SPECIFIC ROTATION , LAURENT'S HALF SHADE POLARIMETER

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Specific Rotation

Liquids containing an optically active substance like sugar rotate the plane of linearly polarised light. The angle through which the plane polarised light is rotated depends on

- Thickness of the medium
- Concentration of the solution or density of the active substance
- Wavelength of light
- Temperature

Def : The specific rotation is defined as the rotation produced by a decimeter(10cms) long column of liquid containing 1 gm of active substance in 1 c.c of solution .

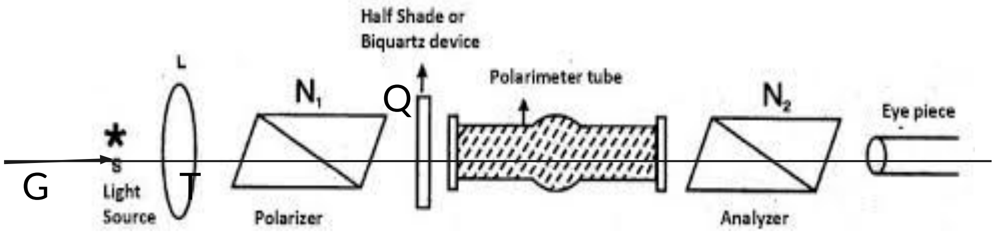
Specific rotation $S = 10\,\theta / l \cdot c$

⇒ where θ = angle of rotation , l = length of the solution in cm

c = concentration of active substance in gms /cc in solution.

The angle through which the polarisation is rotated by a optically active substance is determined with the help of **Polarimeter**. When this instrument is used to determine the quantity of sugar in a solution , it is known as **Saccharimeter.**

Laurent's Half Shade Polarimeter



It consists of two nicol prisms N_1 & N_2. N_1 is a polariser and N_2 is an analyser. N_2 is capable of rotation about a common axis of N_1, and N_2. The rotation of analyser can be read on a graduated circular scale. Behind N_1, there is a half wave plate of Quartz Q which covers one half of the field of view, while the other half G, is a Glass plate. The glass plate G absorbs the same amount of light as the Quartz plate Q. 'T' is a glass tube. It is filled with an optically active substance (say sugar soln). This tube is closed at ends by cover slips and metal covers.

Light from monochromatic source S is incident on the converging lens L , then on N_1 . After passing through N_1 the beam is plane polarised . One half of the beam passes through the Quartz plate Q and the other half passes through the glass plate G . Suppose the plane of vibration of plane polarised light incident on the half shade plate along AB , where AB makes an angle θ with YY’

On passing through Quartz plate , it is split up into O-rays and E-rays . After passing through the Quartz plate a path difference of $\lambda/2$ is introduced between them. The vibrations of the beam coming out of the Quartz will be along CD and where as the vibrations of the beam emerging out of the glass plate will be along AB . If the analyser N_2 has its principle plane along YY' , the amplitude of light incident on the analyser N_2 from both the halfs will be equal. Therefore, the field of view will be equally bright.

If the analyser N_2 is rotated to the right of YY' then the right half will be brighter as compared to the left half of the analyser N_2 is rotated to the left of YY' , the left half is brighter as compared to right half.

To find the specific rotation of an optically active substance the analyser N_2 is set in the position for equal brightness for the field of view without the solution in the tube. Then the reading is noted . then the tube is filled with the solution of known concentration (c). On the introduction of the tube containing sugar solution, the field of view is not equally bright. The analyser is rotated in the clockwise direction and is brought to a position , so that the whole field of view is equally bright. Again the reading is noted. Difference of these two readings gives the angle of rotation of plane of vibration (θ). The length 'l' of the tube is noted.

Substituting these values , in the formula **$S = 10\,\theta / l.c$** the specific rotation of optically active substance is calculated.