Soot

- Overview
- Soot in DNS
- Soot modeling.
  - Sectional models.
  - Mono-disperse
  - MOM
    - QMOM
    - Momic.

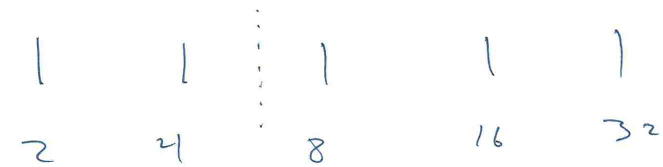
Sectional Models.

Bins

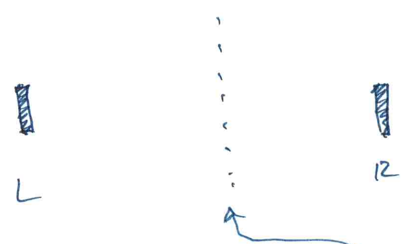
Bin spacing (Geometric).

Particles won't "land" in Given bins Due to Rxn

→ assign so that we conserve # & mass.



2 + 4 = 6



- m, N is given
- $N_R = \dfrac{m - m_L}{m_R - m_L} \cdot N$
- $N_L = N(1 - \ ) = \dfrac{m_R - m}{m_R - m_L} \cdot N$

- $N_R + N_L = N$
- $m_L N_L + m_R N_R = m N$ → So, N, mN is preserved.

Chemistry.

Nucleation.

J_{nuc} (=) $\frac{\#}{m^3 \cdot s}$ at size m_{nuc}.

$$\dot{M}_{0,nuc} = J_{nuc}$$

$$\dot{M}_{1,nuc} = m_{nuc} J_{nuc}$$

Growth, Oxidation

$$\dot{M}_{0,grw} = 0$$

(growth Doesn't change # of particles, only their size)

$$\dot{M}_{1,grw} = A_p \cdot M_0 \cdot k_s$$

$$= \pi d_s^2 \cdot M_0 \cdot k_s$$

k_s (=) $\frac{kg_s}{m^2 \cdot s}$.

$$= \pi \left(\frac{6 M_1}{\pi \rho_s M_0}\right)^{2/3} \cdot M_0 \cdot k_s$$

Coagulation.

$$\dot{M}_{0,coag} = \frac{1}{2} \sum_{j=1}^{i-1} \beta_{j,i-j} n_j n_{i-j} - n_i \sum_{j=1}^{\infty} \beta_{ij} n_j$$

$$= \beta M_0^2 \quad \text{for 1 size.}$$

$$\beta_{ij} = K_f \left(\frac{1}{m_i} + \frac{1}{m_j}\right)^{1/2} \left(m_i^{1/3} + m_j^{1/3}\right)^2 = K_f m^{1/6} = K_f \frac{M_1^{1/6}}{M_0^{1/6}}$$

$$\dot{M}_{0,coag,f} = K_f \cdot 4\sqrt{2}\, M_1^{1/6} M_0^{11/6}$$

$$\dot{M}_{1,coag,f} = 0$$

since coag Doesn't change mass.

Monodisperse.

- Sectional model with 1 bin
- or, MoM with a PDF: $n(m) = \delta(m - \bar{m})$

$$\left.\begin{aligned} M_0 &= N \\ M_1 &= \rho Y_s \end{aligned}\right\} \text{ transport these}$$

$$\rightarrow \bar{m} = \frac{\rho Y_s}{N} = \rho_s \cdot V_s = \rho_s \cdot \frac{\pi}{6} d_s^3 \longrightarrow d_s = \left(\frac{6\bar{m}}{\pi \rho_s}\right)^{1/3}$$

$$d_s = \left(\frac{6 \rho Y_s}{N \cdot \pi \cdot \rho_s}\right)^{1/3}$$

$\bar{m}$ varies w/ time & position