OPERATOR CERTIFICATION EXAM CRIB SHEET 7/27/06

1 gallon = 3.8 liters

1 mile = 5280 feet

1 pound = 454 grams = 7000 grains

1 acre = 43,560 square feet

1 horsepower = .746 kilowatt
= 550 ft-lbs/sec
= 33,000 ft-lbs/min

F = (1.8 x C) + 32

C = (F - 32) x .55

1 cubic foot = 7.48 gallons

1 liter = 1000 milliliters

1 gram = 1000 milligrams

1 % = 10,000 mg/l

1 grain per gallon = 17.1 mg/l = 17.1 ppm

Q = AV

1 cubic foot per second = 450 gal/min

Q = Flow
A = Area
V = Velocity

1 cubic foot of water = 62.5 pounds

1 gallon of water = 8.34 pounds

1 foot water head = .433 psi

1 mg/l = 8.34 pounds/million gallons of water

$$*\text{Dosage (mg/l)} = \frac{(\text{lbs chemical per day})\ (120{,}000)\ (\%)}{\text{gallons of water treated}}$$

$$*\text{Dosage (mg/l)} = \frac{(\text{lbs chemical used})\ (\%)}{(\text{MGD of water treated})(8.34\ \text{lbs/gal})}$$

$$*\text{Lbs of chemical} = \frac{(8.34\ \text{lbs/gal})(\text{MGD})(\text{dosage in mg/l})}{\%}$$

$$*\text{Lbs of chemical} = \frac{(\text{gpm})(.012)(\text{dosage in mg/l})}{\%}$$

* % refers to the percentage of available chemical taking into account purity and available ion

$$\text{Removal efficiency} = \frac{(\text{In-Out})(100\%)}{\text{In}}$$

(V1)(N1) = (V2)(N2)
V = Volume
N = Normality

$$\text{Work Hp} = \frac{(\text{lbs water raised per minute})(H')}{33{,}000\ \text{foot-pounds per minute per Hp}}$$

$$\text{Brake Hp} = \frac{\text{Work Hp}}{\text{Pump efficiency}} \qquad \text{Wire to Water Hp} = \frac{\text{Brake Hp}}{\text{Motor efficiency}}$$

$$\text{Alkalinity in mg/l (as CaC03)} = \frac{(\text{ml of } H_2SO_4)(N)(50{,}000)}{\text{ml of sample}}$$

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

pH = -Log (H+)

$$\text{Weir Overflow Rate} = \frac{\text{Flow}}{\text{Weir Length}}$$

$$\text{Surface Settling Rate} = \frac{\text{Flow}}{\text{Area}}$$

$$\text{Equivalent Flow Rate} = \frac{(\text{Actual Flow Rate})\ 100}{\text{C Value}}$$

$$\text{Head} = \frac{\text{ft-lb}}{\text{lb}}$$

$$\text{Velocity Head} = \frac{V^2}{64.4\ \text{ft/sec}^2}$$

$$\text{Specific Capacity} = \frac{\text{Well yield in gpm}}{\text{Drawdown in ft}}$$

Drawdown = Pumping water level - Static water level

$$\text{Filter Backwash Rate} = \frac{\text{Flow}}{\text{Filter Area}}$$

$$\text{Filter Loading Rate} = \frac{\text{Flow}}{\text{Filter Area}}$$

$$\frac{\text{Molecular Weight}}{\text{New Measurement}} \quad (\text{Old concentration}) = (\text{New concentration})$$
$$\text{Molecular Weight}$$
$$\text{Old Measurement}$$

$$\text{Normality} = \frac{\text{Number of equivalent weights of solute}}{\text{Liters of solution}}$$

$$\text{BOD (mg/1)} = \frac{(\text{Initial DO - Final DO})\ \ \text{Vol of BOD bottle}}{\text{Vol of WW sample}}$$

$$\text{Per Cent Volume Solids} = \frac{[\ \text{Wt Dry sample in grams - Wt Ash in grams}\ ]\ 100\%}{\text{Wt Dry sample in grams}}$$

$$\text{Per Cent Sludge Solids} = \frac{(\text{Wt Dry sample in grams})\ \ 100\%}{\text{Wt Wet sample in grams}}$$

$$\text{TSS in mg/1} = \frac{[\ \text{filter w/ residue in grams - filter wt in grams}\ ]\ 1000\ 1000}{\text{Sample volume in ml}}$$

$$\text{Food/Mass Ratio} = \frac{\text{Influent BOD in \#/day}}{\text{MLVSS in \#'s}}$$

$$\text{Sludge Age (days)} = \frac{\text{Suspended solids in aeration tank in \#'s}}{\text{Suspended solids in influent in \#'s/day}}$$

$$\text{Sludge Vol Index} = \frac{(\text{Settled sludge volume in ml/1})\ (1000)}{\text{MLSS in mg/1}}$$

Lbs of BOD per day = (BOD in mg/1)(8.34)(MGD)

Influent SS = (SS in mg/1)(8.34)(MGD)

MLSS in lbs = (MLSS in mg/1)(8.34)(Volume of Aeration Tank in MG)

$$\text{Hydraulic Loading} = \frac{\text{Flow in MGD}}{\text{Surface area}}$$

$$\text{Reduction of volatile solids(VS) (\%)} = \frac{(\text{VS in} - \text{VS out}) \times 100\%}{\text{VS in} - (\text{VS in} \times \text{VS out})}$$

$$\text{Organic Loading} = \frac{\text{BOD to filter in \#'s/day}}{\text{Filter volume}}$$

$$\text{\% Capture} = \frac{(\text{Sludge SS in mg/l} - \text{Return Liquor SS in mg/l})\ 100\%}{\text{Sludge SS in mg/l}}$$

$$\text{Moisture} = \frac{(\text{Wet sludge in grams} - \text{Dry solids in grams})\ 100\%}{\text{Wet sludge in grams}}$$

$$\text{Organic Loading of Pond} = \frac{\text{\#'s of BOD per day}}{\text{acres}}$$

$$\text{Flow Velocity} = \frac{\text{Length of grit chamber}}{\text{Time to pass thru chamber}}$$

$$\text{Flow Velocity} = \frac{\text{Rate of flow to chamber}}{\text{Cross section area of chamber}}$$

$$\text{Mean Cell Residence Time (MCRT) in days} = \frac{\text{Aeration Tank TSS in lbs} + \text{Clarifier TSS in lbs}}{\text{TSS Wasted in lbs/day} + \text{Effluent TSS in lbs/day}}$$

$$\text{Saturator Feed Rate (gpm)} = \frac{(\text{Water flow in gpm})(\text{Dosage})}{18{,}000}$$

$$\text{Fluoride Dosage (mg/l)} = \frac{(\text{Gal from Saturator})(18{,}000)}{\text{Water treated in gallons}}$$

Lime Softening*

Lime Dosage = CO_2 + Carbonate Hardness + Mg^{+2} + Excess

Soda Ash Dosage = Total Hardness - Total Alkalinity

Noncarbonate Hardness = Total Hardness - Carbonate Hardness

Total Hardness = $Ca^{+2} + Mg^{+2}$

*All values are as $CaCO_3$

Chlorine dose = Chlorine residual + Chlorine demand

Watts (AC Circuit) = Volts x Amps x Power Factor

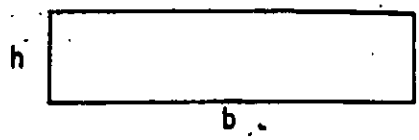
Watts (DC Circuit) = Volts x Amps

$$\text{Specific Gravity} = \frac{\text{Specific Weight of Substance, lbs/gal}}{\text{Specific Weight of Water, lbs/gal}}$$

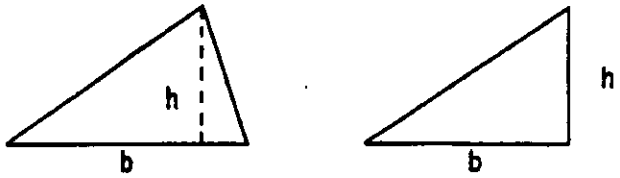
Water and Wastewater Works Operator Certification Examination

Formulas

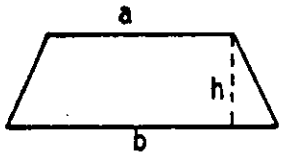
1. Area of a rectangle = b x h



2. Area of a triangle = ½ x b x h

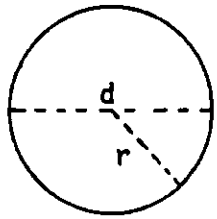


3. Area of a trapezoid = ½(a+b) x h

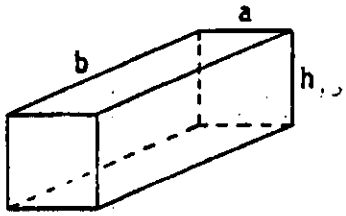


4. Area of a circle = $\pi \times r^2 = 3.14 \times r^2 = \frac{\pi d^2}{4}$

   Circumference of a circle = $2 \times \pi \times r$



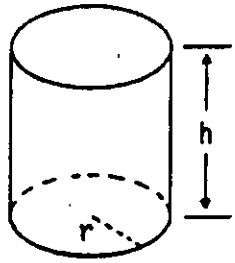
5. Volume of a cube = a x b x h



6. Volume of a sphere = $\frac{4}{3} \times \pi \times r^3$

   Surface area of a sphere = $4\pi r^2$

7. Volume of a circular cylinder = $\pi \times r^2 \times h$



8. Volume of a circular cone = $\frac{1}{3} \times \pi \times r^2 \times h$