UDONSI VICTOR
18/ENG07/014 PETROLEUM ENGR.
ENGMAT 282

a) Applying Balance law:
Accumulation rate = Input rate of salt − Output rate of salt.

Denoting the amount of salt present in the tank at anytime t as y, its time rate of change is given as;

$$\frac{dy}{dt} = y_{in} - y_{out}$$

Since 50gal of brine enters the tank per minute and one gallon contains (1+sin t) lb of salt, at t = 1, (1+sin t) = (1+sin 1) = 1.02 lb of salt.

It means that the amount of salt entering the tank is;

$$y_{in} = 50\ \frac{gal}{min} \times 1.02\frac{lb}{gal} = 51\ \frac{lb}{min}$$

The tank contains 1200gal of water with dissolved salt, & 30 gallons of the solution leaves the tank per minute. That is $\frac{30gal}{1200gal} = 0.025$.

= 2.5% of the content of the tank. It that the case 2.5% of the salt present in the tank will also leave the tank for minute. In other words

$$y_{out} = 2.5\%\ of\ y$$

(a) Therefore; $\frac{dy}{dt}\frac{lb}{min} = 51\frac{lb}{min} - 2.5\%\ of\ y\frac{lb}{min}$

b) $\frac{dy}{dt} = 51 - 0.025y$; $\frac{dy}{dt} = -0.025y + 51$

$$\frac{dy}{dt} = -0.025\left[\frac{-0.025y + 51}{-0.025y - 0.025}\right]; \frac{dy}{dt} = -0.025(y - 2040);$$

$$\frac{dy}{(y-2040)} = -0.025dt; \int\frac{dy}{(y-2040)} = \int -0.025dt$$

$$\int\frac{dy}{(y-2040)} = -0.025\int dt; \ln(y-2040) = -0.025t + c$$

$$y - 2040 = e^{-0.025t+c}; y - 2040 = e^{-0.025t}e^{c}$$

$$y - 2040 = e^{-0.02t}\ y_0;\ y - 2040 = y_0 e^{-0.025t};$$

$$y = y_0 e^{-0.025t} + 2040;\ \text{Given that when } t = 0 \text{ in}$$

Circularly); $y = 150lb$

$$150 = y_0 e^{0.025t(0)} + 2040;\ 150 - 2040 = y_0 \times 1;$$

$$y_0 = 1890$$

Then

$$y = 1890e^{-0.025t} + 2040$$

$$y = 2040 - 1890e^{-0.025t}$$