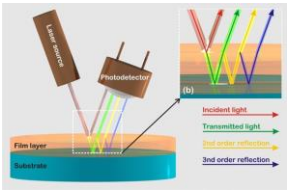
ThetaMetrisis APPLICATION NOTE #012

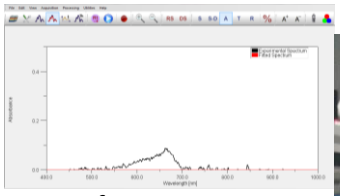


Determination of substance concentration in solutions through absorption measurements

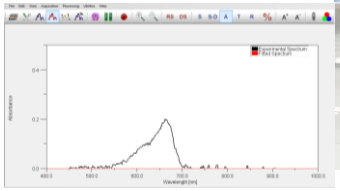
Goal: The real time measurement of the absorption & concentration of liquid samples.

Means & Methods: An FR-Basic VIS/NIR configured to operate in the 360-1000nm spectral range is combined with a FR-Film/Cuvette holder for the accurate real time monitoring of the absorption or transmittance of liquids in standard quartz cuvettes. The substance used in the present study was Methylene blue (MB), a heterocyclic aromatic chemical compound, and the absorbance of its aqueous solutions was measured. At room temperature, MB appears as a solid, odorless, dark green powder that yields a blue solution when dissolved in water. Methylene blue aqueous solutions show absorbance in visible region due to involving of π-π*and n-π* transitions present in molecules. The specifics of absorption depend on a number of factors, including protonation, adsorption to other materials, and metachromacy - the formation of dimers and higher-order aggregates depending on concentration and other interactions. More often the solvatochromic effect is dominant and dependant on the polarity of solvent.

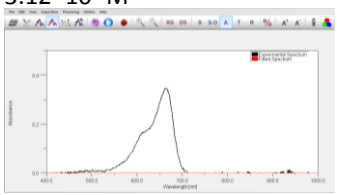
Results: The absorption spectra as they recorded through FR-Monitor are illustrated in the figure below for various concentrations. The concentration range is following the Beer-Lambert law where Absorbance is a linear function of the molar concentration (A=εbC). Thus, calculation of the molar absorptivity (or molar absorption coefficient, ε) of the examined chemical compound is attainable. The absorption measurements are performed at 668nm according to bibliography and the results are in good agreement with the literature.



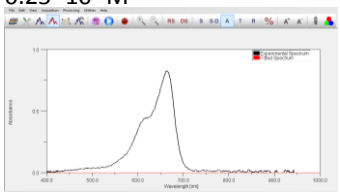
$1.56*10^{-6}$M



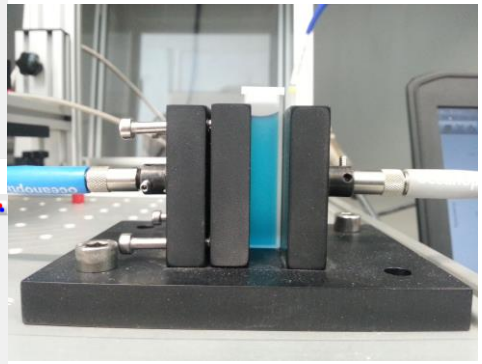
$3.12*10^{-6}$M

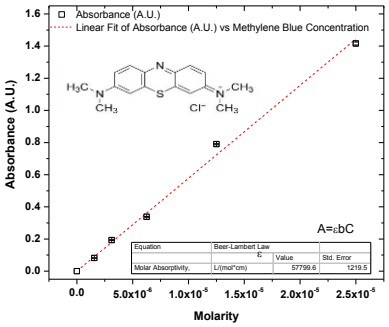


$6.25*10^{-6}$M



$1.25*10^{-5}$M





Measurement Set-up. Absorbance calibration curve of Methylene Blue at 668nm at 25°C.

Conclusions:

Determination of A_{max} wavelength.

Determination of concentration via Beer-Lambert law with high sensitivity and Limit of Detection (LOD), i.e. for Methylene Blue aqueous solutions, $LOD=4.67*10^{-7}$M.

The described procedure is reliable, very simple and conveniently applicable in most laboratories with low time of analysis.

[1] T. Mahmood et al, European Academic Research 1(6), 2013, p: 1100, [2] J. Cenens et al, *Clay and Clay Minerals* 36 (3), 1988, p: 214. [3] A. Ghanadzadeh Gilani et al, Journal of Molecular Liquids 179, 2013, p: 118.