Episode 21: Mixing problems

Chemistry (chemical reactions) Medicine (drug administration, dialysis) Ecology (filtration of pollution)

Problem. A tank contains 20 kg salt dissolved in 5000 l of water. Brine containing 0.03 kg of salt per liter or water enters the tank at a rate of 25 l/min. The solution is kept mixed and drains from the tank at the same rate. How much salt remains in the tank after half an hour?

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. . h.c.l. const.

y(0) = 20 im/in Solve DE: $\frac{dy}{dt} = \frac{150 - y}{200}$ $\frac{dy}{150-y} = \frac{dt}{200}$ $\int \frac{dy}{150-y} = \int \frac{dt}{200}$ $-h|150-y| = \frac{t}{200} + C,$ h 1150-y/ = - t - C, $|150-y| = e^{-\frac{t}{200}-C_1}$ $150 - y = Ce^{-\frac{t}{200}}$ $y = 150 - Ce^{-\frac{t}{200}} | gen. sol.$ Initial cord. ; $20 = \frac{\gamma(0)}{1} = \frac{150 - (e^{0})}{1} = 20 - \frac{130}{1} = 20 = \frac{130}{1}$ $y(t) = 150 - 130e^{-\frac{t}{200}}$ Sol. of IVP-<u>*</u>200 y=130e ηy y= 150-130 e 150 120 2*0* ∍t -120 y= -130 000 him y(t) = 150 What is 150? 150 = 0.03 · 5000, concertration val of fraktig the trater taule

 $y(30) = 150 - 130 \cdot e^{-\frac{30}{200}} \approx 38.1$ (kg) t Answer