

Aging Evaluation of Ammonium Perchlorate/Hydroxyl Terminated Polybutadiene-Based Solid Rocket Engine by Reactive Molecular Dynamics Simulation and Thermal Analysis

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Abstract : Propellants based on Hydroxyl Terminated Polybutadiene/Ammonium Perchlorate (HTPB/AP) are the most commonly used in most of the rocket engines used by the Brazilian Armed Forces. This work aimed at the possibility of extending its useful life (currently in 10 years) by performing kinetic-chemical analyzes of its energetic material via Differential Scanning Calorimetry (DSC) and also performing computer simulation of aging process using the software Large-scale Atomic/Molecular Massively Parallel Simulator (LAMMPS). Thermal analysis via DSC was performed in triplicates and in three heating ratios (5 °C, 10 °C, and 15 °C) of rocket motor with 11 years shelf-life, using the Arrhenius equation to obtain its activation energy, using Ozawa and Kissinger kinetic methods, allowing comparison with manufacturing period data (standard motor). In addition, the kinetic parameters of internal pressure of the combustion chamber in 08 rocket engines with 11 years of shelf-life were also acquired, for comparison purposes with the engine start-up data.

Keywords : shelf-life, thermal analysis, Ozawa method, Kissinger method, LAMMPS software, thrust

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