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Simulation of Metal Flow to Investigate the Application of Antilock Brake Mechanic System in Deep Drawing Process of Cup

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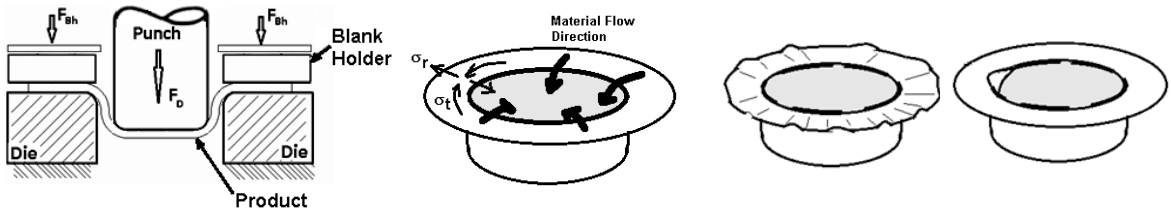
ABSTRACT This paper presents the importance of simulation of metal flow in deep drawing process which employs an antilock brake mechanic system. Controlling the force and friction of the blank holder is imperative to assure that the sheet metal is not locked on the blank holder, and hence it flows smoothly into the die. The simulation was developed based on the material displacement, deformation and deep drawing force on flange in the radial direction, that it is controlled by blank holder with antilock brake mechanic system. The force to blank holder was applied periodically and the magnitude of force was kept constant during simulation process. In this study, the mechanical properties of the material were choses such that they equivalent to those of low carbon steel with its thickness of 0.2 mm. The diameter and the depth of the cylindrical cup-shaped product were 40 mm and 10 mm, respectively. The simulation results showed that the application of antilock brake mechanic system improves the ability to control the material flow during the drawing process, although the maximum blank holder force of 13000 N was applied. The optimum condition was found when the drawing process was performed using blank holder force of 3500 N, deep drawing force of 7000 N, friction coefficient of 0.25 and speed of punch stroke of 0.84 mm/sec. This research demonstrated that an antilock brake mechanic system can be implemented effectively to prevent cracking in deep drawing process.

Introduction

A drawing process refers to a sheet metal forming process where a sheet metal is radially drawn into a forming die by implementing a mechanical action of punch. It is called "deep drawing" when the depth of the drawn part exceed the diameter of the product. Although this process has been known and used for many years, there are many problems that may occur during the process and still become the attraction of many researchers. The process of deep drawing and problems that often occur in this process are illustrated in Figure 1.



(a) **(b)** **(c)**

Figure 1. (**a**) Process of drawing deep; (**b**) Flow of material and stress deformation; (**c**) Crack and wrinkle defect.

Controlling the flow of material properly during a deep drawing process is very important in order to prevent product defects such as wrinkling and cracking. Endelt, B [1] investigate the application of a flexible blank-holder system to adjust the blank-holder pressure individually in different zones in the flange area [1]. The draw-in of the flange is influenced by the blank-holder pressure and therefore, the draw-in can be controlled by adjusting/controlling the pressure. Online