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THE SERVICE LIFE ASSESSMENT OF NEPE PROPELLANT

Abstract

The NEPE propellant with high-level nitramine explosive and nitrate ester shows different aging characteristics with that of the classic HTPB propellant, the aging mechanism and storage characteristic are more complex. The assessment of the propellant's storage life is an acknowledged problem. The thermal accelerated aging experiments of the NEPE propellant samples were carried out, Mechanical properties, energy properties, and variation of stabilizers content of NEPE propellant were measured. According to the aging data, it can be concluded that the aging of NEPE propellant has three stages, namely, stage of post-curing (stage I), stage of gradual degradation of micro-phase structures (stage II), and stage of chemical accelerated aging (stage III). The three stages cause the double-peak characteristic of the aging process of NEPE propellant. The tensile strength is one important token of the mechanical properties of NEPE propellant; its value increases slowly during the stage I, and begins to decline at the start of the stage II, which cause the first peak. Then the value of tensile strength shows the trend of decline at the prophase of the stage II but increase again at the metaphase. Finally, the value of tensile strength begins to decrease at the start of the stage III, which cause the second peak. The mechanical properties collapse at the end of stage III. NEPE propellant is one type of high polymer, so the accelerated aging is an imbalanced entropy increasing process. The tensile strength variation fits the Gaussian distribution. Because the mechanical properties of propellant decline rapidly after the second peak, the time of the inflexion of the second peak can be used as the criterion of the service life assessment. Then the service life assessment model was established based on the double peak properties of the tensile strength of NEPE propellant, which was combined with Arrhenius equation and chemical reaction kinetic,. And the service life of NEPE propellant was predicted at normal temperature.