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Petroleum Engineering
16/ENG07/003
200LV

1 The power P dissipated in a resistor is given by equation

1 $P = \frac{E^2}{R}$

if E = 200 volts and R = 8 ohms, find the change P resulting from the drop of 5 volts in E and increase of 0.20 ohms in R

Soln

$\frac{\partial P}{\partial E} = \frac{2E}{R}$, $\frac{\partial P}{\partial R} = \frac{-E^2}{R^2}$ δE = 5 volts, δR = 0.20Ω

$$\delta P = \frac{\partial P}{\partial E}\delta E + \frac{\partial P}{\partial R}\delta R$$

$$\delta p = \frac{2E}{R}(-5) + -\left(\frac{E^2}{R^2}\right)(0.20$$

$$\delta p = \frac{2 \times 200}{8}(-5) - \left(\frac{200^2}{8^2}(0.20)\right)$$

$-250 - 125$

$= -375$

∴ the power reduces by -375

2 The deflection y at the centre of a circular plate suspended at the edge and uniformly loaded is given in Eqn (2)

$$y = \frac{Kwd^4}{t^3}$$

where w = total load, d = diameter of plate, t = thickness and K is a constant

Calculate the approximate percentage change in y if w is increased by 3 percent, d is increased by $2\frac{1}{2}$ percent and t is increased by 4 percent

$$\frac{\partial y}{\partial w} = \frac{Kd^4}{t^3}, \quad \frac{\partial y}{\partial d} = \frac{4Kwd^3}{t^3}, \quad \frac{\partial y}{\partial t} = \frac{-3Kwd^4}{t^4}$$

$$\delta w = +3\% = \frac{3w}{100}, \quad \delta d = +\frac{2\frac{1}{2}d}{100}, \quad \delta t = +\frac{4t}{100}$$

$$\delta y = \frac{\partial y}{\partial w}\delta w + \frac{\partial y}{\partial d}\delta d + \frac{\partial y}{\partial t}\delta t$$

$$\delta y = \frac{Kd^4}{t^3}\left(\frac{+3w}{100}\right) + \frac{4Kwd^3}{t^3}\left(\frac{+2\frac{1}{2}d}{100}\right) + \frac{-3Kwd^4}{t^4}\left(\frac{+4t}{100}\right)$$

$$\delta y = \frac{3Kd^4w}{t^3 100} + \frac{2\frac{1}{2}\times 4Kwd^4}{t^3 100} + \frac{-12Kwd^4}{t^3 100}$$

$$\delta y = \frac{Kwd^4}{t^3}\left(\frac{3}{100} + \frac{10}{100} - \frac{12}{100}\right)$$

$$\delta y = y\left(\frac{1}{100}\right)$$

The approximate percentage change in y is 1 percent of y