Forming

Module -1: Fundamental concepts relevant to metal forming technology

Lecture-5: Material behavior in metal forming

Quiz - Answers

1. How does friction affect the forming process?

Friction causes non-homogeneous deformation during forming. Due to friction the forming load is increased.

2. Why is fracture criterion important in metal forming?

Fracture criterion determines the limit of formability of materials. Based on it one can specify the limiting values of strains for forming processes.

3. An annealed copper solid cylinder of 40 mm diameter and 20 mm height is compressed frictionless, plastically to a reduction in height of 70%. What is the work done in this process? Assume suitable data.
   Assuming for annealed copper, the values of k = 315 MPa, n = 0.54,
   We can calculate the work done per unit volume from:

   u = $\bar{Y}\varepsilon$ where $\bar{Y}$ is average flow stress.

   Average flow stress is given by $\bar{Y} = \frac{k\varepsilon^n}{1+n}$

   ε = ln(ho/hf) = 0.357

   $\bar{Y} = \frac{k\varepsilon^n}{1+n}$= 135 MPa.

   $Total\ work\ done$ = 48,28 X Volume = 1313 N-m.

4. Prove that the average flow stress for a typical plastic material which obeys power law relation between stress and strain, is : $\bar{Y} = \frac{k\varepsilon^n}{1+n}$

We have by definition for average flow stress,

$$\bar{Y} = \int_0^\varepsilon \sigma d\varepsilon = \int_0^\varepsilon k\varepsilon^n d\varepsilon$$

Substituting for σ, integrating and applying the limits, we obtain the required relation.

5. What is redundant deformation? What is its effect in forming?

It is the shear deformation caused by non-homogeneous plastic deformation during forming process. It causes an increase in forming work required.