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Comparing Performance of Oil-Grit Separators and Stormwater Filtration Technology for Meeting Enhanced Water Quality Objectives

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Overview

- Basic Stormwater Quality Objectives
- Basic Treatment Approach with Oil-Grit Separators (OGS)
- Advantages and Limitations of OGS Devices
- Enhanced Stormwater Quality Objectives
- Enhanced Treatment Approach with Filtration Technologies
- Advantages and Limitations of Filter Devices
- Comparative Performance of OGS and Filter Devices
- Where Are Stormwater Treatment Requirements Headed?

Basic Stormwater Quality Objectives

- 80% removal of Total Suspended Solids (TSS)

- TSS is the surrogate for pollutants of concern:
  - Turbidity
  - Particulate-bound metals (copper, zinc, cadmium, lead)
  - Particulate-bound nutrients (phosphorus and nitrogen)
  - Particulate-bound hydrocarbons
  - Particulate-bound bacteria

- Oil capture and retention

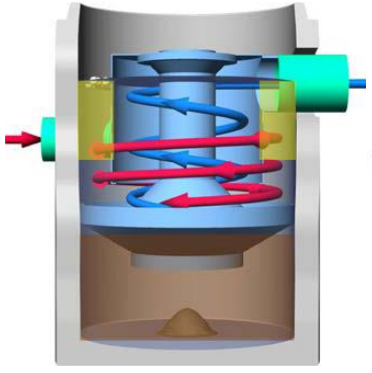
Basic Treatment Approach with Oil-Grit Separators

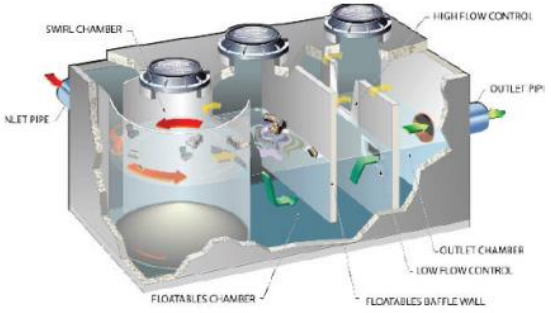
- OGS devices typically are vertical oriented cylinders (manholes) or multi-chambered rectangular vaults
- Contain a permanent pool of water in the treatment chamber
- May utilize special components to direct the flow path, attenuate water velocity. and enhance settling of particulates and capture of oil
- May utilize internal bypass features to prevent or minimize resuspension and washout of captured pollutants
- May utilize baffles or screens to capture and isolate trash and debris

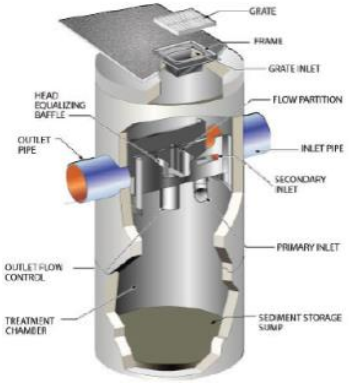
Primary Treatment Mechanisms of OGS

- **Gravity separation**
  - Settling of high specific gravity particulates
  - Floatation of low specific gravity oil and trash / debris

- **Spill capture**
  - Capture and retention of oil and fuel

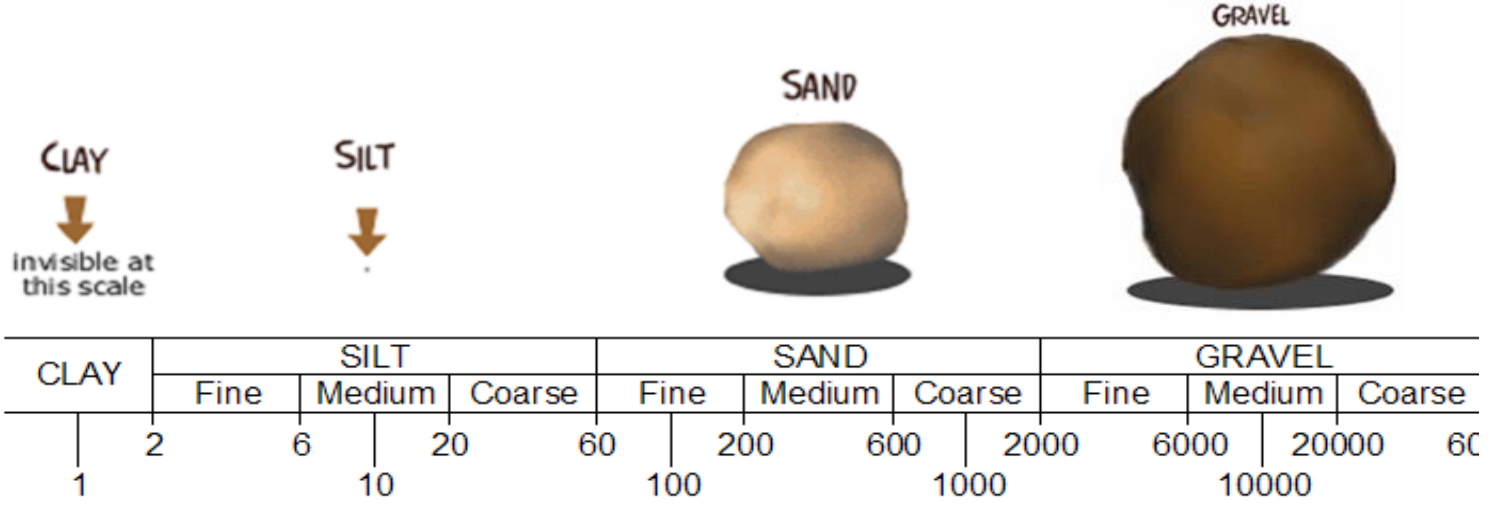






Advantages of OGS

- Good capture of coarse (> 75 micron) high specific gravity particulates (sand, degraded asphalt) at relatively high surface loading rates (flow rate / surface area)
- Good capture of oil (varies by OGS type)
- Scour prevention with internal bypass (varies by OGS type)



Advantages of OGS

- Maintenance interval can be extended by proper sizing to add sediment capacity
- **Very effective pretreatment for ponds, LID / GI, and filters**
  - Extend maintenance interval of the downstream BMP
  - **Reduce total maintenance costs**
- Relatively low cost of maintenance by vactor truck

Limitations of OGS

- TSS and floatables capture is sensitive to flow rate and detention time
- Relatively low capture of fine (< 50 micron) particulates, except at low surface loading rates and during inter-event settling periods
- Relatively low and variable capture of particulate-bound pollutants (metals, nutrients, hydrocarbons, bacteria) that are concentrated on fine particle fractions
- Poor capture of neutrally buoyant particulates (specific gravity similar to that of water, typically organic particulates)

Limitations of OGS

- Relatively low and variable reduction in turbidity
- Generally do not achieve 80% annual TSS removal unless **properly sized** to account for:
  - Site hydrology
  - Site's actual TSS particle size distribution
  - Annual sediment load
  - **Must use surface area-based scaling**
- Some OGS types are prone to **scour** during intense storm events, especially when undersized

Enhanced Stormwater Quality Objectives

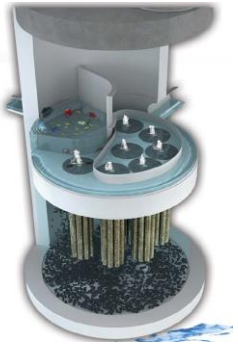
- ≥ 80% removal of Total Suspended Solids (TSS)
- ≥ 40% removal of Total Phosphorus
- ≥ 50% removal of Total Metals
- Optional Turbidity target
- **Sensitive watersheds** often have requirement for removal of some fraction of ***dissolved*** nutrients and metals

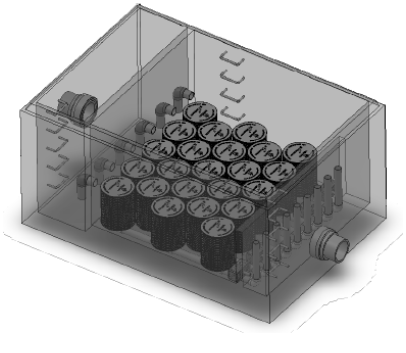
Enhanced Treatment Approach with Filtration Technologies

- OGS treatment mechanism (gravity separation) is insufficient to meet enhanced treatment objectives.
- Filters utilize filtration through a granular or membrane media.
- The **effective pore size** of the granular media bed or membrane establishes the lower limit of particle size fractions that are removed (typically < 20 microns)
- Filter maintenance interval is extended by **OGS pretreatment** and placement of the filter off-line to bypass large storm flows.

Primary Treatment Mechanisms of Filter Devices

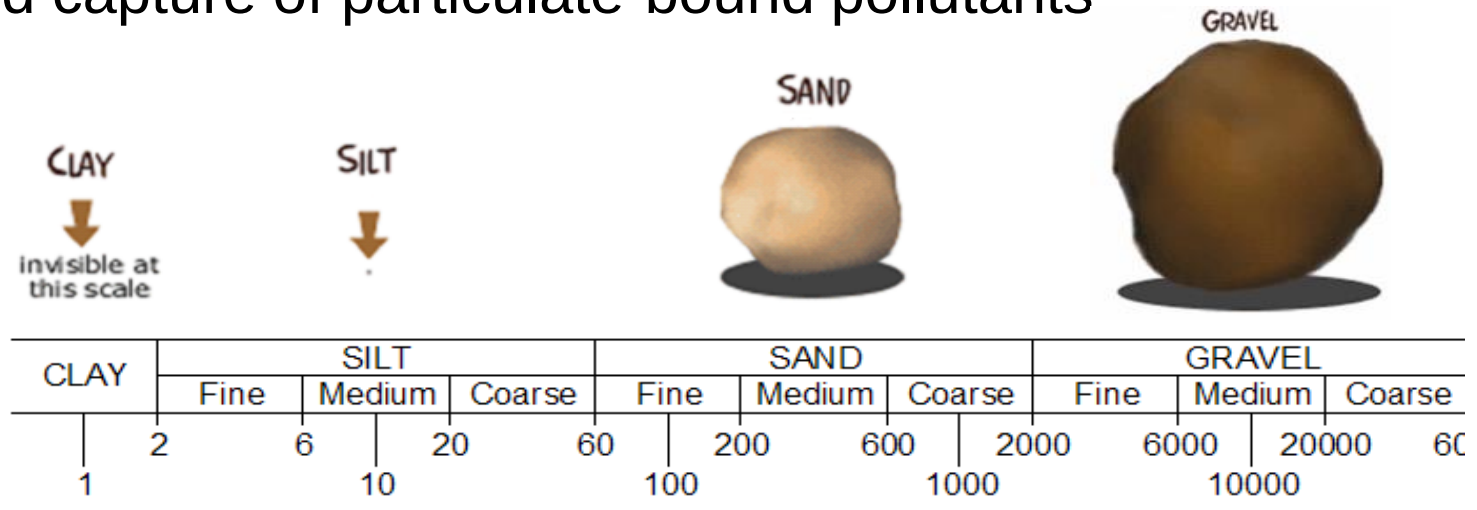
- **Gravity separation** (typical pretreatment)
  - Settling of high specific gravity particulates
  - Floatation of low specific gravity oil and trash / debris
- **Filtration**
  - Physical entrapment of fine particulates on / within the granular or membrane media
- **Adsorption** (polishing)
  - Selective capture of dissolved metals or nutrients on the surfaces of the media





Advantages of Filter Devices

- Consistently high capture of TSS (coarse **and fine** particulates)
- TSS removal is relatively insensitive to flow rate and specific gravity of particulates
- Substantial reduction in turbidity
- Good capture of particulate-bound pollutants



Advantages of Filter Devices

- Good capture of oil, trash, and debris
- Good capture of selected dissolved metals and nutrients (varies by filter and media type) for sensitive watersheds

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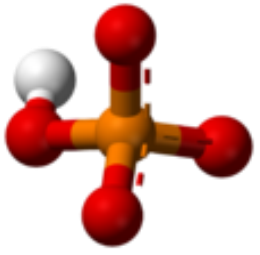


Adsorptive media

- Manufactured membrane filters are very effective pretreatment for extending the service life of bioretention and adsorptive media filters

Limitations of Filter Devices

- Adherence to maintenance schedule is more critical for filter than for OGS due to eventual occlusion (clogging) of the filter media with accumulated sediment
- Maintenance cost is typically higher than OGS due to servicing of media
- Land-based filters (sand filters, bioretention) typically have a much larger footprint (10X or greater) due to low design surface loading rate
- Compost-containing bioretention and green roof media (and other organic or recycled media) may **leach** substantial concentrations of dissolved nutrients and metals

Comparative Testing

OGS Test Unit: Diameter 1200 mm

- University of Florida **Laboratory Testing**
- Ground silica test sediment, specific gravity 2.65
- Particle size distribution (PSD)

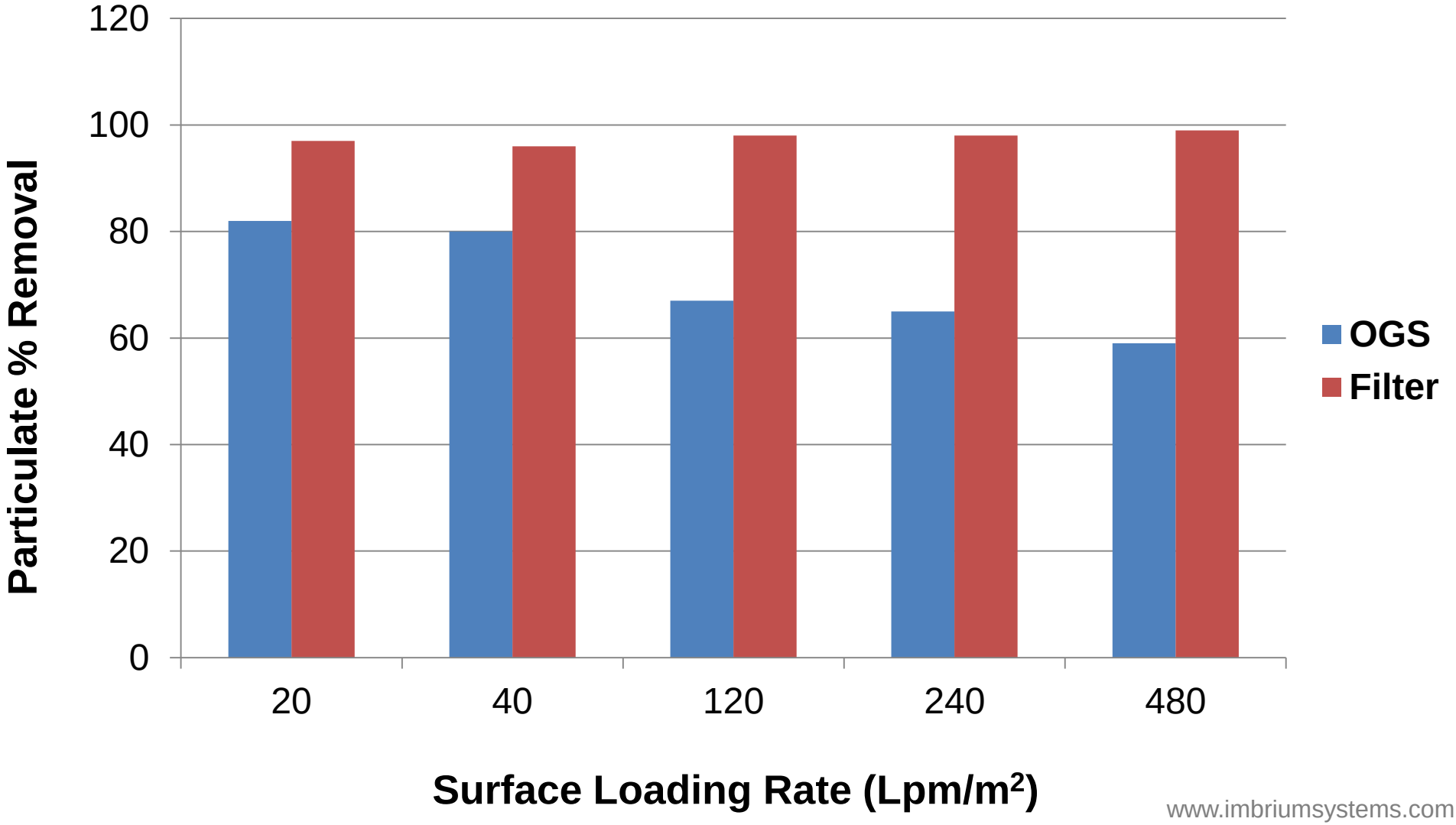
  D90 = 250 microns D50 = 67 microns D20 = 8 microns

Filter Test Unit: Diameter 1200 mm, **3 membrane cartridges**

- University of Florida **Field Testing**, Student Union parking lot
- Particulate loading from site, **50% organics**, specific gravity **< 2.65**
- 12 storms selected from 25 total storms to best match median PSD with OGS test sediment

  D90 = 308 microns D50 = 57 microns D10 = 6 microns
- Surface loading rate is at peak flow rate of selected storm event

Comparative Particulate Removal - OGS vs. Filter



Enhanced Treatment with Filter

In addition to > 90% particulate removal, the Filter provided:

60% Total Phosphorus removal

50% Total Nitrogen removal

> 50% Total Metals removal

85% Turbidity reduction

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Where Are Stormwater Treatment Requirements Headed?

- **OGS** primarily used for **Pretreatment** (50 – 70% TSS removal)
- **Filters** used for **Basic Treatment** (80% TSS removal) and **Enhanced Treatment**
  - Remove high % of Total Metals / Total Nutrients / Turbidity
- Precedent established in various parts of the world.
  - Quebec
  - States of Maryland, New Jersey, New York, Washington
  - New Zealand

Thank You

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