A Non-Linear Discrete Modified Kuhn Model for the Viscoelastic Behavior of a Polyethylene Composite

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Use of high density polyethylene (HDPE) pipes in buried pipe applications such as storm water drains and sanitary sewer lines is steadily increasing.

The viscoelasticity of HDPE is non linear as it is seen from creep data. In this work we propose a new non-linear viscoelastic model for HDPE. The model is based on a model developed by Lubliner and Panoskaltsis (1992), named by them the modified Kuhn model of viscoelasticity. This model has been developed in both continuous and discrete forms. The discrete modified Kuhn model consists of a series of Kelvin type Kuhn elements, with the advantage that the number of model parameters remains the same, regardless of the number of Kuhn elements introduced. Then, one can use a large number of Kuhn elements for a better accuracy in modeling, without increasing the number of parameters. In this work, the discrete modified Kuhn model of viscoelasticity has been enhanced by introducing non-linearity in it. Nonlinearity has been introduced in the external spring, in order to describe the instantaneous nonlinearity of the material. Additionally, the internal springs of the model as well as the dashpots have been made non linear to describe the nonlinearity in the viscoelastic region. An internal variable representation of the new model has been also obtained. The new model is compared against experimental results and its predictive capabilities are demonstrated.

REFERENCES

[1] J. Lubliner and V.P Panoskaltsis (1992). The Modified Kuhn Model of Linear Viscoelasticity. Int. J. Solids Structures Vol. 29, pp. 3099-3112.

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