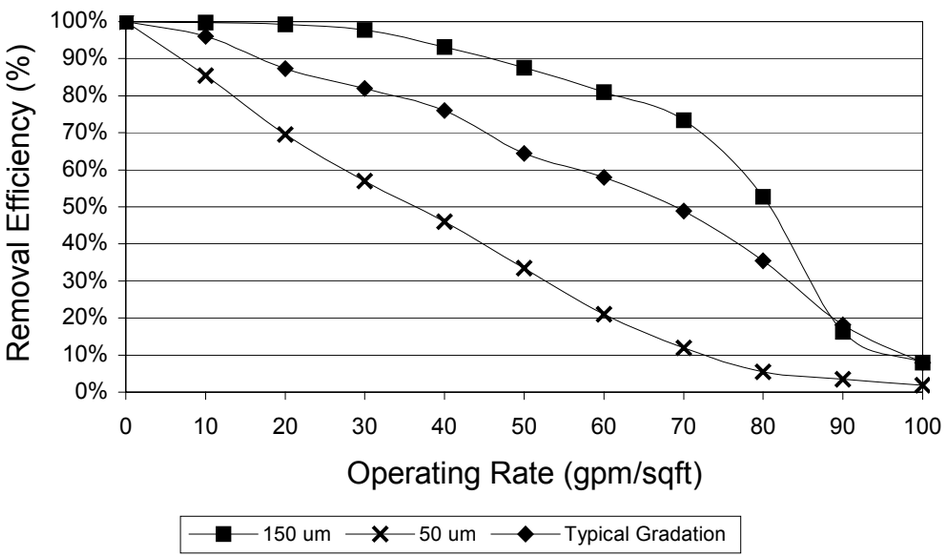
TECHNICAL BULLETIN NO. 1

Vortechs® Stormwater Treatment System Performance: Removal Efficiencies for Selected Particle Gradations



These performance curves are based on laboratory tests using a full scale Vortechs® Model 2000. The testing protocol used is summarized on the following page. The 150-micron curve demonstrates the results of tests using particles that passed through a 100-mesh sieve and were retained on a 150-mesh sieve. The 50-micron curve is based on tests of particles passing through a 200-mesh sieve and retained on a 400-mesh sieve. A gradation with an average particle size (d_{50}) of 80 microns, containing particles ranging from 38–500 microns in diameter was used to represent typical stormwater solids.

As the graph clearly shows, Vortechs® Systems maintain positive total suspended solids (TSS) removal efficiencies over the full range of operating rates. This allows the System to effectively treat all runoff from large, infrequent design storms as well as runoff from more frequent low-intensity storms. Vortechs® Systems are designed to treat peak flows from 1.6 cfs up to 25 cfs without bypassing. However, external bypasses can be configured to convey peak flows around the System if treatment capacity is exceeded. The Vortechs® System can be configured to direct low flows from the last chamber of the System to polishing treatment when more stringent water quality standards are imposed. In all configurations, high removal efficiencies are achieved during the lower intensity storms, which constitute the majority of annual rainfall volume.

Vortechs® Systems are sized based on flow rate rather than volume, which allows effective treatment of runoff from the entire storm, including high-intensity flows. This design basis addresses the deficiencies of conventional volume-based BMPs, which capture the first half or whole inch of runoff but may bypass prematurely, allow resuspension of previously captured pollutants, and/or wash out at higher flow rates. For more information about the Vortechnics sizing methodology, please refer to Technical Bulletin No. 3.

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Laboratory Quality Control Brief

The following protocol contains standard operating procedures for Total Suspended Solids (TSS) testing in the Vortechnics laboratory. These guidelines were followed in the creation of the preceding performance curves.

Sediment Source

Sediment samples are sorted according to ASTM Special Technical Publication 477 B, which establishes sieve analysis procedures. U.S. Standard Sieves in a Gilson SS-15 sieve shaker are used to separate particles to the various fractions required for our tests. To ensure uniformity of those fractions, an unsorted sample is sieved until less than 1% of that sample passes through the sieve in one minute. All sediment recovered after a test is dried and re-sieved according to this procedure before reuse. Unless otherwise specified, mineral sediments with a density of 2.65g/cm^3 are used.

Flow Calibration and Regulation

Flow calibration is accomplished by calculating the head at the baffle wall required to produce a given flow rate through the orifice and the weir in the flow control wall. Flow is regulated by a 12-inch butterfly valve located upstream of the Vortechs® System. In order to simulate field conditions, flow rates are changed gradually to avoid flow surges through the System. The test flow rate is set by observing the head in the Vortechs® System and adjusting the regulating valve accordingly. Before any samples are collected, the valve must remain fixed for a period equal to half of the detention time so that flow equalizes throughout the System. Each test group is planned so that flow rates increase incrementally in consecutive tests.

Sediment Metering

All sediment is injected into the inlet pipe via a ¼-inch flexible hose using a Watson Marlow 5058 peristaltic metering pump. For TSS tests, a known gradation of sediment and water are combined in approximately a 1/2 pound/gallon ratio in a holding tank and homogenized by a mixing propeller powered by a 1/3 horsepower motor. The mixer is activated at least 5 minutes before testing commences and runs continuously throughout the test. The metering pump is activated for a period of time equal to at least half of the detention time of the Vortechs® System at the test flow rate, before the first influent sample is taken. The pump must run continuously until the last effluent sample is taken.

Sample Collection

All influent samples are taken from a 6-inch gate valve located upstream of the Vortechs® System. A collection bin housing a 500 mL sample container is positioned beneath the valve. Five seconds before each sample is taken, the valve is quickly opened and closed to eliminate any interference from particles that have settled in the low velocity region of the gate. This eliminates artificially high influent readings. The time that the influent sample was taken is recorded and the corresponding effluent sample is collected after a period of time equal to the detention time. Effluent grab samples are collected at the discharge pipe, by sweeping the mouth of a 500 mL bottle through the exiting flow stream. Samples are annotated and refrigerated until they can be analyzed.

Sample Analysis

TSS samples are analyzed in the Vortechnics laboratory, following EPA method 160.2, a method for the measurement of total non-filterable solids. Volume measurements are accurate to 0.6 mL using a 500 mL graduated cylinder. An Acculab V-1 analytical balance with a readability of 0.001 g is used to measure mass.