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Six Sigma-Based Optimization of Shrinkage Accuracy in Injection Molding Processes

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Abstract : This paper focuses on using six sigma methodologies to reach the desired shrinkage of a manufactured high-density polyurethane (HDPE) part produced by the injection molding machine. It presents a case study where the correct shrinkage is required to reduce or eliminate defects and to improve the process capability index Cp and Cpk for an injection molding process. To improve this process and keep the product within specifications, the six sigma methodology, design, measure, analyze, improve, and control (DMAIC) approach, was implemented in this study. The six sigma approach was paired with the Taguchi methodology to identify the optimized processing parameters that keep the shrinkage rate within the specifications by our customer. An L9 orthogonal array was applied in the Taguchi experimental design, with four controllable factors and one non-controllable/noise factor. The four controllable factors identified consist of the cooling time, melt temperature, holding time, and metering stroke. The noise factor is the difference between material brand 1 and material brand 2. After the confirmation run was completed, measurements verify that the new parameter settings are optimal. With the new settings, the process capability index has improved dramatically. The purpose of this study is to show that the six sigma and Taguchi methodology can be efficiently used to determine important factors that will improve the process capability index of the injection molding process.

Keywords : injection molding, shrinkage, six sigma, Taguchi parameter design
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