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Quantitative Study of Shrinkage and Warpage Behavior for Microcellular and Conventional Injection Molding

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This research investigated the effects of processing conditions on the shrinkage & warpage (S&W) behavior of a box-shaped, polypropylene part using conventional and microcellular injection molding. Two sets of 26-1 fractional factorial DOE were employed to perform the experiments and proper statistical theory was used to analyze the data. After the injection molding process reached steady state, molded samples were collected and measured using an optical coordinate measuring machine (OCMM), which had been evaluated using a proper R&R (repeatability and reproducibility) measurement study. By analyzing the statistically significant main and two-factor interactions, the results show that the supercritical fluid (SCF) content (nitrogen in this case, in terms of SCF dosage time) and the injection speed affect the S&W of microcellular injection molded parts the most, whereas pack/hold pressure and pack/hold time have the most significant effect on the S&W of conventional injection molded parts. Also, this study quantitatively showed that, within the processing range studied, a reduction in the S&W could be achieved with the microcellular injection molding process.