en la angla

Change of Concentration in a Tank

("continuously-stirred tank reactor")

V = volume of the tank
q = flow rate through the tank (= inlet flow rate, and = outlet flow rate)
t = time; t = 0 is the "initial" time
f.t = tank concentration at time t; f.0 = initial tank concentration
w = inlet concentration

task: solve for f in terms of V, q, f.0, w, and any other known functions

Solution:
rate of change of concentration at time t = $f'.t$

$$= \left(\frac{\text{mass in} - \text{mass out}}{\text{volume}}\right)$$

$$= \frac{qw - q\,f.t}{V}\ .$$

$$\therefore\ f' = \frac{qw - qf}{V}\ .$$

$$\therefore\ \frac{f'}{f-w} = \frac{-q}{V}\ .$$

$$\therefore\ \int \frac{f'}{f-w} = \int \frac{-q}{V} + c_1\ .$$

$$\therefore\ \lambda..(f-w) + c_2 = \left(-\frac{q\,i}{V} + c_3\right) + c_1\ .$$

$$\therefore\ \lambda.(f-w) = -\frac{q\,i}{V} + c_4\ .$$

$$\therefore\ f - w = \mathcal{E}..\left(-\frac{q\,i}{V} + c_4\right).$$

$$\therefore\ f - w = (\mathcal{E}.\,c_4)\,\mathcal{E}..\left(\frac{-q\,i}{V}\right).$$

$$\therefore\ f - w = c\,\mathcal{E}..\left(\frac{-q\,i}{V}\right).$$

$$\therefore\ f = w + c\,\mathcal{E}..\left(\frac{-q\,i}{V}\right).$$

$$\therefore\ f.0 = w + c\ .$$

$$\therefore\ c = f.0 - w\ .$$

$$\therefore\ f = w + (f.0 - w)\,\mathcal{E}..\left(\frac{-q\,i}{V}\right).$$

DONE