Outline

Review of:

- Bending

- Deep drawing

- Redrawing

- Stretch forming

- Spinning

- Superplastic forming

Example 1: Sheet Bending

A piece of sheet metal has a true strain to fracture of 0.3. What is the minimum bend radius for a piece of this sheet metal if its thickness is 0.5 mm?

Example 2: Deep Drawing

A deep drawing operation is performed on 3.0 mm stock. The part is a cylindrical cup with inside diameter = 70 mm. Find the required starting blank size and whether the operation is feasible or not if,

(i)   The height of the cup is 50 mm and the corner radius on the punch is zero.

(ii) The height of the cup is 60 mm and the corner radius on the punch is zero.

(iii) The height of the cup is 60 mm and the corner radius on the punch = 10 mm.

<u>Example 3:</u> Deep Drawing

Is it possible to fabricate a 190 mm diameter cup from an initial blank of 460 mm diameter in three stages, with successive reductions of 40%, 20% and 15%. What is the minimum LDR required for this procedure?

Example 4: Spinning

Estimate the maximum power in shear spinning a 15 mm thick annealed 304 stainless steel (K = 1275 MPa, n = 0.45) that has a diameter of 40 cm on a conical mandrel of α = 45°. The mandrel rotates at 100 rpm, and the feed is f = 25 mm/rev. (***Hint**, the tangential force can be calculated as $F_t = W\, t_o\, f \sin \alpha$, $t = t_o \sin \alpha$ and $\varepsilon = \frac{\cot \alpha}{\sqrt{3}}$ where W is the specific energy of deformation, t_o is the original thickness)*

Example 5: Stretch Forming

A 15 in. long work piece with a cross sectional area of 0.5 in² is stretched with a force, F, until α = 20°. The material has a true stress-true strain curve σ = 100,000 ε^{0.3} psi.

(a) Find the total work done, ignoring end effects or bending.

(b) What is α_{max} before necking begins?

F

10 in.   5 in.

α
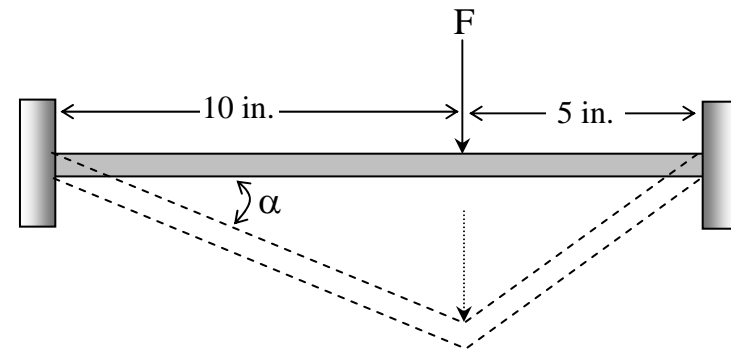
Example 6: Superplastic Forming and Superplasticity

During a high temperature tensile test of a material, it is noted that changing the strain rate by a factor of 8 increases the true stress by a factor of 3. Is this material superplastic? Support your answer by calculation.

Next topic:

Powder Metallurgy