

Blue content quantification by the U500 method

During the initial investigation of the phenomenon called "Light pollution", the question of the spectral dependence of the degree of interference was raised, especially in the field of astronomy. It soon became clear that short-wave radiation of the visible spectrum, i.e. simply "blue" light, which plays a fundamental role in signals for the entire field of biology, is a problem area not only for astronomy.

For scientific purposes it is self-evident that the any monitored phenomena need to be somehow quantified and thus more or less complex measurement and calculation methodologies for expressing the "blue component" in emitted light are gradually appearing.

One of the simplest is probably the metric known as "U500", which expresses the percentage share of the energy of blue light with wavelengths up to 500 nm to the total energy of light in the visible range.

The 500 nm limit was clearly suggested for this purpose on the basis of long-term research on human color vision, where the general consensus is accepted that shades already described as predominantly green are separated by those lights where blue predominates, just around the wavelength of 500 nm.

This spectral limit for quantifying the blue component of light is used, for example, in the methodology for G-index¹⁾ (author: D. Galadí-Enríquez, 2017), which was adopted in some countries as a tool for legislative regulation (see Fig. 1).

The U500 concept is also used in the binding legislation of Chile²⁾, which is a known world leader in the protection of dark areas around astronomical observatories.

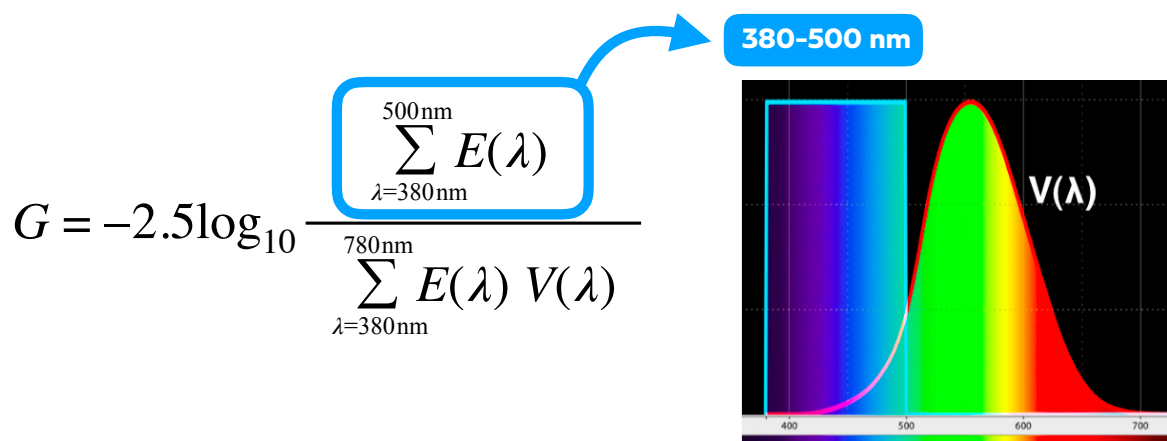


Fig. 1 The short-wave energy of light in the 380-500 nm range is part of the G-index calculation

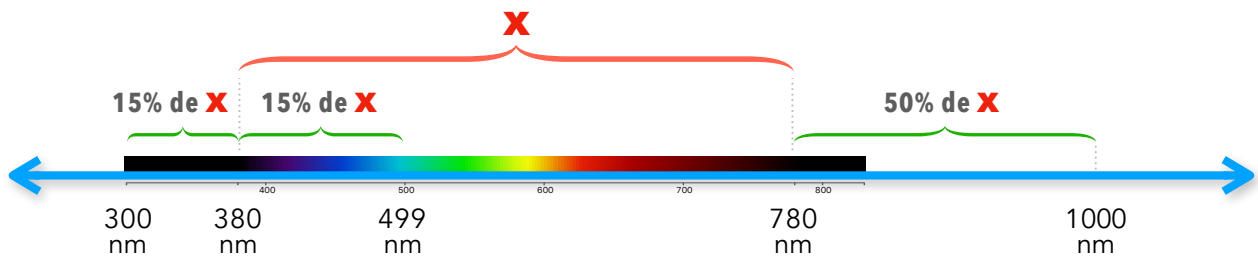


Fig. 2 The Chilean regulation 2012 includes 3 spectral bands and limits the blue component as follows: between 380 nm and 499 nm no more than 15% of total spectral radiance (Total range is between 380 nm and 780 nm).

The parameter Bc U500 therefore represents the relative share of the energies of the two bands in the visible spectrum and its mathematical notation for calculation looks like this:

$$U500 = \frac{\sum_{\lambda=380\text{nm}}^{500\text{nm}} E(\lambda)}{\sum_{\lambda=380\text{nm}}^{780\text{nm}} E(\lambda)} * 100 \quad [\%]$$

Sources:

- [1] Beyond CCT: The spectral index system as a tool for the objective, quantitative characterization of lamps, D. Galadí-Enríquez, 2017
- [2] Establece norma de emisión para la REGULACIÓN DE LA CONTAMINACIÓN LUMÍNICA, DS No.43/2012 MMA, Revision 2020 starting by October 2024