Illinois Environmental Protection Agency
Division of Water Pollution Control
Class K Study Guide
Industrial Wastewater Operator Certification

The purpose of this study guide is to help you prepare for Class K industrial certification examinations. Currently, there are two types of Class K examinations that are offered. The first type is "facility specific" and covers a particular industrial facility or facilities. Persons who pass a "facility specific" Class K examination will be issued a certificate that is only valid for the specific industrial facility or facilities for which the examination was taken.

Persons seeking certification for a surface water or groundwater remediation treatment system for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil, may opt to take another type of Class K examination. A general Class K examination is available which covers treatment systems associated with these water remediation systems. A person who passes this general exam will be issued one Class K general certificate that is valid for all water remediation systems for contamination resulting from gasoline, diesel fuel, kerosene, jet fuel, or heating oil.

When you take a Class K exam, you are given one exam booklet containing questions, formulas and conversion factors; two sheets of scratch paper; and two pencils. The only item you may bring to the exam site is your calculator, which must be non-programmable and incapable of storing alpha-numeric data. You are allowed a maximum of three hours to complete the exam. A copy of the conversion factors and formulas is provided at the back of this study guide. If you familiarize yourself with the format, it should cut down your referencing time during the examination.

Usually within four weeks of exam completion your results are sent to your home address. A score of 70% or higher is required to pass these examinations. If you score less than 70%, you may reschedule for the same type of Class K exam by telephone without submitting another application, or by completing and returning the exam scheduling form provided with your results.

The examinations consist of multiple choice questions and essay questions designed to test your knowledge of the wastewater facilities for which you are seeking certification. During the exam, you should be capable of providing, without the use of supplemental aids, the following information as it relates to industrial wastewater treatment works:

1.   flow schematics;

2.   purpose of each treatment unit;

3.   theory of operation (principles of treatment) for each treatment unit;

4.   measures used to prevent and correct process upsets;

5.   methods used for solids handling;

6.   sludge disposal techniques;

7.   sources, characteristics, and concentrations of the industrial wastes;

8.   removal efficiencies for each treatment unit;

9.   effluent monitoring requirements;

10.   laboratory techniques and interpretation of laboratory results;

11.   safety considerations;

12.   rules and regulations which apply; and

13.   record keeping.

The following example math questions have been provided to show you the type of questions you might expect to see on an examination. These specific example questions will not be used on the examinations.

1.   A rectangular sludge tank which is 15 feet wide, 20 feet long, and 10 feet deep is filled to a depth of 8 feet with sludge. If a tank truck can haul 2,000 gallons per trip, how many trips would it take to empty the sludge tank?

        a. 2 trips
        b. 5 trips
        c. 7 trips
        d. 9 trips

2.   An industry discharges 600 mg/l BOD at a rate of 260 gpm into a city sewer. What is the PE load being discharged by the industry?

        a. 11,000
        b. 15,000
        c. 17,000
        d. 27,000

3.   A wet well is 8 feet long by 6 feet wide. Marks are placed on the sides of the wet well 15 inches apart indicating a liquid depth of 15 inches. Using a stopwatch, you note that the 15 inch depth was filled in 2 minutes and 15 seconds at a time when no pump was in operation. When one pump was turned on, the same 15 inch depth was drawn down in 5 minutes and 30 seconds. Assume the inflow to the wet well remained continuous and at a constant rate during the test. Calculate in gallons per minute the rate at which sewage was being pumped.

        a. 174 gallons/min
        b. 234 gallons/min
        c. 282 gallons/min
        d. 326 gallons/min

4.   The influent BOD to an industrial wastewater treatment plant is 600 mg/l, and the effluent BOD is 20 mg/l. What is the BOD removal efficiency of the plant?

   a. 80%
   b. 85%
   c. 90%
   d. none of the above

The formulas that will be provided for your use during the examination are on the following page.

LIST OF SUGGESTED READINGS:

1. Industrial Waste Treatment, A Field Study Training Program - Prepared by Sacramento State College.

2. MOP FD-3, Pretreatment of Industrial Wastes - Water Environment Federation.

3. MOP OM-2, Preliminary Treatment for Wastewater Facilities - Water Environment Federation.

4. MOP11, Operation of Wastewater Treatment Plants - Water Environment Federation.

5. MOP1, Safety in Wastewater Works - Water Environment Federation.

Suggested reading items #2, #3, #4 & #5 are available from:

   Water Environment Federation
   Publications Order Department
   601 Wythe Street
   Alexandria, Virginia 22314-1994
   (800) 666-0206
   Website: www.wef.org

Suggested reading item #1 is available from:

   Office of Water Programs
   California State University, Sacramento
   6000 J Street
   Sacramento, California 95819-2694
   (916) 278-6142
   Website: www.owp.csus.edu

              or

   Correspondence Course Coordinator
   Environmental Resources Training Center
   Campus Box 1075 - Southern Illinois Univ.
   Edwardsville, Illinois 62026-1075
   (618) 650-2030

FORMULA SHEETS

CONVERSION FACTORS

Pi (π) = 3.14
1 gallon of water = 8.34 pounds
1 gallon of water = 4 quarts = 8 pints = 3.785 liters
1 Population Equivalent (PE) = 0.17 pounds BOD/person/day
                 "   = 0. 20 pounds SS/person/day
                 "   = 100 gallons water/person/day
1 day = 24 hours = 1440 minutes
1 square foot (ft^2) = 144 square inches (in^2)
1 square yard (yd^2) = 9 square feet (ft^2)
1 cubic foot (ft^3) = 7.5 gallons = 1728 cubic inches (in^3)
1 cubic yard (yd^3) = 27 cubic feet (ft^3)
1 acre = 43,560 square feet (ft^2)
1 horsepower (HP) = 33,000 foot-pounds/minute (ft-lb/min) = 746 watts = 0.746 kilowatts (kw)
1 foot of water = 0.433 pounds/square inch (psi)
1 pound/square inch (psi) = 2.31 feet of water

VOLUMES, AREAS, & PERIMETERS

GIVEN: V = Volume, L = Length, H = Height, W = Width, r = radius, d = diameter, π = Pi,
        b = base, P = Perimeter, C = Circumference

VOLUMES

Rectangular Solid: V = L x W x H   Cylinder: $V = \pi r^2 H = \dfrac{\pi d^2 H}{4} = 0.785\, d^2 H$

Sphere: $V = 4/3\ \pi r^3$ Cone: $V = 1/3\ \pi r^2 H$

Pyramid: V = 1/3 L x W x H

PERIMETER

Polygon: $P = L_1 + L_2 + L_3 + \dots + L_n$ Circle: C = πd

AREA

Rectangle: A = L x W   Triangle: A = 1/2 b x H

Circle: $A = \pi r^2 = \dfrac{\pi d^2}{4} = 0.785\, d^2$ Trapezoid: $A = 1/2\ (b_1 + b_2)\ H$

PROCESS FORMULAS

TEMPERATURE

$^{o}F = 9/5 \ ^{o}C + 32$ $\qquad\qquad$ $^{o}C = 5/9 \ (^{o}F - 32)$ $\qquad\qquad$ $^{o}K = \ ^{o}C + 273$

ELECTRICITY

Power = Current x Voltage $\qquad\qquad$ Voltage = Current x Resistance

MISCELLANEOUS

Efficiency = $\dfrac{\text{(In - Out)}}{\text{In}}$ x 100% $\qquad\qquad$ Velocity = $\dfrac{\text{Distance}}{\text{Time}}$

Detention Time = $\dfrac{\text{Volume}}{\text{Flow Rate}}$ $\qquad\qquad$ Q = AV

Application Rate = Concentration x Flow x Conversion Factor

Loading Rate = $\dfrac{\text{Concentration x Flow x Conversion Factor}}{\text{Area}}$

Mixed Concentration =
$$\dfrac{\text{(Upstream Flow x Upstream Concentration) + (Effluent Flow x Effluent Concentration)}}{\text{Downstream Flow}}$$

ANSWERS TO EXAMPLE MATH QUESTIONS

1. Volume of Tank = L x W x H

   $$\frac{\text{Volume of Tank}}{\text{Volume of Truck/Trip}} = \frac{\text{L x W x H}}{\text{2000 gallons/trip}}$$

   $$\frac{\text{15 ft x 20 ft x 8 ft 7.5 gallons/ft}^3}{\text{2000 gallons/trip}} = \frac{\text{18,000 gallons}}{\text{2000 gallons/trip}} = 9 \text{ trips}$$

2. BOD Application Rate = concentration (mg/l) x flow (MGD)[*] x conversion factor =

   600 mg/l x 0.3744 MGD x 8.34 lb/gallon = 1873.5 lbs/day

   $$\text{PE} = \frac{\text{BOD Application Rate}}{\text{BOD Conversion Factor}} = \frac{\text{1873.5 lbs/day}}{\text{0.17 lbs BOD/person/day}} = 11{,}020 \text{ persons}$$

   [*]Flow (MGD) = $\frac{\text{260 gallons/minute x 60 minutes/hour x 24 hours/day}}{\text{1,000,000}}$ = 0.3744 MGD

3. Volume of wet well filled in 2 minutes & 15 seconds = L x W x H
   $$= 8 \text{ ft x 6 ft x 1.25 ft x 7.5 gallons/ft}^3$$
   $$= 60 \text{ ft}^3 \text{ x 7.5 gallons/ft}^3$$
   $$= 450 \text{ gallons}$$

   Flow Rate Into Tank = $\frac{\text{Volume}}{\text{Time}}$

   $$= \frac{\text{450 gallons}}{\text{2.25 minutes}} = 200 \text{ gallons/minute}$$

   Volume entering wet well while pump runs = Flow Rate x Time
   $$= 200 \text{ gallons/minute x 5.5 minutes}$$
   $$= 1100 \text{ gallons}$$

   Pumping Rate = $\frac{\text{(Wet Well Volume) + (Flow Volume)}}{\text{Time}}$

   $$= \frac{\text{450 gallons + 1100 gallons}}{\text{5.5 minutes}} = 282 \text{ gallons/minute}$$

4. Efficiency = $\frac{\text{In – Out}}{\text{In}}$ x 100%

   $$= \frac{\text{600 mg/l – 20 mg/l}}{\text{600 mg/l}} \text{ x 100\%}$$

   $$= \frac{\text{580 mg/l}}{\text{600 mg/l}} \text{ x 100\%} = 0.97 \text{ x 100\%} = 97\%$$