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Technology That Separates

STORM BULLETIN 4

USE OF SWIRL CONCENTRATORS FOR STORMWATER TREATMENT

- **Swirl concentrators** have been used since 1950 for treatment of combined sewer overflows. The basic innovation back then was to orient the inflow pipe tangentially to the circular treatment chamber. This produces a swirl action with a higher swirl velocity adjacent to the wall of the chamber. Thus the velocity gradient causes the settleable sediment in the water to migrate and concentrate in the low velocity area in the middle of the chamber floor. A small flow of sediment-laden water is continually drained off through a pipe connected to the floor of the chamber.

- **EPA programs** have assesses swirl chamber efficiencies. EPA–670/2-74-026 provides results from a 1974 program that evaluated hydraulics and removal efficiency associated with different internal weir configurations using a 3-ft diameter swirl chamber. EPA-600/2-78-122 provides results from a 1978 pilot plant using a 3-ft diameter chamber. Elaborate mathematical analyses of flow fields and particle settling paths were also included. Agglomeration effects were negligible. Removal efficiency data was related to the gravity separation parameter WA/Q. The published curve fits the following equation:

  $E = 100P/(1+BP)$, where
  - E = % removal efficiency
  - P = ideal settling parameter = WA/Q
  - $B > 0$ equals $0.80\pm$ for tested configuration
  - W = particle gravity settling rate, ft/sec (gravity acceleration = 32 ft/sec^2)
  - A = chamber water surface area, ft^2
  - Q = flow rate, ft^3/sec
  - S = surface overflow rate, gpm/ft^2
  - $S = 449Q/A$

  Environment 21 laboratory test data for the V2B1 configuration is consistent with the trends obtained from EPA pilot plant tests.

- **Sediment removal due to centrifuge effect** in a swirl concentrator is insignificant. This is because the inlet pipe water velocity does not generate significant centripetal acceleration. A typical case would be an 8-ft diameter swirl concentrator (r = 4 ft) with an inlet pipe flow velocity of 1.5 fps for the water quality event. The resulting centripetal acceleration is:

  $C = V^2/R$, where
  - C = centripetal acceleration, ft/sec^2 = 0.55 ft/sec^2
  - V = velocity of particle = 1.5 ft/sec
  - R = radius of rotation = 4 ft

  Particle removal due to centripetal acceleration of 0.55 ft/sec^2 is only 1/60 the particle removal due to gravity acceleration of 32 ft/sec^2.

- **In a Stormwater swirl concentrator without floor drain** stored sediment be can re-entrained when subjected to swirl velocity in excess of the threshold re-suspension velocity.

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The threshold suspension velocity is 2.5 – 3.0 ft/sec. for sandy sediment. Laboratory model tests are needed to relate inlet pipe flow velocity to swirl velocity and sediment re-entrainment as the sump fills with sediment. In some cases inserts are placed in the sump to create a sediment storage area that is not exposed to high swirl velocity. Duration and values for inlet pipe flow velocity will vary for each site, and consequently sediment storage capacity will be site-specific.