

# VMS Vault Maintenance System

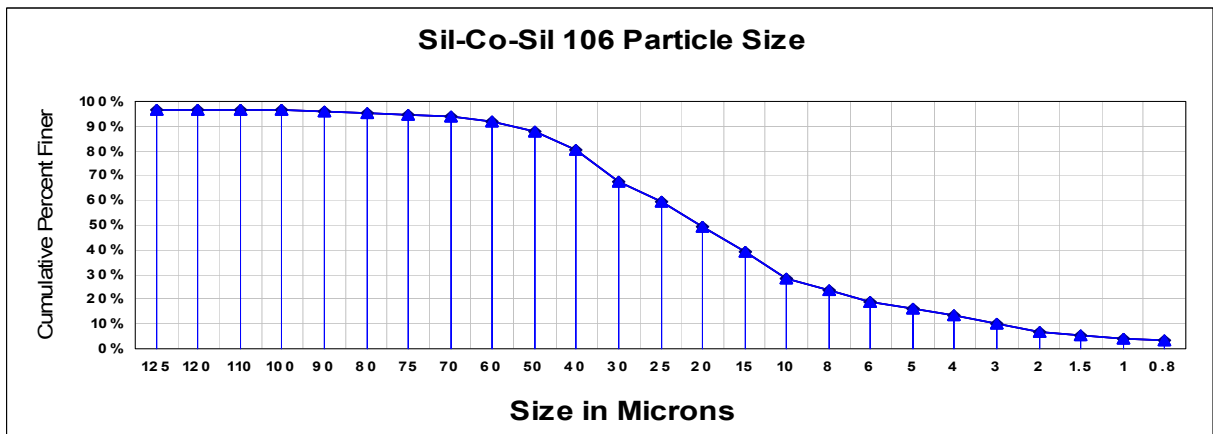
## *Sediment Removal Efficiency Test and Oil Removal Efficiency Test*

A full scale test was performed to determine the sediment removal efficiency of the Vault Maintenance System (VMS). The VMS was designed to allow the direct discharge to the environment of waters accumulated in underground vaults while complying with discharge guidelines set forth by regulatory agencies.



The standard reference sediment used in this performance test was **Sil-Co-Sil 106**, obtained from US Silica. This silica powder is the **benchmark to test BMPs** for efficiency of sediment removal. The regulatory goal for sediment removal efficiency using Sil-Co-Sil 106 is 80%. Anything above this value is considered excellent.

**Sil-Co-Sil 106** has 27 percent of its particle sizes between 150-45 microns and 73 percent below 45 microns, with 12 percent 1.5 micron and below, of which 3 percent are sub-micron.



The test was conducted using two 360 gallon open top storage bins. One used as a sediment holding vault, the other as a receiving vessel. A channel connecting the two bins held the VMS. The VMS was connected to a two-inch hose with an in-line turbine flow meter and pressure gauge. The assembly was connected to a 110 gpm submersible centrifugal pump.

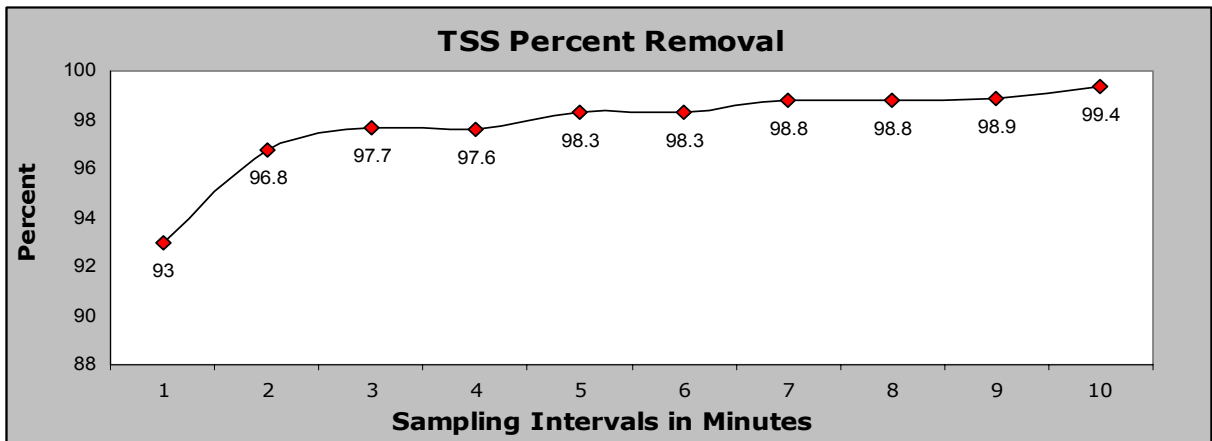
The holding tank was filled to capacity and Sil-Co-Sil 106 was added to the water. The circulation valve was opened and the water was re-circulated until the Sil-Co-Sil 106 was consistently mixed, at which time the initial sample was taken. Samples were taken from the outfall channel after filtering thru the sock at 1 minute intervals.

A final sample was taken from the receiving tank representing a composite of the total filtrate from the sock.

The samples were analyzed for Total Suspended Solids (TSS) using EPA Method 160.2.

The results are as follows:

TSS EPA Method 160.2				
Initial Sil-Co-Sil 106 with TSS of 2700 Mg/L unfiltered				
Sample ID	Time Interval	Flow GPM	TSS Mg/L	Percent Removal
#1	1 min	73	222	93
#2	2 min	11	87	96.8
#3	3 min	9	72	97.7
#4	4 min	7	66	97.6
#5	5 min	5	49	98.3
#6	6 min	4	46	98.3
#7	7 min	3	34	98.8
#8	8 min	3	35	98.8
#9	9 min	3	33	98.9
#10	10 min	2	19	99.4



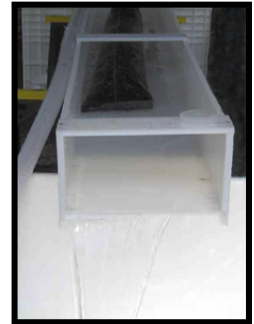
**Conclusion:** The filtration efficiency increased with time. This was due to sediments being deposited within the VMS, filling in the fabric’s micron pores, allowing enhanced removal of sub micron particles. Flow rates will vary dependent on the sediment’s micron ratings. Sil-Co-Sil 106 is an extremely fine powder, unlike normal sediments. Natural sediments such as soil or cinder clay allow much greater flow rates and loading as the larger particle sizes keep the fabric’s micron pores from sealing off. The overall sediment removal rate from the total of the filtrate was 98.3 percent, which far exceeds the 80 percent standards for rating BMP devices.

# Oil Removal Efficiency Test

The **Vault Maintenance System (VMS)** consisting of patented and proprietary technologies, configured as a multi-staged filtration unit, was designed to remove hydrocarbons and sediments from the water.



**One half quart of motor oil and cinder clay** was added to the holding tank and re-circulated with the centrifugal pump to maintain the oil and clay in suspension.



The **initial sample** was taken from the sampling valve located just before the VMS, and the subsequent **samples were taken from the outfall channel** after filtering thru the VMS. The flow rate during this test maintained a flow rate above 30 GPM with a pressure of 3.0 PSI. The VMS retained over 5 pounds of sediment during the test.

The samples were analyzed for total Oil & Grease using EPA Method 1664.

The results are as follows:

Oil & Grease EPA Method 1664				
Sample ID	Sample Volume ml	Wt Residue	Oil & Grease Mg/L	Percent Removal
Initial Sample	500	1.136	2270 Mg/L	Unfiltered
#1 Start - 5 min	500	>0.001	ND	100
#2 Mid - 7 min	500	>0.001	ND	100
#3 End - 10 min	450	>0.001	ND	100



**Conclusion:** The VMS had the ability to remove the 2270 Mg/L oil in the sediment-laden water to non-detectable levels and no oil sheen was visible in the receiving vessel for the duration of the test.

The above testing validates that the **Vault Maintenance System** when used as directed, is a valuable best management practice — **BMP** — tool.