Wastewater Treatment Ponds

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SOUTHWEST ENVIRONMENTAL FINANCE CENTER

gram is made possible cooperative agreement EPA.

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Weekly Wastewater Technical Assistance Office Hours

- Troubleshooting, operator certification, training, financials, FOG and other Pretreatment topics, etc.
- Tuesdays 11am-12pm (MST)
- Zoom
- Contact: A.J. Barney ajbarney1@unm.edu
  James Markham jmarkham@unm.edu

Or leave your email in the chat and we will send you a link

Operator Certification

Certification programs are regulated by the states

- Texas- TCEQ, New Mexico- NMED, Oklahoma- ODEQ

Certification levels (1-4, D-A, etc.)

- Complexity of the system
- Population
- Experience

Available resources

- California State University, Sacramento- Wastewater operation manuals
- State distributed resources and need to know lists

Certification exam- Study!!

Wastewater Treatment Ponds/ Lagoons Agenda

- What is a wastewater treatment pond and how do they work?
- Types of Ponds and Biology
- Pond Operation and Maintenance
- Pond Analysis and Regulations
- Pond Safety
- Pond Math

What is a wastewater treatment pond?

- Oldest form of wastewater treatment
- Utilized in storage, sedimentation, and contaminant removal processes
- Used for domestic, industrial, and agricultural wastewater treatment
- Utilizes microbes found in wastewater to mimic natural processes

Pond Advantages and Disadvantages

Advantages

- Cheap
- Minimal upkeep
- Minimal equipment
- Simple systems
- Energy efficient and minimal environmental impact
- Sometimes aesthetically pleasing

Disadvantages

- Land intensive
- Water quality affected by seasonal changes
- Treatment capabilities are limited
- Can have odor issues
- Recovery time is extensive after upsets

How do ponds work?

Influent enters the pond sometimes proceeded by screening

Solids settle due to gravity

Microbes consume organics in the wastewater

Heavy solids settle to the bottom

Treated wastewater is discharged and some evaporates

Settled sludge removed periodically

Ponds have a liner to prevent seepage

Types of Wastewater Treatment Ponds

Aerobic- Microorganisms use oxygen to consume organics through cellular respiration

Anaerobic- Microorganisms that thrive in the absence of oxygen convert organic matter to methane (CH_4), carbon dioxide (CO_2), and water.

Facultative- Aerobic and anaerobic areas are stratified aloe for different chemical reactions at the top vs the bottom. These are the most common types of ponds used.

Aerobic Pond

Depth: 3-5 ft

Loading Rate: 15-20 lbs BOD/acre day, 50 lbs BOD/acre day if mechanically aerated

Detention Time: 10-20 days

Usually used as a polishing pond or final cell in a multistage pond system. Oxygen diffuses from the atmosphere and some additional oxygen provided by algae. UV from sunlight kills pathogens.

Anaerobic Pond

Depth: > 14 ft

Loading Rate: 200-1000 lbs BOD/acre day

Detention Time: 1-50 days

Used to treat industrial wastes and as storage. Organic wastes are treated through the fermentation process, which tends to decrease the pH of the wastewater.

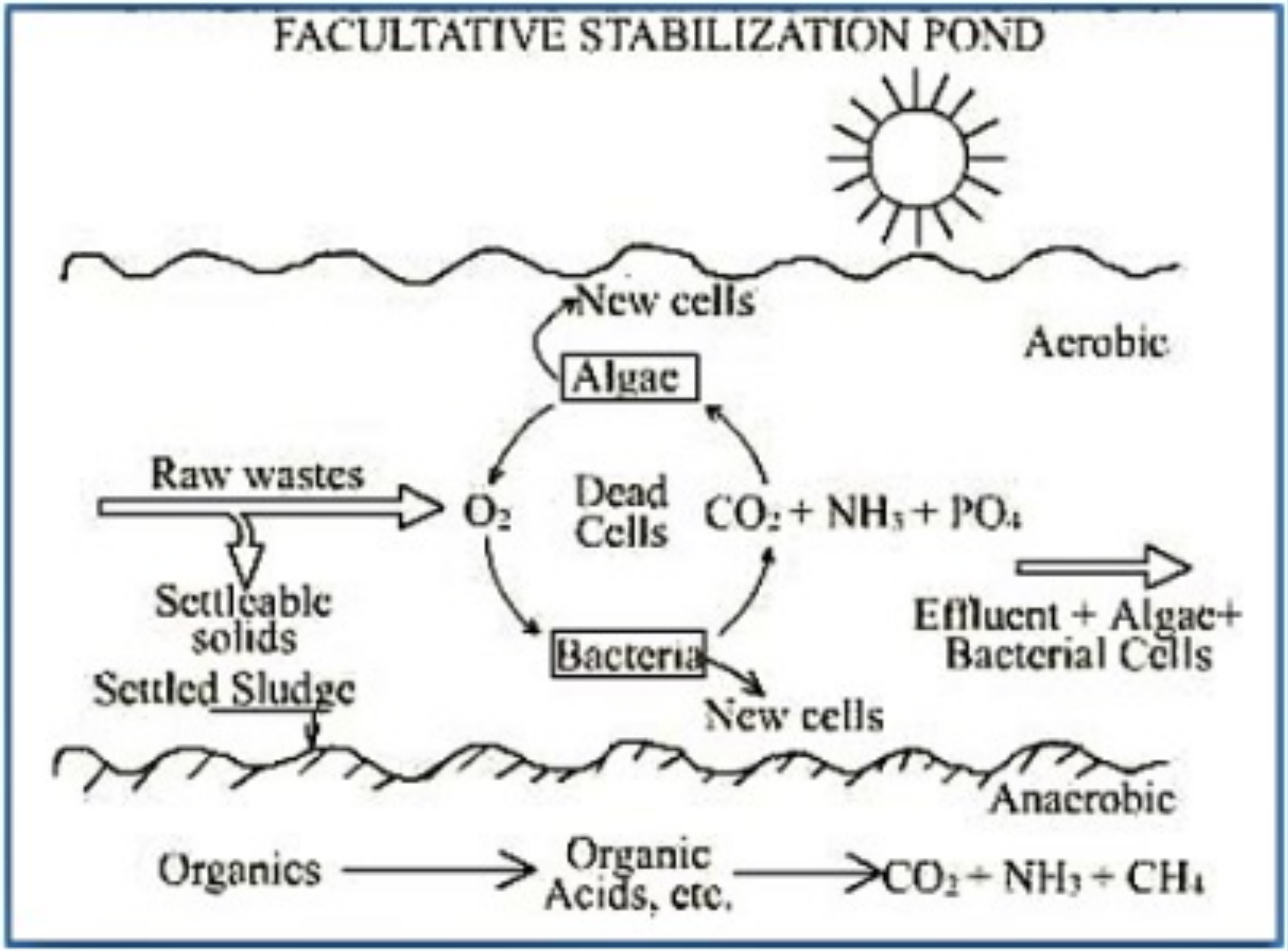
Facultative Pond

Depth: 4-8

Loading Rate: 15-50 lbs BOD/acre day

Detention Time: 30-60 days

Have anerobic layer at the bottom where settled solids are consumed and the top layer is where aerobic decomposition occurs. Hydrogen Sulfide produced at the bottom is consumed in the aerobic layer. Facultative bacteria use oxygen when available and live in anaerobic areas when there is no oxygen. Oxygen produced by algae with some from the atmosphere.


FACULTATIVE STABILIZATION POND
New cells
Aerobic
Algae
Raw wastes
O_2
Dead Cells
$CO_2 + NH_3 + PO_4$
Settleable solids
Settled Sludge
Bacteria
Effluent + Algae+ Bacterial Cells
New cells
Anaerobic
Organics
Organic Acids, etc.
$CO_2 + NH_3 + CH_4$

Aerobic Conditions

Algae produce oxygen through photosynthesis

Aerobic bacteria use oxygen to reduce BOD and produce CO_2

CO_2 is used by algae along with sunlight

Nitrification converts ammonia to nitrate and denitrification converts nitrate to nitrogen gas

Anaerobic Conditions

- Microorganisms hydrolyze proteins, carbohydrates, and fats, into fatty acids, amino acids, and sugars
- Fatty Acids, amino acids, and sugars are metabolized to organic acids and volatile fatty acids (VFAs) through acidogenesis
- Methanogens convert organic acids and VFAs to methane and CO2.
- BOD is reduced and some nutrients are removed

Algae Diurnal Cycle

Algae perform respiration in the absence of CO_2 and sunlight

CO_2 mixes with water to create carbonic acid (H_2CO_3)

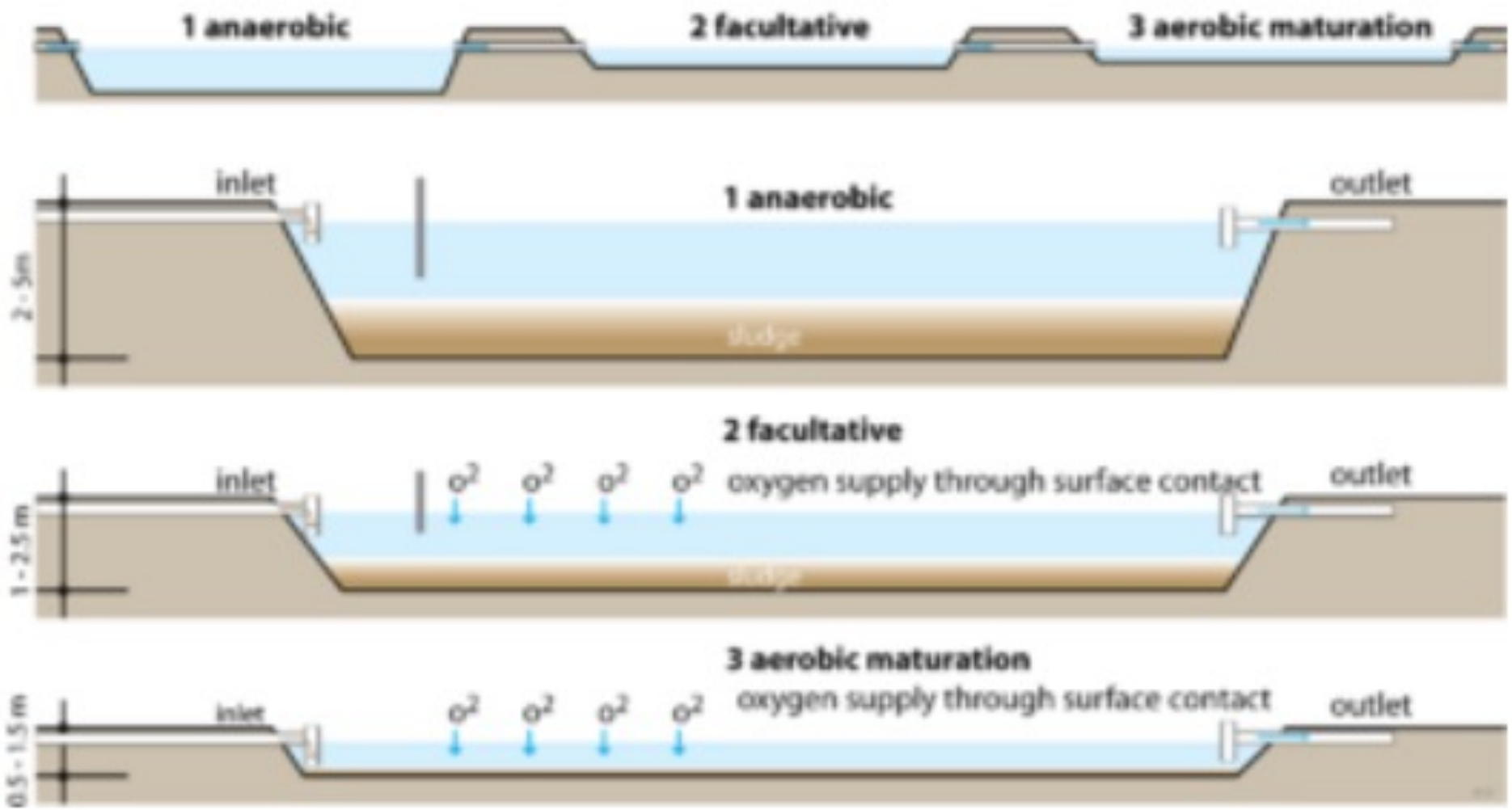
During the day pH is lowered, because algae consume CO_2 and there is less carbonic acid formation

At night pH increases as algae perform respiration and create CO_2 that forms carbonic acid

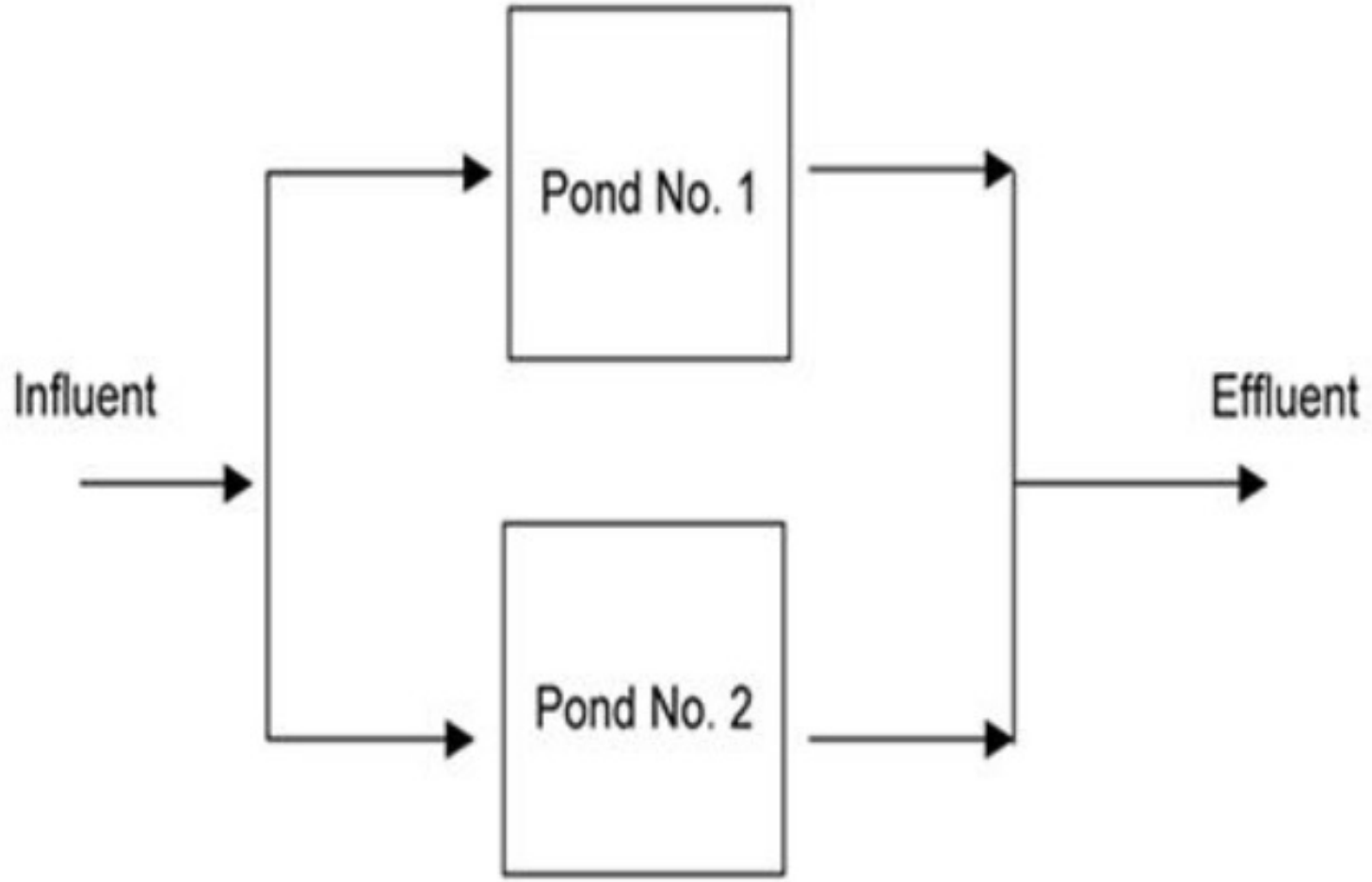
Pond Configuration

- Series- Ponds used in sequence
- Parallel- Ponds running simultaneously
- Oxidation Ponds in Series- Mechanically aerated ponds proceeded by a clarifier
- Polishing Ponds- Follow biological treatment and polish overall water quality. Shallow and aerobic.

Series Operation



Parallel Operation



Pond Operation and Maintenance

- Scum Control
- Odor Control
- Weed and Vegetation Upkeep
- Levee Maintenance
- Sludge Removal

Scum Control

Scum leads to odors, blockages, and operation issues

Scum is the layer of floating solids and grease

Skimming, baffles, and aeration can be used to reduce scum

Scum is an indicator of changing biological activity and is a larger problem in colder months

Odor Control

Odors can indicate overloading, poor housekeeping, and unwanted biological growth

If overloading occurs, influent should be diverted temporarily

Remove scum and excessive vegetation frequently

Floating aeration devices and recirculation can also be utilized

Weed and Vegetation Upkeep

- Weeds, duckweeds, and cattails inhibit pond performance
- Weed provide shelters for mosquitos and other nuisance insects
- Duckweed inhibits sunlight
- Cattails hinder air circulation
- Herbicides are a last resort

Levee Maintenance

- Levee slope erosion is caused by wave action or surface runoff from precipitation
- Easily erodible material can be supplemented with stones and rubble
- Install native low growing grasses
- Remove plants with long roots and burrowing animals

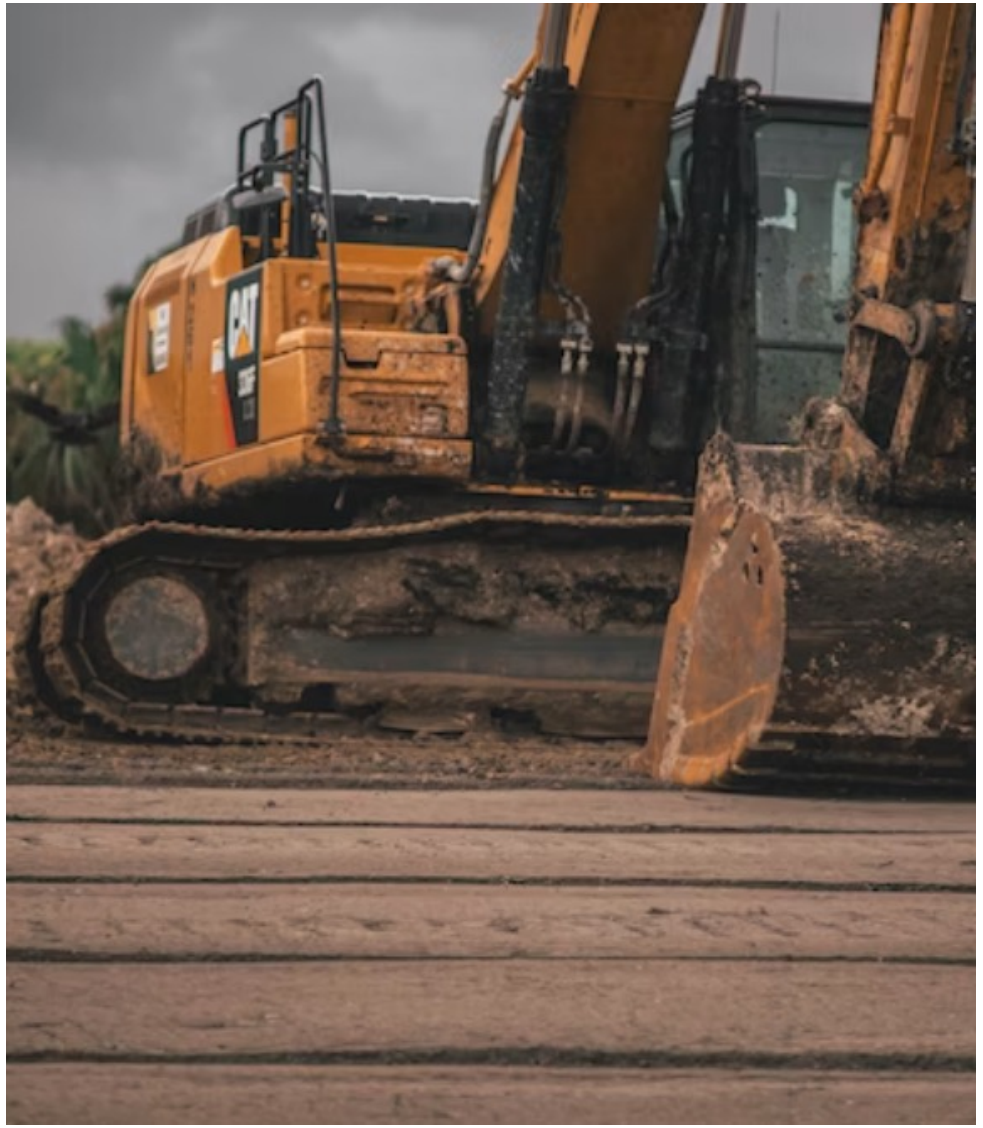
Sludge Removal

Sludge should be checked annually

Sludge must be removed to prevent reduced treatment efficiency, decreased capacity, odor production, algal blooms, risk of passthrough, and compliance issues

Pond should be drained and then the sludge dredged or vacuumed out

Sludge can be land applicated, dewatered, or incinerated



Pond Analysis and Regulations

- Test for pH, Temp, and dissolved oxygen (DO) regularly and at consistent times
- Ponds should be observed for visual characteristics
- BOD, TSS, and other water quality parameters are also important treatment and performance indicators, and permit requirements

pH and DO

- Desired pH is 7.5 or greater
- Primary Ponds: pH > 7.0, DO> 1 mg/L
- Secondary Ponds: pH > 8.0, DO > 5.0 mg/L
- pH and DO lowest at night

Visual Characteristics

- Color:
- Deep green = Good DO and high pH
- Dull green = declining pH and lowered DO
- Gray = Overloaded
- Also important to make sure liner is working properly along with any mechanical equipment such as aerators

BOD, TSS

- BOD and TSS should also be sampled at the influent to determine changes to loading and to meet permit requirements
- Effluent: BOD ~ 20-50 mg/L, TSS ~ 40-80 mg/L
- Ammonia, nitrogen, and chlorine are also important and usually permit specific
- These are important parameters that must be met for periodic discharging ponds

Safety Considerations

PPE during maintenance and sampling

The buddy system should be used during maintenance

- Especially if boats are required during maintenance

Approved flotation devices should be considered

Utilize signage to inform of drowning and contamination

Pond Math

$$Volume = SA \times D$$

$$Detention\ Time = \frac{Volume}{Flow\ Rate}$$

$$Hydraulic\ Loading\ Rate = \frac{Flow\ Rate}{SA}$$

$$Organic\ Loading\ Rate = \frac{Flow \times BOD\ Concentration}{SA}$$


Questions?

CONTACT INFORMATION

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