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A TEST STUDY OF UNDERWATER IGNITION OF SOLID ROCKET MOTOR

Abstract

Because of inertia of water, the working performance of SRM in water is greatly different from which in air. These differences can bring new problems to structure design and performance prediction of SRM. In order to study of the performance of SRM in water and differences from in air, some ignition tests in different depth water and in air were done. In these tests, Pressure and thrust are measured, and high-speed digital camera is used to catch the evolvement of gas jet. There are many interesting findings in the ignitions of SRM in water. During ignition transient, the gas jet advances in axial direction and expands in radial direction, forming a cone in fore which points to the downstream at the first several milliseconds when gas jet enters into water. When the gas jet expands in radial direction to a certain level, it stops expanding and advances downstream only. As time passes, the back section of the gas jet forms a cylinder and there are several radial shrinkages in the cylinder section. From the measured thrust, we can find a big jump of thrust at the instant time when gas jet enters into water, which is several times greater than that in the working time. This big jump is not existent in air. Through a certain numerical treatment of the thrust, we can get a nearly ideal attenuation curve, which lasts long for 0.1-0.4s. After ignition transient, from the photos we can see that the gas jet can clearly be divided into three sections: gas bubble sectionmixing section and mixed section. From these photos we can also see that the bubble section is always oscillating in high frequency and low amplitude, at the same time which oscillates several times in low frequency and high amplitude. These two oscillation form are independent and of superposition. This phenomenon is consistent with the characteristic of the thrust curve in working time. In this paper, we thoroughly describe the characteristics of SRM in water, and some analysis is done to explain these characteristics, which are greatly helpful to the underwater motor design and performance prediction.