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Experimental Analysis and Parametric Optimization on Compressive Properties of Diamond-Reinforced Porous Al Composites

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Abstract

The present study aims to optimize the compressive properties of porous aluminum composites fabricated using the powder metallurgy (PM) space holder technique. These properties were optimized by taking into consideration different processing factors such as sintering temperature, compaction pressure, and sintering time. The experimental design was formulated using L9 orthogonal array by employing these three parameters at three levels. The density, porosity, plateau stress, and energy absorption capacity were determined and analyzed. The impact of individual input parameters was evaluated using the Taguchi-based S/N ratio and analysis of variance (ANOVA). The main effect plots outlined the optimum parameter levels to achieve maximum values for compressive properties (plateau stress and energy absorption capacity). The results revealed that the sintering temperature and time significantly impact compressive properties. The ANOVA analysis exhibited similar results, with maximum contribution from sintering temperature. Further response optimization of compressive properties concluded that the maximum values could be achieved at optimum parameters, i.e., a sintering temperature of 590 °C, compaction pressure of 350 MPa, and sintering time of 90 min. Further, confirmation tests on the optimized parameters revealed improved results and some minor errors and deviations indicating that the selected parameters are vital for controlling the compressive properties of the aluminum composites. © 2022 by the authors.

Author Keywords

energy absorption capacity; plateau stress; porosity; porous aluminum composite; relative density; Taguchi L9 orthogonal array

Index Keywords

Aluminum, Analysis of variance (ANOVA), Compaction, Energy absorption, Powder metallurgy, Sintering; Aluminum composites, Compressive properties, Energy absorption capacity, Orthogonal array, Plateau stress, Porous aluminum, Porous aluminum composite, Relative density, Sintering temperatures, Taguchi L9 orthogonal array; Porosity

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