Abstract

This work aims to study the effect of some parameters which influence the deep drawing process, such us punch and die corner radius, lubricant, drawing speed, blank size (drawing ratio) and blank material.

In order to visualize the plastic flow, the gird – marking technique is employed. A low carbon steel (1008–AISI) is chosen to carried out the majority of the work, with sheet thickness of (t_o=0.5mm) and blank diameter (D_b=82 mm).

In order to get the best die design and the effect of die radius on the punch load, cup wall thickness and the strain distribution over the cup wall, six types of punches with diameter (Dp=42.7 mm) and corner radius (p=3, 6, 9, 12, 15, 21.35 mm), and six types of dies with diameter (d_D=44 mm) and corner radius (d=2, 4, 6, 8, 10, 12 mm) have been chosen and then manufactured with a radial clearance of (C = 1.3t) at assembly with the punch.

Two types of lubricant (motor oil C40 and mixture of oil and graphite powder) are used, various drawing speeds equal two (50, 250, 500) mm/min also used. Addition blanks of various diameter from low carbon steel material (65, 70, 75, 80, 82) mm are drawn. Then blanks from (304L – AISI) austenitic stainless steel and (1050–ISO) pure aluminum were drawing with punch profile (p=6, 21.35) mm and different die profile radius.

The result show that the maximum drawing force decrease with an increase die profile radius, while punch profile don't alter the punch load and its maximum value. Also the optimum die profile radius configuration for the drawing process is [p6d6] and [p9d6] which give minimum strain distribution and best uniform cup wall thickness. This means that the value of punch profile radius is equal to (p=12 t_o) and (p=18 t_o), while the value of die radius is equal to (d=12 t_o).

High drawing speed (V=500 mm/min) leads to increase the drawing force and more thinning in cup corner occure. An addition The larger the chosen blank size (drawing ratio), the larger will be the maximum drawing load and the more thinning in cup corner region occure.

The maximum drawing force of the (304L) austenitic stainless steel is higher than the other two material and for low carbon steel is higher than aluminum material. And the minimum die corner radius that the cup can be completely drawn without defect is (d=4 mm) for low carbon steel and (304L) austenitic stainless steel, while for aluminum (d=6 mm).