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# DEVELOPMENT OF CLOSE-LOOP PRESSURIZATION SYSTEM USING CO2

**Abstract**

In a conventional liquid engine system, a gas pressurization system or a turbo pump pressurization system is applied to pressure oxidant and fuel. In these system, it is required to equip a large tank to store the pressurization gas or a heavy turbo pump. In flight systems which requires weight saving, this heavy pressurization system is a restriction to design whole engine systems.

In order to break this situation, a new pressurization system using $CO_2$ has been developed by Japan Aerospace Exploration Agency (JAXA). This system is a kind of gas pressurization system. The pressurization source $CO_2$ is, however, stored in liquid phase. Compared to conventional pressurization systems, it can reduce a weight of a tank storing the pressurization source because the volume of the liquid source is small. During burning of the engine, $LCO_2$ is vaporized by regenerative cooling strategy and $GCO_2$ pressures oxidant and fuel. In order to control the pressure of $CO_2$, this system has a instrument called charger. It is a kind of piston and it pressures $CO_2$. There is a close-loop line in this system and the piston is driven by $CO_2$ itself. From a perspective of energy, kinematic energy to drive the piston is supplied through the regenerative cooling.

This paper shows a mathematical modeling of this close-loop pressurization system and a result of a demonstration experiment conducted in Akiruno, Japan. In order to drive this close-loop system stably, several tuning of parameters was required. By this demonstration experiment, a feasibility of this new pressurization system is shown. In future, this system is applied to a $N_2O$/Ethanol liquid rocket engine which is now under development in JAXA.