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VARIATION OF PRESSURE AND MICROSTRUCTURAL CHANGES WITH WEB TO FLANGE RATIO AND DIE LAND LENGTH IN COLD EXTRUSION OF T-SHAPED SECTION

J. S. Ajiboye[1*], O. I. Ajewole[2] and S. O. Solate[2]

[1]Department of Mechanical Engineering, University of Lagos, Lagos, Nigeria joesehinde@yahoo.com (J. S. Ajiboye)	[2]Research students, Department of Mechanical Engineering University of Lagos

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ABSTRACT

In this study, detailed experimental findings on the pressure and microstructural changes due to changing die land length and web to flange ratio of cold-formed T-shaped lead alloy is presented. Increasing die land length leads to increasing surface hardness of the extrudate. It was found that the extrudate hardness value decreases with increasing web to flange ratio to a minimum value at a known area ratio of Ar = 0.45 and beyond this minimum value increasing web to flange ratio leads to increasing hardness value. Therefore, to achieve homogeneous and grain structure refinement of extrudate, web to flange ratio of Ar = 0.45 is recommended. There is a good agreement between theory and the experiment.

Metal flow in complex geometries, especially one with re-entrant corners can be very intricate and the need of process to achieve superplasicity with minimum cost will be a welcome development [1]. The present research seeks to predict optimum area ratio that produces this desire superplasticity in the plastic deformation of round lead billet to T-shaped section with increasing web to flange ratio. The detail theoretical formulation of the velocity field and upper bound solution is found in ref. [2]

Fig. 1 shows the effect of increasing die land length on the surface hardness of T-shaped section. It is observed that increasing die land length leads to increasing surface hardness of T-section. Fig. 2 shows the contribution of die land lengths to extrusion pressure in the extrusion of T-shaped section. The dimensionless die land length extrusion pressure contribution, $\Delta P_o/Y$, is seen to generally increase with increase die land lengths. Fig. 3 shows that increasing web to flange ratio leads to decreasing surface hardness in the extrusion of T-section until a minimum value is reached at a known area ratio. Beyond this area ratio, increasing area ratio causes increasing surface hardness of the extrudate.

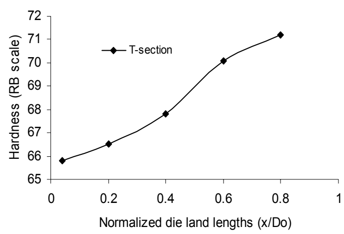


Fig. 1: Effect of increasing die land length on surface hardness of extrusion of T-shaped section

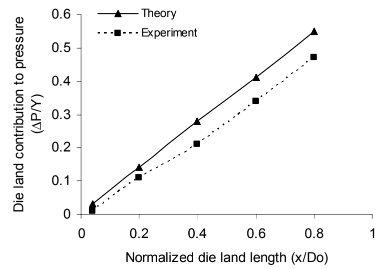


Fig. 2: Contributions of die land lengths to extrusion pressure in T-shaped extrusion

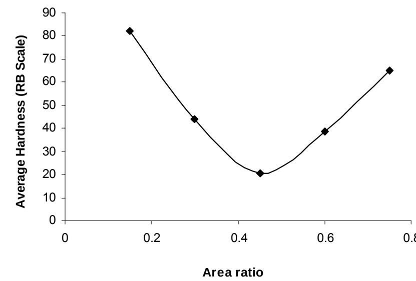
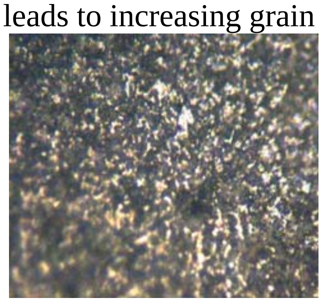
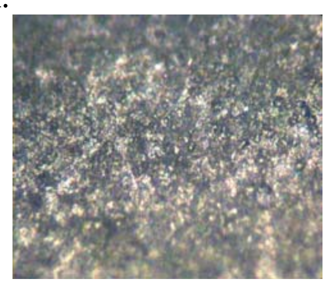


Fig. 3: Effect of increasing web to flange ratio on surface hardness of extrusion of T-shaped section

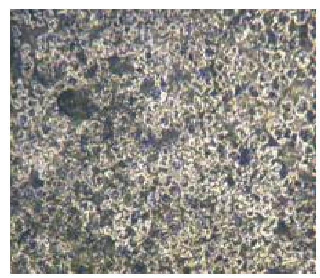
Fig. 4 shows obvious changes in grain morphology as a result of increasing web to flange ratio. There is a fairly uniform and fine-grain structure till Ar = 0.45 which seems to have the finest particles of lead. Beyond this minimum value increasing web to flange ratio leads to increasing grain growth.



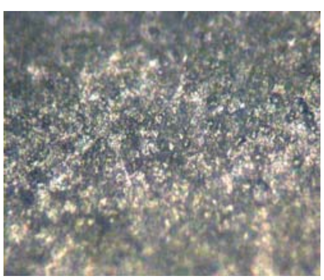
Ar = 0.15



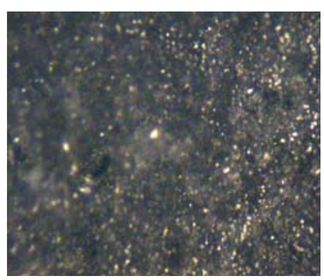
Ar = 0.30



Ar = 0.60



Ar = 0.45



Ar = 0.75

Fig. 4: Effect of increasing web to flange ratio on the surface microstructure of lead alloy in the extrusion of T-shaped section

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