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The Impact of Precipitation Scenarios on the Characteristics of Porous Media: Numerical Simulation vs Experiments

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Several biological processes have been developed in the recent years in which the hydro-mechanical soil properties can be modified by precipitating calcium carbonate. Microbial and enzyme induced carbonate precipitation (MICP and EICP) have gained interest in potential biological processes to improve the mechanical properties of the soil by precipitating calcium carbonate, which forms cementing bonds between soil particles. However, the formation of inter-particle cementation also alters the porosity and connectivity of the pores and the hydrodynamics of the porous media. In this study, a computational algorithm is developed using a pore network model generated based on the initial grain size distribution and void ratio of a sand sample. The effect of the initial conditions such as hydrolysis rate and particle/pore characteristics on the carbonate precipitation behavior is studied and employed into the numerical algorithm. In addition, the effect of different resulting precipitation patterns such as contact binding, grain coating and pore filling on the fluid flow, permeability, water retention characteristics and pore size distribution of the bio-cemented soil samples are simulated using the pore network model. The numerical results are compared to the experimental hydraulic conductivity and soil water characteristics measurements of the EICP treated soil samples.

References

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