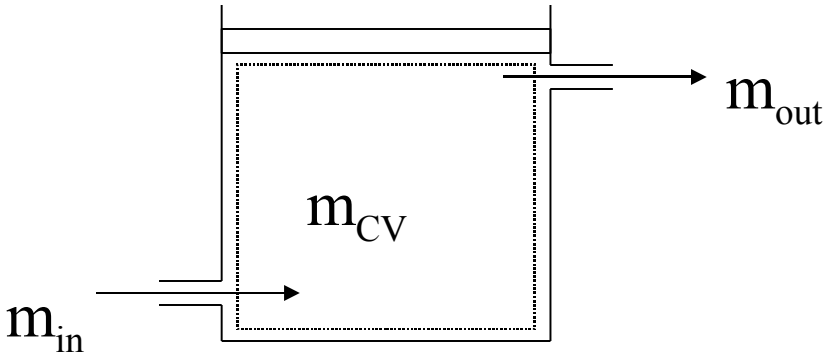
Mass Conservation (Mass Balance)



Mass Balance:

$$\Delta m_{CV} = \sum m_{in} - \sum m_{out}$$

Net change of mass of CV

Total of all mass entering

Total of all mass exiting

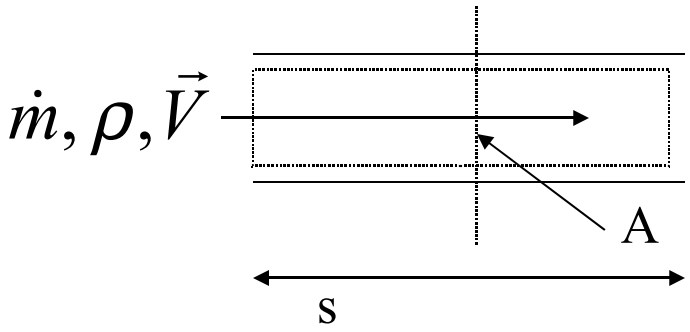
$$\frac{dm_{CV}}{dt} = \sum \frac{dm_{in}}{dt} - \sum \frac{dm_{out}}{dt}$$

Rate of change of mass of CV

Total of all mass flow rates for all inlet channels

Total of all mass flow rates for all exit channels

Mass flow rates and Speed for a channel



$$m = \rho V$$

$$m = \rho s A$$

For flow rates;

$$\frac{dm}{dt} = \rho \frac{ds}{dt} A$$

$$\dot{m} = \rho \vec{V} A$$

but $sA = V$

$$\frac{ds}{dt} A = \dot{V}$$

Thus;

$$\dot{m} = \rho \vec{V} A = \frac{\vec{V} A}{v} = \rho \dot{V} = \frac{\dot{V}}{v}$$