

MATERIALS AND STRUCTURES SYMPOSIUM (C2)  
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DEVELOPMENT AND VERIFICATION OF POLYMER-LINED COMPOSITE LIQUID HYDROGEN  
TANK FOR REUSABLE VEHICLE

**Abstract**

In Institute of Space and Astronautical Science, Japan Aerospace Exploration Agency (ISAS/JAXA), composite tanks are being investigated and developed in order to reduce the structural weight of a cryogenic propellant tank for reusable vehicle. A concept of a polymer-lined composite tank was proposed and three prototype tanks were made and verified in series. Each test result was evaluated and production process was modified, and at last the third prototype tank passed the all tests. This paper reports the completion of this polymer-lined composite liquid hydrogen tank for reusable vehicle. This paper includes the concept of polymer-lined composite tank, design method, and verification results of prototype tanks. At first the outline of polymer-lined composite tank, their benefits, and overview of production process are shown. This also includes a comparison with the previously developed metal-lined composite tank. Next, the design method based on not only stress and strain but fracture mechanics is shown. Fracture-mechanical evaluation is important to prevent delamination of composite or exfoliation of metal parts. Some example of choice for metal material is also shown. At last the results of the tests for three prototype tanks and other trial tanks are shown. Their failure modes are evaluated and prevent method for each failure is described. As the final result, the third prototype tank passed a proof pressurized test and repeated pressurized tests for MEOP. The test data were fine and any delamination, exfoliation or H<sub>2</sub> gas leak was never detected. This concludes the completion of polymer-lined composite liquid hydrogen tank for reusable vehicle.