EFFECT OF DEEP DRAW RADIUS IN DEEP DRAWING PROCESS WITH DIFFERENT PUNCHING LOADS IN FORMABILITY OF ALUMINIUM 6061

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Abstract

In the current work, the CAD model of deep drawing with different die radius profile has been developed in ABAQUS (CAD) domain, the model has been simulated using ABAQUS software on structural domain, in order to predict various parameters influencing the formability of aluminium 6061 sheet during deep drawing process with different die draw radius. Four types of configurations of deep drawing structure with different die draw radius including validation model have been considered. The simulation of the optimized models i.e. 6mm of die draw radius gives nominal value of stress, shear stress, plastic strain and thickness at different punching force of 800, 900, 1000, 1100, 1200, 1300 and 1400N which has optimized and converged result as compared to respected models of different die draw radius in deep drawing process.

Keywords— Deep drawing, Vonmises stress, Shear stress, Plastic strain, Thickness, Punching force, Aluminium 6061.

I. INTRODUCTION

Deep drawing is a sheet metal forming process in which a sheet metal blank is radially drawn into a forming die by the mechanical action of a punch. [1] It is thus a shape transformation process with material retention. In the wall of the part that will be in contact with the punch, the deformation of the circle must be zero in order to achieve the plane deformation condition. Thinning is noticeable and results in uneven component thickness so that the component thickness is lowest at the point where the component loses contact with the punch, that is, at the punch radius. The thickness of the thinnest part determines the maximum stress that can be transferred to the deformation zone. Due to the constant volume of material, the flange thickens and leads to contact of the drum holder at the outer edge rather than at the outer edge.

METHODOLOGY

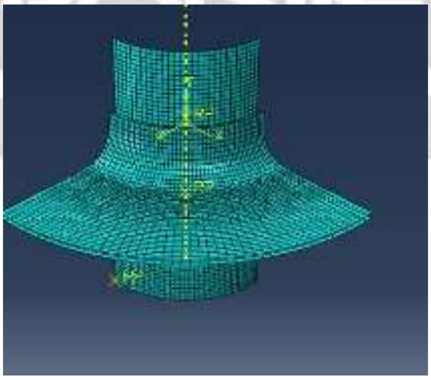

Figure 2: Mesh model of deep drawing components.

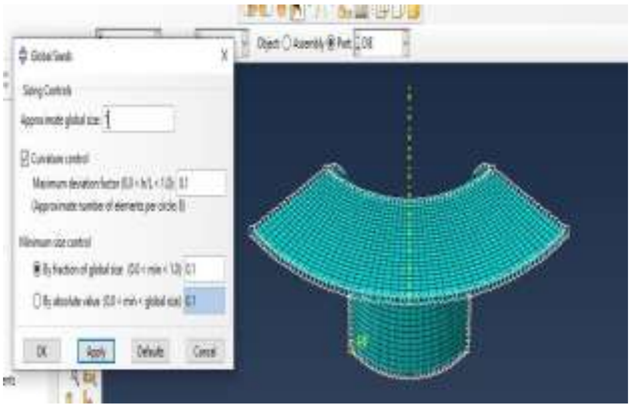

Figure 3: Mesh model of die.

Objective

The objective of present research work is to predict stresses with different die draw radius with punching force for determination of optimized model of deep drawing die.

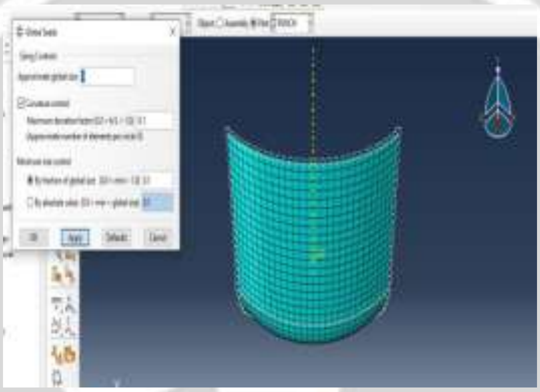

Figure 4: Mesh model of punch.

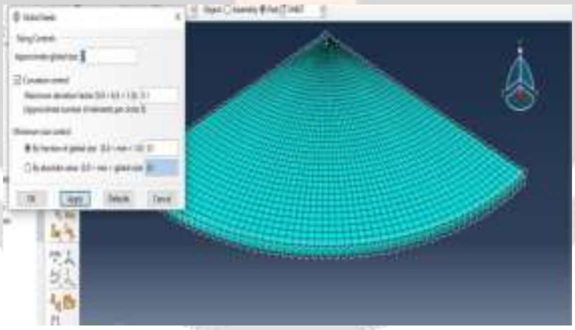

Figure 5: Mesh model of sheet.

Results obtained from ABAQUS for punching force of 800N and die draw radius of 5mm.

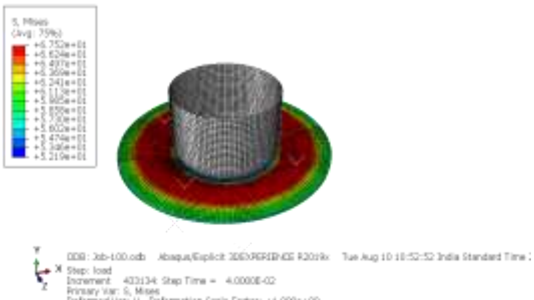

Figure 6 Vonmises stress for deep drawing structure at punching force of 800N (Validation Model).

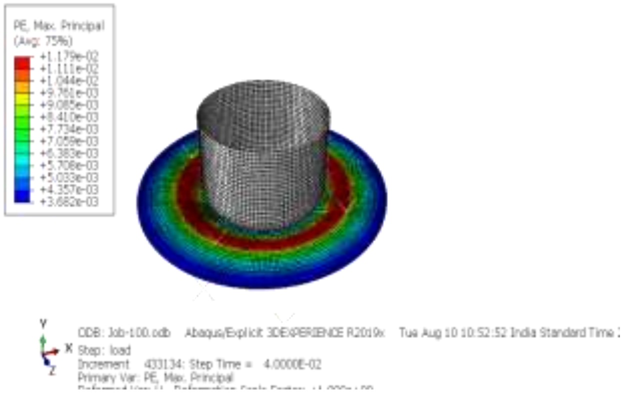

Figure 7 Plastic strain for deep drawing structure at punching force of 800N (Validation Model).

Results obtained from ABAQUS for punching force of 900N and die draw radius of 5mm.

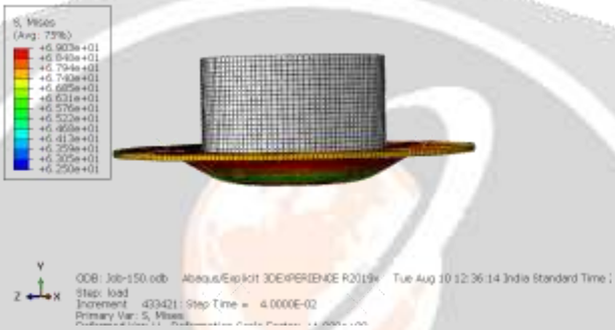

Figure 8 Vonmises stress for deep drawing structure at punching force of 900N (Validation Model).

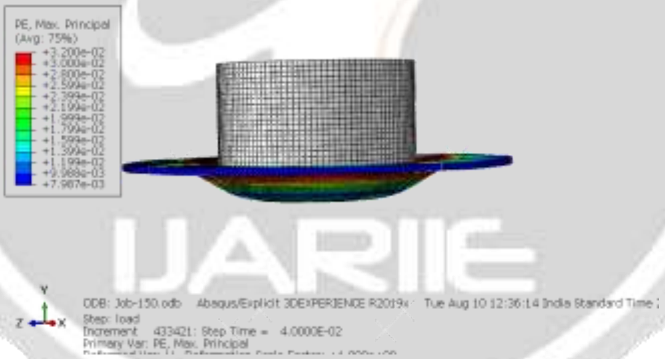

Figure 9 Plastic strain for deep drawing structure at punching force of 900N (Validation Model).

Results obtained from ABAQUS for punching force of 1000N and die draw radius of 5mm.

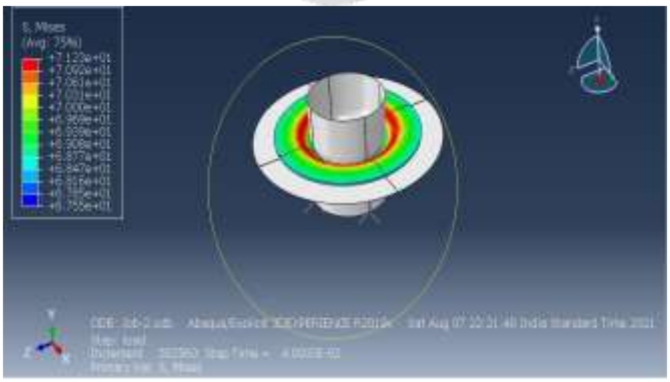

Figure 10 Vonmises stress for deep drawing structure at punching force of 1000N (Validation Model).

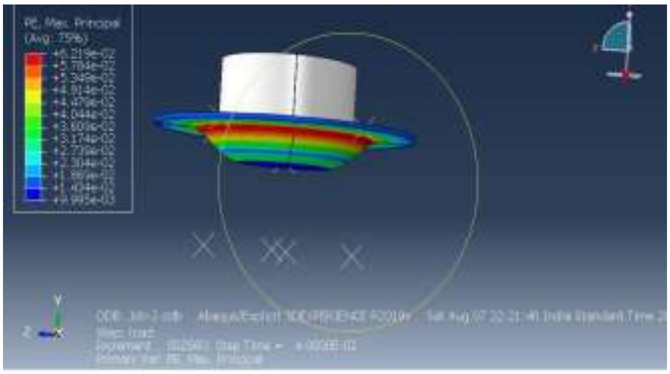

Figure 11 Plastic strain for deep drawing structure at punching force of 1000N (Validation Model).

Results obtained from ABAQUS for punching force of 1100N and die draw radius of 5mm.

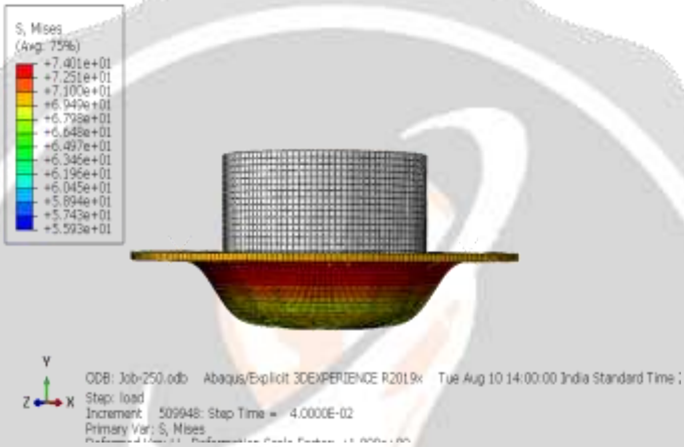

Figure 12 Vonmises stress for deep drawing structure at punching force of 1100N (Validation Model).

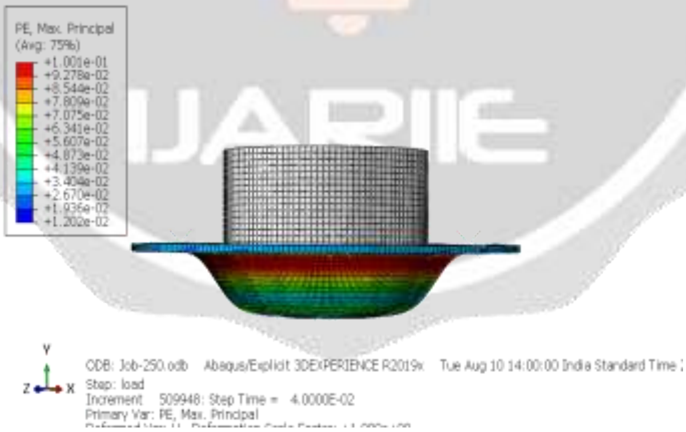

Figure 13 Plastic strain for deep drawing structure at punching force of 1100N (Validation Model).

Results obtained from ABAQUS for punching force of 1200N and die draw radius of 5mm.

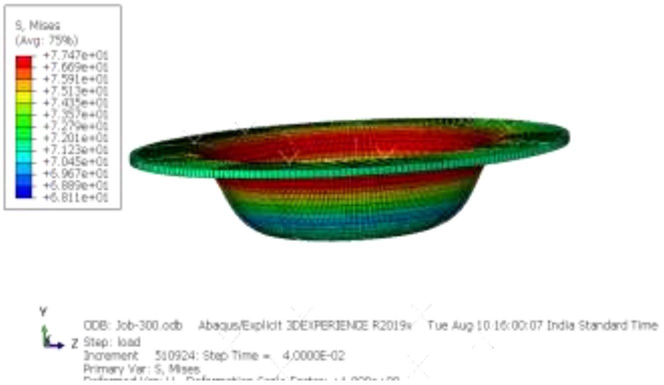

Figure 14 Vonmises stress for deep drawing structure at punching force of 1200N (Validation Model).

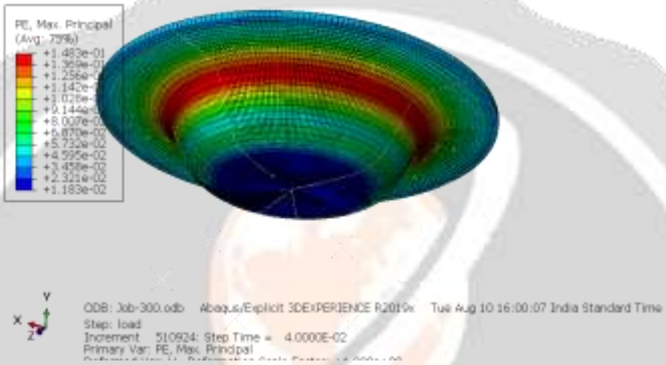

Figure 15 Plastic strain for deep drawing structure at punching force of 1200N (Validation Model).

Results obtained from ABAQUS for punching force of 1300N and die draw radius of 5mm.

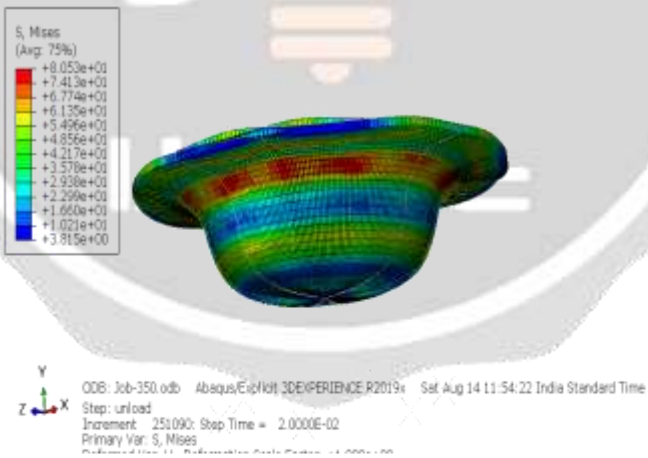

Figure 16 Vonmises stress for deep drawing structure at punching force of 1300N (Validation Model).

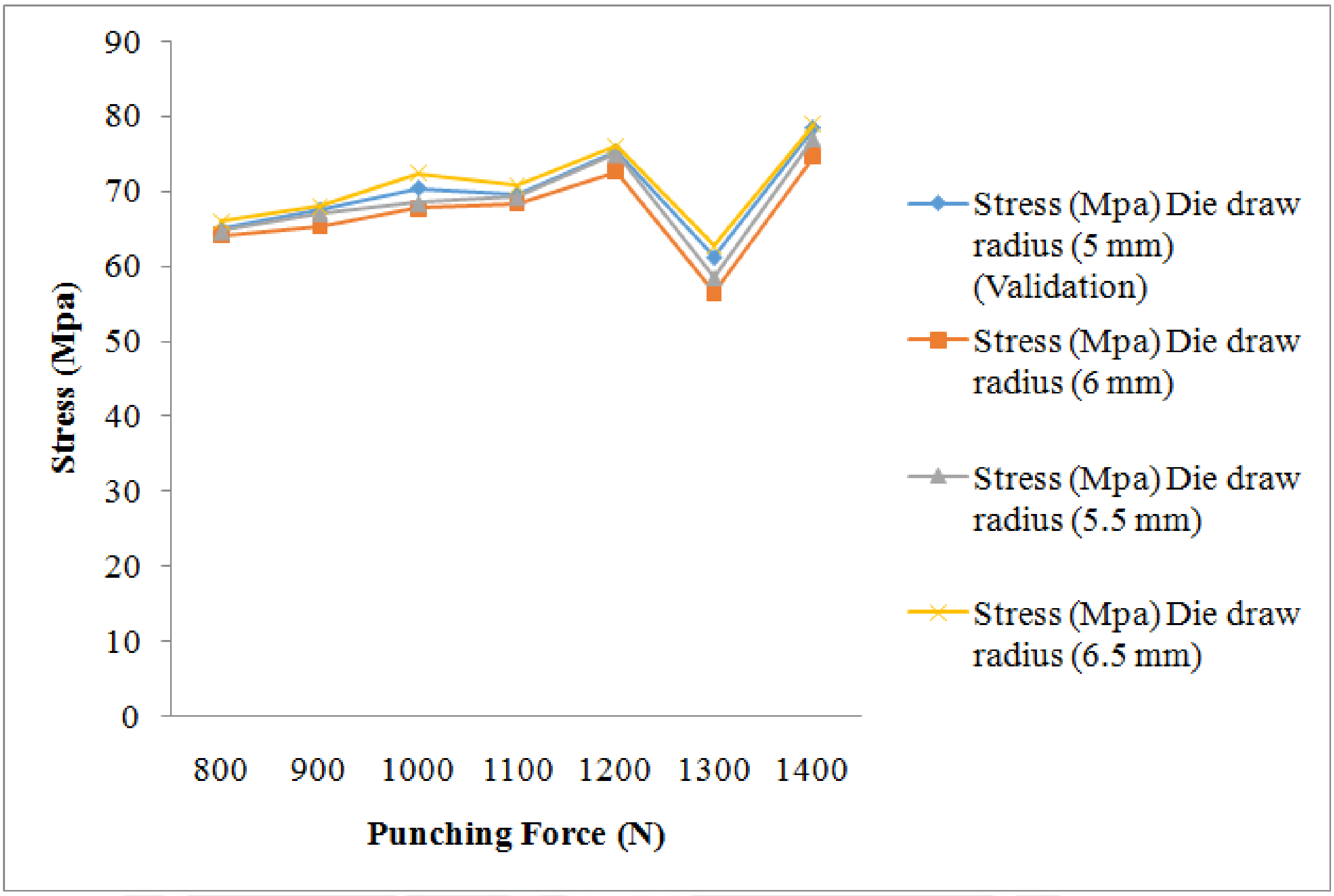

Figure 17 overall comparison of stress in (MPa) with respect to punching force (N) in different die draw radius in deep drawing structures.

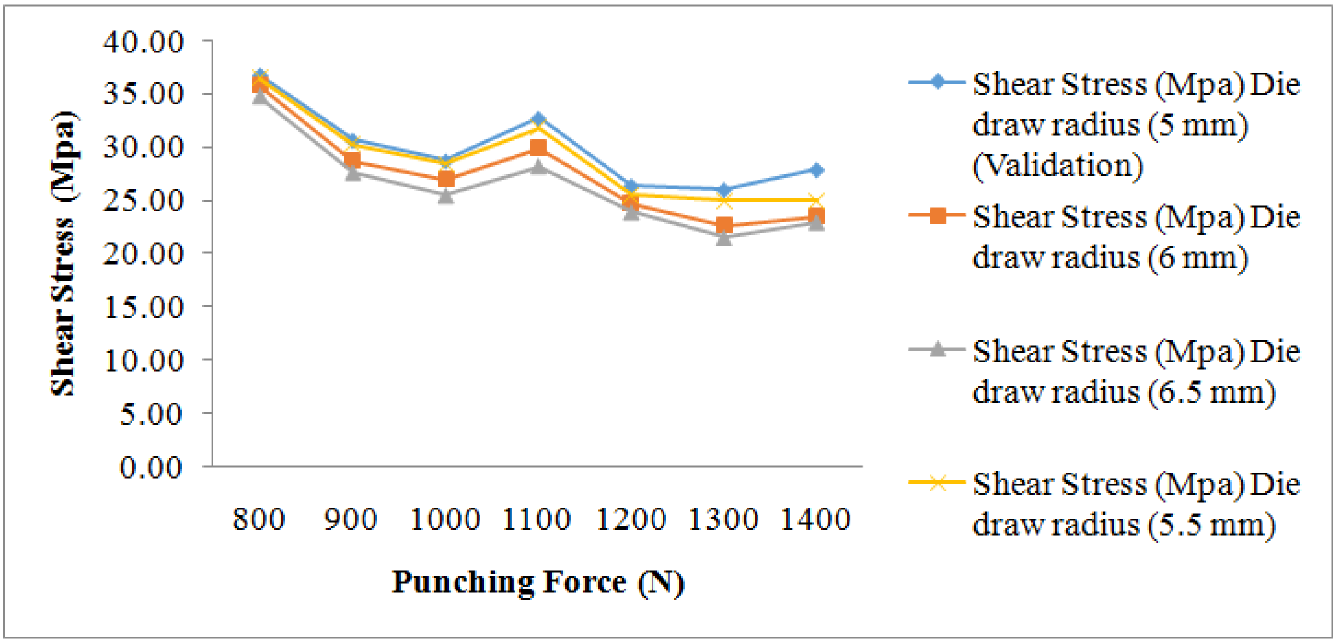

Figure 18 overall comparison of shear stress in (MPa) with respect to punching force (N) in different die draw radius in deep drawing structures.

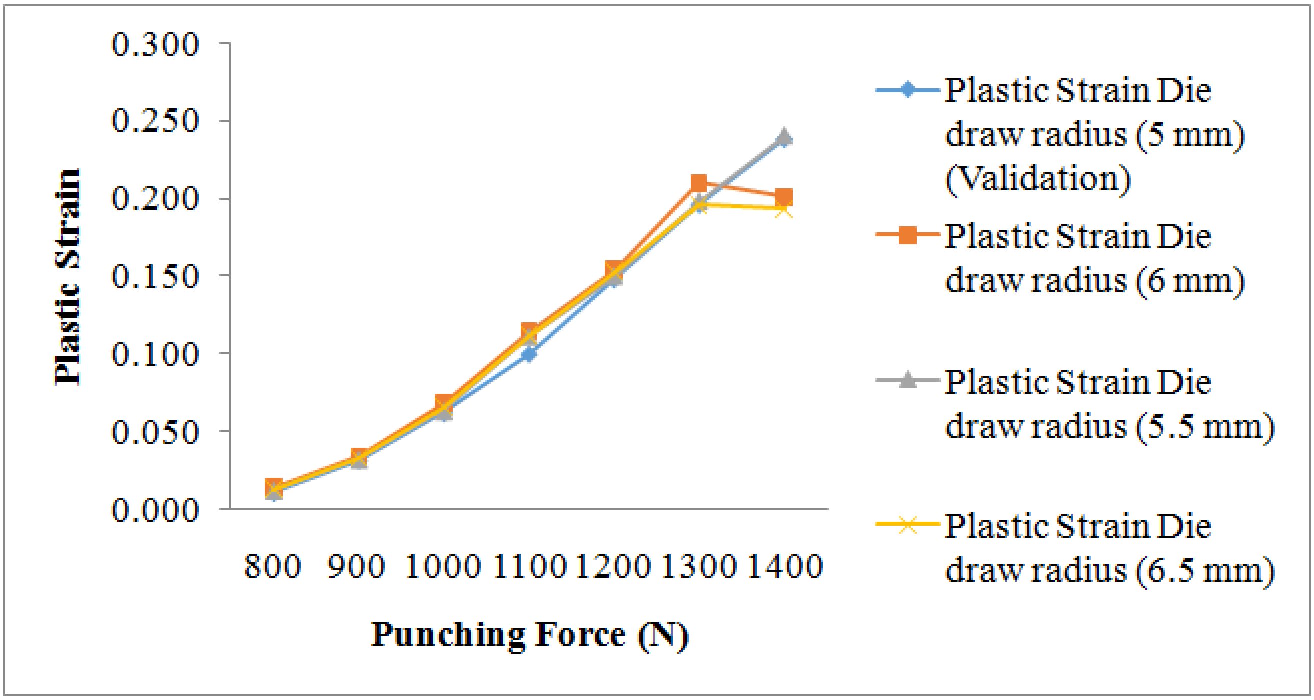

Figure 19 overall comparison of plastic strain with respect to punching force (N) in different die draw radius in deep drawing structures.

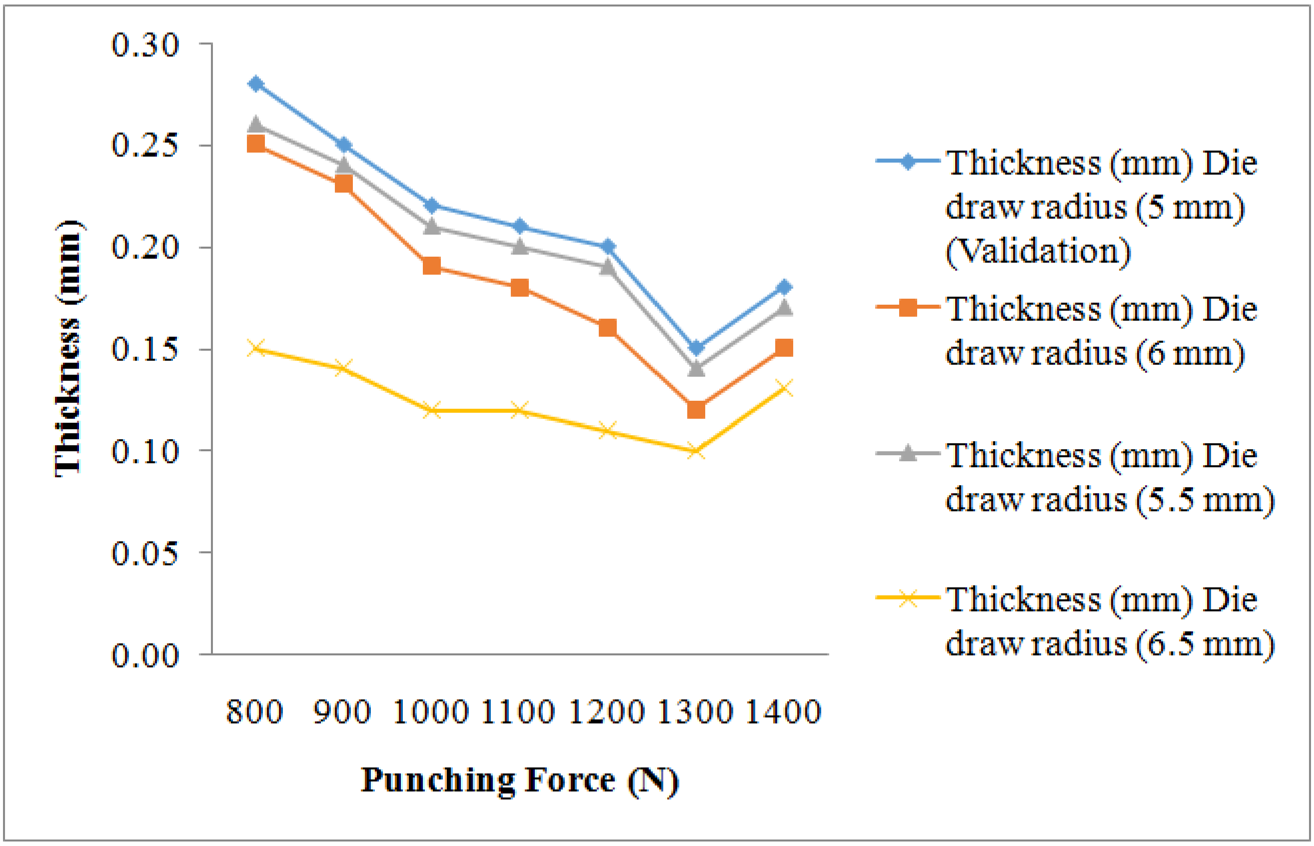

Figure 20 overall comparison of thickness in (mm) with respect to punching force (N) in different die draw radius in deep drawing structures.

CONCLUSIONS

1. The different die draw radius in deep drawing model was developed on ABAQUS modelling domain and analysis was done using the ABAQUS software (Structural domain).
2. The stress distribution is the effective parameter in the structure stability of different die draw radius profiles with different punching forces i.e. 800, 900, 1000, 1100, 1200, 1300 and 1400N.
3. In the study deep drawing structure with die draw radius i.e. 5mm (validation), 5.5mm, 6mm and 6.5mm are the key geometric parameter on the performance of structural formability of aluminium 6061 sheet with different die draw radius under different punching force with an implementation on deep drawing structure with the developed stresses and structure homogeneity effect are improved.
4. The optimum result is observed in 6mm of die draw radius with different punching force, it concludes that at punching force of between 1200 to 1350, the obtained stresses are optimum as compared to other die draw radius of deep drawing.

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