Pitchakorn Chavanatnusorn 2009: Determination of the Optimal Processing Conditions in Plastic Injection Molding Using Computer-aided Engineering, Artificial Neural Network Model, and Genetic Algorithm. Master of Engineering (Engineering Management), Major Field: Engineering Management, Department of Industrial Engineering. Thesis Advisor: Mr. Chuckaphun Aramphongphun, Ph.D. 232 pages.

This research work presents a systematic approach to determine the optimal processing conditions by optimizing the quality of plastic injection-molded parts and their process cycle time. Two plastic parts were used as study cases: (i) a rectangular lid and (ii) a roof tile. The part's qualities considered were the residual stress of the rectangular lid and the warpage of the roof tile. In addition, six process parameters in injection molding: (i) material type, (ii) melt temperature, (iii) injection speed, (iv) packing pressure, (v) packing time, and (vi) cooling time, were optimized by using Computer-aided Engineering (CAE) software, the Design of Experiments (DOE) technique, the Artificial Neural Network (ANN) model, and the Genetic Algorithm (GA) method. The well-known CAE software, Moldflow, was used to simulate the injection molding process, which significantly reduce the production time and cost. The $2^{k-p}$ Fractional Factorial design was employed to find the effects of the parameters on: (i) the residual stress and cycle time of the rectangular lid in Case 1 and (ii) the warpage and cycle time of the roof part in Case 2. A complex relationship among (i) the processing conditions, residual stress and cycle time in Case 1 and (ii) the processing conditions, warpage and cycle time in Case 2 was determined by using the ANN model. The GA method was then applied to optimize the processing conditions in terms of the minimum residual stress of the rectangular lid and the minimum warpage of the roof tile. According to the experimental results based on the optimized processing conditions, it was found that: (i) the residual stress of the rectangular lid in Case 1 was reduced by 26.43% with a 10.26% decrease of the cycle time and (ii) the warpage of the roof tile in Case 2 was reduced by 40.85% without an increase of the cycle time.

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