Numerical Study on Properties of Interior Ballistics According to Solid Propellant Positions in Chamber

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Analysis of the interior ballistics is essential for the development of a gun or propellant configurations. The granular solid propellants having high energy and fast burning rate produce great thrusts in extremely short time intervals, therefore, it is necessary of a numerical code for the interior ballistics of the two-phase(Gas-Particle) flow. Recently, the interior ballistics code(IBcode) has been developed.

For large guns, the propellant charge is usually contained in a metallic or combustible cartridge case affixed to the projectile; however, the propellant often dose not fill all the available volume within the case.

In this situation, the position of the solid propellant in the chamber have a strong influence on performance of the interior ballistics. So, in this study, a performance of the interior ballistics according to the position of the solid propellant in the chamber has been investigated using the IBcode.

In previous researches, the propellants have been evenly distributed in the chamber. In this study, however, three cases of the existence of empty space in the chamber at which the propellants are not evenly distributed are considered: Propellants are located in the region near the base, propellants in the region near the breech, and propellants in the center of the chamber, respectively.

Fig. 1 Analysis Cases
Fig. 2 is mean pressure. In this result, there is no difference according to propellant position in the chamber. But other results have shown the performance variations of the interior ballistics according to propellant position in the chamber.

Fig. 3 is breech pressure. The case of the propellant located in the region near the breech, pressure of the chamber increase locally. Then pressure wave is created and propagated to the empty space(base). Contrarily, the case of the propellant located in the region near the base, pressure wave is propagated to the breech. Because of this phenomena, pressure oscillation is appeared.

Fig. 4 is base pressure. Same reason, pressure oscillation appeared.

Fig. 5 is differential pressure. The quantity indicated on the differential pressure profile as $-\Delta P$, known as the initial reverse differential pressure, can be affect to the performance of the interior ballistics( and hence, in most cases, the "badness").

The case of the propellant located in the region near the base and breech has shown that the negative differential pressure and the difference between the breech pressure and the base pressure are much higher than those of the case of the propellant located in the center of the chamber. The case of the propellant in the center of the chamber is, therefore, more profitable to improve the performance of the interior ballistics.