The Creep Behavior of Standard Linear Solid

The creep characteristics of the standard linear solid (Fig. 1) have been recently considered by Supanekar and Daruwalla,[1] who concluded that for "fast" or "rapid" creep, the spring constants E_a and E_m must be as high as possible. They further assert that for rapid dye uptake also, these spring constants must be as high as possible. A casual examination of the model suggests intutively that rapid creep should be possible only if the spring constant E_a is small because creep, which is retarded elastic deformation, is primarily governed by the movement of this spring retarded by the dashpot having viscosity coefficient η_m. The following brief analysis shows that a small E_a would result in rapid creep.

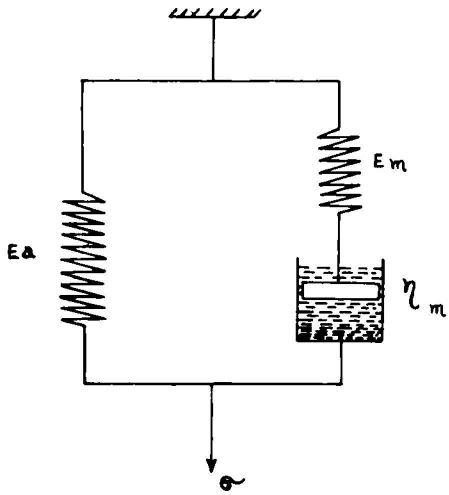

Fig. 1. The standard linear solid.

The creep equation of the standard linear solid is

$$\epsilon = \epsilon_\infty(1 - A_e{}^{-Bt}) \tag{1}$$

where ϵ = strain at time t; $\epsilon_\infty = \sigma/E_a$, where σ is the creep stress; $A = E_m/(E_m + E_a)$; and $B = E_aE_m/[\eta_m(E_m + E_a)]$.

Differentiation of eq. (1) yields

$$\frac{d\epsilon}{dt} = \epsilon_\infty AB_e{}^{-Bt} \tag{2}$$

This may be rewritten as

$$\frac{d\epsilon}{dt} = A^2_e{}^{-Bt}\left(\frac{\sigma}{\eta_m}\right). \tag{3}$$

In the above equation the terms containing the spring constants are A and B. It is obvious from eq. (3) that for high creep rate, A must be large and B must be small. Now, $A = 1/(1 + E_a/E_m)$; and, therefore, for large A, E_a must be small. Also, $B = 1/[\eta_m(1/E_a + 1/E_m)]$; and, therefore, for small B, E_a must be small.

References

1. S. D. Supanekar and E. H. Daruwalla, *J. Appl. Polym. Sci.* 17, 863 (1973).

Textile Technology Department
Indian Institute of Technology
Hauz Khas, New Delhi 110 029, India

V. B. GUPTA

Received August 13, 1974
Revised February 11, 1975