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NOTES

Estimation of Polymer-Solvent Interaction Parameter K′ for Polypropylene in Cyclohexane

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In the present work, the estimation of polymer-solvent interaction parameter K′ for polypropylene in cyclohexane has been done.

The Mark-Houwink constants, being characteristic for a given polymer-solvent system, are usually obtained by measuring the intrinsic viscosity, [η], for a series of monodispersed samples of a polymer under consideration. Thus, a plot of log [η] against the logarithm of corresponding molecular weight, $\overline{M}$ (obtained by any absolute method) yields a straight line whose slope provides the value of shape factor, a, and intercepts the polymer-solvent interaction parameter, K′.

The procedure discussed above is, however, laborious and time-consuming. Chiang[1] in order to overcome this difficulty proposed an alternative method to find a and K′ values in case of high polymers without the knowledge of the molecular weights of monodispersed fractions.

It is well known that the intrinsic viscosity is related to the molecular weight of the polymer by an empirical equation due to Mark-Houwink, *i.e.*,

$$[\eta] = K'M^a \tag{1}$$

and in a θ-solvent the intrinsic visosity is proportional to the square root of the molecular weight[2], i.e.,

$$[\eta]_\theta = KM^{0.5} \tag{2}$$

Eliminating M from Eqs. (1) and (2) and taking the logarithm, we have

$$\log [\eta] = 2a \log [\eta]_\theta + \log (K'/K_{2a}) \tag{3}$$

With the aid of Eq. (3) the values of a and K′ can be calculated on the basis of the graphical dependence log [η] vs. log $[\eta]_\theta$, the former from the slope of the line, and the latter from its ordinate intercept.

In the present note Eq. (3) has been applied for determining the Mark-Houwink constants of atactic polypropylene at 25°C for which the relevant viscosity data are available[3] both in a good (cyclohexane) and a theta (cyclohexanone) solvent and are recorded in Table 1.

TABLE 1
INTRINSIC VISCOSITY DATA OF POLYPROPYLENE IN CYCLOHEXANE AT 25°C AND CYCLOHEXANONE AT 92°C

Molecular weight of the sample ($\overline{M}_n \times 10^{-5}$)	[η] cyclohexane (dl/g)	[η] cyclohexanone (dl/g)
3.20	4.08	0.99
1.40	2.30	0.64
0.44	0.80	0.37
0.15	0.32	0.20

The value of shape factor, a, for polypropylene-cyclohexane system obtained from the slope of the plot log [η] versus log $[\eta]_\theta$ has been found to be 0.79 which is very close to the value of 0.80, obtained by Kinsinger and Hughes[3].

The value of polypropylene-cyclohexane interaction parameter, K', as calculated from the ordinate intercept, is found to be 1.4×10^{-4} which coincides well with the reported[3] value of 1.6×10^{-4}. Moreover, the value of K calculated from Eq. (2) comes out to be 17.1×10^{-4} as against the literature[3] value of 18.2×10^{-4}.

PEFERENCES

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