5th International Conference on Control & Signal Processing (CSP-2021)
Proceedings Book Series –PBS-Vol 2, pp.48-51

Management of the Electrical lighting Energy

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Abstract— **This paper presents a detailed analysis for the lighting energy management. In fact, different types of lighting that exist on the market dedicated to residential lighting have been compared in order to control the abandoned consumption. This comparative analysis brings us to a better choice of lighting to use in terms of luminous efficiency, energetic and economical. Finally, it has been concluded that the most efficient and least consuming lamps are those belonging to the LED technology.**

Keywords— **Electricity management, Lighting, Power consumption, Energy saving.**

I. INTRODUCTION

The increase of electricity consumption in residential buildings can largely be explained by the increase of electrical charges, which often, despite their low power, consume an overwhelming amount of electricity.

For these reasons, and in face of the challenges of global warming and depletion of fossil resources, energy efficiency has become one of the key subjects for all fields of activity with considerable potential for Tunisia while Renewable energies remains modest [1].

The correlation between consumption, costs and ecology is simple but crucial and to achieve it, a variety of methods and processes combined with a rigorous energy management and energy efficiency program is needed. Indeed, it is necessary to change the practices of the electric energy used at home and insist on an active behaviour management of the needs.

Residential energy consumption is very varied and lighting accounts presents a significant share of electricity consumption around 19 % worldwide (3 % of world crude oil demand) [2].

These loads are generally not interruptible, because of their operation, and also their influence on the visual comfort. Studies in the tertiary sector have shown that energy savings can be achieved through improved lighting management. This better use of the light passes through a decrease in intensities, the use of presence sensors and timers.

The approach is based on an understanding of the lighting equipment functioning by determining the different criteria and technical specifications of several lighting existing on the market. The aim of this work is to ensure a correct light efficiency while respecting the environmental aspect and above all to find the solution of economic lighting to reduce power call.

II. BENEFITS OF STANDARDISATION IN LIGHTING

The standards in lighting are established by experts from the whole industry: the ECS (European Committee for Standardisation), the IEC (International Electro technical Commission) for the international scale and the AFNOR (French National Organization for Standardisation).

The standards in lighting are a compromise between the rules of the art, the technical capacities of the equipment and the economic moment constraints. The benefits of standardisation are obtained by all economic lighting actors.

The lighting quality can be expressed by the classic three-dimensional model which includes:

-The well-being of the individual: visibility, comfort and safety.

-The economy.

-The environment.

In Tunisia, the official standardisation which called INNORPI (National Institute for Standardisation and Industrial Property), is the national information point on standards. This institute certifies conformity with the standards of products, services and management systems and it also manages the national conformity marks [3].

III. LIGHTING

This is a very greedy and costly position, accounting for 17.6 % of household electricity consumption in Tunisia in 2009. All of these effects will increase by 60 % in 2030.

There are several types of devices apartment used for lighting in an installation: incandescent lamps, halogen lamps (with or without dimmer), neon tubes, low consumption lamps, etc. For example, halogen lamps generally present a resistive characteristic, or low-consumption lamps generates nonlinearity and call for harmonic-rich input current [4, 5].

To choose the most suitable light lamp, we have to start from Lumens (lm) and not from Watt. The Lumens represent the illumination that the lamp will produce:

-For an incandescent lamp, it is necessary to multiply its power in Watt by 12.

-For an halogen lamp, it is necessary to multiply its power in Watt by 20.

-For a compact fluorescent lamp, it is necessary to multiply its power in Watt by 60.

ISSN: 2961-6611

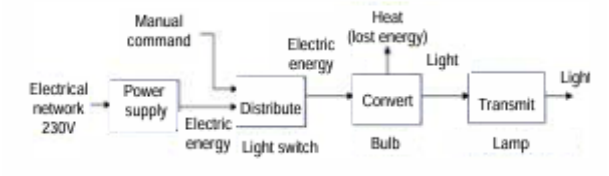

Fig. 1 Functional diagram of the electric lighting energy chain at the home

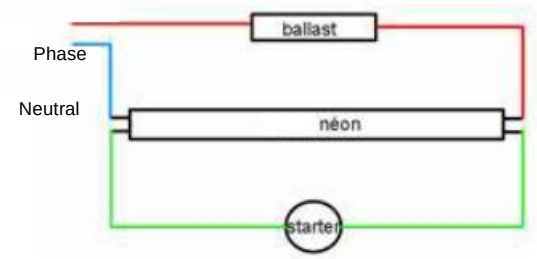

Fig. 2 Operation principle of a compact fluorescent tube

These values of 12, 20 and 60 represent the luminous efficiency (lm / W). The higher it is, the better because the lamp will produce more lights for less electricity consumption [6].

LEDs lamps have the most important light output generally including between 80 and 95 lm / W and they concur more and more the fluorescent lamps. Even, if it is better to choose a good quality fluorescent compact rather than a low-end LED lamp since it is essential to be equipped by a coherent lamp and not a harmful one to health especially when the lifetimes of products are counted in decades.

On the other hand, it is clear that incandescent and halogen lamps are obsolete because of their lifetimes and their electrical consumption.

A. Conventional incandescent lamps

The principle is based on heating the filament at a very high temperature (about 2500 °C). This technique presents the disadvantage of the lifetime, the luminous efficiency and the loss of heat. Indeed, 5 % of energy absorbed by the lamp is estimated to be restored in light and the remainder being in heat. As a result, these light bulbs are being phased out and this started in 2009 by the European Union.

B. Halogen incandescent lamps

The halogen lamps have the same operating principle as conventional incandescent lamps. The only except is that the halogenated gases contained in the halogen one will prevent sublimation of the filament which will increase its lifetime (nearly 2 times greater). Moreover, by avoiding sublimation, there will be no (or less quickly) vapors settle on the walls.

However, by disadvantage, halogen lamps often have the reputation of being very energy consuming. Nevertheless the halogen technology continues to evolve (appearance of new gases used ...).

However, halogen tubes should always be avoided. Indeed, they are often of great power (greater than 100 W) and are used only for indirect lighting with a limited lifetime (2000 h).

C. Compact fluorescent lamps-low power

Compact fluorescent lamps have the same functional principle as a neon tube but folded on itself. These lamps are now attracting the attention of all. Both for their good lighting capabilities and their low consumption, but also on polemics and health risks presumed: mercury pollution, production of a magnetic field, Etc. [7].

An electronic ballast (electronic component that acts on the electric current) causes a large electrical discharge. So the creation of a magnetic field, then, of ultraviolet radiation invisible to the naked eye. Fluorescent dust on the surface of the lamp will therefore convert these ultraviolet radiations into visible radiation (light).

The major disadvantage is the risk of mercury poisoning when the lamp is breaking. In fact, fluorescent lamps contain mercury steam around 1 to 25 mg and 20 to 30 mg in fluorescent tubes.

D. LEDs lamps (Light-Emitting Diode)

It is a type of electric lamp that uses light emitting diodes which are the electronic components that allow the transformation of electricity into light. It is indeed during the displacement of electrons between two semiconductors that light will be emitted (depending on the type of conductor). The lamp is made up of several LEDs of high powers joined together because their luminous flux is still too low.

The advantages that can be cited are:

-Very long lifetime: up to 40000 h, this is several decades of use compared to 10000 h for compact fluorescent lamps.

-Very good light output (about 6 times more than the conventional incandescent lamp).

TABLE I
COMPARISON AND EQUIVALENCE OF INCANDESCENT LAMPS (I) / HALOGEN (H) / COMPACT FLUORESCENT (F) AND LED (L)

lamp power(W)	**40**				**60**				**100**			
Type	I	H	F	L	I	H	F	L	I	H	F	L
Electric power (W)	40	28	9	6	60	48	13	8	100	70	20	12
Light output (lm)	415	440	405	500	720	630	720	810	1200	1200	1350	1300
Light yield (lm/W)	10.4	15.7	45.0	83.3	12.0	13.1	55.4	101.3	12.0	17.1	67.5	108.3
Lifetime (year)	2.5	5.5	21.9	82.2	2.7	5.5	21.9	82.2	2.7	5.5	21.9	82.2
Saved energy over lifetime(KWh)	-	24	248	1020	-	24	376	1560	-	60	640	2640

ISSN: 2961-6611

-Good resistance to cycles 'ignition, extinction'.

-No risk of pollution: LEDs lamps don't contain mercury and are largely recyclable as not dangerous waste.

-Temperature bulb without risk of burning [8].

Table 1 presents a comparison of these lamps with several criteria and we note that compact fluorescent and LED lighting consume respectively 9 W and 6 W. These powers look quite similar but less than the consumption of incandescent and halogen lamps (40 W and 28 W). Regarding the lifetime, a compact fluorescent lamp ensures a lifetime 4 times longer than an halogen lamp having the same power.

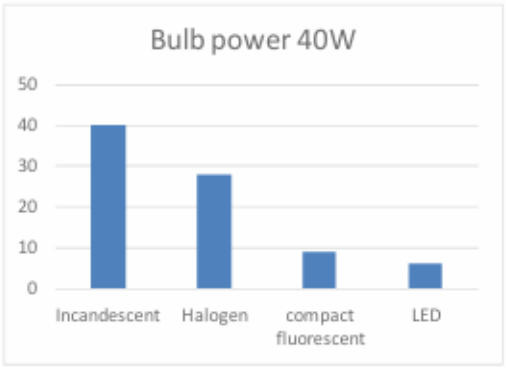

Fig. 3 Diagram of statistical data for the electrical consumption of different lamps

At this stage, according to the statistic table on figure 3, the decreasing ranking of bulb's electrical consumption appears clear but a new competitive threshold is installed. It's eventually between the compact fluorescent lamps and LED ones.

TABLE II
COMPARATIVE TABLE LED / COMPACT FLUORESCENT

Comparative	neon tube LED	compact fluorescent tube
Consumption	low	high
lifetime	>50 000 h (> 6 years, alight 24h/24 7days/7)	>18 000 hours
Recycling	easy	specialized
CO2 emission	low	high
Radiation	-	infrared and ultraviolet
Toxicity	-	mercury, lead, phosphorus
Blink light and buzzing sound	-	frequent
Ignition	instantaneous	progressive
Solidity	Very resistant	fragile
Heat clearance	low	high
Maintenance	rare	frequent

The «Global Efficient Lighting» forum which took place in Beijing, China, in November 2014, assumed that if all light sources were switched to LED technology, global electricity consumption for lighting would be halved.

LED technology continues to be improved. Indeed, performance's LED doubles every two years and prices drop by 20 % each year. According to table II, the consumption of a neon tube LED is lower than the compact fluorescent one against a longer life. In addition, we notice clearly the absence of toxicity and the negligence of the CO2 emission.

IV. CONCLUSIONS

It's in an energy efficiency context that the transition to efficient lighting in Tunisia presents an important significant energy-saving potential. Notably through the elimination of incandescent lamps and their replacement by more efficient technologies. Indeed, the ANME recommends the use of low-consumption lamps which proves to be more economical and environmentally than traditional incandescent lamps or even fluorescent tubes. The choice of a lamp must be made according to the utility in order to guarantee a sufficient quality lighting. Also, it is always necessary to privilege the contributions of natural lighting and optimize the space according to the light access by creating additional openings or glass windows.

This deduction represents one of the most direct and economical solutions to reduce the consumption and associated greenhouse gas (GHG). So, the implementation of such an optimization outcome must also be well based on the beneficial choice and the technique of the lighting that the hourly operating schedule.

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ISSN: 2961-6611