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The wettability of surfactant solutions on particles in simulated reservoirs

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The study employed the Washburn capillary rise method to explore the wettability of three conventional cationic, anionic, and nonionic surfactants - CTAB, SDS, and TX-100 - on powders with varying polarities and the resultant behavior of droplets under capillary force. For kaolin, illite, and silica nanoparticles, CTAB's hydrophilic portion interacted with the powder through electrostatic forces. TX-100 molecules adhered to solid particles via hydrophilic epoxy groups and hydrogen bonding interactions. SDS molecules attached to hydrophilic particles through hydrophobic groups and Lifshitz-van der Waals interactions. Moreover, in the case of hydrophobic oil sands, CTAB, SDS, and TX-100 exhibited adsorption through hydrophobic interactions. Notably, at the critical micelle concentration (CMC), surfactant molecules aggregate to form micelles, impacting solution mobility and altering wetting properties such as contact angles. This study highlights the dynamic interplay between surfactant solution surface tension, solid-liquid interfacial tension, and their effects on wetting behavior at varying solution concentrations. The competitive relationship between dynamic adsorption and microscopic surface tension influences the wetting dynamics of the solution.

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