

论文

改进的岩石非线性黏弹塑性蠕变模型及其硬化黏滞系数的修正

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摘要:

基于蠕变过程中的硬化-损伤机制, 在对江西东乡铜矿砂质页岩单轴循环加卸载蠕变试验数据分析过程中, 提出硬化-损伤效应的时效机制, 并基于此对高应力条件下衰减蠕变阶段的黏滞系数(硬化黏滞系数)进行修正; 结合定常蠕变阶段的损伤蠕变机制, 提出高应力条件下岩石损伤效应的累积-扩散机理, 并据此引入以累积损伤蠕变量为判定准则的加速蠕变触发模型(非线性蠕变体)描述岩石的不稳定蠕变特征。在此基础上, 引入瞬时塑性元件, 与虎克体和黏弹塑性体串联, 建立了一个能够完整描述岩石蠕变全过程的非线性黏弹塑性蠕变模型。试验曲线与模型曲线较吻合, 说明对高应力下硬化黏滞系数修正的必要性, 改进非线性蠕变体的正确性与合理性。

关键词: 黏弹塑性蠕变模型 硬化黏滞系数 硬化-损伤效应 累积损伤蠕变量 瞬时塑性元件 加速蠕变体

Improved nonlinear viscoelasto plastic rheological model of rock and its correction of hardening coefficient of viscosity

Abstract:

Under uniaxial loading instrument, the cyclic loading and unloading creep test on the sandy shale specimens of Dongxiang Copper Mine was done. Based on the hardening damage mechanism of creep process, the timeliness of hardening damage effect was proposed during the analysis of creep data. And then the coefficient of viscosity (hardening coefficient of viscosity) in the decay creep stage under high stress condition was corrected. Based on the creep mechanism of damage in the stationary creep stage, the accumulation diffusion mechanism of rock damage effect was put forward under high stress condition. Hereby, the triggering model (nonlinear creep body) of accelerated creep according to the accumulative creep deformation of damage was introduced to describe the unstable creep characters. On these bases, introduced the instantaneous plastic component, combined with the hooker body and viscoelasto plastic body, the nonlinear rheological model of rock was established to describe the overall process of creep. The comparison between nonlinear rheological model and experimental curves show that two curves accord well each other, the correction of hardening coefficient of viscosity is necessary, and the improved nonlinear viscoelasto plastic rheological model is available and reasonable.

Keywords: viscoelasto plastic rheological model; hardening coefficient of viscosity; hardening damage effect; accumulative creep deformation of damage; instantaneous plastic component; accelerating creep body

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