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TIME-DEPENDENT BEHAVIOR OF ROCK SALT EXPERIMENTAL INVESTIGATION AND THEORETICAL ANALYSIS

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博士学位论文摘要 The rheological behavior of rock salt is important for many engineering applications. This dissertation reports on experiments and model analyses of rock salt. An in-depth study is presented of the time-dependent properties of rock salt. It consists of two parts. The first part is the experimental investigation, which is aimed at improving the understanding of the rheological behavior of rock salt. Uniaxial and trtaxial creep and relaxation experiments have been performed to further this goal. The second part is the analysis of constitutive models of the mechanical behavior of rock salt and the evaluation of their predictive capability. The objective of this research is to upgrade the understanding of the time-dependent properties of rock salt and to develop a more reasonable damage constitutive theory to describe the complete mechanical response of rock salt.

In the first part, besides conventional creep and relaxation tests, stepwise, loadins and reloading, and alternating relaxation and creep tests are described. Twelve tests have been performed, rangig in duration from a few hours to 4 months. The axial stress ranges from 13 to 43 MPa. Confining pressure ranges from 0 to 11.2 MPa. The confinins pressure effect, the stress level, and the load path effect on the creep and stress relaxation of rock salt are analyzed through the experimental investigation. The pre-creep effect on stress relaxation is obtained. The experimental investigations reveal that the confining pressure effect on the creep is significant only in the low-pressure range (0~3 MPa). Steady state strain rate is independent of the load path. The pre-creep strain and the confining pressure affect the stress relaxation significantly. The existence of a transient strain limit and of a lower creep limit is confirmed by the experimental results presented in this dissertation.

The second part of this study reviews constitutive theory equations currently used in rock salt mechanics research and suggests a new constitutive equation in order to represent the testing data obtained. An endochronic model is developed in order to model the temperature effects on the material response. A new damage constitutive equation is proposed in order to represent the entire creep behavior. A comparison of theoreticaliy calculated results with experimental results is given. Based on thermodynamic theory and damage mechanics, an evolution equation of creep damage of rock salt is proposed. A new creep constitutive equation is derived from this evolution equation. The new model predicts the damage behavior induced by the creep usins only a few material parameters, which have obvious physical meaning.

Key works rock salt, time-dependent behavior, testing study, theoretical analysis

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