

Chapter 13

Factorial Design for Reduction of Variation on Plastic Parts Weight: Plastic Parts Weight and Injection Molding

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ABSTRACT

This research aims to find the causes of weight variation of plastic products that cause a high cost and rework. The importance of using statistical control on the weight of plastic parts is presented; describing the type of machinery used to manufacture, considering the properties and applications of material as Acetal and conditions for injection molding operation, where a 2^4 factorial experimental design was used to find the variables which influence the weight of the product to maintain a stable process. An efficient solution was developed considering the variables of pressure and injection time to be highly significant in the weight of the plastic parts. Finally an optimal arrangement is generated for the plastic injection process which ensures a stable production process and ensures the quality of the product, which implies a reduction of costs and compliance with design specifications.

INTRODUCTION

Currently, one of the most popular manufacturing processes is the plastic injection molding, term given to all synthetic organic materials which can be moldable plastics, become softened by the application of heat, and are given a form by means of pressure by some mold having characteristics such as strength, durability, flexibility and visual appeal. The production of large volumes of plastic is economically vi-

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able, because the plastic can be recycled, leading to a reduction of waste during production and, thus, taking care of the environment. Metal inserts can be placed into the mold, such as bearings, contacts, screws to produce composite parts.

This research is based on the injection molding process of a company in the appliances sector located in Querétaro, México.

Within the processing of items made of plastic, some of the most important steps are the design of the part and the selection of the material to be processed, in addition to the machinery and the most suitable method for the projected operation. Design features, shape, required material and amount of tolerance for, production are the dominant characteristics for the selection of the manufacturing process. Alternative methods exist to manufacture the product with the same quality, thus making an economic evaluation is important to choose the best alternative.

A universal goal in any company is to reduce the variability of all operations and the product, even up to the time of delivery of the product, variability is a very subtle enemy causing expenses.

In the manufacturing molding line, problems arose that caused defective parts, that were rejected by the customer. In the company, 80% of the products are made of plastic, therefore a large amount of waste is generated from this material, having an average of two tons a week. 70% of this waste is caused by the parts that do not meet weight specifications.

This work aims to find the factors causing the change in weight of the plastic parts and get the best experimental arrangement for the ideal weight.

The company during its production process of plastic parts has a high cost of scrap and rework due to the variety that exists in the weight of the products; this variable had not been controlled, so it was proposed to perform a series of analyses of possible causes that affect production, supported by a powerful tool such as it is the design of experiments and a group of experts from the business.

The characteristics, properties, applications, processing, and operating conditions of the material involved (acetal) are also described.

The methodology used to develop this research, to find the factors (variables) that influence the weight of plastic parts, was a design of experiments 2^4 . Four hypotheses were formulated, based on a survey to the company's staff with the most expertise in plastics. The data collection was done by means of a matrix with the combination of two levels of all operational parameters, the response variable (weight of the part), and factors that were thought had an influence.

The results were the development of the factorial design, statistical results, in addition to their interpretation and conclusions where the best operating conditions and restrictions are set.

BACKGROUND

Through time, the man has known and made use of natural plastic materials such as horn, amber, and tortoiseshell because of their good properties. During the fifties and sixties the production and consumption of plastics grew enormously, being the time of greatest commercial heyday. Nowadays, almost all objects of daily life, even clothing, incorporate a percentage of plastic fibers. Most items around us on a daily basis are partially or completely made of plastic, such as: televisions, pens, calculators, disks, appliances, cars, airplanes, etc. So the technology has resorted to the use of plastics.

Some of the characteristics of the material used in this research are:

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