

Attached Growth Processes

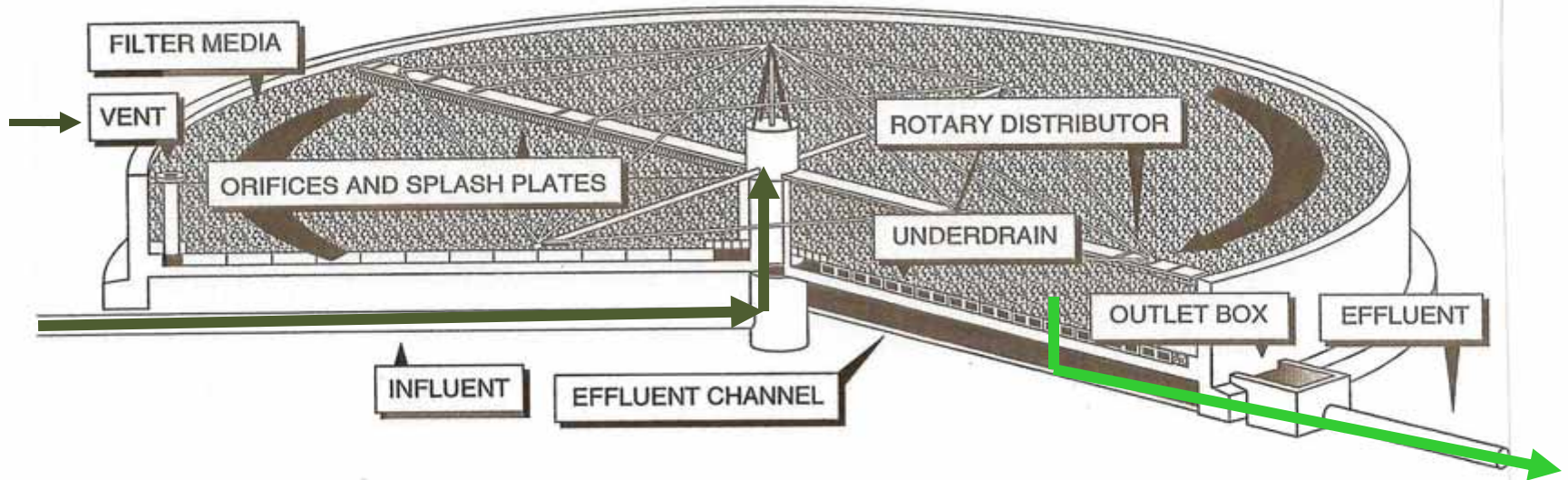
New Mexico Rural Water
Association
Revised 2012

Secondary Biological Treatment

- Utilizing bacteria and other organisms to reduce the organic levels in the wastewater (BOD & TSS removal 90%+)
- Developing a sludge that can be easily settled is the operational objective of secondary treatment
 - Trickling Filters → Also known as “Fixed Film”
 - RBCs →
 - Activated Sludge
 - Lagoons

Trickling Filters - Secondary Biological Treatment

(Filter Tower or Biofilter)



Media

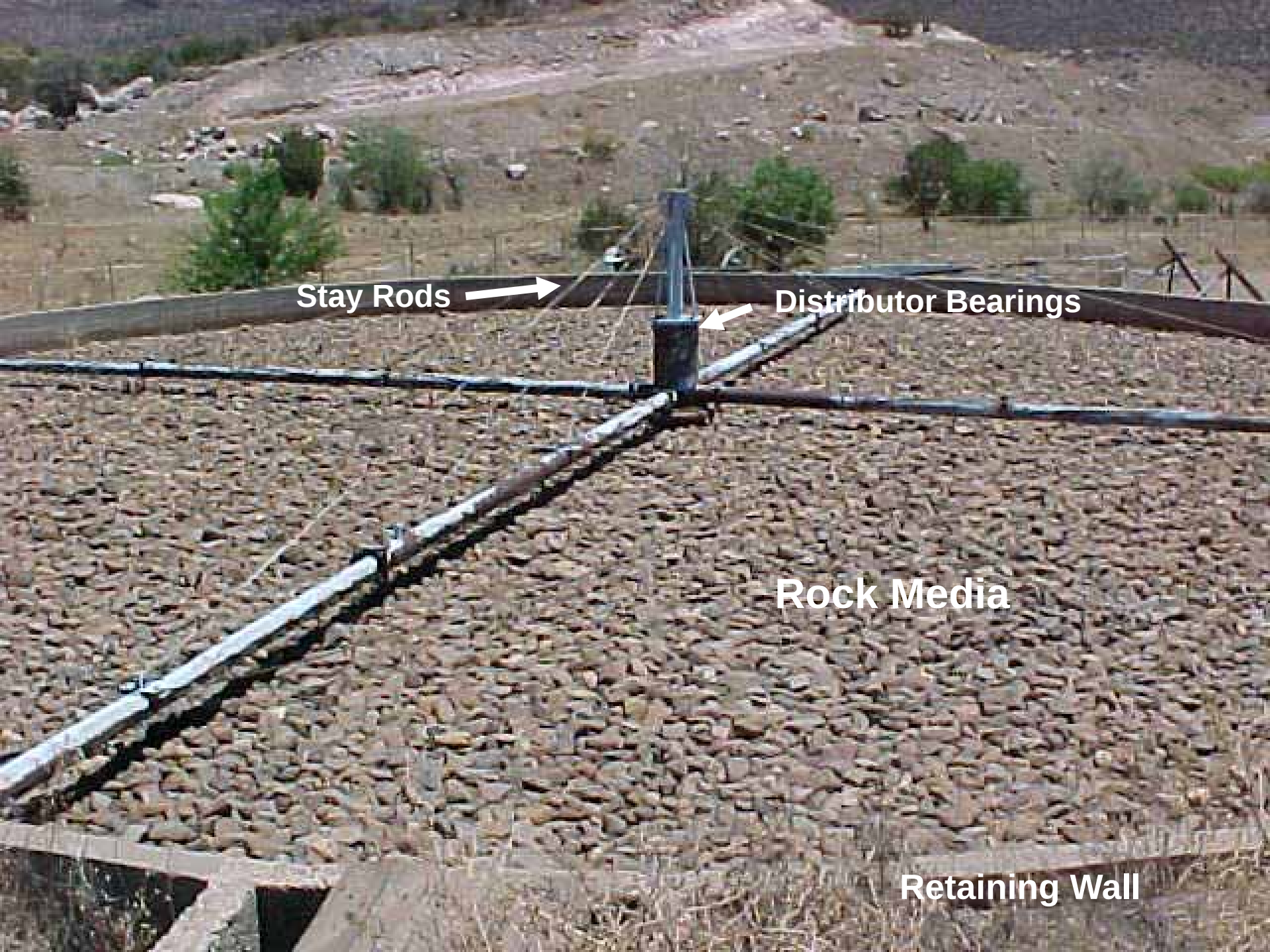
- Rocks
- Synthetic
- Wood

Three Basic Parts

Media

Under drain system

Distribution system

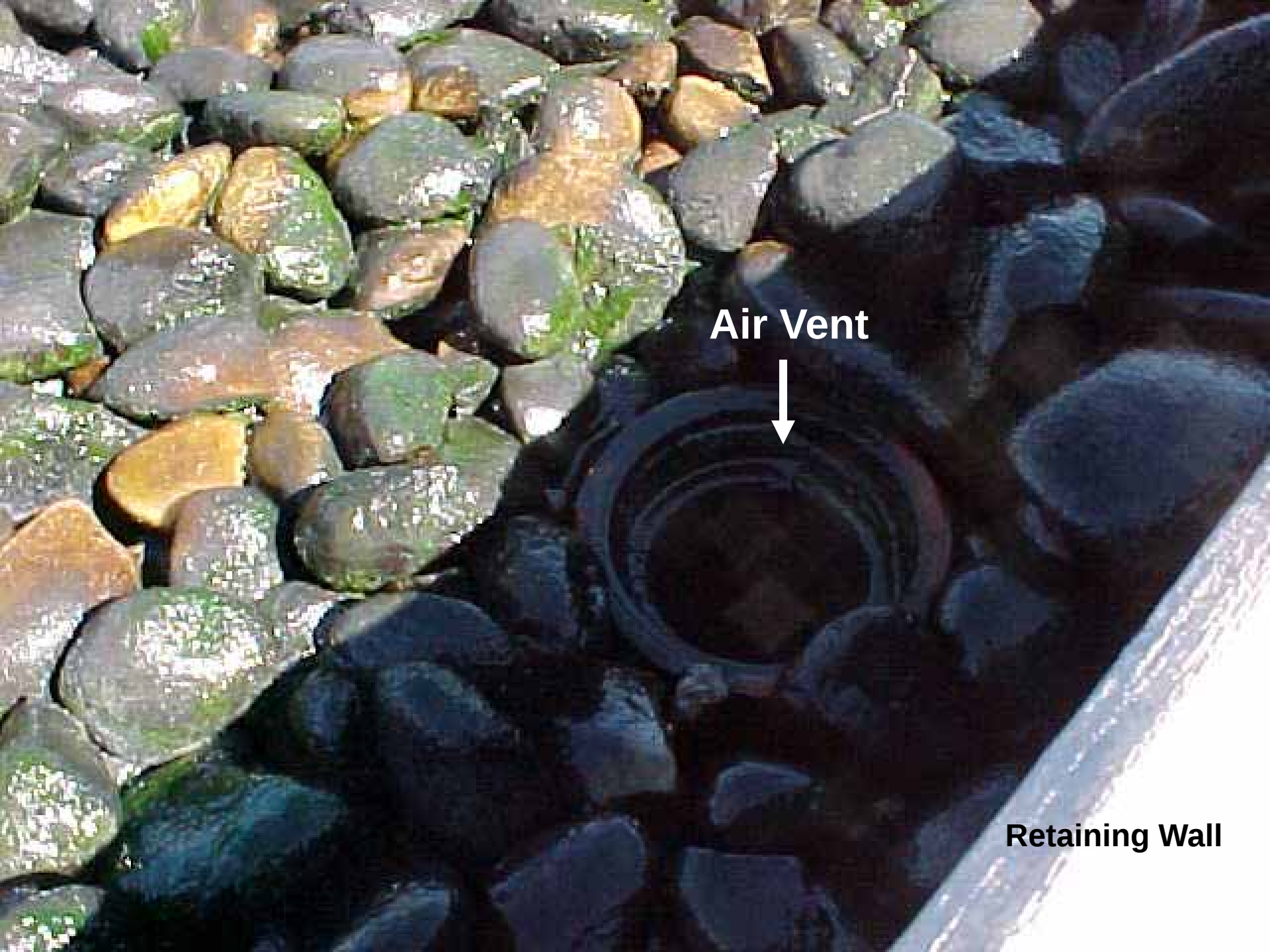


Stay Rods

Distributor Bearings

Rock Media

Retaining Wall



Air Vent

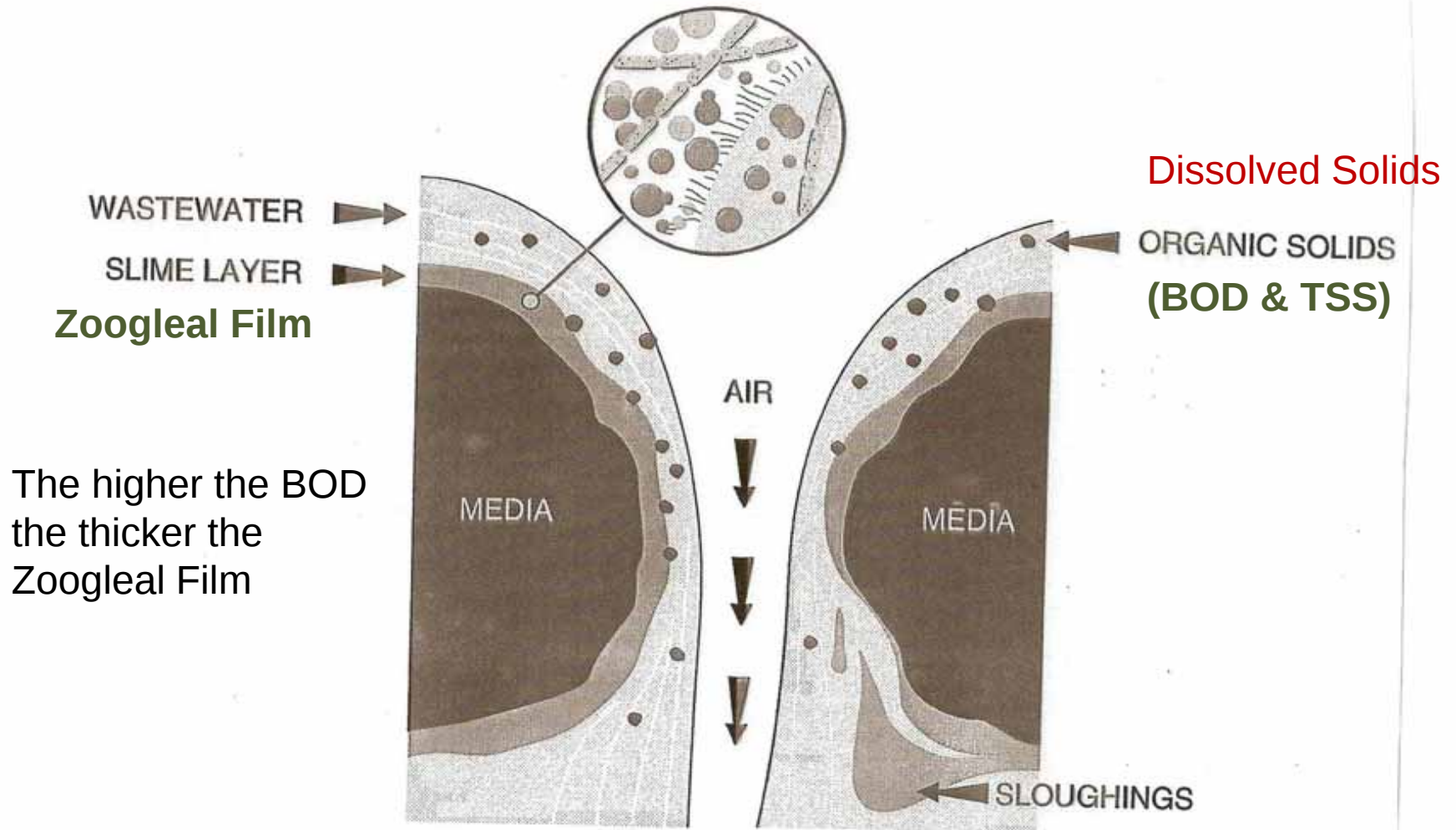


Retaining Wall





Bacteria, protozoa & other organisms



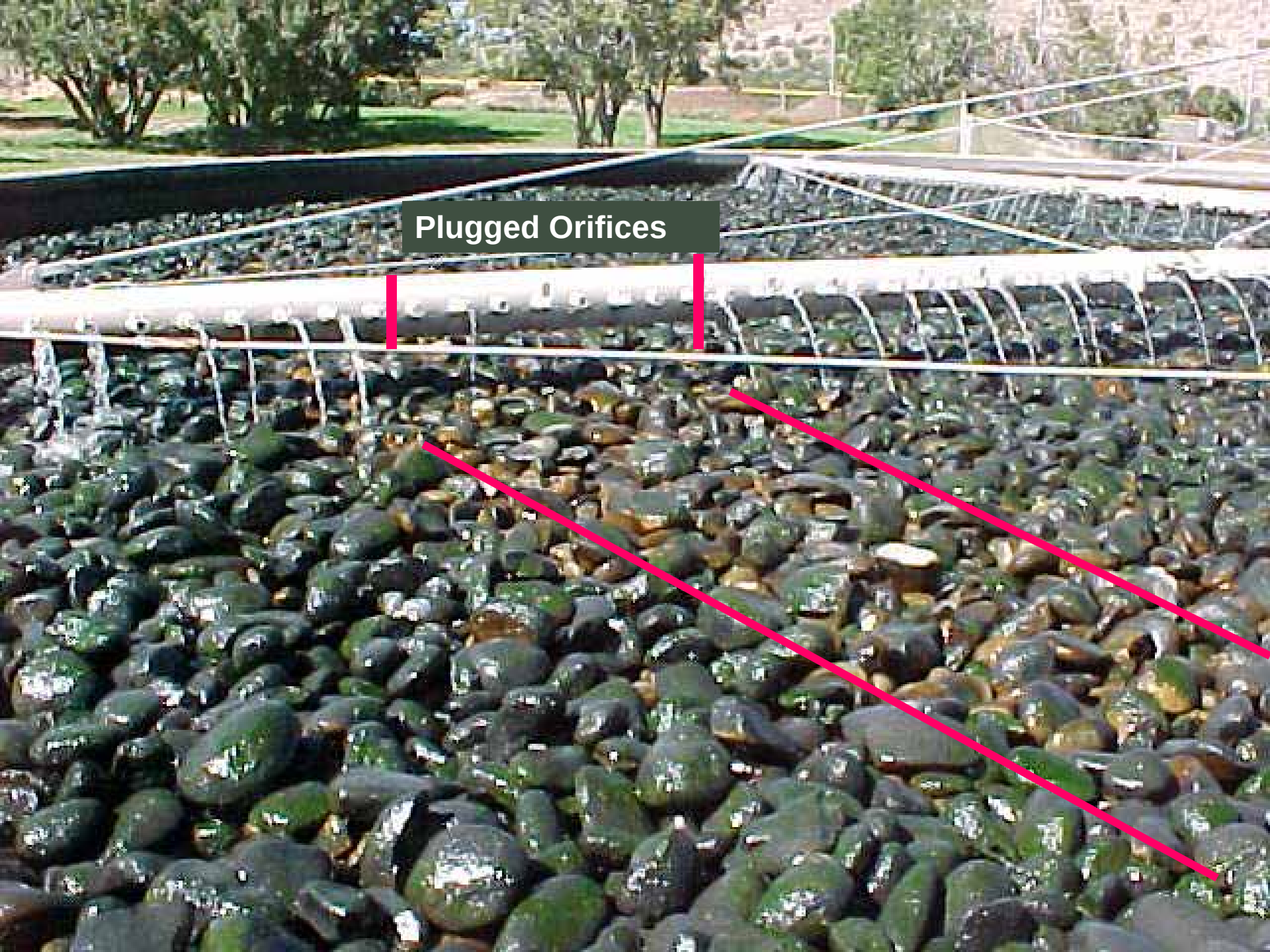


What is the “green growth”? Is it doing the work?

**Trickling Filter recovering
from growth die-off**



Plugged Orifices



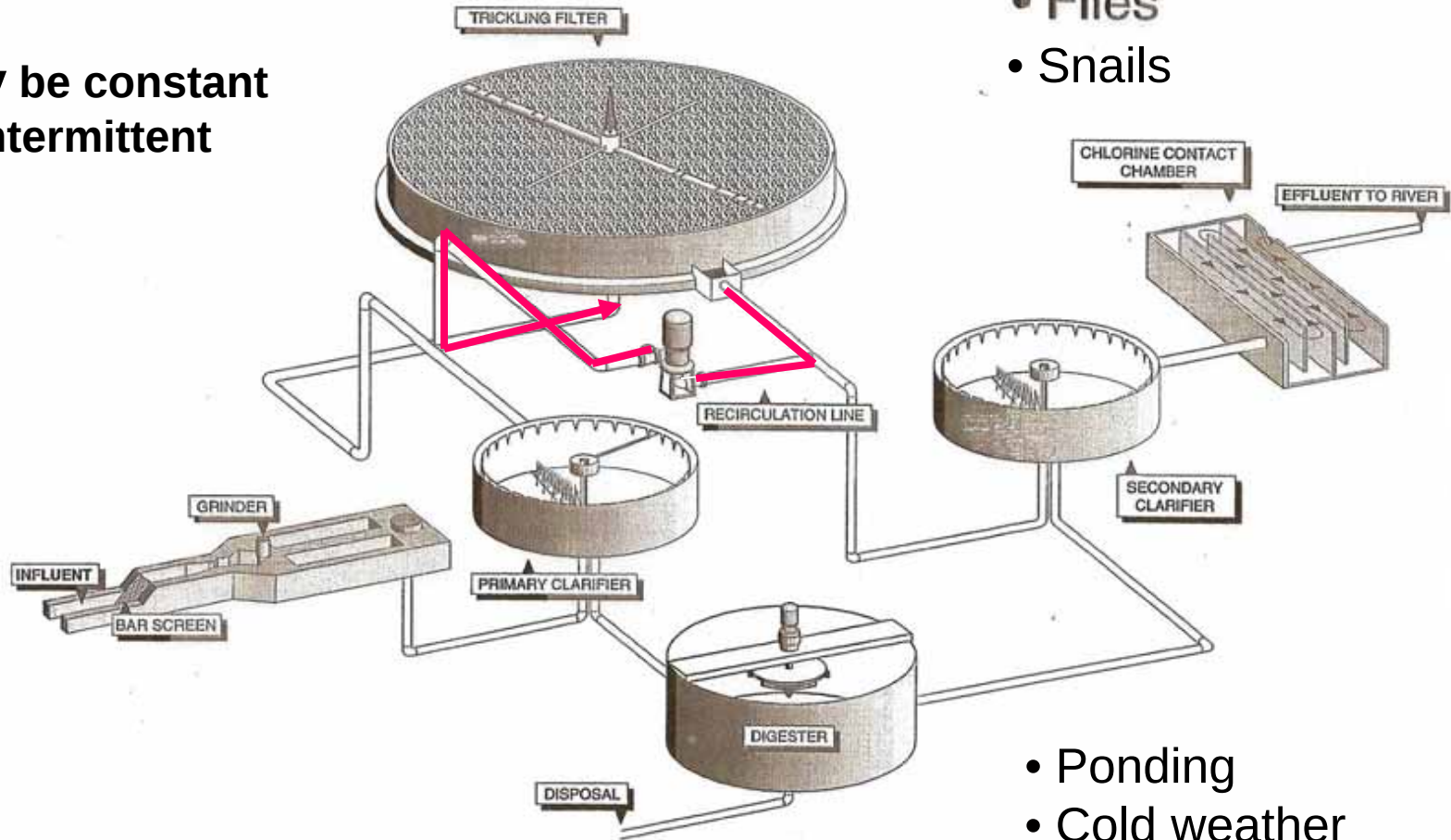


Rock Media contains about 35% void space

Recirculation

- Increase efficiency
- Maintain film thickness

May be constant
or intermittent



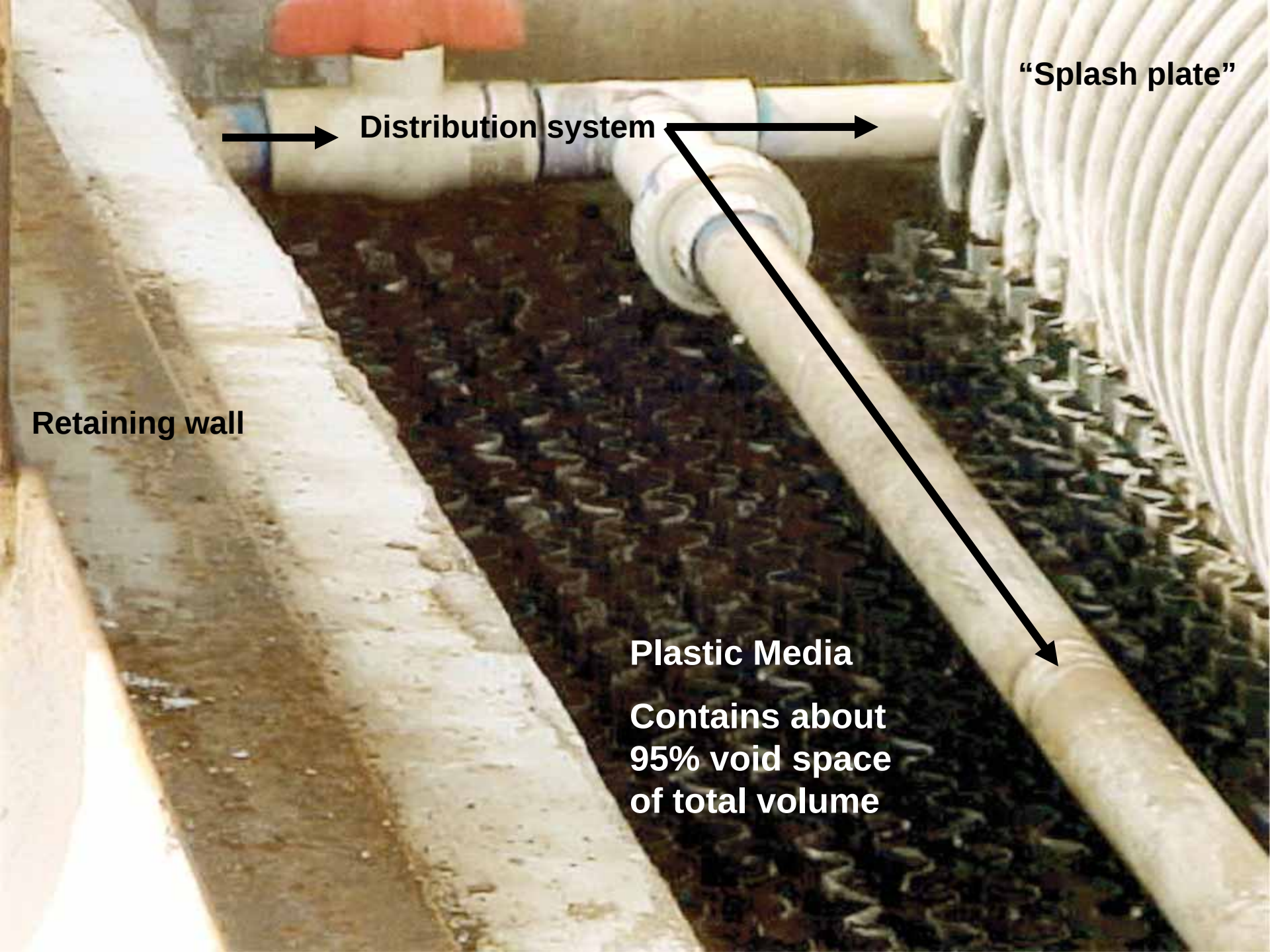
Problems

- Odor
- Effluent quality
- Flies
- Snails

- Ponding
- Cold weather

Biotower





"Splash plate"

Distribution system

Retaining wall

Plastic Media

**Contains about
95% void space
of total volume**



Biotower

Plastic Media

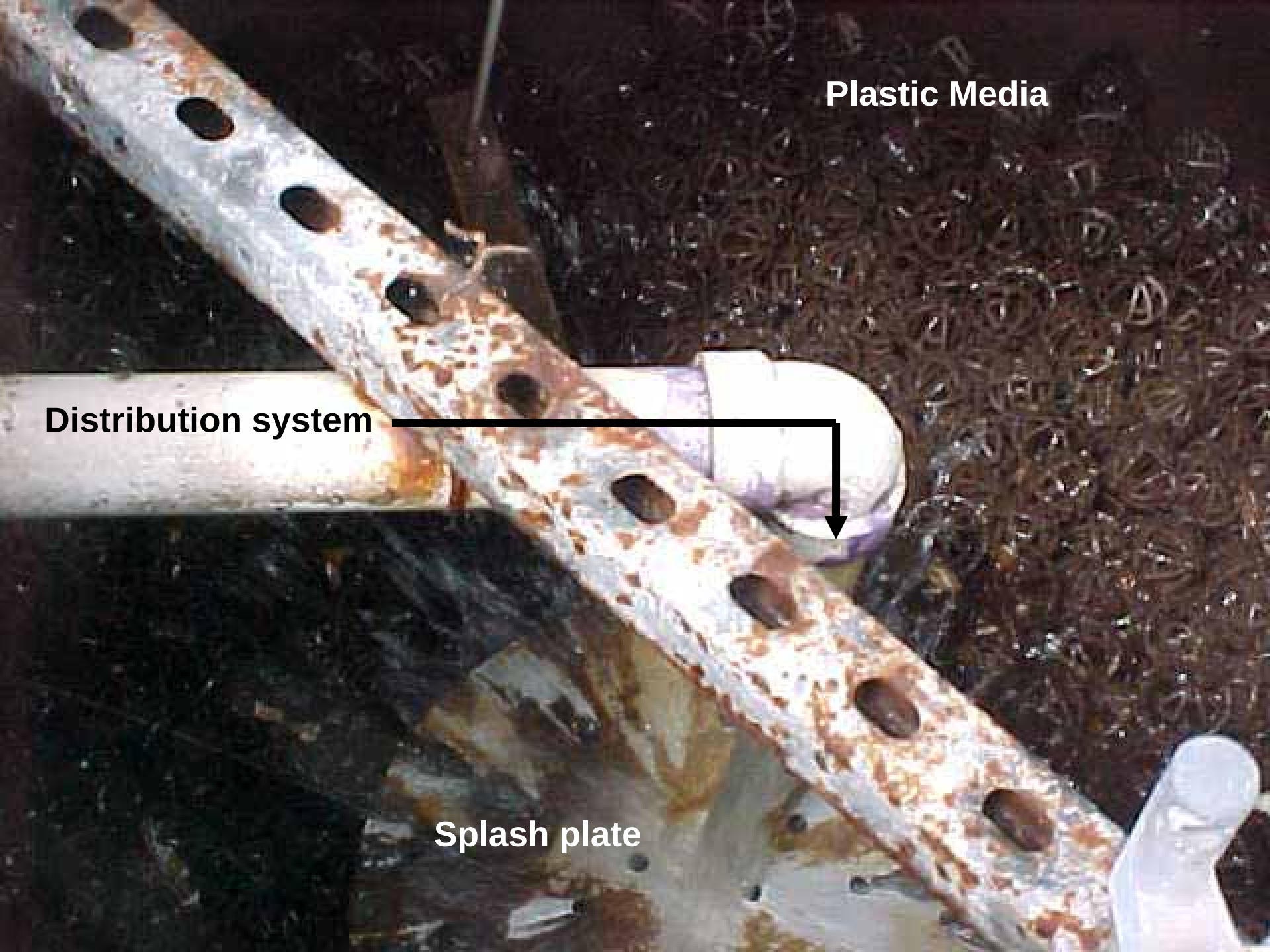


Why isn't the growth green?

Plastic Media

Distribution system

Splash plate



Classification of Filters

- By flow pattern

 - Series

 - Parallel

 - Single-stage or two-stage

- By hydraulic or organic loading

 - Standard rate

 - High rate

 - Roughing

Standard Rate Filter

- Hydraulic loading = 25 -100 gal/day/sq ft.
- Organic loading = 5 - 25 lbs/day/1,000 cu ft.
- Media depth = 6 – 8 ft.
- Produce effluent BOD = 20 – 25 mg/l

High Rate Filter

- Hydraulic loading

Rock = 100 - 1,000 gal/day/sq ft.

Synthetic = 350 – 2,100 gal/day/sq ft.

- Organic loading

Rock = 25 – 100 lbs/day/1,000 cu ft.

Synthetic = 50 – 300 lbs/day/1,000 cu ft.

Media depth = 3 – 5 ft.

Designed to receive wastewater
continually

High Rate Filters cont'

- More uniform sloughing occurs
- Sloughings are lighter weight
- Harder to settle

Roughing Filter

- High rate filter receiving **very** high organic load
- Organic loading = 100 – 300 lbs/day/1,000 cu ft.
- Used primarily to cut BOD load on subsequent secondary processes such as second stage filter or activated sludge
- Used for strong organic industrial wastes
- 50 -70 % BOD removal

Operational Conditions

- Ponding
- Odors
- Filter flies
- Snails
- Sloughing
- Poor effluent quality
- Cold weather problems



Ponding

Loss of open area in voids between media

Causes

High organic loading without sufficient
recirculation rates

Lack of good primary clarification

Improperly sized media –too small or not
uniform in size

Accumulation of trash plugging filter voids

Uncontrolled sloughing

Excessive growth of insect larvae or snails



Remedies for Ponding

- Spray with high pressure water
- Hand turn or stir media surface
- Remove trash & debris accumulation
- Dose filter with 5 mg/l chlorine for several hours
- Flood filter. Keep media submerged for 24 hours to cause sloughing
- Shut off flow for several hours to allow growth to dry out

Odors



- Aerobic process
- Foul odors indicate anaerobic conditions

Or odor-producing compounds in high concentrations

Odor Remedies

- Maintain aerobic conditions in sewers and primary treatment units
- Check ventilation; Remove obstructions or heavy biogrowth in under drains and in voids
- Keep under drains no more than 50% full
- Increase recirculation to provide more O_2 and increase sloughing

Keep wastewater splash away from exposed structures, grass and other surfaces

Filter Flies



- *Psychoda*
- Gnat-sized
- Prefers an alternately wet and dry environment
- Found most frequently in low/standard rate filters – not much in high (hah!)

Remedies for Filter Flies

- Increase recirculation rate
- Keep orifice openings clear
- Apply approved insecticides to filter walls
- Flood filters for 24 hours
- **Practice good housekeeping and grounds maintenance**



Sloughing

- Problem is uncontrolled sloughing
- Remedy is to increase the recirculation rate to the filter on a weekly basis to encourage regular, controlled sloughing

Poor Effluent Quality

- Check organic load (BOD) to the filter
- Measure both soluble and total BOD in the final effluent
- High total BOD indicates problems with escaping solids
- High soluble BOD indicates the trickling filter removal capacity is being exceeded

Cold Weather Operation

- Decrease amount of recirculation
- Operate two filters in parallel
- Adjust or remove orifice splash plates to reduce spray effect
- Construct windscreens, covers or canopies to reduce heat loss
- Physically break-up and remove larger areas of ice build-up
- Keep unit running



Maintenance



- Bearings and seals

Monitor oil weekly by drawing off a portion

- Distributor arms

Open dump gates and flush weekly

Observe for smooth operation

Adjust turnbuckles as needed to provide even flow

Clean splash plates

- Underdrains

Flush every 3 – 6 months to keep clean & clear





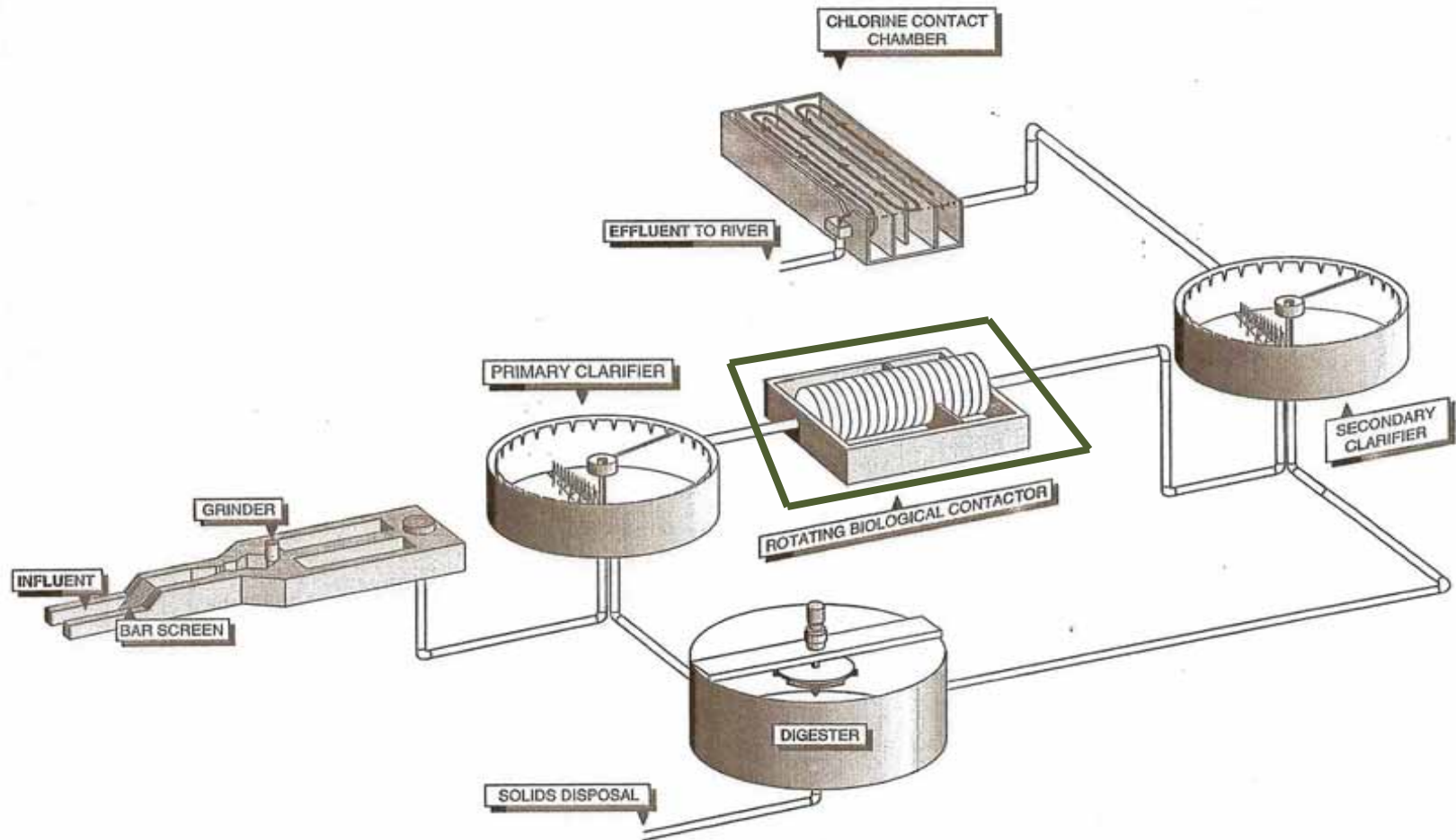
Safety



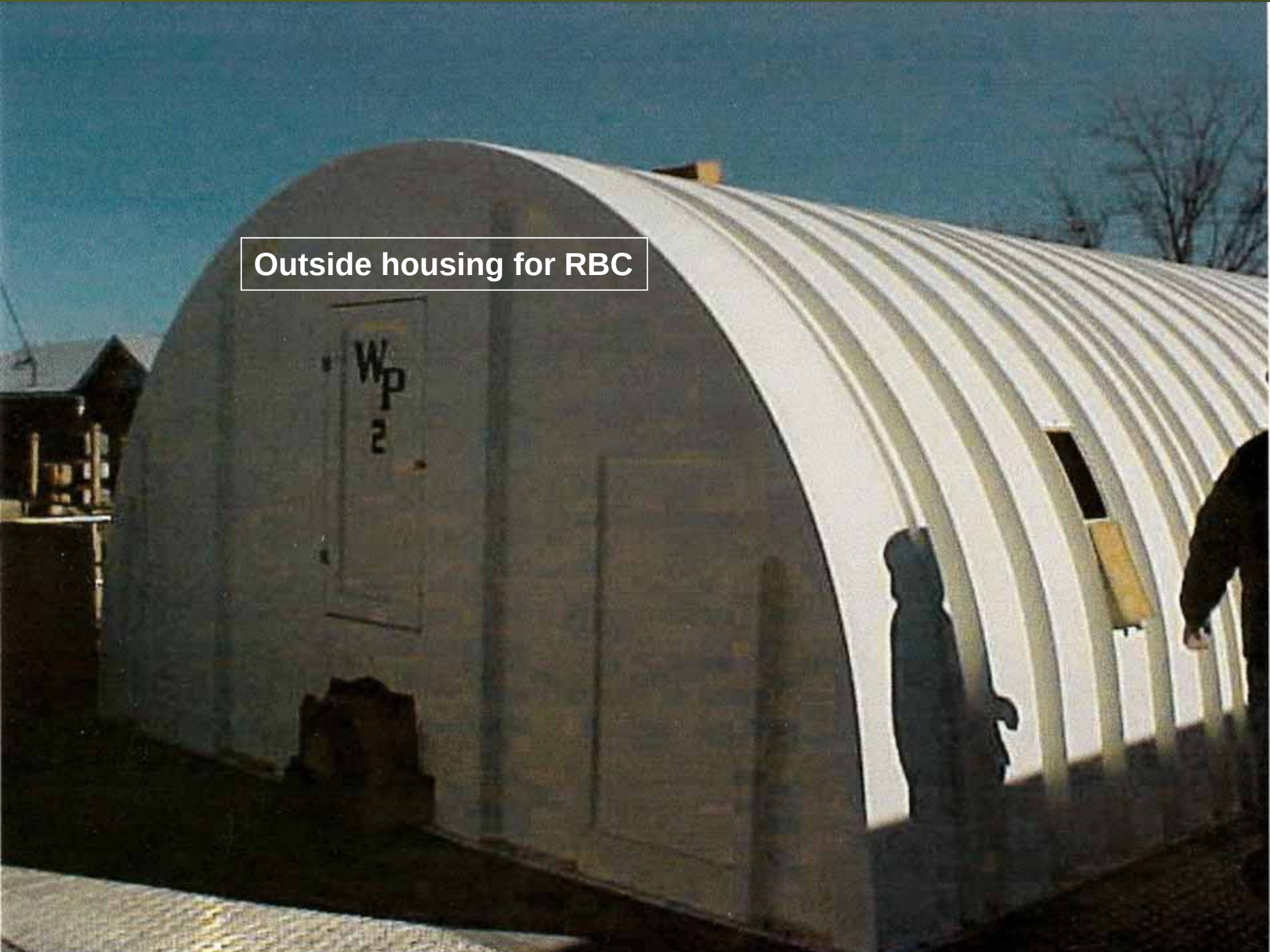
- Shut off flow to filter and allow distributor to stop rotating before working on it
- DO NOT attempt to stop arm rotation manually
- Take extreme care when walking on media – it is *very* slippery

RBC - ROTATING BIOLOGICAL CONTACTOR

Secondary Biological Treatment



Outside housing for RBC





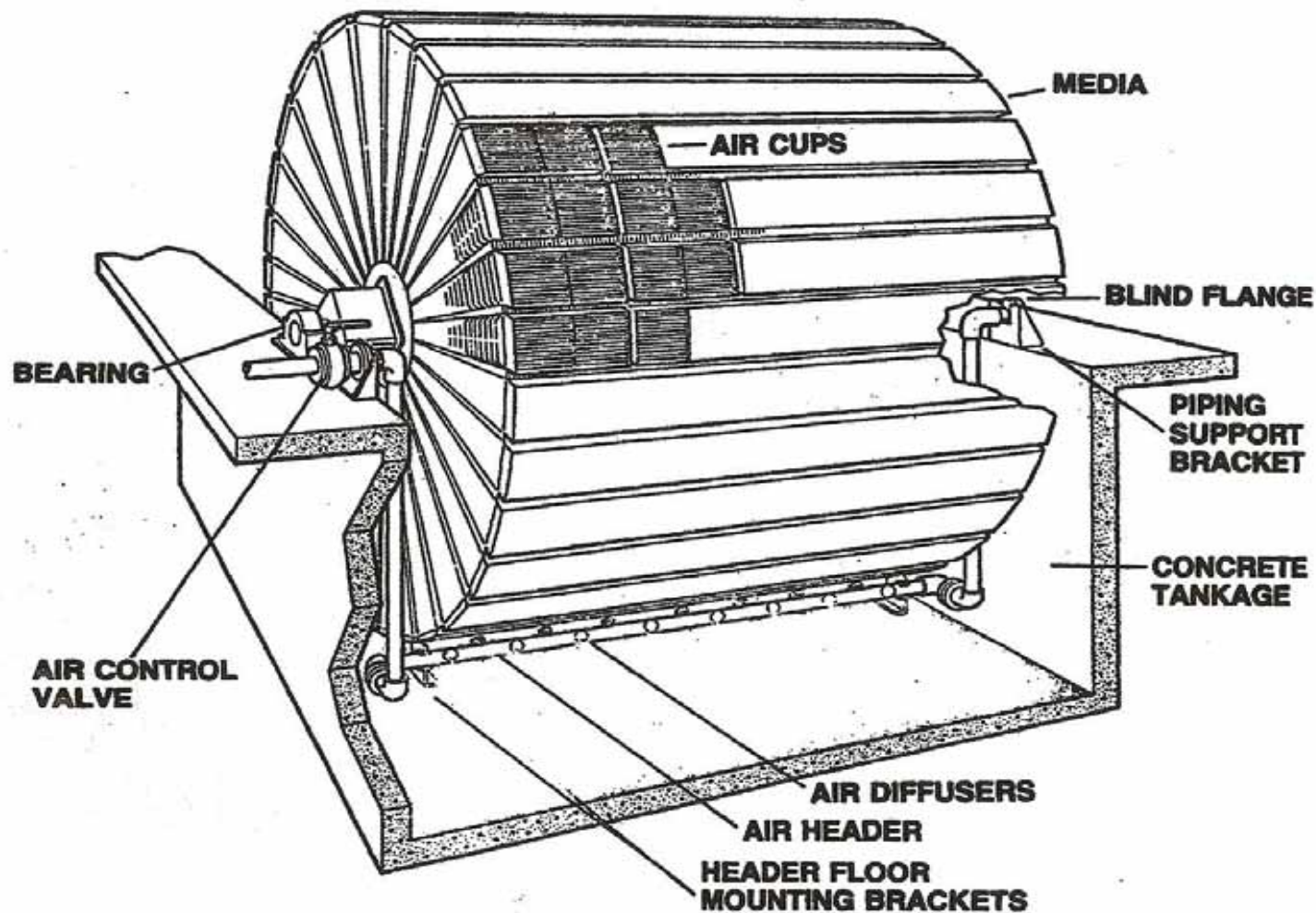
RBC Covers

- Protect *Zoogleal* film from freezing
- Prevent intense rains from washing off the biological slimes
- Stop exposure to direct sunlight to prevent algae growth and brittle media
- Protection for operators during equipment maintenance



Shaft & Media are called the 'DRUM'

**Mechanical
Drive Assembly**



Air Driven RBC Unit



Up to 25 feet in length

High density plastic circular sheets
Usually 12 feet in diameter



- Media rotate at 1.5 rpm
- 40 % of media surface is submersed
- Some slimes are *sloughed off* as media rotates downward into wastewater
- Usually operates as a “once thru” system with no recycled effluent or sludge

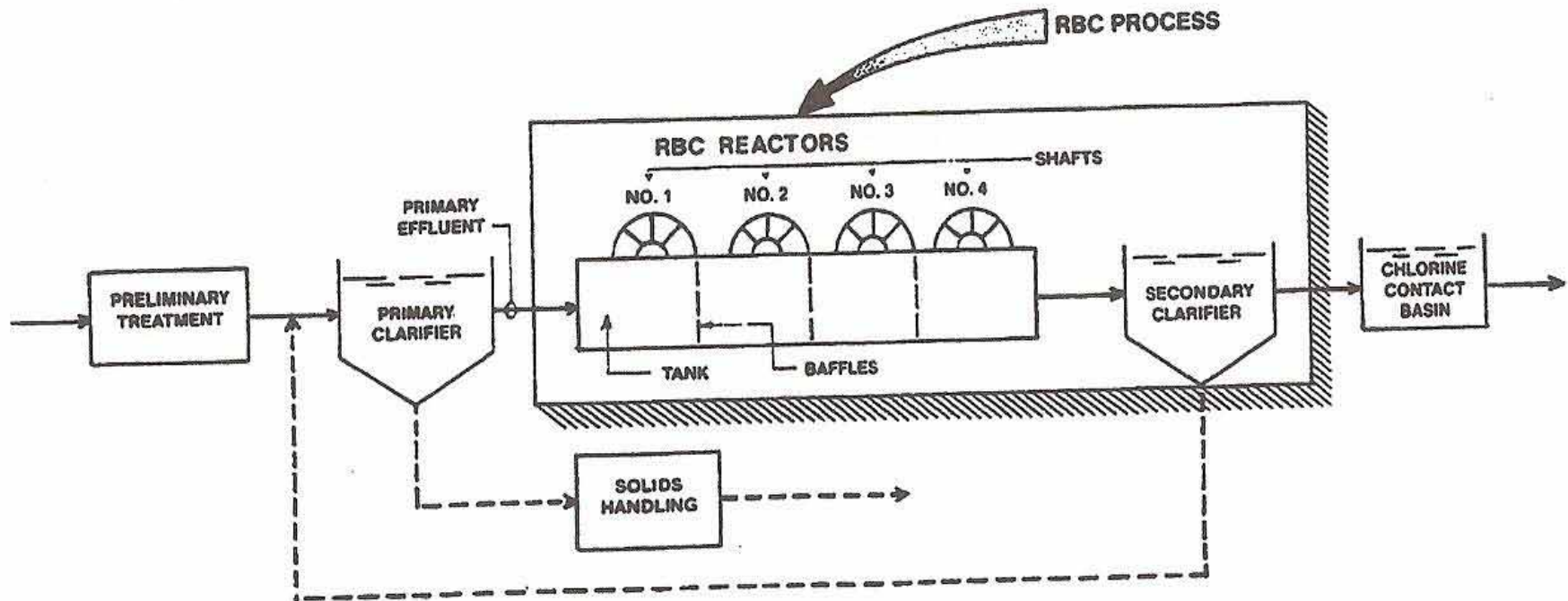
Commonly operated in four stages

Four Stages

- Stages separated by removable baffles, concrete wall or cross-tank bulkhead
- Used to maximize effectiveness of media surface area
- First stage receives high BODs and reduces BOD at a high rate
- As BOD levels decrease from stage to stage, nitrification begins



Rotating Biological Contactors – Side View



RBCs are designed to ONLY treat **soluble** material

What is “Soluble Material”?

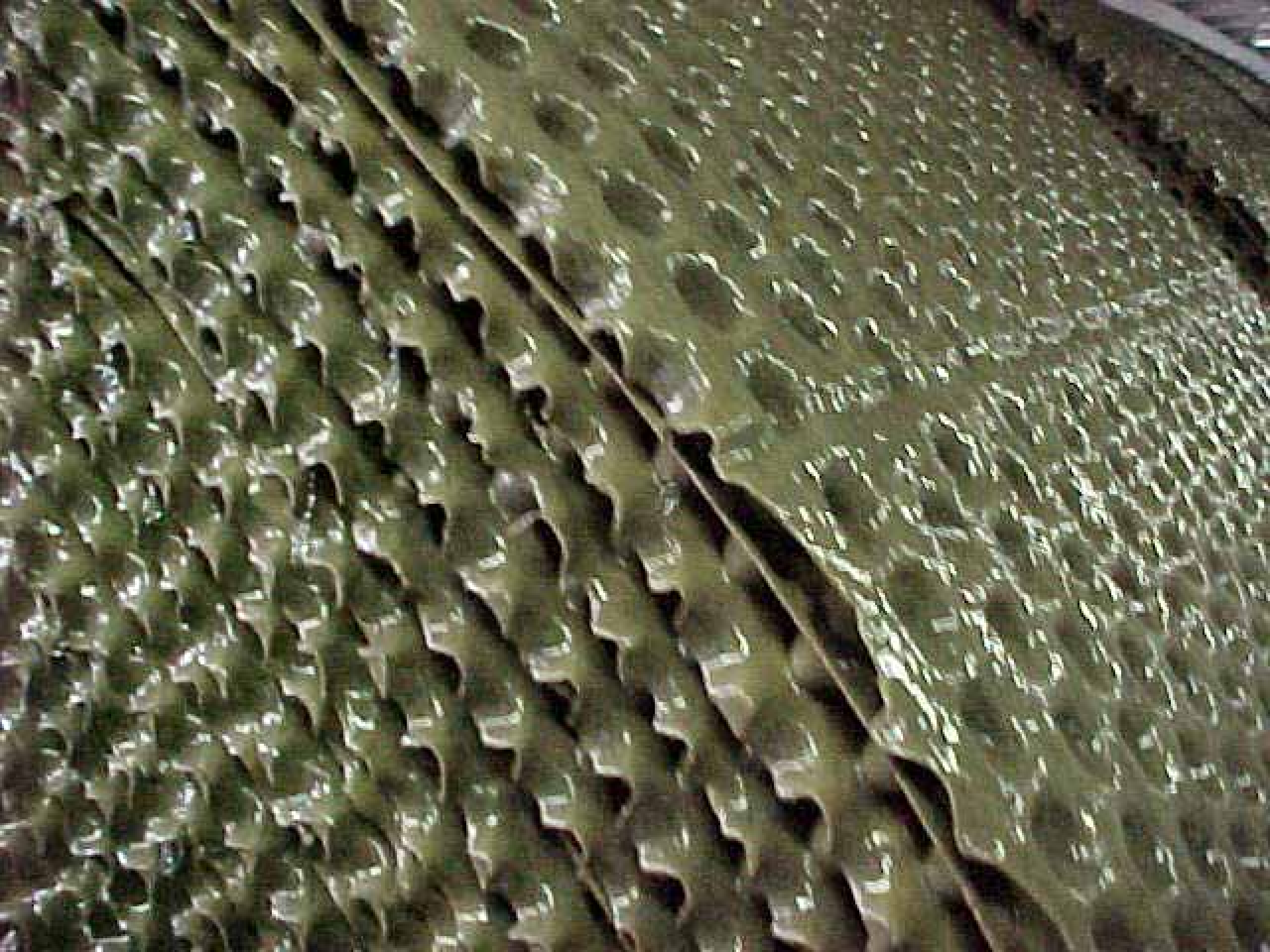
What are the two large categories of **SOLIDS** in wastewater?

- Suspended and dissolved
 - ***Soluble*** material is whatever is ***dissolved*** in the water-cannot be removed by settling or floating
 - Needs bacteria to consume the dissolved portion and “convert” it to more organisms

Media Observations

- Biomass color – Goes from gray to brown
- No algae present
- Fairly uniform coverage
- Very few or no bare spots
- Inoffensive odor
- No sulfide odors





RBC Operational Concerns

Loping

- Heavy media growth on one side
- Variation in rotation speed
- Can break the shaft
- Cure with dosage of chlorine

Prevent loping during power outages by hand turning $\frac{1}{4}$ turn every four hours

Black Appearance

- Could be organic overloading
- Look for low dissolved oxygen in effluent
- Place another RBC unit in service
- Pre-aerate influent to RBCs
- Review operation of primary clarifiers and digesters

White Appearance

- Could result from industrial discharges or sludge deposits in bottom of bay
- *Beggiatoa*
 - Filamentous organism
 - Reduces treatment efficiency
 - Appears as a **white growth** on media
 - May indicate low dissolved oxygen (DO)

Remedies

- Place another RBC unit in service
- Pre-aerate influent to RBCs
- Remove baffle between stages 1 and 2
- Drain bays and remove sludge deposits



Sloughing

- Severe sloughing or low growth
- May be due to toxic or inhibitory substances
- Unusual variations in flow and/or organic loading
- Loading peaks reduced and diluted concentration of toxic substance allowed to reach media
- Toxic substances identified and eliminated

Maintenance

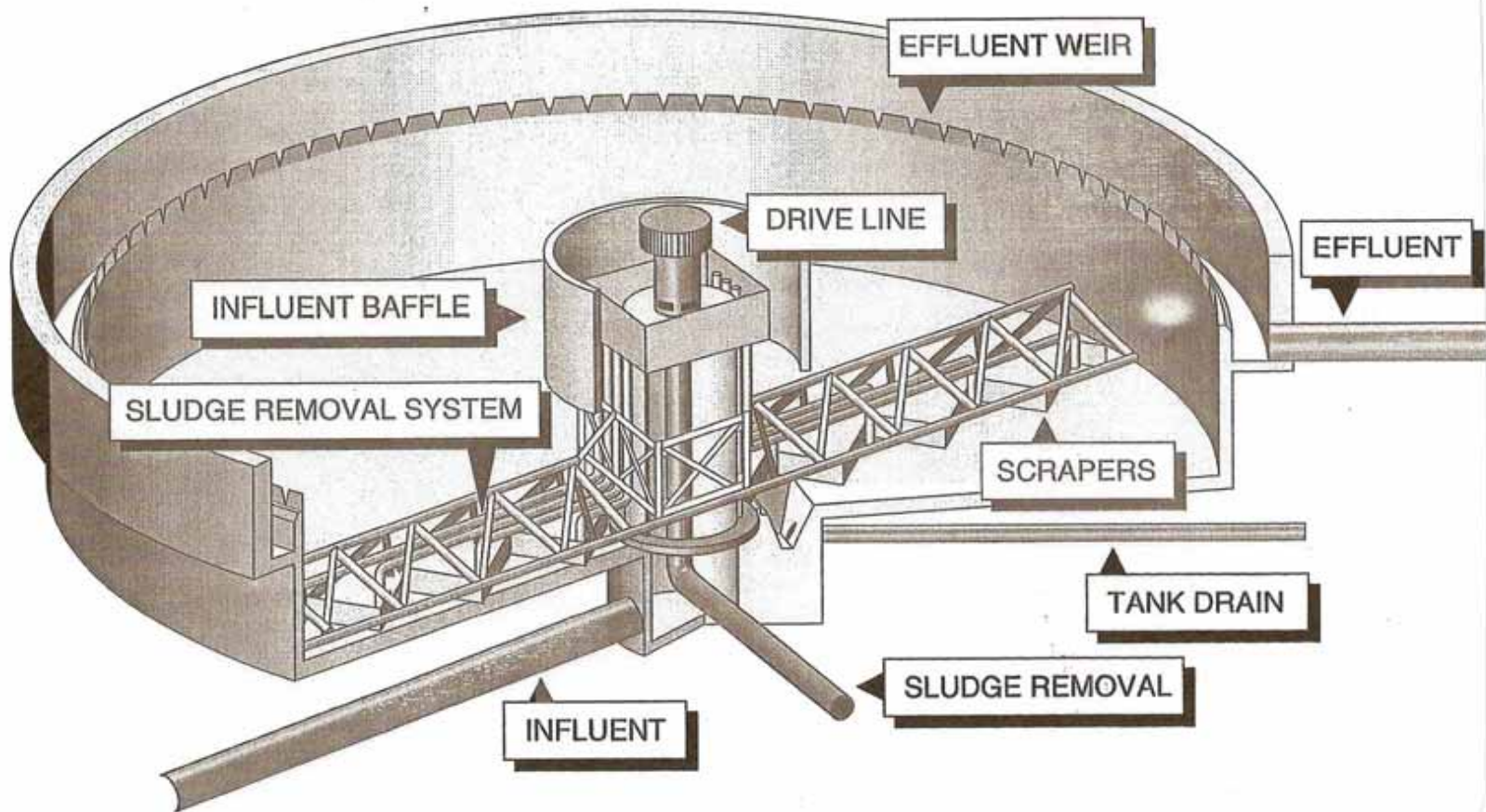


- Few moving parts
- Minor amounts of preventive maintenance
- Inspect all moving parts in accordance with manufacturer's O & M Manual
- Cover exposed parts with layer of grease
- Paint metal parts



SECONDARY CLARIFIERS

- Settle MLSS - Activated Sludge
- • Sloughing - Trickling filter - RBC



Considered part of the secondary treatment process

What are “Sloughings”?

What settles out in the secondary clarifier?

- A. Sand and grit
- B. Poop particles
- C. Microscopic organisms 



SECONDARY
CLARIFIER

Toilet Tidbits

- In 1857, Joseph Gayetty sells the first factory-made toilet paper in the U.S. These were loose, flat sheets of paper, pre-moistened and medicated with aloe; each sheet had Gayetty's name printed on it.

