Experimental study of fragmentation of novel fuel for hybrid rocket

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Keyword : Hybrid rocket, Solid fuel, TNT equivalency, Blasting, Fragmentation characteristic

A hybrid rocket engine has normally liquid oxidizer and solid fuel. The Hybrid rocket engine has a number of very attractive features. One of the most attractive features is high safety. It is said that the TNT equivalency of the hybrid rocket system is zero for static mixing failures[1] because the oxidizer and the fuel are stored independently and it is nearly impossible for the solid fuel and liquid or gaseous oxidizer to be mixed intimately. On the other hand, the TNT equivalency may not be zero in a dynamic situation, such as the mixing of the liquid or gaseous oxidizer and the solid fuel is promoted by a certain accident. However, the TNT equivalency is not known well in such a situation. It is necessary to investigate the TNT equivalency exactly for safety.

In order to obtain the TNT equivalency in the dynamic situation, we will carry out combustion experiments of fuel blocks fragmented by high explosives in oxygen atmosphere. In this paper, for the first step of investigating TNT equivalency, blasting tests in the air were carried out to investigate the fragmentation characteristic of the fuel blocks. PMMA (Polymethyl methacrylate), and PP (polypropylene) as conventional fuels and wax and low melting point thermoplastics (LT) as novel fuels are chosen for the fuel blocks. The shape of the fuel blocks is cylinder. The high explosive is set into the fuel block. Fig. 1 shows the fuel block with the explosive in a chamber. The size of the fuel blocks and the amount of the high explosives were varied. The fuel blocks were blasted in the chamber in the air atmosphere. Fig. 2 shows the fragmented fuel after blasting. The distributions of the sizes of the fragmented fuel were obtained. The influence of the material, the block size and the amount of the high explosive on the fragmentation characteristics were compared.

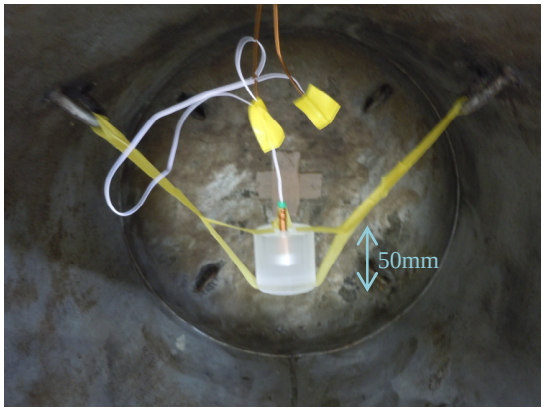

Fig. 1. Fuel block with explosive (PMMA)

Fig. 2. Fragmented fuel after blasting (PMMA)

References

[1] U.S. Department of Transportation, “Hazard Analysis of Commercial Space Transportation,” Volume 2, page 5-11, May 1988.