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Stability of Aqueous Dispersions of Titanium Dioxide Against Sedimentation and Aggregation

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ABSTRACT

Particles of titanium dioxide (TiO_2) are widely used as white pigments in paints and inks, due to their brightness and high refractive index. Yet, with TiO_2 having a high density (4.2 g/cm^3), particles with typical sizes of 300 nm sediment rapidly even before significant agglomeration can occur. Thus, increasing the stability of TiO_2 dispersions against sedimentation as well as aggregation is important. We studied the effect of sodium dodecyl sulfate (SDS), a commonly used dispersant, on the stability of aqueous dispersions of TiO_2 with weight fractions from 0.01 to 40. The sedimentation time of each dispersion, defined to be the time for which the particles were found to settle from an initial sample of height of 1 cm to 0.5 cm, was obtained by visual observation. The sedimentation time for 40 wt% TiO_2 exceeded 100 hours, but was less than 24 hours for 0.01 wt%. The viscosities of aqueous solutions with varying SDS concentrations were also measured, increasing by about 50% as the SDS concentrations increased from 0 mM to 200 mM. This increase in viscosity cannot therefore fully explain the observed increase in sedimentation time with increasing SDS concentration. The viscosity data were also used to determine the effective sizes of the SDS micelles. The effective diameter of micelles was raised from 3 nm to 6 nm and then remains constant as the SDS concentrations increased from 0 mM to 200 mM. Overall, the results show that the viscosity effects have little influence on the sedimentation behavior and the sedimentation time is increased with increasing TiO_2 particle concentration.

KEYWORDS

Titanium dioxide, dispersion stability, sodium dodecyl sulfate, viscosity, nanoparticles

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