CALCULATIONS FOR TWO-STATION METHOD

A = amount settled in array. Number of particles, d'less.

$\left[\frac{L\,L^3}{TL\,L^3}\right.$

$$\frac{dA}{dt} = \frac{C'V_s}{h}(1-Er')\,\phi\,\forall_A$$

Primes denote calculations specific to array

$$\frac{dA}{dt} = \frac{C'V_s}{h}(1-E_r')\,\phi_0\, e^{-kt}\,\forall_A$$

k is measured from whole-experiment removal rate.

Let $k' = \phi_0 \frac{C'V_s}{h}(1-E_r')\forall_A$ $\quad \left[\frac{1}{L^3}\,\frac{L}{TL}\,L^3\right] = \left[\frac{1}{T}\right]$

$$\frac{dA}{dt} = k'e^{-kt}$$

$u = -kt \quad du = -k\,dt$

$$A = \int_0^T k'e^{-kt}\,dt = -\frac{k'}{k}e^{-kt}\Big|_0^T = -\frac{k'}{k}e^{-kT} + \frac{k'}{k} = \frac{k'}{k}\left(1-e^{-kT}\right)$$

$$\boxed{k' = \frac{kA}{(1-e^{-kT})}} \quad \left[\frac{1}{T}\right]$$

T = total time of experiment

At any given sampling time,

$$\left(\frac{d\phi}{dt}\right)_{settling} = \frac{-k'\,\bar{\bar{\phi}}}{\phi_0\,\forall_A},$$

where $\bar{\bar{\phi}}$ is the number concentration averaged over 2 stations.

Across the sample volume —

A_c = amount removed due to capture $\left(\frac{\#\text{particles}}{\text{Volume}}\right)$ $\quad u$ = velocity

L = length (streamwise) of sample array $\quad \forall_A$ = volume of array

$$\boxed{A_c = \phi_{upstream} - \frac{k'\phi_{upstream}}{\forall_A\,\phi_0}\,\frac{L}{u} - \phi_{downstream}} \quad \left[\frac{\#}{L^3}\right]$$

$$\boxed{\eta\,\bar{\bar{\phi}}\,L\,d_c\,I_c^* = A_c}$$

$\left[\frac{L}{L^3}\,\frac{L\,L}{L^3}\right]$

* Based on volume of array (l_{array} = test section)

TWO-STATION METHOD, IN TERMS OF BULK MASS CONC.

A_m = Amount settled by mass

$$k' = \frac{kA}{(1-e^{-kT})} \qquad A_m = \frac{4}{3} A \rho_b \pi \left(\frac{d}{2}\right)^3 = \frac{1}{6} A \rho_b \pi d^3$$

d = mass-weighted mean sediment diameter (different from d_c = Collector/stem diameter)

$$\boxed{k' = \frac{6kA_m}{\rho_b \pi d^3 (1-e^{-kT})}}$$

C = mass concentration

$\bar{\bar{C}}$ = concentration averaged @ two stations.

C_c = concentration removed due to capture

C_0 = mass concentration @ time 0.

$$\boxed{C_c = C_{upstream} - \frac{k' C_{upstream}}{\forall_A C_0} \frac{L}{u} - C_{downstream}}$$

$$\boxed{C_c = \eta \bar{\bar{C}} L d_c I_c^*}$$

* Based on volume of array

HOW TO CALCULATE d FROM LISST DATA, ASSUMING NON-FLOCCULATED PARTICLES:

Mass of a particle = $\rho_b \cdot \frac{1}{6} \pi D^3$

$$d = \frac{\sum_i^n C_{v_i} \rho_b d_i}{\sum_i^n C_{v_i} \rho_b}$$

D = size class-specific diameter

C_{v_i} = volumetric concentration $\left(\frac{\text{vol sed}}{\text{vol sample}}\right)$

i = size class

n = total # size classes

SINGLE-STATION METHOD

$$\frac{d\bar{C}}{dt} = -\left[\underbrace{\frac{C v_s}{h}}_{\text{Get this from no-dowel experiments}} (1-\varepsilon_r) + \eta' u d_c I_c\right] \bar{C} = -k\bar{C}$$

* What is the particles' density?
* Are particles flocculated?
  → Fix ultrasonic processor
* Try single-station method, broken down by size class

- Correction factor for settling based on diff b/t settling amount inside vs outside array?