ARKAN JAWDAT ELIAS.
"COMPRESSION, DAMPING AND IMPACT CHARACTERIZATION OF 7020 ALUMINUM ALLOY FOAM".
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Abstract

Aluminum foams are new materials mainly produced by expansion in proper chambers. A relevant quantity of voids is generated in the metallic matrix during manufacturing, resulting in a low material density. Aluminum foams are strongly affected by cells size, cells shape, foam density, weight fraction and types of additives to aluminum foam.

In this work, the influence of particle size and weight fraction of Al_2O_3 particles on compression, drop load impact and damping behavior of 7020 aluminum alloy foam was experimentally investigated and then modeled using ANSYS12 software.

Tensile and compression tests for solid 7020 aluminum alloy matrix composite reinforced by specific particle size and weight fraction of alumina (in the as cast and precipitation age hardened conditions) were carried out to determine their mechanical properties. These fundamental properties were later compared with that of 7020 aluminum alloy foams.

Experimental results of compression test for aluminum alloy foam showed an increase in Young's modulus, yield stress and strain hardening index as the weight fraction of alumina powder as reinforcement is increased, and as the particle size is decreased.

The total strain to fracture of 7020 aluminum alloy foams under compression loading decreases as the weight fraction of alumina powder is increased, and the particle size is decreased.

The precipitation age hardened aluminum alloy foam exhibited higher Young's modulus, yield stress, strain hardening index than that for as cast aluminum alloy foams.

Aluminum alloy foam samples under compression loads were modeled in many two- dimensional structural models. A weaker cruciform-hemispherical model has a good agreement with the stress-strain of experimental results when strains are less than 0.6.

Experimental results of drop weight impact test for 7020 aluminum alloy foam (as cast and as precipitation age hardened) showed a rise in acceleration-time curves, a decrease in the time to reach zero velocity and a decrease in the deflection as the weight fraction of alumina particles is increased, and the particle size of alumina is decreased.

The precipitation age hardened aluminum alloy foams manifested higher Young's modulus under dynamic loads than that for as cast aluminum alloy foams.

Impact test of aluminum alloy foam was modeled in three dimensions as honeycomb structures and a cubic structure, but the best model was found to be a cubic one which has a good agreement with the experimental results.

Impact test models were solved in transient and LS-Dyna solvers, and the results showed a good agreement with each other.

Damping tests for aluminum alloy foam (as cast and as precipitation age hardened) at natural frequencies revealed an increase in damping ratio as the weight fraction of alumina particles is increased, and the particle size of alumina particles is decreased.

Damping behavior of precipitated aluminum alloy foam showed higher damping ratio than that for as cast aluminum alloy foam for all particle sizes and weight fractions of alumina.

Keywords: Aluminum foam, Alumina powder, Compression, Damping ratio, Impact