Analysis of Ejector Mode of Liquid Rocket Based Combined Cycle Propulsion

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The overall theoretic physical and mathematical models are established for a liquid rocket based combined cycle (RBCC) propulsion. The numerical solutions are then used to perform the performance analysis of the ejector mode. The influence of the factors, including flight Mach number, rocket chamber pressure, ratio of oxidizer to fuel, and ratio of ejecting area, are then elaborated in the present study.

The LOX/kerosene liquid rocket engine (LRE) with a specified 100ton thrust force is established. The configuration of combined cycle is constructed by multi-ejectors with a joint mixing and secondary combustion chamber, in which the liquid-rockets are assembled in the struts of scramjet combustor. The ratio of ejecting area is varied by changing the area of air-breathing intake. The partial results are presented as follows.

Figure 1 shows the ejector coefficient changing with the free stream Mach number at the sea level condition. With the increase of chamber pressure the ejector coefficient is decreased, but it is increased with the free stream Mach number increasing. Figure 2 shows the specific pulse variations with Mach number. For a higher Mach number, the augment of specific pulse of combined cycle is larger. At the sea level, the lower chamber pressure of LRE can enhance the specific pulse of combined cycle.

Figure 3 presents the results of specific pulse augment with changing of ejector area ratio for different chamber pressures at the sea level condition. Here σ=Ar/Ai. With the increasing of ejecting area, the specific pulse augment is lowered downed. At the sea level, the lower chamber pressure of LRE can realize a higher specific pulse augment.

For the above analysis, the OF ratio of rocket is taken as 2.6 for the LOX/kerosene bi-propellant. The research conclusions are useful for guiding the engineering design and tests.

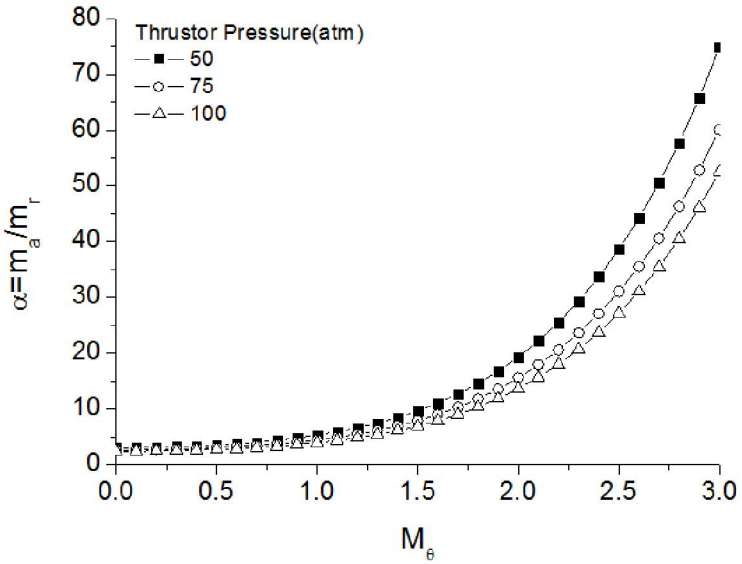

Fig. 1 Ejector coefficient for different thruster pressure

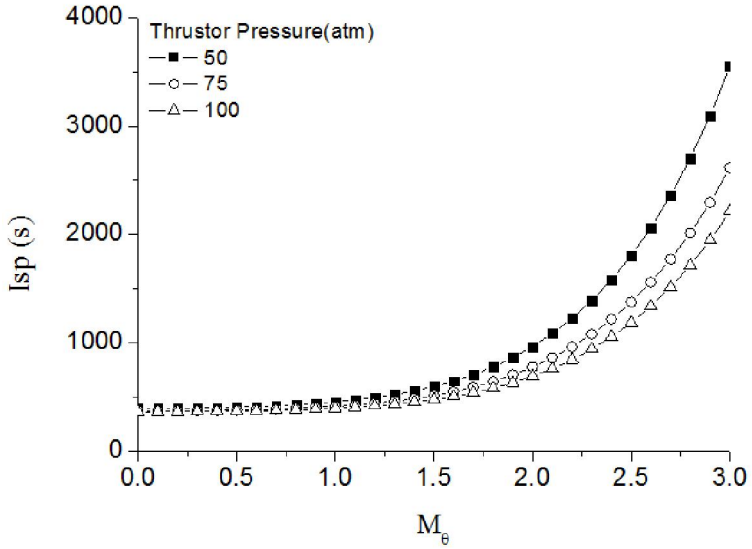

Fig. 2 Specific pulse variations for different thruster pressure

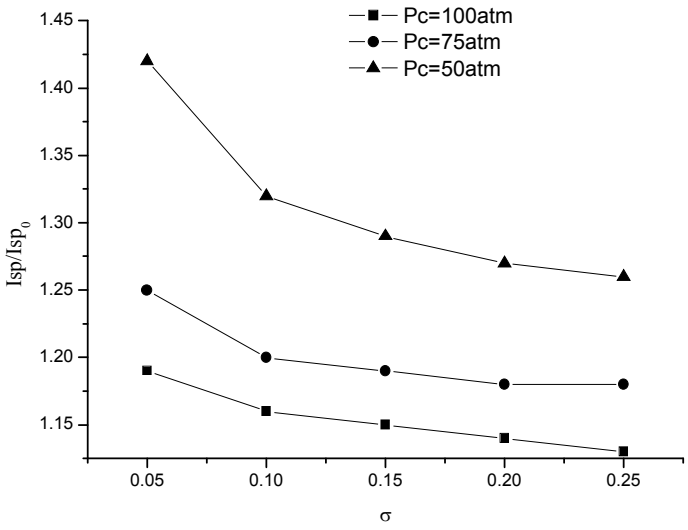

Fig. 3 Specific pulse augment with changing of ejector area ratio for different chamber pressures