

The Principle of Beer's Law

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The Beer-Lambert Law (also called Beer's Law) is a relationship between the attenuation of light through a substance and the properties of that substance. In this article, the definitions of transmittance and absorbance of sunshine by a substance are first introduced followed by an evidence of the Beer-Lambert Law.

The Beer-Lambert law is a linear relationship between the absorbance and the concentration, molar absorption coefficient and optical coefficient of a solution:

$$A = \epsilon cl$$

A = Absorbance (M-1 cm-1)

ϵ = Molar Absorption coefficient (M-1 cm-1)

c = Molar Concentration (M)

l = Optical path length (cm)

The molar absorption coefficient is a sample dependent property and is a measure of how strong an absorber the sample is at a particular wavelength of light. The concentration is just the moles L-1 (M) of the sample dissolved within the solution, and therefore the length is that the length of the cuvette used for the absorbance measurement and is typically 1 cm.

The transmittance, T, of the solution is defined as the ratio of the transmitted intensity, I, over the incident intensity, I₀:

$$T = I/I_0$$

This takes values between 0 and 1. However, it is more commonly expressed as a percentage transmittance:

$$T (\%) = 100 I/I_0$$

The absorbance, A, of the solution is related to the transmittance and incident and transmitted intensities through the above relation.

Absorbance may be a dimensionless quantity and will, therefore, be unitless. However, it is quite common to see units of AU stated after the absorbance which are too said to either stand for arbitrary units or absorbance units. These units are redundant and will be avoided. Another common encounter is that the use of the term optical density or OD in situ of absorbance. Optical density is an

older term that, within the context of absorption spectroscopy, is synonymous with absorbance; however, the utilization of optical density in situ of absorbance is discouraged by the IUPAC.

According the Beer-Lambert law, absorption of radiation depends on:

- intensity of the incident beam
- path length
- concentration of absorbing species (chromophores)
- extinction coefficient

The Beer-Lambert law is designed for monochromatic light and its absorption increases with decrease in radiation wavelength. "Potential stabilizing materials are expected to reflect, absorb, or refract UV radiation without emission of radiation wavelengths, which may be harmful to the protected materials." These leads to the many of the practical issues that need to be kept in mind are as follows:

- effect of material mixtures
- cross-section of absorption
- effect of dispersion
- action of organic absorbers
- action of inorganic particulates

attenuation of radiation throughout cross-section of sample

- surface ablation
- effect of particle size
- conditions of reflection
- conditions of refraction
- effect of refracted and absorbed radiation (see subsequent section)

UV absorber or screener does not exist in polymeric material alone but it is dispersed within the matrix of the material to be protected. It is therefore pertinent that there's a contest for incoming radiation between UV absorber and other components of the mixture under study.

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The Beer-Lambert Law implies that both the sort and therefore the concentration of the molecules are important within the process of radiation absorption. there's no information during this law about the character of sunshine . Also, the law doesn't consider the properties of the fabric nor the angle of incident beam which together determine the particular amount of beam energy getting used (absorbed or reflected and transmitted). The Beer-Lambert Law may be a convenient means to calculate the results of spectroscopic experiments (e.g., the concentration of the absorbing species, the extinction coefficient of the absorbing substance, etc.).

Spectrophotometry mainly concentrates on the separation, quantification, and identification of matter. There is no involvement of in depth pre-processing of the sample to urge the

results. For example, bilirubin count during a blood sample is often determined by employing a spectrophotometer. Using this law it becomes easy to study the absorptivity coefficient of the sample when the concentration is low ie; $<10\text{mM}$ but as the concentration becomes high i.e.; $>10\text{mM}$ there is a deviation as the electrostatic interactions become more.

CONFLICT OF INTEREST

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