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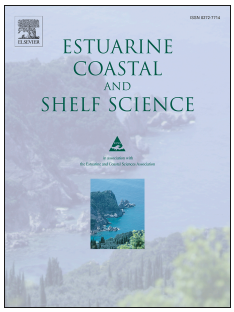

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Coagulation Processes of Kaolinite and Montmorillonite in Calm, Saline Water

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Abstract:

A three dimensional numerical model for simulating the coagulation processes of colloids has been performed by monitoring the time evolution of particle number concentration, the size distribution of aggregates, the averaged settling velocity, the collision frequency, and the collision efficiency in quiescent water with selected salinities. This model directly simulates all interaction forces between particles based on the lattice Boltzmann method (LBM) and the extended Derjaguin-Landau-Verwey-Overbeek (XDLVO) theory, and thus, can reveal the collision and coagulation processes of colloidal suspensions. Although using perfect spherical particles in the modeling, the results were compared with those for kaolinite and montmorillonite suspensions to demonstrate the capability of simulating the responses of these particles with highly irregular shape. The averaged settling velocity of kaolinite aggregates in quiescent saline water reached a maximum of 0.16 mm/s when the salinity increasing to about 3, and then, exhibited little dependence on salinity thereafter. Model simulations results (by choosing specific values that represent kaolinite's characteristics) indicate a similar trend: rapid decrease of the particle number concentration (i.e., rapidly flocculated, and thus, settling velocity also increases rapidly) when salinity increases from 0 to 2, and then, only increased slightly when salinity was further increased from 5 to 20. The collision frequency for kaolinite only decreases slightly with increasing salinity because that the fluid density and viscosity increase slightly in sea water. It suggests that the collision efficiency for kaolinite rises rapidly at low salinities and levels off at high salinity. For montmorillonite, the settling velocity of aggregates in quiescent saline water continuedly increases to