Sidney's Big Book of Water and Wastewater Math

INDIGO WATER GROUP

Unit Conversions to Know by Heart

1 inch = 2.54 centimeters
1 meter = 3.28 feet
1 mile = 5280 feet

1 acre = 43,560 ft^2
1 m^2 = 10.76 ft^2

1 gallon = 3.785 liters
1 ft^3 = 7.48 gallons
1 m^3 = 35.31 ft^3

1 ft water = 0.433 psi

1 gallon = 8.34 lbs when specific gravity is 1.0
1 kg = 2.2 lbs

1% = 10,000 mg/L
1 mg/L = 1 ppm
1 μg/L = 1 ppb

1 day = 1440 minutes
1 hp = 0.746 kW

1 gram = 15.43 grains
1 grain per gallon = 17.1 mg/L

Water Formulas

pounds per day = (concentration in mg/L)*(flow rate in mgd)*(8.34)

chlorine dose = demand + residual

velocity = $\frac{\text{flow}}{\text{area}}$ $\qquad V = \frac{Q}{A}$

flow rate = $\frac{\text{volume}}{\text{time}}$ $\qquad Q = \frac{V}{t}$

overflow rate = $\frac{\text{flow rate}}{\text{area}}$

weir loading rate = $\frac{\text{flow rate}}{\text{feet of weir}}$

(concentration 1)*(volume 1) = (concentration 2)*(volume 2) $\qquad C_1V_1 = C_2V_2$

(conc. 1)*(volume 1) + (conc. 2)*(volume 2) = (conc. 3)*(volume 3)

$$C_1V_1 + C_2V_2 = C_3V_3$$

horsepower = $\frac{\text{(flow in gpm)*(lift in feet)}}{3960}$

Activated Sludge
F:M, MCRT, SRT, Space Loading, and more!

Activated Sludge Problems

Q =	20	MGD	A-basin =	6	MG
BOD5 =	250	mg/L	MLSS =	3000	mg/L
NH3-N =	30	mg/L	Clarifier =	2	MG
			Core SS =	600	mg/L
Effluent TSS is negligible			WAS =	7500	mg/L
			WAS =	110	gpm

1. Calculate the hydraulic retention time of the aeration basin. Then, calculate the hydraulic retention time of the clarifier. Express your answers in hours.

2. Calculate the Space Loading to the Aeration Basins:

3. Calculate the F:M.

4. Calculate the SRT and the MCRT for this system. How much do they differ?

5. Calculate the total oxygen (not air) demand on the system in one day. Use a value of 1.2 lbs of oxygen per pound of BOD and 4.33 lbs of oxygen per pound of ammonia.

6. If my target MCRT is 10 days, what should my wasting rate be adjusted to? Up or down?

7. Assume that a total of four aeration basins make up the 6 MG of volume. If one basin is taken off-line and the MLSS concentration does not change in the other three basins, what is the new food to microorganism ratio?

8. Iif each of the aeration basins is 16 feet deep and 33 feet wide, how long is each basin? Round to the nearest whole foot.

9. If there are two clarifiers and they are each 75 feet in diameter, what is the surface overflow rate?

Express your result in gpd/sft.

1. $Q = \frac{V}{t}$

$20\ MGD = \frac{6\ MG}{t}$

$(20\ MGD)(t) = 6\ MG$

$t = 0.30$ days

$0.30\ \text{days} \left| \frac{24\ \text{hours}}{1\ \text{day}} \right| = 7.2$ hours

∴ HRT for aeration basins is 7.2 hours

$Q = \frac{V}{t}$

$20\ MGD = \frac{2\ MG}{\text{time}}$

$(20\ MGD)(t) = 2\ MG$

$t = 0.10$ days

$0.10\ \text{days} \left| \frac{24\ \text{hours}}{1\ \text{day}} \right| = 2.4$ hours

∴ HRT for the clarifiers is 2.4 hours.

2. Space Loading $= \frac{\text{lbs } BOD_5}{1000\ \text{cuft a-basin}}$

First, I need to know the volume of the aeration basins in cuft. Convert.

$6\ MG \left| \frac{1000000\ \text{gallon}}{1\ MG} \right| \frac{1\ \text{cuft}}{7.48\ \text{gallons}} \left| = 802139 \text{ cuft}\right.$

Divide by 1000 to get $802.139 \cdot 1000$ cuft

$$\text{Space Loading} = \frac{\text{lbs of BOD}}{\text{1000 cuft basin}}$$

$$\text{Space Loading} = \frac{(250^{mg/L})(20\text{ MGD})(8.34)}{802.139 \cdot 1000\text{ cuft}}$$

$$\text{Space Loading} = \frac{41700}{802.139}$$

$$\text{Space Loading} = 51.99\text{ lbs}/1000\text{ cuft}$$

3. $$\frac{F}{m} = \frac{\text{lbs BOD}_5}{\text{lbs MLSS}}$$

$$\frac{F}{m} = \frac{(250^{mg/L})(20\text{ MGD})(8.34)}{(3000^{mg/L})(6\text{ MGD})(8.34)}$$

$$\frac{F}{m} = \frac{41700}{1050120}$$

$$\frac{F}{m} = 0.28$$

4. $$\text{SRT} = \frac{\text{lbs of MLSS in aeration basin}}{\text{lbs wasted}}$$

$$\text{SRT} = \frac{(3000^{mg/L})(6\text{ MGD})(8.34)}{(7500^{mg/L})(110\text{ gpm})(8.34)}$$

↑ Uh Oh! My units don't match. I need to convert.

$$\frac{110 \text{ gallons}}{\text{minute}} \left| \frac{60 \text{ minutes}}{1 \text{ hour}} \right| \frac{24 \text{ hours}}{1 \text{ day}} \left| \frac{1 \text{ MG}}{1000000 \text{ gallons}} \right| \frac{\text{MG}}{\text{day}}$$

$= 0.1584$ MGD

$$SRT = \frac{(3000^{mg/L})(6 \text{ MGD})(8.34)}{(7500^{mg/L})(0.1584 \text{ MGD})(8.34)}$$

SRT = 15.15 days

Good! How about MCRT?

$$MCRT = \frac{(\text{lbs MLSS in basin}) + (\text{lbs MLSS in clarifier})}{\text{lbs wasted}}$$

$$MCRT = \frac{(3000^{mg/L})(6 \text{ MGD})(8.34) + (600^{mg/L})(2 \text{ MGD})(8.34)}{(7500^{mg/L})(0.1584 \text{ MGD})(8.34)}$$

$$MCRT = \frac{150120 + 10008}{9908}$$

MCRT = 16.16 days

BIG BLANKETS MEAN
BIGGER DIFFERENCES
BETWEEN SRT AND
MCRT.

5. FIRST, Find pounds of BOD and ammonia coming into the plant.

ppd BOD = (250 mg/L)(20 MGD)(8.34)
ppd BOD = 41700

ppd NH_3-N = (30 mg/L)(20 MGD)(8.34)
ppd NH_3-N = 5004

THEN, calculate pounds of oxygen needed for each.

$$41700 \text{ pounds BOD} \left| \frac{1.2 \text{ pounds}}{1 \text{ pound BOD}} \right| = 50040 \text{ lbs oxygen}$$

$$5004 \text{ pounds } NH_3 \left| \frac{4.33 \text{ pounds } O_2}{1 \text{ pound } NH_3} \right| = 21667 \text{ lbs oxygen}$$

TOTAL OXYGEN DEMAND = 50040 + 21667
= 71707 ppd

6. $\text{MCRT} = \dfrac{\text{lbs MLSS total}}{\text{lbs wasted}}$

$$10 \text{ days} = \frac{(3000 \text{ mg/L})(6 \text{ MGD})(8.34) + (600 \text{ mg/L})(2 \text{ MGD})(8.34)}{\text{lbs wasted}}$$

$$10 \text{ days} = \frac{150120 + 10008}{\text{lbs wasted}}$$

$$10 \text{ days} = \frac{160128 \text{ lbs}}{\text{lbs wasted}}$$

$$\frac{\text{lbs wasted}}{\text{day}} = 16012.8$$

To convert this to a pumping rate, use the same ppd formula.

$$\text{ppd WAS} = (\text{mg/L WAS})(\text{MGD})(8.34)$$

$$16012.8 \text{ ppd} = (7500 \text{ mg/L})(\text{MGD})(8.34)$$

$$0.256 \text{ MGD} = \text{flow rate}$$

$$\frac{0.256 \text{ MG}}{\text{day}} \Big| \frac{1 \text{ day}}{24 \text{ hrs}} \Big| \frac{1 \text{ hr}}{60 \text{ min}} \Big| \frac{1000000 \text{ gal}}{1 \text{ MG}} \Big| = 178 \frac{\text{gallons}}{\text{min}}$$

7. $\frac{6 \text{ mg}}{4 \text{ basins}} = \frac{1.5 \text{ mg}}{\text{basin}}$

$\frac{F}{m} = \frac{(250 \text{ mg/L})(20 \text{ MGD})(8.34)}{(3 \text{ basins})(1.5 \text{ mg/basin})(3000 \text{ mg/L})(8.34)}$

$\frac{F}{m} = \frac{41700 \text{ ppd}}{112590 \text{ ppd}}$

$\frac{F}{m} = 0.37$

8. Basin dimensions are
16 deep
33 wide
? length

Each basin holds 1.5 mg. Convert to ft^3

$1.5 \text{ mg} \left| \frac{1000000 \text{ gal}}{1 \text{ mg}} \right| \frac{1 \text{ ft}^3}{7.48 \text{ gal}} \Big| = 200535 \text{ ft}^3$

Volume = length × width × depth
$200535 \text{ ft}^3 = (\text{length})(33 \text{ ft})(16 \text{ ft})$
380 ft = length

9. The surface overflow rate is defined as the amount of flow moving through the area of the clarifier.

The first step is to find the total surface area of both clarifiers.

$A = \pi r^2$

$A = (3.1415)(75/2)(75/2)$

$A = (3.1415)(37.5)(37.5)$

$A = 4417.7\ ft^2$

There are 2 clarifiers, so the total available surface area is $8835.5\ ft^2$

Next, convert influent flow from MGD to gpm.

$$\frac{20\ MG}{day} \left| \frac{1000000\ gal}{1\ MG} \right| \frac{1\ day}{24\ hrs} \left| \frac{1\ hr}{60\ min} \right| = 13889\ gpm$$

$$SOR = \frac{13889\ gpm}{4417.7\ ft^2}$$

$SOR = 3.14\ gpm/ft^2$

ACTIVATED SLUDGE – F:M, SRT, and MCRT

1. A plant ran blowers for 24 hrs/day at 5000 cu.ft/min. How many cu.ft/min of air were required to remove a pound of BOD per day if the activated sludge system removed 6000 lbs/day?
a) 595
b) 660
c) 1100
d) 1200

2. Calculate the F:M ratio. Influent flow volume is 1 MG, Average BOD to aeration tank = 140mg/L, Aeration tank capacity = 250,000 gal, MLSS concentration = 2000 mg/L
a) 0.25
b) 0.28
c) 0.30
d) 0.32

3. An activated sludge plant receives a flow rate of 2 MGD with a BOD of 240 mg/l. If the desired f/m ratio is 0.4 and the primary clarifiers remove about 30% of the influent BOD, how many pounds of MLVSS should be maintained in the process? Round to nearest unit.
a) 6000 lbs
b) 7005 lbs
c) 4008 lbs
d) 3503 lbs

4. How many lbs. of solids are in a 400,000 gallon aeration tank if the suspended solids concentration is 1200 mg/l?
a) 3000
b) 4000
c) 4400
d) 4800
e) 5200

5. What is the MLSS concentration in an activated sludge plant that has a 1 MG aeration basin and carries 16000 lbs of solids in the aeration basin?
a) 1800
b) 1760
c) 1860
d) 1920

6. Given the following, what is the F/M ratio of this activated sludge process? Tank dimensions are 80 ft long x 20 ft wide x 12 ft deep. Average flow rate is 300 gpm. Plant influent BOD is 180 mg/l. Primary effluent BOD is 150 mg/l. MLSS is 1350 mg/l.

a) 0.15
b) 0.33
c) 0.21
d) 0.40

7. If the influent flow to the aeration basin is 5 MGD with a BOD concentration of 200 mg/L, how much sludge will need to be wasted if the yield is 0.7 lb/lb?

a) 5840 lbs
b) 5480 lbs
c) 5237 lbs
d) 4088 lbs

8. Consider a conventional activated sludge treatment process with a desired F:M ratio of 0.8. If the plant flow is 5 mgd and BOD of the primary effluent is 150 mg/l, how many pounds of mixed liquor volatile suspended solids should be maintained in the aerator?

a) 7819 lb
b) 5402 lb
c) 10,465 lb
d) 89587 lb

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9. In an aeration tank, the MLSS is 2500 mg/l, and the recorded 30-minute settling test indicates 230 ml. What is the sludge volume index (SVI)?

a) 65
b) 83
c) 92
d) 101

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1. FIRST, FIND THE lbs OF BOD REMOVED PER MINUTE

$$\frac{6000 \text{ lbs BOD}}{\text{DAY}} \cdot \frac{1 \text{ DAY}}{1440 \text{ min}} = 4.17 \text{ lbs/min BOD}$$

$$\frac{5{,}000 \text{ cuft}}{\text{min}} \cdot \frac{1 \text{ min}}{4.17 \text{ lbs BOD}} = 1199 \text{ cfm/lb BOD}$$

2. $\frac{F}{m} = \frac{\text{lbs BOD}}{\text{lbs MLVSS}}$

BOD

$\text{lbs} = (\text{mg/L})(Q, \text{mgd})(8.34)$

$\text{lbs} = (140 \text{ mg/L})(1 \text{ mgd})(8.34)$

$\text{lbs} = 1167.6$

MLVSS

$\text{lbs} = (\text{mg/L})(Q, \text{mgd})(8.34)$

$\text{lbs} = (2000 \text{ mg/L})(0.25 \text{ mgd})(8.34)$

$\text{lbs} = 4170$

NOTE: Since VSS was not available, the total MLSS was used

$$\frac{F}{m} = \frac{1167.6 \text{ lbs BOD}}{4170 \text{ lbs MLSS}}$$

$$\frac{F}{M} = 0.28$$

Typical Ranges of F:M

Extended aeration	0.05 – 0.10
Conventional	0.2 – 0.4
High Rate	>1.0

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3. If the primary clarifiers are removing 30% of the influent BOD, then the food going to the aeration basin is

$$(240 \text{ mg/L})(0.70) = 168 \text{ mg/L}$$

$$\text{lbs BOD} = (\text{mg/L})(Q, \text{mgd})(8.34)$$
$$= (168 \text{ mg/L})(2 \text{ mgd})(8.34)$$
$$= 2802.24$$

$$\frac{F}{m} = \frac{\text{lbs BOD}}{\text{lbs MLVSS}}$$

$$0.4 = \frac{2802.24 \text{ lbs BOD}}{\text{lbs MLVSS}}$$

$$(0.4)(\text{lbs MLVSS}) = 2802.24 \text{ lbs BOD}$$
$$\text{lbs MLVSS} = 7005.6$$

4. $\text{lbs} = (\text{mg/L})(Q, \text{mgd})(8.34)$

$$\text{lbs} = (1200 \text{ mg/L})(0.4 \text{ mg})(8.34)$$
$$\text{lbs} = 4003.2$$

5. $\text{lbs} = (\text{mg/L})(Q, \text{mgd})(8.34)$

$$16{,}000 \text{ lbs} = (\text{mg/L})(1 \text{ mg})(8.34)$$
$$1918 = \text{mg/L}$$

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6. First, find lbs of BOD

$$\frac{300\text{ gal}}{\text{min}} \Big| \frac{1440\text{ min}}{1\text{ day}} \Big| \frac{1\text{ MG}}{10^6\text{ gal}} \Big| = 0.432\ \frac{\text{MG}}{\text{day}}$$

lbs BOD = (mg/L)(Q, mgd)(8.34)
= (150 mg/L)(0.432 mgd)(8.34)
= 540.4

Then, find lbs of MLSS

Volume = length * width * height
= (80 ft)(20 ft)(12 ft)
= 19200 ft^3

$$19200\ ft^3 \Big| \frac{7.48\text{ gallons}}{1\ ft^3} \Big| \frac{1\text{ MG}}{10^6\text{ gallons}} \Big| = 0.144\text{ MG}$$

lbs MLSS = (mg/L)(Q, mgd)(8.34)
= (1350 mg/L)(0.144 mgd)(8.34)
= 1621.3

$$\frac{F}{M} = \frac{\text{lbs BOD}}{\text{lbs MLSS}}$$

$$\frac{F}{M} = \frac{540.4\text{ lbs BOD}}{1621.3\text{ lbs MLSS}}$$

$$\frac{F}{M} = 0.33$$

7. lbs BOD = (mg/L)(Q, mgd)(8.34)
= (200 mg/L)(5 mgd)(8.34)
= 8340

if the yeild is 0.7 lbs MLSS for every lb BOD, then (8340 lbs BOD)(0.7) = 5838 lbs MLSS to waste

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8. $\text{lbs BOD} = (\text{mg/L})(Q, \text{mgd})(8.34)$

$= (150 \text{ mg/L})(5 \text{ mgd})(8.34)$

$= 6255$

$$\frac{F}{m} = \frac{\text{lbs BOD}}{\text{lbs MLSS}}$$

$$0.8 = \frac{6255 \text{ lbs BOD}}{\text{lbs MLSS}}$$

$$(0.8)(\text{lbs MLSS}) = 6255 \text{ lbs BOD}$$

$$\text{lbs MLSS} = 7818.75$$

9. $$SVI = \frac{(SSV \text{ at } 30 \text{ min, mL})(1000)}{(MLSS, \text{ mg/L})}$$

$$SVI = \frac{(230 \text{ mL})(1000)}{2500 \text{ mg/L}}$$

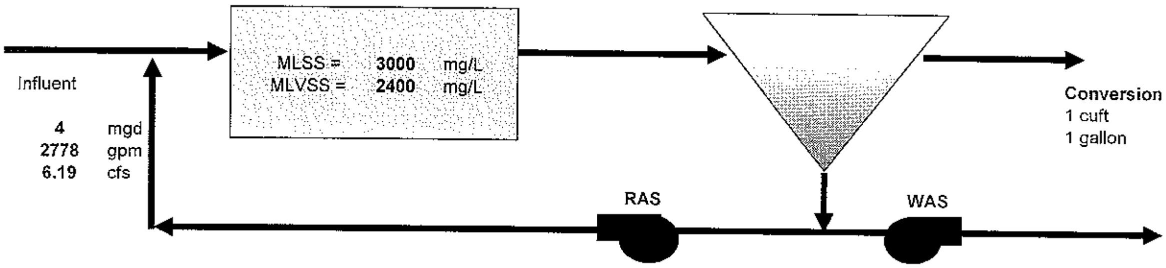
$$SVI = 92 \text{ mL/g}$$

*SSV = Settled sludge volume

SVI of 70-150 mL/g NORMAL

SVI > 200 IS BULKING SLUDGE

Numbers in **RED** can be changed. Numbers in **BLUE** are calculated by the spreadsheet.



Conversion Factors
1 cuft = 7.48 g
1 gallon = 8.34 lt

Aeration Basin Characteristics		
Length	150	ft
Width	50	ft
Depth	12	ft
# Basins	2	each
MLSS	3000	mg/L
MLVSS	2400	mg/L
Volume	180000	ft3
	1346400	gallons
	1.35	mg
HRT	8.1	hours

Secondary Clarifier Characteristics		
Diameter	65	ft
Depth	12	ft
# Clarifiers	2	
CCC*	1200	mg/L
*Clarifier core concentration of TSS		
Volume	79639	ft3
	595703	gallons
	0.60	mg
HRT	3.57	hours

WAS Characteristics		
TSS	6500	mg/L
Flow	0.05	mgd
	34.72	gpm

Effluent Characteristics		
TSS	12	mg/L

Aeration Basin	33687	lbs
Clarifier	5962	lbs
WAS	2711	lbs
Effluent	400	lbs
SRT	10.8	days
MCRT	12.7	days

$$pounds = (mg/L)(million\_gallons)(8.34)$$

$$MCRT = \frac{(Lbs\_MLSS\_AerationBasin) + (Lbs\_MLSS\_Clarifier)}{(Lbs\_WAS) + (Lbs\_TSS\_Effluent)}$$

***NOTE: SRT does not take the solids in the clarifier into account.**

Problem ~~One~~: #10

A WWTP has 2 aeration basins on-line. The combined volume of all basins is 180000 cuft. If the MLSS concentration is 3000 mg/L, how many pounds of MLSS are in the aeration basin?

Answer: lbs Convert cuft to million gallons. Then calculate pounds.

Problem ~~Two~~: #11

A WWTP has 33686.928 pounds of MLSS under aeration. There are 2 clarifiers on-line. Each one is 65 feet in diameter and 12 feet deep. A core sample taken with a sludge judge contains 1200 mg/L of TSS. Assuming a WAS concentration of 6500 mg/L at a flow rate of 34.7222222222222 gpm, what is the SRT or solids retention time?

Answer: ____ days Note: even though clarifier data is given, the problem is asking for SRT, not MCRT.

Problem ~~Three~~: #12

For the wastewater treatment plant described in problem two, where should the wasting rate be set if the target MCRT is 15 days? Express your answer as gpm. MLSS = 3000 mg/L.

Answer: lbs per day to waste
gpm

MCRT = (Lbs Aeration + Lbs Clarifier) / (Lbs WAS + Lbs Effluent)

Problem ~~Four~~: #13

A WWTP has 2 aeration basins on-line. Each basin is 150 feet long by 50 feet wide by 12 feet deep. The MLSS concentration is 3000 mg/L. The waste pump operates at 34.7222222222222 gpm for 15 minutes out of every hour. If the WAS concentration is 6500 mg/L, what is the SRT?

Answer: ____ days Note: The pump runs for 15 minutes or 1/4 of the total time per hour.

Problem ~~Five~~: #14

For the WWTP described in problem ~~two~~ 12, what percentage of the solids inventory is in the secondary clarifiers?

Answer:

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10. $180{,}000 \text{ cuft} \left| \frac{7.48 \text{ gal}}{1 \text{ cuft}} \right| \frac{1 \text{ mg}}{10^6 \text{ gal}} \Big| = 1.3464 \text{ mg}$

lbs = (mg/L)(Q, mgd)(8.34)

lbs = (3000 mg/L)(1.3464 mgd)(8.34)

lbs = 33687

11. $SRT = \frac{\text{lbs in A-basin}}{\text{lbs WAS} + \text{lbs EFF}}$

SRT = Solids Retention Time

$\frac{34.72 \text{ gal WAS}}{\text{min}} \left| \frac{1440 \text{ min}}{1 \text{ day}} \right| \frac{1 \text{ mg}}{10^6 \text{ gal}} \Big| = 0.05 \text{ mg}$

lbs WAS = (mg/L)(Q, mgd)(8.34)

= (6500 mg/L)(0.05 mgd)(8.34)

= 2710.5

$SRT = \frac{\text{lbs in A-basin}}{\text{lbs WAS} + \text{lbs EFF}}$ ← assumed to be zero since no info. given

$SRT = \frac{33686.9 \text{ lbs MLSS}}{2710.5 \text{ lbs WAS}}$

SRT = 12.4 days

12. $MCRT = \frac{\text{lbs A-basin} + \text{lbs clarifier}}{\text{lbs WAS} + \text{lbs effluent}}$

MCRT: set at 15 days

lbs A-basin, lbs WAS: know these

lbs effluent: this is zero

The only thing I don't know is lbs of MLSS in the clarifier.

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12. cont.

2 clarifiers

$V = \pi r^2 h$

$V = (3.14)(32.5\ ft)(32.5\ ft)(12\ ft)$

$V = 39799.5\ ft^3$

↑ multiply by 2 for total volume

$V = 79599\ ft^3$

$$79599\ ft^3 \left| \frac{7.48\ gal}{1\ ft^3} \right| \frac{1\ MG}{10^6\ gal} \Big| = 0.5954\ MG$$

lbs in Clarifier $= (mg/L)(Q, mgd)(8.34)$

$= (1200\ mg/L)(0.5954\ mg)(8.34)$

$= 4958$

$$MCRT = \frac{lbs\ A\text{-}basin + lbs\ Clarifier}{lbs\ WAS + lbs\ EFF}$$

$$15\ days = \frac{33686.9\ lbs + 4958\ lbs}{lbs\ WAS + \emptyset}$$

$$15 = \frac{38644.9}{lbs\ WAS}$$

$(15)(lbs\ WAS) = 38644.9$

lbs WAS = 2576.3 ← last step is to calculate gpm from lbs

lbs WAS $= (mg/L)(Q, mgd)(8.34)$

$2576.3 = (3000\ mg/L)(Q, mgd)(8.34)$

$0.1029 = Q$, mgd

$$\frac{0.1029\ MG}{day} \left| \frac{10^6\ gallons}{1\ MG} \right| \frac{1\ day}{1440\ min} \Big| = 71.5\ gpm$$

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13. Volume = length × width × depth

$V = (150\ ft)(50\ ft)(12\ ft)$

$V = 90{,}000\ ft^3$ for one basin, so $180{,}000\ ft^3$ for 2 basins

$$180{,}000\ ft^3 \left| \frac{7.48\ gal}{1\ ft^3} \right| \frac{1\ MG}{1{,}000{,}000\ gal} \right| = 1.35\ MG$$

lbs MLSS = (mg/L)(Q, mgd)(8.34)

lbs MLSS = (3000 mg/L)(1.35 MG)(8.34)

lbs MLSS = 33777

$$\frac{34.72\ gal}{min} \left| \frac{15\ min}{hour} \right| \frac{24\ hours}{1\ day} \left| \frac{1\ day}{10^6\ gal} \right| = 0.0125\ \frac{Mgal}{day}$$

lbs WAS = (mg/L)(Q, mgd)(8.34)

lbs WAS = (6500 mg/L)(0.0125 mgd)(8.34)

lbs WAS = 667.6

$$SRT = \frac{\text{lbs in A. basin}}{\text{lbs WAS} + \text{lbs EFF}}$$

$$SRT = \frac{33777\ \text{lbs MLSS}}{667.6\ \text{lbs WAS} + \emptyset}$$

SRT = 50.6 days

14. $\%\ CLARIFIER = \frac{CLARIFIER}{TOTAL}$

$$\%\ CLARIFIER = \frac{4958\ lbs}{33686.9 + 4958}$$

% CLARIFIER = 0.128

OR

12.8%