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SOLID PROPELLANT BURNING RATE MEASUREMENTS USING ULTRASONIC TECHNIQUE

Abstract

Burning rate is one of the most important input parameter of solid propellant that required for the prediction of ballistic performance of solid rocket motors. Burning rate is very sensitive to the composition and particle size distribution of ingredients and it can vary considerably from one mix to another due to small changes in these parameters. Hence it is necessary to measure burning rates experimentally for accurate values. There are different methods to measure burning rate and ultrasonic burning rate (UBR) method is comparatively a new method. Indian Space Research Organisation recently implemented this method for the burning rate measurement of certain solid rocket motors in their production plants. One of the large motor for which this method adopted is a three-segmented strap-on booster motor loaded with 12 tonnes of AP-HTPB-Al composite solid propellant. Casting of this motor is done in 6 batches of propellant mixes with about 2 tonnes at a time in a mixer. Ultrasonic burning rate is evaluated for every mix using a small block (approximately 3 kg) of propellant cast separately from the same mix along with the main motor. From this block, 5 small propellant specimens (weight: 70g and size: 35 diameter and 40 mm length) are tested in a laboratory setup for burning rates by the ultrasonic technique and this burning rate is used for the performance prediction of the motor. So far, close to 4000 specimen measurements were done for 720 batch mixes of propellants used in 120 rocket motors. The paper discusses the details of these measurements, its dispersion and burning rate index estimated from these tests. The average burning rate of the propellant was 5.6 mm/s at 4 MPa reference pressure with a dispersion (1σ) of 0.047 mm/s. The paper also compares the measured chamber pressure of this motor with the predicted pressure using these burning rates.