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Optimisation of die casting process in Zamak alloys

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Abstract

The casting industry is one of the major industries in the world with a great impact in everybody's life. Die casting is a process where a permanent mould is used, and melted metal is injected by pressure, allowing smaller cycles and continuum parts production. This study is focused in die casting applied to automobile industry where many casted parts are used in their components. The study was developed in order to maximise the quality of small parts injected in Zamak alloy for automotive components. Using simulation, the runners' location was improved as well as gas relief.

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1. Introduction

Nowadays, automotive is one of the most demanding industries. The restrictive laws regarding safety concerns and environment imposed since the nineties by many countries in the world, including the European Union and United States, especially California, has boosted the need for sharper products with high technology, in order to achieve the new goals imposed, leading the automotive industry to the cutting edge of development. In line with this evolution, cars are developing faster, the competition between automakers has increased rapidly also with the aim to achieve the social requirements of noise and pollution reduction, and increase the safety and energy efficiency

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without the loss of performance and escalation of costs, trying even to build cars with better performance and lower cost [1]. Automakers today need to have in mind the construction of vehicles designed and engineered to be in harmony with people and nature [2]. These are the main requirements for the automotive industry: environmental and safety issues along with quality, design and leadership. Hence, in order to achieve this, engineering departments need to focus their efforts in technological improvements, like CO and other emissions reduction, fuel economy and crashworthiness, along with the improve of quality and mechanical performances. Each of these issues has his own way of development through the employment of electronics, materials or production processes [3].

The automobile industry is one of the leading industries with a high grade of quality standards. Indeed, many of the standards and quality tools employed today in all kinds of business were developed in the automotive environment. The well-known maintenance approach creative in the seventies by Denso, a Toyota supplier, and spread all over the world, is an example of the high-quality standards this industry means. To accomplish all the main standards imposed by the automotive sector, quality is a key factor in order to fulfil those requirements, the introduction of questionable products must dictate an ethical conduct of responsible action, there for, poor-quality products development, not only brings bad reputation to the company that produces them, but also in the last case may lead to injuries, lawsuits and increased government regulation [4], which in the worst sceneries may end up in lowered stocks and subsequent takeovers, firm dissolution and bankruptcy. The automotive industry is a sector that moves hundreds or even thousands of stakeholders with it, each automaker has his own suppliers, creating an interdepending net in which reliability is a key player for this whole industry to work. Therefore so that a product could be delivered in time, all his parts must be delivered also in its own time and with the quality parameters as the product engineering had previously established. So, for this thrust could be effective, quality standards must be implemented and spread through all the suppliers in order to develop core values that become every day's guideline for each corporate structure since CEOs to product-line employees [5]. The need for high-quality standards imposes corporates to implement management procedures and philosophies, the most used nowadays is the Total Quality Management (TQM), which involves everyone in an organization, in a continuous effort to improve quality and achieve customer satisfaction [6], this principle relies on three philosophy keys: (a) continuous improvement, (b) involvement of everyone in the organization and (c) customer satisfaction by meeting or exceeding customer expectations. To implement this principle, seven concepts are indicated, which are based on the 14 points that quality guru W. Edwards Deming defined to do this implementation, as follows: (1) continuous improvement, (2) Six Sigma, (3) employee empowerment, (4) benchmarking, (5) just-in-time, (6) Taguchi concepts and (7) knowledge of TQM tools. [7]. Each of these concepts has his own procedures and tools to get its purpose, in whiling to achieve Total Quality Management. By doing so, the automotive industry not only improves the quality standards, but also forces their own suppliers to do so, and so on, creating a total quality industry.

Command cables are mechanical ways of movement transmission between two or more systems. These systems are divided into actuators and receptors.

Casting industry presents huge activity with products applied in a wide range of areas. High-pressure die casting is a manufacturing process for the production of accurate, dimensioned, sharply defined, smooth or textured surface metal parts. The process is based on the injection of liquid metal under high pressure and at a fast velocity into a reusable steel die [8]. The steel mould must be made in two halves, so the parts could be removed. These two halves are then mounted in the die casting machine in a precisely aligned way, in a manner that one stays stationary (cover die), and the other is moveable (ejector die). The mould can produce a high series of parts in a very short period of time. High-pressure die casting is the fastest method for producing nonferrous metal castings [9].

Dies go from the most simple with only one runner and die cavity, to the most complex ones with moveable slides and cores, depending on the configuration of the part. However, any die must have a runner for the metal to flow, a thermal system to make the mould act like a heat exchange, and gates and vents, so the gases and pores trapped in the liquid metal can get out of the die cavity before solidification, avoiding imperfections on parts. Moulds dedicate to the manufacturing of command cables terminals for cars fit into the first ones: a steel treated

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