CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

This chapter discussed a short description of the project background including objectives, scopes and problem statement of this project on effect of fluid flow rates and stamping time parameters to the tensile strength of hot-stamping parts.

1.2 PROJECT BACKGROUND

In the upcoming years, one of the most important challenges for the automotive industry is to meet the demand of reducing the fuel consumption with a contemporaneously increase of the safety properties. This can be primarily realized by reducing the weight of body by using thinner materials with higher strength. Therefore more high and ultra-high strength steels such as boron 22MnB5 are increasingly used in the automotive industry, due to their improved forming properties. Therefore, hot stamping is a viable alternative solution and widely used. According to Naderi et al. (2008), hot stamping is a non isothermal forming process for sheet metals, where forming and quenching take place in one combined process step. Hot stamping is more energy-intensive than the conventional processes. Hot-stamped parts are stronger and less steel is needed to produce an equally strong part, which means lower energy consumption as steel producers need to process less raw material based on the article Merklein et al., (2006).
As-delivered the base material 22MnB5 has a ferritic-pearlitic microstructure with a tensile strength of about 600 MPa. After passing through the hot forming process, the component finally exhibits a martensitic microstructure with strength of about 1500 MPa. A pre-condition for the desired final high strength martensitic microstructure, is that the blank must be austenitized first for about 5–10 min in a furnace at about 900–950°C. After having achieved a homogeneous austenitic microstructure the blank is transferred automatically to the water cooled die within three seconds, where forming and quenching takes place simultaneously. Strength of steel sheet can improved through fast cooling after heating it to a temperature range where an austenitic phase exists and through the phase transformations of the austenite to martensite phases (Merklein et al., 2006).

Cooling rate and flow rate have very strong effects on the properties of quenching process in hot stamping. To meet the high cooling rates required for quenching, the cooling water must flow at very high velocities, and such flows are highly turbulent and separated.

Furthermore, to obtain efficient cooling rate and flow rate in the tool, the optimal designing of an economical cooling channel or cooling system in hot stamping must be consider. In additional, the efficiently cooling tool must be designed to achieve homogeneous temperature distribution of the hot stamped part. Besides that, in quenching process, the flow of cooling must be considered at different cooling channel such as cooling must be flow at die, punch and both of tool channel.

An experiment is set up to examine the effect of cooling rate and flow rate on hot stamping process of boron steel 22MnB5. This experiment set up to different flow of cooling where cooling through the punch only, die only, and both of stamping tools. That is for investigate the best result for tensile strength.
1.3 PROBLEM STATEMENT

As-delivered the base material 22MnB5 has a ferritic-pearlitic microstructure with a tensile strength of about 600 MPa. So, hot stamping is the best alternative to solve this problem. In order to achieve high strength by hot stamping with high strength steels, materials should be heated above austenitic temperature and then cooled rapidly such that the martensitic transformation will occur. Normally, the tools are heated up to 200°C without active cooling systems in serial production (Hoffmann et.al.,2007). However, in hot forming processes, the tool temperature must maintain below 200°C to achieve high strength. So, in this studies have been conducted regarding the design of cooling systems in a hot stamping tool and the flow of cooling that can investigate the best strength for the materials.

Water is the fastest method for cooling between the other method such as air, oil and vacuum. So, in stamping process, flow water source must be control at room temperature (24 °C) of water. The different flow rate is uses in this project. Then, compare the cooling flow to evaluate which is the most effective flow rate that effect to stamping process. To meet the high flow rates required for stamping, the cooling water must flow at very high velocities, and such flows are highly turbulent and separated. Consequently, there is a need for good understanding of these flows and their consequences for the process.

1.4 PROJECT OBJECTIVES

The objectives of the project are to:

(i) To investigate the effect of different flow rate and stamping time to tensile strength and cooling rate for boron steel 22MnB5 during stamping process.

(ii) To analyze the effect of different location flow of cooling through the stamping tool to tensile strength during stamping.