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EFFECT OF SILICA NANOPARTICLES ON SURFACTANT ADSORPTION KINETICS

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Abstract

This study investigates the effect of fumed silica nanoparticles (SiO2) on the surface tension behavior of three surfactant types: sodium dodecyl sulfate (SDS; anionic), polysorbate 80 (Tween 80; nonionic), and dodecyltrimethylammonium bromide (DTAB; cationic). Surface tension measurements were conducted using the pendant drop method for pure surfactant solutions and surfactant/SiO2 suspensions at concentrations ranging from 0.001 to 16 mM and SiO2 content of 0.1-0.5 wt %. The addition of silica nanoparticles altered the surface tension kinetics compared to pure

surfactant solutions across the same concentration range. For SDS and DTAB systems, the isotherms showed non-monotonic changes with characteristic inflection points, whereas Tween 80 demonstrated more gradual modifications. This complex behavior indicates competitive adsorption mechanisms at the interface, where nanoparticles can either disrupt surfactant packing (increasing tension) or facilitate synergistic stabilization (decreasing tension) depending on concentration regime and electrostatic interactions. Understanding these concentration-dependent transitions is crucial for optimizing colloidal stability in practical applications such as agrochemical formulations.

Keywords:
Surfactants, SDS, Surface Tension, Sio2, Fumed Silica