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Micro Plastic Part Fabrication Using Custom Made Vertical Injection Molding Machine

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Abstract. This study focuses on fabrication of a micro plastic part using custom made vertical injection molding machine. Electrical discharge machining (EDM) and micro mechanical machining was used to fabricate micro shape cavity on aluminum mold. The mold was embedded with Polymethyl Methacrylate (PMMA) window to observe the behavior of plastic melt flow during injection. The custom made vertical injection molding machine has capabilities to produce a micro plastic part. But, the filling behavior observation was contrast with MoldFlow analysis software. The flashing problem occurs at each molded micro part due to improper selection of injection molding parameter.

Introduction

Fabrication of micro plastic parts using injection molding technique is getting more attention nowadays due to miniaturization and high precision requirements. Most researchers define it as microinjection molding. Plastic are very popular materials and widely use in a variety of engineering applications. Plastic materials are relatively less costly, mass production capability, and good mechanical properties [1]. Due to the rapid development of micro engineering technologies, there is an increasing trend towards product miniaturization. In this context, microinjection molding of plastic materials is one of the key technologies for micro manufacturing [2]. There are several definitions of microinjection molded parts. Kukla et al. [3] defined the microinjection molded parts as:

1) parts with micro-weight: Parts with micro-weight are parts with masses of a few milligrams, but their dimensions are not necessarily on the μm scale.
2) parts with micro-structured regions: Parts with micro-structured regions are characterized by local micro-features of the μm order, such as micro-holes and slots.
3) parts with microprecision dimensions: Parts with micro-precision are parts of any dimension that they have tolerances in the 1 mm range.

On the other hand, Weber and Ehrfeld [4], categorized the parts manufactured by microinjection molding into:

4) Type A are parts with overall sizes of less than 1 mm, while
5) Type B has larger overall dimensions but incorporate micro-feature.

However, for the ultra-thin wall plastic, Song et al. [5] defined as the parts that have a nominal wall thickness of 1 mm or less. The microinjection molding technologies bring improvements in sophistication, reliability, efficiency and lead to new applications in various fields [6]. Currently, there are lots of micro plastic parts which had been successfully molded such as microcontact printing [7], microcantilevers [8], microprobe [9] and micro lens [10].

Many researchers also performed studies on the plastic flow in micro channel to understand the behavior of the micro flow. Chien et al. [11] studied the on rheological behavior of polymer melt flowing through various sizes of micro-channels. The study had shown that the rheological behavior of polymer melt in the microscopic scale is different from the macroscopic scale. Young [1] analyzed