
A Critique of Diffuse Double Layer Models Applied to Colloid and Surface Chemistry

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Abstract: The use of Derjaguin-Landau-Verwey-Overbeek (DLVO) theory in colloid science has continued to the present day in spite of the inability of this theory to explain, even qualitatively, numerous phenomena exhibited by clays and other colloidal materials. An alternative description of the fundamental forces involved in the formation of dispersions and gels was presented in 1938 by Langmuir, but was never widely accepted among colloid scientists. Recent experimental and theoretical work, particularly in Japan, has revived this alternative view, in which a long-range Coulombic attraction force appears to explain several phenomena, particularly transitions among ordered and disordered phases of colloidal particles in dilute salt solutions.

Examples are given from surface chemistry where rather complex models based on diffuse double layer theory are used to explain chemical adsorption behavior that often has a simpler explanation. It is argued that the rule of parsimony (Ockham's Razor) should be applied to complex models that appear to explain the data at hand before such models are taken to be generally valid. A satisfactory fit of model predictions to experimental data obtained under a very limited range of conditions does not prove the validity of the model. Thus, it is concluded that the DLVO theory and its modifications fail to meet the 2 criteria necessary to the acceptance of a theory: agreement with observations and simplicity.

Key Words: Clay Dispersion • Clay Swelling • Diffuse Double Layer • DLVO • Electrostatic Attraction • Theory • Interparticle Forces • Ockham's Razor • Schiller Layers • Smectites

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