Example #1 Calculate Pounds Under Aeration for a Rectangular Extended Aeration Basin

Tank Dimensions:

60 ft. long by 20 ft. wide and 12.0 ft. deep

Mixed Liquor Suspended Solids (MLSS):

3200 mg/L

% Mixed Liquor Volatile Suspended Solids (MLVSS)

85%

Example 1 Demo.xls

18

Worksheet #1 handout

Calculate Pounds Under Aeration for

Square or Rectangular Tanks

[ ] Input required

_____ Calculate Value

Comments: Example 1

Square Footage (Surface Area)

Length, ft		Width, ft		Sq. Ft.
[ ]	x	[ ]	=	_____

Volume in Cubic Feet

		Sq. Ft.		Operating depth, ft		Cu. Ft.
		_____	x	[ ]	=	_____

Capacity in Gallons

volume in Cu. Ft.		gals. Per cubic ft		Capacity in gallons	Capacity in MG
_____	x	7.48	=	_____	_____

Pounds of (MLSS) Mixed Liquor Suspended Solids

MLSS in mg/L		# per gal water		Capacity in MG		pounds MLSS
[ ]	x	8.34	x	_____	=	_____

Pounds of (MLVSS) Mixed Liquor Volatile Suspended Solids

pounds MLSS		Percent MLVSS		pounds MLVSS
_____	x	[ ]	=	_____

Example #2 Calculate Pounds Under Aeration for a Circular Aeration Basin

Tank Dimensions:

60 ft. diameter and 12.0 ft. deep (at sampling)

MLSS:

2,000 mg/L

% MLVSS:

78%

Example 2 Demo.xls 

19

Worksheet #2 Handout

Calculate Pounds Under Aeration for for Circular Basins

Input Required

Calculate Value

Comments: Example 2

Square Footage (Surface Area)

Diameter,ft		Diameter,ft		1/4 Pi Factor		Sq. Ft.
	x		x	0.785	=	

Volume in Cubic Feet

	Sq. Ft.		Operating depth, ft		Cu. Ft.
		x		=	

Capacity in Gallons

volume in Cu. Ft.		gals. Per cubic ft		Capacity in gallons	Capacity in MG
-	x	7.48	=		

Pounds of (MLSS) Mixed Liquor Suspended Solids

MLSS in mg/L		# per gal water		Capacity in MG		pounds MLSS
	x	8.34	x		=	

Pounds of (MLVSS) Mixed Liquor Volatile Suspended Solids

pounds MLSS		Percent MLVSS		pounds MLVSS
	x		=	

Example #3 Detention Time

Average Flow:

504,000 gpd

Peaking Factor:

3.0

Circular Clarifier:

42 ft. diameter

and 12.0 ft. average depth

Example 3.xls

59

Worksheet #3 handout

Input required

Calculate Value

Detention Time (clarifiers or aeration basins)

Comments: Example 3

Peak Flows

Peak Factors greater than 4.0 are usually problematic and both ADF and Peak Detention Times should be monitored. Normally only ADF is used for DT calculations.

ADF		Peak Factor		Est. Peak Flow
	x		=	

Determine Capacity in gallons

Area of a Rectangular or Square Tanks

Length		Width		Depth		Capacity, Cu. Ft.
	x		x		=	-

OR

Area of a Circular Tank

Diameter		Diameter		1/4 PI		Depth		Capacity, Cu. Ft.
	x		x	0.785	x		=	

Convert Cu. Ft. to Gallons

Capacity, Cu. Ft.		gallons/ Cu. Ft.		Gallons
	x	7.48	=	

Calculate Detention Time, hours

Capacity, Gals		hrs/day		ADF Flow Rate, gpd		DT, hrs (ADF)
	x	24	/		=	

If Peak Factor is greater then 4.0 monitor DT for both ADF and Peak Flows

Capacity, Gals		hrs/day		Peak Flow Rate, gpd		DT, hrs (Peak)
	x	24	/		=	

Example #4 Secondary Clarifiers Surface Overflow Rate (SOR)

Average Flow to Clarifier No. 1:

750,000 gpd

Peak Flow Rate:

2,000,000 gpd

Circular Clarifier:

45 ft. tank diameter

Example 4.xls

60

Worksheet #4 handout

Secondary Clarifiers

Surface Overflow Rate (SOR), gpd/sq. ft.

[ ] Input Required

_____ Calculated Value

[ ] Standards

Peak Flows

Peak Factors greater than 4.0 are usually problematic.

Normally SOR is calculated using only peak flows.

Some operators/engineers use Peak and Average Flows.

Comments: Example 4

Clarifier [ ] **Information**

[ ] ADF to Clarifier, gpd [ ] Peak Flow, gpd Peak Factor _____

Circular Clarifier (Surface Area, Sq. Ft.)

[ ] Diameter, Ft. X [ ] Diameter, Ft. X 0.785 (1/4 PI) = _____ Sq. Ft. Surface Area

Or

Rectangular Clarifier (Surface Area, Sq. Ft.)

[ ] **Feet** Length x [ ] **Feet** Width = _____ Sq. Ft. Surface Area

Surface Overflow Rate (SOR), gpd/sq. ft.)

_____ , gpd / _____ = _____ SOR, ADF

Average Flow Surface Area

_____ , gpd / _____ = _____ SOR, Peak

Peak Flow Surface Area

Conventional Activated Sludge	800 gpd/sq. ft. Average Flow	1,200 gpd/sq. ft. Peak Flow
Nitrification and Extended Air	500 gpd/sq. ft. Average Flow	1,000 gpd/sq. ft. Peak Flow

Example #5 Secondary Clarifiers Solids Loading Rate (SLR)

Average Daily Flow to Clarifier No. 1:
0.750 MGD
Peak Flow Rate:
2.00 MGD
Clarifier Surface Area:
1,590 sq. ft.
RAS Rate 90%
MLSS 2800 mg/L

Example 5.xls

61

Worksheet #5 handout

Secondary Clarifiers

Solids Loading Rate (SLR), ppd/Sq. Ft.

[ ] Input Required

_____ Calculated Value

[ ] Standards

Peak Flows

Normally SOR is calculated using only peak flows.

Some operators/engineers use Peak and Average Flows.

Comments: Example 5

Clarifier [ ] Information

[ ] ADF (Q) to Clarifier, MGD

[ ] Peak (Q) Flow, MGD Peak Factor _____

[ ] Avg.RAS, MGD

[ ] Peak.RAS Flow, MGD

[ ] MLSS, mgL

[ ] Clarifier Surface Area, Sq. Ft.

Q + R Flow at ADF _____ MGD Q + R Flow at Peak _____ MGD

Calculate Pounds to Clarifer

_____, MGD x 8.34 x _____, mg/L = _____, pounds per day

(Q + R) ADF Flow MLSS to Clarifier (daily average)

_____, MGD x 8.34 x _____, mg/L = _____, pounds per day

(Q + R) Peak Flow MLSS to Clarifier (Peak Flow)

Calculate SLR

_____, pounds per day / _____ = _____ **ppd/sq. ft. @ average flow**

to Clarifier at ADF Surface Area

_____, pounds per day / _____ = _____ **ppd/sq. ft. @ peak flow**

to Clarifier at Peak Flow Surface Area

SLR - Conventional Activated Sludge	[40] ,ppd/sq. ft. Average Flow	[50] ,ppd/sq. ft. Peak Flow
SLR - Nitrification and Extended Air	[30] ,ppd/sq. ft. Average Flow	[35] ,ppd/sq. ft. Peak Flow

Example #6 Flow-Thru Activated Sludge
Organic Loading and F/M Ratio

Average Daily Flow to Basin No. 1:
0.800 MGD

Influent BOD:
160 mg/L

Basin Capacity:
0.500 MG

Should wasting rate be adjusted?

MLSS/MLVSS:
2200 mg/L / 1850 mg/L

Desired F/M Ratio:
0.10

Example 6 Demo.xls

42

Worksheet #6 handout

Flow-thru Activated Sludge Processes

Organic Loading and F/M Ratio

[ ] Input Required

_____ Calculate Value

Use this Worksheet for a single in service basin. Calculate / estimate flow entering basin.

Basin [ ] Information

Comments: **Example 6**

Operating data (Organic Loading and FM Ratio)

[ ] Flow to basin, MGD

[ ] Basin Capacity, MG

[ ] MLSS, mg/L

_____ % MLVSS

[ ] MLVSS, mg/L

[ ] Influent or P.E. BOD, mg/L

_____ Aeration Cap. In 1000 cu. Ft. (Basin Capacity, gals / 7.48 / 1000)

Pounds of BOD entering basin

BOD in mg/L		# per gal water		Flow in MGD		pounds of BOD/day
_____	x	8.34	x	_____	=	_____

Calculated Organic Loading (ppd of BOD/1000 cu. Ft.)

_____ pounds per day BOD / _____ 1000 cu.ft. capacity = _____

Pounds of (MLVSS) Mixed Liquor Suspended Solids

MLVSS in mg/L		# per gal water		Capacity in MG		pounds of MLVSS
_____	x	8.34	x	_____	=	_____

Food to Microorganisms

pounds of BOD/day		pounds of MLVSS		FM Ratio
_____	/	_____	=	_____

DESIRED FM Ratio [ ]

to **increase** F/M increase wasting

to **decrease** F/M decrease wasting

Example #7 Flow-Thru Activated Sludge
Sludge Age (SA) & Sludge Volume Index (SVI)

Flow Rate to Basin No. 1:	0.800 MGD
Influent TSS:	160 mg/L
Basin Capacity:	0.500 MG
MLSS/MLVSS:	2200/1850 mg/L
30 min. settling test	300 ml/L
Desired SA	10 days
Desired SVI	100

Example 7 Demo.xls

46

Worksheet #7 handout

Flow-thru Activated Sludge Processes

Sludge Age (SA) and Sludge Volume Index (SVI)

[ ] Input Required

_____ Calculate Value

Use this Worksheet for a single in service basin. Calculate/ estimate flow entering basin.

Basin [ ] Information

Comments: Example 7

SA and SVI Information

[ ] Flow to Basin, MGD

[ ] Basin Capacity, MG

[ ] MLSS, mg/L

_____ % MLVSS

[ ] MLVSS, mg/L

[ ] Influent or P.E. TSS, mg/L

[ ] 30 min settling test, ml/L

Pounds of TSS entering basin

TSS in mg/L		# per gal water		Flow in MGD		pounds of TSS/Day
_____	x	8.34	x	_____	=	_____

Pounds of (MLSS) Mixed Liquor Suspended Solids

MLSS in mg/L		# per gal water		Capacity in MG		pounds MLSS
_____	x	8.34	x	_____	=	_____

Sludge Ave (SA) Days (using MLSS)

pounds MLSS		pounds of TSS/Day		**SA Days**
_____	/	_____	=	_____

decrease wasting to raise SA

DESIRED SA Days [ ]

Sludge Volume Index (SVI)

30 min settling, ml/L		MLSS, mg/L				
_____	/	_____	x	1,000	=	_____ **SVI**

DESIRED SVI [ ]

Example #8 Flow-Thru Activated Sludge Solids Retention Time (SRT)

Effluent Flow (for Basin #1):	0.800 MGD
Effluent TSS:	5 mg/L
Basin Capacity:	0.500 MG
MLSS:	2200 mg/L
Waste Sludge:	11 gpm
Waste Sludge Suspended Solids (WSSS):	6,500 mg/L
Desired SRT:	11.0 Days

Should the wasting rate be changed?

Example 8 Demo.xls

49

Worksheet #8 handout

Flow-thru Activated Sludge Processes

Solids Retention Time (SRT)

[ ] Input Required

_____ Calculate Value

Use this Worksheet for a single in service basin. Calculate/ estimate flow entering basin.

Basin [ ] Information

Comments: **Example 8**

SRT Information

[ ] Effluent Flow, MGD

[ ] Basin Capacity, MG

[ ] MLSS, mg/L

[ ] WSSS, mg/L

[ ] Wasted Sludge, gpm

_____ Wasted Sludge, MGD

[ ] Effluent TSS, mg/L

Pounds of (MLSS) Mixed Liquor Suspended Solids

MLSS in mg/L		# per gal water		Capacity in MG		pounds MLSS
_____	x	8.34	x	_____	=	_____

Solids Wasted, ppd

WSSS in mg/L		# per gal water		Waste Sludge in MGD		WSSS in ppd
_____	x	8.34	x	_____	=	_____

Effluent TSS Wasted, ppd

TSS in mg/L		# per gal water		Effluent Flow in MGD		TSS Over Weir, ppd
_____	x	8.34	x	_____	=	_____

Total ppd Wasted (Waste Sludge and TSS Over Weir):

WSSS in ppd		TSS Over Weir in ppd		Total Solids Wasted, ppd
_____	+	_____	=	_____

	pounds MLSS		Total Solids Wasted, ppd		days
SRT	_____	/	_____	=	_____

DESIRED SRT
Days [ ]

Example #9 Sequencing Batch Reactor Calculating Pounds Under Aeration (Square or Rectangular Basins)

Dimensions:

90 feet long by 80 feet wide

9.5 feet LWL

MLSS/MLVSS:

2500 mg/L / 1850 mg/L

Depth of Basin at Sampling:

14.5'

Calculate for Basin No. 1

Example 9 Demo.xls

54

Worksheet #9 handout

Calculate Pounds Under Aeration for

Square or Rectangular SBR Basin

[ ] Input required

_____ Calculate Value

Comments: Example 9

Use this worksheet for a single SBR Basin.

Basin [ ] Information

[ ] Basin Length, feet

[ ] Basin Width, feet

[ ] MLSS, mg/L at sample depth

[ ] MLVSS, mg/L at sample depth

[ ] Depth of basin at sampling, feet

[ ] Low Water Level (LWL), feet

Conversion Factor (CF) = _____ (Sample Depth / LWL)

Square Footage (Surface Area)

Length, ft		Width, ft		Sq. Ft.
_____	x	_____	=	_____

Volume in Gallons at Low Water Level (LWL) Depth

Sq. Ft.		LWL, Ft.		gallons per cubic foot		Capacity in gallons at, LWL		MG Capacity at LWL
_____	x	_____	x	7.48	=	_____	or	_____

Pounds of (MLSS) Mixed Liquor Suspended Solids at LWL

MLSS in mg/L		CF		# per gal water		MG Capacity at LWL		**pounds MLSS**
_____	x	_____	x	8.34	x	_____	=	_____

Pounds of (MLVSS) Mixed Liquor Suspended Solids at LWL

MLVSS in mg/L		CF		# per gal water		MG Capacity at LWL		**pounds MLSS**
_____	x	_____	x	8.34	x	_____	=	_____

Example #10 Sequencing Batch Reactor Calculating Pounds Under Aeration (Circular Basins)

Dimensions:

90 feet diameter

9.5 feet LWL

MLSS/MLVSS:

2500 mg/L / 1850 mg/L

Depth of Basin at Sampling:

14.5'

Example 10.xls

62

Worksheet #10 handout

Calculate Pounds Under Aeration for

Circular SBR Basin

[ ] Input required

_____ Calculate Value

Comments: Example 10

Use this worksheet for a single SBR Basin.

Basin [ ] Information

[ ] Basin Diameter, feet

[ ] MLSS, mg/L at sample depth

[ ] MLVSS, mg/L at sample depth

[ ] Depth of basin at sampling, feet

[ ] Low Water Level (LWL), feet

Conversion Factor (CF) = _____ (Sample Depth / LWL)

Square Footage (Surface Area)

Diameter		Diameter		1/4 pi		Sq. Ft.
_____	x	_____	x	0.785	=	_____

Volume in Gallons at Low Water Level (LWL) Depth

Sq. Ft.		LWL,Ft.		gallons per cubic foot		Capacity in gallons at, LWL		MG Capacity at LWL
_____	x	_____	x	7.48	=	_____	or	_____

Pounds of (MLSS) Mixed Liquor Suspended Solids at LWL

MLSS in mg/L		CF		# per gal water		MG Capacity at LWL		**pounds MLSS**
_____	x	_____	x	8.34	x	_____	=	_____

Pounds of (MLVSS) Mixed Liquor Suspended Solids at LWL

MLVSS in mg/L		CF		# per gal water		MG Capacity at LWL		**pounds MLVSS**
_____	x	_____	x	8.34	x	_____	=	_____

Example # 11 Sequencing Batch Reactor Food To Microorganisms (F/M), Sludge Age (SA), and SVI

Flow to Basin No. 1:

0.750 MGD

Influent BOD:

180 mg/L

Influent TSS:

170 mg/L

Settling Test:

480 ml/L at 60 minutes

MLSS:

2,500 mg/L

Pounds of MLSS/MLVSS at LWL: as calculated in Example #9

16,282 / 12,049

Example 11 Demo.xls

55

Worksheet #11 handout

SBR Activated Sludge Process

F/M Ratio, Sludge Age (SA), and SVI

[ ] Input Required

_____ Calculate Value

Use this Worksheet for a single in service basin. Calculate/ estimate flow entering basin.

Comments: Example 11

Basin [ ] Information

F/M Ratio, Sludge Age (SA), and SVI

[ ] MLSS pounds at LWL

[ ] MLVSS pounds at LWL

[ ] Influent or P.E. BOD, mg/L

[ ] Influent or P.E. TSS, mg/L

[ ] Flow to Basin, MGD

[ ] Settling test, ml/L

[ ] MLSS, mg/L at sampling depth

[ ] Minutes (settling test)

Pounds of BOD entering basin(s)

BOD in mg/L		# per gal water		Flow in MGD		pounds of BOD/Day
_____	x	8.34	x	_____	=	_____

Pounds of TSS entering basin(s)

TSS in mg/L		# per gal water		Flow in MGD		pounds of TSS/Day
_____	x	8.34	x	_____	=	_____

F/M Ratio

BOD		MLVSS at LWL		
_____ ,ppd	/	_____ , pounds	=	_____ **F/M**

Sludge Ave (SA) Days (using MLSS)

MLSS Pounds at LWL		pounds of TSS/Day		
_____	/	_____	=	_____ **SA Days**

increase wasting to lower SA **or decrease wasting to raise SA**

Sludge Volume Index (SVI), ml/gm

settling, ml/L		MLSS, mg/L				
_____	/	_____	x	1,000	=	_____ **SVI**

Example #12 Sequencing Batch Reactor Solids Retention Time (SRT)

Effluent Flow (Basin #1):	0.750 MGD
Effluent TSS:	6 mg/L
MLSS at LWL:	16,282 pounds
Waste Sludge (rate):	160 gpm
Wasting time:	24 mins./cycle
Cycles per day:	5
WSSS:	6,500 mg/L
Desired SRT:	14.0 Days

Example 12.xls

63

Worksheet #12 handout
SBR Activated Sludge Process
Solids Retention Time (SRT)

[ ] Input Required
_____ Calculate Value

Use this Worksheet for a single in service basin. Calculate/ estimate flow entering basin.

Basin [ ] Information

Comments: Example 12

SRT Information

[ ] Effluent Flow, MGD (basin)
[ ] Effluent TSS, mg/L
[ ] MLSS, pounds at LWL
[ ] WSSS, mg/L
[ ] Wasted Sludge, gpm
_____ Wasted Sludge, MGD (in 24 hours)
[ ] Wasting Minutes per cycle
[ ] cycles per day

Solids Wasted, ppd

WSSS in mg/L		# per gal water		Waste Sludge in MGD		WSSS in ppd
_____	x	8.34	x	_____	=	_____

Effluent TSS Wasted, ppd

TSS in mg/L		# per gal water		Effluent Flow in MGD		TSS Over Weir, ppd
_____	x	8.34	x	_____	=	_____

Total ppd Wasted (Waste Sludge and TSS Over Weir):

WSSS in ppd		TSS Over Weir in ppd		Total Solids Wasted, ppd
_____	+	_____	=	_____

Solids RetentionTime (SRT)

pounds MLSS		Total Solids Wasted, ppd		days
_____	/	_____	=	_____

DESIRED SRT
Days [ ]