EFCN

**Wastewater Operator Certification Webinar Series**

Date: July 26, 2023

**Topic: Preliminary Treatment**

www.efcnetwork.org

*This program is made possible under a cooperative agreement with US EPA*

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# Introduction

## Putting Preliminary Treatment into Context

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**Typical Influent Pollutant Concentrations**

| Parameter | Concentration | Effluent Goal |
|---|---|---|
| BOD5 | 200 mg/L | < 30 mg/L |
| TSS | 200 mg/L | < 30 mg/L |
| TDS | 800 mg/L | < 1000 mg/L |
| Settleable Solids | 10 mL/L | < 0.1 mg/L |
| pH | 6- 9 | 6- 9 |
| Fecal Coliform | Too numerous to count | < 500 cfu/ 100mL |
| TKN (Ammonia + Organic Nitrogen | 30 mg/L | < 10 mg/L Total Nitrogrn |
| Nitrate/ Nitrate (Inorganic Nitrogen) | < 1.0 mg/L | |
| Phosphorus | 2.0 mg/L | < 1.0 mg/L |
| Fats, Oils, and Grease | Varies greatly | None Visible |
| 30/45 Effluent Rule | | |
| Parameter | 30-day average | 7-day averge |
| BOD5 | 30 mg/L | 45 mg/L |
| TSS | 30 mg/L | 45 mg/L |

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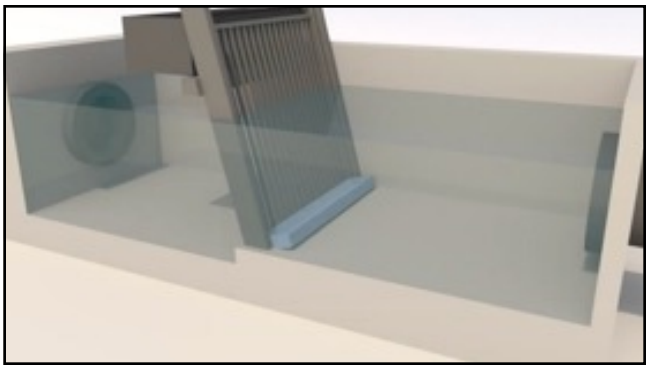

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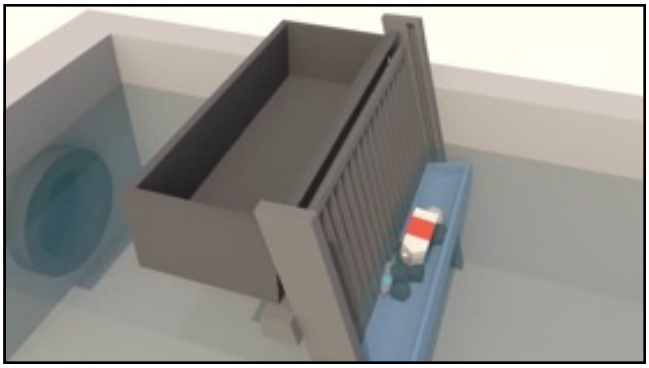

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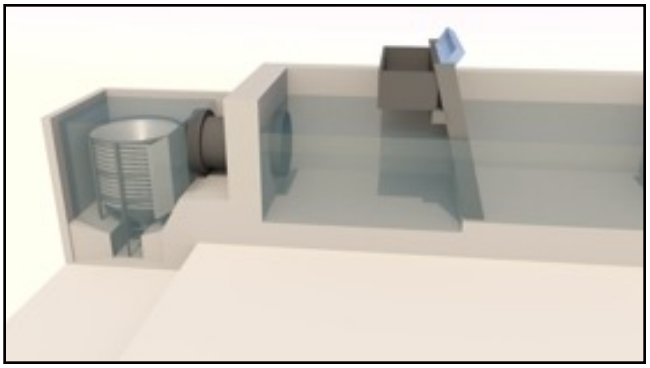

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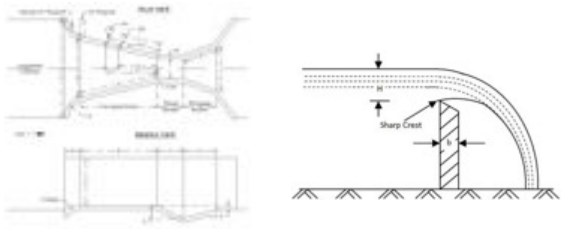
## Flow should be measured

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## May incorporate flow equalization and/or pre-aeration

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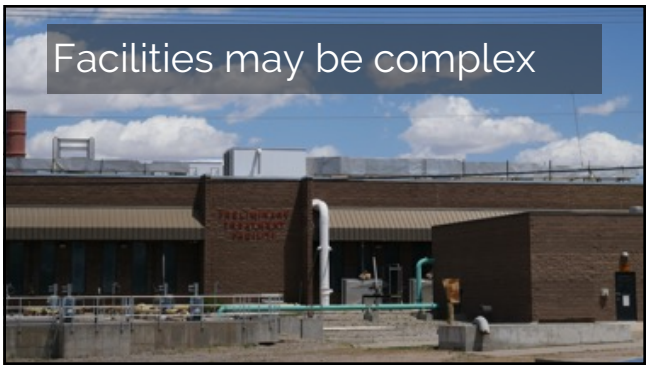
## Facilities may be complex



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## Facilities may be smaller

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What do these processes have in common?

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The come before "primary treatment"

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They are physical processes

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They protect the treatment equipment

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They protect the environment

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They prep the wastewater for primary and secondary treatment.

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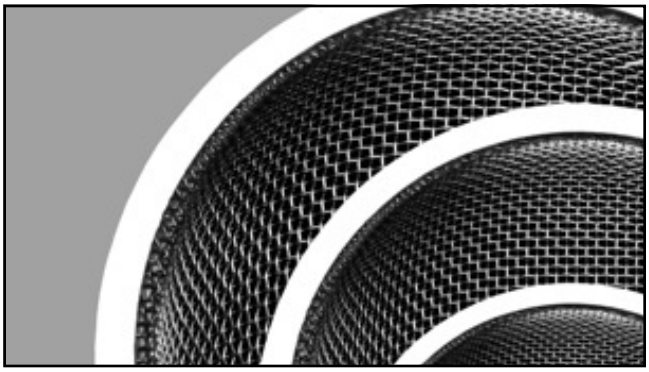

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What is “Preliminary Treatment”?
(The short version)?

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“Preliminary treatment is the removal of metal, rocks, sand, eggshells and similar materials that may hinder the operation of a treatment plant.”

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How do we do it?
(The short version)

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"Preliminary treatment is accomplished by using equipment such as bar racks, or bar screens, shredders, and grit removal systems."

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# Preliminary Facilities

## Coarse Screens

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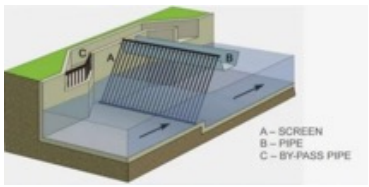
Bar Screens

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## Materials

Typically made from noncorrosive metal:

- Aluminum, or
- Stainless Steel

## Gap Sizes

- Between 3/8" and 2" it's a "Bar Screen"
- Over 2" it's a "Bar Rack" or "Trash Rack"

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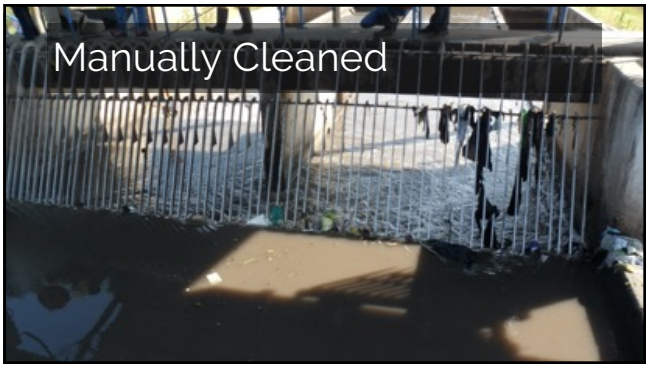


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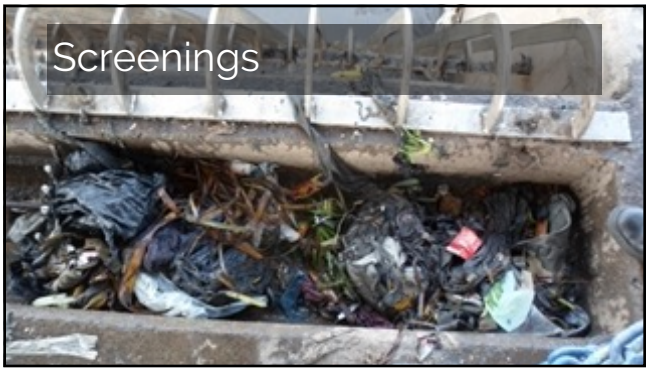


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## Design Considerations

| Screening Device Classification | Size Classification (range of screen opening) |
|---|---|
| Manually Cleaned Bar Screen | Coarse: 1 - 2 in |
| Mechanically Cleaned Bar Screen | Coarse: 0.6 -0.3 in |
| Fine Bar Screen (Mechanically Cleaned) | Fine Coarse: 0.1 – 0.5 in |

Source: Crites and Tchobanoglous, 1998.

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# Coarse Solids Reduction

## Communitors, Grinders and Macerators

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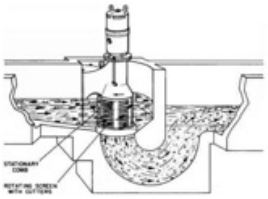
## Comminutors

- Rags and debris are shredded and left in the water
- Can clog equipment and be labor intensive
- Require electricity unlike manual bar screens



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## Grinders

Source: https://franklinmiller.com/grinders/

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## Macerators

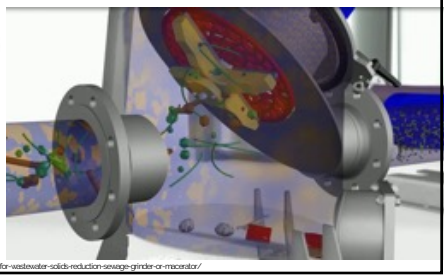

Image Source: https://blog.craneengineering.net/whats-best-for-wastewater-solids-reduction-sewage-grinder-or-macerator/

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## Preliminary Facilities

Fine Screens

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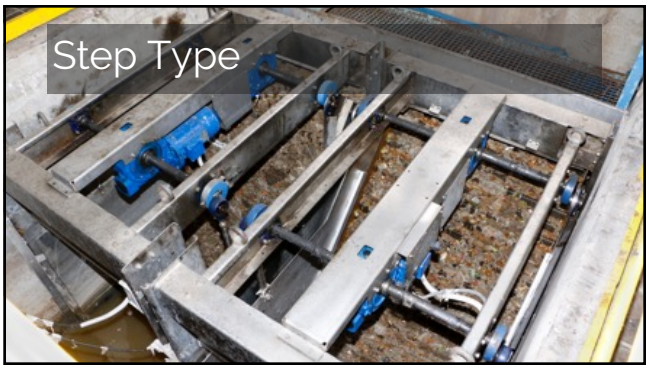


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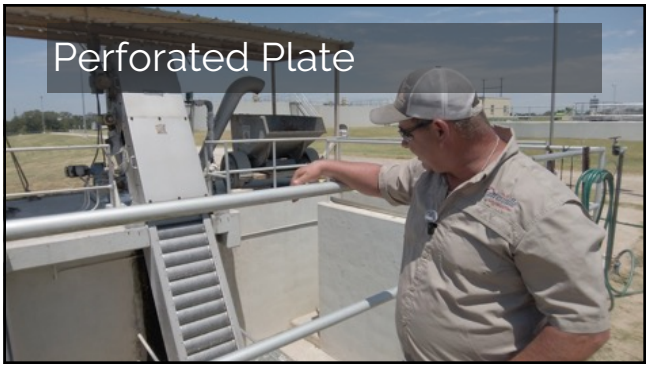
## Perforated Plate



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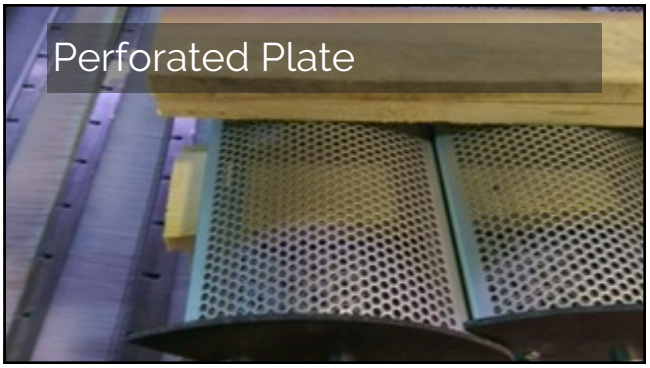
## Perforated Plate



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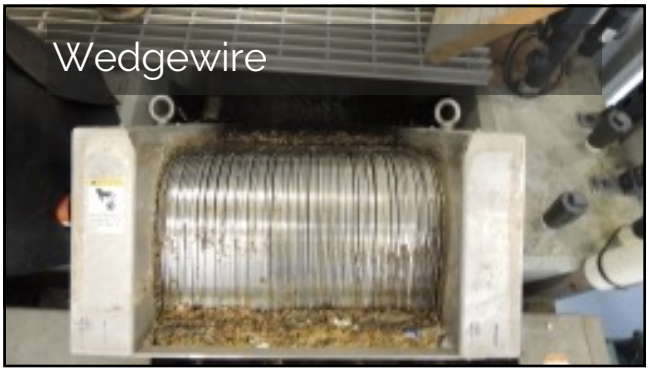
## Wedgewire



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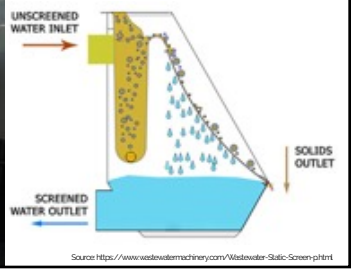
## Static Screen

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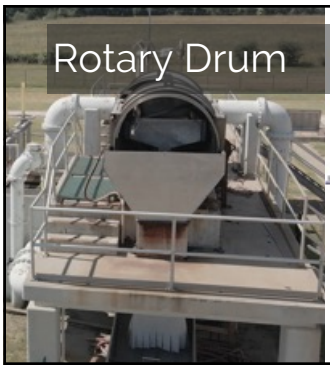
## Rotary Drum



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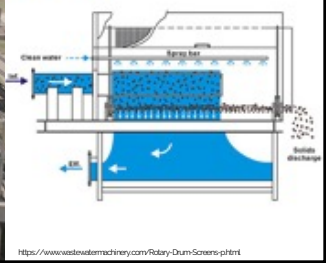

https://www.wastewatermachinery.com/Rotary-Drum-Screens-p.html

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## Screening vs Grinding

**Screening REMOVES** materials from the influent stream

**Communition or Grinding REDUCES** the size of larger materials in the influent stream

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## Design Considerations

| Screening Device Classification | Size Classification (range of screen opening) |
|---|---|
| Fine Bar Screen (Mechanically Cleaned) | Fine Coarse: 0.1 – 0.5 in |
| Perforated Plate (Mechanically Cleaned) | Fine Coarse: 0.1 – 0.4 in |
| Rotary Drum (Mechanically Cleaned) | Fine Coarse: 0.1 – 0.5 in |
| Fixed Parabolic Fine Screen | Fine: 0.01 - 0.13 in |
| Rotary Drum | Fine: 0.01 - 0.13 in |
| Rotary Disk | Very Fine: 0.01 – 0.02 in |

Source: Crites and Tchobanoglous, 1998.

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## Screening vs Grinding

**Screening PROTECTS** downstream equipment from damage by large objects

**Communition & Grinding PREPARES** the larger materials in the influent stream for further treatment and removal by reducing their size

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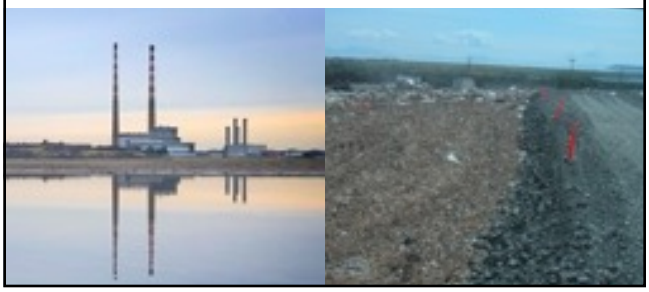
## Screenings Handling



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## Grit Removal

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## What is "grit?"

Traditionally defined as particles larger than **0.008 inches** (0.21 mm) and specific gravity of 2.5 (mostly inorganic)

Some modern equipment removes grit particles down to about **0.006 inches** (0.15 mm)

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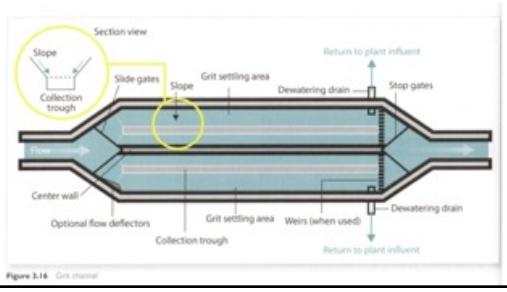
## Removal Devices: Grit Channels

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## Removal Devices: Grit Channels

| Component | Purpose |
|---|---|
| Settling Area | Place for grit to settle for later removal |
| Center Wall | Separates grit channels |
| Slide or Inlet Gate | Regulates number of channels in service for flow velocity |
| Stop or Outlet Gate | Insert to prevent backflow when cleaning |
| Weir | Controls channel water velocity |
| Grit Hopper or Grit Storage | Accumulates and stores grit before removal and disposal |
| Dewatering Drain | Drains channels for inspection |
| Drain Valve | Allows channel draining |

Source: Operation of Wastewater Treatment Plants, Volume 1, 8th Edition, 2019, OWP, Table 3.4

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## Horizontal Flow Design Criteria

| Item | Range Metric | Typical Metric |
|---|---|---|
| Detention Time | 45 - 90 seconds | 60 seconds |
| Horizontal Velocity | 0.8 – 1.3 ft/s | 1 ft/s |
| Settling Velocity (50 mesh) | 9.2 – 10.2 ft/min | 9.6 ft/min |
| Settling Velocity (100 mesh) | 2 - 3 ft/min | 2.5 ft/min |
| Headloss (% of channel depth) | 30 – 40% | 36% |

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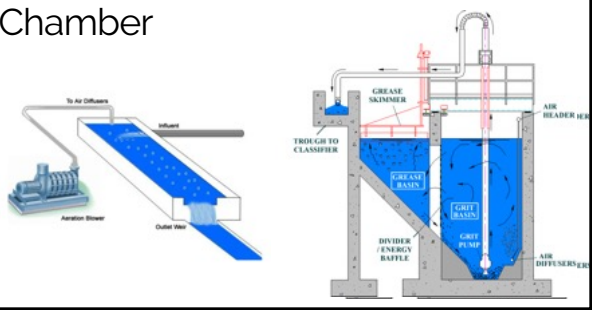
## Removal Devices: Aerated Grit Chamber

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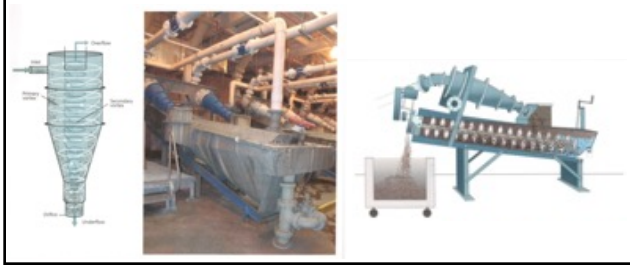
## Removal Devices: Cyclone Separator



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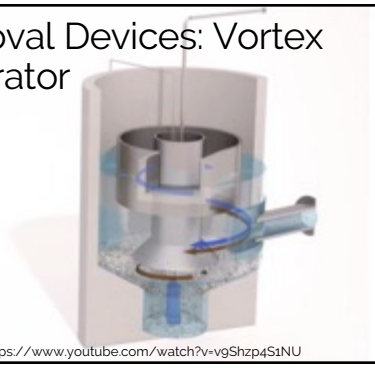
## Removal Devices: Vortex Separator



Source: Grit King - https://www.youtube.com/watch?v=v9Shzp4S1NU

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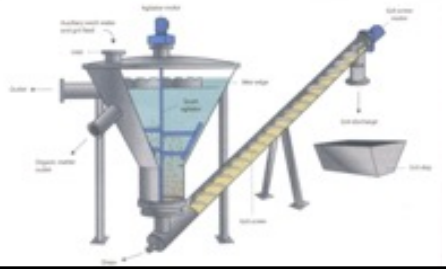
## Grit Washing and Disposal (Classifiers)



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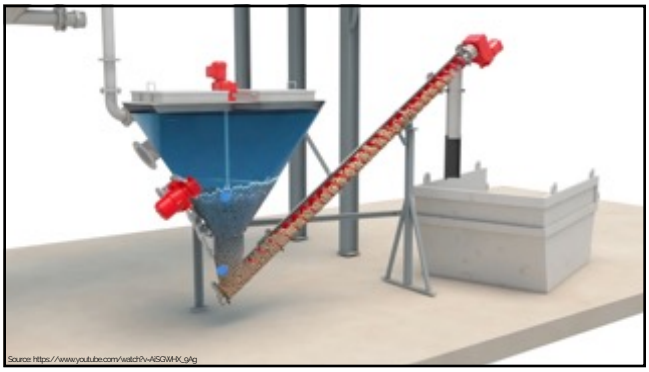

Source: https://www.youtube.com/watch?v=ASQWHK_gAg

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## Grit Handling

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## Flow Measurement

It's important (and covered more l n depth in a different webinar)

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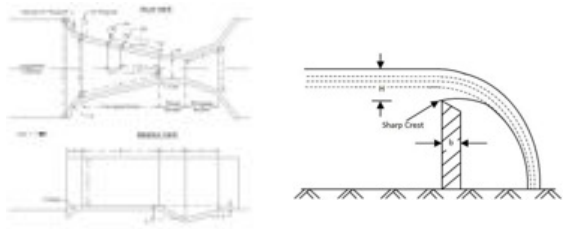
## Flow should be measured

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## Flow Equalization & Pre-Aeration

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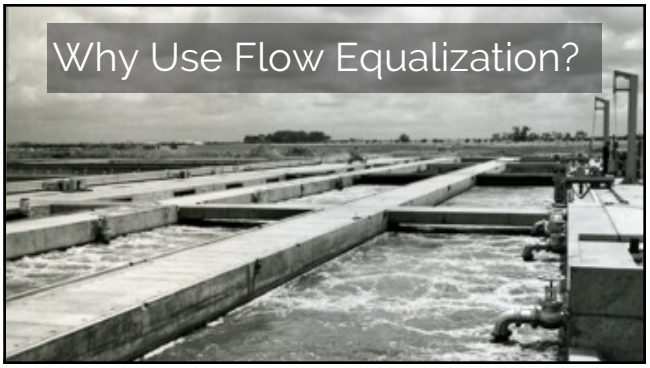


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## Why Use Flow Equalization?

To even out flow in the treatment plant

May allow for a smaller treatment plant

Less common in the US than in Europe

Has to be sized to account for extreme flows, particularly for combined systems

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## Why Use :Pre-Aeration?

To add oxygen and reduce

Hydrogen Sulfide

Methane

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## Odor Control

Management Strategies

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## What Causes Odors at WWTPs?

They're largely the result of organic decomposition.

Hydrogen Sulfide

Ammonia

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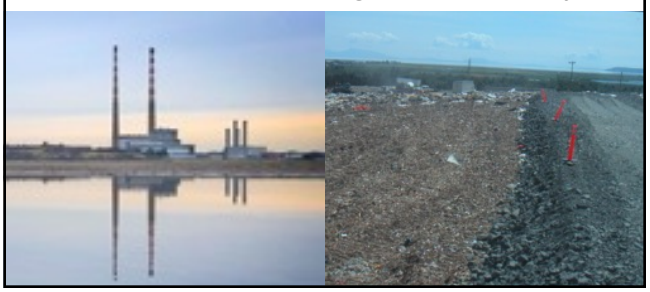
## Remove Screenings Frequently



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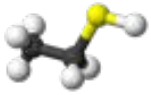
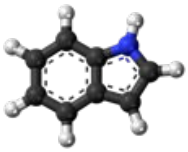
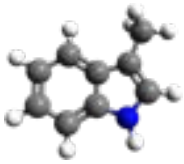
## Other Gases – Natural and Industrial



Ethane Thiole
(Ethyl Mercaptan)



Indole



Skatole

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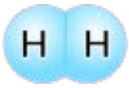
## Other Natural Gases

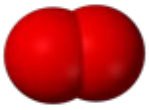
Carbon Dioxide




Hydrogen Gas

Methane

Nitrogen Gas



Oxygen Gas

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## Office Hour Details

Time: Every Tuesday from: 9:00 AM to 10:00 AM PDT
10:00 AM to 11:00AM MDT
11:00 AM to Noon CDT
Noon to 1:00 PM EDT

Reach out via email: ajbarney1@unm.edu
jmarkham@unm.edu

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## CONTACT INFORMATION

SOUTHWEST
ENVIRONMENTAL
FINANCE CENTER

A.J. Barney: ajbarney1@unm.edu
James Markham: jmarkham@unm.edu

Department of Civil Engineering MSC01 1070
1 University of New Mexico
Albuquerque, NM 87131
505-277-0644
swefc@unm.edu
http://swefc.unm.edu

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