environment21
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Technology That Separates

STORM BULLETIN 5

STORMWATER PRETREATMENT USING GRAVITY SEPARATORS

Sizing based on Total Suspended Solids (TSS) Removal is not appropriate for Stormwater Treatment because stormwater wash-off events are extremely inconsistent and occur at unpredictable intervals. Pollutant composition in storm water is also site-specific and inconsistent. Confusion has resulted from regulatory agency use of “percent Total Settleable Solids (TSS) removal” as a standard for stormwater treatment. A standard for TSS removal should not be misinterpreted as size removal based on predicting per cent TSS removal.

The accepted approach to determine size removal is to provide the capability to meet a defined hydrology and hydraulic scenario. This is the reason for the term “Best Management Practice” (BMP). Professional Engineers should attempt to make realistic predictions of the precise level of treatment that will be obtained.

A typical treatment scenario for detention/filtration systems defines peak flow rate, runoff depth, runoff volume, detention time, pollutant composition, and treatment science. Filter media are sized to ensure adequate removal of the design particle size.

There is no negligible detention in a gravity separator. Agency-approved sizing methodology is usually not available, so a reasonable alternative is to base the treatment scenario on simulated rainfall tests for scouring sediment from pavement and 80% removal of sandy sediment. EPA scour data suggests using a rainfall intensity of 0.80”/hr (equivalent to 0.70 ft^3/sec/impervious acre). A representative settling velocity for sandy sediment (1.0-1.5 cm/sec) and typical weir crest depth suggests a residence time of 10-15 seconds for an “ideal” chamber treating a flow of 0.70 ft^3/sec/impervious acre. Turbulent chambers will require longer residence time.

Laboratory models are used to develop detailed data for sediment particle removal efficiency and head losses at different flow rates, and for sediment re-suspension and carryover at high flow rate events. Laboratory model data should be consistent with sedimentation science and head loss equations. Scale-up should be consistent with the treatment scenario for the water quality event.

Separator configuration should be evaluated with respect to water surface area available for sediment settling and flow patterns that reduce turbulence and distribute flow evenly throughout the sedimentation system. A larger water surface area can provide improved residence time and sediment removal and will also improve flow distribution with reduced turbulence. A favorable outlet configuration for sedimentation is an overflow weir.

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Re-entrainment of accumulated sediment is usually not a significant concern if timely maintenance is provided. Design for long term sediment storage requires a reasonable assumption for the annual mass of sediment wash-off. Laboratory models are needed to evaluate the sediment pile entrainment caused by turbulence that is adjacent to the pile of accumulated sediment. Proper dissipation of the inlet flow stirring power is often used to prevent excessive entrainment. Another approach is to bypass the treatment chamber when inlet flow stirring power becomes excessive, however local regulators should be contacted to establish the minimum rainfall intensity at which bypassing will be allowed.

Removal of entrained oil droplets by flotation occurs but there is no standard for the treatment scenario. But residence time can be used to provide an estimate of the size of oil droplets that can be removed. Installed chambers with less than a minute of residence time often contain floating oil. This would imply that some of the oil in pavement wash-off consists of droplets 500-1000 µ (1/32 inch) in size.