"Effect of Denaturing Agent on the Molecular Association of Poly Vinyl Pyrrolidone."

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Introduction

In recent years [1-3] there has been growing interest in the solution properties of polyvinyl pyrrolidone (PVP) because of its ability to form complexes with various drugs which in turn make them stable and delay the degradation. PVP is a polymer of great industrial, Biological (simple model of protein, blood plasma substitute) and Scientific (hydrophobic and hydrophilic properties) importance [4-7].

Keeping in view these importance an attempt has been made to see the effect of denaturing agent on the solution properties of PVP.

Results and Discussion

In our previous paper [8-10] we presented the intrinsic viscosity-Molecular weight relationship, rheology and unperturbed chain dimension of low molecular weight PVP in methanol. In continuation to that we study the effect of certain salts on the behaviour of PVP to overcome some discrepancies. For example investigation was made [11,12] of the possible effect of the presence of sodium chloride and other salts used in physiological solutions, in the test solutions of PVP. The results of these analysis presented in Table-1, indicate that the presence of these salts had no significant effect on the intrinsic viscosity and on the molecular weight by light scattering.

Frank and Levy [13] reported that 1 M NaCl had little effect on the [n] of PVP solutions. On the other hand, Jergensons [14] found the intrinsic viscosity to be reduced by the presence of 1M KCl and 0.25M $MgCl_2$ and to be slightly increased by 1M $MgCl_2$.

As discussed earlier [1] PVP provide good site for hydrogen bonding and fortunately there are some

Table-1: Salts effect on intrinsic viscosity and Mol. wt. of PVP.

Solvent	PVP K-30 sample		PVP K-60 sample	
	[n]	M.Wt.	[n]	M.Wt.
Water	0.210	33,800	0.284	74,000
0.9% NaCl	0.209	33,300	0.282	74,000
1.8% NaCl	0.208	33,000	0.286	71,000
3.6% NaCl	0.216	32,000	-	-
Physiological Salt. Soln.	0.207	33,000	0.284	74,000

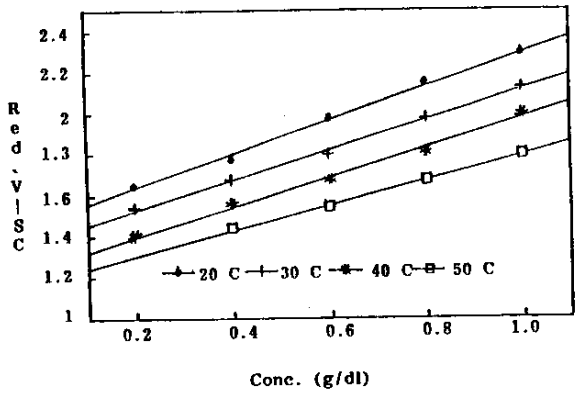


Fig. 1: Plot of reduced viscosity vs concentrations of PVP(Mw 3,60,000) in water at different temperature.

chemicals which are known to have the ability to break Hydrogen bonds [15]. Guanidinium sulphate is also included to this class of chemicals. Fig. 1 shows the Huggin's plot of aqueous PVP solution while Figs. 2 and 3 represents effect of the addition of 0.02 M GS and 0.05 M GS respectively at different temperatures. Addition of GS has lead to a decrease in the viscosities of aqueous PVP solution.

The intrinsic viscosities and Huggin's constants calculated through linear least square analysis for original aqueous PVP and 0.02 M GS and 0.05 M GS solution are shown in Table-2. The

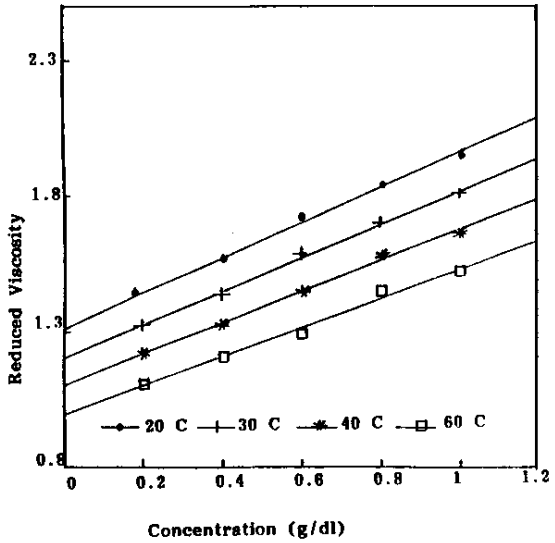


Fig. 2: Plot of reduced viscosity of PVP(Mw. 3,60,000) in 0.02 M guanidine sulphate at different temperatures and concentrations.

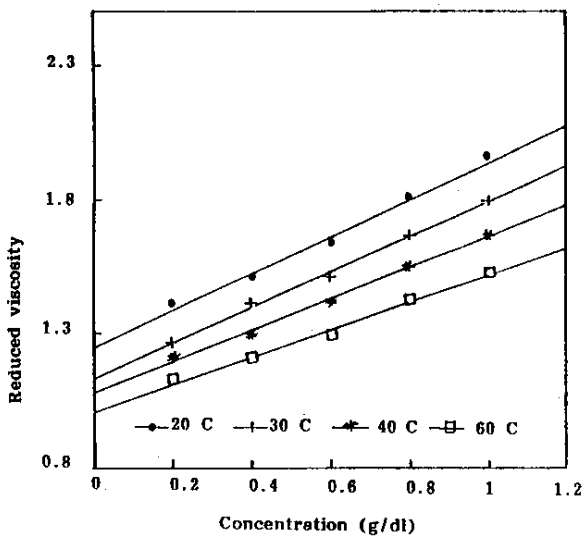


Fig. 3: Plot of reduced viscosity of PVP (Mw. 3,60,000) in 0.05 M Guanidine sulphate at different temperatures and concentrations.

observed decrease indicate the action of GS to break the hydrogen bonded structure of PVP in aqueous solution by the probable mechanism. Hydroxyl group of water is linked with PVP through long chains of water molecule themselves and PVP polymer. These links of hydrogen bonding are broken by the

Table-2:

°C	Aq. PVP soln.		Aq. PVP with 0.02M GS		Aq. PVP with 0.05M GS	
Temp.	[n]	KH	[n]	KH	[n]	KH
20	1.473	0.38	1.316	0.37	1.255	0.43
30	1.383	0.38	1.206	0.42	1.136	0.50
40	1.253	0.46	1.108	0.46	1.082	0.49
50	1.180	0.47	1.032	0.52	1.020	0.54

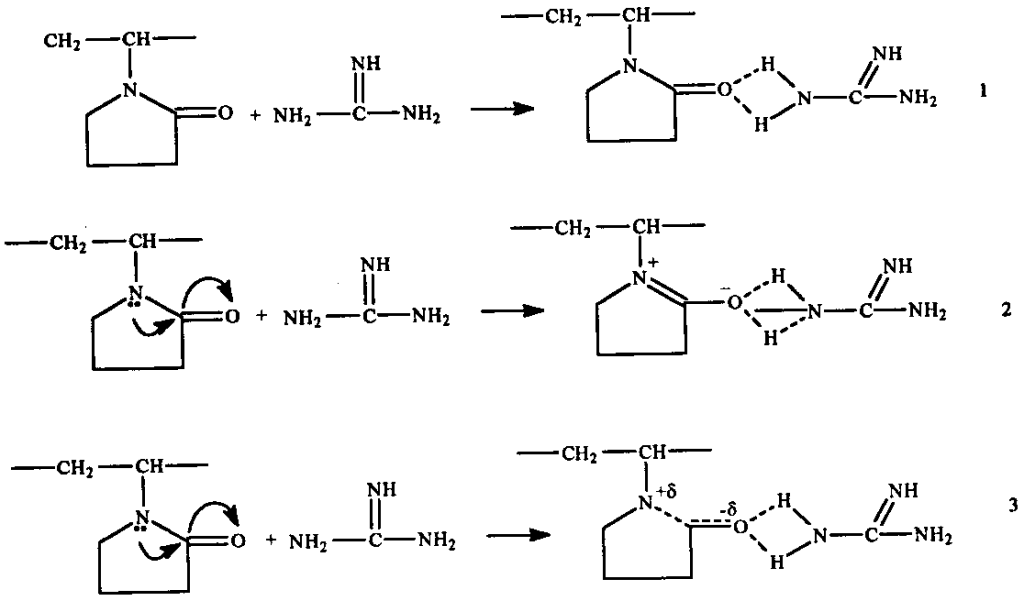
guanidine molecule through similar type of hydrogen bonding but one molecule of guanidine attracts the PVP molecules that's why decrease in viscosity is observed. This bonding seems to be stronger than that of water hydrogen bonding. There are two possibilities that either PVP nucleus exist as such (1) or give full negative charge to oxygen in pyrrolidone nucleus (2) which is being attracted through H-bonding of guanidine hydrogens. Both the structures 1 and 2 can be represented by a single structure i.e. (3) according to rules of resonance.

The same type of effect of guanidinium compounds was observed by Ise and Okubo [16] in their study on the solubility of naphthalene in aqueous polymer solutions. However the conclusion of Olgun *et al.*, [11] that the viscosity of compact coils are no longer concentration dependent not seem to be true because over here with increase in concentration of the denaturing agent the viscosities continuously decreases while Huggin's constant increases.

At the end the effect of temperature was also investigated. Increase in temperature means supply of thermal energy to the system and so that weak hydrogen bonds due to thermal energy break down and hence viscosity decreases. An interesting conclusion can be drawn from this that although denaturing agent for breaking hydrogen bond, has been added but this 0.02M and 0.05M GS solution are not enough concentration to break all the existing H-bonds in aqueous PVP solution. If this concentration was enough for the removal of H-bonding then temperature might have no effect on the viscosity. Also we do not agree with the conclusion drawn by Olgun [11] that addition of salt in PVP solution in the temperature range 20-40°C has no effect on the viscosity of solution.

Experimental

Commercial PVP K-90 sample used for this study was obtained from GAF corporation, England.



For viscosity determination Ostwald viscometer was used which was so dimensioned that Kinetic energy correction was negligible. All measurements were made at 20-50°C ± 0.01 with starting concentration around 0.2g/100 ml while the concentration of the denaturing agent Guanidinium sulphate was 0.02 and 0.05M.

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