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TESTING AND MODELING FOR THE CREEP AND RECOVERY BEHAVIOR OF KEVLAR CABLES

Abstract

Kevlar cable has been widely used in space engineering projects due to its excellent radiation-resistant, heat-resistant and high-strength characters. In many situations of high precision, the mechanical stability of Kevlar cable often determines the work accuracy and the service life of space equipments such as large deployable antennas. However, Kevlar cable belongs to the family of polymer whose load-elongation characteristics are time-dependent. With the actions of prestress and space ambient temperature environment, Kevlar cable shows a creep and recovery behavior which has restricted the development of space equipments into high accuracy and high stability. Therefore, this paper investigated the creep and recovery laws of Kevlar cable by experiments, and then established a viscoelastic constitutive model to describe the creep and recovery behavior of Kevlar cable. Firstly, experimental data with various working conditions including different prestresses and different temperature environments were collected. Next, one-dimensional nonlinear viscoelastic constitutive model was proposed to describe the creep and recovery behavior of Kevlar cable based on Schapery's theory. And eventually, the model parameters were determined by the nonlinear least squares method for curve fitting the experimental data.