Assignment 3 Arjun Menon MP

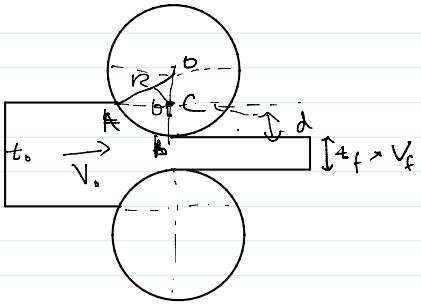
01 April 2021 10:12

Q1) In metal forming operations, flow stress is key. The behaviour of a metal undergoing deformation is affected by the strain rate effect of a material. The effect of strain rate becomes significant when the temperature is high. The deformed shape of the material is also affected by the strain rate effect.

Q2) No slip point; Roll velocity = worked

$$V_0 \times b \times t_0 = V_f \times b \times t_f$$

$$V_f > V_0$$

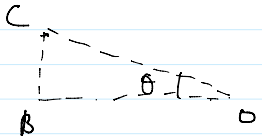


AC = Angle of bite

$$BC = \sqrt{OC^2 - OB^2} = \sqrt{R^2 - \left[R - \frac{t_0 - t_f}{2}\right]^2}$$

$$BC = \sqrt{R^2 - R^2 - \left(\frac{t_0 - t_f}{2}\right)^2 + 2RR\left(\frac{t_0 - t_f}{2}\right)}$$

$$l = \sqrt{Rd} \qquad BC = \sqrt{Rd}$$



$$\sin\theta = \frac{BC}{OC} \qquad \sin\theta = \frac{\sqrt{Rd}}{R} = \sqrt{\frac{d}{R}}$$

θ = Angle of bite = $\sqrt{\frac{d}{R}}$

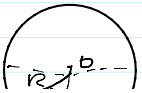
Arc of contact = $OC = R - d/2$

$$R^2 = L^2 + [R - d/2]^2$$

$$R^2 = L^2 + R^2 + \frac{d^2}{4} - Rd$$

$$Rd = L^2 \qquad L = \sqrt{Rd}$$

Condition for max draft :-

Point 

condition for max angle -

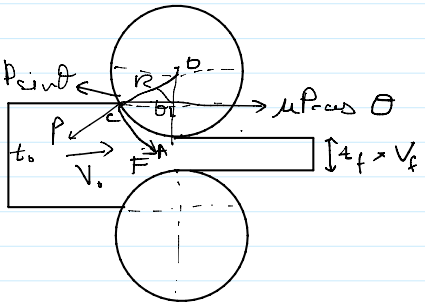
$$\mu P\cos\theta - P\sin\theta > 0$$

$$\mu > \tan\theta$$

$$\tan\theta = \frac{BC}{OB} = \frac{\sqrt{R\Delta}}{R-\left(\frac{t_0-t_f}{2}\right)}$$

$$\tan\theta = \sqrt{\frac{R\Delta}{R}} = \sqrt{\frac{\Delta}{R}} = \mu$$

$$d_{max} = \mu^2 R$$



3)

i) $d_{max} \propto \mu^2$ which means that as the friction increases so does the draft

ii) $d_{max} \propto R$ as Radii of rolls increases so does the draft

iii) Reduction of grain size.

5) Roll forging process is a process where the workpiece is fed through 2 specially shaped rolls to create a long product with varying cross-section. The grooves in the rollers allows the heated part to have varying cross-section.

The main difference between rolling and forging is that the isotropy of forging is higher than that of rolling. Which means that the mechanical properties of forging is lower than that of rolling.