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Title: The Art of Lighting - Illuminating Your Shopping Experience



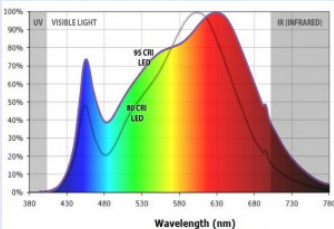
The Art of Lighting - Illuminating Your Shopping Experience

Lighting is something that surrounds us every day. It can evoke feelings of happiness or sadness, energize us or make us feel tired. It even influences our body clock. Most people take it for granted and don't think too much about it; however, when lighting is done right, it makes items stand out from their surroundings. This is when it starts transforming from an item you may have just passed by, to an item that instantly made it into your basket. To make that transformation, we have to look at items such as color properties, intensity, and direct them to what we want to illuminate.

For a refrigerated case manufacturer, lighting is something that elevates a retailer's display so their products look attractive to a customer. Along with properties that make items look attractive, lighting can also have some negative effects on products within the case. These negative effects include the addition of heat on the product which can affect product integrity, and the physical space the lighting can occupy within the case. All of these have to be taken into account when designing the right light source to be applied for the application or case where it will be used.

In order to understand how to achieve the proper lighting in a reach-in display case or walk-in cooler, we first need to understand some basics about lighting. The table on next page (Table A) shows some terms we will use throughout this paper and their definitions.

Table A.

Light Intensity
<p>Lumens – Standard unit of measurement of luminous flux. This is used to measure the total quantity of visible light emitted by a light source in all directions.</p> <p>Lux - SI unit to measure illuminance. One lux equals one lumen per square meter.</p> <p>Foot-candle (fc) – A unit measurement that is the equivalent of one candle of light in one square foot of area.</p> <p>Efficacy – This is a simple formula of lumens/watts to show how efficient a light is in producing lumens. It is important to consider the power supply in this equation as well.</p>
Color Quality
<p>Correlated Color Temperature (CCT) or Kelvin Temperature (K) - This is the measure of a light source's color appearance and is the overall hue we see off of a light. For supermarkets, we normally stay between 2700K and 4000K color temperatures. The lower the number, the warmer the color temperature. A warm white incandescent light bulb is traditionally 2700K, while 4000K is a very white light and is often used in dairy and frozen food cases.</p> <p>CRI – This stands for Color Rendering Index and it measures the ability of a light source to display color of various objects. This index is between 0-100 with 100 being the most accurate. A warm white 2700 incandescent light bulb is considered 100, and the sun at 5500K is considered to be 100. Yet both of these light sources would display the colors of a product dramatically different, so this scale is not necessarily what you want to only look at when looking at a light. Normally, if you have a light in the 90+ CRI range though, you have a good source on the product.</p> <p>Spectral Power Distribution – This is a graph that shows all the visible light waves that come from a light source onto a product. The stronger the light wave the more of that color you will bring out in a product.</p>  <p>The graph displays the spectral power distribution of two LED light sources. The x-axis represents Wavelength (nm) from 380 to 780, and the y-axis represents relative intensity from 0% to 100%. The 95 CRI LED curve shows a higher peak in the blue region (around 450 nm) and a higher peak in the red region (around 630 nm) compared to the 90 CRI LED curve. The 90 CRI LED curve shows a higher peak in the green region (around 530 nm). Both curves show a significant peak in the red region (around 630 nm) and a smaller peak in the blue region (around 450 nm). The 95 CRI LED curve is consistently higher than the 90 CRI LED curve across most of the visible spectrum.</p> <p>TM-30-15 – This is used in conjunction with CRI and uses a Fidelity Index and Gamut Index to ascertain a clear representation of expected output from a light source.</p>

Now that we know some of the common lighting terms, we will talk about how to put “Light Intensity” and “Color Quality” to work for illuminating products inside of the refrigerated door display case or walk-in cooler.

When we talk about light intensity, it is important to think about all sources of light around the case or cooler, and how they interact with a customer's view. The human eye is a muscle and responds to any light that it sees. Therefore, if a store has skylights or has a high-ambient light level, a customer's eye will adjust to them as well as what is inside the display case where you are trying to attract their eye. If other light sources in the environment are too bright, they can cause the reach-in doorcase to appear darker. That is because it takes the human eye up to 25 minutes to adjust to darkness from a bright area². Therefore, it is important for us to think about all light sources and if they actually drive us to use more light in our overall light strategy. Ideally, you want a 3+/1 or more contrast ratio between your display case light and the ambient light around it for the most merchandising impact.

Along with the contrast ratio, it is good to reduce visible light sources and any glare that can be seen on the glass. The glare will usually come from overhead lights, skylights or windows. It can be very hard to overcome glare inside the case no matter how much light you use inside of it. A good way to test how much windows or skylights are affecting the overall displays is to examine the store mid-afternoon and then again at night when outside light isn't as present. If ambient light is a problem, there are ways to reduce it such as with shades, signage, light boxes, etc.

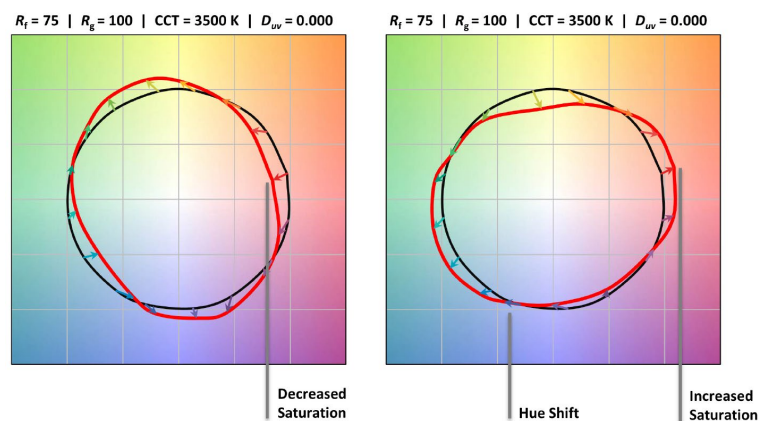
Now that we have talked about controlling ambient lighting around the reach-in display case, we can talk about the light inside the case. Display case lighting should have uniform illumination across the product. This is left-to-right and from top-to-bottom in the case, while trying to hide the light source. Because people naturally focus on areas that are the brightest, their eyes will be focused on the product. The best way to do this is with minimal energy and good optics that help direct the light evenly on the products in an efficient manner. There are also variables like shelf depth, width and product type that affect the distribution of light inside a display case... All of these will affect the distribution of light.

Most of the lighting used are LEDs because they work well in cold environments, give off minimal heat and are energy efficient. One way to measure the quality of an LED system is its efficacy. This is the ration of light output to energy output. Another way is to measure the overall system is to read the lux or foot-candles that reach the product. This is where the customer will focus on the products, and you want uniformity and optimal product illumination.

Lastly, color quality is seldom considered when looking at light intensity. A system can have low intensity with high-color quality and appear brighter to a customers' eye. If this is ignored and just system efficacy is taken into account, products may not have the color "pop" needed for an attractive display. You would see this early on with LED and many times with fluorescent light sources in the past.

Color quality can be seen when looking at the chroma values in a chromaticity chart or when looking at TM-30 saturation and fidelity charts³. Previously, companies made light color choices by just looking at CRI. This was based on 8 pastel colors and not on saturated colors because they are not included in the standard CRI values. Over the years, this has shifted to take into account the special

CRI colors which looks at 15 colors in which the saturated colors are included. This makes a large difference in retail where you want colors to be vivid. Another way to look at colors is by the TM-30 gamut index (Rg). This index gives you a better idea of color saturation from a light source. Products that have a higher color saturation appear brighter than the same light level in a less saturated state. TM-30 also has a fidelity index which measures how accurate the colors are displayed.



Once lighting properties are understood, they can be applied to a product such as a reach-in display case. This is when lighting becomes an art. If a light source is chosen with the right illumination intensity and color saturation, the displayed products should stand out, and not only attract a customers' eye, but stimulate a decision to purchase.

1 <https://lumicrest.com/cri-quality-of-light-explained/spectral-plot-lumicrest-vs-80-cri/>

2 <https://www.thevintagenews.com/2017/02/02/pirates-wore-eye-patches-to-adjust-to-the-contrasting-light-above-and-below-deck/>

3 https://www.energy.gov/sites/prod/files/2016/04/f30/tm-30_fact-sheet.pdf