum. Because the eye's sensitivity changes with the wavelength, the output of lamps is commonly measured in lumens, a measure that accounts for the effect of the source's spectrum on the eye. The luminous efficacy of CFL sources is typically 60 to 72 lumens per watt, versus 8 to 17 lm/W for incandescent lamps.

4.2.5. Embodied energy

While CFLs require more energy in manufacturing than incandescent lamps, this embodied energy is more than offset by the fact that they last longer and use less energy than equivalent incandescent lamps during their lifespan.

4.2.6. Cost

While the purchase price of an integrated CFL is typically 3 to 10 times greater than that of an equivalent incandescent lamp, the extended lifetime and lower energy use will more than compensate for the higher initial cost. A US article stated "A household that invested \$90 in changing 30 fixtures to CFLs would save \$440 to \$1,500 over the five-year life of the bulbs, depending on your cost of electricity. Look at your utility bill and imagine a 12% discount to estimate the savings."

CFLs are extremely cost-effective in commercial buildings when used to replace incandescent lamps. Using average U.S. commercial electricity and gas rates for 2006, a 2008 article found that replacing each 75 W incandescent lamp with a CFL resulted in yearly savings of \$22 in energy usage, reduced HVAC cost, and reduced labor to change lamps. The incremental capital investment of \$2 per fixture is typically paid back in about one month. Savings are greater and payback periods shorter in regions with higher

electric rates and, to a lesser extent, also in regions with higher than U.S. average cooling requirements.

4.2.7. Starting time

Incandescent's reach full brightness a fraction of a second after being switched on. As of 2009, CFLs turn on within a second, but may still take time to warm up to full brightness. Some CFLs are marketed as "instant on" and have no noticeable warm-up period, but others can take up to a minute to reach full brightness, or longer in very cold temperatures. Some, that use a mercury amalgam, can take up to three minutes to reach full output. This and the shorter life of CFLs when turned on and off for short periods may make CFLs less suitable for applications such as motion-activated lighting.

CHAPTER 5

COMPARITIVE ANALYSIS OF INCANDESCENT LAMP AND CFL

CHAPTER 5

COMPARITIVE ANALYSIS OF INCANDESCENT LAMP AND CFL

Table 5.1 – Parameter comparison between Incandescent Lamp and CF

Sl.No	Parameter	Incandescent lamps	Compact Fluorescent Lamps
1.	Life Time (in burning hour)	1000	10,000
2.	Luminous Efficiency in Lumen /Watt	11	50
3.	Energy cost or 10,000 burning hour @ Rs.1.75 / Kwh	1750	400
4.	Purchase cost per lamp in Rs.	25	250
5.	Operation cost in Rs. (3 + 4)	$1750+25 = 1775$	$400 + 250 = 650$
6.	Heat developed and cooling	More heat developed and it takes longer time to cool	Less heat developed and quick cooling
7.	Starting time to reach full brightness (in seconds)	0.27	1

Table-5.2. Electrical power equivalents between Incandescent lamp and CFL

Sl.No	Luminous Efficiency	Incandescent Lamps		Compact Fluorescent Lamps	
		Watts	Cost in Rs	Watts	Cost in Rs
1.	450	40	15	9–13	95
2.	800	60	20	13–15	100
3.	1,100	75	25	18–25	145
4.	1,600	100	30	23–30	180
5.	2,600	150	35	30–52	200

Source: Secondarydata

Table 5.3 - Comparative Wattage of CFLs and Incandescent Lamp

Incandescent Lamp (Watts)	CFL (Watts)
25	5
50	9
60	15
75	20
100	25
120	28
150	39

Table 5.4. Cost Comparisons between CFLs and Incandescent Lamp

Description	25-Watt CFL	100-Watt Incandescent
Cost of Lamps(in Rupees)	150	25
Lamp Life	1,667 days (4.5 years)	167 days
Annual Energy Cost in Rupees(10 Hours per day with power consumption charges as 2 Rupees/Kwh)	182.50	730
Lamps Replaced in 4.5 years	0	10
Energy cost for 4.5 years	$182.50 \times 4.5 = 971.25$	$730 \times 4.5 = 3535$
Total Cost for 4.5 years	$971.25 \times 150 = 1121.25$	$3535 + 250 = 3785$
Savings in Rupees	2663.75	0

Based on Luminous values

Source: Secondary Data

Ref: Friedel, Robert, and Paul Israel (1986). Edison's electric light: biography of an invention. New Brunswick, New Jersey: Rutgers University Press. pages 115–117

CHAPTER 6

CONCLUSION

CHAPTER 6

CONCLUSION

From the comparison of CFL Vs Incandescent Lamps by this project the cost and performances of both the Incandescent and CFL are analyzed.

The following table shows the various Manufactures of CFL with Wattage ratings and the product cost are given.

Table 6.1. Various Companies Cost Comparison for CFL Lamps with Wattage Ratings

Sl.no.	Wattage Rating	Various manufactures of CFL lamps (cost in rupees)				Incandescent lamps (PHILIPS)	
		PHILIPS	SAMSON	OSRAM	VINVERTH	Watts	Cost in Rs.
1	5	132	95	115	120	25	15
2.	8	135	100	130	165	50	20
3.	11	155	145	140	180	75	22
4.	18	190	180	180	250	100	25
5.	23	220	200	210	280	150	35

Interpretation: From this Table, we found that, 23 wattage CFL Samson

Make having the cost of Rs. 200 and the cost of 150 wattage of Philips

Make Incandescent lamp having the cost of Rs.350 (Rs.35 x 10 bulbs).

So, CFL is better and cheaper in total cost of the product.

Finally this cost comparison shows the various brands of CFL and the Models of Samson brand is cost wise better than other brands.

Meanwhile Viverth have to reduce the cost of the product to get the Market demand.

Life Span of CFL over Incandescent Lamps compared with no. of days of usage

Vs Cost.

Life Span of CFL and Incandescent Lamps

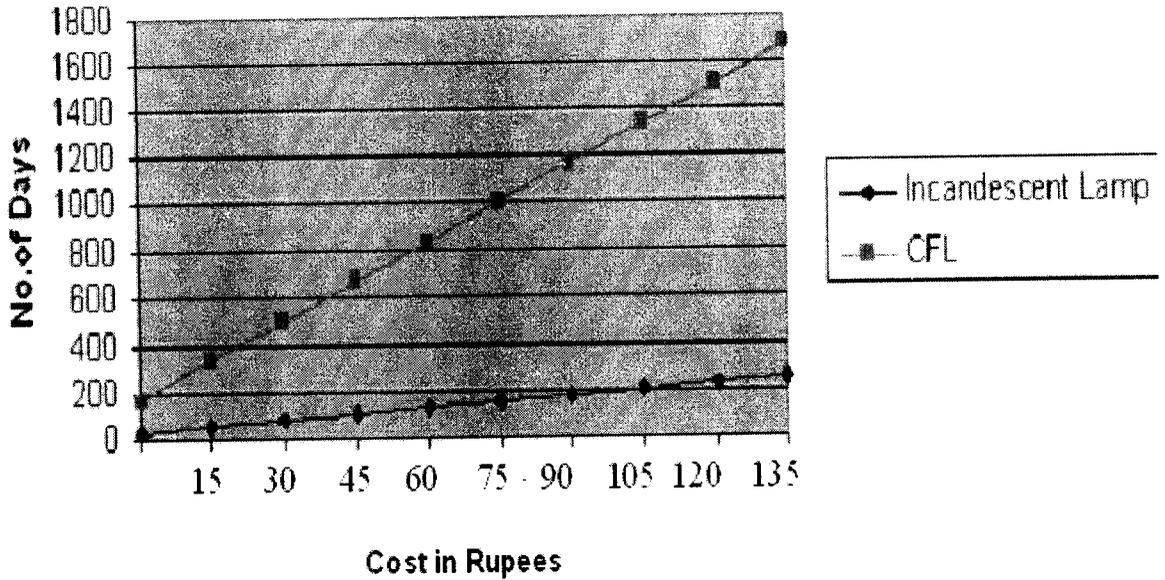


Fig 6.1

The following figure indicates that the power utilized for CFL and Incandescent Lamps compared with Luminous efficiency.

Comparison of chart for luminous efficiency Vs power consumption

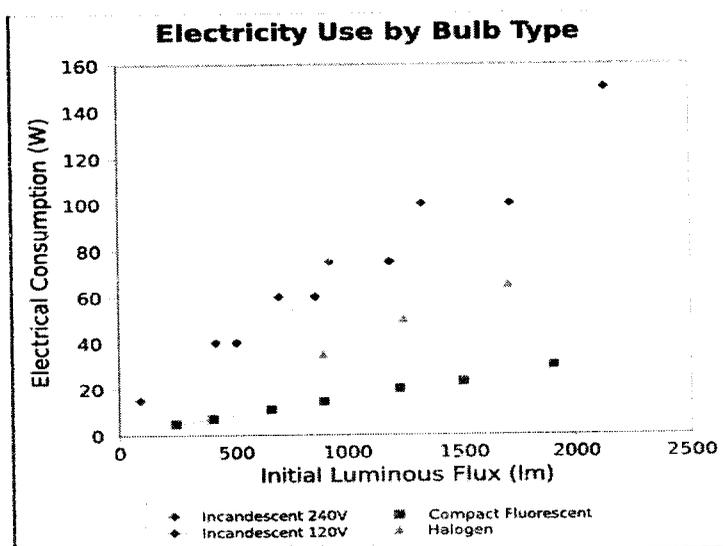


Fig 6.2

It is concluded that the CFL are having more advantages than Incandescent lamps. Some of the special features of CFL are given below.

- CFL's last up to 10 times longer than incandescent bulbs
- CFL's use about 75% less energy than incandescent bulbs
- CFL's produce 90% less heat, while producing more light per watt than incandescent bulbs
- CFL's will save you money on your electric bill!

CFLs are more energy efficient because they use less energy to provide the same amount of light. Fluorescent bulbs use discharge technology, which uses energy to create an arc of excited mercury vapor across the bulb. Less energy is needed to maintain this arc than to keep an incandescent filament burning. To provide less energy to the bulb, the bulb is designed to operate on high frequency electronics that reduce the energy used by the bulb.

CHAPTER 7

REFERENCES

CHAPTER 7

REFERENCES

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