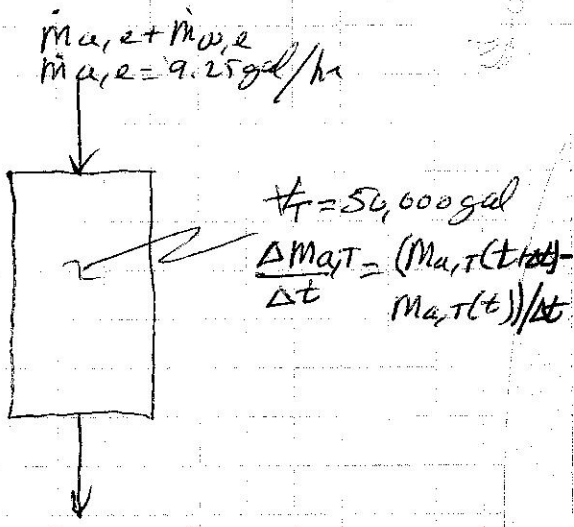
Reply to thread 798-357424



Assume the medium to be water

" concentration of additive in parts per million by weight

Relationships & nomenclature

w - water	T - tank
a - additive	t - time
$\dot{m}$ - mass rate	$\forall$ - volume, $\dot{\forall}$ - flow rate
e - inlet to tank	i - initial condition
o - outlet from tank	f - final condition
m - mass	C - concentration ppm(W)

assume constant temperature process

$\dot{m}_{(w,e)} = \dot{m}_{(w,o)} = \rho_{H_2O} \dot{\forall}_w$

$C_{(a,e)} = 35 \text{ ppm}(W) = m_{(a,e)} / m_w$

$C_{(a,o)} = 19 \text{ ppm}(W) = C_{(a,T,f)}$

$C_{(a,T,i)} = 3 \text{ ppm}(W)$

$\dot{m}_{(a,e)} = C_{a,e} \dot{m}_{w,e}$, $\dot{m}_{a,o} = C_{a,o} \dot{m}_{w,o}$

Mass conservation by Integration

$$\Delta M_{(a,T)} = M_{(a,T)}(t+\Delta t) - M_{(a,T)}(t) = (\dot{m}_{(a,e)} - \dot{m}_{(a,o)})\Delta t$$
$$= (m_{(w,T)})(\Delta C_{(a,T)}) = \dot{m}_w (C_{(a,e)} - C_{(a,o)})\Delta t$$

$$\frac{m_{(w,T)}}{\dot{m}_w} \int_{C_{(a,T,i)}}^{C_{(a,T,f)}} \frac{dC_{a,T}}{(C_{a,e} - C_{a,o})} = \int_{t_0=0}^{t} dt$$

$C_{(a,T,t)}$ ← $\equiv C_{(a,T,t)}$ at any time

$\rho_{H_2O} \forall_t \rightarrow$ $\rho_{H_2O} \dot{\forall}_{w,e} \rightarrow$

$$\frac{m_{(w,T)}}{\dot{m}_w} \left(-\ln\left(\frac{C_{a,e} - C_{a,T,f}}{C_{a,e} - C_{a,T,i}}\right) \Bigg|_{3 \text{ ppm}(W)}^{19 \text{ ppm}(W)} \right) = t$$

$$\frac{-50000}{9.25} \left[\ln\left(\frac{35-19}{35-3}\right) \right] = t$$

$$3110.08 \text{ hr} = t$$

$$129.6 \text{ days} = \Longleftarrow$$