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THE EFFECT OF BAND TENSION IN SEMI-PLANAR WINDING OF COMPOSITE PRESSURE VESSEL

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Pressure vessels are widely used in commercial and aerospace applications as well as transportation vehicles. The filament-winding process is an efficient and viable technique used commonly in the mass production of fiber-reinforced composite pressure vessel. A tensile force, which is called tension, is usually applied to the fiber band to make the fibers place on the required path. However, a band freshly laid under tension exerts a radial pressure on the wound layers and a circumferential stresses. These residual stresses make a limitation to apply higher tension in filament winding process. Furthermore, strength of liner to carry the tension and discontinuity of fibers could be another limitation. In this paper, a semi-planar path was chosen as a winding pattern, a high density polyethylene (HDPE) was selected as liner and a thermosetting resin (Epoxy) used as matrix in the carbon reinforced filament wound layer. The liner was 89.5mm in outside diameter, 5mm thick, and 220mm length with dome geometry to satisfy a geodesic path. The 2D Finite Element Code (FEC) was used to predict the mechanical behavior of pressure vessels for a 20 MPa (200 bar) pressure service condition with 1.5 as safety factor. The tension was varied from 10N to 30N on a 3.5mm band width. Finally by comparing the obtained Von-Misses stresses in liner, deduced stresses from inside pressure and residual stresses due to tension in fibers by using Tsai-Wu failure criteria, the proper tension was obtained.