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石灰岩应力－应变全过程的非Darcy流渗透特性

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摘要 利用瞬态渗透法测定了石灰岩在应力－应变全过程的非Darcy流渗透特性，发现一种新的试验现象，即在峰后大应变状态下非Darcy流b 因子为负。这一试验现象使得人们可以立足于实验室试验来验证、预测和分析岩石渗流失稳现象和规律。建立了一种瞬态法测定岩石渗透特性的试验系统的动力学模型，介绍了由孔隙压力差单一时间序列提取非Darcy流渗透特性参数(渗透率、非Darcy流b 因子和加速度系数)的方法，并对石灰岩标准试样进行了应力－应变全过程的渗透试验。研究表明，无论在峰前还是峰后，石灰岩的渗流都不服从Darcy定律；当非Darcy流b 因子为正时，非Darcy流的渗透率小于Darcy流的渗透率；当Darcy流b 因子为负时，由于裂隙的贯通，孔隙压力迅速衰减，石灰岩中渗流可能失稳。提出的非Darcy流渗透特性的测定方法，继承了以往实验室试验的成熟技术，只是在数据处理方面进行了尝试，既不增加试验成本，又不加大试验的技术难度，便于被用户接受。

关键词 岩石力学 渗透特性 非Darcy流b 因子 加速度系数 石灰岩

分类号

SEEPAGE PROPERTIES OF NON-DARCY FLOW IN COMPLETE FAILURE PROCESS OF LIMESTONE

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Abstract

A dynamic model of test system is established to study the seepage properties of non-Darcy flow in rock specimen，and seepage properties parameters(permeability，non-Darcy flow b factor，and acceleration coefficient) of limestone specimens are picked up based on the analysis of individual time series of porous pressure gradient. A new phenomenon comes to light in the test process that the non-Darcy flow b factor of the specimen in post-failure stage is less than zero. The discovery of this new phenomenon makes it possible for engineers to verify，forecast，and analyze the instability of seepage flow in rock in laboratory. Test results show that seepage flow in limestone does not obey Darcy¢s law whether it is in post-failure stage or in ante-failure stage. The permeability of non-Darcy flow is less than that of Darcy¢s flow when the non-Darcy flow b factor is positive；the seepage flow would be instable when the non-Darcy flow b factor is negative because of the interpenetration of fracture in the specimen. With the help of test results，the mechanism of water inrush in coal mines can be explained more convincingly by the nonlinear dynamics theory，and a new idea is provided to engineers in the control of water seepage in surrounding rock strata in coal mines. The tests adopt previously familiar methods，and more efforts are involved only in the data process. It does not increase the test cost，nor does it make the test more difficult. So it is doubtless to be used widely in the near future.

Key words rock mechanics seepage properties non-Darcy flow b factor acceleration coefficient limestone

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