THE DEFORMATIVE PROPERTIES OF COMPOSITE MATERIALS UNDER INCREASED TEMPERATURE AND MOISTURE

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Introduction

The possibilities to use composite materials in important constructions depend on the mechanical properties of these materials under concrete conditions of exploitation. The definite conditions are characterised by the temperature's regime, degree of moisture and the duration of the material's loading. These three factors can function either simultaneously or not. It is necessary to take into consideration that if the values of these factors is increased, the composite material's resistance to load is diminished. Experimental data show, that creep is the most characteristic deformative property for the composites based on polymer resin. The research about the effect of temperature and moisture on creep of the composites has been carried out very little and basically it has experimentally empirical character. The obtained results quantitatively characterise the given deformative properties of the composite materials, they do not allow to forecast these properties in materials with different qualitative and quantitative structure.The aim of this work is to forecast creep of reinforced plastics at fixed temperature and moisture based on principles of structural mechanics of composite materials [1].

Results and Discussion

Experimental data prove that the deformative properties of fibres in reinforced plastics, like glass fibres, carbon fibres, boron fibres, do not depend on temperature and moisture. On the other hand, the deformations of the resin depend on temperature and moisture. The interval from indoor temperature to glass transition temperature of the matrix material special attention has been paid to in the work. The dependence of deformations of resin from temperature and moisture is expressed by function F (M,T). Fig. 1. shows character of changing of function F (M,T) for epoxy resin. It characterizes the ratio of short term deformation between dry resin at indoor temperature and deformations at increased moisture and temperature. Long term ratio of these deformations is characterised by

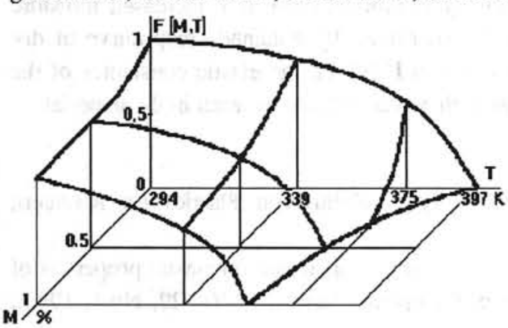

Figure 1 Character of the function F (M,T)

function $F^n(M,T)$, where n>1. In work [2] the function F (M,T) is suggested in the following form:

$$F(M,T) = \sqrt{\left(1 + aM + bM^2\right)\frac{T_{go}}{T_{go} - T_o} - \frac{T}{T_{go} - T_o}}$$

Parametrs a, b, T_{go} are determined according to experimental data.

In composing and solving equations of balance for reinforced two-component materials, the possibility has been obtained to forecast deformative properties for composite materials reinforced with direct fibres. The obtained relationships contains characteristics of deformative properties of components and structural parameters of the composite material. These equations help us to forecast creep of composite materials of various structures and various components at different temperatures and moisture, using the experimentally obtained creep line of dry polymer resin at fixed temperature (initial temperature) and function F (M,T). Fig. 2 shows the forecasted and the experimentally proved curves of transversal creep for unidirectionally reinforced glass-epoxy plastic at increased moisture and two diferent levels of temperature. Coherences to forecast creep for reinforced plastics with freely oriented unidirectional layers has been obtained making use of balance condicions [3] of laminated materials.

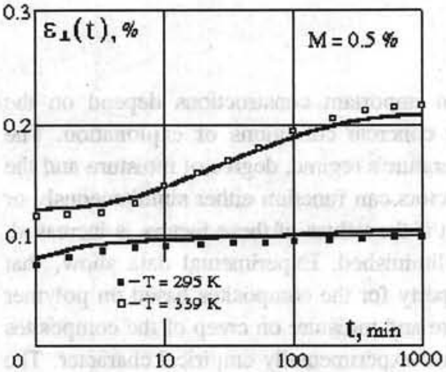

Figure 2 Transversal creep curves

Conclusions

The suggested methodology gives the opportunity to forecast deformative properties of long term loeded unidirectionally or multidirectionally reinforced plastics at increased moisture and temperature.The necessary information is experimentally obtained creep curve of dry resin at definite temperature, parameters of function F (M,T), the elastic constantes of the components, their quantitative connections as well as geometrical location in the material.

References

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