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Heteroaggregation of Graphene Oxide Nanoparticles and Kaolinite Colloids

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Graphene oxide (GO) is a material with rapid production growth, consequently GO nanoparticles are expected to eventually penetrate subsurface formations and interact with fine mineral particles. This study examines the heteroaggregation of GO nanoparticles with kaolinite (kGa-1b) colloids under various conditions. Dynamic batch experiments were conducted in solutions with different pH values (pH=4, 7, and 10), different ionic strengths (IS=1.4, 6.4, and 21.4 mM), and at three controlled temperatures (8, 14, and 25°C). The size of the aggregates and kGa-1b colloids was measured throughout the duration of the experiments. The interaction energies between GO nanoparticles and kGa-1b colloids were calculated using measured zeta potentials and applying the DLVO theory. The experimental results showed that a substantial amount of GO nanoparticles (15-30% of the initial concentration) attached immediately onto kGa-1b colloids, and that the attachment process reached equilibrium in just a few minutes. Also, it was shown that neither temperature nor pH played a significant role in the attachment of GO nanoparticles onto kGa-1b colloids. In contrast, IS was shown to influence attachment. The equilibrium experimental data were fitted nicely with a Langmuir isotherm, suggesting monolayer attachment.