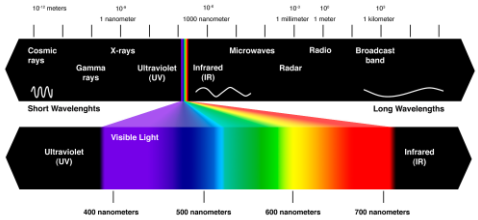
Introduction to Colour – VLE course Script

2. Light

Let's take natural daylight as the first example.

A guy called Isaac Newton, a famous scientist passed natural light through a prism and saw that the light was split into a rainbow. He therefore rightly said that the white light we see is made up of all the different colours in this rainbow.
As we can see these are the colours of the rainbow and hopefully you can see as we have talked about reflection what needs to be taken away and what needs to be left to make something appear red. More on that later.
We will discuss what a perfect light is and how we can measure it but we will also talk about how not all white light is the same and we will explain this by showing what coloured lights white light can be made up of.

So a little more detail



Just concentrate on the bits that are coloured and labelled visible light. Why is it called visible light? Because it is the light that our eyes as humans can interpret into what we call colour.

Visible Light – The light that humans can interpret i.e. see.

There are different wavelengths that are emitted from a light source.
The violet ones have a shorter wavelength (the tightly packed squiggly line under the term Cosmic rays and then further showing a longer wavelength above Infra Red) than the red ones and the other colours all exist in between.
All around us are the other wavelengths but we can't see them they do not affect our vision; that is they are not detected by our eyes and analysed by our brain.

That all seems quite simple but unfortunately it is not. That's because the human eye and brain are involved and also light sources vary in what they actually put out and we vary in how we see things.

So how does a light source vary?

A Caribbean beach has very bright sunlight and makes all the colours look vibrant, it seems to add an intensity to the colours that we see. Remember that item of clothing that you bought on holiday and brought it back home?

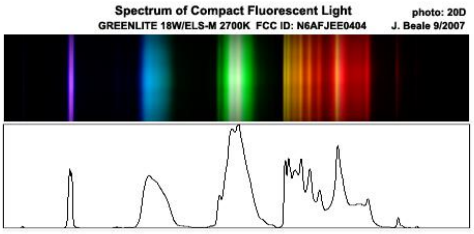
It looked so much different. It no longer has that intensity and some of the colours just don't have the same appeal, almost as if the hue has changed. But we are the same and the article is the same. The difference is the wavelengths of light that are being emitted by the sun and its affected by the clouds in the sky but also where in the world the sun is being seen.
Even just in the UK the difference in the quality of light is different from a sunny day and on an overcast day.
As a lot of suppliers are overseas we somehow need to tame the sunlight when we are talking to suppliers but remember our customers will take our products out in all sorts of conditions.

Using an artificial light source - a bulb of some sort is a way of standardising some things.

First let's look though at the different types of bulbs available.

Tungsten,
Fluorescent,
CFL (Compact Fluorescent Lamp, LED (Light emitting Diode),
Halogen

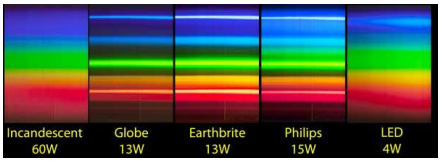
All different ways of producing what we see as a white light. However you all know from home that the actual colour of the light from these varies.
We also know that there are a lot of different manufacturers of these and that they are not produced to produce a standard light. So what light do they produce?
We analyse what comes out of these bulbs (light sources) by measuring the different wavelengths that make up the light we see in the region that we know visible light appears. We can therefore see what is coming out and the results might be surprising.



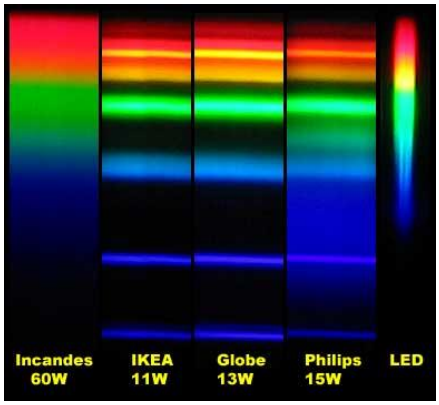
This gives us the spectrum as we can see above.
The higher the peak the more of that wavelength is coming out of the light source. Where it is low there is none of that wavelength. This is very different than all the colours of the spectrum being visible in perfect sunlight where there is an equal intensity of all the wavelengths.

What is fascinating here is that we still see this as white light.

What does this tell us? Lights interacting with each other is its own system and how we interpret this is not perfect. We see some blue, green and red light and we perceive it as white.



If we look at different light bulbs side by side we can see that actual difference. Notice the difference between the incandescent the CFL which are the ones labelled Ikea, globe and Phillips and the LED. There are definite gaps in some of the wavelengths that are emitted. Again what effect do we think this has on how we see colour?



Think about how many different lights there are, take a look next time you are at home or in the store to see the different systems and the different manufacturers. So this needs to be standardised and it is.

A body of experts called CIE all come together and create standard lights and specifications for these that should be used when colour is being assessed for QC. These standard light sources and specifications are used not just in textiles but in all industries where colour is communicated and assessed including automotive, printing even food.

If we look at this in a slightly different way we can see what we mean by the graphs on this slide. The names are either those that are used or the ones in brackets are the names given by the CIE organisation.

Daylight is what we suspect ideal natural light to be and a standard light is manufactured and available. As mentioned there are a few other specifications that need to be met for these light sources to be used in good lighting cabinets but that is another course.
The other lights are commonly available ones. These graphs are not for all domestic lights or TL84 lights but these are the ideals.

As you can see the Tungsten light is missing blue light but has a lot of red.
When we look at reflection from an object you will see how this changes the colour we see if we change the light source and terms we have for the effects we see.

The other 2 graphs have very specific peaks in three distinct areas which means as previously described we still see white light but I think it is obvious that this will affect the colour we see.

We know that the light has an immense effect on the colour which we see.

Colours are often evaluated under two or three different sources, usually

Daylight,
Store Light and
Domestic (tungsten filament) light

TL84 is commonly used in Europe and the Far East as a Store Light for retailers like M&S.
CWF is a fluorescent light commonly used in Stores in USA.

Illuminants are defined as Spectral Power Distributions (SPD), which give the relative energy or intensity of the light at set wavelengths across the visible spectrum.

Daylight is a white light which is slightly bluish, but emits a good proportion throughout the visible spectrum. It is a good light to observe all the colours within the visible spectrum. It also has UV emission.
Domestic light has its energy content at the red end of the spectrum with very little at the blue end, it is seen as a very reddish light. It is difficult to assess differences in very dark shades especially between blacks and navy blues.
TL84 is a fluorescent lamp using three phosphors in the red, green & blue parts of the spectrum deliberately that the eye's RGB cones are sensitive to. The deficiency of this light is in the yellow region so the stores often use spotlights (Tungsten) to illuminate gold jewellery.
Cool White (CWF) is used predominately in the USA for both stores and offices. There are three peaks in the blue, green and yellow. There is a low emission in the red region. A bright orange will be seen as a flat yellowish shade.