DEPARTMENT OF PHYSICS

MAR THOMA COLLEGE FOR WOMEN, PERUMBAVOOR

SPECTROMETER - HOLLOW PRISM

Aim

To determine the refractive index of a transparent liquid using hollow prism and spectrometer.

Apparatus

Spectrometer, sodium vapour lamp, reading lamp, reading lens, spirit level, hollow glass prism, and the given liquid.

Theory

Refractive index μ of the liquid is given by $\mu = \frac{sin\frac{A+D}{2}}{sin\frac{A}{2}}$, where A is the angle of the prism and D is the angle of minimum deviation.

Procedure

Preliminary adjustments of the spectrometer are done and the least count o spectrometer is noted as described earlier (see experiment no. 3). Now spectrometer is ready for use. Here the experiment is done in two steps; first we find the angle of the prism and secondly we find the angle of minimum deviation Clean the hollow glass prism and fill it with the given transparent liquid v refractive index is to be found out. Wipe it dry from outside and see that there air bubbles inside. After this find the angle of the prism.

<u>To find the angle of the prism</u>

First of all make the base of the prism table horizontal by using spirit level this adjust the levelling screws (3 in number) of the prism table.

To determine the angle of the prism (A) mount the prism on the prism table to its base towards the clamp. The prism table is rotated such that light fro collimator falls symmetrically on the faces AB and AC of the prism (see below). The vernier table is clamped. The telescope is adjusted to get the image the slit reflected from the face AB. The telescope is then clamped and adjusted the image of the slit reflected from the face AC without disturbing the arrangement. If the arrangement of the prism is disturbed we have to again go back toface AB and see whether we get the reflected image after the correction. If not the process has to be repeated till we get the images from both faces for the position of the prism.

Now the telescope is brought to the face AB to view the brightest image of the slit and clamp the telescope. Then by working the tangential screw the cross wire of the telescope is made to coincide with the image. If the slit is narrow, the point of intersection of the cross wires is kept at the centre of the image. If the slit is not narrow the point of intersection of the cross wire is made to coincide with the fixed edge of the slit. The readings of the circular scale and coinciding vernier divisions on both verniers are noted (this being a circular scale readings will differ by 180°). Then the total reading = main scale reading + verniers scale coincidence division × least count.

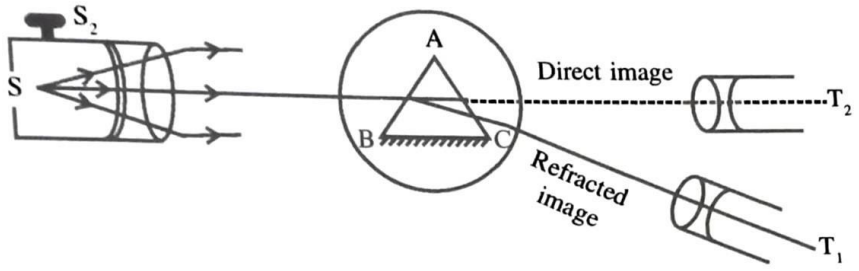
The telescope Is then unclamped and brought to the other face AC to view the image of the slit. After getting the image the telescope is clamped and the crosswire is adjusted to coincide with the image by working the tangential screw. The corresponding reading of both verniers are noted. Then the total readings of each vernier are calculated as before.

The difference in readings of vernier on both faces (AB and AC) gives twice the angle of the prism, from which the angle of the prism A can be found. The mean value of A is found.

<u>To find the minimum deviation</u>

First of all we have to set the prism in the minimum deviation position. To set the prism in minimum deviation position, place the prism ABC on prism table, such that light coming from collimator falls on the face AC at an acute angle. Look for the spectrum through the face AB. Rotate the prism table gradually. The spectral line also turn. This is because in rotating the prism table angle of incidence changes. Therefore angle of deviation changes. For a particular position of the prism, the spectral line becomes stationary. If we rotate the prism further in the same direction the spectral line is seen to move in the opposite direction. Fix the prism table, where the spectral line appears stationary. This is the minimum deviation position.

After setting the prism in the minimum deviation position, turn the telescope to the position T, (see figure below), so that its cross wire coincides with the image of the slit. This can be done by fixing the telescope. For fine adjustments make use of the tangential screw. Then take the main scale readings and vernier scale coincidence divisions of both the verniers and calculate the total reading for each vernier as before.



Now the prism is removed. The telescope is brought in line with the collimator to view the direct image of the slit. Fix the telescope and by working the tangential screw the cross wire is made to coincide with the image of the slit. The readings of the main scale and vernier scales are noted then calculate the total reading for each vernier as before. The difference in readings of the corresponding verniers gives the angle of minimum deviation. The mean angle of deviation is found out.

Knowing A and D, the refractive index of the material of the given liquid u can be calculated by using the formula.

$$\mu = \frac{\sin\frac{A+D}{2}}{\sin\frac{A}{2}}$$

Observations and tabulations

Value of one main scale division = ……degree = ...minute

Number of divisions on the vernier, n = ……

Least count (L.C.) = $\frac{Value\ of\ 1\ M.S.D}{n}$ =.....minute

Tabular column to find angle of the prism (A)

	Vernier I			Vernier II		
	M.S.R.	V.S.R.	Total reading	M.S.R.	V.S.R.	Total reading
Reading of image reflected from face AB (X_1)						
Reading of image reflected from face AC (X_2)						
Difference between X_1 and X_2 (2A)				Difference between X_1 and X_2 (2A)		

∴ Mean 2A =……..

∴ A = …….

Tabular column to find minimum deviation (D)

	Vernier I			Vernier II		
	M.S.R.	V.S.R.	Total reading	M.S.R.	V.S.R.	Total reading
Reading of image reflected from face AB (X_1)						
Reading of image reflected from face AC (X_2)						
Difference between X_1 and X_2 (2A)				Difference between X_1 and X_2 (2A)		

Mean D =

Angle of the prism, A =……

Angle of minimum deviation, D = ……..

Refractive index of the given transparent liquid $\mu = \frac{sin\frac{A+D}{2}}{sin\frac{A}{2}}$ = ….

Result

The refractive index of the given transparent liquid μ = ...…….

References

Experimental Physics – I, For First, Second, Third and Fourth Semester, BSc Degree Programme, Dr.P.Sethumadhavan, Prof. K.C. Abraham, Prof .Sunil John, **Manjusha Publications**

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