利用 3D 列印裂隙網路試體進行滲透率實驗

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摘要

近年來，3D 列印技術因可重複製作、快速成形、精度高等優點，已被廣泛運用在模具生產、教育、醫學等領域。而在能源工程領域中，因不易取得代表性的裂隙岩體，因此利用裂隙參數和 3D 列印技術製作代表性的裂隙岩體。本研究欲探討異向性裂隙網路的滲透率行為，故設計三維裂隙網路模型，並利用 3D 列印技術將試體製作出來。所使用的光固化 3D 列印技術為 SLA(Stereolithography)，因精度較高且列印出的試體之基質滲透率幾乎為零，適合用來探討裂隙岩體的滲透率行為。目前的裂隙網路設定為均向裂隙、裂隙半徑為 3 mm、開口寬為 0.2 mm，並利用 YOKO2 系統測量其氣體滲透率，同時也利用數值模擬來估算裂隙岩體的水力傳導係數。比較實驗與模擬結果，發現差異甚大，代表仍須對參數做調整，以符合原先設計的裂隙網路模型。未來將列印相同的裂隙網路模型，進行滲透率實驗，來驗證 3D 列印技術的可重複製作性，並設計異向性的裂隙網路模型，探討異向性裂隙岩體之滲透率行為。

Permeability experiments using 3D printed fracture network sample

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Abstract

For the past few years, 3D printing technology has been widely used in mold production, education, medicine and other fields due to its reproducible, rapid prototyping and high precision. Because it is difficult to obtain the representative fractured rock mass in energy engineering, The fracture parameters and 3D printing technology are used to establish the representative fractured rock mass. In this study, we want to discuss the permeability behavior of the anisotropic fracture network, so we design a three-dimensional fracture network model and use the 3D printing technology to print the sample. One of the light curing 3D printing technology is called SLA (Stereolithography). Due to the high precision and the matrix permeability of the printed sample is almost zero, which are suitable for studying the permeability behavior of fractured rock mass. The current setting of the fracture network is isotropic fracture. The fracture radius is 3 mm, and the aperture is 0.2 mm. We measure gas permeability by the YOKO2 system, and the numerical simulation is also used to estimate the hydraulic conductivity of the fractured rock mass. Comparing the experimental and simulation results, it is found that the difference is very large, and the parameters still need to be adjusted to conform to the originally designed fracture network model. In the future, the same fracture network model will be printed, and conduct the permeability experiments to verify the reproducibility of 3D printing technology, and design anisotropic fracture network model to investigate its permeability behavior.