

Particle settling in a one-dimensional water body

December 31, 2016


In this example we create a simple model of particles settling in a one dimensional water column. Similar to the previous example, three particles classes will be considered. But in this example, their settling velocities will be different. We will use an array of storage block to create water column. The water column is assumed to have a height of 1.5m which is discretized into 10 equally sized layers, each represented by a single storage block. The particles are assumed to be initially uniformly distributed and are allowed to settle under gravity.

1. **Create a new project**
2. **Introducing particle classes:** From the **Project Explorer** click on **Water Quality** and right-click on **Particles** and then select "Add Particles" from the drop-down menu.
3. **Setting particle properties:** Set the following properties for the particle by clicking on the **Particle**:
 - **Name:** *Particle I*
 - **Model:** *Single Phase*
 - **Settling velocity:** *10m/day*

Add two more particle types with the following properties:

- **Name:** *Particle II*
- **Model:** *Single Phase*
- **Settling velocity:** *1m/day*

- **Name:** *Particle III*
- **Model:** *Single Phase*
- **Settling velocity:** *0.1m/day*

4. **Save:** It is now a good time to save the
5. **Create a storage block and set the properties:** Add a storage block by clicking on the storage icon  on the top tool bar. Set the following properties for the storage block:
 - **Bottom Area:** $10m^2$
 - **Initial water depth:** $0.15m$
 - **Depth:** $0.15m$
 - **Saturated moisture content:** 1 (There is no solid media in the storage blocks)
 - **Initial particle concentration:** Click on the ellipsis, "...", in front

of the **Particle Initial Concentration** label in properties windows and enter a concentration of 10 for the three particle classes as is shown in Figure 1.

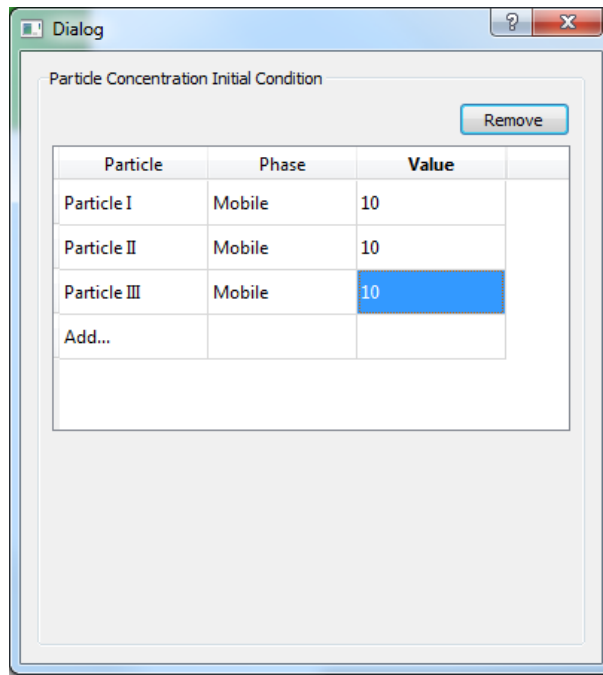



Figure 1: Particle initial concentration

- **Creating an array of storage blocks:** Right-click on the storage block that was just created and choose **Make Array of Blocks** item from the menu. Choose **Vertical 2D array** option and enter 10 in the **Number of rows** box. Click Ok.
- 6. **Turn settling on for all the connectors:** By default the settling option for the connectors is set to **No**. In order to allow settling transport to occur via connectors the **Settling** option should be turned to **Yes**. Select all the connectors one by one and set the **Settling** property to **Yes**.
- 7. **Run the model:** Click on the run bottom on the left hand side tool bar  and wait for the simulation to end.

8. **Checking the results:** Right click on the **Storage (10)** block and choose **Plot Water Quality Results**→**Particle I**→**Mobile** to see the temporal variation of **Particle I** particle class at the bottom of the column. Do the same thing for **Particle II** and **Particle III** particle groups. You can copy and paste all curves into one window to compare the results for each particle class (Figure 2).

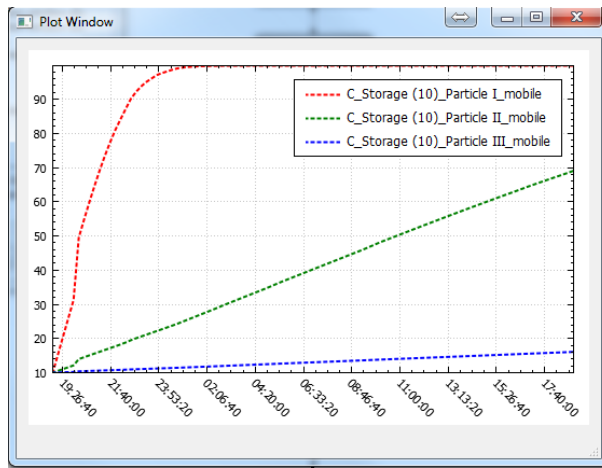


Figure 2: Particle initial concentration

9. **Adding particle diffusion:** Change **Diffusion coefficient** for all the particles to $0.1m^2/day$ by clicking on each particle size from **Project Explorer**→**Water Quality**→**Particles**→.Run the simulation again. The diffusion should prevent all particles to settle to the bottom block.