INTISARI

Seiring perkembangan zaman, kebutuhan akan komponen berukuran mikro semakin meningkat. Pada proses pembuatan komponen mikro tersebut dapat digunakan metode *micromanufacturing* seperti *punching* pada proses *sheet metalworking*. Proses *punching* sendiri memanfaatkan gaya geser yang terjadi pada bahan uji. Sehingga, pada penelitian ini penulis melakukan penelitian menggunakan mesin *micropunch* dengan bahan uji berupa pelat baja.

Penelitian ini bertujuan untuk mendapatkan parameter yang lebih baik dalam melakukan proses *punching* pada pelat baja dengan meninjau dari pengamatan *punch force* serta profil *sheared edge* yang dihasilkan dari proses *punching* tersebut. Dalam penelitian ini digunakan *cutting tool* berupa *punch* dan *die*. *Punch tool* yang diuji adalah *Double Shear Angle* (DSA) dan *Single Shear Angle* (SSA) berdiameter 1,7 mm dengan diameter lubang *die* sebesar 1,78 mm. Bahan uji *punching* berupa pelat material baja dengan ketebalan 0,3 mm. Pada pengujian ini dilakukan variasi geometri *punch tool* yakni DSA dan SSA. Variasi temperatur pelat baja yang diuji yakni dengan suhu ruang ~30 °C dan *preheating* dengan target temperatur 100 °C. Hasil pengujian yang diamati berupa *punch force* atau beban yang diterima *load cell* serta visualisasi profil *sheared edge* yang didapat dari mikroskop Dino-Lite. Pada penelitian ini juga dilakukan pengamatan terkait kesumbuan atau *alignment punch-die* yang diukur menggunakan *pixel* dan kalibrasi jangka sorong serta mikroskop. Pengamatan *alignment* dilakukan untuk mengetahui bagaimana pengaruh *misalignment* terhadap hasil *punching*.

Hasil pengujian yang diperoleh menunjukkan bahwa perbedaan geometri *punch* dan adanya proses *preheating* dapat memengaruhi *punch force* serta profil *sheared edge* yang dihasilkan dari proses *punching* pada mesin *micropunch*. Berdasarkan data terlihat bahwa *punch force* menurun saat adanya *preheating* pada pelat baja baik saat menggunakan *punch* geometri DSA maupun SSA. Sedangkan pada penggunaan *punch* SSA mendapatkan *punch force* yang lebih rendah daripada *punch* DSA baik saat benda uji bertemperatur ruang maupun setelah proses *preheating* dikarenakan perbedaan *clearance* saat awal penetrasi. Pada profil *sheared edge* baik dengan perlakuan *preheating* maupun suhu ruang, diperoleh ketinggian *rollover* dan *fracture* dengan *punch* SSA lebih tinggi daripada DSA, sedangkan ketinggian *burnish* dan *burr* saat menggunakan *punch* DSA lebih tinggi daripada SSA. Namun dari hasil pengamatan tersebut juga ditemukan adanya perbedaan nilai *punch force* setiap *load cell*. Hal tersebut terjadi karena adanya *misalignment punch-die*. *Misalignment* tersebut mengakibatkan adanya perbedaan *clearance punch-die* sehingga pembacaan nilai *punch force* setiap *load cell* cukup berbeda.

Kata kunci: *punching, sheared edge, geometry, punch force, preheating.*

ABSTRACT

Along with the times, the need for micro-sized components is increasing. In making these micro components, micromanufacturing methods such as punching in the sheet metalworking process can be used. The punching process itself utilizes the shear force that occurs in the test material. Therefore, in this study, the authors conducted research using a micro-punch machine with the test material in the form of steel plates.

This study aims to obtain optimal parameters in the punching process on steel plates by reviewing the punch force observations and the sheared edge profile resulting from the punching process. This study used cutting tools in the form of punch and die. The punch tools tested were Double Shear Angle (DSA) and Single Shear Angle (SSA) with a diameter of 1.7 mm with a die hole diameter of 1.78 mm. The punching test material is a steel plate with a thickness of 0.3 mm. In this test, variations in the geometry of the punch tool are carried out, namely DSA and SSA. Variations in the temperature of the steel plate were tested with room temperature ~30 °C and preheating with a target temperature of ~100 °C. The test results were observed in the form of punch force or the load received by the load cell and visualization of the sheared edge profile obtained from the Dino-Lite microscope. In this study, observations were also made regarding the axis or alignment of the punch-die which was measured using pixels and calipers and microscope calibration. Alignment observations were made to find out how the misalignment affects the punching results.

The test results indicate that the difference in punch geometry and the presence of a preheating process can affect the punch force and sheared edge profile resulting from the punching process on a micro-punch machine. Based on the data, it can be seen that the punch force decreases when there is preheating on the steel plate both when using DSA and SSA punch geometries. While the use of SSA punch gets a lower punch force than DSA punch both when the test object is at room temperature and after the preheating process because of differences in clearance at the beginning of penetration. In the sheared edge profile with both preheating and room temperature treatment, the rollover and fracture heights with SSA punch were higher than DSA, while the burnish and burr heights when using DSA punch were higher than SSA. However, from these observations, it was also found that there were differences in the value of the punch force for each load cell. This happens because of the punch-die misalignment. The misalignment results in differences in punch-die clearance so that the readings of the punch force values for each load cell are quite different.

Keywords: punching, sheared edge, geometry, punch force, preheating.