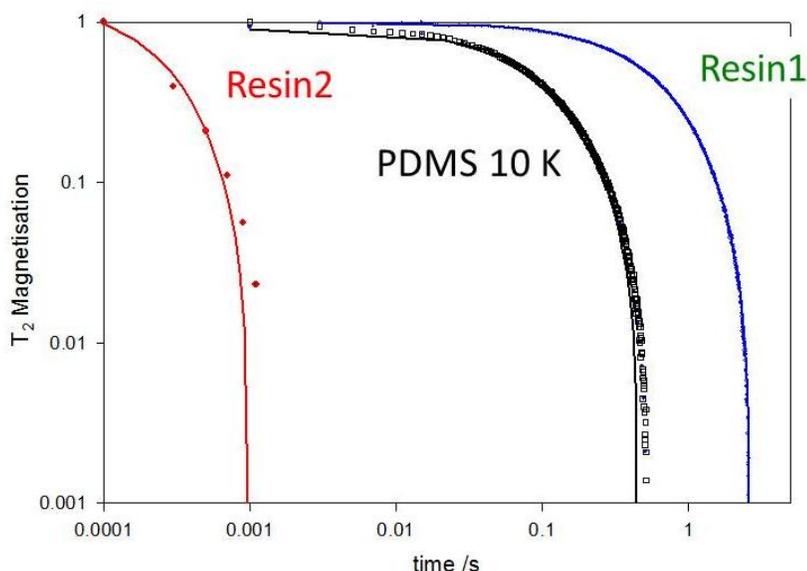


## NMR Relaxation of Resins and Polymers

Paints are pigmented materials as distinct from clear films (surface coatings) such as lacquers and varnishes. Modern painting processes may include composite systems in which the total paint system comprises several thin films, e.g. primer, undercoat and topcoat. Some, but not all, of which may be pigmented because it is virtually impossible to meet the requirements of the painting process by the use of a single coat. Two important constituents of paints are the binders and the primary pigment. The former are resins and polymers melts/liquids that provide the basis of the continuous film and so seal, or protect, the surface to which the paint is applied. The latter are fine inorganic or organic particulates that provide opacity, color and other optical or visual effects.

The polymers or resins used in paints are classified according to their molecular weight and major differences occur between them depending upon the methods of application and cure, the nature of the substrate and the conditions of use. However, they will all exhibit a characteristic NMR relaxation time. As the viscosity of liquid increases the relaxation time should decrease and this is illustrated in Figure 1 below. In this example, the Resin 1 (blue •) is a small nanoparticle with a radius of gyration of 3 Å. At room temperature it is a low viscosity mobile liquid that has a long ( $T_2$ ) relaxation time. The polydimethylsiloxane (PDMS) (black •) is a viscous liquid polymer (with a Mw of 10KD); as is evident, it has a shorter  $T_2$ . The Resin 2 (red •) is a solid at room temperature and so has a very short  $T_2$  relaxation time. Thus, the effects of addition of resin particles on the viscosity of polymer melts/liquids can be studied directly using relaxation methods. By analogy, the mixing and dispersion of pigment particulates in paint vehicles can be investigated.



Note: the solid lines are fits to the experimental points.

Hence, NMR relaxation measurements offer the formulator a new and powerful tool to study not just the physical and mechanical characteristics of polymer and resins alone but also their potential interaction between themselves and other components of paints.