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MARK THROWER MANAGING EDITOR

The rise and rise of the LED

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We used to see a range of lighting technologies, including: incandescent; induction; discharge; and, LED (Light Emitting Diode). These would perform in the three fundamental areas lighting is required: general; task; and, display (but not overlooking architectural/environmental/accent lighting for completeness). We now associate LED technology as suitable in most applications.

LED technology is now at the forefront of the lighting industry – most new installations utilise LEDs and most retrofit is also being upgraded with LED technology. This article provides an overview of LED Technology in lighting and what future trends and possibilities with LEDs lighting we might see. Before that, what is an LED in simple terms?

Electroluminescence

The technology is based on a physics term known as electroluminescence. This is the emission of light through a material that is activated by an electric current. In the case of LEDs, the materials used are semiconductors. Semiconductors contain electric holes, which refer to the existence of positively charged atoms (i.e. atoms that lack electrons). When a suitable voltage is applied to semiconductors, electrons can recombine with electric holes within the device, releasing energy (and light) in the form of photons.

The LED is not necessarily a recent technology; it is the development of these in recent years that has made it more suitable for the applications we think of today. First written about in the 1920s and some mentions even before this, first notable uses began in the late 1950s and early 1960s. This was mainly around indictor lights – think of the red light on your remotes.

This was principally down to two things: they were expensive; and the lumen per watt (the efficacy) was less than 35lm/W but more commonly seen at 9lm/W – not on par with the existing technologies. Lumen being the amount of light output from a light source and watts being the power to produce that light output.

However, they started being used in applications such as screens, car brake lights and traffic lights. The development of higher efficacies and lower cost brought them to the attention of the lighting community or at least heightened their interest. As a result, we have seen many new entrants to the lighting industry. You may think of them as good for us to see but not good for things to be lit by them for us to see.

It should not be overlooked that the drive for lower energy consumption and LEDs having a theoretical efficacy greater than 150lm/W (beyond any of the existing technologies) also promoted their adoption.

There are LEDs which can be theoretically higher than this, for example: white LED with phosphorescence colour mixing at 260lm/W. To put this into context, T5 fluorescent lamps are generally around 95-105lm/W and metal halides are around 80-125lm/W.

The US Department of Energy recognised the impact that efficacy would have on LED market penetration. It published a study in 2009 stating that LED technology would be the primary technology for the lighting industry when it hit 110lm/W, a level it projected it would reach in 2012. While we started to see lighting (luminaires) products at this level prior to this date, the price point was probably still a bit high for most people's appetite.

However, today we can see many widely available LED products at this range in a very competitive price point, and perhaps have done for several years now. In fact, we generally see LED as the source of light in most products and applications now.

LEDs' useful life

There is another aspect with LED technologies that should be highlighted here, and that is useful life. When they first came on the scene the useful life for lighting products was 30,000 hours but quickly reached 50,000 hours. T5 fluorescent lamp can reach 20,000 hours but more commonly 12,000hours. High pressure sodium lamps' life is around 20,000 hours. By the time that 110lm/W was achievable at an attractive price point, many of the chips (common name for the wafer diodes in luminaires) could last 70,000 hours or more.

However, during the development the limiting factor was more the drivers (the part that regulates the electrical current to the chips). It is becoming more expected now that LED luminaires have at least a five-year warranty as a result on all part but seven years is being seen more and more now. Competition is aiding this aspect as providers look to differentiate themselves in a very competitive market.

So, up to today we have witnessed increased use in different applications; better efficacies to the point that LED is the technology for most applications now; price reductions; useful life far longer than other lamp technology; and, increased competition between suppliers.

‘LED technology is now at the forefront of the lighting industry - most new installations use LEDs’

The other advantages are: range of colours and flexibility of colour in a luminaire; sizes; warm up times; cycling from switching not reducing life; in some applications better dimming; little infrared given off; slow failures (reduced output rather than complete failure); better at shock resistance than some technologies; and, operational savings through maintenance and energy consumption.

Before we go onto the crystal ball gazing of what trends we may see in the future for lighting and LED lighting; it may be useful to mention the main parts of an LED luminaire. First, we have the chips. When using light emitting diodes for general lighting purposes, the aim is to produce light with a colour temperature close to white and in some cases warmer orange. There are two basic ways to produce white from light emitting diodes: by using individual LEDs, which emit light of three primary colours (blue, green and red) and when mixed together, they produce white light, or using a phosphor coating in order to convert light emitted from an ultraviolet LED into white light.

Then we have the drivers, the part that regulates the electrical current to the chips. They have several ways of doing this and this will depend on whether they are switched or dimmed. Ensuring the useful life of these in selecting luminaires will avoid a surprise down the line. The third main aspect to an LED luminaire is the lens or in most cases a prismatic lens.

This is essential for the distribution of the light from the luminaire. It is this aspect that you would need to think of when selecting a fitting to avoid glare in an office but also give you the uniformity for the space (or even directional if that is the purpose).

It is also the aspect that is overlooked by people when retrofitting and end up with high lighting levels and glare – mainly because they have selected on price and been naïve to think most LED luminaires are the same. The last point is really a trigger for those specifying luminaires to be careful to

select on good design principles and not on lumens out and price as this has an occurrence to come back to haunt you.

Boosting functionality

So, with price of LED technology having come down the next development in lighting will be focused on boosting functionality. They'll have built in capabilities such as increased intelligence, sensors, built-in wireless connectivity and colour tuning. Expect buzzwords such as 'IoT ready'; and, 'digital light.'

First, humancentric lighting. We have known some of the benefits of colour temperature on us and how it affects our natural rhythms (circadian rhythms). Until recently to have two different types of colour temperature in an area it was necessary to have two or more luminaires.

However, with LEDs we can expect to start seeing colour changing luminaires. Care homes and other health care facilities but also offices or other places of work will be the first applications for these. This can aid night workers who often work in conflicting lighting or indeed patients like dementia sufferers.

As much as colour temperature is a benefit, light pollution is of equal concern. This is perhaps not a new thing if anyone lives in a street that has had their road lighting changed to LED. With the cooler temperature replacing the warmer orange of high pressure sodium here it is recognised that this is a nuisance in some cases – it is the opposite colour from what we want in evenings.

The trend shall be that we should expect some regulators or local governments addressing the problem of light pollution. Just as a side note to all those that read their phones in bed – change your display for evening hours to the warmer screen and you may find you sleep better.

From the cutting edge will be Li-Fi (wireless optical networking technology for data transmission). It may not be seen in our day-to-day lives for a while as the early adopters will be the security, military and diplomatic sectors where computer users want the convenience of Wi-Fi but without its vulnerabilities. However, the advantages of Li-Fi over Wi-Fi means that it will soon be coming to a place near you. Advantages include: higher speeds than Wi-Fi; 10,000 times the frequency spectrum of radio; more secure because data cannot be intercepted without a clear line of sight; prevents piggybacking; eliminates neighbouring network interference; unimpeded by radio interference; and last but not least, does not create interference in sensitive electronics, making it better for use in environments like hospitals and aircraft.

> **'With LEDs we can expect to start seeing colour changing luminaires. Health care facilities will be the first applications'**

Connected work environments

Connectability. Big word but big ambitions for some. There are two areas I see this coming to fruition: connected work environments; and, connection to customers. The first is all around the internet of things. Pieces of will soon be connected and smart, with interaction with our own wearables. It's happening now but will gather pace. We are even starting to see this on TV adverts now, so providers are pushing it.

The connection to customers is I suspect going to be like marmite. Walking into a shop, an app is going to tell you what 'tailored offers' there are for you today or if you want to know where something else is you search it on your phone and get directions. Remember that shop knows your buying habits through your loyalty card and lighting shall be centric to this. We shall also see the rise of smart grids and lighting coming into these connected outdoor environments. Lighting has a key role to play in smart grids.

So, what about controls? We have already seen the Bluetooth and Wi-Fi connection of luminaires which is pushing out hardwire control systems (for example DALI). This means all the cost is in the fittings which means prices shall come down as manufacturing gathers pace. In addition, competition will build between manufacturers.

We are also likely to see a growth in luminaires with in-built sensors. Each luminaire shall be its own sensor, light source and the control module - a complete integrated luminaire. This will rise in areas which desire the flexibility in lighting but also people will desire better functionality; and of course, operational ability from a smart phone. We might even say goodbye to wall switches and wall clutter. This then leads into our connected environments we mention above.

Last but not least, is the design of the luminaires themselves and lighting as part of the design of the building. We are going to start seeing minimalism – lighting blending into the architecture of spaces. In apparent contradiction, we are likely to see more artistic features of lighting – more buildings with various colours. This is also likely to become more adventurous as well as more art pieces indoors (think art deco as an example of this).

So, whatever of these trends excite you or displease you; they are on the way and it is all thanks to LED development and we should be better for it.

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CPD SERIES 16 | MODULE 03 | JULY/AUGUST 2018

ENTRY FORM

LED TECHNOLOGY

Please mark your answers on the sheet below by placing a cross in the box next to the correct answer. Only mark one box for each question. You may find it helpful to mark the answers in pencil first before filling in the final answers in ink. Once you have completed the answer sheet in ink, return it to the address below. Photocopies are acceptable.

QUESTIONS

1. What are the three main areas that lighting is used?

- ☐ General, task, display
- ☐ General, indicators, display
- ☐ Display, indicators, task
- ☐ Task, display, reading

2. When did we first see the use of LEDs in practical applications?

- ☐ 1910s
- ☐ 1950s
- ☐ 1970s
- ☐ 2000s

3. How many ways are there to provide white light from LEDs?

- ☐ 3
- ☐ 2
- ☐ 5
- ☐ 4

4. What is the typical warranty of an LED luminaire now?

- ☐ 3 years
- ☐ 10 years
- ☐ 7 years
- ☐ 6 years

5. What is the common efficacy of LED luminaires for general lighting?

- ☐ 35 lm/W
- ☐ 95 lm/W
- ☐ 110 lm/W
- ☐ 260 lm/W

6. How many key components do we have in an LED luminaire?

- ☐ 2
- ☐ 3
- ☐ 6
- ☐ 8

7. LiFi is slower than Wifi at transferring data?

- ☐ True
- ☐ False

8. Where do we think we shall see more human centric lighting in the near future?

- ☐ Petrol Stations
- ☐ Sports arenas
- ☐ Care Homes
- ☐ Night Clubs

9. What colour of light do we prefer in the evenings before we would like to go to sleep?

- ☐ Cool White
- ☐ Blue
- ☐ Warm Orange
- ☐ Green

10. Where are we likely to see the uptake of LiFi first?

- ☐ Hospitals
- ☐ Schools
- ☐ Petrol Stations
- ☐ Zoos

Please complete your details below in block capitals

Name ..... (Mr. Mrs, Ms) .....

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Completed answers should be mailed to:

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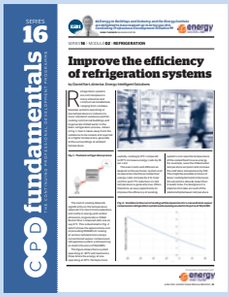

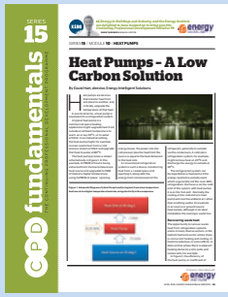

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