Research Articles

DEVELOPMENT OF HOT STAMPING TOOL BY USING INDIRECT HOT STAMPING FOR BASIC BENDING PART (U-SHAPE)

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In hot stamping process, (UHSS) blank was cut into the rough shape. The blank is then heated to the temperature (900 - 950 °C) for 5 to 10 minutes inside the furnace. Then, the blank must be transferred quickly to the press to avoid the part is cooled before forming. After that, the blank is formed and cooled simultaneously by the water cooled die for 5 to 10s. Due to the contact between hot blank and the cool tool, the blank is cooled in the closed tool [1]. Today, hot stamping exists in two different types of methods which are direct and indirect. For indirect hot stamping method, before the blank is heated inside the furnace, it then undergoes cold pre-forming process. This process is done once after the blank is cut.

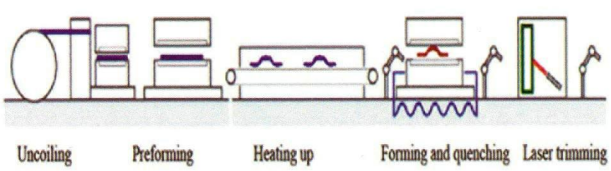

Figure 1: *Sketch map of hot forming with indirect method of hot forming [1].*

In this paper, the method of indirect hot stamping will be used is shown in Fig. 1. The usage of nearly complete cold pre-formed part focused on quenching and calibration operation in the press process after austenization so called indirect hot stamping process [2]. When increasing of tensile strength up to 1500 MPa, the material is formed into full martensite transformation [1]. Indirect process provides a part to be drawn, unheated to approximately 90 and 95% of its final shape in a conventional die. It is then followed by a partial trimming operation depending on edge tolerance which difference with direct process. Then, the pre-forms are heated in continuous furnace and quenched in the die. The additional step is added to extend the forming limits for the complex shapes by hot forming and quenching of the cold formed parts [3]. The advantage of indirect hot stamping process is able to conduct at all parts with complex shapes and almost all of the current stamped carrying parts.

Additionally, the forming performance of the blank at high temperature is subsequently hot forming process can be ignored to ensure the martensite microstructure of the blank is followed by complete quenching [4].

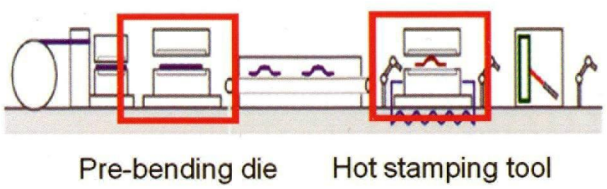

Figure 2: *Schematic flow of indirect process for basic bending part (U-shape).*

In this article, the flow for indirect process for basic bending part is shown in Fig. 2. The flow is started from the pre-bending die design and then, hot stamping tool design for U-shape. The product is chosen based on Hu et al., [3] and Taylor et al., [5]. According to Hu et al., [3], the blank size dimension used is 280 mm x 80 mm x 1.6 mm and the stroke of punch (SOP) is 51.6 mm, while in Taylor et al., [5], the (SOP) used is 71.8 mm where the details of the dimension is shown in Fig 1.3 below. So, in this article, the product is designed based on those details, with difference (SOP) length. This is because, higher length of SOP will result higher length of spring used. If long spring is used, the construction will be high and it will not be able to fit into the available/desired machine. Thus, in order to minimize the length of spring, the SOP length, 50 mm will be used on this product, and the dimension of the width for the part is 80 mm, by referring Hu et al., [3]. For the corner radius of this part, it is based on Taylor et al., [5].

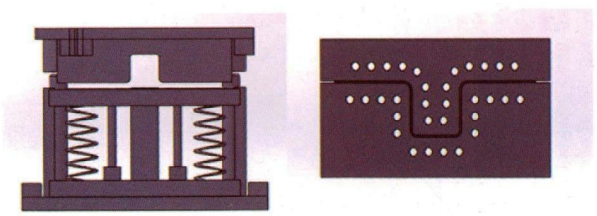

Figure 3: *Schematic diagram of U-shaped model by Hu et al., [3] and Taylor et al., [5].*