SPACE PROPULSION SYMPOSIUM (C4)
Propulsion System (1) (1)

Author: Mr. Vikash Kumar
Liquid Propulsion System centre, India, vikashkumar@lpsc.gov.in

Dr. K Nandakumar
Indian Space Research Organization (ISRO), Liquid Propulsion Systems Centre (LPSC), India, nandakumar_k@lpsc.gov.in

EFFECT OF FUEL INJECTION SCHEMES IN A VORTEX COMBUSTION CHAMBER

Abstract

This study details the experimental investigations on the effect of fuel injection schemes in a vortex combustion chamber. In a vortex combustion chamber the oxidizer is typically injected tangentially at the aft end of the combustion chamber and the fuel is injected through inlet ports at the head end. The process results in the formation of a vortex of gaseous oxygen resulting in the confinement of combustion products to the inner core of the combustion chamber. The outer vortex protects the chamber wall from excessive heating loads via convective cooling, thus resulting in lower wall temperatures. This feature not only reduces cooling requirements, but also permits more flexibility in material selection that can ensure durability and reduced weight of the chamber.

Experiments were conducted to study the effect of fuel injection schemes on the cooling behavior of the combustion chamber. Two different fuel injection schemes namely co-flow and counter flow with respect to oxidizer entry were studied. In each case, the oxidizer entry configuration was kept unchanged and experiments were conducted by changing the fuel entry configuration. Gaseous methane and gaseous oxygen were used as fuel and oxidizer respectively in each experiment. The vortex combustion chamber consists of a main combustion chamber with provision for fuel entry, spark plug, conical section with manifold for oxidizer inlet and an exhaust pipe. Combustion is initiated with the help of the spark and the established combustion flame front propagates through the main combustion chamber. A series of experiments were conducted by maintaining similar mixture ratios for each fuel injector configurations. Temperatures were measured along the combustion chamber wall in both cases and the results were compared for these two configurations. The results indicate that the rise in wall temperature using co-flow fuel injector configuration is less than the rise in temperature during counter flow fuel injector configuration.