Polarimeter

Polarimeters used for Pharmaceutical Applications

Polarimetry Fundamentals

Polarimetry is a sensitive, non-destructive technique for measuring the optical activity exhibited by inorganic and organic compounds. A compound is considered to be optically active if linearly polarised light is rotated when passing through it. The amount of optical rotation is determined by the molecular structure and concentration of chiral molecules in the substance. Each optically active substance has its own specific rotation as defined in Biots law:

$$[\alpha]_{\lambda}^{T} = \frac{\alpha_{\lambda}^{T}}{c \cdot l}$$

$[\alpha]$ = specific rotation, l = optical pathlength in dm; λ = wavelength, T = temperature, α = optical rotation, c = concentration in g/ml.

The polarimetric method is a simple and accurate means for determination and investigation of structure in macro, semi-micro and micro analysis of expensive and non-duplicable samples. Polarimetry is employed in quality control, process control and research in the pharmaceutical, chemical, essential oil, flavour and food industries. It is so well established that the United States Pharmacopoeia and the Food and Drug Administration include polarimetric specifications for numerous substances.

Special applications are:

Determination of product purity by measuring specific rotation and optical rotation of

- ⇒ Amino Acids
- ⇒ Amino Sugars
- ⇒ Analgesics
- ⇒ Antibiotics
- ⇒ Cocaine
- ⇒ Codeine
- ⇒ Dextrose
- ⇒ Serums
- ⇒ Steroids
- ⇒ Tranquilizers
- ⇒ Vitamins

How to perform a measurement

Example: Investigation of a mixture of L– and D-glutamic acid

Calculate the specific rotation, [a], of the sample according to

$$[a] = a / (c * l)$$

where a represents the observed rotation, i.e., the reading from the polarimeter, c represents the concentration of the sample in grams per milliliter (g/mL) and l represents the length of the sample container in centimeters (cm).

For the example, if a sample prepared from 1.5 g of optical material dissolved in water to a final volume of 10 mL and measured in a 5.0-cm cell was determined to have an optical rotation of +3.5 degrees, then the concentration would be 1.5 g / 10 mL = 0.15 g/mL, and [a] = 3.5 / (0.15 * 5.0) = 4.7.

To find the specific rotation of one of the enantiomers in the mixture in its pure form you can use e.g. some dictionaries of organic compounds, specialised books or you search through the World Wide Web.

If the compound under investigation is a mixture of L- and D-glutamic acid, then L-glutamic acid exhibits a specific rotation of +12 degrees.

Calculate the enantiomeric excess (x) according to

x = (observed specific rotation) / (specific rotation of pure enantiomer) * 100%.

For this example glutamic acid :

$$x = (3.5 / 12) * 100\% = 29\%.$$

This means that the sample contains a 29 percent excess of L-glutamic acid. Or, because the percentages of the D- and L-enantiomers must sum to 100 percent, then the sample contains 64.5 percent L-glutamic acid and 35.5 percent D-glutamic acid.

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