WASTEWATER LAGOONS TRAINING AND TROUBLESHOOTING

TYPES OF LAGOONS

- AEROBIC
- ANAEROBIC
- FACULTATIVE

AEROBIC

- Lagoons that have dissolved oxygen distributed throughout their contents all the time. Require additional source of oxygen to supplement the minimal amount that can be diffused from the atmosphere at the water surface. The additional source of oxygen may be supplied by algae, during sunlight hours, by mechanical agitation of the surface, or by bubbling air provided by compressors through the pond.

ANAEROBIC

- Lagoons that are without any dissolved oxygen throughout their entire depth. Treatment depends on fermentation of the sludge at the lagoon bottom. This process can be quite odorous under certain conditions. But, is highly efficient in destroying organic wastes. Anaerobic lagoons are mainly used for processing industrial wastes, although some domestic-waste lagoons will become anaerobic when they are badly overloaded.

FACULATIVE

- Lagoons are the most common type in current use. The upper portion of these lagoons is aerobic, while the bottom layer is anaerobic. Algae or surface type mechanical aerators supply the oxygen to the upper layer.

LAGOONS ARE DESIGNED TO:

- CONTINUOUS DISCHARGE
- CONTROLLED DISCHARGE
- NO DISCHARGE

CONTINUOUS DISCHARGE

- USUALLY DISINFECT THE PLANT EFFLUENT IN ORDER TO DESTROY THE PATHOGENIC (DISEASE CAUSING) ORGANISMS

CONTROLLED DISCHARGE

- WASTEWATER IS HELD FOR LONG PERIODS OF TIME BEFORE DISCHARGING.
- DISCHARGE PERIODS ARE USUALLY TWICE A YEAR
  - SPRING - SHORTLY AFTER THE ICE BREAKS UP
  - FALL - AFTER THE FIRST FROST

BASED ON TWO FACTORS

- CONDITION OF RECEIVING STREAM
- CONDITION OF LAGOON CONTENTS

NO DISCHARGE LAGOONS

- EVAPORTION RATE AND/OR GROUND PERCOLATION EQUALS OR EXCEEDS THE INFLUENT RATE

BIOCHEMISTRY OF A LAGOON

- The life cycle of a lagoon depends on a number of factors. Organisms, including algae, bacteria and protozoa depend on levels of dissolved oxygen nutrients and each other for viability.

ALGAE

- Microscopic plants present in lagoons. Green algae that belong to chlorella family are most common and stay near the surface of water. Algae depend on nitrogen, phosphorous, CO_2 and sunlight to carry on photosynthesis oxygen is a by product of photsynthesis.

BACTERIA

- Microscopic one celled organisms responsible for the majority of wastewater stabilization. Bacteria present in a lagoon operate either aerobically, anaerobically or in a facultative state.

AEROBIC BACTERIA

- Utilize dissolved oxygen during its life cycle to breakdown organic material. As these bacteria multiply and break down carbonaceous - BOD flocculation occurs and the cells settle. Byproducts of organic material breakdown are nutrients (N&P), CO_2, and water.

FACULATIVE BACTERIA

- These bacteria operate with or without oxygen. Facultative bacteria operate in the middle portion of a lagoon and use chemically bound oxygen for life activity. NO3, SO4 are utilized in respiration for life activities.

ANAEROBIC BACTERIA

- Thrive in conditions where dissolved oxygen is absent. In a lagoon, these bacteria degrade organics in the sludge layer. Sludge is formed by a combination of settable solids, flocculated bacteria from aerobic zone and dying algae that drops to bottom. H_2S, CH_4, CO_2, NH_3 are major byproducts from anaerobic activity.

PROTOZOA

- Indicate levels at which wastes have been stabilized. Protozoa feed on bacteria and algae and keep those numbers in check. Lig. Paramecium, vorticella, ciliates, daphnia.

- All of the above mentioned work together to stabilize wastewater. Lagoons are the most natural form of treatment in the wastewater industry. However, an imbalance in nutrients or abnormal loadings can inhibit natural action or encourage one group of organisms to dominate leading to other problems

Nutrient balance for bacteria. Optimum ration of carbon, nitrogen, phosphorous

- For every 100 mg/l of carbonaceous BOD There should be 5 mg/l of NH_3-N 1 mg/l of P_3

- To alleviate abnormal loadings or inhibitory substances, a growing part of lagoon treatment is utilizing bioaugmentation to break up sludge blankets and improve BOD, SS & NH_3-N removal.

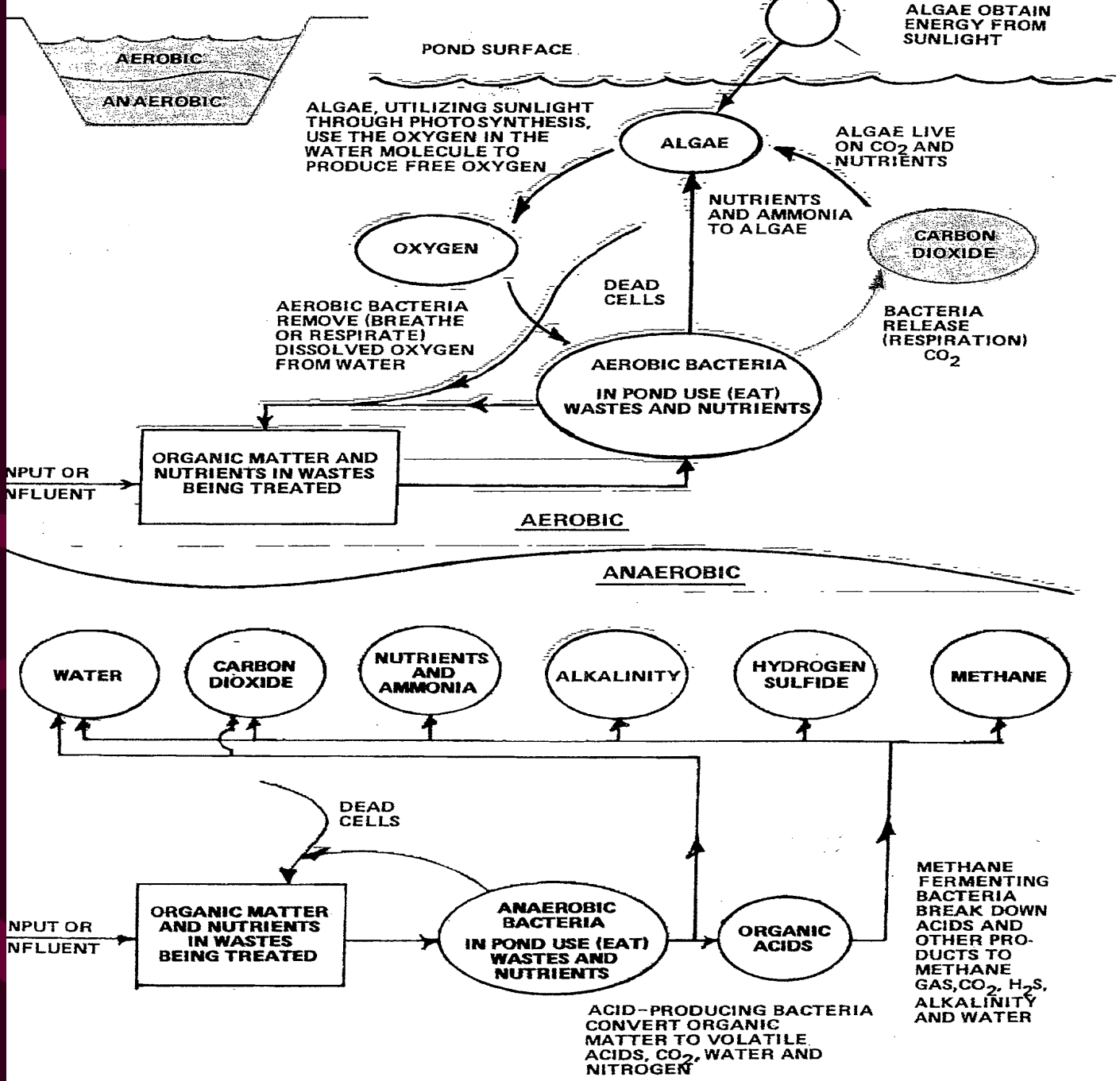


Fig. 9.4 Process of decomposition in aerobic and anaerobic layers of a pond

DESIGN CONSIDERATIONS

CAPABILITY TO MOVE WATER AROUND WITHIN THE SYSTEM

- Pre-mixing lagoon contents with influent to supply oxygen to raw wastewater
- Portable pumps or pond recirculation

MULTIPLE INLETS AND OUTLETS

- IMPROVES LAGOON CIRCULATION

INTER-LAGOON TRANSFER PIPES WITH VALVES OR GATES

- PERMITS INDIVIDUAL LAGOON LEVEL
- OPERATE AT OPTIMUM LAGOON LEVEL
  - Example: Primary cell operates well at 8 foot water depth. Final cell operates better at 3 foot water depth.

OUTLET STRUCTURE

- PERMITS CONTROL OF LAGOON DEPTHS
- CONTROL OF DISCHARGE RATE

ODOR CONTROL

- RESULT OF OVER LOADING
- LONG PERIODS OF CLOUDY WEATHER
- POOR LAGOON CIRCULATION
- INDUSTRIAL WASTES
- ICE MELT

ODOR SOLUTIONS

- Run system in parallel to reduce loading
  - Apply chemicals:
    - Bacteria
    - Nitraid

INSTALL SUPPLEMENTAY AERATION

RECIRCULATE LAGOON EFFLUENT TO LAGOON INFLUENT

ELIMINATE SEPTIC OF HIGH-STRENGTH INDUSTRIAL WASTES

ANIMAL CONTROL

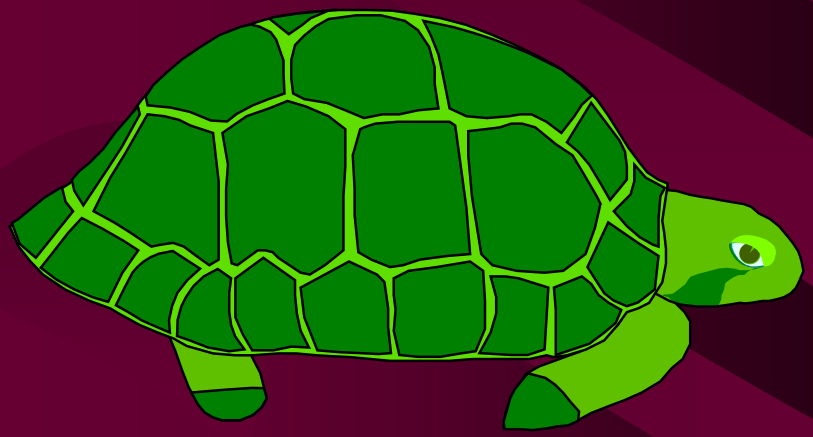
- BURROWING ANIMALS: CAUSE DIKE ERROSION
  - REMOVE FOOD SUPPL: CATTAILS, BURR REED
  - MUSKRATES: RAISE AND LOWER LAGOON (6-8 INCHES) OVER SEVERAL WEEKS SO AS TO FLOOD TUNNEL AND EXPOSE TUNNEL
  - CHECK WITH GAME COMMISSION ABOUT APPROVAL METHODS, SUCH AS LIVE TRAPPING

ANIMAL CONTROL (cont.)

- GEESE: CAUSE HIGH FECAL COUNTS IN EFFLUENT, AND POSSIBLE AMMONIA INCREASE?
  - Dog has best result
  - Chicken wire on banks
  - Blanks from shot gun
  - Fox?

ANIMAL CONTROL (cont.)

- TURTLES: Can burrow up to two feet in bottom of lagoon
  - Trap and release in nearby stream



CONTROL DIKE VEGETATION

- HIGH WEEDS PROMOTE ANIMAL NESTING PLACES FOR ANIMALS
  - CAN CAUSE WEAKENING OF THE DIKE
  - UNSIGHLTLY APPEARANCE
  - REDUCES WIND ACTION

DIKE VEGETATION CONTROL SOLUTIONS

- MOWING: BEST METHOD
- SPRAY WITH APPROVED WEED CONTROL CHEMICALS
- PULL WEEDS BY HAND
- GRAZING (MAY INCREASE FECAL COLIFORM EFFLUENT
- LOWER POND LEVEL AND BURN OFF

SCUM CONTROL

- CAUSES
  - Pond bottom is turning over with sludge floating to the surface
  - Poor circulation and wind action
  - High amounts of grease and oil in influent

SCUM CONTROL (cont.)

- SOLUTIONS
  - Break up scum with high pressure hoses, pumps, fire truck. Scum usually sinks once broken up.
  - Remaining scum should be removed and buried or hauled to landfill.

OPERATION AND MAINTENANCE GOALS FOR LAGOONS

1. Meet NPDES discharge levels
2. Discharge when it has the best quality with least effect on receiving stream.
3. Primary cells should have a deep green sparkling color (high D.O.)
4. Secondary or final cells high in D.O.
5. Wave action on surface when wind is blowing

OPERATION AND MAINTENANCE GOALS FOR LAGOONS

6 No weeds growing in water or on banks

7 Dikes are well seeded above water line and grass is kept mowed

8 Erosion is controlled by riprap

9 Inlet and outlet structures are kept clean of debris, grease, scum, etc.

1 0 Mechanical equipment is well maintained

1 1 A schedule for getting things done

OPERATION CONSIDERATIONS FOR AERATED LAGOONS

- Maintain a minimum of 1 mg/l DO
- Aerators should produce good turbulence and a light amount of froth
  - Monitor DO at aerated cell outlet daily
  - Keep large debris out of lagoon that will damage aerators

OPERATION CONSIDERATIONS FOR AERATED LAGOONS

- For diffused air systems that use blowers:
  - Check blower daily
  - Visually inspect aeration pattern for dead spots
  - Measure DO at several points weekly in the lagoon and adjust to maintain even distribution
- Periodic maintenance must be performed, such as lubrication, adjustment and replacement. Make a checklist of maintenance tasks frequency from the manufacturer’s instructions.

OPERATION AND PREVENTATIVE MAINTENANCE

- PLANT SURVEY: Drive around perimeters of lagoons taking notes of the following conditions:
  - Daily: Any buildup of scum on pond surface and discharge outlet boxes.
  - Daily: Sings of burrowing animals
  - Daily: Anaerobic conditions. Noted by odor and black color
  - Daily: Water grown weeds

OPERATION AND PREVENTATIVE MAINTENANCE cont.

- Daily: Evidence of dike erosion
- Daily: Dike leakage
- Daily: Fence damage
- As needed: Ice buildup in winter
- Daily: Evidence of short circuiting

OPERATION AND PREVENTIVE MAINTENANCE (cont.)

- Mechanical Equipment: Check mechanical equipment and perform scheduled preventive maintenance on the following pieces of equipment according to the manufacturer’s recommendations.

Pump Stations

A .	Daily:	Remove debris
B .	Daily:	Check pump operation
C .	Weekly:	Run emergency generator
D .	Daily:	Log run times
E .	Weekly:	Clean floats, bubblers, or other control devises
F .	Per Manufacturer:	Lubricate

Comminuting Devices

A . Weekly: Check cutters

B . Per Manufacturer Lubricate

Aerators

A .	Daily:	Record run times
B .	Monthly	Check Amperage
C .	Per Manufacturer	Lubricate

Chlorinators

A . Daily:

B . As needed

Check feed rate

Change Cylinders (two people)

Flow Measuring Device

A . Daily: Check and clean floats, etc.

B . 3 Months Verify accuracy

Valve and gates

A . Daily: Check to see if set correctly

B . Monthly: Open and close to be sure they operate

BREAK TIME!!