

Abstract Submitted  
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**From liquid to stone: a polydispersive colloidal model for cement setting**<sup>1</sup> ENRICO MASOERO, ROLAND PELLENQ, FRANZ-JOSEF ULM, SIDNEY YIP, Massachusetts Institute of Technology, EMANUELA DEL GADO, ETH Zurich — The main binding phase of cement is the nano-porous C-S-H gel, (calcium-silicate-hydrate). Here we investigate the temporal evolution of the mechanical properties of cement across the rigidity transition from liquid paste to solid stone, due to the precipitation of C-S-H. This transition is named “setting” and occurs several hours after mixing cement powder with water. We present a numerical model of random insertion of colloidal C-S-H nano-particles in the Monte Carlo framework. The particles interact with each other according to a generalized Lennard-Jones potential. Depending on the particle size polydispersity, the packing fraction of the final assemblies ranges between 0.64 and 0.73. The mechanical properties of the assemblies indicate that the packing fraction is the key parameter for continuum mechanics models at larger scales. In fact, both the stiffness and the strength of the assemblies increase with the packing fraction, while the ductility decreases. On the other hand, the evaluation of the specific surface requires an additional parameter fixing the length scale, for example, the characteristic size of the nano-pores. We finally show the relevance of our results for cement setting with a simple semi-analytical model of micro-pore filling.

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