MECHANICS ANALYSIS ON THE COMPOSITE FLYWHEEL STACKED FROM CIRCULAR TWILL WEAVE FABRIC RINGS

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Summary: The filament winding composite flywheel for energy storage had a shortcoming of very low strength along the radial direction due to no filament reinforcement distribution. The failure along the radial direction due to delamination may happen for the thick cylinder composite flywheel at high rotational speed.

The new idea to solve the low radial strength problem of the composite flywheel is to use woven fabric materials. The 2D woven fabric composite in form of circular ring has fibers in both the tangential and radial directions to bear the stress. This structure features the combination of the typical two-dimensional orthogonal textile fabric and the classic axial laminations, performing new characters in mechanics. Samples of woven composite disks with 2D woven fabric materials were designed and fabricated for spinning test for the first time.

The mechanics analysis on the thin woven composite disk was carried out originally. With the introduction of micromechanics methods, the elastic constants of the unit cell model of periodic volume representing the whole fabric were extracted from different geometrical simplification and homogenization theories. The stiffness and strength of the orthogonal twill weave fabric element in the composite disk was predicted to evaluate the failure spinning speed of the woven fabric composite disks.

The tension test date on the samples of twill weave fabric composite offered the valuable reference to the prediction of the failure of the disk sample. The spinning test confirmed the good prospect of the woven fabric materials for composite flywheel development.