GIVEN

Crude Oil Storage Tank.
- » initially contains
  - * $\forall_i = 1000\ m^3$
- » pumped
  - * in $A_{in} V_{in} = 2 \frac{m^3}{min} = \frac{1}{30} \frac{m^3}{s}$
  - * out $V_{out} = 1.5 \frac{m}{s}$; diameter $\equiv d_{out} = 0.15\ m$
- » specific vol $\equiv v_{oil} = 0.0015 \frac{m^3}{kg}$

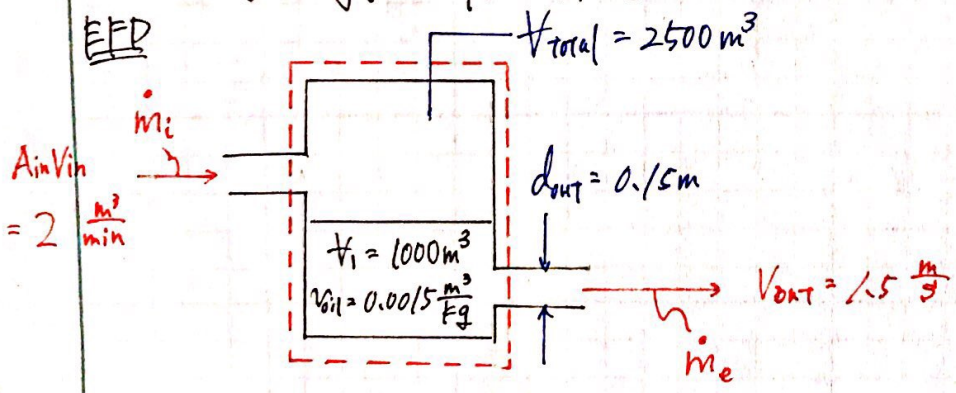
FIND

(a) $m_{oil} \equiv$ mass of oil after 24 hrs.
(b) vol of oil in tank @ that time.

ASSUMP
- open system.
- incompressible fluid.
- rigid body. • SSSF
- uniform flow $\Delta PE = \Delta KE = 0$

EQN
$$\frac{dm}{dt}\Big|_{sys} = \Sigma \dot{m}_i - \Sigma \dot{m}_e$$

FBD



SOLN

$$\frac{dm}{dt} = \frac{(A_{in}V_{in})}{v_{oil}} - \frac{\left[\pi \left(\frac{d_{out}}{2}\right)^2 V_{out}\right]}{v_{oil}}$$

$$dm = \left[\frac{\frac{1}{30}\ m^3/s}{0.0015\ m^3/kg} - \frac{\pi (0.075\ m)^2 (1.5\ m/s)}{0.0015\ m^3/kg}\right] dt \cong \left(4.55 \frac{kg}{s}\right) dt$$

$$\int_{m_1}^{m} dm = \int_0^t 4.55\, dt$$

$$m(t) - \frac{\forall_i}{v_{oil}} = 4.55t$$

$$\therefore\ m(t) = 666667 + 4.55t$$

(a)

$$m(24\times60\times60) = 666667 + 4.55\times(24\times60\times60)$$
$$\approx 1059787 \text{ kg}$$

$$\boxed{1.06\times10^{6} \text{ kg}}$$

(b) $V_2 = m(24\times60\times60)\times 0.0015\frac{m^3}{kg}$

$\approx 1589.68 \text{ m}^3$

$$\boxed{1.59\times10^{3} \text{ m}^3}$$