THE THERMODYNAMICALLY MODEL OF DIAGRAM OF LOADING AND REMAINING LIFE

FEDOTOV Vladimir

Institute of Engineering Science, Yekaterinburg, Russian Federation

Abstract

Many modern constructions are exploited under various conditions of mechanical, thermal, diffusion and other physical and chemical effects. All this can significantly affect to the metal structure and properties of structural elements. Normally it is not possible to determine such properties during the exploitation of the construction in the conditions of traditional mechanical (engineering) methods of testing, because it requires obtaining natural samples with subsequent calculation of structures for durability and reliability. This can lead to a substantial weakness of the construction and as a result to its destruction, therefore it is important to find the conditions of exploitation under which the construction uses all its resource without breaking the integrity and reducing the threshold strength. One of the ways of solving this global problem can be the construction of mathematical models using the basic statutes of thermodynamics. On the basis of concrete examples here we present the results of mathematical modeling and analysis of experimental data within a single strategy.

Obtaining a reliable experimental data is considerably more complicated when applied various physical fields. If it is necessary to take into account their number of experiments increases significantly while the overall accuracy of the results reduces. Further evolution is possible here probably by postulating the type of relationship based on the real internal strain mechanism. Strain diagram can be divided into four sections, where each section has a different thermodynamic nature. In classical mechanics on the first section the behavior of the quadratic elastic potential is studied. Due to the linearity of function and low density of dislocations the loss of stability cannot occur here. The processes in this part are in the thermodynamic equilibrium. This site is limited by the limit of proportionality. Please note that we consider here the limit of proportionality rather than the fluidity limit. Dividing the strain process into four stages is quite arbitrary, since each section may have different representative volumes and thermodynamic mechanisms may be of different nature. On the second stage of the process a local loss of stability can happen, it’s forced by the formation of dissipative structures that give rise to non-linearity before reaching the yield point. The third section is a strain hardening. The appearance of the second and third stages makes insufficient their studying by the methods of the static deformation based on "experimental approximation". Description of this part of the diagram can be based on the studying of non-equilibrium thermodynamics that deals with irreversible processes leaded to a decrease of entropy by self-organizing ordered and dissipative structures that occur in open systems, exchanging energy and matter with the environment. Synergetic studies the kinetics of the entropy and the dissipation function is expressed as the multiplying of a generalized flow and generalized force causing it. Non-equilibrium processes inherent to the bifurcation. According to I. Prigozhin, who developed the mechanism which describes the behavior of the system near bifurcation points, the system selects one of several options for the future due to random fluctuations. Reaching the stage of bifurcation, the system loses stability. The alternation of stability and instability is a common phenomenon in evolution. This means that after bifurcation the system cannot be returned to its original state of any open system. The fourth stage of softening is the stage of instability.

Keywords: diagram of loading, the elastic potential, resource, dissipation function, hardening
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