Application of Sunlight LEDs

LEDs, which reproduce the sunlight spectrum by up to 98 percent, are characterised by many positive effects on humans and animals as well as very natural colour rendering. This allows for a wide range of applications - from hospital, school and museum lighting to lighting for animal husbandry and plant growth.

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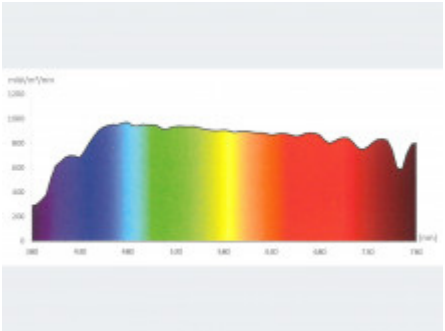
Colour does not equal colour - it depends on the light source. Usually the different colour rendering can already be seen when looking at an item of clothing in the changing room. Under the illumination of a conventional LED, colours often appear completely different than in the subsequent comparison in daylight. The structure of fabrics is also difficult to see under conventional LED lighting. The reason for this is the uneven colour spectrum emitted by the light source in the changing room.

Basic Data

Sunlight LEDs try to imitate the colour spectrum of the sun and thus natural light. In order to achieve this, the colours need to be uniformly emitted in the visible range. Such LEDs can then be used in various applications such as museums or galleries, as they do not falsify the colours of the exhibit. But they also find use in schools, practices or animal husbandry, as the light has a positive effect on both humans and animals.

The subject becomes clear when looking at the different colour spectra of standard LEDs and sunlight, as shown in Figures 1 and 2. A comparison between the spectrum of a conventional LED and that of the sun at noon shows that sunlight emits all colours in the visible range from 380 nm to 780 nm in an even distribution. Therefore, sunlight can optimally represent any color as well as fine structures or small color differences for the eye.

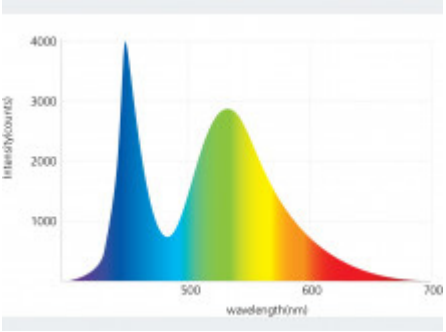
The decisive advantages of LEDs so far have been their small size, low energy consumption and high luminous efficacy. However, when looking at the light spectrum of a conventional white LED, the disadvantage of unbalanced colour distribution becomes apparent. While the blue component is very pronounced, a strong component in the blue-green range and the red component are completely absent compared to the daylight spectrum. As a result, people perceive the red and blue-green colours in a falsified way.



Picture 1: Sunlight spectrum with cloudless sky at 12 o'clock noon. Source: euroLighting

Comparative Values for Color Rendering

In addition to the quantitative evaluation of the light spectrum, the color rendering of a light source can also be qualitatively compared with the ideal thermal radiation source using the comparison parameters of the Color Redering Index (CRI) or the TM-30-15 metric. In CRI evaluation, 15 reference colors of an ideal radiator can be compared with the colors of the test light source. The closer the individual values are to 100, the closer the color spectrum is to the ideal. The mean value of the first eight colors and thus the overall impression of these colors is made clear by the Ra value. An even more precise statement is provided by the TM-30-15 metric, in which a total of 99 reference colors are compared with the test light source. Here, too, the number 100 is the optimum for the individual comparison values and the summarizing mean value Rf.



Picture 2: Colour spectrum of a conventional cold white LED.
Source: euroLighting GmbH

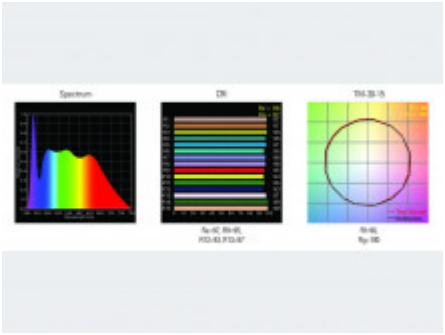
With commercially available LEDs, the CRI color rendering value is in the range between 80 and 90, with deficits mainly in the red and blue ranges. In order to counteract this problem, the Korean LED manufacturer Allix is using a violet LED chip as the main component of white LEDs instead of a conventional blue chip for its new developments. In combination with several different phosphor layers, this chip achieves a broader and more uniform spectrum than before. The Xenoled II and Xenosun product ranges thus come close to the sunlight spectrum by up to 98 percent. This is reflected in the optimum colour rendering with an Ra value between 95 and 99 and an Rf parameter between 96 and 98.

Lighting in Museums

Sunlight-like LEDs can be applied for use in museums and galleries for the presentation of art paintings and sculptures. They are also suitable for various other applications where natural colour rendering is important. With the help of LEDs, developers can also prevent sensitive objects from being damaged by infrared light, as light-emitting diodes do not emit this oposed to halogen lamps.

Further areas of application can be found on the next page.

For school, practice and retirement home



Picture 3: Spectrum + colour rendering values for Xenoled II with 5000 Kelvin (cold white). Source: euroLighting GmbH

In addition to optimum colour perception, lighting with sunlight-like LEDs provides another decisive advantage: people feel at home in an atmosphere of well-being. This effect is most noticeable in spring, when the hours of sunshine increase again during the day. After the dark winter months, increasing daylight makes you feel better, fitter and in a better mood. This mood-enhancing effect has long been known in the health sector and is already being used specifically in the therapy of patients suffering from depression with the aid of daylight-like lamps.

These positive properties of light on the body can be used in almost any application. Switching lighting in schools to new LEDs can increase pupils' attention and learning ability. Two schools in Nagold, Germany, have already been able to test this in a small study. Several classrooms were fitted with new LED daylight lighting, after which the pupils' behaviour was observed over a period of one year. In the course of the study, tendencies towards increased concentration and reduced fatigue among students were observed.

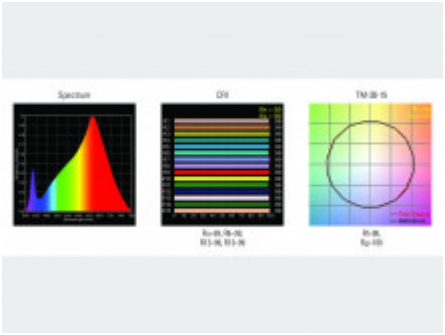
In practices or clinics, daylight-like lighting can help patients relax and relieve anxiety during treatment. In homes for the elderly, appropriate lighting changes increase of activity and quality of life of residents, makes reading much easier and conveys a feeling of security.

HCL Applications

With the Human Centric Lighting (HCL) lighting concept emerging in recent years, which orients the light colour, intensity and direction of lighting to the course of the day in sunlight, there is already an advantageous model for exploiting the positive effects of the sun. However, the existing HCL systems use conventional LEDs, whose spectra differ significantly from those of the sun despite their adapted light colour.

Here, too, a solution is offered by the use of Allix LED series, which comprise a standard product portfolio of daylight-like LEDs in colour temperatures of 2500 to 6500 Kelvin. If the sunlight LEDs are used according to the HCL concept, natural interior lighting is obtained despite the artificial light source.

Better light in Animal Husbandry



Picture 4: Spectrum + colour rendering values for Xenoled II with 3000 Kelvin (warm white). Source: euroLighting GmbH

Depending on the application requirements, the LED spectrum can be extended beyond the visible range to include ultraviolet light from 330 nm and infrared light up to 950 nm, which comes even closer to the natural sunlight spectrum in the overall picture.

This type of lighting can be used in poultry farming. Birds can already see in the ultraviolet range from about 330 nm, which is no longer visible to the human eye. However, many poultry farmer do not take into account the UV component in the light, which is important for the bird's eye. For the animals, this results in a loss of orientation and makes it more difficult to recognise food and other birds. This can be remedied by adapting the lighting to as natural a light as possible, as already laid down in the Animal Welfare and Animal Husbandry Ordinance, and by extending the light spectrum into UV light.

In cattle, the visible area is smaller than in humans because they can not recognize red tones from 620 nm. In the blue-green range, on the other hand, they have their maximum vision, which is, however, only slightly emitted by the colour spectrum of the previous LEDs. For stable lighting, cattle farms can also make use of the new LEDs with a uniform colour spectrum. The sunlight-like light improves the cattle's perception, promotes the maintenance of animal health and thus tends to reduce the need for pharmaceutical products.

Application in Plant Growth

With regard to plants, there are completely different aspects that play a role in lighting. In order to determine these lighting requirements at every stage of plant growth, Allix has carried out several comparative studies with different coloured LEDs. The study evaluated the colour, shape and weight of each crop to determine the optimal lighting conditions for plant growth. Based on the results of these studies, Allix developed a special selection of LEDs specifically for use in plants. This selection contains only the light components that are beneficial for the growth of the respective plant. With the help of these special LEDs it is possible to achieve a maximum harvest even in the cold, dark winter months.