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# Variation of the Limiting Viscosity Number With the Temperature at Which Polymer is Prepared


by

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# Variation of thc Limiting Viscosity Number With the Temperature at Which Polymer is Prepared

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**SUMMARY**

The purified methyl acrylate and acrylonitrile have been polymerized at there different temperatures by using benzoyl peroxide as initiator. The limiting viscosity numbers of all the polymer samples were measured. As ve have expexted, the limiting viscosity numbers or the number average molecular weights of the polymers decreased with increasing temperature.

A relationship between the limiting viscosity numbers and the temperatures has been obtained as follow,

for PMA : $$\log [\eta] = -0.56 + 5 \times 10^2 \frac{1}{T}$$

for PAN : $$\log [\eta] = -0.40 + 5 \times 10^2 \frac{1}{T}$$

## EXPERIMENTAL

*a) Purification of Metarials:*

Methyl acrylate, benzoyl peroxide, benzene were purified as that described previously (1).

Dimethyl formamide (DMF) was dried by standing for 2 hours over KOH, overnight over anhydrous $CaSO_4$, and distilled at a pressure of 25 mm mercury (2).

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Acrylonitrile was purified by the method of Bamford and jenkins (3).

*b) Preparation of Polymers:*

All the polymerization reactions were carried out in the sealed pyrex tubes without solvent at three different temperatures (60 °C, 50 °C, 40 °C) Polyacrylonitrile samples were filtered directly, washed with ethyl alcohol, and dried in a vacuum oven at 60 °C to constant weight. Polymethyl acrylate samples were precipitated and purified by using cold petroleum ether and acetone as precipitant and solvent respectively, and then dried in a vacuum oven at 40 °C to constant weight.

c) *Viscosity Measurements:*

The spesific viscosities of polyacrylonitrile and polymethyl acrylate were measured at four different concentrations in DMF and benzene respecrively.

Percent polymerizations were measured by gravimetric estimation of the polymers at a series of times. The plots of the percent polymerization against time are shown in Figure 1 and Figure 2.

All the experimental results are summarized in Table I and Table II.

TABLE I

PAN; $[Bz_2O_2] = 5.4 \times 10^{-3}$ mole litre$^{-1}$

| t°C | Time (min) | Pol % | $[\eta]$ (dl g$^{-1}$) | log $[\eta]$ | $\frac{1}{T} \times 10^3$ |
|---|---|---|---|---|---|
| 60 | 4 | 1.59 | 12.60 | 1.10 | 3.00 |
| 50 | 16 | 1.99 | 14.00 | 1.15 | 3.09 |
| 40 | 75 | 1.90 | 15.50 | 1.19 | 3.19 |

TABLE II

PMA; $[Bz_2O_2] = 5.4 \times 10^{-3}$ mole litre$^{-1}$

| t°C | time (min) | Pol % | $[\eta]$ (dl g$^{-1}$) | log $[\eta]$ | $\frac{1}{T} \times 10^3$ |
|---|---|---|---|---|---|
| 60 | 2 | 1.31 | 8.70 | 0.94 | 3.00 |
| 50 | 5 | 2.79 | 9.50 | 0.98 | 3.09 |
| 40 | 18 | 2.20 | 10.80 | 1.03 | 3.19 |

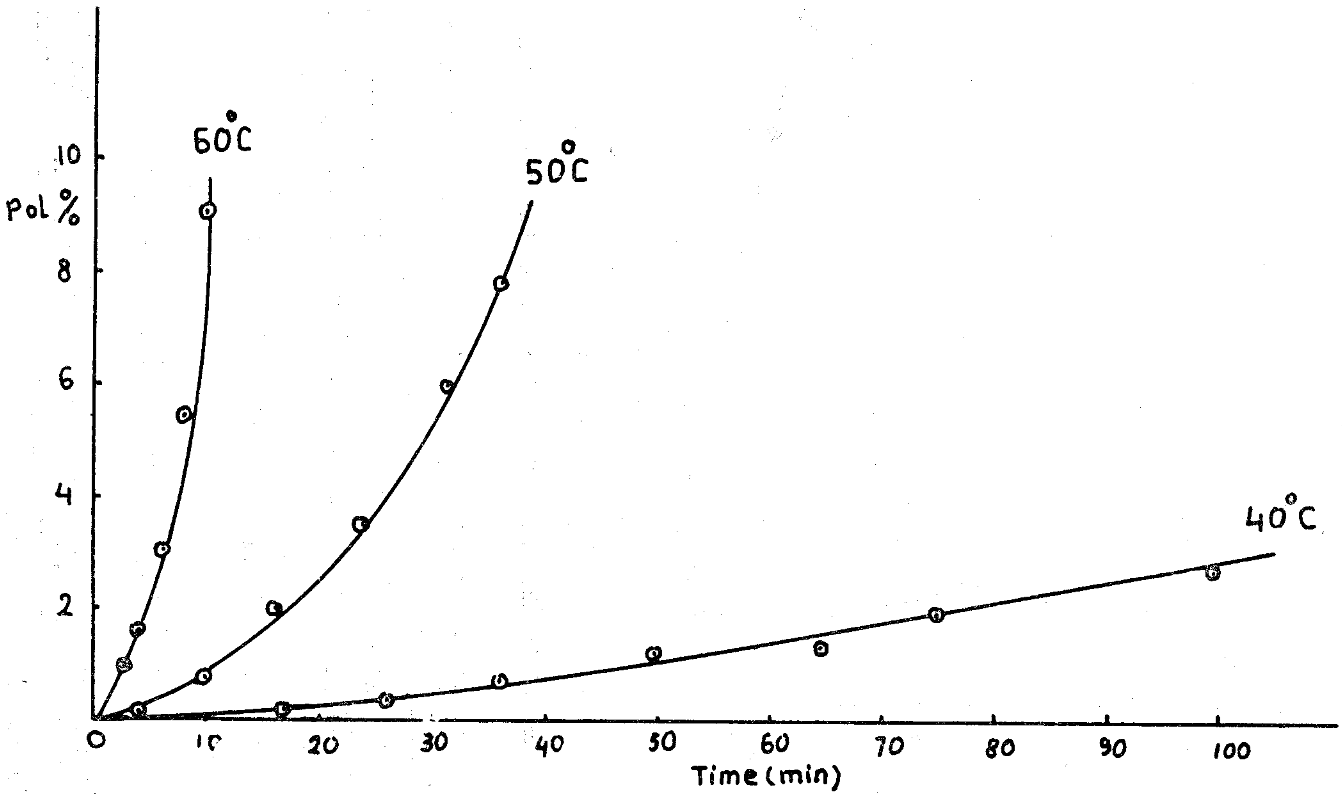


Figure 1. Polymerization of Acrylonitrile at three different temperatures.

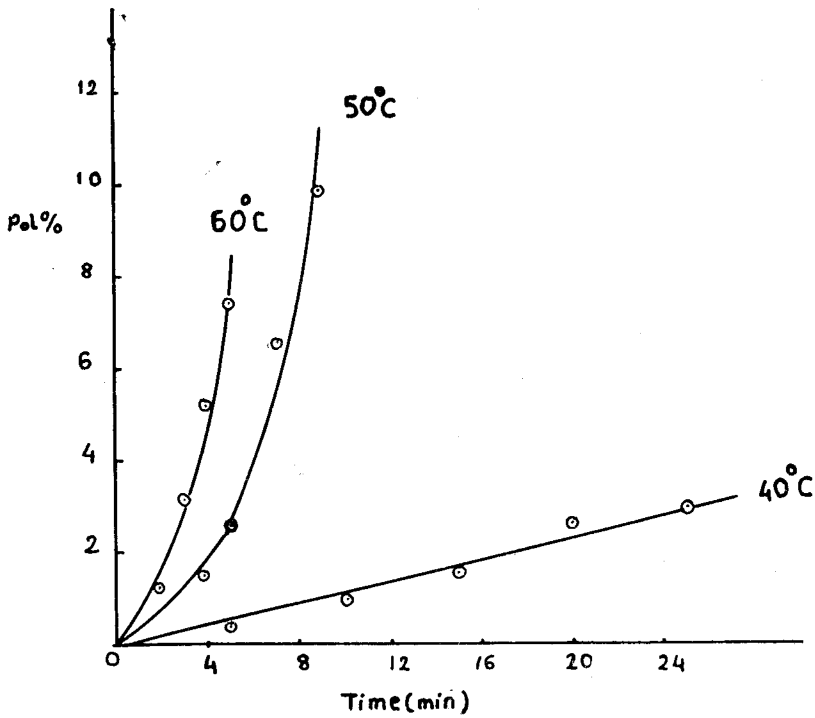


Figure 2. Polymerization of methyl acrylate at three different temperatures.

The plots of log $[\eta]$ against $1/T$ for the two polymers are given in Figure 3

From the Figure 3, the following relationships have been obtained for polymethyl acrylate and polyacrylonitrile respectively.

$$\log\ [\eta] = -0.56 + 5 \times 10^2 \times \frac{1}{T}$$

$$\log\ [\eta] = -\ 0.40 + 5 \times 10^2 \times \frac{1}{T}$$

As a result of this work we can get to the conclusion that the molecular weight of the two polymers are equally affected by the change of temperature.

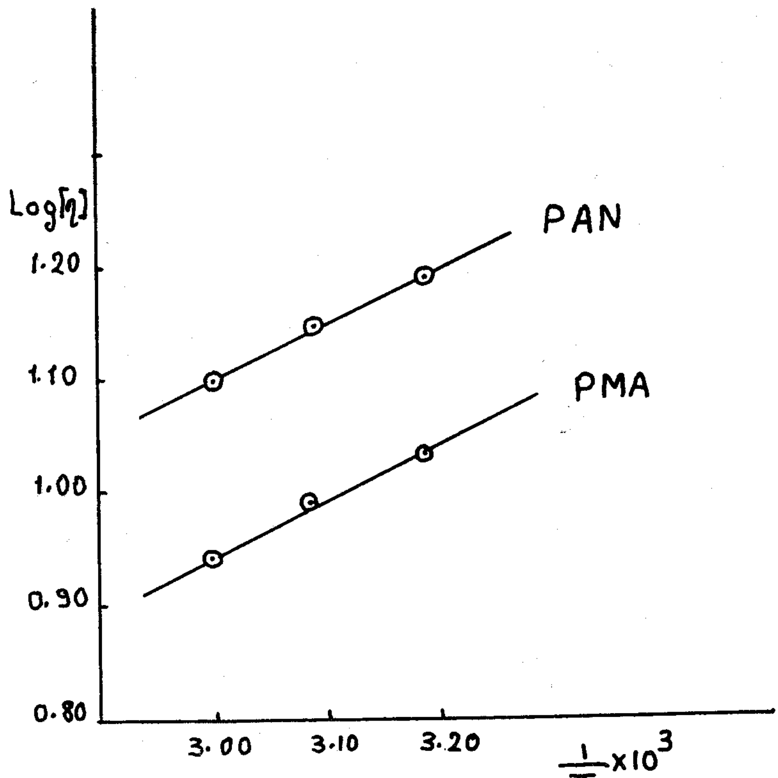


Figure 3. Variation of the Limiting Viscosity Number with Temperature.

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## ÖZET


Akrilonitril ve metil akrilat aynı koşullarda üç ayrı sıcaklıkta polimerleştirildi. Meydana gelen plimerlerin limit viskozite sayıları yani intrinsik viskoziteleri tayin edildi. Her iki polimere ait limit viskozite sayılarının polimerin elde edildiği sıcaklık ile polimetil akrilat ve poliakrionitril için

$$\log [\eta] = -0.56 + 5 \times 10^2 \frac{1}{T}$$

$$\log [\eta] = -0.40 + 5 \times 10^2 \frac{1}{T}$$

bağlantılarına uygun bir şekilde değişiştiği ve buradan her iki polimerin molekül ağırlığının sıcaklık değişiminden aynı şekilde etkilendiği sonucuna varıldı.

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