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EXPERIMENTS ON RESIDUAL COMPRESSIVE STRENGTH AFTER FATIGUE OF CARBON FIBER  
FABRIC COMPOSITES OF SPACECRAFT IN HYDROTHERMAL ENVIRONMENT

**Abstract**

During the service, the composite structure of spacecraft suffers the general environment, such as temperature, humidity, lighting, sunlight etc. and local environment, such as fuel, lubricants, cleaner etc. which affect its integrity. It also suffers the maneuver load, gust load. The most important environmental factor is the combined effect of temperature and humidity. The influence of the mechanical properties of composite materials in hot and humid environment is called hydrothermal effect. Hydrothermal environment will influence the mechanical properties of the composites, especially the mechanical properties of matrix. In process of spacecraft design, the durability of composite structures need to be confirmed, mainly the effect of hydrothermal. However, the fatigue test with the full size structure in hydrothermal conditions is not only costly, but also time-consuming. Therefore, it is necessary to test the key parts of the structure or a typical structure in hydrothermal environment, as the reference of the full scale structure. If the test results show that the environment spectrum has influence on the performance of structure, the durability test on the full scale structure must consider the influence. If the environment spectrum does not cause the decrease of material properties, or has little effect, the fatigue tests of a full-scale composite structures can be performed at room temperature. Then the results can be corrected by a coefficient of correction. Thus the cost can be greatly reduced. This research content comes from a certain type spacecraft. The typical laminates were chose to carry out the standard environment fatigue test, the hydrothermal environment fatigue test, and compression strength test after fatigue. Compare the test result at temperature of  $70 \pm 2$  degree Celsius, relative humidity of  $80 \pm 5\%$  RH with the result of standard environment will show whether the hydrothermal environment decrease the performance of structure. In order to study the performance of a structure and fatigue damage tolerance design to provide experimental basis. The fatigue performance and damage tolerance design can be determined according to the experiment. According to the ASTM standard, fatigue tests are carried out at hydrothermal environment and standard environment. After that, residual compressive strength test of two groups of specimens are carried out. The results show that the hydrothermal environment has little effect on residual strength of the specimens after fatigue. This study provides experimental foundations for the fatigue performance and damage tolerance of spacecraft.