Refractive Index Increments of Polybutylisocyanate

INTRODUCTION

The refractive index increment dn/dc of a polymer in a given solvent and at a particular temperature is the basic parameter which must be known to make molecular weight determinations by light scattering. This quantity is also of importance in gel permeation chromatography and sedimentation analysis of macromolecular compounds.

Polyisocyanates are very interesting in the aspect of their chain structure—rod for the low molecular weights and flexible chain for high molecular weights. Their solution properties have been investigated, but the data are far from being complete. The data of the refractive index increment are also available in a restricted amount.

Data on dn/dc of polybutylisocyanate are reported only for green light (λ_0 = 546 nm) and for solutions in chloroform.[1-3] We have completed these data by estimation of dn/dc for solutions in chloroform for blue (λ_0 = 436 nm) and red light (λ_0 = 633 nm) and for solutions in carbon tetrachloride for blue (λ_0 = 436 nm), green (λ_0 = 546 nm) and red light (λ_0 = 633 nm).

The use of this last wavelength was justified because of the use of He–Ne lasers in modern light scattering devices.

The values of dn/dc for green (λ_0 = 546 nm) and blue light (λ_0 = 436 nm) were calculated from experimental data. The values of dn/dc for red light (λ_0 = 633 nm) were extrapolated from the dependence $dn/dc = f(\lambda_0^{-2})$ based on the relation of Cauchy [4-6]:

$$n = A + \frac{B}{\lambda_0^2}$$

where A and B are constants and n = index of refraction.

EXPERIMENTAL

The Brice–Phoenix Differential Refractometer Model BP-2000-V has been used for all measurements.

Two solvents, carbon tetrachloride and chloroform, analytical grade (Merck, Germany), freshly distilled before use, were employed for the preparation of solutions.

The measurements were carried out with the samples of polybutylisocyanate synthesized as described in Refs. 7 and 8.

The polymer solutions were prepared in following way: The mixtures of polymer and solvent were heated during 4 hrs at a temperature of 55–60°C. Then, the solutions were taken out of the oven, and the measurements were performed immediately after the solutions had attained room temperature.

RESULTS AND DISCUSSION

Results of the measurements and calculations for different solvents and for different wavelengths are summarized in Table I.

The correlation coefficients were calculated for the dependence of Δn vs. c [Δn is the difference between refractive indices of solution and solvent and c is the polymer concentration (g/mL)].

CONCLUSIONS

The refractive index increments dn/dc of polybutylisocyanate in two solvents and for three light wavelengths were determined. The measurements were performed at ambient temper-

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TABLE I

Refractive Index Increments dn/dc (cm^3/g) of Polybutylisocyanate at ambient Temperature (20 ± 1°C) for Various Wavelengths λ_0 *In Vacuo* (nm).

		dn /dc			
Solvent	λ_0	Literature data	Experimental data	Remarks	Correlation coefficient
Carbon tetrachloride	436	—	0.47_5	Measured value	0.9913
Carbon tetrachloride	546	—	0.042_5	Measured value	0.9920
Carbon tetrachloride	633	—	0.039_0	Calculated value	—
Chloroform	436	—	0.061_5	Measured value	0.9986
Chloroform	546	0.054[1-3]	0.054_5	Measured value	0.9993
Chloroform	633	—	0.050_5	Calculated value	—

ature (20 ± 1°C). The value of dn/dc in chloroform and for wavelength 546 nm is identical with the literature data.

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