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15/ENG04/046
INDUSTRIAL UTILIZATION OF ELECTRIC POWER (CEEE 552)

SOLUTION

1) Distance (D) = 1.5Km or 1500m

Schedule Speed = 36 Km/hr = $\frac{36000}{60 \times 60}$ = 10m/s

Breaking retardation = 3Km/h/s

= $\frac{3000}{60 \times 60}$ = $\frac{5}{6}$ m/s²

Schedule time of run = $\frac{1500}{10}$ = 150s

Actual time of run = 150 − 25 = 125s

$V = \frac{d}{t}$

$V_a = \frac{1500}{125} = 12 m/s$; $V_{max} = 1.25 \times 12$
$= 15 m/s$

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

$= 5/3$

Equally

$K = \frac{1}{2}\left[\frac{1}{\alpha} + \frac{1}{\beta}\right] \Rightarrow \frac{5}{3} = \frac{1}{2}\left(\frac{1}{\alpha} + \frac{6}{5}\right)$

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

$= 1.7 Km/h/s$ //

2) $V_a = 36 Km/h = \frac{36000}{60 \times 60} = 10 m/s$

$\alpha = 1.8 Km/h/s = \frac{1.8 \times 1000}{60 \times 60} = 0.5 m/s^2$

$\beta = 3.6 Km/h/s = \frac{3.6 \times 1000}{60 \times 60} = 1.0 m/s^2$

$t = \frac{D}{V_a} = \frac{2000}{10} = 200s$

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

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

$= 11 m/s = 39.6 Km/h$

3) If L is the side of the tank, then total surface area of the tank $= 6L^2$

$6L^2 = 6$

$L = 1m^2$

Volume of the tank $= L^3 = 1m^3$

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

$= 5.4m^3$

Since $1m^3$ of water weighs 1000Kg, mass of water to be heated daily $= 5.4 \times 1000$

$= 5400Kg$

Heat required to raise the temperature of water = ~~5400 × 4200~~

$= 5400 \times 4200 (65 - 20)$

$= 1020 MJ = \frac{1020}{3.6} = 283.3 KWh$

Daily loss from the surface of the tank $= 6.3 \times 6 \times (65 - 20) \times \frac{24}{1000} = 40.8 kW$

Energy supplied per day $= 283.3 + 40.8 = 324.1 kWh$

Loading in KW $= \frac{324.1}{24} = 3.5 KW$

Efficiency of the tank $= 283.3 \times \frac{100}{324.1} = 87.4\%$

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

If the current is taken as ref. quantity, then Sec voltage is

$V_2 = 20(0.6 + j0.8)$
$= (12 + j16) v$

Secondary Impedance $Z_2 = \frac{12 + j16}{5 \times 10^4} = (2.4 + j3.2) \times 10^{-4}$ ohm

If the Secondary resistance is doubled while reactance remains constant, the impedance when health is half full becomes

$Z_2 = (4.8 + j3.2) \times 10^{-4}$ ohm

Now Sec current $I_2 = \frac{20}{(4.8 \times j3.7) \times 10^{-4}}$

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

Now power factor $= \cos 33.7 = 0.832$

Hence, power absorbed $= 20 \times 3.466 \times 10^4 \times 0.832 \times 10^4$
$= 580 kW$

5 Without Reflector

$E = \frac{300}{20^2} = 0.75\ lm/m^2$

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

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

$E = \frac{300}{0.89 + 500}$

$= 0.534\ lm/m^2$

Scanned by CamScanner

With Reflector

Luminous output of the lamp = $300 \times 4\pi$ lumen

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

$= 600\pi$ lm

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

$= 6$ lm/m^2

It is the same at every point on the disc.