

Conceptual Design on Main Components of the Electric-Pump Cycle Engine

Wonkeun Ki(marine_236@naver.com)¹, Jaechong Lee¹, Hwanil Huh²

¹Department of Aerospace Engineering, Graduate School of Chungnam National University, Daejeon, Republic of Korea, ²Department of Aerospace Engineering, Chungnam National University, Daejeon, Republic of Korea

Abstract

In the electric-pump cycle engine, the propellant supply flow rate is controlled by the motor speed. Therefore, it is advantageous that the flow rate control is easy and the supply flow rate is stable. Also, when the electric-pump cycle engine is applied, the system configuration and the ignition sequence are simplified compared to the gas generator cycle engine. Until now, the electric-pump cycle is suitable for small launch vehicles and upper stages of launch vehicles because power density and energy density of electric motors and batteries are limited. However, since researches on electric cars and electric aircraft are being actively carried out, technologies related to the electric motor and the battery are being matured together. So, in the future, It is expected that applying the electric-pump cycle to the first stages of launch vehicles is available.

The design concepts of the electric-pump cycle engine were devised in the 1980s. And then theoretical researches on applying the electric-pump cycle engine to satellite thrusters and launch vehicles were actively performed from the early 2000s. In 2018, Rocket Lab, a New Zealand-based US company, has proved the applicability of the electric-pump cycle engine, named Rutherford, to their small launch vehicle, named Electron.

In Chungnam National University, research on the conceptual design of an electric-pump cycle engine is being conducted. The electric pump and the electric motor are the main components because they are directly related to the supply flow rate and the supply pressure of propellants. Therefore, the design parameters of the electric pump and the electric motor will be analyzed. And the design program that shows the supply flow rate and the supply pressure of propellants according to the design parameters will be developed. Further, the main components will be verified by simulations and experiments.

Keywords: *Electric-pump cycle engine, Conceptual design, Launch vehicle*

References

- [1] Kwak, H.D., Kwon, S.J. and Choi, C.H., Performance Assessment of Electrically Driven Pump-fed LOX-kerosene Cycle Rocket Engine: Comparison with Gas Generator Cycle, *Aerospace Science and Technology*, Vol. 77, pp. 67-82, 2018
- [2] Jeong, S.M., Kim, K.S., Oh, S.J. and Choi, J.Y., New Technologies of Space Launch Vehicles including Electric-Pump Cycle Engine, *Journal of The Korean Society for Aeronautical and Space Sciences*, Vol. 44, No. 2, pp. 139-155, 2016

Biography

Wonekun Ki is an M.S. candidate in Aerospace Engineering at Chungnam National University. His research interests include propellant supply systems for liquid rocket engines. Currently, he is working on projects designing the electric-pump cycle engine that use the electric motor instead of the gas generator.