

## LETTER TO THE EDITORS

### Viscosity of Polyvinyl Alcohol

An earlier paper<sup>1</sup> reported studies in these laboratories on the solvation of polyvinyl alcohol in acetone-water and in *n*-propanol-water mixtures. These mixtures showed very different behavior when used as fractionating systems for this polymer,<sup>2</sup> and also considerable variation with respect to selective sorption.<sup>1</sup> In continuation of these studies, viscosity measurements on polyvinyl alcohol in the aforementioned systems have been carried out.

The materials used were the same as those reported earlier.<sup>1</sup> Viscosity measurements were made with Ostwald viscometers, extrapolation of the  $\eta_{sp}/c$  versus  $c$  plots being carried out in the usual way. Concentrations were appropriately corrected for thermal expansion.

Results of the viscosity measurements at 25°C. for various acetone-water and *n*-propanol-water mixtures are shown in Table I. For the system polyvinyl alcohol-acetone-water, the values of  $[\eta]$  are essentially constant with varying nonsolvent (acetone) content. The slopes of the  $\eta_{sp}/c$  versus  $c$  lines do vary however. The reason for this is not clear, but the maximum slope appears to be in the region of 10-15% acetone. This is roughly the composition above which there seems to be no selective sorption.<sup>1</sup>

For the system polyvinyl alcohol-*n*-propanol-water, the intrinsic viscosity rises slightly with increasing nonsolvent and then decreases sharply as the concentration of *n*-propanol exceeds about 30%. This is consistent with the view that small amounts of the mild nonsolvent *n*-propanol actually improve the solvent, but as the precipitation point is approached the mixture is a very poor solvent and chain coiling leads to a lowering of intrinsic viscosity. Similarly

the trend toward an increase in slope as the percentage of *n*-propanol increases could be due to increased association as the solvent becomes poorer.

Viscosity studies of polyvinyl alcohol in dilute solutions in water, 10% acetone-90% water and 10% *n*-propanol-90% water were also carried out as a function of temperature. The temperature dependence of the intrinsic viscosity is

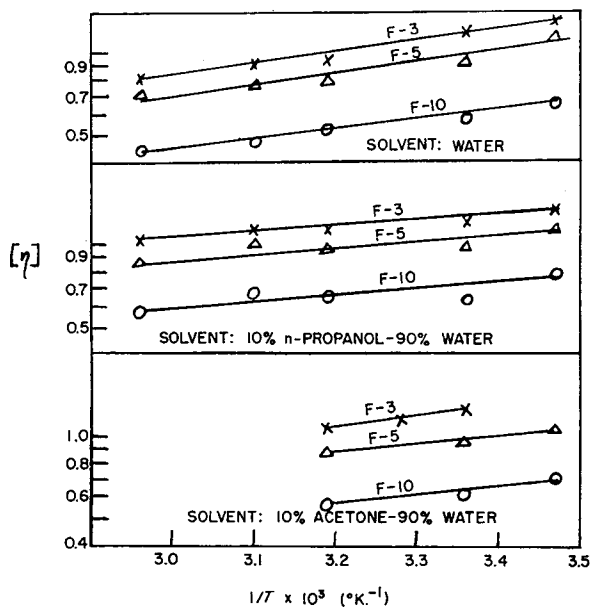


Fig. 1. Temperature dependence of intrinsic viscosity.

TABLE I  
Intrinsic Viscosity of Polyvinyl Alcohol in Mixed Solvents at 25°C.

Acetone-water				<i>n</i> -Propanol-water			
Sample	Weight % acetone	$[\eta]$	Slope	Sample	Weight % <i>n</i> -propanol	$[\eta]$	Slope
F-3	5.0	1.22	1.13	Original	4.8	0.90	0.80
	10.0	1.23	1.12		7.9	0.91	0.90
	15.0	1.25	1.04		15.0	0.92	0.96
	18.0	1.21	0.93		20.5	0.99	0.94
F-7	5.0	0.88	0.53	27.0	0.96	0.92	
	10.0	0.86	0.61	31.2	0.80	0.92	
	15.0	0.92	0.46	32.7	0.79	0.99	
	18.0	0.89	0.48				
Original	20.0	0.88	0.42				
	4.5	0.90	0.86				
	9.4	0.91	0.90				
	14.4	0.90	1.00				
	18.1	0.92	0.76				
	20.1	0.92	0.68				

shown in Figure 1. Application of the theory of Flory and Fox<sup>3</sup> indicated that, within the limits of experimental error, there is little to choose between the three systems, although the water-*n*-propanol system appears to be a slightly better solvent than the other two.

This work was supported by a grant from Research Corporation. This support is gratefully acknowledged.

#### References

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Received November 4, 1958