NMR RELAXATION, POWDER WETTABILITY AND HANSEN SOLUBILITY PARAMETERS APPLIED TO NANOPARTICLE DISPERSIBILITY

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The ease with which particles can be dispersed in a liquid is dependent on the details of the liquid to be used and the surface chemistry of the particles. The particle wettability, as controlled by dispersion forces, dipole-dipole forces and hydrogen bonding is the primary influence. Being able to predict the appropriate liquids to use for a given particle is of considerable interest to the formulator; there has been much interest in semi-empirical routes to selecting the optimum solvent (or solvent mixture) for pigment particles.

The Hansen Solubility Parameters (HSP) approach, originally devised to study polymer-solvent compatibility can be applied to solid materials. Determination of the particle HSP, traditionally by visual observation, is subjective, time-consuming, error-prone and is only qualitative. Extinction profiles measured over centrifugation time are more qualitative; the influence of density and viscosity of different solvents employed must be accounted for and the solids concentration must be chosen with care.

NMR solvent relaxation measurements are sensitive to the same intermolecular forces between solvent and particles with which HSP are concerned. We will show relaxation data obtained using three different nanosize zinc oxide powders, each having a completely different surface chemistry.

Results suggest that a straightforward, quantitative, fast instrumental approach to determining the HSP of a nanomaterial is feasible and, further, that NMR relaxation can also discriminate between suspensions that may initially appear similar but exhibit different long-term colloidal stability. NMR relaxation measurements can be made at almost any industrially relevant solids concentration without requiring further sample preparation; any hydrogen-containing solvent can be used.

The ability to project solid-liquid interactions obtained by NMR relaxation into Hansen space is powerful, is much simpler and easier than sedimentation and can potentially provide formulators with a time-saving method to optimize and select the liquid composition (solvent plus surfactant additives) for desired particle suspension performance.

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