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Optimization of Injection Molding Parameters for Plastic Part Using Taguchi-TOPSIS Method

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Abstract. This paper reports an simulation study to improve the shrinkage of plastic automobile part by optimizing the injection molding parameters using the Taguchi-TOPSIS method. The Reverse Engineering(RE) and rapid prototyping (RP) technique were used to modelling and createing a prototype model of plastic automobile part. Employing the finite element software, MoldFlow Plastic Insight, the effect of injection parameters on the warpage and shrinkage of plastic part were examined carefully. The simulation results show that Taguchi-TOPSIS method provided an outstanding result for the optimization of injection parameters to produce minimum volumetric shrinkage. The injection parameter of melt temperature was the most significant parameter that influences the warpage and volumetric shrinkage for plastic automobile part in this study.

Introduction

The market requirement for automobile parts is very large. In order to satisfy the customer commoditization, many automobile part has been changed the original design to make it has a better shape or better functionality. Plastic injection molding is wildly used for manufacturing varieties of plastic automobile parts. It has been played a significant role in the development of modern automobile industrial technology. To produce finished plastic parts with good quality, it is necessary to optimize the injection molding parameters such as injection speed, injection pressure, melting temperature, mold temperature, cooling time and etc. Several studies have been carried out to improve or to optimize the quality characteristic so as to produce high quality commercial plastic product on injection molding machine [1]-[4]. The Taguchi method is an efficient method to optimize the single-quality control of plastic injection molding process. Nevertheless, the Taguchi method is not appropriate for optimizing a multi-response problem since engineering judgment is the main optimization procedure in Taguchi method. In order to overcome this problem, the TOPSIS is proposed to optimize the multi-response problem. The purpose of this study is to develop a combining Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) with the Taguchi method to improve the real product quality of plastic parts.

Experimental method

In this study, the Reverse Engineering(RE) and rapid prototyping (RP) technique were used to modelling and creating a prototype model of plastic automobile part. The 3D point cloud data STL model, the translated CAD model and the finished rapid prototyping solid model were presented in Figs. 1-3. The STL file of the CAD drawing was imported into the Moldflow Plastic Insight (MPI) software package to simulate the shrinkage and warpage characteristics of plastic part. The Taguchi method and TOPSIS were combined to find the optimal injection molding parameters with different injection molding conditions.

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