A MESOMECHANICAL ANALYSIS OF CREEP UNDER DIFFERENT TIME-INDEPENDENT LOADINGS

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The general author's mesomechanical model with tensorial internal variables is applied to creep of steel 0,5Cr0,5Mo0,3V under different loading levels. It is shown that the creep process can be described by the mesomechanical model in its whole course up to rupture. However, the model parameters can be influenced at the very beginning by the application of the applied load if it is high enough to cause changes in the internal structure. This problem is specific for creep at high temperatures and significant differences in the loading levels (contrary to the small-strain plasticity studied usually at low temperatures, where the model parameters can be considered the same for different loadings).

Key words: *creep, mesomechanics, tensorial internal variables*

1. Introduction

In the author's three monographs [3, 4, 5] and in a number of his papers the problem of modeling the effect of internal structures, stresses and strains in different materials has been attacked from the point of view of representing these phenomena on the mesoscale. The main attention has been paid to inelastic time-independent processes, but generally, the author's concept is applicable to time-dependent rheological processes as well. In the last years, some such processes have been analyzed in the author's papers [7, 8]. It has been shown that with the use of our model all three stages of creep and possible subsequent relaxation processes can well be described.

The merits of our model have been demonstrated among others in [8] by a confrontation of the model with the fundamental rheological characteristics that E. Krempl [9] has specified on the basis of extent experimental investigations of a number of metallic materials. These characteristics are as follows:

A. For a given strain rate and for a given relaxation time the stress drop can be independent of the stress and strain at which relaxation starts. In the instances where the relaxation curves have been measured it was shown that not only the relaxation drops but also the stress vs. time curves can be identical.

B. The stress drops in a constant time interval depend on prior strain rate. They are nonlinearly related to the prior strain rate. A tenfold increase of the strain rate increases the stress drop by much less than a factor of ten.

C. At the end of relaxation periods of constant duration the test associated with the fastest (slowest) prior strain rate can exhibit the smallest (largest) stress magnitude.

D. Once straining is resumed at the end of the relaxation periods the flow stress characteristic of the strain rate is reached quickly. The stress–strain curve after relaxation follows the

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