

EFFECT OF THE THERMAL AND GAS-DYNAMIC PROPERTIES OF SOLID ROCKET PROPELLANT PARTICLES ON THE PROPELLANT COMBUSTION RATE

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The aim of this work is to eliminate the explosion possibility of a rocket engine that operates on a fast-burning solid propellant. The problem is considered by analogy with experiments conducted earlier. Various ways to increase the propellant combustion rate are presented. Examples of how the solid propellant combustion rate depends on the metal fuel and the oxidizer particle size are given. It is shown that unstable combustion of a solid propellant at high combustion chamber pressures is due to unstable combustion of the gas phase in the vicinity of the bifurcation point. Zeldovich's theory of nonstationary powder combustion is applied to analyzing the explosion dynamics of the Hrim-2 missile's solid-propellant sustainer engine. This method of analysis has not been used before. The suggested version that this phenomenon is related to the aluminum particle size allows one to increase the combustion rate in the combustion chamber of a liquid-propellant engine, thus avoiding the vicinity of the bifurcation point. The combustion of solid propellants differing in aluminum particle size is considered. The metal fuel and the oxidizer particle sizes most optimal in terms of explosion elimination are determined and substantiated. The use of submicron aluminum enhances the evaporation of ammonium perchlorate due to the infrared radiation of aluminum particles heated to an appropriate radiation temperature. This increases the gas inflow into the charge channel, thus impeding the suppression of ammonium perchlorate sublimation by a high pressure, which is important in the case where the engine body materials cannot withstand a high pressure in the charge channel. This increases the stability and rate of solid propellant combustion. It is shown that the Hrim-2 missile's solid propellant cannot be used in the Hran missile. The combustion rate is suggested to be increased by using fine-dispersed aluminum in the solid propellant.

Keywords: *solid rocket propellant, combustion chamber, solid-propellant rocket engine, combustion rate, ammonium perchlorate*

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