Assignment 1

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1. Given

$T_m = 1510°C$, $E = 20V$, $I = 200 A$ $n = 0.9$

$K = 40$ W/m

We know, $D = \frac{du}{2\alpha y}$ or $\eta = \frac{Q\mu}{4\pi\alpha_s^2 \rho c (T_m - T_0)}$

where $\frac{K}{\rho c} = \alpha \rightarrow$ diffusivity

$Q = EIn = 20 \times 200 \times 0.9 = 3600$ J/s

$\eta = \frac{Q \times \mu}{4\pi\alpha^2\rho(T_m - T_0)}$ $\boxed{\eta = 2.6526}$

$D = \frac{du}{2\alpha_s}$ where $\alpha_s = 9.091 \times 10^{-6}$, $D = 0.8$ (given)

$0.8 = \frac{d \times 5 \times 10^{-3} \text{ m/s}}{2 \times 9.091 \times 10^{-6}}$ $\therefore d = 2.90912$ mm

$W = 2d = 5.81824$ mm

2. Width of HAZ ; phase transition temperature = 780°C

$\eta = \frac{Q \times \mu}{4\pi\alpha^2\rho c(T_m - T_0)} = 5.5873$

$D = \frac{du}{2\alpha_s}$ & $D = 1$ for $n = 5.5873$

$\therefore d = 3.6365$ mm

$W_1 = 2d = 7.2738$ mm

$HAZ = \frac{W_1 - W}{2} = 0.72728$ mm

Assignment - 2

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$T_m = 1510^\circ c$, $J = 200A$, $v = 5mm/s$

$E = 20\,V$, $T_s = 25^\circ c$, $n = 0.9$, $\rho C = 1.0044\, J/mm^3 K$

$e = 5mm$, $H_{net} = 720\, J/mm$

a) $y_1 = 1.5mm$; $y = 3mm$

$$\frac{1}{T_p - T_0} = \frac{(2\pi e)^{1/2} (\rho C h y)}{(H_{net})} + \frac{1}{T_m - T_0} \rightarrow (1)$$

$T_{p_1} = 1184.0063^\circ c$, $T_{p_2} = 975.376^\circ c$

b) $T_p = 730^\circ c$, $y = 5.9\ mm$ using eq^n no (1)

c) Here $T_0 = 200^\circ c$

Using, $$\frac{1}{T_p - T_0} = \frac{1}{T_m - T_0} + \frac{(2\pi e)^{1/2} \rho C h y}{(H_{net})}$$

$$\frac{1}{T_p - 200} = \frac{1}{1510 - 200} + 1.2627 \times 10^{-4}\, y$$

$T_p = 730^\circ c$

$\therefore y = 8.897\ mm$

d) Net energy becomes

$(100 + 10\%)\ 720\ J/mm$

$\therefore$ We get , $y = 6.5\ mm$

e) $v = 10\ mm/s$

$$H_{net} = \frac{nEI}{v} = \frac{0.9 \times 20 \times 20}{10}\ J/mm$$

$= 360\ J/mm$

$\therefore y = 2.95\ mm$