

# Optical Rotation in Polymer

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**ABSTRACT:** Optical Rotation and hence the Specific Rotation is a measure of the optical anisotropy present in the system and can be studied by polarimetry. The variation in specific rotation with wavelength of incident radiation is called as optically rotatory dispersion and is studied with the help of spectro polarimetry. The mean residual rotation of any polymer is taken as a measure of their secondary structure. As such a study of an optical rotation is taken up and the variation of specific rotation with the degree of polymers in polyethylene glycols is reported.

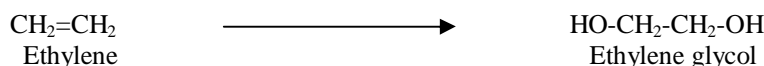
**KEYWORDS:** Specific rotation, molar rotation , molecular weight , density and ethylene glycols.

## I.INTRODUCTION

**About the samples:** The samples all are of analar grade, they are procured from precision instruments and chemicals, Guntur, AP, India . They are used directly without further purification for fear of de polymerization.

**Polyethylene Glycols:** Polyethylene glycols can be obtained by self - polycondensation of ethylene glycol. The same polymer usually with high molecular weight. When obtained by a ring opening polymerization of ethylene oxide is called polyethylene oxide. These are water soluble as well as soluble in inorganic solvents. PEGs of different molecular weights are waxy solids commercially known as carbowax. These are widely used in cosmetics, textile and pharmaceutical industries.

Ethylene Glycol, in general is obtained by the oxidation of ethylene while terephthalic acid by the oxidation of p-xylene



Poly ethylene terephthalate is produced by the condensation of Ethylene glycol. It's boiling point is 197<sup>0</sup>.

It is aliphatic, colorless viscous liquid soluble in water and alcohol in all Proportionalities, and insoluble in ether. It has a characteristic disagreeable order of aldehyde region.

## II.RELATED WORK

Nowadays, polymers represent a class of materials widely used in all fields of our daily life. Beside the optical properties which are intensely studied (reflection, refraction, absorption, transmission), optical activity of polymers presents a great interest. Therefore, the synthesis and characterization of optically active polymers have been receiving a special attention. These materials have found interesting applications because of their specific properties and they are used as a stationary phase in chromatographic methods for enantiomeric separations or as key materials for various optical devices, for example, lenses, optical disks, and functional films for liquid crystal displays, due to their ease of processing, light weight, high transparency, and low cost . Optical properties of polymers are not so different from others substances The specific rotation  $[\alpha]$  is dependent on the modification of the wavelength. Optical rotatory dispersion curves can be normal (characterized by no minima or maxima) or abnormal (they present a minimum or a maximum or both). In the latter case, the polymer presents an absorption band in the investigated spectral range.

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The abnormal curves are also known as Cotton effect. The study of the dependence of the specific rotation on the wavelength is important because it offers valuable information concerning the conformational changes and Cotton effect. If the macromolecule presents a spiral conformation, (for example with a similar structure, excepting those properties which are related to the dimension and the structure of the macromolecular chain or to the conformational changes [4]. In the case of polymers one can distinguish two kind of optical properties: Measurements of the specific rotation offer information regarding the conformational changes. The specific rotation of the investigated polymers displays a great dependence on the wavelength. Assuming that an inversion of optical rotation in the studied examples of chiral ethylene oxides occurs, the systems suffer a transition from a random conformation to a helical conformation. Thus, it is proposed that polymer 3 and possibly 1 and 2 adopt helical conformations in water.

## II.METHOD

Polarimeter is an optical instrument used for measuring the optical rotation in optically active solutions. The plane polarized light can be rotated in either clockwise or anti clockwise direction. Solution that rotates the plane polarized light in the clockwise direction is called dextro rotator and the solution that rotates the plane polarized light in anti clockwise direction is called leavo rotator.

The spectro polarimeter is used to determine the specific rotation and molar rotation of the solution. The specific rotation is defined as the angle of rotation per unit concentration per unit length of the medium.

$$\text{Specific rotation } \alpha = \frac{100\theta}{ld}$$

Where l – is the length of the polarimeter,

$\theta$  – is angle of rotation and

d – is the density of liquid and it's value is  $d = \frac{M}{V}$

M is mass of the solvent in KG and V is the solution in M<sup>3</sup>.

$$\text{And molar rotation } (\alpha)_m = \alpha * M.$$

Where M - is molecular weight of the polymer.

$\alpha$  - is the specific rotation.

## III.PROCEDURE

The polarimeter is fit with Laurent half shade which facilitates the separation of left circularly polarized and right circularly polarized lights and the intensity of resultant radiation changes with the orientation of the incident light with polarimeter Laurent half shades. The position of polarimeter is adjusted for uniform intensity (either uniformly bright/uniformly dark) before solution is taken. The reading in analyzer is noted when the water is filled in the polarimeter tube and uniform intensity is achieved (let the angle be  $\theta_1$ ). The same process is repeated for Ethylene Glycol solutions of various orders of polymerizations and the corresponding readings are taken (let the angle be  $\theta_2$ ). A change in the angle of rotation for a given polymer is taken as ' $\theta$ ' ( $\theta_1 - \theta_2$ ). If l is the length of the polarimeter tube (in decimeters) the specific rotation and molar rotations are given by  $\alpha = \frac{100\theta}{ld}$  and  $(\alpha)_m = \alpha * M$ .

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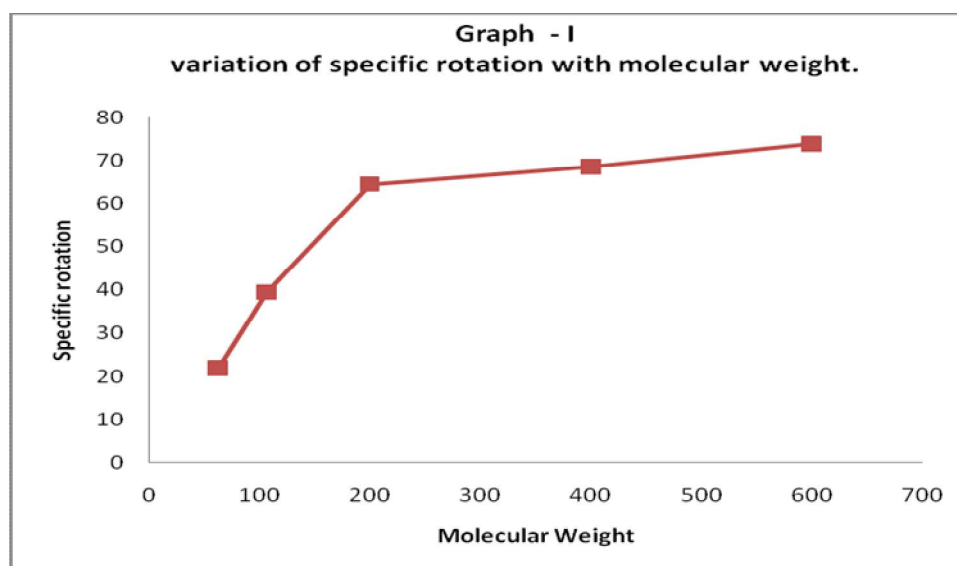
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**TABLE – I**  
**Variation of specific rotation and molar rotation with molecular weight.**

S.No	Name of the Polymer	Molecular weight	Density Gram/cc	Specific rotation In degrees	Molar rotation (*10 <sup>2</sup> )
1	Ethylene glycol	62.07	1.111	21.78	13.52
2	Di – ethylene glycol	106.17	1.115	39.39	41.82
3	Poly ethylene glycol 200	200	1.122	64.54	129.09
4	Poly ethylene glycol 400	400	1.123	68.65	274.62
5	Poly ethylene glycol 600	600	1.124	73.99	443.96

The necessary data on molecular weight, density...etc are obtained from the references 1, and 2. The specific rotation, molar rotation and molecular weight along with densities are reported in table I. The variation in specific rotation and molar rotation as a function of molecular weights of ethylene glycols are given in graph I.

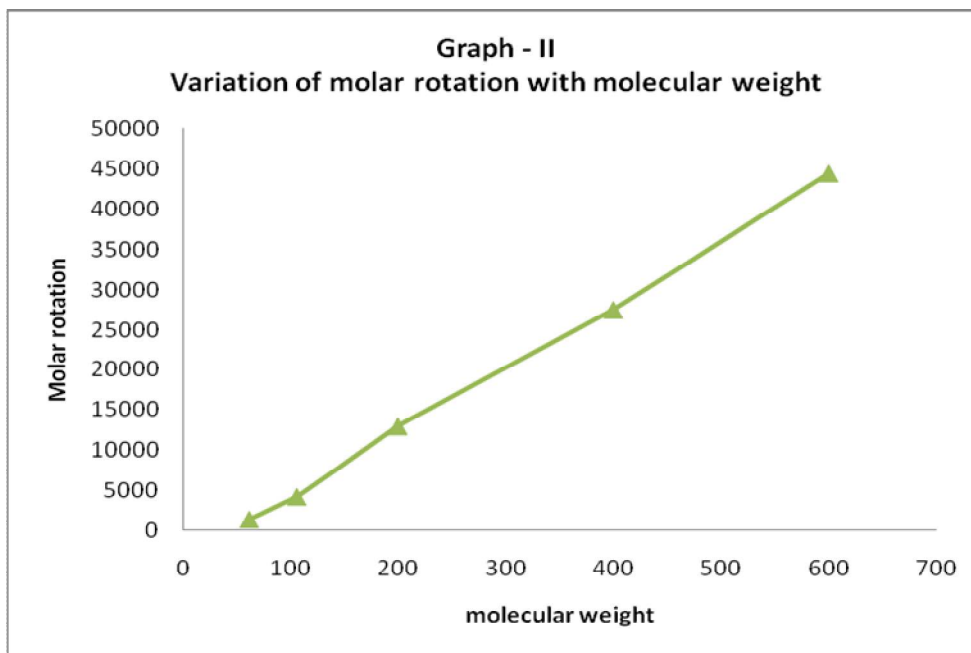


Graph I shows the variation of specific rotation with molecular weight. It shows that with the molecular weight (or degree of polymerization) increases the specific rotation varies linearly, after reaching the saturation the molecular weight variation is very small. In case of molar rotation, the linearity is applicable for all molecular weights.

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### III. RESULTS AND DISCUSSION

This is a fundamental experiment which need to be done carefully , the identification of intensity variation in the two semicircular images in the most important part of this experiment .when the analyser is rotated the intensities of both the half's vary , i.e the brighter portion becomes dull and darker portin fads such that at one point both becomes equally dull. From this point on it analyser is rotated further in the clockwise direction , the block position changes its position . Similarly rotating in the anticlockwise direction ,the block portion again change its position . An experimenter needs to practice this for a given concentration several times and remember it.

In the case of water it is quite easy to identify the variation .As the concentration of solution increase ,the angle of rotation through the liquid also will increase , so light arriving at analyser may become dark in intensity and hence the shape of perfectly semicircular image may get distorted. In such cases the tube had to be rotated in the tube chamber and refocusing of eye piece may also have to be done.

The results as well as the graph indicate that there is a linearity of increasing the molar rotation with molecular weight where as the specific rotation shows marked increase for small molecular weights and approaching a saturation limit of higher values molecular weight .This shows that increase in physical properties like density ,refractive index and specific rotation with molecular weights reaches a saturation value at higher degree of polymerization . This might be due to the increasing association effect in the polymers and the non availability of free electrons to this physical variations.

### IV .CONCLUSION

We have implemented an optical properties of the polymers in liquid state or nano polymers in liquid form. In case of nano polymers not in liquid form they dissolved in to proper solvent in different concentrations we have to study a optical rotation and specific rotations .

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