When white light is used, the refractometer is provided with a compensating system. The apparatus gives readings accurate to at least the third decimal place and is provided with a means of operation at the temperature prescribed. The thermometer is graduated at intervals of 0.5 °C or less.

2.2.7. OPTICAL ROTATION

Optical rotation is the property displayed by certain substances of rotating the plane of polarisation of polarised light.

The specific optical rotation $[\alpha_m]_\lambda^t$ is the rotation, expressed in radians (rad), measured at the temperature t and at the wavelength λ given by a 1 metre thickness of liquid or solution containing 1 kilogram of optically active solute per cubic metre of solution. For practical reasons the specific optical rotation $[\alpha_m]_\lambda^t$ is normally expressed in milliradians metre squared per kilogram (mrad.m².kg⁻¹)

The Pharmacopoeia adopts the following conventional definitions.

The *angle of optical rotation* of a liquid is the angle of rotation α, expressed in degrees (°), of the plane of polarisation at the wavelength of the D-line of sodium (λ = 589.3 nm) measured at 20 °C using a layer of 1 decimetre; for a solution, the method of preparation is prescribed in the monograph.

The *specific optical rotation* $[\alpha]_D^{20}$ of a liquid is the angle of rotation α, expressed in degrees (°), of the plane of polarisation at the wavelength of the D-line of sodium (λ = 589.3 nm) measured at 20 °C in the liquid substance to be examined, calculated with reference to a layer of 1 decimetre and divided by the density expressed in grams per cubic centimetre.

The *specific optical rotation* $[\alpha]_D^{20}$ of a substance in solution is the angle of rotation α, expressed in degrees (°), of the plane of polarisation at the wavelength of the D-line of sodium (λ = 589.3 nm) measured at 20 °C in a solution of the substance to be examined and calculated with reference to a layer of 1 decimetre containing 1 gram of the substance per millilitre. The specific optical rotation of a solid is always expressed with reference to a given solvent and concentration.

In the conventional system adopted by the Pharmacopoeia the specific optical rotation is expressed in degree millilitres per decimetre gram $[(°).ml.dm^{-1}.g^{-1}]$.

The conversion factor from the International System to the Pharmacopoeia system is the following:

$$[\alpha_m]_\lambda^t = [\alpha]_\lambda^t \times 0.1745$$

In certain cases specified in the monograph the angle of rotation may be measured at temperatures other than 20 °C and at other wavelengths.

The polarimeter must be capable of giving readings to the nearest 0.01°. The scale is usually checked by means of certified quartz plates. The linearity of the scale may be checked by means of sucrose solutions.

Method. Determine the zero of the polarimeter and the angle of rotation of polarised light at the wavelength of the D-line of sodium (λ = 589.3 nm) at 20 ± 0.5 °C. Measurements may be carried out at other temperatures only where the monograph indicates the temperature correction to be made to the measured optical rotation. Determine the zero of the apparatus with the tube closed; for liquids the zero is determined with the tube empty and for solids filled with the prescribed solvent. Carry out at least five measurements and calculate the average.

Calculate the specific optical rotation using the following formulae, dextrorotation and laevorotation being designated by (+) and (−) respectively.

For liquids: $$[\alpha]_D^{20} = \frac{\alpha}{l \cdot \rho_{20}}$$

For solids: $$[\alpha]_D^{20} = \frac{100\alpha}{l \cdot c}$$

Calculate the content c in g/l or the content c' in per cent *m/m* of a dissolved substance using the following formulae:

$$c = \frac{1000\alpha}{l \cdot [\alpha]_D^{20}} \qquad c' = \frac{100\alpha}{l \cdot [\alpha]_D^{20} \cdot \rho_{20}}$$

α = angle of rotation in degrees read at 20 ± 0.5 °C,

l = length in decimetres of the polarimeter tube,

ρ_{20} = density at 20 °C in grams per cubic centimetre. For the purposes of the Pharmacopoeia, density is replaced by relative density (*2.2.5*),

c = concentration of the substance in g/l,

c' = content of the substance in per cent *m/m*.

2.2.8. VISCOSITY

The *dynamic viscosity* or *viscosity coefficient* η is the tangential force per unit surface, known as *shearing stress* τ and expressed in pascals, necessary to move, parallel to the sliding plane, a layer of liquid of 1 square metre at a rate (v) of 1 metre per second relative to a parallel layer at a distance (x) of 1 metre.

The ratio dv/dx is a speed gradient giving the *rate of shear D* expressed in reciprocal seconds (s^{-1}), so that $\eta = \tau / D$.

The unit of dynamic viscosity is the pascal second (Pa.s). The most commonly used submultiple is the millipascal second (mPa.s).

The kinematic viscosity v, expressed in square metres per second, is obtained by dividing the dynamic viscosity η by the density ρ expressed in kilograms per cubic metre, of the liquid measured at the same temperature, i.e. $v = \eta/\rho$ The kinematic viscosity is usually expressed in square millimetres per second.

A capillary viscometer may be used for determining the viscosity of Newtonian liquids and a rotating viscometer for determining the viscosity of Newtonian and non-Newtonian liquids.