Recap: Conservation Eq.

Eq. 2.2-1: Conservation Eq. for Fixed CV

$$\frac{d}{dt}\int_V b\,dV = -\int_S \vec{F}\cdot\vec{n}\,dS + \int_V B_V\,dV$$

- $\frac{d}{dt}\int_V b\,dV$: rate of change of quantity within CV
- $-\int_S \vec{F}\cdot\vec{n}\,dS$: rate at which quantity enters CV
- $\int_V B_V\,dV$: rate of formation of quantity in CV

Eq. 2.2-4: Conservation Eq. for Moving CV

$$\int_{V(t)} \frac{\partial b}{\partial t}\,dV = -\int_{S(t)} \vec{F}\cdot\vec{n}\,dS + \int_{V(t)} B_V\,dV$$

Eq. 2.2-12: Conservation Eq. for Interior Points

$$\frac{\partial b}{\partial t} = \underbrace{-\vec{\nabla}\cdot\vec{F}}_{\text{flux density}} + B_V \quad ; \quad \vec{\nabla}\cdot\vec{F} = \sum_i \frac{\partial F_i}{\partial x_i}$$

divergence of flux (vector field)

Eq. 2.2-7: Conservation Eq. for Moving CV and Moving Interface

$$\int_{V(t)} \frac{\partial b}{\partial t}\,dV + \underbrace{\int_{S_I(t)} (b_A - b_B)\vec{n}_I\cdot\vec{v}_I\,dS}_{\text{rate of change attributed to the discontinuity of } b \text{ at interface}} = -\int_{S(t)} \vec{n}\cdot\vec{F}\,dS + \int_{V(t)} B_V\,dV$$

S... outer surface boundary
V... total volume including phase A+B

Eq. 2.2-8: Extension of Eq. 2.2-7 with formation at interface

$$\int_{V(t)} \frac{\partial b}{\partial t}\,dV + \int_{S_I(t)} (b_A - b_B)\vec{n}_I\cdot\vec{v}_I\,dS = -\int_{S(t)} \vec{n}\cdot\vec{F}\,dS + \int_{V(t)} B_V\,dV + \int_{S_I(t)} B_S\,dS$$