

PROCEEDINGS

Prediction of Burst Pressure of Filament Wound Composite Shell Under Winding Tension

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ABSTRACT

Addressing the issue of stress distribution non-uniformity in adjacent fiber layers caused by stress relaxation effects during filament winding, the hoop winding process of a $\phi 150$ mm sand mandrel was taken as the research object. The hoop strain on the mandrel surface was measured experimentally and compared with simulation results. Based on consideration of residual winding stresses, a refined material property model for a $\phi 480$ mm composite shell under complex winding patterns was established to predict the burst pressure under descending tension systems of 20 N and 30 N. The results indicate that when constant tension is applied during hoop winding, the residual stress in the fibers exhibits a trend of being lower in the inner layers and higher in the outer layers due to the stress relaxation effect of outer fibers on inner fibers. Failure in the shell occurs in the hoop winding layers of the cylindrical section. Moreover, a 30 N descending tension magnitude increases the stress gradient between inner and outer layers, making the hoop winding layers more prone to failure. The predicted results are within the error range compared to experimental results, providing valuable insights for designing tension systems during the winding process of composite shells and enhancing their load-bearing capacity.

KEYWORDS

Winding process; stress relaxation effect; elastic superposition principle; residual stress

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