SANI JOHNPAUL
15/ENG04/055

1. $D = 1500m$,

Schedule Speed $= 36 km/hr = 36 \times 5/18 = 10 m/s$

Breaking retardation $\beta = 3 \times 5/18 = 5/6 \; m/s^2$

$v = d/t \therefore t = d/v = 1500/10 = 150s$

Actual run-time $= 150 - 25 = 125s$

$V_a = \frac{1500}{125} = 12 m/s$

$V_{max} = 1.25 \times 12 = 15 m/s$

$K = \frac{D}{V_m^2}\left[\frac{V_m}{V_a} - 1\right] = \frac{1500}{15^2}(1.25 - 1)$

$= 5/3$

Recall $K = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{1}{\beta}\right)$

$\frac{5}{3} = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{6}{5}\right)$

$\alpha = 0.4 m/s^2 = 0.47 \times 18/5$

$= 1.7 km/h/s$

$\therefore$ acceleration $\alpha = 1.7 km/h/s$ //

2. $V_a = 36 km/h = 36 \times 5/18 = 10 m/s$

$\alpha = 1.8 m/h/s = 1.8 \times 5/18 = 0.5 m/s^2$

$\beta = 3.6 km/h/s = 3.6 \times 5/18 = 1.0 m/s^2$

$t = 2000/10 = 200s$

$K = \frac{(\alpha + \beta)}{2\alpha\beta} = \frac{(0.5 + 1.0)}{2(0.5 \times 1)} = 1.5$

$V_m = \frac{t - \sqrt{t^2 - 4KD}}{2K} \; . = \frac{200 - \sqrt{200^2 - 4 \times 1.5 \times 2000}}{2 \times 1.5}$

$= 11 m/s = 11 \times 18/5$

$= 39 km/h$

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3\. Total Surface area of tank = $6l^2$

$\therefore 6l^2 = 6$, $l = 6/6 = 1m^2$

Total Volume of tank = $1^3 = 1m^3$

Volume of water to be heated daily = $6 \times (1 \times 0.9) = 5.4m^3$

Since $1m^3$ of water = 1000kg,

mass of water = $5.4 \times 1000 = 5400kg$

Heat required to raise temp of water = $5400 \times 4200 \times (65-20)$

$= 1020mt$

If 1kwh = 3.6mt

then 1020mt = 1020/3.6

= 283.3kwh

Daily loss from the tank = $6.3 \times 6 \times (65-20) \times 24/1000$

= 40.8 kwh

Energy supplied per day = 283.3 + 40.8 = 324.1 kwh

Loading in kwh = 324.1/24

= 3.5kw

Efficiency of the tank = $\frac{283.3}{324.1} \times 100$

= 87.4 %

4\. Secondary current = $\frac{600 \times 10^3}{20 \times 0.6} = 5 \times 10^4 A$

If this current is taken as the reference quantity,

$V_2 = 20(0.6 + J0.8) = (12 + J16)V$

$\therefore$ Secondary impedance $Z_2 = \frac{(12 + J16)}{(5 \times 10^4)}$

$= (2.4 + J3.2) \times 10^{-4}$ Ohms (Ω)

$\therefore Z_2 = (4.8 + J3.2) \times 10^{-4} \Omega$

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Second current $I_2 = \frac{20}{(4.8 \times 13.7) \times 10^{-4}}$

$= 3.466 \angle -33.7^\circ \times 10^4$ A.

$Pf = \cos 33.7 = 0.832$

$\therefore$ power absobed $= 20 \times 3.466 \times 10^4 \times 0.832 \times 10^4$

$= 580$ kW

(5) No reflector,

(a) $E = \frac{300}{20^2}$

$= 0.75$ lm/m²

(b) $\theta = \tan^{-1}\left(\frac{10}{20}\right) = \tan^{-1}(0.5) = 26.6^\circ$

$\cos\theta = 0.89$, $x^2 = 10^2 + 20^2 = 500$

$\therefore E = \frac{300}{0.89 \times 500}$

$= 0.534$ lm/m²

with reflector

luminous output of the comp- $300 \times 4\pi$ lumn

flux directed by the reflector $= 0.5 \times 1200\pi$

$= 600\pi$ lm

Illuminator produced on disc $= \frac{600\pi}{100\pi}$

$= 6$ lm/m²

$\therefore$ Same with energy point on the disc.

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