Spectroscopic studies of commercial LED lights & the emerging danger of "Blue-Light Hazard"

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Abstract - - This paper was formed to put some light on the hazardous effect of commercial LED bulbs by performing the spectroscopic measurements. This paper is putting light in the path for harmless lighting system.

Key Words: Spectroscopy, LED (light emitting diode)

1. INTRODUCTION

LED devices have set a new trend in the technology market today, their use is increasing exponentially because they are easy to manufacture, cost effective and power efficient. Use of LEDs can be seen from the balcony bulb of a ban glow to the bulb on a street vendor's vegetable cart, wrist watches and mobile phones etc. [1,2,3]

White light, with color temperature around 5000 K, is preferred especially in Asian countries over conventional incandescent lamps. This is the reason for surge in commercial value for white LED's. White LED Bulbs are also available in many shades, from cool white (5500 K and higher) and warm white day light (2700 K to 3500 K) range. It is a known fact that by the use of different materials such as GaAs, GaP, GaAsP etc white light can be obtained[4,5].These white LEDs bulbs have many advantages but they suffer from some critical problems.
In cool white LEDs, substantial amount of energy is present in blue region of spectra ie, wavelengths between 400-500 nm. This is known as blue hazard whereas in daylight LEDs wavelengths in blue region are very feebly present. "Blue-light hazard" causes retinal injury created by photochemical reaction by electromagnetic exposure of radiation at wavelength between 400-500 nm[6]. A permanent damage to pigment epithelial cells of retina may be caused by the continuous exposure of LED light of shorter blue band spectrum. Moreover longer use of such devices may cause fatigue in eyes and create skin problems [7,8,9].

2. EXPERIMENAL DETAILS

A quick survey of local market revealed that 7 watt , 6000K LED bulb has largest market share in LED bulb sale, so accordingly, we have taken 7 watt, 6500K bulb of a popular brand (Bulb-A), a 7 watt, 6500K unbranded bulb (Bulb-B) and an 12 volt,7 watt LED strip , unbranded, popularly used by street vendors (Bulb-C).

Spectroscopic studies are carried out with the help of Avant's Ava Spec- 2048 spectrometer for obtaining the emission spectra of different LED bulbs.

Since UV scatter more than visible light, emission spectra of these LED bulbs at far field has also been obtained.

Optical power measurements were performed by the help of Benchmark FO power meter at different supply voltages to find out intensity variations in light output with variations in supply voltage.

3. RESULTS AND DISCUSSION

The lamp specifications mentioned on the packaging include its power ratings, given in watts, indicating total amount of electrical power consumed by the bulb, total amount of visible light emitted by bulb i.e. its luminous flux given in lumen and color of emitted light in color temperature.

The total electric power consumption and luminous flux of all the three bulbs is evaluated and is tabulated in table 1,row 1,2&3, respectively against the values marked on the packaging.

It is evident from the table 1 that unbranded bulbs (ie. Bulbs B & C) are not performing as per specifications provided on the packaging. The bulbs B & C are consuming greater power than the specified values and are also less efficient as compared to bulb A.

Table -1

S.No	PARAMETER	SPECIFIED VALUE	ESTIMETED VALUE		
		BULB A, B &C	BULB – A	BULB – B	BULB -C
1	Electric Power	7 watt	7 watt	8.2 watt	8 watt
2	Colour Temperature	6500K	-	-	-
3	Luminous Flux	600 lumen	600 lumen	575 lumen	450 lumen

4	Blue Content (200nm-500nm)-near field	Not Mentioned	34%	35.06 %	38.76 %

For finding out the presence of blue content in the complete range, the emission spectra in near field (at a distance of 30 cm. from the bulb) for Bulbs A, B, and C are plotted as figures 1(a), 1(b) and 1(c) respectively. This data is used to find out the percentage distribution of Blue light content (200nm – 500nm) in them. The results are tabulated in table 1, row 4 and row 5 respectively.

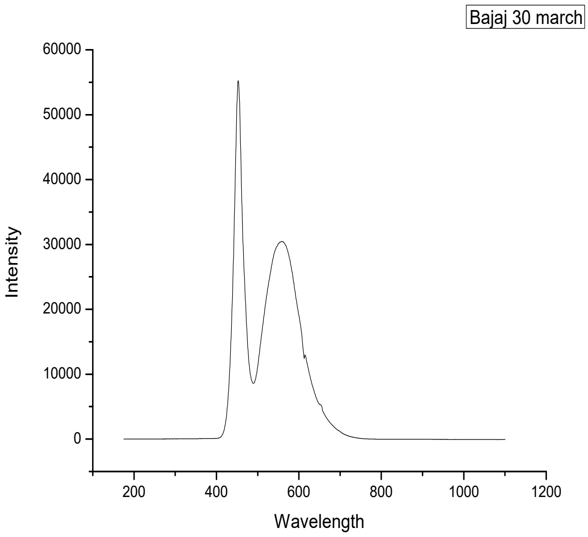

Fig -1(a): Spectra of Branded LED bulb "A"

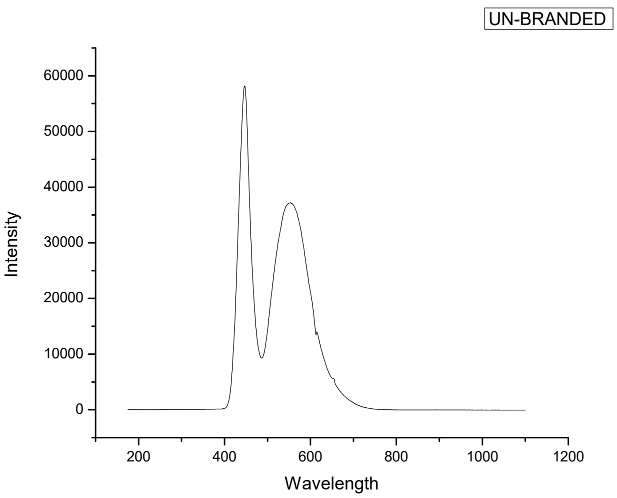

Fig -1(b): Spectra of un-branded LED bulb "B"

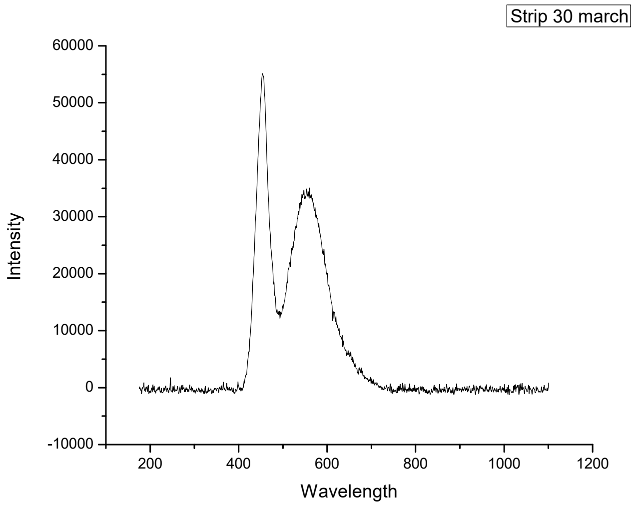

Fig -1(C): Spectra of un-branded bare LED strip

We find that a substantial amount of Blue region is present in all the bulbs. All the three graphs are approximately similar showing a significant peak at blue region (400nm - 500nm). The maximum percentage of Blue region is in bulb C, which is the bare LED strip and does not come with any covering and hence appears to be most dangerous.

4. CONCLUSIONS

The results obtained clearly indicate that a substantial amount of Blue light is present in all kinds of LED bulbs whether branded or un-branded having color temperature greater than 6000K , which is creating a high risk for Blue Hazard, Therefore a proper Blue light protection is necessary for these bulbs available in the market. This finding becomes more important if these bulbs are to be used in near field operations. Finally we suggest proper regulatory mechanism to regulate sale of LED lights in the market for different applications.

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BIOGRAPHIES

Aman Nagi received the B.Sc. degree from MJP Rohailkhand University, Bareilly,India, in 2012 and the M.Sc. degree in Applied Physics from Amity University, Uttar Pradesh, India, in 2014.
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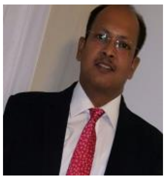

Description "**Rajiv Manohar** obtained his Ph.D. degree in 1999 from University of Lucknow, Lucknow (India). Currently, he is Professor in the department of Physics, Lucknow University. His field of interest in research is the study and characterization of the pure and doped liquid crystals. He has published more than 100 international research papers in repute journal. He has also been awarded "Young scientist" by Indian Science congress and Indian liquid crystal society. He has also been awarded by UGC research award. He is a life time member of International liquid crystal society, Indian liquid crystal society and Indian science congress. He is also a member of editorial board of some repute international journals. "

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