Article 119

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Performance of Oil-Grit Separators in Removing Pollutants at Small Sites

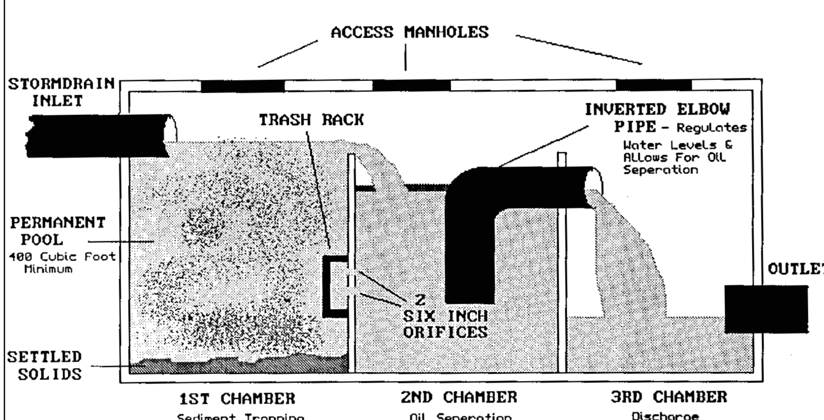
Despite our best hopes, some dogs just won't hunt. The same is true with the performance of some stormwater practices. A case in point is the standard oil-grit separator, or OGS (Figure 1). These underground structures consist of three chambers, two of which are wet. An inverted elbow pipe drains the second chamber, under the theory that oil and grease will initially float on the surface, but then adhere to suspended particles, which eventually settle to the bottom of the chamber. The first chamber is designed to trap grit, coarse sediments, trash and debris. The contents of both chambers are removed on a quarterly basis as part of the normal maintenance regime.

Oil-grit separators are popular because they are relatively cheap and can be easily installed at many small sites without sacrificing land. Unlike other stormwater practices that are sized to handle a half inch or more of runoff, the total design storage volume within an OGS is about a tenth of an inch. While it has always been acknowledged that such a small treatment volume limits overall pollutant removal, it was reasoned that the basic design should at least be capable of trapping oil, grit or trash generated at parking lots. Consequently, OGS systems have enjoyed wide application at gas stations, fast food joints and other small, but highly impervious development sites. Over the last decade, several hundred OGS have been installed across the Washington D.C. metropolitan area, and they are still routinely included in many stormwater practice manuals in other parts of the country.

Our understanding about the pollutant removal capability of the OGS has been fundamentally changed as a result of a five-year research study by Dave Shepp and his colleagues at the Metropolitan Washington Council of Governments. In the first phase of the study, Shepp discovered four indirect lines of evidence that suggest OGS pollutant removal performance is extremely limited. First, dye tests revealed that OGS had very short residence times during small storms (often less than 30 minutes). Second, an average of only two inches of sediment accumulation in the two pool chambers was measured in 109 installed OGSs, and deposition did not increase no matter how long an OGS had been in service. Third, the initial finding that OGS systems did not retain sediments was confirmed by monitoring the accumulation of sediment in 17 OGSs on a monthly basis. Shepp found sediment depths frequently changed within the OGS, but seldom accumulated over time. A characteristic profile is shown in Figure 2. Lastly, none of the 109 OGS surveyed in field were found to have had sediment clean-outs specified in their maintenance agreements.

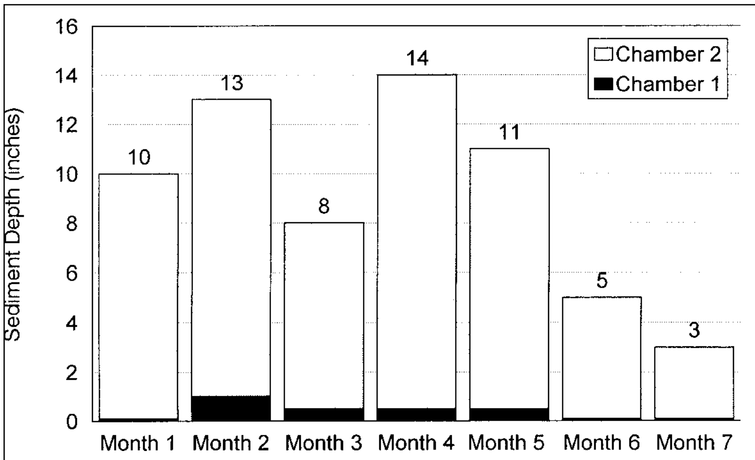
In the second phase of the study, the pollutant removal performance of a typical OGS was directly measured in the field. The OGS served a one-acre parking lot of a fast food joint. Prior small site monitoring revealed that fast food parking lots generated above normal concentrations of many urban pollutants, such as hydrocarbons, nutrients, metals and carbon—giving new meaning to the term "a greasy spoon" (see Table 1). Thirteen storm samples were collected at the OGS site, using innovative sampling techniques within the confined spaces of the practice. Rainfall during the monitored storms ranged from 0.2 to 1.96 inches in depth (median 0.61 inches, mean duration three hours). Inflow and outflow event mean concentrations (EMCs) were then compared to examine pollutant removal performance for 18 different water quality parameters.

By almost any measure of performance, the oil-grit separator did not show any capability to remove pollutants in storm runoff (Table 2). Net negative removal efficiency was computed for suspended sediment, total organic carbon, hydrocarbons, total phosphorus, organic nitrogen, and extractable and soluble copper. Negative removal efficiencies were observed in over half the



An oil grit separator is an underground structure used to treat stormwater runoff at very small sites. Recent research demonstrates that this practice has little or no pollutant removal capability.

Figure 1: Schematic of Standard Design of Oil-Grit Separator



Poor sediment retention in an OGS is evident in the month-by-month fluctuation in the two main chambers.

Figure 2: Change in Sediment Depth in an Oil-Grit Separator over a Seven-Month Period (Shepp, 1995)

Table 1: Mean of Storm Runoff EMCs for Takoma Park McDonald's Site (Shepp, 1995; Rabinal and Grizzard, 1995)

Stormwater Pollutant	Median Concentration (mg/l)	Mean Concentration (mg/l)
Total Suspended Solids	20.8	42.9
Total Hydrocarbons	7.0	12.4
Total Organic Carbon	18.6	41.3
Total Phosphorus	0.27	0.49
Ortho phosphorus	0.06	0.101
Total Nitrogen	2.22	2.85
Total Zinc	0.144	0.452
Total Copper	0.010	0.021

storms sampled for these parameters (with the exception of suspended sediment and soluble copper). Positive removal rates were calculated for a few parameters, most notably ortho-phosphorus, nitrate, lead and zinc, but the improvement in pollutant concentration was often very minor. This is evident when the mean outflow concentrations from the OGS are considered (last column of Table 2). The concentration of nearly every water quality parameter remains well above levels frequently encountered in "untreated" urban stormwater runoff. OGS also appear to have little capability to retain litter and debris, as less than 30% of the OGS surveyed in the project had accumulated moderate to high levels of trash and debris.

Taken together, the four different performance indicators suggest that the OGS tested was a modest exporter of several key storm water pollutants. At first glance, this finding seems physically impossible, as it is hard to imagine an internal source of pollutants within an underground concrete vault. The likely answer to this mystery involves parking lot maintenance. It seemed to be a daily practice for employees to wash down the parking lot to provide a cleaner atmosphere for customers. It is speculated the wash water may have been the source of the missing pollutants.

Based on his research, Shepp recommends that the use of standard OGS design be abandoned at small sites. Performance monitoring has shown sand filters to be a much more effective practice. He contends that no practice is likely to be effective on small sites unless it is designed to capture 0.25 to 0.5 inches of runoff at a bare minimum. Further, such practices should be designed to be off-line from the major storm water conveyance systems. Otherwise, Shepp maintains that the flows from pipes designed to carry the ten-year peak discharge rate will "hydraulically doom" any small site practice.

This contention is supported by recent performance monitoring of a modified oil-grit separator in Austin, Texas. Tom Curran sampled 17 storm events at an OGS that served a parking lot (LCRA, 1996). The modified two chamber tank contained sorbent pillows to adsorb oils, and was regularly maintained. Designed to pretreat runoff for a peat sand filter, the off-line OGS appeared to perform the pretreatment function reasonably well. Curran found that it was able to remove about 10 to 40% of stormwater pollutants that entered it (see Table 3).

Much higher removal rates were recently reported for three full-size, off-line underground structures known as multiple chamber treatment trains or MCTTs (see article 111). The design of these advanced structures stand in sharp contrast to the typical OGS. For example, the MCTT has up to ten times more storage volume than standard OGS design and is equipped with numerous other internal design features to promote greater removal.

In summary, the evidence overwhelmingly suggests that oil-grit separators are a very poor stormwater practice and should probably be dropped as a treatment option, unless these systems are designed off-line and with the same treatment volume of other stormwater practices.

—TRS

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Table 2: Summary of Performance Data at McDonald's Oil-Grit Separator in Seat Pleasant, MD (Shepp, 1995)

Stormwater Pollutant	Mean Individual Storm Efficiency	Mean Group Storm Efficiency	Majority of Storms Show Export	Mean OGS Outflow Concentration (mg/l)
Total Suspended Solids	(-21.2)	(-7.5)	NO	48.3
Total Organic Carbon	(-73.4)	(-36%)	YES	17.5
Total Hydrocarbons	(-35.4)	(-29)	YES	4.82
Total Phosphorus	(-75.5)	(-41)	YES	0.41
Ortho-phosphorus	7.6	40	NO	0.05
Total Kjeldahl Nitrogen	(-19.8)	(-44)	YES	1.74
Nitrate-Nitrogen [b]	34.7	47	NO	0.20
Ammonia-Nitrogen	(-44.2)	20	NO	0.11
Total Cadmium	(0)	(0)	NO	0.0011
Total Chromium	(-21.8)	(-19)	YES	0.0065
Total Copper	(-40.7)	(-11)	YES	0.013
Soluble Copper	(-58.5)	3.5	NO	0.004
Total Mercury	35.6	20	NO	0.001
Total Lead	7	8.2	NO	0.008
Total Zinc	3.3	17.0	NO	0.174
Soluble Zinc	1.6	21.1	NO	0.071

[a] Calculated as the mean of all inflow EMCs compared to the mean of all outflow concentrations.

[b] Includes nitrite.

Table 3. Pollutant Removal Performance of an Off-Line Oil-Grit Separator in Austin, TX (Curran, 1996)

Pollutant	Removal Efficiency (EMC)%
Total Suspended Solids	41
Total Organic Carbon	22
Total Phosphorus	37
Ortho-phosphorus	(-14)
Total nitrogen	15
TKN	21
Nitrate	14
Lead	10
Zinc	39

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