

with change of pressure. Whether or not the degree of association changes with pressure, the effect of association apparently changes with pressure, becoming stronger with increase of pressure and consequently complicating the interlocking.

From these considerations it appears probable that the interlockings in this group of mixtures are complicated by the structural differences of the component molecules and their effects. Thus the observed complexities in the viscosity isobars, Figs. 3 to 9 inclusive, are unique functions of mixture and they display such bewildering variations with concentration that it seems hopeless to attempt to express the viscosity at high pressures by a quantitative relation. It may be stated that the irregularities observed in the viscosity are of such magnitudes that it is impossible to consider them as due to experimental errors.

The results for the *n*-pentane benzene mixtures are significant. While these mixtures might be classed with those in the first group, since all are composed of nonpolar components, it is evident, however, from an inspection of Fig. 9 that the interlocking must be quite different. The departures of the viscosity isobars from linearity at 30° are in the nature of sags which extend uniformly over the concentration range and which vary greatly with pressure. But at 75°, the sags are much different, being absent or less in amount at the corresponding pressures; however, at the highest pressure, the qualitative natures of the curves become more nearly similar to those at 30°. There is no reason for abnormality in the pentane benzene mixtures due to such effects as previously discussed and the interlocking would be thought characteristic of the component molecules.

A complete explanation of the sags in the viscosity isobars of the *n*-pentane benzene mixtures would necessitate more exact information about viscous interlocking. Yet, it does not seem unlikely that a change in orientation with change of pressure, effected in such a way that there is a tendency for the flat planes of the benzene molecules to become parallel with the direction of relative motion, might conceivably

result in an interlocking not unlike that which has been considered in the first group of mixtures. This particular type of interlocking in pentane benzene mixtures offers a qualitative explanation of a relative viscosity less than that obtained if the pressure and temperature coefficients of viscosity of the components were additive in mixture.

CONCLUSIONS

The log viscosity for two mixtures, *n*-hexane carbon disulphide and *n*-hexane *n*-decane at different pressures and temperatures, has been shown to obey Arrhenius' equation for the viscosity of a binary mixture, indicating that the pressure and temperature coefficients of viscosity of the components are additive. It is believed that a comparatively simple type of interlocking occurs in these mixtures due to the effectively linear structure of the molecules and the absence of non-uniform molecular fields such as would cause some sort of association. For the mixtures *n*-hexane diethyl ether, *n*-hexane chlorobenzene, *n*-pentane benzene, and eugenol carbon disulphide, few generalities can be stated about association of molecules and the resulting kinds of interlocking at high pressures for they are specific properties of mixture.

The viscosity of liquids is not at all well understood notwithstanding the theoretical advances of Raman¹⁹ and Andrade.²⁰ While the viscosity of liquids at high pressures represents somewhat unusual experimental conditions, nevertheless it displays those salient features of structure which exist in liquids at more normal conditions but which probably are less effective in the comparatively large "free-space." Considering the results of this investigation, viscosity is a specific property of the molecule and as such it offers prohibitive difficulties for any complete, theoretical generalizations at present.

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¹⁹ C. V. Raman, *Nature* 3, 532 (1923); 3, 600 (1923).

²⁰ E. N. da C. Andrade, *Phil. Mag.* 17, 497 (1934), and 17, 698 (1934).

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