

# PREDICTING THE VISCOSITY OF MIXTURES OF POLYSACCHARIDE THICKENING AGENTS IN AQUEOUS SOLUTION

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Suspected interactions between hydrophilic polysaccharides used as viscosity-enhancing additives in liquid and semisolid dosage forms have been noted previously (Walker and Wells 1982). These interactions may lead to an increase or decrease in solution viscosity compared with that anticipated from prior knowledge of the properties of the individual polysaccharides. However, deciding exactly what the expected viscosity should be, is complicated by the lack of a theoretically-based model for the prediction of the viscosities of solutions containing a mixture of non-interacting polysaccharides. This paper presents a novel, theoretically-based method for predicting the viscosity of such solutions, and describes its experimental verification for a series of substituted celluloses.

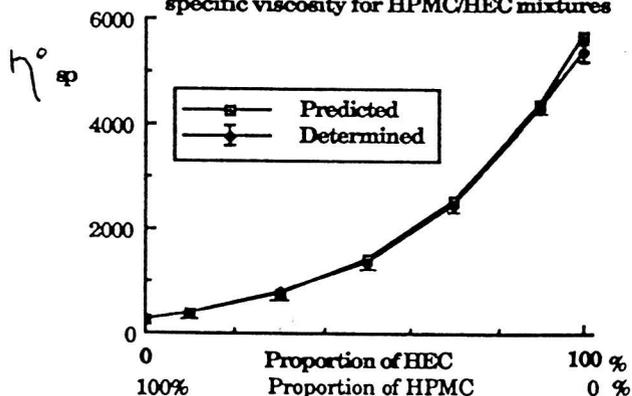
The method is derived from that described by Morris et al (1981) to model the viscosity:concentration relationship in single component polysaccharide solutions. This states that the zero shear specific viscosity of a polysaccharide solution of sufficient concentration for molecular coil overlap is given by the equation:  $\text{Log} \eta_{sp}^0 = x \text{Log}(C[\eta]) + \text{Log} k$  (1) where  $\eta_{sp}^0$  is the zero shear specific viscosity at polysaccharide concentration C,  $[\eta]$  is the intrinsic viscosity, and x and K are constants dependent upon polysaccharide

By adapting this theory to two-component polysaccharide systems it was postulated that the changes in zero shear specific viscosity with changing composition would be described by equation 2.

$$\text{Log} \eta_{sp}^0(A+B) = f_A x_A (\text{Log}(C(f_A [\eta_A] + f_B [\eta_B]))) + f_A \text{Log} k_A + f_B \text{Log} k_B \quad (2)$$

where  $f_A$  and  $f_B$  are the weight fractions of polysaccharides A and B. The validity of equation 2 was tested experimentally using combinations of polysaccharides believed to be non-interacting. Maintaining a total polysaccharide concentration of 1.0% w/w and a temperature of 25°C, the zero shear specific viscosities of two-component aqueous solutions containing hydroxypropyl methylcellulose (HPMC) and hydroxyethylcellulose (HEC); and HPMC and hydroxypropylcellulose (HPC) were determined from low shear viscosity measurements obtained using a Deer rheometer (concentric cylinder geometry MG7101). As is illustrated by fig.1 the experimental values obtained proved to be in excellent agreement with the corresponding theoretical data

Figure 1. Predicted and determined values of specific viscosity for HPMC/HEC mixtures



predicted by equation 2. This correlation between theoretical and practical values shows the applicability of the model for predicting zero shear specific viscosities of mixed polysaccharide solutions, and may permit the model to be employed in future studies to determine the discrepancy between measured and anticipated viscosities of polysaccharide solutions where pronounced polymer-polymer interactions may occur.

Morris, E.R. et al (1981) Carbohydrate Polymers 1: 5-21

Walker, C.V., Wells, J.I. (1982) Int.J.Pharmaceutics 11: 309-322