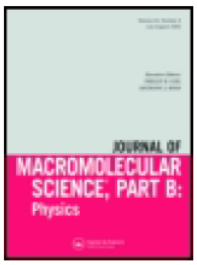

Taylor & Francis

Journal of Macromolecular Science, Part B
Physics

ISSN: 0022-2348 (Print) 1525-609X (Online) Journal homepage: http://www.tandfonline.com/loi/lmsb20

Prediction of the Creep of Elastomers Taking into Account the Forces of Entropic Elasticity of Macromolecules (Prediction of Creep of Elastomers)

Vladimir I. Kartsovnik

To cite this article: Vladimir I. Kartsovnik (2018): Prediction of the Creep of Elastomers Taking into Account the Forces of Entropic Elasticity of Macromolecules (Prediction of Creep of Elastomers), Journal of Macromolecular Science, Part B, DOI: 10.1080/00222348.2018.1470836

To link to this article: https://doi.org/10.1080/00222348.2018.1470836

Accepted author version posted online: 30 Apr 2018.
Published online: 08 Jun 2018.

JOURNAL OF MACROMOLECULAR SCIENCE®, PART B: PHYSICS
https://doi.org/10.1080/00222348.2018.1470836

Prediction of the Creep of Elastomers Taking into Account the Forces of Entropic Elasticity of Macromolecules (Prediction of Creep of Elastomers)

Vladimir I. Kartsovnik

The Society of Sciences & Engineering "KIW-Gesellschaft e.V.", Dresden, Germany

ABSTRACT

Accounting for the increase in the energy of activation of viscous flow of polymers by an amount proportional to the force of entropic elasticity of the stretched macromolecules, allows for a quantitative description of the curves of deformation of elastomers in the models of Kelvin-Voigt and the standard linear solid. For these models, application of a rubber-like elasticity modulus, increasing with the increase of deformation, enables calculation of Flory's correction factor for the network defects for the deformation curves of a rubber. The curves of creep of silicone rubbers under constant load for various temperatures were measured. For the Kelvin-Voigt model differential equations the dependence of the coefficients of linear approximations of these equations on loadings and temperatures were measured. The possibility to predict the time of achieving given creep values based on the proposed Kelvin-Voigt model equations were demonstrated.

ARTICLE HISTORY
Received 6 November 2017
Accepted 19 April 2018

KEYWORDS
Activation energy; creep of rubbers; Eyring's viscosity theory; Kelvin-Voigt model; prediction of creep; rubber-like elasticity modulus

Introduction

In discussing the thermal motion of atoms in liquids and solids, Frenkel analyzed the jumps of the atoms and molecules into vacancies in the flow.[1] Eyring introduced ideas about the influence of external forces, f, on the decrease of the activation energy, E_0, during the jump of atoms into the vacancies.[2] In this case the viscosity of the flow, η, can decrease according to the equation:

$$\eta = Af \exp \frac{E_0 - bf}{k_B T} \tag{1}$$

Where A is the pre-exponential factor, k_B is Boltzmann's constant, T is the absolute temperature and b is the factor proportional to the "viscosity factor" according to Eyring and coworkers.[3] These ideas were confirmed in research on metal deformation.[4] If we follow the logic of Eyring polymers additionally require taking into consideration the external impacts transferred through the valence bonds of the chain structures of macromolecules.[5,6]

CONTACT Vladimir I. Kartsovnik vkartsovnik@googlemail.com Bunsenstr. 9, 01139, Dresden, Germany.