APPENDIX F-1 & F-2

# Study Guides for Pond Operators

# Appendix F-1

# STUDY GUIDE

# INTRODUCTION TO STABILIZATION PONDS AND AERATED LAGOONS

SUBCLASS D

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF SCIENCE SERVICES
OPERATOR CERTIFICATION PROGRAM
http://dnr.wi.gov/org/es/science/opcert/

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* Note – As of Jan 2010, this study guide cont ains objectives plus key knowledges.

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## PREFACE

This operator's study guide represents the results of an ambitious program. Operators of wastewater facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subclass.

The objectives in this study guide have been organized into modules, and within each module they are grouped by major concepts.

**NOTE:** As of January 2010, this study guide also includes key knowledges.

## HOW TO USE THESE OBJECTIVES WITH REFERENCES

In preparation for the exams, you should:

1. Read all of the key knowledges for each objective.
2. Use the resources listed at the end of the study guide for additional information.
3. Review all key knowledges until you fully understand them and know them by memory.

**IT IS ADVISABLE THAT THE OPERATOR TAKE CLASSROOM OR ONLINE TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.**

### Choosing A Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates is available on the DNR Operator Certification home page http://dnr.wi.gov/org/es/science/opcert/ It can also be found in the annual DNR "Certified Operator" or by contacting your DNR regional operator certification coordinator.

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## INTRODUCTION TO THE OPERATION OF PONDS AND LAGOONS

## MODULE A: PRINCIPLE, STRUCTURE AND FUNCTION

### CONCEPT: PRINCIPLE OF PONDS

**1.** Explain the reasons for using Ponds to treat wastewater.

**PONDS HAVE HISTORICALLY BEEN USED TO PROVIDE DETENTION TIME FOR WASTEWATER TO ALLOW IT TO BE STABILIZED THROUGH NATURAL PROCESSES. WASTEWATER IS TREATED BY THE ACTION OF BACTERIA (BOTH AEROBIC AND ANAEROBIC), OTHER MICRO AND MACRO ORGANISMS, ALGAE, AND BY THE PHYSICAL PROCESS OF GRAVITY SETTLING. WHEN PROPERLY DESIGNED, PONDS ARE CAPABLE OF PROVIDING THE EQUIVALENT OF SECONDARY TREATMENT FOR BOTH BOD AND SUSPENDED SOLIDS.**

**2.** Discuss the advantages and disadvantages of Pond systems as compared to bio-mechanical systems for wastewater treatment.

| ADVANTAGES | DISADVANTAGES |
|---|---|
| * LOW CONSTRUCTION COST | * LARGE LAND REQUIREMENTS |
| * LOW OPERATIONAL COST | * POSSIBLE GROUNDWATER CONTAMINATION FROM LEAKAGE |
| * LOW ENERGY USAGE | * CLIMATIC CONDITIONS AFFECT TREATMENT |
| * CAN ACCEPT SURGE LOADINGS | * POSSIBLE SUSPENDED SOLIDS PROBLEMS (ALGAE) |
| * LOW CHEMICAL USAGE | * POSSIBLE SPRING ODOR PROBLEMS (AFTER ICE-OUT) |
| * FEWER MECHANICAL PROBLEMS | * ANIMAL PROBLEMS (MUSKRATS, TURTLES,ETC.) |
| * EASY OPERATION | * VEGETATION PROBLEMS (ROOTED WEEDS,DUCKWEED,ALGAE) |
| * NO CONTINUOUS SLUDGE HANDLING | * LOCALIZED SLUDGE PROBLEMS (DEPOSITION NEAR INLET) |

**3.** Describe the following types of ponds:

A. Areobic.
B. Anaerobic.
C. Aerated.
D. Facultative.

**A. AEROBIC: AN AEROBIC POND SYSTEM WOULD HAVE OXYGEN DISTRIBUTED THROUGHOUT THE ENTIRE AREA. THIS WOULD BE SIMILAR TO A CLEAN LAKE WITH ANAEROBIC CONDITIONS OCCURRING ONLY IN BOTTOM SED-IMENTS. THIS CONDITION WOULD PROBABLY ONLY OCCUR IN A TREATMENT SYSTEM UPON INITIAL START-UP WHEN THE POND WOULD BE FILLED WITH A CLEAR WATER SOURCE, OR WHEN COMPLETELY MIXED WITH SUPPLEMENTAL AIR.**

**B. ANAEROBIC: AN ANAEROBIC POND WOULD BE DEVOID OF ALL OXYGEN THROUGHOUT THE ENTIRE AREA. THIS TYPE OF POND SYSTEM WOULD ONLY BE USED IN SPECIAL APPLICATIONS, USUALLY FOR TREATING CERTAIN INDUSTRIAL WASTES. IF A NORMAL POND SYSTEM IS TOTALLY ANAEROBIC, IT IS ORGANICALLY OVERLOADED. THE ONLY EXCEPTION WOULD BE UNDER ICE COVER FOR A FILL AND DRAW TYPE FACILITY.**

**C. AERATED: AN AERATED POND SYSTEM WOULD HAVE SUPPLEMENTAL AIR SOURCES TO PROVIDE DISSOLVED OXYGEN. THIS IS USUALLY ACCOMPLISHED WITH SURFACE MECHANICAL AERATORS AND MIXERS, OR BY VARIOUS FORMS OF DIFFUSERS SUPPLIED WITH COMPRESSED AIR FROM MECHANICAL BLOWERS OR COMPRESSORS. FOR EQUAL SIZED PONDS, THE AERATED POND WOULD PROVIDE THE BEST TREATMENT DUE TO THE MECHANICAL ADDITION OF OXYGEN, AND FOR A GIVEN ORGANIC LOADING, WOULD REQUIRE THE LEAST AMOUNT OF LAND AREA.**

**D. FACULTATIVE: MOST STABILIZATION POND FACILITIES ARE OF THIS TYPE. THE POND CONTAINS AN AEROBIC SURFACE ZONE, AN ANAEROBIC BOTTOM ZONE, AND A TRANSITIONAL (FACULTATIVE) ZONE IN BETWEEN. THIS ALLOWS AEROBIC ORGANISMS TO FUNCTION IN THE UPPER AREA, ANAEROBIC ORGANISMS IN THE LOWER AND SLUDGE AREA, AND FACULTATIVE ORGANISMS IN THE MIDDLE AREA. A FACULATIVE ORGANISM CAN USE DISSOLVED OXYGEN OR COMBINED OXYGEN, BECAUSE THEY CAN ADAPT TO CHANGING CONDITIONS. THEY CAN CONTINUE DECOMPOSITION WHEN THE SYSTEM CHANGES FROM AEROBIC TO ANAEROBIC, ORFROM ANAEROBIC TO AEROBIC.**

**4.** Discuss the relationship between bacteria and algae in a Pond system.

**IN ANY WASTEWATER POND, TREATMENT IS ACCOMPLISHED BY A COMPLEX COMMUNITY OF ORGANISMS. THEY WORK IN AN INTERACTION WITH EACH OTHER WHICH IS MUTUALLY BENEFICIAL. ALGAE, LIKE ALL GREEN GROWING MATTER, USES NUTRIENTS AND CARBON DIOXIDE**

**IN THE PRESENCE OF SUNLIGHT TO PRODUCE OXYGEN IN A PROCESS CALLED PHOTOSYNTHESIS. THE OXYGEN PRODUCED IS USED BY BACTERIA TO ASSIMILATE ORGANIC MATTER, BREAKING IT DOWN INTO SIMPLER MATERIALS AND RELEASING CARBON DIOXIDE TO BE USED BY THE ALGAE.**

**CONCEPT: STRUCTURE AND FUNCTION**

**5.** Draw line diagrams of three Ponds in Series and in Parallel operation.

**SERIES:**

**INCOMING ---> POND ---> POND ---> POND --->DISCHARGE**
**WASTE #1 #2 #3 OF TREATED**
**STREAM EFFLUENT**

**PARALLEL:**

**POND#1**
**INCOMING DISCHARGE**
**WASTE ---> ---> POND#3 --------> OF TREATED**
**STREAM EFFLUENT**
**POND#2**

**6.** Explain the function of each part of the following parts of a Pond system:

A. Dikes.
B. Pond Seal.
C. Inlet and Outlet Water Control.
D. Flow Meter/Weirs.
E. Headworks/Screening.
F. Rip Rap.

**A. DIKES - THE POND SIDES WHICH GIVE THE POND IT'S DEPTH AND STRUCTURE.**

**B. POND SEAL - A CLAY OR SYNTHETIC LINER THAT KEEPS WASTEWATER FROM PERCOLATING INTO THE GROUNDWATER.**

**C. WATER CONTROL STRUCTURES:**

**1. INLET - THE PIPING ARRANGEMENT THROUGH WHICH WASTEWATER IS INTRODUCED INTO THE POND.**
**2. OUTLET - THE STRUCTURE TO MAINTAIN THE SELECTED POND WATER LEVEL AND ALLOW TREATED WASTE TO FLOW OUT.**

**D. FLOW METER/WEIRS - DEVICES TO MEASURE INCOMING OR DISCHARGED WASTEWATER FLOW RATES.**

E. **HEADWORKS/SCREENING - SOMETIMES PROVIDED TO REMOVE RAGS AND LARGE OBJECTS.**

F. **RIP RAP - ROCK OR STONE PLACED AT NORMAL POND OPERATING LEVELS TO PREVENT EROSION OF THE DIKES THAT COULD OCCUR FROM WIND ACTIONS.**

**7.** Describe two common kinds of pond water level control structures.

**A. SUBMERGED PIPE OUTLET WITH WATER LEVEL CONTROL BOARDS BOARDS ARE REMOVED OR ADDED TO RAISE OR LOWER THE POND LEVEL (USUALLY IN A MANHOLE).**

**B. TELESCOPING VALVE - A TELESCOPING PIPE SECTION THAT CAN BE RAISED OR LOWERED TO CONTROL WATER LEVELS (USUALLY IN A MANHOLE-LIKE STRUCTURE).**

**8.** State two important functions of an Aeration System.

**A. IT ADDS DISSOLVED OXYGEN TO THE POND CONTENTS.**
**B. IT MIXES THE POND CONTENTS.**

**9.** Describe the function of each of the following components of a Pond Aeration System:

A. Compressors/Blowers.
B. Airlines.
C. Diffusers.
D. Mechanical Aeration.

**A. COMPRESSORS/BLOWERS: USED TO PROVIDE LOW PRESSURE AIR USED IN THE POND AERATION SYSTEM.**

**B. AIRLINES: A PIPING SYSTEM USED TO CONVEY COMPRESSED AIR TO THE POINTS OF APPLICATION.**

**C. DIFFUSERS: VARIOUS TYPES OF EQUIPMENT USUALLY LOCATED NEAR THE POND BOTTOM. USED TO FORM BUBBLES IN THE POND LIQUID TO ENTRAIN OXYGEN AND PROVIDE MIXING.**

**D. MECHANICAL AERATION: SEVERAL DIFFERENT TYPES OF EQUIPMENT (USUALLY ON FLOATS) THAT SPRAY THE WATER INTO THE AIR TO ENTRAIN OXYGEN AND PROVIDE MIXING.**

**10.** Discuss the purpose of a Blower Air Relief Valve in a Pond Aeration System.

**IN THE EVENT OF EXCESS PRESSURE (PLUGGED DIFFUSERS OR AIR LINES) THE PRESSURE RELIEF VALVE WILL OPEN TO RELEASE EXCESS PRESSURE AND PROTECT THE PIPING, DIFFUSERS, AND THE BLOWER.**

**11.** Describe what is meant by the term "freeboard" in a Pond system.

**FREEBOARD IS THE DISTANCE BETWEEN THE NORMAL MAXIMUM OPERATING WATER SURFACE OF THE POND, AND THE TOP OF THE DIKE. FREEBOARD IS NORMALLY 3 FEET (MEANING THE WATER LEVEL SHOULD BE KEPT WITHIN 3 FEET FROM THE DIKE TOP).**

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## MODULE B: OPERATION AND MAINTENANCE

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### CONCEPT: OPERATION

**12.** Describe series and parallel modes of Pond operation, and state conditions when each should be used.

**A STABILIZATION POND SYSTEM IS USUALLY COMPOSED OF A NUMBER OF INDIVIDUAL CELLS(PONDS) AND CAN BE OPERATED IN SEVERAL MODES.**

**SERIES: IN THIS MODE THE FLOW GOES THROUGH EACH CELL(POND) IN SUCCESSION (E.G. PRIMARY CELL TO SECONDARY CELL TO TERTIARY CELL). THIS TYPE OF FLOW PATTERN NORMALLY PROVIDES THE BEST DEGREE OF TREATMENT AND MINIMIZES ALGAE IN THE EFFLUENT.**

**PARALLEL: IN THIS MODE OF OPERATION THE INFLUENT FLOW IS DIVIDED INTO TWO OR MORE PRIMARY CELLS. PARALLEL OPERATION IS NORMALLY USED WHEN LOADINGS EXCEED DESIGN LEVELS, WHEN ORGANIC OVERLOADS ARE EXPECTED,OR DURING WINTER CONDITIONS WHEN CLIMATIC CONDITIONS REDUCE THE AMOUNT OF DISSOLVED OXYGEN.**

**13.** Discuss why some Ponds have difficulty meeting suspended solids limits.

**THE MOST COMMON PROBLEM IN MEETING SUSPENDED SOLIDS LIMITS IN POND SYSTEMS WOULD BE EXCESSIVE ALGAE GROWTH BEING DISCHARGED WITH THE FINAL EFFLUENT. OTHER MINOR PROBLEMS**

**THAT COULD CAUSE SUSPENDED SOLIDS EFFLUENT PROBLEMS ARE RISING SLUDGE, AND SOMETIMES ABUNDANT ZOOPLANKTON (SUCH AS DAPHNIA).**

**14.** Explain why an operator should prefer to have a Pond dominated by green algae.

**GREEN ALGAE IS THE PREFERRED SPECIES THAT INDICATES A PROPERLY FUNCTIONING POND SYSTEM. IF BLUE-GREEN ALGAE TAKE OVER (USUALLY INDICATING ORGANIC OVERLOADING), THEY CAN CAUSE BLACK-GREEN FLOATING MATS. THIS CAN CAUSE OPERATIONAL PROBLEMS SUCH AS SHORT-CIRCUITING, REDUCTION OF MIXING, POOR LIGHT PENETRATION, MAT REMOVAL PROBLEMS, ODOR, AND GENERAL UNSIGHTLINESS. SPRING TURN-OVER MAY CAUSE A BLUE-GREEN ALGAE BLOOM.**

**15.** List ways most Ponds gain Dissolved Oxygen.

**A. PHOTOSYNTHESIS BY ALGAE WITHIN THE POND(MAIN SOURCE OF OXYGEN IN MOST POND TYPE SYSTEMS, ESPECIALLY SHALLOW PONDS IN THE 3-5 FOOT DEPTH RANGE).**
**B. DIFFUSION OF ATMOSPHERIC OXYGEN AT THE POND SURFACE WITH THE ACTION OF THE WIND PROVIDING MIXING OF THE OXYGEN RICH SURFACE LAYER WITH THE WATER BELOW.**
**C. THE USE OF COMPRESSED AIR SYSTEMS OR SURFACE MECHANICAL AERATORS.**

**16.** Explain why dissolved oxygen concentrations vary with Pond depth.

**OXYGEN LEVELS VARY WITH DEPTH FOR A NUMBER OF REASONS. THE MAIN REASON IS THE RELATIONSHIP OF THE ORGANISMS WITHIN THE POND. OTHER REASONS ARE THE PHYSICAL ACTIONS WITHIN THE POND, AND THE LOADING TO THE POND.**

**THE RELATIONSHIP OF ORGANISMS INVOLVES THE GENERAL INTERACTION BETWEEN ALGAE AND BACTERIA. THE ALGAE ARE THE MAIN SOURCE OF OXYGEN IN A POND SYSTEM. ALGAE GROWTH IS GREATEST NEAR THE SURFACE WHERE LIGHT PENETRATION AND PHOTOSYNTHESIS IS THE GREAT- EST. OXYGEN LEVELS DECREASE WITH DEPTH, DUE TO LESS LIGHT PENETRATION NEEDED FOR PHOTOSYNTHESIS.**

**THE ALGAE USE CARBON DIOXIDE IN THE PROCESS OF PHOTOSYNTHESIS AND PRODUCE OXYGEN. THE BACTERIA STABILIZE ORGANIC MATTER USING THE OXYGEN AND PRODUCE CARBON DIOXIDE.**

**THE PHYSICAL DIFFUSION OF ATMOSPHERIC OXYGEN OCCURS AT THE SURFACE OF PONDS AND IS MIXED IN THE UPPER LAYERS BY WIND ACTION. THE AMOUNT OF MIXING IS LIMITED, SO THE OXYGEN LEVELS DECREASE WITH DEPTH.**

**THE FINAL FACTOR AFFECTING OXYGEN LEVELS IS THE ORGANIC LOADING TO THE SYSTEM. IF ORGANIC LOADINGS ARE SMALL, THE OXYGEN LEVELS WILL BE MAINTAINED AT GREATER DEPTHS. IF ORGANIC OVERLOADING OCCURS, THE WHOLE POND COULD GO ANAEROBIC.**

**17.** List the steps to follow during start-up of a Pond system.

**A. FILL WITH CLEAR WATER (RIVER OR WELL WATER) IF IT HAS A PLASTIC LINING, PARTLY FULL IF IT HAS A CLAY SEAL. THIS APPROACH PREVENTS WEEDS, DRYING OF THE POND, AND PREVENTS ODORS WHEN SEWAGE IS ADDED.**

**B. CONDUCT LEAKAGE TESTS.**

**C. BEGIN ADDING RAW WASTEWATER.**

**18.** Describe strategies to use when operating a Fill and Draw Pond system.

**FILL AND DRAW POND SYSTEMS ARE DESIGNED FOR INTERMITTENT DIS-CHARGE. DISCHARGES ARE USUALLY IN THE SPRING AND FALL WHEN STREAM FLOWS ARE HIGH AND TEMPERATURES LOW. LOW TEMPERATURE ALLOWS MORE OXYGEN TO BE DISSOLVED IN WATER. IT IS NECESSARY TO HAVE A HOLDING CAPACITY FOR A MINIMUM OF SIX MONTHS FLOW. SAMPLING OF THE POND TO BE DISCHARGED IS REQUIRED AND APPROVAL MUST BE OBTAINED FROM THE DNR.**

**19.** Explain the conditions that indicate times to Drawdown and to Fill a Pond.

**A. DRAWDOWN:**

**A POND SHOULD BE DRAWN DOWN IN FALL AFTER THE FIRST FROST AND WHEN THE ALGAE CONCENTRATION DROPS OFF, THE BOD IS STILL LOW, AND WHEN THE RECEIVING STREAM TEMPERATURE IS LOW WITH ACCOMPANYING HIGH DISSOLVED OXYGEN.**
**A POND SHOULD BE DRAWN DOWN IN SPRING BEFORE ALGAE CONCENTRATION INCREASES, WHEN THE BOD LEVEL IS ACCEPTABLE, AND WHEN THE RECEIV-ING STREAM FLOWS ARE HIGH (LOW TEMPERATURE WITH HIGH DISSOLVED OXYGEN HELPS). DURING THE ACTUAL DISCHARGE, THE EFFLUENT MUST BE SAMPLED FOR BOD, SUSPENDED SOLIDS AND pH AT A FREQUENCY SPECIFIED IN THE DISCHARGE PERMIT.**

**TO DRAW DOWN A POND, ISOLATE THE POND, IF POSSIBLE, ONE MONTH BEFORE THE DISCHARGE PERIOD. BEGIN TESTING TO MONITOR POND CONTENTS FOR BOD, SUSPENDED SOLIDS, AND pH. SEND RESULTS TO THE DNR AND OBTAIN APPROVAL TO DISCHARGE. CALCULATE WHAT VOLUME WILL BE NEEDED FOR STORAGE, AND DISCHARGE AT LEAST THAT AMOUNT. DETERMINE FROM THE DISCHARGE PERMIT DAILY DISCHARGE VOLUME, AND CALCULATE TOTAL DAYS**

**REQUIRED FOR DISCHARGE. CALCULATE, OR USE A CHART PROVIDED BY THE DESIGN ENGINEER, TO FIND WHAT LEVEL THE POND WILL BE LOWERED AND HOW MANY INCHES/DAY IT WILL DROP. PONDS ARE NEVER COMPLETELY DRAWN DOWN AS THIS COULD DRY OUT THE SEAL AND CAUSE LEAKAGE.**

**B. FILL A POND:**

**ALWAYS LEAVE AT LEAST ONE OR TWO FEET OF TREATED WASTEWATER IN A POND SO THE WASTEWATER WILL HAVE AN ACTIVE BACTERIAL CONCENTR-ATION. THIS GREATLY AIDS IN MAINTAINING OXYGEN AND PREVENTS ODORS OR ORGANIC UPSETS. IF POSSIBLE, FILL AS SLOWLY AS POSSIBLE, STARTING WITH THE PRIMARY POND. IF THERE ARE TWO OR MORE PRIMARIES, ALTERNATE FLOW TO EACH ON A DAILY BASIS. CONTINUE FILLING THE PRIMARY UNTIL IT IS FULL. THIS MAY TAKE SEVERAL MONTHS. ALLOW FLOW OF THE PRIMARY POND CONTENTS TO THE SECONDARY POND.**

**20.** List the reasons why an operator would vary Pond levels.

**A. TO DRAW DOWN THE CELL.**
**B. TO HOLD CONTENTS LONGER AND ALLOW MORE TREATMENT AND DETENTION TIME ( ESPECIALLY IN WINTER ).**
**C. TO REPAIR AERATION EQUIPMENT OR OTHER STRUCTURE.**
**D. TO REPAIR LEAKS.**
**E. TO CONTROL MUSKRATS.**
**F. TO CONTROL ROOTED WEEDS.**
**G. TO FLOOD CUT CATTAILS.**

**21.** Describe the proper operation of Multiple Seepage Cells.

**THE BEST OPERATION IS LOAD AND REST. DRYING OCCURS BETWEEN LOAD-INGS SO AN AEROBIC ZONE IS MAINTAINED IN THE SOIL. ALTERNATE EVERY THREE WEEKS, TO A MONTH. BEFORE DISCHARGING TO A SEEPAGE CELL, THE POND CONTENTS MUST BE MONITORED FOR BOD AND SUSPENDED SOLIDS. WHEN A DISCHARGE IS OCCURRING, A DAILY CHECK FOR THE VOLUME TO THE SEEPAGE CELL AND THE DEPTH OF WATER IN THE CELL IS APPROPRIATE. THE FLOW SHOULD BE UNIFORMLY DISTRIBUTED ACROSS THE ENTIRE SEEPAGE CELL.**

**22.** Discuss how to transfer liquid from cell to cell.

**IN A 2-CELL SYSTEM, ISOLATE CELL#2, DRAW DOWN CELL#2 FIRST, THEN REFILL CELL#2 FROM CELL#1. CONTROL VALVES BETWEEN CELLS ARE REGULATED SO THE TRANSFERS ARE GRADUAL.**

**23.** Describe how to check for efficient aeration of a Pond.

**MONITOR POND DISSOLVED OXYGEN, WATCH SURFACE AERATION PATTERNS FOR CHANGES, READ AIRLINE PRESSURE GAUGE, CHECK FOR CHANGES IN EFFLUENT BOD, AND MONITOR ALL AERATION EQUIPMENT. FOR PROPER TREATMENT, AN AERATED POND SHOULD HAVE AN**

**ADEQUATE SUPPLY OF DISSOLVED OXYGEN. FOR PRACTICAL PURPOSES, THE DISSOLVED OXYGEN IN THE SURFACE MIXED ZONE SHOULD AVERAGE APPROXIMATELY 2 mg/L.**

**24.** Explain why pH values vary in a Pond.

**THE VARIATION IN pH IN A FACULTATIVE POND NORMALLY OCCURS IN THE UPPER AEROBIC ZONE, WHILE THE ANAEROBIC AND FACULTATIVE ZONES WILL BE RELATIVELY CONSTANT. THIS VARIATION HAPPENS DUE TO THE CHANGES THAT OCCUR IN THE CONCENTRATION OF DISSOLVED CARBON DIOXIDE. WHEN CARBON DIOXIDE IS DISSOLVED IN WATER IT FORMS A WEAK CARBONIC ACID WHICH WOULD TEND TO LOWER pH. THE RELATIONSHIP BETWEEN ALGAE AND BACTERIA AFFECT THE CARBON DIOXIDE LEVELS. DURING INTENSE PHOTOSYNTHESIS, ALGAE USE CARBON DIOXIDE AND PRODUCE OXYGEN TO BE USED BY BACTERIA TO ASSIMILATE ORGANIC WASTES. THE ALGAE USE MUCH OF THE CARBON DIOXIDE AND THE pH CAN RISE SIGNIFICANTLY(pH IN THE 11 TO 12 RANGE IS NOT UNCOMMON).**

**DURING THE NIGHT OR DURING CLOUDY WEATHER, THE ALGAE RESPIRE AND ACTIVE PHOTOSYNTHESIS DOES NOT OCCUR. THE BACTERIA CONTINUE TO USE UP OXYGEN AND PRODUCE CARBON DIOXIDE. THIS CAN CAUSE A SIGNIFICANT DROP IN THE POND pH, ESPECIALLY IF THE INFLUENT WASTEWATER HAS LOW ALKALINITY. THIS SAME pH SWING CAN OCCUR IN NATURAL PONDS, LAKES, AND STREAM IMPOUNDMENTS. DURING PEAK SUMMER ALGAE ACTIVITY, THE DISSOLVED OXYGEN OF STREAM IMPOUNDMENTS HAVE VARIED FROM DAWN LEVELS OF LESS THAN 1 mg/L, TO LATE AFTERNOON VALUES OF 13-15 mg/L (SUPERSATURATION).**

**25.** Describe the affects of seasonal changes on Pond treatment efficiency.

**WINTER**: **TREATMENT EFFICIENCY DECREASES IN THE WINTER WITH COLDER TEMPERATURES AND LESS SUNLIGHT THROUGH THE ICE COVER. SHORTER PERIODS OF SUNLIGHT AND ICE COVER LIMITS THE AMOUNT OF PHOTOSYNTHESIS. THIS REDUCES DISSOLVED OXYGEN IN THE POND. THE COLD WATER ALSO SLOWS DOWN BACTERIAL ACTION, REDUCING TREATMENT EFFICIENCY. IF SUFFICIENT ICE COVER IS PRESENT,THE POND MAY GO ANAEROBIC. EMERGENT WEEDS AND DUCKWEED DIE-OFF. DURING THIS PERIOD, FILL AND DRAW PONDS ARE OPERATED BY STORING WASTEWATER FOR A SPRING DISCHARGE.**

**SPRING**: **AFTER ICE-OUT, ODORS MAY OCCUR FOR SEVERAL DAYS UNTIL DISSOLVED OXYGEN IS RESTORED. AS TEMPERATURES INCREASE, BIOLOGICAL ACTIVITY INCREASES FOR BOTH BACTERIA AND ALGAE. TREATMENT EFFICIENCY BEGINS TO IMPROVE WITH INCREASING BIOLOGICAL ACTIVITY. AFTER THE THE POND HAS STABILIZED, A SPRING DISCHARGE FOR**

**FILL AND DRAW TYPE SYSTEMS IS USUALLY DONE PRIOR TO ACTIVE ALGAE GROWTH.**

**SUMMER:** **THE LONG SUNNY DAYS PROVIDE MAXIMUM OXYGEN LEVELS FROM ALGAE PHOTOSYNTHESIS. WARM WATER TEMPERATURES INCREASE BACTERIA ACTION TO PROVIDE THE BEST ENVIRONMENT FOR EFFICIENT TREATMENT. OPERATIONAL PROBLEMS INCLUDE: CONTROLLING ROOTED EMERGENT WEEDS, REMOVING DUCKWEED AND CONTROLLING ALGAE BLOOMS. DURING THIS PERIOD, FILL AND DRAW POND SYSTEMS ARE OPERATED BY STORING WASTEWATER FOR A FALL DISCHARGE.**

**FALL:** **A TRANSITIONAL TIME, BUT IN REVERSE OF SPRING. WATER TEMPERATURES BEGIN DROPPING, REDUCING BACTERIAL ACTIVITY AND PHOTOSYNTHESIS AS THE DAYS GET SHORTER. TREATMENT EFFICIENCIES BEGIN TO DROP AS WINTER APPROACHES. WHEN THE ALGAE LEVELS DROP AND THE BOD STABILIZES, FILL AND DRAW TYPE SYSTEMS NORMALLY DISCHARGE.**

**26.** Discuss the operating procedures for dealing with a spring thaw.

**PONDS WILL USUALLY FILL UP FAST DURING SPRING THAW AND LEVELS MUST BE WATCHED SO DIKES DO NOT OVERFLOW. DISCHARGE SHOULD BE CONTINUOUS UNTIL LEVELS STABILIZE. START SPRING DRAW DOWN OF THE PONDS IF OPERATING ON FILL AND DRAW. THE COLLECTION SYSTEM USUALLY HAS INFILTRATION, AND FLOW IS QUITE LARGE DURING THE SPRING THAW. DRAW PONDS DOWN WHEN STREAMS ARE COLD AND FLOWS HIGH.**

**CONCEPT: MAINTENANCE**

**27.** List some components of a maintenance management and recordkeeping system.

**A. MAINTENANCE INVENTORY OF PARTS AND OIL.**
**B. WEATHERIZATION OF PLANT AND EQUIPMENT.**
**C. INSURE O&M MANUAL IS BEING FOLLOWED.**
**D. MAINTAIN A MANAGEMENT CHECKLIST WHICH MIGHT INCLUDE:**
**1. EACH MAINTENANCE DUTY.**
**2. FREQUENCY OF MAINTENANCE.**
**3. INVENTORY OF PARTS NEEDED.**
**4. DETAILED DESCRIPTION OF PROPER METHODS OF MAINTENANCE.**

**MAINTENANCE RECORD KEEPING IS THE USE OF VARIOUS FORMATS TO RECORD THE PERFORMANCE OF ACTUAL MAINTENANCE. TYPICAL EXAMPLES WOULD BE A FOLDER FILING SYSTEM (FILE CABINET). A CARD SYSTEM FOR RECORDING INFORMATION, AND THE USE OF MICROCOMPUTERS WITH APPROPRIATE SOFTWARE. ANY OF THESE**

**SYSTEMS CAN BE USED FOR RECORD KEEPING AND PLANNING MAINTENANCE.**

**28.** Describe the meaning of air gauge readings on a blower.

**HIGH READINGS OF AN AIR GAUGE ARE CAUSED BY PLUGGED AIRLINE, ORIFICES, DIFFUSERS, OR ICE CAP. LOW READINGS OF AN AIR GAUGE COULD BE CAUSED BY A FAULTY BLOWER, AN AIR LEAK, OR CLOGGED BLOWER INLET FILTER.**

**IN EITHER CASE, THERE IS A POSSIBILITY THAT THE BLOWER COULD OVERHEAT, CAUSING DAMAGE TO THE UNIT. A HOT BLOWER SHOULD BE SHUT-DOWN AND CORRECTIVE ACTION TAKEN.**

**29.** List the most common maintenance problems associated with Pond systems.

**A. WEED CONTROL - CATTAILS AND OTHER ROOTED AQUATIC PLANTS.**
**B. ALGAE CONTROL - BLUE-GREEN AND ASSOCIATED FLOATING ALGAE MATS.**
**C. BURROWING ANIMALS - MUSKRATS AND TURTLES.**
**D. DUCKWEED CONTROL AND REMOVAL.**
**E. FLOATING SLUDGE MATS.**
**F. DIKE VEGETATION - MOWING AND REMOVING WOODY PLANTS.**
**G. DIKE EROSION - RIP RAP AND PROPER VEGETATION.**
**H. FENCE MAINTENANCE TO RESTRICT ACCESS.**
**I. MECHANICAL EQUIPMENT - PUMPS, BLOWERS ETC.**

**30.** Discuss the maintenance of seepage cells.

**RAKE THE DRY SURFACE WITH EQUIPMENT THAT WILL NOT COMPACT SOIL. CONTROL WEEDS BY TILLING THE SOIL. KEEP LEVEL. SEEPAGE CELL MAINTENANCE INVOLVES AERATING THE SOIL CRUST WHICH BUILDS-UP AT THE SOIL-AIR INTERFACE. THIS CRUST IMPEDES WATER AND OXYGEN PERCOLATION INTO THE SOIL. ANY SUITABLE TILLING EQUIPMENT CAN BE USED. TILLING 6" TO 12" HELPS CONTROL WEED GROWTH WHICH PROLIF-ERATES ON THE SURFACE. AVOID UNNECESSARY SOIL COMPACTION.**

**31.** Describe the ways to control aquatic vegetation.

**ROOTED WEEDS CAN BE CONTROLLED BY PHYSICAL REMOVAL OF NEW GROWTH BY HAND, OR MOWING WITH A SICKLE BAR AFTER ICE HAS FORMED, RAISE WATER LEVEL ALLOWING THE ICE TO PULL THE WEEDS OUT. BY INCREASING THE WATER LEVEL TO REDUCE LIGHT PENETRATION TO STOP PHOTOSYNTHESIS. OTHER POSSIBLE WAYS WOULD BE TO LOWER THE WATER LEVEL AND BURN THE WEEDS OR USE AN APPROVED HERBICIDE.**

**32.** Explain how to remove duckweed from the Pond surface.

**DUCKWEED MUST BE PHYSICALLY REMOVED WITH A RAKE, PUSHBOARD OR BROOM. WITH SUFFICIENT WIND, THE DUCKWEED WILL BE PUSHED TO ONE SIDE OR CORNER OF A POND. THIS IS AN IDEAL TIME TO RAKE THEM OUT. IT IS IMPORTANT THAT DUCKWEED NOT BE ALLOWED TO BECOME TOO ABUNDANT, AS IT REDUCES OXYGEN TRANSFER AT THE WATER SURFACE, REDUCES LIGHT PENETRATION AND PHOTOSYNTHESIS, AND UPON DECOMPOSING, CAN CAUSE BOTH ODOR AND BOD PROBLEMS.**

**33.** Discuss how to deal with floating mats.

**FLOATING MATS ON POND SYSTEMS ARE CAUSED BY FLOATING SLUDGE, BLUE-GREEN ALGAE, OR OIL AND GREASE. THE MOST COMMON ARE THE SLUDGE AND ALGAE MATS. THE FIRST ATTEMPT TO CORRECT THIS WOULD BE TO TRY TO BREAK-UP THE SLUDGE OR ALGAE MATS, ALLOWING THEM TO SETTLE TO THE BOTTOM. IF THIS DOES NOT WORK, IT WILL BE NECESS-ARY TO RAKE THEM OUT AND DISPOSE OF THEM. IF OIL AND GREASE ARE A PROBLEM, THE SOURCE OF THIS MATERIAL SHOULD BE ELIMINATED TO PREVENT A RECURRENCE OF THIS PROBLEM.**

**34.** Describe how cattails are controlled without chemicals.

**CATTAILS CAN BECOME ESTABLISHED IN THE SHALLOW WATER ALONG THE DIKES. CONTROLLING CATTAILS IS A PROBLEM BECAUSE OF THEIR EX-TENSIVE ROOT SYSTEMS. PHYSICAL REMOVAL HAS THE POSSIBILITY OF DAMAGE TO THE POND LINER. WHEN CATTAILS ARE YOUNG, PULLING THEM OUT IS VERY AFFECTIVE. ANOTHER AFFECTIVE METHOD IS TO LOWER THE POND LEVEL, CUT THE CATTAILS, AND THEN RAISE THE WATER THREE FEET OVER THE CATTAILS WHICH EFFECTIVELY KILLS(DROWNS) THEM. ONE METHOD WOULD BE A BOAT MOUNTED WEED CUTTER TO CUT THEM OFF BELOW THE WATERLINE.**

**35.** Identify types of dike vegetation, and how to control grass and other plant growths.
**IT IS VERY IMPORTANT THAT DIKES HAVE A PROTECTIVE GRASS COVER TO PREVENT EROSION FROM RUNOFF AND WAVE ACTION. THE GRASSES USED SHOULD BE FAST GROWING, SPREADING, WITH SHALLOW, BUT DENSE ROOT SYSTEMS(E.G. RYE, BROME AND QUACK). MOWING SHOULD BE DONE PER-IODICALLY SO THAT THE DIKES CAN BE OBSERVED AND TO REDUCE BREEDING AREAS FOR INSECTS.**

**NO LONG ROOTED PLANTS SHOULD BE ALLOWED ON DIKES(ALFALFA, WILLOWS OR ANY WOODY SCRUBS) AS THEIR ROOT STRUCTURE COULD CAUSE DIKE LEAKAGE, DAMAGE TO THE POND SEAL, OR STRUCTURAL FAILURE TO THE DIKE. ALL WOODY PLANTS SHOULD BE REMOVED BY PULLING OR MOWING, AND IN THE EVENT THEY BECOME ESTABLISHED, IT WILL BE NECESSARY TO USE BRUSHING METHODS (EG. PRUNING, CHAIN SAW, BRUSH SAW, WEED WACKER, ETC.). GRAZING ANIMALS SHOULD NOT BE USED TO CONTROL DIKE VEGETATION AS THEY DAMAGE DIKES AND INCREASE EROSION PROBLEMS.**

## MODULE C: MONITORING AND TROUBLESHOOTING

### CONCEPT: MONITORING

**36.** State the normal pressure reading range for the Discharge Gauge in a blower unit.

**5 - 14 PSI.**

**37.** Describe what types of things that need monitoring usually found in the discharge permit for influent and effluent from a Pond system.

**THE DISCHARGE PERMIT WILL SPECIFY THE TYPE OF SAMPLES(GRAB OR COMPOSITE) REQUIRED, AND THE FREQUENCY OF SAMPLING. NORMALLY, BOTH RAW WASTEWATER AND FINAL EFFLUENT WILL REQUIRE SAMPLING FOR BOD, SUSPENDED SOLIDS, FECAL COLIFORM, AND pH. OTHER PARAMETERS MAY BE SPECIFIED IN INDIVIDUAL DISCHARGE PERMITS, SUCH AS, AMMONIA, TOTAL NITROGEN, NITRATES, CHLORIDES, TOTAL DISSOLVED SOLIDS OR TOXICS.**

**38.** List ways to measure the Dissolved Oxygen level of a Pond.

**A. DISSOLVED OXYGEN METER.**
**B. WINKLER DISSOLVED OXYGEN DETERMINATION.**

**39.** Define where samples should be taken on a Pond to monitor the influent and effluent.

**SAMPLES OF RAW WASTEWATER SHOULD BE TAKEN AT THE POINT WHERE THE RAW WASTEWATER ENTERS THE WET WELL. SAMPLES OF FINAL EFFLUENT SHOULD BE TAKEN WHERE THE FINAL EFFLUENT LEAVES THE TREATMENT SYSTEM. USE THE LAST MANHOLE AFTER THE POND, JUST BEFORE DIS-CHARGE INTO A STREAM OR RIVER.**

**THE MOST IMPORTANT FACTOR IN LOCATING AN INFLUENT SAMPLING POINT WOULD BE TO ENSURE THAT IT IS WELL MIXED AND IS REPRESENTATIVE OF THE RAW WASTEWATER. IF GRAB SAMPLES ARE SPECIFIED, THEY SHOULD NOT BE COLLECTED DURING UNUSUAL FLOW CONDITIONS, SUCH AS, VERY LOW FLOW PERIODS ( EARLY MORNING, LATE EVENING OR WEEKENDS), DURING A MAJOR STORM, POWER OUTAGE, OR AN OBVIOUS SLUG LOADING. THE SAMPLE SHOULD BE REPRESENTATIVE OF THE NORMAL LOADING. THE FINAL EFFLUENT SAMPLE SHOULD BE AT A WELL-MIXED REPRESENTATIVE LOCATION.**

**40.** Describe how to take a representative sample of the contents of a Pond.

**OVERALL POND SAMPLING IS NORMALLY DONE FOR FILL AND DRAW TYPE SYSTEMS TO BE SURE POND CONTENTS ARE SUITABLE FOR DISCHARGE TO THE RECEIVING WATER COURSE. IT IS IMPORTANT THAT THIS SAMPLING BE REPRESENTATIVE OF THE POND CONTENTS. THIS WOULD MEAN THAT MULTIPLE SAMPLES SHOULD BE COLLECTED AND THEN COMPOSITED PRIOR TO LABORATORY ANALYSIS. ONE SUGGESTED METHOD WOULD BE TO TAKE SAMPLES AT FOUR LOCATIONS AROUND THE POND AT LEAST 8 FEET FROM THE DIKE AND FROM BELOW THE WATER SURFACE OF THE POND. MIX TOGETHER THOURGHLY PRIOR TO ANALYSIS.**

**41.** Explain how the following samples should be collected and preserved for analysis:

A. BOD.
B. Fecal Coliform.
C. Suspended Solids.
D. Dissolved Oxygen.
E. pH.

**A. BOD: SAMPLES SHOULD BE TAKEN AT PEAK FLOW TIMES(I.E.,11:00AM, 12:00 NOON AND 1:00PM), COMPOSITED TOGETHER, MIXED WELL, PRESERVED WITH ICE, AND SENT FOR ANALYSIS AS SOON AS POSSIBLE TO PREVENT DEGRADATION WITHIN 48 HRS @ $3^0$C.**

**B. FECAL COLIFORM: THIS SAMPLE OF THE UNCHLORINATED EFFLUENT MUST BE COLLECTED IN A SEPARATE STERILIZED CONTAINER, PRESERVED WITH ICE AND SENT FOR ANALYSIS AS SOON AS POSSIBLE. IF SAMPLING A CHLORINATED DISCHARGE, SODIUM THIOSULFATE MUST BE ADDED AND NOTED ON THE LAB SLIP.**

**C. SUSPENDED SOLIDS: SAME AS FOR BOD.**

**D. DISSOLVED OXYGEN: MUST BE ANALYZED IMMEDIATELY AFTER SAMPLING.**

**E. pH: MUST BE ANALYZED IMMEDIATELY AFTER SAMPLING.**

**42.** Discuss how to collect a representative sample from a groundwater monitoring well.

**THE REQUIREMENTS FOR GROUND WATER SAMPLING POINTS AND PARAMETERS TO BE TESTED WILL BE IN THE DISCHARGE PERMIT. WHEN SAMPLING GROUND WATER, START WITH UP-GRADIENT WELLS FIRST, AND THEN MOVE TO DOWN-GRADIENT WELLS. THE SEQUENCE**

**OF PROCEDURES FOR OBTAIN-ING A REPRESENTATIVE SAMPLE WOULD BE:**

1. **DETERMINE GROUND WATER ELEVATION USING PROPERLY CLEANED AND RINSED EQUIPMENT (COPPER COATED TAPE, OR AN ELECTRIC TAPE).**
2. **SUBTRACT DEPTH TO WATER FROM REFERENCE POINT. USUALLY, WELL TOP TO GET GROUND WATER ELEVATION.**
3. **DETERMINE DEPTH OF THE WELL FROM REFERENCE POINT TO GET ELEV-ATION OF WELL BOTTOM.**
4. **SUBTRACT BOTTOM OF WELL ELEVATION FROM GROUND WATER ELEVATION TO OBTAIN DEPTH OF WATER IN THE WELL.**
5. **USE THE DEPTH OF WATER IN THE WELL AND THE INSIDE CASING DIAMETER TO GET VOLUME OF WATER IN THE WELL.**
6. **BAIL FOUR VOLUMES OF WATER AS DETERMINED FROM ABOVE VOLUME.**
7. **AFTER BAILING FOUR VOLUMES, COLLECT SAMPLE AND SEND TO THE LABORATORY, FOLLOWING ANY INSTRUCTION OF THE LABORATORY (E.G. PRE-FILTERING OR ANY PRESERVATION THAT MAY BE REQUIRED).**

**CONCEPT: TROUBLESHOOTING**

**43.** List the possible causes of low water levels in a Pond.

**A. LEAKING LINER.**
**B. LEAKING CONTROL STRUCTURES.**
**C. UNDERLOADED FACILITY (OVER DESIGNED).**
**D. DIKE LEAKS CAUSED BY BURROWING ANIMALS.**
**E. IMPROPER SETTINGS OF CONTROL STRUCTURES.**

**44.** List the causes and corrective actions for Seepage Cells that do not seep.

| | **CAUSE** | **CORRECTIVE ACTION** |
|---|---|---|
| **A.** | **COMPACTED CELL BOTTOM.** | **REWORK CELL BOTTOM WITH MECHANICAL EQUIPMENT TO LOOSEN AND AERATE SOIL.** |
| **B.** | **HYDRAULIC OVERLOAD.** | **REDUCE OVERLOAD BY ALTERNATING SEEPAGE CELL LOADING.** |
| **C.** | **SLUDGE BUILD-UP.** | **REMOVE SLUDGE FROM CELL. CORRECT OPERATION OF TREATMENT PONDS PRECEDING SEEPAGE CELLS.** |

**45.** List some causes of Pond short-circuiting, and give corrective action for each.

| CAUSE | CORRECTIVE ACTION |
|---|---|
| **A. EXCESSIVE ROOTED WEED GROWTH.** | **CONTROL WEED GROWTH TO RESTORE NORMAL FLOW PATTERNS AND DETENTION TIME.** |
| **B. HYDRAULIC OVERLOADING.** | **REDUCE HIGH LOADINGS BY ELIMINATING EXCESS I/I IN THE COLLECTION SYSTEM.** |
| **C. DESIGN RELATED PROBLEMS.** | **CHANGE INLET OR OUTLET STRUC TURE LOCATION TO STOP SHORT-CIRCUITING OR ADD BAFFLES AS NEEDED.** |

**46.** Discuss the causes and corrective action for a Pond having a suspended solids violation while meeting BOD limits.

**THE MOST PROBABLE CAUSE OF THIS PROBLEM WOULD BE AN ALGAE BLOOM. DEPENDING ON THE TYPE OF ALGAE PRESENT, THE CORRECTION OF THE CAUSE OF THE BLOOM CAN BE:**

**IF, THE ALGAE IS OF THE NORMAL GREEN VARIETY, POSSIBLE SOLUTIONS COULD INCLUDE:**

**A. DRAW OFF EFFLUENT FROM BELOW THE SURFACE TO TRY TO REDUCE ALGAE CONCENTRATION.**
**B. CONSTRUCT BAFFLES TO GET A BETTER QUALITY EFFLUENT.**
**C. IF POSSIBLE, USE ANOTHER CELL AND LET THE OTHER "REST" UNTIL THE BLOOM SUBSIDES.**
**D. CONSIDER USE OF A SAND FILTER FOR ALGAE REMOVAL.**
**E. SWITCH TO SERIES OPERATION OF PRIMARY CELLS IF YOU ARE PRESENTLY OPERATING IN PARALLEL.**
**F. CONSIDERATION CAN BE GIVEN TO USE OF AN APPROVED ALGICIDE.**
**G. IF OPERATIONAL CHANGES CANNOT CORRECT THE PROBLEM, AN ALGAE PERMIT VARIANCE CAN BE PURSUED.**
**H. CHECK COLLECTION SYSTEM FOR EXCESS NUTRIENT LOADING (ESPECIALLY PHOSPHORUS).**

**IF THE ALGAE PROBLEM IS CAUSED BY THE BLUE-GREEN VARIETY, POSS-IBLE SOLUTIONS WOULD BE:**

**A. CORRECT THE OBVIOUS ORGANIC OVERLOADING THAT IS OCCURRING.**
**B. IF ORGANIC LOADING CANNOT BE REDUCED, CONSIDERATION FOR MECHANICAL SURFACE AERATION MUST BE CONSIDERED.**
**C. IF OPERATING PRIMARY CELLS IN SERIES, CONSIDER PARALLEL OPERATION.**

**D. IF SIGNIFICANT INDUSTRIAL LOADING IS PART OF THE RAW WASTE-WATER, CHECK NUTRIENT BALANCE OF BOD TO NITROGEN TO PHOS-PHORUS (THE RATE OF 100/5/1 SHOULD BE ADEQUATE FOR AEROBIC TREATMENT). CHECK FOR LOW pH.**

**E. IF LOADING AND NUTRIENTS ARE IN THE ACCEPTABLE RANGE, CON- SIDERATION CAN BE GIVEN TO AN APPROVED ALGICIDE.**

**F. IF OPERATIONAL CHANGES CANNOT CORRECT THE PROBLEM, FACILITY RE-DESIGN IS PROBABLY REQUIRED.**

**47.** Describe what might be done if a system has unacceptable high effluent pH values.

**IF HIGH EFFLUENT pH IS OCCURRING, IT WILL BE NECESSARY TO DET-ERMINE THE CAUSE OF THIS PROBLEM. IF IT IS CAUSED BY INFLUENT FLOWS, THE SOURCE OR SOURCES MUST BE FOUND AND CORRECTIVE ACTION TAKEN. MOST LIKELY, IT WOULD BE AN INDUSTRIAL SOURCE AND PRE-TREATMENT WOULD HAVE TO BE INSTITUTED.**

**HIGH EFFLUENT pH ATTRIBUTED TO NORMAL ALGAE PHOTOSYNTHESIS WOULD ALMOST BE IMPOSSIBLE TO CONTROL (RECIRCULATION COULD BE TRIED, BUT IT WOULD NOT BE VERY AFFECTIVE). THE ONLY OTHER ALTERNATIVE OF HIGH pH CAUSED BY ALGAE PHOTOSYNTHESIS WOULD BE TO APPLY FOR AN ADJUSTMENT IN pH LIMITATIONS IN THE DISCHARGE PERMIT.**

**48.** Discuss the causes and corrective actions for a Pond with odor problems.

**WHEN PROPERLY OPERATED AND LOADED, POND SYSTEMS WILL NORMALLY EXPERIENCE ODOR PROBLEMS ONLY IN THE SPRING, RIGHT AFTER ICE-OUT. THIS ODOR IS CAUSED BECAUSE OF ANAEROBIC CONDITIONS THAT OCCURRED UNDER THE ICE. IN MOST CASES, THIS CONDITION MAY ONLY LAST FROM A FEW DAYS TO A WEEK, UNTIL NORMAL AEROBIC CONDITIONS ARE RESTORED. WHEN A POND SYSTEM IS NOT OPERATED PROPERLY; WHEN RECEIVING AN INDUSTRIAL SLUG LOAD, OR, WHEN BEING OVERLOADED ORGANICALLY, ANAEROBIC CONDITIONS CAN PERSIST FOR SOME TIME WITH SIGNIFICANT ODORS FROM BOTH ANAEROBIC CONDITIONS AND THE DIE-OFF OF BLUE-GREEN ALGAE DOMINATING THE SYSTEM. THE POND SYSTEM MAY HAVE BLUE-GRAY APPEARANCE WITH THE ODOR.**

**TO CORRECT THIS SITUATION, THE OPERATOR SHOULD MAKE OPERATIONAL CHANGES (EG. FROM SERIES TO PARALLEL OPERATION, REDUCE ORGANIC OVERLOAD IF POSSIBLE, ISOLATE THE REST OF THE PROBLEM CELL, OR CONTROL OF ALGAE AND DUCKWEED). POSSIBLE CHEMICAL CONTROL FOR POND ODORS WOULD INCLUDE THE USE OF HYDROGEN PEROXIDE, SODIUM NITRATE OR MASKING AGENTS. IT IS ALWAYS BEST TO CORRECT ODOR PROBLEMS WITH OPERATIONAL CHANGES BEFORE RESORTING TO CHEMICAL MEANS. IF THE OPERATIONAL CHANGES CANNOT CORRECT THE PROBLEM, CHEMICALS CAN BE USED UNTIL THE FACILITY CAN BE RECONSTRUCTED, OR ADDITIONAL AERATION CAN BE PROVIDED.**

**49.** Describe the consequences of not controlling floating and rooted weeds in a Pond system.

**FLOATING WEED MATS COULD PREVENT SUNLIGHT FROM ENTERING THE POND, CAUSING ANAEROBIC CONDITIONS. FLOATING DUCKWEED, IF NOT REMOVED, WILL CONTINUE TO REPRODUCE AND MAKE THE PROBLEM WORSE. THESE MATS WILL BLOCK SUNLIGHT FROM ENTERING THE POND SLOWING ALGAE PHOTO-SYNTHESIS AND REDUCING OXYGEN PRODUCTION. THE POND COULD GO ANAEROBIC. MATS ALSO BLOW INTO DEAD ZONES OF THE POND AND REDUCE THE AFFECTIVE AREA OF THE TREATMENT POND, AND WOULD HINDER SURFACE AERATION BY REDUCING WIND TURBULENCE. ROOTED WEEDS COULD PIERCE THE POND SEAL AND LEAD TO LEAKS. THIS IS ESPECIALLY TRUE FOR WOODY VEGETATION. THE ROOTED WEEDS ARE FOOD AND COVER HABITAT FOR MUSKRATS. MUSKRATS BUILD DENS INTO THE BANKS WHICH ALSO LEAD TO SIGNIFICANT LEAKAGE. LARGE AMOUNTS OF ROOTED WEEDS IN THE POND COULD ALSO CAUSE SHORT-CIRCUITING.**

**50.** List some burrowing animals that cause damage to dikes, and discuss control methods for each.

| ANIMAL | CONTROL |
|---|---|
| **A. GOPHERS AND BADGERS.** | **TRAPPING/SHOOTING (PERMIT REQUIRED).** |
| **B. MUSKRATS.** | **VARYING WATER LEVELS, REMOVE FOOD SOURCES (ROOT WEEDS) OR TRAPPING/ SHOOTING (PERMIT REQUIRED).** |
| **C. TURTLES(MINOR PROBLEM).** | **TRAPPING/SHOOTING (POSSIBLE PERMIT).** |

**51.** Discuss how to legally remove burrowing animals from a Pond system.

**MUSKRATS, GOPHERS AND BADGERS, ARE FURBEARERS. THEIR REMOVAL AND POSSESSION IS SUBJECT TO DNR FURBEARER REGULATIONS. CONTACT SHOULD BE MADE WITH THE COUNTY DNR WARDEN FOR SPECIFICS ON HOW TO REMOVE ANIMALS AND WHAT PROCEDURES TO FOLLOW. THERE MAY BE A REQUIREMENT FOR SPECIAL DISPOSITION OF THE HIDES AND CARCASSES.**

**DNR WARDENS AND WILDLIFE MANAGERS HAVE THE AUTHORITY TO GIVE SPECIAL REMOVAL PERMITS. ASK FOR PERMISSION TO USE DEN SETS AND GROUP SETS. SOME OF THESE TRAPS ARE ILLEGAL, BUT THE POND OPERATOR CAN USE THEM TO SPEED REMOVAL. THE DNR CAN ALSO ISSUE PERMITS TO SHOOT ILLEGAL RATS.**
**DO NOT USE POISON BAIT AROUND BERMS. ANIMALS OR EVEN HUMANS MIGHT INGEST THE POISON. PREDATOR ANIMALS (HAWKS AND OWLS) MIGHT FEED ON A POISONED ANIMAL AND COULD DIE.**

## MODULE D: SAFETY AND CALCULATIONS

**CONCEPT: SAFETY**

**52.** Describe how a Pond could be judged an "Attractive Nuisance."

**THE TERM "ATTRACTIVE NUISANCE" IS A LEGAL EXPRESSION THAT IMPLIES THE POND COULD BE ATTRACTIVE TO POTENTIAL USERS, SUCH AS, DUCK HUNTERS, FISHERMAN OR PLAYING CHILDREN. SINCE PONDS HAVE FAIRLY STEEP SLOPES, THE POTENTIAL FOR SOMEONE FALLING-IN AND DROWNING IS A SIGNIFICANT LEGAL PROBLEM THAT MUST BE A CONCERN. IT IS IMPORTANT THAT ADEQUATE FENCING AND SIGNING BE PROVIDED.**

**53.** Discuss reasonable Pond security precautions against trespassing and vandalism.

**SECURITY IS NECESSARY TO PROTECT THE AREA FROM UNAUTHORIZED ACCESS AND TO PROTECT THOSE WHO ENTER THE FACILITY. THE COMM-UNITY COULD BECOME SUBJECT TO LIABILITY AND LEGAL ACTION IF IT FAILS TO MAKE A REASONABLE EFFORT TO RESTRICT TRESPASSING.**

**REASONABLE FENCING INCLUDES:**

**A. GATES AND LOCKS WHICH ARE KEPT SECURE AT ALL TIMES. GATES TO RESTRICT VEHICLES AND ATV'S. AT A MINIMUM, STEEL OR ALUMINUM GATES WITH SOLID ANCHOR POSTS AND A SIGN ARE REQUIRED.**
**B. FENCES INCLUDE A STURDY WIRE FENCE WITH SIGNS. FENCE LINES SHOULD BE BRUSHED AND SIGNED AT SUITABLE INTERVALS.**
**C. REGULAR DRIVE-BY PATROL BY THE LOCAL POLICE IS RECOMMENDED. WORK WITH ADJACENT PROPERTY OWNERS TO REPORT SUSPICIOUS VEHICLES OR PEOPLE IN THE AREA.**

**54.** List the personal safety precautions that should be practiced by persons operating a Pond system.

**A. DO NOT ENTER A MANHOLE ALONE, OR ANY CONFINED SPACE, WITHOUT PROPER EQUIPMENT AND SOMEONE TO ASSIST YOU.**
**B. WEAR LIFE JACKETS WHEN WORKING AROUND PONDS.**
**C. LEARN TO SWIM.**
**D. WASH-UP AFTER CONTACT WITH SEWAGE.**
**E. LOCK-OUT ELECTRICAL CIRCUITS TO SHUT-DOWN AERATORS. (THIS**

**REFERS TO THE TENDENCY OF AERATORS TO LOWER THE SPECIFIC GRAVITY OF WATER. A PERSON WHO FALLS OVERBOARD COULD SINK FASTER IF THE AERATORS WERE WORKING. OPERATORS HAVE BEEN KNOWN TO DROWN EVEN WITH LIFE JACKETS ON).**

**F. NEVER PERFORM ANY HAZARDOUS TASK AROUND A POND WITHOUT BEING ACCOMPANIED BY SOMEONE.**

**G. USE CARE WHEN MOWING OR TRIMMING GRASS AROUND BURIED ELECTRIC CONDUITS.**

**55.** Discuss the risks involved while walking on the ice of a Pond to collect samples.

**THE BIGGEST PROBLEM IN WALKING ON THE ICE OF A TREATMENT POND WOULD BE THE POSSIBILITY OF THE ICE BREAKING AND CAUSING A POTENTIAL DROWNING. INFLUENT WASTEWATER IS WARM ENOUGH TO CAUSE POSSIBLE THIN ICE NEAR THE INFLUENT PIPING. SAFETY PRECAUTIONS SHOULD BE USED WHEN GOING OUT ON THE ICE, SUCH AS: FLOTATION EQUIPMENT, A ROPE CONNECTED TO SHORE, LIFE JACKETS, AND ALWAYS BE ACCOMPANIED BY SOMEONE ELSE ( IT WOULD ALSO BE ADVISABLE TO HAVE COMMUNICATION EQUIPMENT AVAILABLE SUCH AS A RADIO OR MOBILE TELEPHONE IN CASE OF EMERGENCY). ANOTHER RISK IS THE POSSIBILITY OF FALLING, WHICH CAN BE REDUCED BY GOOD FOOTWEAR.**

**56.** Discuss the safety precautions that should be practiced while using grass cutting equipment around a Pond.

**USE CAUTION WHEN CUTTING NEXT TO ELECTRICAL CABLES. USE CARE WHEN SPRAYING WEEDS AROUND ELECTRICAL CABLES AND EQUIPMENT. THE SPRAY COULD CONDUCT A CURRENT AND CAUSE ELECTRICAL SHOCK.**

**BE CAREFUL OPERATING MOWING EQUIPMENT ON BANKS. STEEP BANKS CAN BE VERY HAZARDOUS. ALL MOWERS SHOULD HAVE THROTTLE KILL-SWITCHES. MAKE SURE THE MANUFACTURERS EQUIPMENT OPERATION DIRECTIONS ARE UNDERSTOOD AND FOLLOWED.**

**CONCEPT: CALCULATIONS**

**57.** Given data, calculate Pond surface area in acres.

**GIVEN: POND LENGTH = 400 FEET**
**POND WIDTH = 300 FEET**

**FORMULA:**

**(ONE ACRE = 43,500 SQUARE FEET)**

**AREA OF POND = LENGTH (FT) X WIDTH (FT)**
**(IN SQ.FT.)**

**AREA OF POND = $\frac{\text{SURFACE AREA (SQ.FT.)}}{\text{1 ACRE (SQ.FT.)}}$**
**(IN ACRES)**

**AREA OF POND = LENGTH (FT) X WIDTH (FT)**
**= 400 X 300**
**= 120,000 SQUARE FEET**

**AREA OF POND = $\frac{\text{SURFACE AREA (SQ.FT.)}}{\text{1 ACRE (SQ.FT.)}}$**
**(IN ACRES)**

**= 120,000**
**= 43,560**

**= 2.75 ACRES**

**58.** Given data, calculate Pond volume in gallons.

**GIVEN: POND WIDTH AT MID-DEPTH = 200 FEET**
**POND LENGTH AT MID-DEPTH = 500 FEET**
**POND DEPTH = 6 FEET**

**FORMULA:**

**AREA = LENGTH (FT) X WIDTH (FT)**
**(AT MID-DEPTH) (AT MID-DEPTH) (AT MID-DEPTH)**

**VOLUME = AREA (AT MID-DEPTH) X DEPTH**
**1 CUBIC FOOT = 7.5 GALLONS**

**AREA = 200 X 500**

**= 100,000 SQ. FEET AT MID-DEPTH**

**VOLUME = 100,000 X 6**

**= 600,000 CU.FT.**

**GALLONS = $\frac{\text{600,000 CU.FT.}}{\text{7.5GAL/CU.FT.}}$**

**= 4,500,000 (4.5) MILLION GALLONS**

**59.** Given data, calculate the volume of water discharged in gallons.

**GIVEN: DRAWDOWN DEPTH = 3.0 FEET**
**POND LENGTH = 675 FEET**
**POND WIDTH = 420 FEET**

**FORMULA:**

**VOLUME = LENGTH (FT) X WIDTH (FT) X DRAWDOWN DEPTH (FT) X 7.5**

**(1 CUBIC FOOT = 7.5 GALLONS)**

**VOLUME = 675 X 420 X 3.0 X 7.5**

**= 6,380,000 GALLONS**

**= 6.4 MILLION GALLONS**

**60.** Given data, calculate a lagoons detention time in days.

**GIVEN: SURFACE AREA = 4 ACRES**
**AVERAGE DEPTH = 4 FEET**
**AVERAGE DAILY FLOW = 60,000 GALLONS/DAY**

**FORMULA:**

**(1 CU.FT. = 7.5 GALLONS)**

**VOLUME = 43,560 X ACRES X DEPTH X 7.5**
**(GAL) (SQ.FT./ACRES)**

**= 43,560 X 4 X 4 7.5**

**= 5,227,200 GALLONS**

$$\text{DETENTION TIME (DAYS)} = \frac{\text{VOLUME (GAL)}}{\text{AVG. DAILY FLOW (GAL/DAY)}}$$

$$= \frac{5,227,200}{60,000}$$

**= 87.12 DAYS**

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# STUDY GUIDE

# ADVANCED STABILIZATION PONDS AND AERATED LAGOONS

## SUBCLASS D

WISCONSIN DEPARTMENT OF NATURAL RESOURCES
BUREAU OF SCIENCE SERVICES
OPERATOR CERTIFICATION PROGRAM
http://dnr.wi.gov/org/es/science/opcert/

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* NOTE – As of Jan 2010, this study guide c ontains objectives plus key knowledges.

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## PREFACE

This operator's study guide represents the results of an ambitious program. Operators of wastewater facilities, regulators, educators and local officials, jointly prepared the objectives and exam questions for this subclass.

The objectives in this study guide have been organized into modules, and within each module they are grouped by major concepts.

**NOTE:** As of January 2010, this study guide also includes key knowledges.

## HOW TO USE THESE OBJECTIVES WITH REFERENCES

In preparation for the exams, you should:

1. Read all of the key knowledges for each objective.
2. Use the resources listed at the end of the study guide for additional information.
3. Review all key knowledges until you fully understand them and know them by memory.

**IT IS ADVISABLE THAT THE OPERATOR TAKE CLASSROOM OR ONLINE TRAINING IN THIS PROCESS BEFORE ATTEMPTING THE CERTIFICATION EXAM.**

### Choosing A Test Date

Before you choose a test date, consider the training opportunities available in your area. A listing of training opportunities and exam dates is available on the DNR Operator Certification home page http://dnr.wi.gov/org/es/science/opcert/ It can also be found in the annual DNR "Certified Operator" or by contacting your DNR regional operator certification coordinator.

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## MODULE A: PRINCIPLE, STRUCTURE AND FUNCTION

### CONCEPT: PRINCIPLE OF PONDS

**1.** Describe how the stabilization of organic waste material occurs in nature and in a wastewater treatment plant.

**STABILIZATION OF ORGANIC WASTE IS ACCOMPLISHED BY BACTERIAL DEGRADATION OF ORGANIC WASTE MATERIAL AEROBICALLY, ANAEROBICALLY OR A COMBINATION OF THE TWO. THE AEROBIC ORGANISMS ARE PROVIDED OXYGEN FROM PHOTOSYNTHESIS BY ALGAE.**

**2.** Explain photosynthesis.

**PHOTOSYNTHESIS IS THE CREATION OF PLANT CELL MASS USING CARBON DIOXIDE, WATER, AND NUTRIENTS, WITH SUNLIGHT AS THE ENERGY SOURCE AND CHLOROPHYLL AS A CATALYST. DURING THIS PROCESS, FREE OXYGEN IS GIVEN-OFF.**

**3.** Explain respiration.

**RESPIRATION IS THE PROCESS BY WHICH AN ORGANISM (PLANT OR ANIMAL) ASSIMILATES OXYGEN AND RELEASES CARBON DIOXIDE.**

**4.** Relate photosynthesis and respiration to BOD removal.

**THE OXYGEN PRODUCED BY PHOTOSYNTHESIS CAN BE USED BY BACTERIA IN THEIR LIFE PROCESSES (RESPIRATION), THIS INCLUDES DEGRADING ORGANIC MATERIAL, WHICH REDUCES BOD.**

**5.** Relate pH, carbon dioxide, and dissolved oxygen concentrations to photosynthesis and respiration.

**DURING PHOTOSYNTHESIS, GREEN PLANTS USE CARBON DIOXIDE AND PRODUCE OXYGEN. THIS CAUSES AN INCREASE IN DISSOLVED OXYGEN AND pH (THE pH INCREASE IS DUE TO THE LOSS OF DISSOLVED CARBON DIOXIDE WHICH WOULD NORMALLY FORM A WEAK CARBONIC ACID).**
**DURING RESPIRATION, PLANTS OR ANIMALS USE DISSOLVED OXYGEN TO ASSIMILATE ORGANIC MATERIAL AND GIVE OFF CARBON DIOXIDE. THIS CAUSES A REDUCTION IN THE DISSOLVED OXYGEN AND pH (THE pH DROP IS CAUSED BY THE INCREASE IN CARBON DIOXIDE, CAUSING A WEAK CARBONIC ACID).**

**6.** Explain why a Pond may violate pH permit limits during periods of intense photosynthesis.

**INTENSE SUNLIGHT SPEEDS-UP ALGAE PHOTOSYNTHESIS. ALGAE USE UP CARBON DIOXIDE WHICH RAISES pH TO VERY HIGH LEVELS (11 + SU).**

**7.** Discuss some innovative uses of Aerated Lagoon Systems.

**REARING MINNOWS OR OTHER FOOD FISH. MINNOWS THAT FORAGE ON PLANKTONIC MATERIAL ARE A FOOD SOURCE FOR LARGER FISH.**

**THIS PROCESS WILL WORK PROVIDING THERE IS ENOUGH DISSOLVED OXYGEN. A CONCERN WOULD BE POSSIBLE AMMONIA TOXICITY.**

**CONCEPT: STRUCTURE AND FUNCTION**

**8.** Identify the valve action necessary to bypass a Pond cell.

**CLOSE THE INLET AND OUTLET VALVES ON THE UNIT TO BE BYPASSED. OPEN THE VALVE ON THE BYPASS LINE.**

**9.** Discuss different flow patterns that are used in Multiple Pond treatment systems.

**THERE ARE VARIOUS WAYS TO ROUTE THE HYDRAULIC FLOW THROUGH MULTI-PLE POND SYSTEMS. WITH PROPER VALVING, PONDS CAN BE OPERATED IN EITHER SERIES OR PARALLEL MODES. IN MOST CASES, MULTIPLE CELL TREATMENT IS DESIGNED AND OPERATED IN SERIES. IN A THREE POND SYSTEM, SERIES OPERATIONS WILL MINIMIZE ALGAE IN THE FINAL CELL. IF HIGH ORGANIC LOADING TO THE PRIMARY CELL IS OCCURRING, (ESPECIALLY DURING WINTER MONTHS AND ICE COVER), IT MAY BE DESIRABLE TO OPERATE THE CELLS IN PARALLEL TO REDUCE THE AFFECT OF THIS OVER-LOADING. THIS SHOULD BE CONSIDERED A SHORT TERM SOLUTION, AND IF CONTINUOUS OVERLOADING OCCURS, ACTION NEEDS TO BE TAKEN TO REDUCE THE OVERLOAD OR SYSTEM RE-DESIGN SHOULD BE EVALUATED.**

**10.** Discuss the advantage of Helical Diffusers over Floating Mechanical Aerators.

**HELICAL DIFFUSERS ARE MUCH LESS AFFECTED BY ICE BUILD-UP DURING WINTER WEATHER.**

## MODULE B: OPERATION AND MAINTENANCE

**CONCEPT: OPERATION**

**11.** Explain the theory of isolation of a Pond cell which is experiencing an algae bloom in a Series Pond System.

**ISOLATION OF A POND CELL WHICH IS EXPERIENCING AN ALGAE BLOOM GIVES THE CELL A CHANCE TO "REST" AND RECOVER.**

**12.** Discuss the use of chemicals to control weeds.

**IF CHEMICALS ARE USED FOR POND WEED CONTROL, THEY MUST BE APPROVED FOR THAT SPECIFIC USE AND LABEL DIRECTIONS MUST BE FOLLOWED PRECISELY. IT MAY BE NECESSARY TO PROVIDE ADDITIONAL MONITORING FOR TOXICS. MANY TIMES, THE USE OF A SURFACTANT IS RECOMMENDED TO IMPROVE THE "WETTING" ABILITY OF THE MIXTURE SO IT ADHERES BETTER TO THE TREATED PLANTS.**

**13.** Describe how Pond depth and bubble size affect aeration efficiency.

**THE DEEPER THE POND, THE LONGER THE CONTACT TIME BEFORE THE BUBBLES REACH THE SURFACE. THE SMALLER THE BUBBLES, THE MORE CONTACT SURFACE BETWEEN THE AIR AND WATER, WHICH INCREASES THE TRANSFER RATE.**

**14.** Explain how to balance aerators within and between Ponds.

**BALANCING OF AERATION WITHIN AND BETWEEN PONDS IS ACCOMPLISHED BY USING THE VALVES ON THE MANIFOLD TO GET AN EVEN AGITATION PATTERN.**

**15.** Discuss when Floating Aerators are used for temporary additional aeration capacity.

**FLOATING AERATORS ARE USED FOR ADDITIONAL AERATION CAPACITY TO HANDLE LARGER THAN EXPECTED ORGANIC LOADS DURING THE SUMMER MONTHS.**

**16.** List the important issues to consider in developing a public relations program for a Pond system.

**A. POST A NOTICE EXPLAINING THE PRINCIPLES OF OPERATION OF A POND SYSTEM.**
**B. DEVELOP AN EDUCATIONAL PROGRAM FOR LOCAL ELECTED OFFICIALS.**
**C. EXPLAIN TO THE PUBLIC HOW UNAUTHORIZED ENTRANCE AND USE CAN JEOPARDIZE A PONDS AFFECTIVENESS.**
**D. EXPLAIN WHY CHILDREN SHOULD NOT BE ALLOWED IN THE AREA OF THE PONDS "RAPID DEPTH".**
**E. EXPLAIN WHY YOU SHOULD STAY OFF THE ICE OF A POND AT ALL TIMES.**
F. **ALL PUBLIC INFORMATION AND EDUCATION PROGRAMS COULD BE DONE WITH PUBLIC NOTICE.**

**17.** Explain why alternate discharges to seepage cells should be practiced in a Multiple Seepage Cell system.

**THE ALTERNATE LOADING/RESTING OF SEEPAGE CELLS IS DONE FOR A NUMBER OF REASONS. ONE REASON IS TO ALLOW THE OPERATOR TO PHYSICALLY WORK-UP (DISK,ROTOTILL,OR DRAG) AND CLEAN THE CELL BOTTOM. IT ALSO ALLOWS THE OPERATOR TO CONTROL VEGETATION WITHIN THE CELL. FINALLY, WITH THE NEW GROUND WATER RULES, IT ALLOWS SPREADING THE LOAD OVER A LARGER AREA TO PREVENT GROUND WATER EXCEEDANCES. THE NEW GROUND WATER STANDARDS WILL CHANGE SEEPAGE CELL OPERATIONS TO MEET THESE STANDARDS. THIS MAY MEAN MORE CELLS (LARGER AREA) OR EVEN POSSIBLE DISCONTINUANCE OF SEEPAGE CELLS.**

**18.** List the considerations a Pond operator would have to make when considering accepting septic tank waste.

**A. BOD CONCENTRATION OF HAULERS LOAD.**
**B. SOLIDS LOADING OF THE LOAD.**
**C. D.O. CAPACITY.**
**D. GRIT.**
**E. HYDRAULIC LOADING.**

**NORMALLY, PONDS AND AERATED LAGOONS ARE NOT DESIGNED WITH HOLDING TANKS TO ACCEPT SEPTAGE**

**CONCEPT: MAINTENANCE**

**19.** Identify the items to be included in a Preventive Maintenance plan for a Pond system.
**MONITOR ALL EQUIPMENT: BLOWERS, CHECK VALVES, AIR DIFFUSER ORIFICES, DIKES, ALL PUMPS, CONTROL MANHOLES, AND SHEAR GATES. MAINTAIN SEEPAGE CELLS. A PLANNED MAINTENANCE PROGRAM WILL PRE-VENT PROBLEMS AND WILL IDENTIFY POTENTIAL CONCERNS BEFORE THEY ACTUALLY BECOME PROBLEMS. MAINTENANCE AT A POND SYSTEM INVOLVES SIMPLE HOUSEKEEPING ITEMS WHICH ARE CRITICAL TO GOOD TREATMENT.**

**GOOD HOUSEKEEPING ITEMS ARE:**

**A. REMOVE ANY SCUM WHICH IMPEDES OXYGEN TRANSFER AND CAUSES ODORS.**
**B. MOW DIKES TO THE WATER LINE TO KEEP WEEDS DOWN, DISCOURAGE BURROWING MUSKRATS, AND PROMOTE WIND MIXING.**
**C. MAINTAIN DIKES BY RESTORING ANY EROSION AND/OR FILL MUSKRAT DENS.**
**D. SKIM FLOATING DUCKWEED REGULARLY.**
**E. CONTROL CATTAILS REGULARLY.**
**F. PERFORM PREVENTIVE MAINTENANCE ON ALL MECHANICAL EQUIPMENT AS INSTRUCTED IN THE O&M MANUAL AND THE EQUIPMENT MANUFACTURERS MANUALS.**
**G. EXERCISE VALVES IN THE SYSTEM ON A REGULAR BASIS.**

**20.** List the maintenance items on Aeration Equipment.

**A. PIPING: CHECK ALL AIR PIPING, INCLUDING VALVES AND DIFFUSERS TO ENSURE THAT THERE ARE NO BLOCKAGES.**

**B. CENTRIFUGAL BLOWERS: CHECK OIL LEVELS, AIR FILTERS, RELIEF VALVES, AND DRIVE MOTORS.**

**C. POSITIVE DISPLACEMENT BLOWERS: MAINTAIN OIL LEVELS, AIR RELIEF VALVES, V-BELTS, AIR FILTERS, AND DRIVE MOTORS.**

**D. FLOATING AERATORS: MAINTAIN FLOATS, ELECTRIC LINES, CHECK OIL LEVELS, ANCHORS, DRIVE MOTORS. MAKE SURE IMPELLERS ARE NOT CLOGGED.**

**21.** Explain how to clean clogged Air Diffusers.

**CLEANING OF AIR DIFFUSERS IN POND SYSTEMS CAN BE DONE IN SEVERAL WAYS. IF THE PLUGGING IS MINOR, THE AIR FLOW CAN BE INCREASED BY SHUTTING DOWN SOME SECTIONS TO INCREASE THE AIR TO THE REMAINING SECTIONS OR BY INCREASING BLOWER OUT-PUT (IF POSSIBLE). ANOTHER CLEANING METHOD WOULD BE TO INTRODUCE HYDROGEN CHLORIDE OR OXYGEN /OZONE GAS THROUGH THE AIR LINES. IN SOME INSTANCES, DIVERS HAVE BEEN USED TO MECHANICALLY CLEAN THE DIFFUSERS (ROLLING TUBING THROUGH A FLEX TOOL OR OTHER METHODS). IF NONE OF THESE PROCEDURES WORK, THE LAST OPTION WOULD BE TO DRAW THE POND DOWN TO REPAIR/REPLACE DIFFUSERS.**

**22.** Describe the function and maintenance of the Blower Inlet Filter.

**THE INLET AIR FILTER REMOVES PARTICULATES FROM THE AIR BEFORE THE COMPRESSION STAGE SO DEBRIS DOES NOT GET INTO THE AIR LINE AND PLUG DIFFUSER ORIFICES. IT IS ALSO ESSENTIAL TO**

**PROTECT THE COMPRESSOR FROM ANY DAMAGE, ESPECIALLY FROM GRITTY MATERIALS. THE MAIN MAINTENANCE REQUIREMENT IS TO KEEP THE FILTER CLEAN. USUALLY, THIS IS DONE BY REMOVING THE FILTER AND BLOWING IT OUT WITH COMPRESSED AIR. THE FREQUENCY OF CLEANING IS DEPENDENT ON FILTER SIZE AND AMBIENT AIR QUALITY. OTHER MAINTENANCE ACTIV-ITIES SHOULD BE SPECIFIED BY THE MANUFACTURER OR AS LISTED IN THE O&M MANUAL. FAILURE TO ADEQUATELY CLEAN FILTERS CAN CAUSE REDUCED BLOWER AIR OUTPUT, AN OVERHEATED BLOWER, POSSIBLE DIFFUSER CLOGGING, AND POSSIBLE DAMAGE TO BLOWER AND DRIVE MOTOR.**

**23.** Explain methods of controlling dike erosion.

**THE MAIN METHODS FOR PREVENTING DIKE EROSION ARE PROPER DIKE VEGETATION AND THE USE OF RIP RAP AROUND THE NORMAL OPERATING POND LEVELS TO PREVENT EROSION FROM WAVE ACTION.**

**24.** Discuss how to prevent ice damage to floating aeration equipment.

**ICE DAMAGE OCCURS MOST OFTEN TO FLOATING AERATORS WHEN THEY TIP OVER. THE MOTORS AND POWER CABLES CAN BE DAMAGED OR BROKEN DURING TIPPING. THE BEST METHOD IS TO STABILIZE THEM WITH ADEQUATE GUY CABLES. SINCE OXYGEN REQUIREMENTS ARE LOWER IN THE WINTER, IT IS POSSIBLE TO PROTECT EQUIPMENT BY REMOVING SOME OF THE AERATORS.**

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## MODULE C: MONITORING AND TROUBLESHOOTING

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### CONCEPT: MONITORING

**25.** Set-up a sampling schedule for a Fill and Draw Pond system.

**SAMPLING LOCATIONS SHOULD BE ABOUT EIGHT FEET FROM EACH CORNER AND BELOW THE SURFACE OF THE POND. SAMPLES SHOULD BE COLLECTED ABOUT A WEEK PRIOR TO PROPOSED DISCHARGE. DURING THE ENTIRE DURATION OF DISCHARGE, CHECK THE POND LEVEL DAILY. SAMPLE AT THE CONTROL MANHOLE ON THE FREQUENCY SPECIFIED IN THE DISCHARGE PERMIT.**
**PRIOR TO DRAWING DOWN A POND, THE OPERATOR SHOULD SAMPLE THE POND CONTENTS FOR pH, BOD, AND SUSPENDED SOLIDS. IT IS ALSO NECESSARY TO DETERMINE THE VOLUME NEEDED TO HOLD FLOWS UNTIL THE NEXT DRAW-DOWN (USUALLY 180 DAYS).**

**26.** Describe two ways to determine Dissolved Oxygen levels in a Pond.

**A. USE A DISSOLVED OXYGEN METER.**
**B. PERFORM A WINKLER DISSOLVED OXYGEN TEST.**

**27.** Discuss the requirements for groundwater monitoring.

**CHANGES IN STATE LAW HAVE ESTABLISHED REQUIREMENTS FOR GROUND WATER (NR 140). THIS IS IMPORTANT FOR WASTEWATER SYSTEMS, ESPEC- IALLY LAND DISPOSAL SEEPAGE FACILITIES AND LAGOONS THAT MAY BE LEAKING. NORMALLY, UP-GRADIENT AND DOWN-GRADIENT WELLS WILL BE LOCATED TO DETERMINE IF A SYSTEM IS AFFECTING GROUND WATER. CONCERN AT MUNICIPAL TYPE TREATMENT PLANTS WOULD BE TOTAL DISS-OLVED SOLIDS, CHLORIDES, AND NITROGEN SERIES (AND MORE SPECIF-ICALLY, NITRATES). THESE PARAMETERS WILL BE THE POTENTIAL AREAS THAT POND SYSTEMS MIGHT EXPECT EXCEEDANCES OF THE GROUND WATER STANDARDS WHICH WILL REQUIRE OPERATIONAL CHANGES, DISCHARGE LOCATION CHANGES, OR FUTURE RECONSTRUCTION.**

**CONCEPT: TROUBLESHOOTING**

**28.** Describe how to determine if a drop in Pond water levels is caused by seepage or evaporation.

**A. CALIBRATE THE FLOW METER TO DETERMINE IF THE TOTALIZER IS WORKING PROPERLY.**
**B. CHECK THE RESULTS OF GROUNDWATER SAMPLES TO SEE IF DOWN-GRADE WELLS SHOW SIGNIFICANT CHANGES IN WATER QUALITY.**

**CALIBRATE THE FLOW METER TO DETERMINE IF YOU HAVE ACCURATE INFLUENT FLOW DATA. SET-UP A STAFF GAUGE TO ACCURATELY MEASURE POND ELEVATION. BY FILLING A 55-GALLON DRUM, OR SIMILAR HOLDING DEVICE WITH WATER, THIS CAN BE USED TO DETERMINE THE AFFECTS OF PRECIPITATION AND EVAPORATION. COLLECTING THIS DATA OVER A PERIOD OF TIME CAN BE USED TO DETERMINE THE RATE OF POND SEEPAGE.**

**29.** List the chemical and non-chemical controls for the following Pond conditions:

A. Algae.
B. Rooted Weeds.
C. Duckweed.
D. Organic Overload.

| CONDITIONS | CHEMICAL | NON-CHEMICAL |
|---|---|---|
| **A. ALGAE** | **COPPER SULFATE** | **FILTRATION** |
| **B. ROOTED WEEDS** | **HERBICIDE** | **CUTTING, PULLING OR VARY POND LEVELS** |
| **C. DUCKWEED** | **HERBICIDE** | **WIND AND RAKE** |
| **D. ORGANIC OVERLOAD** | **SODIUM NITRATE** | **REDUCE LOAD AND USE AERATION** |

**NOTE: FOR CATTAIL CONTROL, HERBICIDES ARE USUALLY MOST AFFECTIVE DURING DEVELOPMENT. CUTTING CATTAILS BELOW THE WATER LINE IN FALL IS ALSO AN AFFECTIVE CONTROL METHOD.**

**30.** State the action to take if a polishing Pond produces worse suspended solids effluent than its influent.

**THIS SITUATION IS NORMALLY A PROBLEM ASSOCIATED WITH AN ALGAE BLOOM. THE ALTERNATIVES TO CORRECT THIS PROBLEM WOULD BE TO BY-PASS THE POLISHING POND, OR TO ATTEMPT TO WITHDRAW EFFLUENT FROM A DIFFERENT ELEVATION.**

**31.** List the conditions that might lead to solids build-up on the bottom of a Pond.

**A. HIGH INFLUENT TSS.**
**B. EXCESSIVE WEED GROWTH.**
**C. OVERLOADING.**
**D. POOR TREATMENT.**
**E. HIGH INFLUENT BOD.**
**F. INORGANIC SOLIDS.**

**32.** List some possible consequences of exceeding the design organic loading rate of a Pond system.

**A. POOR TREATMENT.**
**B. HIGH EFFLUENT BOD.**
**C. INCREASE OF SLUDGE SOLIDS.**
**D. POTENTIAL FOR OBJECTIONABLE ODORS.**
**E. EXCESSIVE ALGAE (BLUE-GREEN FILAMENTOUS MATS).**

**33.** Discuss the significance of long-term domination of a Pond by blue-green algae.

**BLUE-GREEN ALGAE DOMINANCE OF A POND SYSTEM IS AN INDICATION OF INCOMPLETE OR POOR TREATMENT. THE PROBLEM WITH BLUE-GREEN ALGAE HAPPENS WHEN THE ALGAE DIES-OFF AND FOUL ODORS OCCUR. IF OPERATIONAL CHANGES CANNOT BE MADE TO ELIMINATE THE BLUE-**

**GREEN ALGAE, THEN CONSIDERATIONS NEED TO BE GIVEN TO PLANT RE-DESIGN.**

**34.** Explain why a Pond receiving a white dairy waste might turn red.

**HIGH PROTEIN WASTE IS CAUSING RED ALGAE TO BLOOM.**

**35.** Describe when and how to use copper sulfate to achieve maximum control of algae.

**USE COPPER SULFATE WHEN ALGAE BECOMES EXCESSIVE. USE LABEL DIRECTIONS FOR MIXING AND APPLYING THIS CHEMICAL. ADDITIONAL MONITORING FOR TOXICS MAY BE REQUIRED. A CONCERN THAT NEEDS WATCHING WHEN TREATING THE ENTIRE POND IS THAT DISSOLVED OXYGEN LEVELS CAN DECREASE DUE TO THE DIE-OFF AND DECOMPOSITION OF ALGAE.**

**36.** List some alternatives to using Copper Sulfate for algae control.

**A. INTRODUCTION OF FISH.**
**B. SPRAY THE PONDS WITH ANOTHER APPROVED ALGICIDE.**
**C. CHANGE OPERATIONAL MODE (IF POSSIBLE).**
**D. DISCHARGE EFFLUENT FROM A DIFFERENT POND LEVEL.**
**E. APPLY FOR AN ALGAE VARIANCE.**

**37.** Describe short circuiting and possible causes and problems it creates.

**SHORT CIRCUITING IS A HYDRAULIC CONDITION WHICH MAY OCCUR IN PARTS OF A POND WHEN THE FLOW PASSES THROUGH MORE QUICKLY THAN THE THEORETICAL DETENTION. THIS TYPE OF FLOW PATTERN REDUCES DETENTION TIME AS COMPARED WITH EVEN UNIFORM FLOW THROUGH THE POND.**

**SHORT CIRCUITING CAN BE CAUSED BY POOR DESIGN AND/OR CONSTRUCTION OF INLET AND OUTLET STRUCTURES, UNEVEN POND BOTTOMS, SHAPE OF THE CELLS, PREVAILING WINDS, AND EXCESSIVE GROWTH OF ROOTED WEEDS.**

**PROBLEMS ASSOCIATED WITH SHORT CIRCUITING INCLUDE: DEAD SPOTS, UNEVEN OXYGEN LEVELS, SLUDGE BUILD-UP, ODOR PROBLEMS, AND, A REDUCTION IN TREATMENT EFFICIENCY.**

## MODULE D: SAFETY AND CALCULATIONS

**CONCEPT: SAFETY**

**38.** List the characteristics of an affective safety program.

**A. RED CROSS FIRST AID TRAINING.**
**B. C.P.R. TRAINING.**
**C. PROPER EQUIPMENT OPERATION NEAR PONDS (MOWING, SNOW REMOVAL FROM DIKES, ETC.).**
**D. WEARING PROPER APPAREL WHEN ENTERING CONTROL STRUCTURES.**
**E. CONFINED ENTRY TRAINING.**
**F. WATER SAFETY COURSE TRAINING.**
**G. UNDERSTANDING USAGE OF CHEMICALS.**

**39.** List some Pond security measures.

**A. FENCING TO PREVENT ANY UNAUTHORIZED ENTRY.**
**B. ERECTING SIGNS WITH PROPER MESSAGE.**
**C. PASSING AN ORDINANCE TO REGULATE USE OF THE AREA AND PENALIZE VIOLATORS.**

**CONCEPT: CALCULATIONS**

**40.** Given data, calculate pounds BOD per acre per day.

**GIVEN: POND SURFACE = 6.2 ACRES**
**AVERAGE DAILY FLOW = 50,000 GPD**
**INFLUENT $BOD_5$ = 220 mg/L**

**FORMULA:**

$$\text{SURFACE LOADING RATE} = \frac{\text{POUNDS OF BOD PER DAY}}{\text{POND SURFACE AREA}}$$

**POUNDS OF BOD/DAY = CONCENTRATION(mg/L) X FLOW(MG) X 8.34**

**= 220 X .05 X 8.34**

**= 91.7 Pounds BOD/DAY**

**SURFACE LOADING RATE = 91.7**

14

**6.2**

**= 14.8 POUNDS BOD/ACRE/DAY**

**41.** Given data, calculate the cost of a chemical ($/Pound) needed to control Duckweed.

**GIVEN: POND SURFACE AREA = 12.5 ACRES**
**APPLICATION RATE = 2.1 PER ACRE**
**CHEMICAL COST = $8.75 PER ACRE**

**FORMULA:**

**COST ($) = AREA (ACRES) X APPLICATION RATE X COST**

**= 12.5 X 2.1 X 8.75**

**= $230**

**42.** Given data, calculate the theoretical detention time of a Pond.

**GIVEN: VOLUME = 5.2 MGD**
**FLOW = .05 MGD**

**FORMULA:**

$$\text{DETENTION TIME} = \frac{\text{VOLUME (MGD)}}{\text{FLOW RATE (MGD)}}$$

**(FOR POND SYSTEMS, DETENTION TIME IS USUALLY EXPRESSED IN DAYS)**

**43.** Given data, calculate a discharge flow rate to achieve a given Pond draw-down.

**GIVEN: POND DIMENSIONS = 200 FEET X 400 FEET**
**(AT MID-POINT OF DRAWDOWN)**
**DRAWDOWN DESIRED = 4 FEET**
**DURATION OF DRAWDOWN = 100 HOURS**
**(ONE CUBIC FOOT = 7.5 GALLONS)**

**FORMULA:**

$$\text{FLOW RATE} = \frac{\text{VOLUME TO BE DISCHARGED}}{\text{DURATION OF DRAW-DOWN}}$$

$$= \frac{\text{200 FT. X 400 FT. X 4 FT. X 7.5}}{\text{100 HOURS X 60 MIN./HR.}}$$

**= 400 GALLONS PER MINUTE**

**44.** Given data, for a Fill and Draw Pond system, calculate the amount of draw-down required and the time required to achieve draw-down.

**GIVEN:**

$$\textbf{AMOUNT OF DRAW-DOWN REQ.} = \frac{\textbf{VOLUME REQ.FOR DESIRED STORAGE TIME}}{\textbf{VOLUME PER FOOT OF DEPTH}}$$

$$\textbf{TIME REQ. FOR DRAW-DOWN} = \frac{\textbf{VOLUME OF DRAW-DOWN NEEDED}}{\textbf{MAXIMUM DRAW-DOWN RATE}}$$

**(1 CUBIC FOOT = 7.5 GALLONS)**

**A POND IS BEING OPERATED FILL AND DRAW WITH THE OPERATOR DRAWING-DOWN A POND TO MEET A DESIRED DETENTION TIME OF 180 DAYS. THE POND DIMENSIONS ARE 400 FEET BY 600 FEET AT AVERAGE DEPTH. THE MEASURED WATER DEPTH IS 6 FEET, WITH THE MAXIMUM OPERATING DEPTH OF 6 FEET, AND THE MAXIMUM DRAW-DOWN RATE OF 0.5 FEET PER DAY. THE INFLUENT FLOW TO THE SYSTEM IS 30,000 GPD. WHAT IS THE MINIMUM NUMBER OF DAYS THAT IT WILL TAKE TO DRAW THE POND DOWN?**

**45.** Given data, calculate the volume of water in a groundwater monitoring well casing.

**GIVEN: INSIDE WELL CASING DIAMETER = 2 INCHES**
**DEPTH OF WATER = 15 FEET**

**FORMULA:**

$$\textbf{VOLUME(GALLONS)} = 3.14 \times R^2 \times \textbf{DEPTH} \times 7.5$$

**(1 CUBIC FOOT = 7.5 GALLONS)**
**(1 CUBIC FOOT = 1728 CUBIC INCHES)**

$$\textbf{VOLUME} = \frac{3.14 \times 1 \times 1 \times (15(\text{FT}) \times 12(\text{IN}) \times 7.5}{1728}$$

**VOLUME = 2.45 GALLONS**

## RESOURCES


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