LIGHTING EVOLUTION: BENEFITS OF LED LIGHTING
As of Jan 1, 2016

Certainly, you have heard and read a lot about the advantages and benefits of the energy efficiency of LED (Light Emitting Diodes) vs traditional lighting. When you compare them to other energy-saving illumination methods that are available on the market today, you will find that LED lighting is, by far, the most power-saving and smart solution. LEDs are extremely energy efficient and long lasting. LED technology is not new. LEDs were introduced commercially in 1962 and commonly used for decades in cars, TV's, watches, radios and many other everyday applications. Recent research and product developments in the field of LED illumination have electrified the LED lighting revolution that will further help us save money and our planet.

Today, LEDs are the latest and most exciting technological advancement in the lighting industry. LEDs are tiny light bulbs that fit easily into an electric circuit, but unlike ordinary bulbs, they don't get hot and don't have a filament that will burn out. LEDs illuminate exclusively by the movement of electrons inside of the semiconductor material; a diode is the simplest sort of semiconductor device with varying ability to conduct electrical current. LEDs operate quite differently than traditional incandescent and fluorescent light bulbs. This makes LEDs far more rugged and durable than traditional light bulbs. Therefore, the lifespan of an LED far surpasses the short life of incandescent and fluorescent bulbs by thousands of hours. LED technology offers many advantages over incandescent, neon and fluorescent lighting devices, such as: exceptionally longer life span, enormously lower energy usage, reduced maintenance costs and many other benefits. LEDs are currently being used for a wide variety of applications such as: residential lighting, aerospace, architectural lighting, automotive, aviation, broadcasting, electronic instrumentation, entertainment and gaming, industrial automation and controls, the military, traffic and safety and transportation.

2016 LED lighting is a big leap forward in technology that can be viewed similarly to the upgrade from analog to digital in telecommunications. LED is a digital light. The advantages versus conventional 'analog' lighting are so significant that they benefit not only the user, but the entire planet.

Key Benefits of LED Lighting vs Conventional Lighting

1. Long Life

Long lifetime stands out as the number one benefit of LED lights. LEDs, and the diodes that power them, have an outstanding operational lifetime expectation that is typically 50,000 hours (25,000 hours for some residential grade and even up to 100,000 hours for specialty applications) compared to 2,000 hours for incandescent bulbs. This represents a 25 to 50 times longer life.

Most commercial LEDs have a lifespan of up to 50,000 hours. This is years of use before required replacement. On average, LED bulbs last 10 to 20 times as long as conventional fluorescent, metal halide, high-pressure sodium and halogen bulbs. Long lifespan of LEDs will dramatically reduce maintenance costs and lower long-term operating costs compared to traditional lighting sources.

Light Emitting Diode lifespan scenarios:

	Hrs per day 24	Hrs per day 12	Hrs per day 4	Hrs per day 3	Hrs per day 2
Hours	50000	50000	50000	50000	50000
"Light Days"	2083.3	4166.7	12500	16666.7	25000
Days in Year	365	365	365	365	365
Life in Years	5.7	11.4	34.2	45.7	68.5

LED's are different from standard lighting: LEDs don't really burn out and stop working like a standard light. LEDs will eventually fade by emitting lower output levels over a long period of time and become less bright. The long lifetime of LEDs reduces the need to replace failed lamps, and this can lead to significant savings, particularly in the cost of sending out maintenance crews. This also makes LED fixtures useful for installation in relatively inaccessible locations.

2. Energy Efficiency

LEDs are extremely energy efficient and consume **up to 90% less** power than incandescent bulbs. Since LEDs use only a fraction of the energy of an incandescent light bulb, there is a dramatic decrease in power costs.

LEDs are superior at efficiently converting electrical energy to photons (light) and heat. When compared to traditional lighting and conventional light bulbs, LEDs use about 80% of the electrical energy to convert to light, while only 20% is lost and converted into other forms of energy such as heat. With traditional incandescent light bulbs, which operate at 20% energy efficiency, 80% of the electricity is lost as heat. Example:

> *If you use traditional lighting and have an electricity bill of e.g US$ 100, then US$ 80 of that money has been used to heat the room, not to light it! Using LED illumination with 80% efficiency, the electricity costs would be around US$ 20 and you'd have saved around US$ 80.*

The electrical wattage reduction and efficient use of the energy acts as a multiplier to achieve even more energy efficiency. Although LEDs have a higher initial cost than incandescent and compact fluorescent light bulbs, the cost is quickly recouped with much lower electricity costs.

3. Ecologically Friendly

LED lights are free of toxic chemicals. Most conventional fluorescent lighting bulbs contain various materials such as mercury, which is highly toxic for the environment. LED lights contain no toxic materials and are 100% recyclable; this will help reduce your carbon footprint. The long operational life and time span mentioned above also means that one LED light bulb can save material and production of 25 equivalent incandescent light bulbs.

4. Durable Quality

LEDs are extremely durable and are built with components that are highly rugged and can withstand even the roughest conditions. LEDs are solid-state lighting devices that utilize semiconductor material instead of a filament or neon gas. An LED light is a tiny chip encapsulated in an epoxy resin enclosure, this makes LEDs far sturdier than traditional incandescent light bulbs or fluorescent tubes. Because LED lights are resistant to shock, vibrations and external impacts, they make great outdoor lighting systems for rough conditions and exposure to weather, wind, rain or even external vandalism, traffic related public exposure and construction or manufacturing sites.

5. Safety

Improved safety may be one of LED's most important benefits. LED lights generate virtually no heat. Therefore, they are cool to the touch and can be left on for hours without incident or consequence if touched. **LEDs produce 3.4 Btu's/hour, compared to 85 Btu's/hour for incandescent bulbs.** In comparison, incandescent lighting expels 80 - 90% of the energy it consumes via heat, making the bulbs hot to the touch. LEDs reduce the potential for safety risks such as burns and fires.

6. Color

LED lights are offered in a variety of base colors such as Red, Green, Blue and Amber. Because traditional incandescent light bulbs use filters to produce colors, they are extremely inefficient. LEDs can be blended together to produce millions of color options.

7. Zero UV Emissions

LED illumination produces little infrared light and close to no UV emissions, and have the benefit of low radiated heat emission. This makes LED lighting highly suitable not only for goods and materials that are sensitive to heat, but also for illumination of UV sensitive objects or materials such artifacts and art in museums, art galleries, archeological sites, etc.

8. Design Flexibility and Dimmability

LEDs can be combined in any shape to produce highly efficient illumination. Individual LEDs can be dimmed, resulting in a dynamic control of light, color and distribution. Well-designed LED illumination systems can achieve fantastic lighting effects, not only for the eye, but also for the mood and the mind:

> *LED mood illumination is already being used in airplanes, classrooms and other locations, with many more LED applications to be introduced within the next few years.*

9. Operational in Extremely Cold or Hot Temperatures

LEDs are ideal for cold and low outdoor temperature setting operations. Low temperatures may affect the operations, and present a challenge, with fluorescent lamps. LED illumination operates well in cold settings, such as outdoor winter settings, freezer rooms, grocery store coolers, etc. Temperature ranges can be below zero degrees Fahrenheit to over 100 degrees Fahrenheit.

10. Light Dispersement

Well-designed LED illumination systems are able to deliver light more efficiently to the desired location. LED illumination is designed to focus light and can be directed to a specific location without the use of an external reflector. This achieves a higher application efficiency than conventional lighting.

11. Instant Lighting & Frequent Switching

LED lights brighten up immediately when powered on. This has great advantages for infrastructure projects such as traffic and signal lights, as well as more flexible sensoring. LED lights can be switched off and on frequently without affecting the lifetime or light emission of the LEDs. In contrast, traditional lighting may take several seconds to reach full brightness, and frequent on/off switching weakens the components.

12. Low-Voltage

A low-voltage power supply is sufficient for LED illumination. This also makes it easy to use LED lighting in outdoor setting by connecting an external solar-energy source. This is a big advantage when it comes to using LED technology in remote or rural areas.

Future of Lighting and Applications

LEDs are rapidly replacing traditional incandescent light bulbs. LEDs are becoming the preferred lighting solution of both professionals and residential users. LED technology is continually advancing - producing brighter and more efficient LED bulbs. The U.S. Department of Energy hopes to reduce the electricity used for lighting by 50% by converting to LED based light source. The dollar-per-lumen cost of LEDs has been drastically reduced in the past few years. Lumen output of LEDs has also been increasing. Even though LEDs currently cost more than conventional lamps, the cost per lumen and cost per watt is very comparable. When overall energy and maintenance savings are considered in purchase decisions, LEDs drive a significantly better return on investment.

LEDs are currently used for a wide variety of different applications such as: residential lighting, aerospace industry, architectural, automotive, broadcasting, electronic instrumentation, entertainment and gaming, the military, traffic and transportation. Since LEDs are focused lights, they can solve specific lighting tasks such as desk lamps, reading lights, night lights, security lights, spotlights, accent lights and lighting for signage. The major recent breakthrough is the fixture and

bulb designs that allow for optimal light disbursement enabling LEDs to meet light requirements of large spaces. As a result, there are a growing number of additional commercial applications in offices, medical facilities, residences, restaurants, colleges, public buildings, manufacturing, warehousing, parking garages, etc. This growth is a direct result of broader awareness and education of facility managers and their desire to reduce expenses.

Knowledge Gap

The main issue facing LEDs adoption is a gap in understanding between the LED industry and the consumer public, be it residential or commercial. Unfortunately, the latter group does not understand much about LEDs and are unfamiliar with crucial issues such as the benefits listed above. Secondarily, the consumer is generally skeptical of lighting changes based on a lack of information, and the recent encouragement, by utilities and the industry, to buy fluorescent lamps. In such a fragmented marketplace, the consumer can be forgiven for being confused, uninformed about the facts, and generally skeptical about the information they receive. That said, LEDs are here to stay and will eventually replace all conventional lighting, as they already have in Europe and Asia.

Additional point of interest:

Due to all of the reasons listed above: NASA uses LEDs extensively. See link below.

Related Reading

http://energy.gov/energysaver/led-lighting

http://www.nasa.gov/mission_pages/station/research/experiments/651.html

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