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B.Tech 6th Sem., MID Term Examination 2022

Name of Subject: Manufacturing Process II

Paper Code: UPB06B18

Enrollment: 19UPB035

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Date: 25/02/2022

2. Cold and hot metal - working Process

- Hot Working :- Hot Working is defined as the process which is done above the recrystallization temperature but below the melting temp. of the metal. The crystallization temperature for lead - tin metal is always the normal temperature. Hence working of the metals at room temperature is always considered as hot working. Hot rolling, hot forging and hot spinning are hot working processes.

- Cold Working :- Cold working is defined as the process which is done below the recrystallization temperature. Generally recrystallization temperature of metal varies between 30% to 50% of melting temperature.

- Advantages & disadvantages of hot working :-

Advantages :- Homogeneity of material is improved.

(i) Drossing of material is highly eliminated.

(ii) Physical property of material are improved.

D. disadvantages:

(i) Large parts are difficult to be worked.

(ii) Residual stresses can be harmful.

(iii) High energy required for plastic deformation.

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Difference between hot working⁽ⁱ⁾ and cold working :-

Hot working

- (i) Working temp. is above the recrystallization temperature
- (ii) Poor surface finish due to ~~heat~~ oxidation
- (iii) Liquid equipment is used in hot working
- (iv) Force required for deformation is less
- (v) Refinement of grains takes place

Cold working

- (i) Working temperature below the recrystallization temperature
- (ii) Better surface finish is obtained
- (iii) Powerful and heavy are used for deformation
- (iv) Force required for deformation is high.
- (v) grains are enlarged

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geometrical B

steps for performing Operation in forging
are as follows:

- (i) Fullering : In fullering decreasing cross section and increasing length takes place
- (ii) Edging :- In edging increase in cross section and decrease in length occurs
- (iii) Rolling :- In rolling straightening of the die takes place
- (iv) Blocking : It ensures complete filling of die cavity
- (v) Bending : it is done to give a turn a shape to metal rod or plate
- (vi) Trimming:- It is used as a finishing operation for forged parts for removing flash

• Von Mises' maximum distortion energy criterion:

According to this theory yielding would occur when total distortion energy absorbed per unit volume due to applied loads exceeds the distortion energy absorbed per-unit volume at the tensile yield point. Total strain energy E_s and strain energy for volume change E_v can be given as.

$$E_y = \frac{1}{2} (\epsilon_1 \epsilon_1 + \epsilon_2 \epsilon_2 + \epsilon_3 \epsilon_3) \text{ and}$$

$$E_v = \frac{3}{2} G_{12} \epsilon_{12}^2$$

Substituting strains in terms of stresses the distortion energy can be given as.

$$E_d = E_y - E_v \cdot \frac{2(1+\nu)}{6G} (G_1^2 + G_2^2 + G_3^2 - G_1 G_2 - G_2 G_3 - G_3 G_1)$$

at the tensile yield point $\epsilon_1 = \epsilon_y$, $\epsilon_2 = \epsilon_3 = 0$

which gives,

$$E_y = \frac{2(1+\nu)}{6G} G_1^2$$

The failure criterion is thus obtained by equating E_d and E_y , which gives

$$(G_1 - G_2)^2 + (G_2 - G_3)^2 + (G_3 - G_1)^2 = 2G_1^2$$

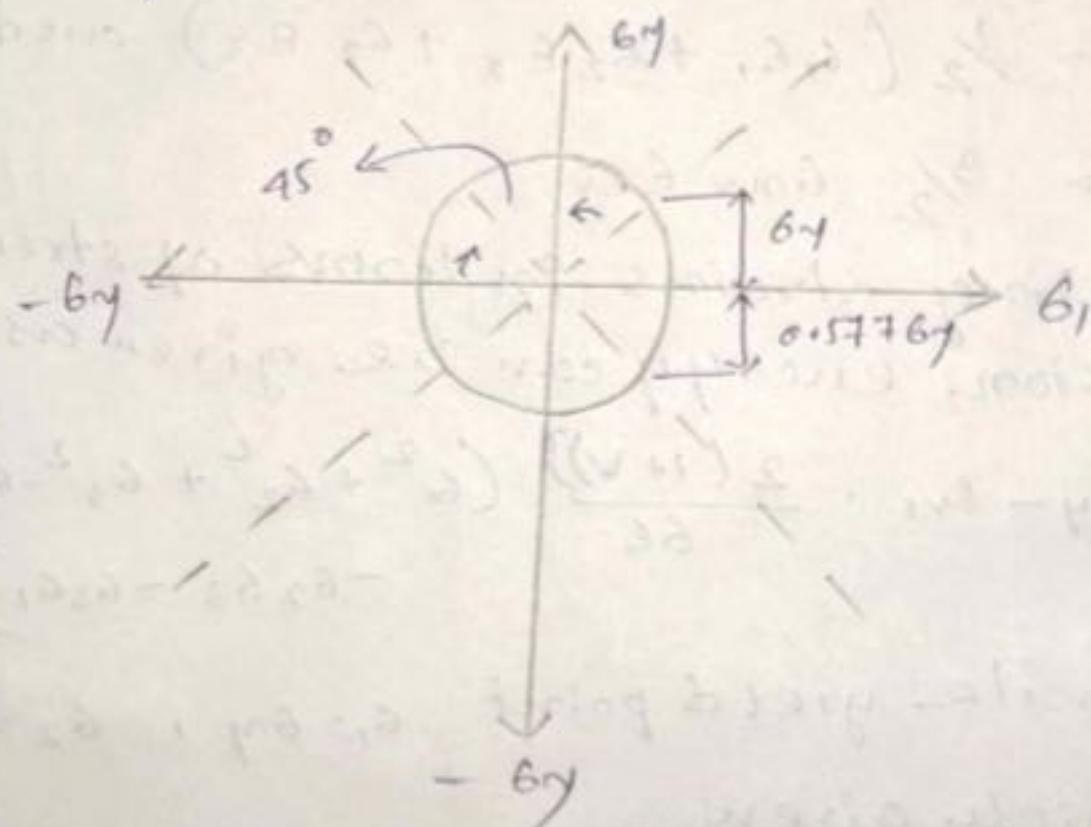
In a 2-D situation if $G_3 = 0$ the criterion reduces to -

$$G_1^2 + G_2^2 - G_1 G_2 > G_y^2$$

$$\text{i.e. } \left(\frac{\sigma_1}{\sigma_y}\right)^2 + \left(\frac{\sigma_2}{\sigma_y}\right)^2 - \left(\frac{\sigma_1}{\sigma_y}\right)\left(\frac{\sigma_2}{\sigma_y}\right) = 1$$

This is an equation of ellipse and the yield surface is shown in the following figure.

This theory agrees very well with experimental results and is widely used for ductile materials.



yield surface corresponding to von mises yield criterion

5) Given,

$$24 \times 24 \times 150 \text{ (Initial dimension)}$$

$$8 \times 72 \times 150 \text{ (Final dimension)}$$

$$\sigma_2 = 7 \text{ N/mm}^2, M = 0.15, 2l = 72 \Rightarrow l = 36 \text{ mm}$$

$$h = 8 \text{ mm}$$

→

$$K = \frac{\frac{D_2}{\sqrt{3}} \times \frac{3}{\sqrt{3}}}{\sqrt{3}} = 4.041$$

$$x_5 = \frac{h}{2u} \ln\left(\frac{l}{2u}\right) = \frac{8}{2 \times 0.15} \ln\left(\frac{1}{2 \times 0.15}\right) = 32.105$$

$$\therefore P_s = 2Ke \left(\frac{2u}{n}\right)^K = 2 \times 4.041 e^{2 \times \frac{0.89}{8} x} = 8.082 e^{0.0375 x} = 8.082 e^x$$

$$= 2K \left[\frac{1}{2u} \left\{ 1 - \ln\left(\frac{1}{2u}\right) + \frac{x}{n} \right\} \right]$$

$$= 2 \times 4.041 \left[\frac{1}{20.15} \left(1 - \ln\left(\frac{1}{2 \times 0.15}\right) + \frac{x}{8} \right) \right]$$

$$= -5.495 + 1.01025 x$$

$$\therefore F = 2 \left[\int_0^{32.105} 8.082 e^{0.0375 x} + \int_{32.105}^{36} (1.01025 x - 5.495) dx \right]$$

$$= 431.09 \left[e^{0.0375 x} \right]_{32.105}^{36} + 1.01025 \left[x^2 \right]_{32.105}^{36}$$

$$- 2 \times 549.5 \left[x \right]_{32.105}^{36}$$

$$\therefore F = 1230.891 \text{ N} \quad [\text{Force per unit length}]$$

So, total force would be $F_{\text{Total}} = F \times 150$)

$$= 1230.891 \times 150$$

$$= 184633.681 \text{ N}$$

$$= 0.184 \times 10^3 \text{ KN}$$