Using a Magnometer to Optimize the Formulation and Preparation of Suspensions of Pigments and Dyes

Dispersions of solid materials in liquids find application in a very wide variety of products, from cosmetic sunscreens to automotive paints and pharmaceutical preparations. The preparation of wet suspensions having a defined dispersed state, with specific properties, is often difficult to achieve because complete knowledge Most industrial methods of formulation have been developed and optimized empirically; they are insufficient as a basis for understanding how and why suspensions of particles in liquids behave as they do and, many times, not as the formulator wants.

Large-scale industrial suspensions are usually prepared by the application of various mechanical treatment (milling and grinding) to a powder slurry using grinding aids. Such materials - “dispersants” - adsorb onto the newly formed surface as the material particle size is reduced, maintaining a stable suspension thus enhancing the overall comminution process.

Numerous materials are sold as dispersing aids. All work to some extent but choosing the most effective one is critical to both product economics and quality. The choice of the correct dispersant requires consideration of both the particles surface chemistry and the suspension medium conditions.

Measurements with the Mageleka Magnometer HRS are fast and the instrument will function with suspensions at all industrially relevant concentrations; it does not require any sample preparation.

Figure 1 shows the effect on surface area of milling - under identical conditions using a sonic mill – a 20% aqueous slurry (at pH10) of a blue (carboxy) dye with a variety of different commercial surfactants (at 2 wt%). The zeta potential (ZP) – a factor related to the particle surface charge – for each suspension was also determined (on diluted samples) using electrophoretic light scattering (ELS).

Figure 1: Milling a Blue (carboxy) Dye

Surfactant (Trade Name)	**Surface Area** (m^2g^{-1})	**Zeta Potential** (mV)
None	15.4	-25
Fluorad	16.0	-33
Natrol 42	18.5	-37
Lomar D	35.5	-40
Aerosol AOT	42	-44
Ultravon W	46.2	-51

The mean surface area in the absence of any dispersant is ca 15 m^2g^{-1}. The blue dye alone has a negative ZP of -25mV - consistent with the known surface chemistry of such dyes (the material contains carboxyl groups which will be fully dissociated around pH =7, leading to a negative surface charge).

Milling in the presence of the surfactants increases the suspension wetted surface area. Such aids are ionic (negative charge) in character and they adsorb onto the newly-formed surface of the dye as grinding proceeds increasing the ZP and enhancing the dispersion process - the better the “grindability”, the lower the energy input needed.

It is clear from the data that, for this blue carboxy dye, the most efficient dispersant is Ultravon W (an indazolium compound).