Determination of Refractive index of liquids using Abbe's refractometer

AIM: To find refractive index of the given liquid samples and find Molar refraction and specific refraction.

APPARATUS:

Abbe's refractometer, light source and samples.

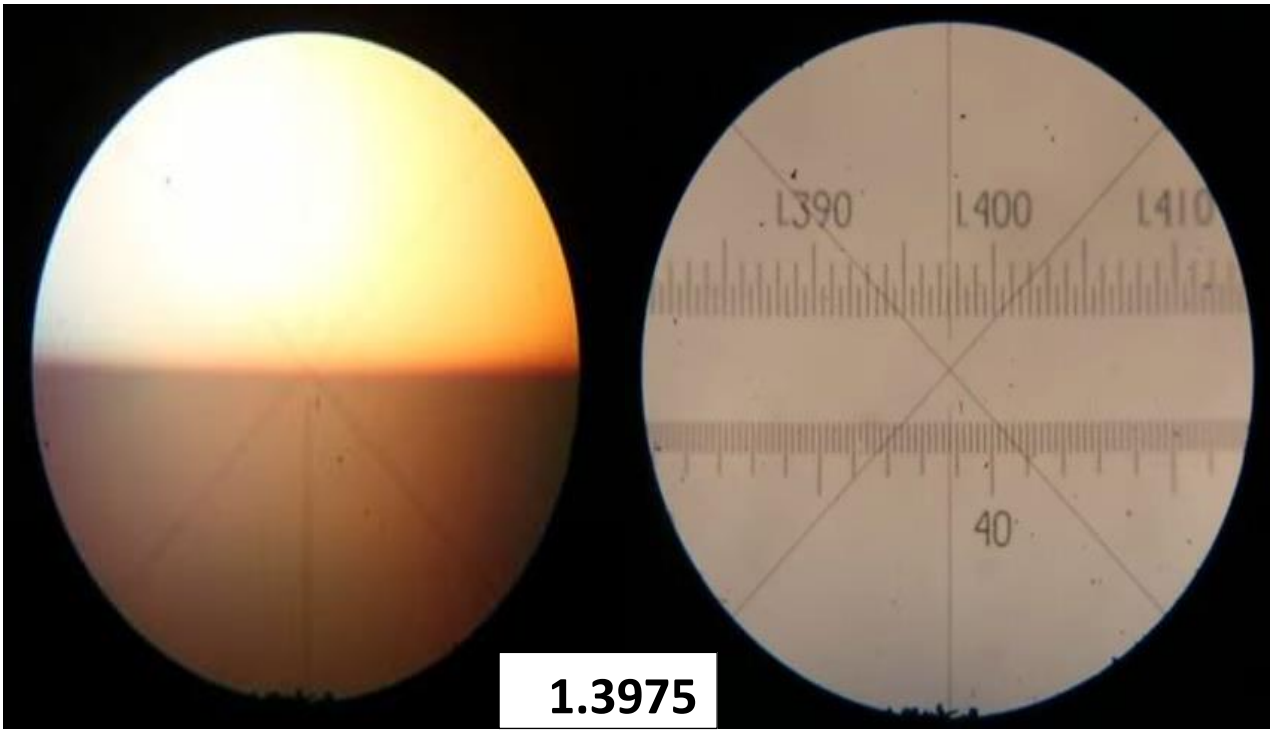
There are various methods to determine the refractive index of liquids. Some of them are

- interferometric methods,
- minimum angle deviation and auto collimation methods, and
- Refractometer methods.

The refractive index is an important optical parameter and extensive research has been done to measure it for liquids. Techniques used for measuring the refractive indices of liquids, gasses, and solids.

Abbe's Refractometer: The Abbe instrument is the most convenient and widely used refractometer, Fig(1) shows Abbe's Refractometer.

Fig(1) Abbe's Refractometer



The Abbe refractometer, named after its inventor Ernst Abbe (1840-1905), was the first laboratory instrument for the precise determination of the refractive index of liquids. The measuring principle of an Abbe refractometer is based on the principle of total reflection. Abbe refractometers are used for measuring liquids. The reference media glasses (prisms) can be selected with high refractive indices. The light from a radiation source is reflected by a mirror and hits a double prism. A few drops of the sample are placed between this so-called Abbe double prism. The incident light beams pass through the double prism and sample only if their angles of incidence at the interface are less than the critical angle of 2 total reflection. A microscope and a mirror with a suitable mechanism are used to determine the light / dark boundary line (shadow line).

Abbe's refractometer is used to measure the refractive index of the given organic liquid. Using a particular monochromatic light source, the apparatus is calibrated with water as the liquid. Adjust the micrometer screw to focus the

boundary between the bright and dark regions. Adjust the refractometer scale to place the cross wire of the telescope exactly on the boundary between the bright and dark regions. Repeat the same process for different organic liquids after the equipment is calibrated.

Snell' s Law :

The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant, for the light of a given colour and for the given pair of media. The refractive angle is determined by Snell's law:

$$n_1 \sin\alpha = n_2 \sin\beta$$

n_1: is refractive index of medium 1

n_2 : is refractive index of medium 2

$$\frac{\sin i}{Sin\, r} = n = \frac{velocity\ of\ light\ in\ 1st\ medium}{velocity\ of\ light\ in\ 2nd\ medium}$$

The index of refraction, or the refractive index, is a basic optical property of materials. Light travels at different speeds in different media. In addition, light travels slower through any medium or material that is not a vacuum. The speed of light in a vacuum is constant and is commonly denoted by c. The index of refraction of a given medium, n, is defined as the ratio of the speed of light in vacuum, c, to the group velocity of light in the medium, v. This ratio is shown as follows:

$$n = \frac{c}{v}$$

The index is also a measure of the amount of refraction that will occur when light passes from one medium to another. The goal of this project is to propose and experimentally verify an accurate method of measuring the refractive index of liquids. The method proposed in this thesis measures the refractive index to the accuracy that the wavelength of the light is known. The

accurate measurement of the refractive index is of great importance in many branches of physics and chemistry and in industrial applications. The precise

determination of the refractive index can give insight into the purity of the material. In many cases, the refractive index data cannot be found in reference books and must be measured as needed. This is why it is useful to determine the refractive index with maximum accuracy and minimum effort and cost. The small differences in the refractive indices of various solutions are also very significant.

PROCEDURE:

1. Clean the surface of prism first with alcohol and then with acetone using cotton and allow it to dry.

2. Using a dropper put 2-3 drops of given liquid b/w prisms and press them together.

3. Allow the light to fall on mirror.

4. Adjust the mirror to reflect maximum light into the prism box .

5. Rotate the prism box by moving lever until the boundary shaded and bright parts appear in the field of view.

6. If a band of colors appear in the light shade boundary make it sharp by rotating the compensator.

7. Adjust the lever so that light shade boundary passes exactly through the center of cross wire.

8. Read the refractive index directly on the scale

9. Take 3 set of readings and find the average of all the readings.

OBSERVATIONS:

Sr.#	Liquid	Refractive index