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Experimental and Numerical Investigation of Mechanical Properties of Thin-Walled 6063 Aluminum Parts Produced by Liquid Impact Forming

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Abstract: Quick, low-cost and high-quality manufacturing is considered a key factor in today's industry. Therefore, researchers have turned to inventing new methods for meeting such requirements. Liquid impact forming is one such method which is being increasingly developed in different industries, such as automotive and aerospace. Considered to be a tube hydroforming process, this forming method utilizes liquid pressure to produce the desired shape. In this study, the liquid impact forming process, applied to a thin-walled tube made of 6063 aluminum alloy, was experimentally and numerically investigated. In the experimental section, a new die was designed and manufactured for deforming the cross section of the aluminum tube into a hexagonal profile. To investigate the characteristics of the hexagonal profile obtained from the forming process, tensile and three-point bend tests were performed. The results obtained from the three-point bend test indicated that the flexural strength of the circular tube was greater than that of the hexagonal profile due to its greater moment of inertia. The numerical results included plastic equivalent strain distribution, variations in the profile thickness and the force required for the forming process. Upon comparing the workpiece thicknesses obtained from numerical simulation and measurements, a good agreement was observed.

Keywords: Liquid impact forming; Finite element simulation; Tensile test; Bend test; 6063 aluminum alloy