Crashworthiness of Different Composite and Aluminum Tubes with Foam Filling by experiments and simulations

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Abstract: For a kind of certain material energy absorption structure, changing its geometrical dimensions can generally cause great change of its energy absorption capacity. The main content of this paper is to investigate the influence rule of the specific energy absorption (SEA) caused by the dimensional changes (intermediate diameter, wall thickness and upper end diameter of the tube). And talk about the impacts of this rule under different conditions, including different materials, combined structure (metal-FRP tube) and foam filling. Firstly some glass fiber reinforced polymer (GFRP) tubes were fabricated using filament winding technology and quasi-static compression tests were conducted to hollow tubes, polyurethane foam-filled tubes and aluminum foam-filled tubes respectively. Finite element models of hollow GFRP, aluminum and aluminum-FRP tubes and polyurethane foam-filled and aluminum foam-filled composite tubes were built respectively. Configurations of models include circular, square and tapered (5 different upper end diameters) tubes. And their SEA were obtained under quasi-static load condition. The result show that changing upper end diameter of the tube can definitely affect its energy absorption capacity, but sensitivities of SEA to dimensional change is different because of different materials and foam filling.

Keywords: crashworthiness; composite tube; foam-filled tube; GFRP; thin-walled tubes