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Low Velocity Impact Response of Prestressed Functionally Graded Hybrid Pipes

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Abstract

Filament wound hybrid composite pipes are frequently used for the transmission of high pressured chemical fluids, disposal of industrial wastes, oil and natural gas transmission lines. In this study, low velocity impact behavior of the glass/carbon functionally graded filament wound composite pipes with ±55° winding angle was experimentally investigated. The hybrid composite pipes were graded with a fixed layer configuration from inside to outside as glass-glass/glass-carbon/carbon-glass/carbon-carbon. The functionally graded hybrid pipes were subjected to different internal pressure values (4, 16 and 32 bar), and impact response and energy absorption capacity of the hybrid composite pipes were investigated by using weight drop test method with impact energies of 5, 10, 15 and 20 J. The impact force and displacement versus interaction time were measured. The impulsive force, energy absorption capability, and damage formation were also investigated. Delamination, radial and surface matrix crack formations were observed as the main failure mechanisms at the outer surface of the hybrid pipes. Moreover, the effect of impact damage decreased with the increasing internal pressure of the pre-stressed hybrid composite pipes. The impact damaged composite pipes were subsequently subjected to burst tests according to ASTM D1599-99 standards to calculate burst strengths of the damaged composite pipes. The hybrid composite pipes subjected to 32 bar internal pressure before impact loading were exhibited highest burst strengths for the same impact energy levels.

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