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A NEWLY DEVELOPED HIGH PERFORMANCE ADN BASED MONOPROPELLANT WITH A SAFETY EVALUATION

Abstract

In this research, the ADN salt was mixed with a new hydrocarbon fuel and the safety evaluation for the developed monopropellant was conducted. ADN based monopropellants are currently being investigated to replace the toxic and carcinogenic hydrazine propellant. ADN based monopropellant is a premixed propellant mixed with an oxidizer, ADN salt and hydrocarbon-based fuel. It has the advantages of high specific impulse and low toxicity compared to hydrazine. However, LMP-103S, which is widely used as an ADN-based monopropellant, has lower specific impulse than LP1856, a HAN-based propellant. In this study, to improve the specific impulse, a new type of glyme fuel was mixed with ADN salt instead of methanol fuel. The new type of glyme fuel has a low vapor pressure and therefore is less likely to be inhaled during the production stage. Also, the new fuel has a high energy and density, which may enhance the specific impulse and density specific impulse. The newly developed ADN based monopropellant has a vacuum specific impulse of 272 seconds in 7 bars, which is approximately 20 seconds higher than LMP-103S. Since the newly developed propellant is the premixed propellant and also has a high specific impulse, detonation phenomenon may occur due to superposition of compressive waves during ignition, which may generate an explosion after forming a shock wave. For this reason, a safety assessment was conducted to confirm the explosion potential of the propellant produced. The blasting cap test was selected for the safety evaluation. The blasting cap test has the advantages of not only using a small amount of sample, but also has a simple and inexpensive configuration system. The prepared blasting cap test system confirmed the reliability of the system by testing the distilled water, ammonium nitrate, and explosive composition of ethanol blended hydrogen peroxide. For the reproducibility of the test, 3 sets of the blasting cap test were carried out for the newly developed monopropellant. In all three tests, the aluminum tube containing the sample burst open the same as the aluminum tubes containing LMP-103S or ammonium nitrate. By measuring the propellants' explosive power, the measured explosive power of the newly developed monopropellant was more explosive than LMP-103S but less explosive than ammonium nitrate. Therefore, ADN based monopropellant produced in this study was considered to be safe. In the next study, the performance and flexibility of the newly developed monopropellant will be evaluated by conducting the combustion test.