

A new method for quantitative design and regulation of artificial rock analogs: Sandy 3D printing and variety postprocess explorations

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摘要: Sandy 3D printing is an emerging technique capable of fabricating artificial rock analogs with designed structure and controllable physical properties and has been widely used in rock mechanics and geosciences. However, the low strength, stiffness and high permeability of sandy 3D printed rock analogs (3D-PRA) has limited the possibility of simulating natural rocks in a wider range of application scenarios. In this paper, three different modification materials (Aqueous nano-silica solution, Polyacrylic Resin Adhesive, Epoxy Resin Adhesive) were used to quantitatively regulate 3D-PRA. The effects of material type and post-processing parameters on the physical, mechanical, and hydraulic properties of the modified 3D-PRA were investigated and analyzed comprehensively. The uniaxial-triaxial compression test were conducted to investigate the mechanical property and failure behavior. The highest uniaxial compressive strength (UCS) and triaxial compressive strength (TCS) approach to 55MPa and 93MPa, respectively. The lowest porosity and permeability reach to 2% and 0.3mD, respectively. The modification mechanism was revealed by investigating the evolution of the pore structure by μ -CT and SEM scanning. For the first effort in literatures, this study established a parametric chart for quantitatively regulating the physical and mechanical properties of 3D-PRA which lays a foundation for expanding the application fields and prospects of 3D-PRA.

关键词: 3D printing, Artificial rock, Modification, Rock mechanics, Permeability