



Investigation sustainable factors to mature concepts at early design stage with respect to mold design criteria and plastic injection process

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Abstract—The main environmental concerns associated with injection molding are energy consumption and waste generation. The questions are: How does the designer measure the sustainability of a concept that may be little more than a sketch and listing of solution principles for critical functionality? This paper will focus on the limitations which can affect the product properties at mold design stage and undesirable affects after injection process on product. Clearly, this study is related to the optimization of plastic products in basic design stage. In order to achieve categorized solutions to avoid the first design stage errors, it has been tried to extract important factors which are ignored by product designers at the first stage who lack sufficient experience and knowledge about molding process. Surely, this investigation would be helpful for product designers to improve their final product concepts in order to reduce consumption time and energy at next designing stages (mold design process). The result is informative group of factors which are concluded through reviewing different papers about designing mold for product concepts.

INTRODUCTION

One of today's manufacturers concerns, is increasing productions competition which has resulted in greater emphasis on high performance and low cost for products in parallel other sustainable goals. Surely, this implies greater pressure at the design stage of the product lifecycle and a reduced number of design-manufacturing analysis iterations. In different product development approaches, there are many Do's and Don'ts to gain maximum beneficial of production process. Clearly, product specifications select one of the more aligned manufacturing process types, but, it would be possible that manufacturing processes affect and change product definitions due to the limitations.

According to *Rosen et al.* (2012), the technology category relating to the environment and manufacturing is affected by the following three factors: 1) Product, 2) Process: Zero emission manufacturing, 3) Practices and it is proved that the

evaluation and analysis of alternatives in decision making processes as an internal use of sustainability-evaluation approach (*Gotze et. al* 2019) is a complicated activity.

The main environmental concerns associated with injection molding are energy consumption and waste generation (*Weissman et al.*, 2010). Injection molding is a complex but highly efficient means of producing a large variety of thermoplastic products and has many advantages, such as short production cycles, excellent surfaces of the products, and has no secondary operations, good results in molding of complicated shapes (*Selvaraj et al.*, 2013).

According to *Weissman et al.* (2010) currently, most injection molded parts are optimized at the design stage with respect to the cost and part quality. So, in order for the energy estimation to be beneficial, it is necessary for the designer to obtain this information at the design stage, before the mold has been machined. In detail, Design stages decision play a key role to less failure, but unfortunately, due to limited information, at the first stage, accurately estimating energy consumption before the part has gone into production can be challenging (*Weissman et al.*, 2010).

Mostly, because of lack of injection proceeding knowledge, product designers cannot predict the problematic situation which happen in the designing product molds stage, effectively. In the case, it seems to need a *categorized informative chart* for product designer to decrease design concept errors. These constraints could be considered at the early design phase to align more with mold design rules and injection process. So, based on the extraction of recorded experiences and the facts in different publications, it is tried to take a step towards saving time, energy and material, in the field of plastic mold design through applying specific indicators for early stage designers.