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OPERATING CHARACTERISTICS ANALYSIS OF THERMODYNAMIC VENT SYSTEM FOR
CRYOGENIC PROPELLANT ON-ORBIT

Abstract

This paper main introduced the importance of thermodynamic vent system (TVS) for future deep space exploration, and summarized the research progress of TVS technology. Based on the manned lunar exploration mission, the characteristics of pressure control were analyzed for the uniform heating of the orbit transfer vehicle and the non-uniform periodic external heat flow. In order to explore the influence of non-uniform heating on the operating characteristics of liquid hydrogen TVS, the proportion of the heating amount of the corresponding wall in the gas phase zone is 30% and 60% respectively. Under the condition of constant total heat leakage, the temperature change of the air pillow is more Sensitive, frequent exhaust times, the relative amount of single-discharge is relatively reduced, but the amount of exhaust loss under the two conditions is unchanged with time, obeying the law of conservation of energy, that is, in the thermodynamic exhaust mode. The effect of uniform heat leakage on the total amount of final evaporation is small. The main reason is that the gas-liquid heat-mass exchange intensity increases under the action of TVS, which breaks the balance of the original self-pressurization process and weakens the influence of non-uniform heat leakage. Further analysis of the influence of different working fluids such as liquid hydrogen and liquid oxygen on the pressure control characteristics, the effect of TVS on the pressure control of the low temperature tank under various working conditions was obtained by one-dimensional calculation. The self-pressurization law was affected by the liquid mass and the initial period. The effect of coldness is very obvious. In the short term, the liquid oxygen weight scale and subcooling become important advantages of evaporation control. Therefore, considering the engineering practice and cost, liquid hydrogen should adopt TVS technology, while liquid oxygen needs more consideration of the full over-cooling method to improve its own cold storage capacity and delay the on-orbit storage time.