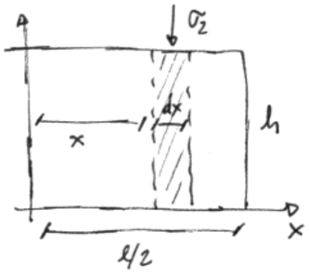
http://sites.google.com/site/ingegneriaunisa

FORMULE x LAVORAZIONI

Lavorazioni per deformazione plastica

Compressione fra stampi (parallelepipedo)

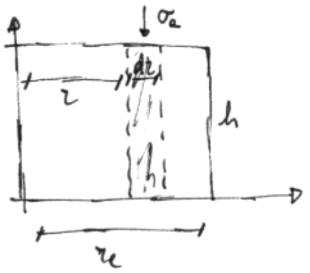


$$\sigma_z = \frac{2}{\sqrt{3}}\sigma_0 \, e^{\frac{2\mu}{h}\left(\frac{l}{2}-x\right)}$$

$$\sigma_0 = K(\varepsilon_T)^n$$

$$p_m = \frac{2}{\sqrt{3}}\sigma_0\left(1+\frac{\mu l}{2h}\right)$$

Compressione fra stampi (cilindrico)



$$\sigma_z = \sigma_0 \, e^{\frac{2\mu}{h}(r_e - r)}$$

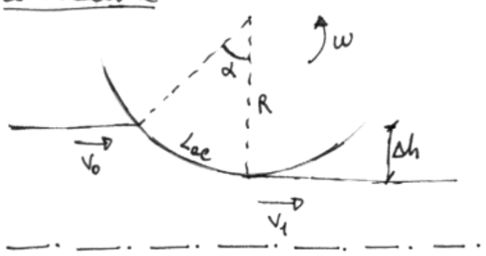
$$\sigma_0 = K(\varepsilon_T)^n$$

$$p_m = \sigma_0\left(1+\frac{2}{3}\frac{\mu}{h} r_e\right)$$

$$L_{ID} = V K \frac{\varepsilon^{n+1}}{n+1}$$

↳ r_e e h sono quelli finali

Laminazione



Condizioni di laminazione o imbocco spontaneo

$$\mu > \mathrm{tg}\,\alpha \qquad \Delta h < \mu^2 R$$

$$L_{ae} = \sqrt{\Delta h \cdot R}$$

$$V_1 > V_e > V_0$$

$$R_z = \frac{V_1}{V_e}$$

$$p_m = \frac{2}{\sqrt{3}}\sigma_0\left(1+\frac{\mu L_{ae}}{2h_m}\right)$$

$$\sigma_0 = \frac{\int_{\varepsilon_i}^{\varepsilon_f} K\varepsilon^n d\varepsilon}{\varepsilon_f - \varepsilon_i}$$

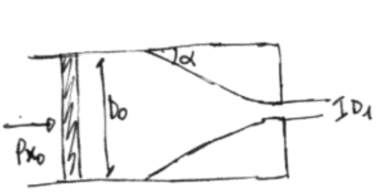
$$M = L_{ae} \cdot F$$

$$W = M\omega$$

$$F = p_m L_{ae} \cdot w$$

$$\varepsilon = \log\frac{A_0}{A_f} = 2\log\frac{D_0}{D_f}$$

Estrusione



$$p_z\ (\text{Resist. matrice}) = \sigma_0 + p_{x0} \quad [\sigma_0 = K\varepsilon_T^n]$$

$$p_{x0} = \sigma_0 \frac{1+B}{B}\left[\left(\frac{D_0}{D_1}\right)^{2B} - 1\right]$$

$$B = \mu\,\mathrm{cotg}\,\alpha$$

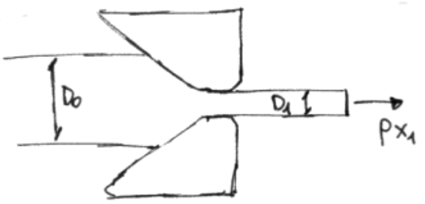
$$p_{x0} \gg \sigma_0$$

OPPURE

$$p_{x0} = \sigma_0(0{,}8 + 1{,}2\varepsilon)$$

$$\sigma_0 = \frac{1}{\varepsilon_f - \varepsilon_i}\int_{\varepsilon_i}^{\varepsilon_f} K\varepsilon^n d\varepsilon$$

<u>Trafilatura</u>



$$p_{x_1} = \sigma_0 \, \frac{1+B}{B} \left[1 - \left(\frac{A_1}{A_0} \right)^B \right]$$

Condizione limite $\quad p_{x_1} = \sigma_{zm}$

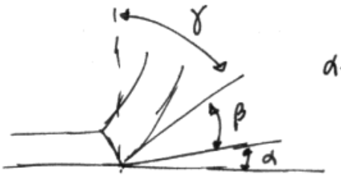
Rapporto max di riduzione $\quad \frac{A_0 - A_1}{A_0} = \left[1 - \frac{B}{1+B} (n+1) \right]^{1/B}$

TAGLIO

~~$T_1^{1/2} = T_2^{1/2} = 2905$~~ 3.

Lavorazioni per asportazione di truciolo
Taglio libero ortogonale

$r_c = \frac{h_0}{h_1}$



$\alpha + \beta + \gamma = \frac{\pi}{2}$ $\qquad MRR = V_t h_0 b_0$

Labbro di usura VB_s $\qquad$ Cratere di usura $\frac{KT}{KM} = \frac{\text{Profondità}}{\text{Distanza}}$

$v T^u = 10^{b/a} = v_1$ $\qquad u = \frac{1}{a}$ → acciai 0,125 → carb. 0,25 → m. ceramici 0,5

↓

$v^\alpha a^\beta p^\gamma T = K$

$\alpha > \beta > \gamma > 0$

$a \sim h_0$

$p \sim w_0$

$\operatorname{tg}\varphi = \frac{r_c \cos\gamma}{1 - r_c \operatorname{sen}\gamma}$

$r_c = \frac{h_0}{h_1}$ diff. da misurare

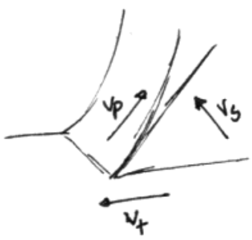
↓

$r_c = \rho \frac{l_1 h_0 b_0}{M}$

$\gamma_s = \frac{\cos\gamma}{\operatorname{sen}\varphi \cos(\varphi - \gamma)}$ → $\dot{\gamma}_s = \frac{V_t \cos\gamma}{\cos(\varphi-\gamma)\, \Delta y}$

↓

Angolo ottimo di scorrimento $\varphi = \frac{\pi}{4} + \gamma/2$



$v_s = \gamma_s \operatorname{sen}\varphi\, V_t$

$v_p = r_c V_t$

$F_z = \frac{F_x}{\operatorname{tg}(\mu - \gamma)}$ $\qquad N = \frac{T}{\operatorname{tg}\mu}$

TENSIONE SCORR. $F_s = F_z \cos\varphi - F_x \operatorname{sen}\varphi$

$F_n = F_z \operatorname{sen}\varphi + F_x \cos\varphi$

$F_z = N\cos\gamma + T \operatorname{sen}\gamma$

$F_x = T\cos\gamma - N \operatorname{sen}\gamma$

$T = F_z \operatorname{sen}\gamma + F_x \cos\gamma$

$N = F_z \cos\gamma - F_x \operatorname{sen}\gamma$

COSTANTE MERCHANT

$\boxed{2\varphi + \mu - \gamma}$

Sollec. tangenz. $\tau_s = \frac{R}{b_0 h_0} \operatorname{sen}\varphi \cos(\mu - \gamma + \varphi)$

↳ Angolo ottimo

$2\varphi + \mu - \gamma = \frac{\pi}{2}$

$P_{TOT} = F_z V_t = \underbrace{F_s V_s}_{P_t} + \underbrace{T V_p}_{P_a}$ → Attrito

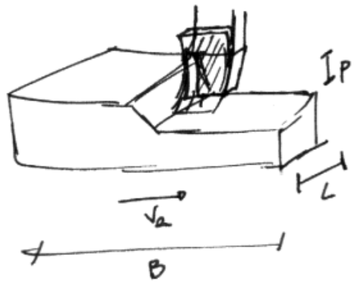
PIALLATURA LIMATURA

$V_{asportato} = BLp$

$N_{corse} = B/a$

$t_l = \frac{L}{V_t} \cdot N_c$

$MRR = V_t \, a \, p$



TORNITURA

$V_t = \frac{\pi D n}{1000}$ $\quad V_a = n \cdot a$ $\quad n = [giri/min]$

$t_l = \frac{\pi D L}{V_t \, a} \cdot 1000 = \frac{L}{V_a}$ $\quad V_{asportato} = \pi(Dp - p^2)L$ $\quad MRR = 1000 \, V_t \, a \, p$

$p_{sp} = \frac{F_z}{ap} = K_s = K_{s0} \, a^{x-1} \, p^{y-1}$ $\quad (y \simeq 1)$

$\downarrow$

$F_z = K_s \cdot S_0 = K_{s0} \, a^x \, p^y$

FORATURA

$MRR = \frac{V_t}{2} \, a \, \frac{D}{2}$ $\quad V_t = \frac{\pi D n}{1000}$