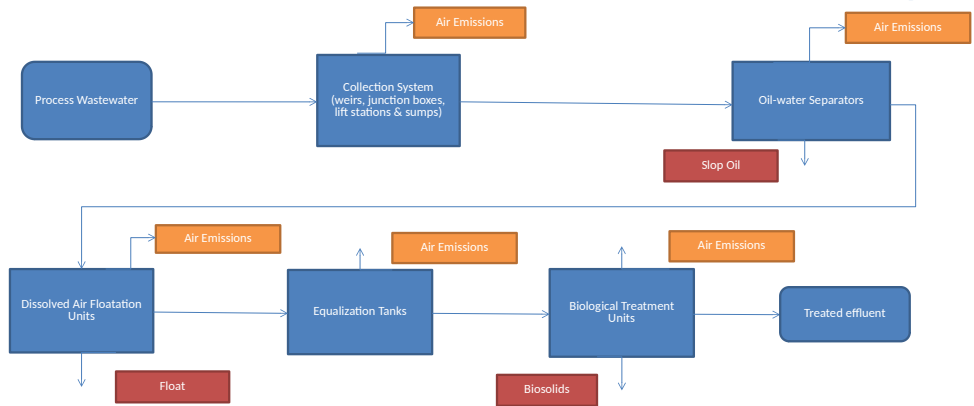


REFINERY WASTEWATER EMISSION TOOL: ICR VERSION 2.1 (RWETv2.1)



The Refinery Wastewater Emissions Tool Version 1.0 (RWET) is an Excel-based model designed to help regulated facilities estimate air emissions from wastewater collection and treatment systems. Separate sheets in RWET represent individual components in a typical wastewater treatment system and can estimate emissions for that particular unit. Effluent concentrations from a particular component can then be used as inputs for the next downstream collection or treatment unit. The calculations are primarily based on those presented in EPA AP-42 but also include updates deemed more accurate in the literature. The equations are presented in Appendix B of the emission protocol document.

Each sheet is set-up with a series of **critical inputs**, **constants/variables** with default values, and **outputs**. The following procedure should be used to reliably use RWET:

1. Determine the critical inputs of the unit listed on the corresponding sheet of RWET and record them on appropriate sheet.
2. Determine the influent concentrations of the pollutants of interest and input them into the model.
3. Review the default values of the variables and constants and make site-specific adjustments if necessary.
4. Review the chemical properties sheet and make any site-specific adjustments if necessary.
5. Record the air emissions for reporting and copy the pollutant effluent concentrations as inputs to the next downstream unit.
6. Repeat this process for the next downstream unit.

This sheet is used for facilities that discharge wastewater to a POTW only.
 Directions: 1) Input (yellow boxes) facility wastewater flow rate and flow rate at the POTW; 2) Input (yellow boxes) constituent concentrations in the facility wastewater. The outputs (green boxes) are the pollutant concentration after dilution in the POTW wastewater. The treatment units of the POTW are then used to estimate air emissions using RWET.

INPUTS	VALUE	UNITS
Wastewater discharge flow rate (Q)	1.000	m ³ /s
POTW Wastewater flow rate (Q _{POTW})	10.000	m ³ /s

CONSTITUENT DISCHARGE CONCENTRATIONS TO POTW (C _i)		
Methanol	1.000	g/m ³
Benzene	1.000	g/m ³
Carbon disulfide	1.000	g/m ³
Methyl ethyl ketone	1.000	g/m ³
Naphthalene	1.000	g/m ³
Cumene	0.000	g/m ³
Ethylbenzene	0.000	g/m ³
Styrene	0.000	g/m ³
1,3-Butadiene	0.000	g/m ³
Ethylene glycol	0.000	g/m ³
Methyl isobutyl ketone	0.000	g/m ³
Toluene	0.000	g/m ³
Phenol	0.000	g/m ³
n-Hexane	0.000	g/m ³
Cresols (total)	0.000	g/m ³
Xylenes	0.000	g/m ³
Methyl tert-butyl ether	0.000	g/m ³
Biphenyl, 1,1-	0.000	g/m ³
Carbonyl sulfide	0.000	g/m ³
Dichloroethane, 1,2-	0.000	g/m ³
Diethanolamine	0.000	g/m ³
Trimethylpentane, 2,2,4-	0.000	g/m ³
Compound A	0.000	g/m ³
Compound B	0.000	g/m ³
Compound C	0.000	g/m ³
Butane (VOC Surrogate)	0.000	g/m ³

CONSTITUENT CONCENTRATIONS AT POTW (C)		
Methanol	0.091	g/m ³
Benzene	0.091	g/m ³
Carbon disulfide	0.091	g/m ³
Methyl ethyl ketone	0.091	g/m ³
Naphthalene	0.091	g/m ³
Cumene	0.000	g/m ³
Ethylbenzene	0.000	g/m ³
Styrene	0.000	g/m ³
1,3-Butadiene	0.000	g/m ³
Ethylene glycol	0.000	g/m ³
Methyl isobutyl ketone	0.000	g/m ³
Toluene	0.000	g/m ³
Phenol	0.000	g/m ³
n-Hexane	0.000	g/m ³
Cresols (total)	0.000	g/m ³
Xylenes	0.000	g/m ³
Methyl tert-butyl ether	0.000	g/m ³
Biphenyl, 1,1-	0.000	g/m ³
Carbonyl sulfide	0.000	g/m ³
Dichloroethane, 1,2-	0.000	g/m ³
Diethanolamine	0.000	g/m ³
Trimethylpentane, 2,2,4-	0.000	g/m ³
Compound A	0.000	g/m ³
Compound B	0.000	g/m ³
Compound C	0.000	g/m ³
Butane (VOC Surrogate)	0.000	g/m ³

This sheet is used for wastewater collection systems. Directions: 1) input the number of collection system components for each process drainage area; 2) input the process drainage area point-of-generation concentrations and flow rate (yellow boxes); 3) review the default air emissions control efficiencies and change if necessary; and 4) record the collection system air emissions and wastewater concentrations for downstream process units air emissions calculations (green boxes).

Collection System Component	Process Drainage Area #1	Process Drainage Area #2	Process Drainage Area #3	Process Drainage Area #4
Number of uncontrolled drains	0	0	0	0
Number of sealed drains	0	0	0	0
Linear meters of open trench	0	0	0	0
Number of uncontrolled manholes	0	0	0	0
Number of sealed manholes	0	0	0	0
Number of uncontrolled junction boxes	0	0	0	0
Number of controlled junction boxes	0	0	0	0
Number of uncontrolled lift stations	0	0	0	0
Number of controlled lift stations	0	0	0	0
Number of uncontrolled sumps	0	0	0	0
Number of controlled sumps	0	0	0	0

Collection System Component Air Emissions Control	Control Efficiency, %	Default Control Efficiency, %
Drain water seal	95	95
Manhole seal	95	95
Junction box water seal	95	95
Lift station control (e.g., carbon adsorption)	95	95
Sump control (e.g., carbon adsorption)	95	95

Wastewater flow rate (Q)	Process Drainage Area #1			
	POG Concentration	Units	Air Emissions	Units
	1.000	m ³ /s		
Methanol	1.0000	g/m ³	0	g/s
Benzene	1.0000	g/m ³	0	g/s
Carbon disulfide	1.0000	g/m ³	0	g/s
Methyl ethyl ketone	1.0000	g/m ³	0	g/s
Naphthalene	1.0000	g/m ³	0	g/s
Cumene	1.0000	g/m ³	0	g/s
Ethylbenzene	1.0000	g/m ³	0	g/s
Styrene	1.0000	g/m ³	0	g/s
1,3-Butadiene	1.0000	g/m ³	0	g/s
Ethylene glycol	1.0000	g/m ³	0	g/s
Methyl isobutyl ketone	1.0000	g/m ³	0	g/s
Toluene	1.0000	g/m ³	0	g/s
Phenol	1.0000	g/m ³	0	g/s
n-Hexane	1.0000	g/m ³	0	g/s
Cresols (total)	1.0000	g/m ³	0	g/s

Xylenes	1.0000	g/m ³	0	g/s
Methyl tert-butyl ether	1.0000	g/m ³	0	g/s
Biphenyl, 1,1-	1.0000	g/m ³	0	g/s
Carbonyl sulfide	1.0000	g/m ³	0	g/s
Dichloroethane, 1,2-	1.0000	g/m ³	0	g/s
Diethanolamine	1.0000	g/m ³	0	g/s
Trimethylpentane, 2,2,4-	1.0000	g/m ³	0	g/s
Compound A	1.0000	g/m ³	Err:502	g/s
Compound B	1.0000	g/m ³	Err:502	g/s
Compound C	1.0000	g/m ³	Err:502	g/s
n-Butane (VOC Surrogate)	1.0000	g/m ³	0	g/s

OUTPUTS				
Compound Name	Total Emissions	Units	Collection System Effluent Concentration	Units
Methanol	0.000000	g/s	1.00000	g/m ³
Benzene	0.000000	g/s	1.00000	g/m ³
Carbon disulfide	0.000000	g/s	1.00000	g/m ³
Methyl ethyl ketone	0.000000	g/s	1.00000	g/m ³
Naphthalene	0.000000	g/s	1.00000	g/m ³
Cumene	0.000000	g/s	1.00000	g/m ³
Ethylbenzene	0.000000	g/s	1.00000	g/m ³
Styrene	0.000000	g/s	1.00000	g/m ³
1,3-Butadiene	0.000000	g/s	1.00000	g/m ³
Ethylene glycol	0.000000	g/s	1.00000	g/m ³
Methyl isobutyl ketone	0.000000	g/s	1.00000	g/m ³
Toluene	0.000000	g/s	1.00000	g/m ³
Phenol	0.000000	g/s	1.00000	g/m ³
n-Hexane	0.000000	g/s	1.00000	g/m ³
Cresols (total)	0.000000	g/s	1.00000	g/m ³
Xylenes	0.000000	g/s	1.00000	g/m ³
Methyl tert-butyl ether	0.000000	g/s	1.00000	g/m ³
Biphenyl, 1,1-	0.000000	g/s	1.00000	g/m ³
Carbonyl sulfide	0.000000	g/s	1.00000	g/m ³
Dichloroethane, 1,2-	0.000000	g/s	1.00000	g/m ³
Diethanolamine	0.000000	g/s	1.00000	g/m ³
Trimethylpentane, 2,2,4-	0.000000	g/s	1.00000	g/m ³
Compound A	Err:502	g/s	Err:502	g/m ³
Compound B	Err:502	g/s	Err:502	g/m ³
Compound C	Err:502	g/s	Err:502	g/m ³
n-Butane (VOC Surrogate)	0.000000	g/s	1.00000	g/m ³

Compound Name	fe, Drains	fe, Sealed Drains	fe, Trenches	fe, Manholes
Methanol	0.000E+00	0.000E+00	4.298E-03	0.000E+00
Benzene	2.263E-01	1.131E-02	3.986E-02	5.690E-02
Carbon disulfide	2.854E-01	1.427E-02	4.830E-02	7.211E-02
Methyl ethyl ketone	6.518E-02	3.259E-03	1.684E-02	1.547E-02
Naphthalene	1.407E-01	7.033E-03	2.762E-02	3.488E-02
Cumene	2.600E-01	1.300E-02	4.467E-02	6.556E-02
Ethylbenzene	2.384E-01	1.192E-02	4.158E-02	6.001E-02
Styrene	2.015E-01	1.008E-02	3.632E-02	5.053E-02
1,3-Butadiene	3.166E-01	1.583E-02	5.275E-02	8.012E-02
Ethylene glycol	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Methyl isobutyl ketone	9.682E-02	4.841E-03	2.136E-02	2.361E-02
Toluene	2.324E-01	1.162E-02	4.073E-02	5.847E-02
Phenol	0.000E+00	0.000E+00	0.000E+00	0.000E+00
n-Hexane	3.343E-01	1.671E-02	5.528E-02	8.467E-02
Cresols (total)	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Xylenes	2.291E-01	1.145E-02	4.025E-02	5.762E-02
Methyl tert-butyl ether	1.455E-01	7.276E-03	2.832E-02	3.613E-02
Biphenyl, 1,1-	1.216E-01	6.079E-03	2.490E-02	2.997E-02
Carbonyl sulfide	3.025E-01	1.512E-02	5.074E-02	7.649E-02
Dichloroethane, 1,2-	1.779E-01	8.895E-03	3.294E-02	4.446E-02
Diethanolamine	0.000E+00	0.000E+00	0.000E+00	0.000E+00
Trimethylpentane, 2,2,4-	4.467E-01	2.233E-02	7.134E-02	1.136E-01
Compound A	Err:502	Err:502	Err:502	Err:502
Compound B	Err:502	Err:502	Err:502	Err:502
Compound C	Err:502	Err:502	Err:502	Err:502
n-Butane (VOC Surrogate)	4.061E-01	2.031E-02	6.554E-02	1.031E-01

fe, Sealed Manholes	fe, Junction Boxes	fe, Controlled Junction Boxes	fe, Lift Stations	fe, Controlled Lift Stations	fe, Sumps	fe, Controlled Sumps
0.000E+00	1.245E-02	6.223E-04	3.253E-02	1.626E-03	2.080E-03	1.040E-04
2.845E-03	8.712E-02	4.356E-03	2.544E-01	1.272E-02	4.925E-03	2.462E-04
3.605E-03	1.049E-01	5.243E-03	3.071E-01	1.536E-02	5.600E-03	2.800E-04
7.736E-04	3.878E-02	1.939E-03	1.108E-01	5.540E-03	3.083E-03	1.542E-04
1.744E-03	6.143E-02	3.071E-03	1.781E-01	8.904E-03	3.946E-03	1.973E-04
3.278E-03	9.722E-02	4.861E-03	2.844E-01	1.422E-02	5.309E-03	2.655E-04
3.000E-03	9.074E-02	4.537E-03	2.652E-01	1.326E-02	5.063E-03	2.531E-04
2.527E-03	7.969E-02	3.985E-03	2.323E-01	1.162E-02	4.642E-03	2.321E-04
4.006E-03	1.142E-01	5.710E-03	3.349E-01	1.674E-02	5.956E-03	2.978E-04
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
1.180E-03	4.828E-02	2.414E-03	1.390E-01	6.950E-03	3.445E-03	1.722E-04
2.923E-03	8.895E-02	4.447E-03	2.598E-01	1.299E-02	4.994E-03	2.497E-04
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	1.104E-03	5.521E-05
4.233E-03	1.195E-01	5.976E-03	3.507E-01	1.753E-02	6.159E-03	3.079E-04
0.000E+00	1.603E-03	8.013E-05	3.078E-04	1.539E-05	1.667E-03	8.334E-05
2.881E-03	8.795E-02	4.398E-03	2.569E-01	1.284E-02	4.956E-03	2.478E-04
1.807E-03	6.289E-02	3.144E-03	1.824E-01	9.121E-03	4.001E-03	2.001E-04
1.499E-03	5.570E-02	2.785E-03	1.611E-01	8.053E-03	3.728E-03	1.864E-04
3.825E-03	1.100E-01	5.499E-03	3.223E-01	1.612E-02	5.795E-03	2.898E-04
2.223E-03	7.260E-02	3.630E-03	2.113E-01	1.056E-02	4.371E-03	2.186E-04
0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00	0.000E+00
5.679E-03	1.532E-01	7.662E-03	4.509E-01	2.254E-02	7.443E-03	3.722E-04
Err:502	Err:502	Err:502	Err:502	Err:502	Err:502	Err:502
Err:502	Err:502	Err:502	Err:502	Err:502	Err:502	Err:502
Err:502	Err:502	Err:502	Err:502	Err:502	Err:502	Err:502
5.157E-03	1.411E-01	7.053E-03	4.147E-01	2.073E-02	6.979E-03	3.490E-04

0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
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g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
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g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
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g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	Err:502	g/s	0.0000	g/m ³	Err:502
g/s	0.0000	g/m ³	0.000E+00	g/s	0.0000	g/m ³	0.000E+00

g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s
g/s	0.0000	g/m ³	Err:502	g/s
g/s	0.0000	g/m ³	Err:502	g/s
g/s	0.0000	g/m ³	Err:502	g/s
g/s	0.0000	g/m ³	0.000E+00	g/s

This sheet is used for uncovered primary weirs and uncovered weirs of oil-water separators.
 Directions: 1) fill in the input data (yellow boxes), review default variables and constant (yellow boxes) and change if necessary; 2) record air emissions (green boxes); and 3) record effluent concentrations (light blue boxes) for downstream process unit emission calculations.

CRITICAL INPUTS	VALUE	UNITS
Weir height, h	1.524	m
Wastewater flow rate, Q	1	m ³ /s
Length of weir, l	1	m
Tail water depth, z	0.1	m
Temperature (T)	25	deg. C

DEFAULT VARIABLES / CONSTANTS	VALUE	UNITS	DEFAULT VALUE
Diffusivity of oxygen in water, D _{o,w}	2.49E-05	cm ² /s	2.49E-05
Universal gas constant (R)	8.21E-05	atm-m ³ /gmol-K	8.21E-05
Fraction of volume that is oil (FO)	0.001	dimensionless	0.001

AIR EMISSIONS	VALUE	UNITS	EFFLUENT WATER CONCENTRATION	UNITS
Methane	0.000000	g/s	0.000000	g/m ³
Benzene	0.000000	g/s	0.000000	g/m ³
Carbon disulfide	0.000000	g/s	0.000000	g/m ³
Methyl ethyl ketone	0.000000	g/s	0.000000	g/m ³
Acetone	0.000000	g/s	0.000000	g/m ³
Ethylbenzene	0.000000	g/s	0.000000	g/m ³
Styrene	0.000000	g/s	0.000000	g/m ³
1,3-Butadiene	0.000000	g/s	0.000000	g/m ³
Ethylene glycol	0.000000	g/s	0.000000	g/m ³
Methyl isobutyl ketone	0.000000	g/s	0.000000	g/m ³
Toluene	0.000000	g/s	0.000000	g/m ³
Phenol	0.000000	g/s	0.000000	g/m ³
Hexane	0.000000	g/s	0.000000	g/m ³
Cyclohexane	0.000000	g/s	0.000000	g/m ³
Diethyl ether	0.000000	g/s	0.000000	g/m ³
Methyl tertiary butyl ether	0.000000	g/s	0.000000	g/m ³
Biphenyl, 1,1'	0.000000	g/s	0.000000	g/m ³
Carbon tetrachloride	0.000000	g/s	0.000000	g/m ³
Perchloroethane, 1,2	0.000000	g/s	0.000000	g/m ³
Dichloroethane	0.000000	g/s	0.000000	g/m ³
Trichloroethane, 2,2,4	0.000000	g/s	0.000000	g/m ³
Compound A	#DIV/0!	g/s	#DIV/0!	g/m ³
Compound B	#DIV/0!	g/s	#DIV/0!	g/m ³
Compound C	#DIV/0!	g/s	#DIV/0!	g/m ³
Influent (VOC Surrogate)	0.000000	g/s	0.000000	g/m ³

CONSTITUENT INFLUENT CONCENTRATIONS (C)	VALUE	UNITS
Methane	0.0000	g/m ³
Benzene	0.0000	g/m ³
Carbon disulfide	0.0000	g/m ³
Methyl ethyl ketone	0.0000	g/m ³
Acetone	0.0000	g/m ³
Ethylbenzene	0.0000	g/m ³
Styrene	0.0000	g/m ³
1,3-Butadiene	0.0000	g/m ³
Ethylene glycol	0.0000	g/m ³
Methyl isobutyl ketone	0.0000	g/m ³
Toluene	0.0000	g/m ³
Phenol	0.0000	g/m ³
Hexane	0.0000	g/m ³
Cyclohexane	0.0000	g/m ³
Diethyl ether	0.0000	g/m ³
Methyl tertiary butyl ether	0.0000	g/m ³
Biphenyl, 1,1'	0.0000	g/m ³
Carbon tetrachloride	0.0000	g/m ³
Perchloroethane, 1,2	0.0000	g/m ³
Dichloroethane	0.0000	g/m ³
Trichloroethane, 2,2,4	0.0000	g/m ³
Compound A	0.0000	g/m ³
Compound B	0.0000	g/m ³
Compound C	0.0000	g/m ³
n-Butane (VOC Surrogate)	0.0000	g/m ³

Q	1.000
Infl (V)	0.311813 (Nakasono)
Infl (F)	2.23916272 (Pincince)

INTERMEDIATE OUTPUTS	KC	K	A	CO	CO ₂	H ₂ O	Pncince	KG Pncince	KG Pncince	Emissions, Pncince
Methane	1.555E-04	5.30E-02	7.1054E-02	1.321E-05	0.04E-05	9.21E-01	1.32144755E-05	0.04197735E-05	0	0
Benzene	2.279E-01	3.78E-02	5.0000E-02	0.00875440	0.032348	2.74E-01	0.0109368724E-01	0.0487379313E-01	0	0
Carbon disulfide	1.265E+00	3.88E-02	5.952E-02	0.00640070	0.004868	2.74E-01	0.005510885268E-01	0.022723918026E-01	0	0
Methyl ethyl ketone	2.239E-01	3.78E-02	4.725E-02	0.00049910	0.00049910	2.74E-01	0.000107985757E-01	0.0004931189E-01	0	0
Acetone	1.973E-02	3.17E-02	3.8404E-02	0.00074010	0.003378	2.72E-01	0.00075526178E-01	0.003447101917E-01	0	0
Ethylbenzene	5.995E-01	3.65E-02	4.924E-02	0.01499510	0.066151	2.74E-01	0.0259298475E-01	0.11484218216E-01	0	0
Styrene	3.219E-01	3.25E-02	4.4994E-02	0.01001730	0.0447663	2.53E-01	0.013631757864E-01	0.060446963103E-01	0	0
1,3-Butadiene	1.123E-01	3.30E-02	4.3395E-02	0.00424420	0.0192353	2.37E-01	0.004777061838E-01	0.02146039450124E-01	0	0
Ethylene glycol	3.001E+00	4.03E-02	9.933E-02	0.00000000	0.0491425	2.85E-01	0.149031001010E-01	0.48916653101E-01	0	0
Methyl isobutyl ketone	7.354E-08	4.80E-02	7.1911E-02	5.288E-09	2.418E-08	3.45E-01	5.28800661E-09	0.41767659E-08	0	0
Toluene	5.639E-03	3.25E-02	4.4994E-02	0.00251180	0.011504	2.33E-01	0.00202534439930E-01	0.001180748904E-01	0	0
Phenol	2.113E-01	3.46E-02	4.962E-02	0.00696930	0.045345	2.45E-01	0.012702967113E-01	0.056119098861E-01	0	0
Hexane	1.622E-06	3.60E-02	4.7728E-02	0.00000000	0.00000000	2.58E-01	7.73997963E-07	3.53811242E-06	0	0
Cyclohexane	4.984E+00	3.24E-02	8.9395E-02	0.03010080	0.088507	2.38E-01	0.1507848166E-01	0.488115211228E-01	0	0
Diethyl ether	6.818E-05	3.65E-02	4.2747E-02	2.853E-05	0.283E-05	2.52E-01	2.82925275E-05	1.04343455E-05	0	0
Methyl tertiary butyl ether	2.488E-01	3.66E-02	4.8556E-02	0.00630840	0.0372736	2.63E-01	0.010327239948E-01	0.04611879757E-01	0	0
Biphenyl, 1,1'	2.289E-02	3.95E-02	5.525E-02	0.00127140	0.005380	2.84E-01	0.001247887398E-01	0.00568232940E-01	0	0
Carbon tetrachloride	1.144E-02	3.36E-02	2.9910E-02	0.00033870	0.0015473	2.41E-01	0.000341654643E-01	0.001560825671E-01	0	0
Perchloroethane, 1,2	2.010E+00	4.55E-02	7.4707E-02	0.03492150	0.1475874	3.27E-01	0.1028836745E-01	0.37523778644E-01	0	0
Dichloroethane, 1,2	5.119E-02	3.90E-02	5.8028E-02	0.00294560	0.013773	2.73E-01	0.00316116569E-01	0.01432617967E-01	0	0
Trichloroethane, 2,2,4	1.581E-09	3.78E-02	4.3153E-02	6.822E-11	3.119E-10	2.74E-01	6.82248186E-11	3.1192382E-10	0	0
Compound A	1.238E+02	2.91E-02	4.4318E-02	0.028908	0.1238059	2.09E-01	0.020105657762E-01	0.0117424945E-01	0	0
Compound B	0.000E+00	0.00E+00	0.000E+00	#DIV/0!	#DIV/0!	0.00E+00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound C	0.000E+00	0.00E+00	0.000E+00	#DIV/0!	#DIV/0!	0.00E+00	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Influent (VOC Surrogate)	3.881E+01	3.90E-02	5.4114E-02	0.03811100	0.1606764	2.80E-01	0.247254181589E-01	0.677110822461E-01	0	0

Constituent	Influent load, g/s	Effluent load, g/s	Air emission load, g/s	% Load as effluent	% Load as emitted	Mass balance check
Methane	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Benzene	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Carbon disulfide	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Methyl ethyl ketone	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Acetone	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Ethylbenzene	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Styrene	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
1,3-Butadiene	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Ethylene glycol	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Methyl isobutyl ketone	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Toluene	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Phenol	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Hexane	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Cyclohexane	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Diethyl ether	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Methyl tertiary butyl ether	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Biphenyl, 1,1'	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Carbon tetrachloride	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Perchloroethane, 1,2	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Dichloroethane	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Trichloroethane, 2,2,4	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!
Compound A	0	0.000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound B	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound C	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound D	0	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Influent (VOC Surrogate)	0	0.000	0.00000	#DIV/0!	#DIV/0!	#DIV/0!

This sheet is used for uncovered oil-water separators only. Directions: 1) fill-in the input data (yellow boxes); review default variables and constant (yellow boxes) and change if necessary; 2) record air emissions (green boxes); and 3) record effluent concentrations (light blue boxes) for downstream process until emission calculations.

CRITICAL INPUTS	VALUE	UNITS
Surface area (A)	200.0	m ²
Total pressure (P _t)	1.0	atm
Wastewater flow rate (Q)	1.000	m ³ /s
Windspeed (U _w)	4.413	m/s

DEFAULT VARIABLES / CONSTANTS	VALUE	UNITS	DEFAULT VALUE
Viscosity of air (ν _a)	0.000181	g/cm-s	0.000181
Density of air (ρ _a)	0.0012	g/cm ³	0.0012
Molecular weight of oil (MW _o)	282	g/g-mol	282
Density of oil (ρ _o)	0.92	g/cm ³	0.92
Flow of oil (Q _o) [default = 0.001*Q]	0.001	m ³ /s	0.001
Fraction of volume that is oil (FO)	0.001	dimensionless	0.001
Oil layer thickness (C _{oil})	1	cm	1

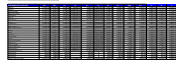
CONSTITUENT INFLUENT CONCENTRATIONS (C _i)	VALUE	UNITS
Methanol	1.000	g/m ³
Benzene	1.000	g/m ³
Carbon disulfide	1.000	g/m ³
Methyl ethyl ketone	1.000	g/m ³
Naphthalene	1.000	g/m ³
Cumene	0.000	g/m ³
Ethylbenzene	0.000	g/m ³
Styrene	0.000	g/m ³
1,3-Butadiene	0.000	g/m ³
Ethylene glycol	0.000	g/m ³
Methyl isobutyl ketone	0.000	g/m ³
Toluene	0.000	g/m ³
Phenol	0.000	g/m ³
n-Hexane	0.000	g/m ³
Cresols (total)	0.000	g/m ³
Xylenes	0.000	g/m ³
Methyl tert-butyl ether	0.000	g/m ³
Biphenyl, 1,1-	0.000	g/m ³
Carbonyl sulfide	0.000	g/m ³
Dichloroethane, 1,2-	0.000	g/m ³
Diethanolamine	0.000	g/m ³
Trimethylpentane, 2,2,4-	0.000	g/m ³
Compound A	0.000	g/m ³
Compound B	0.000	g/m ³
Compound C	0.000	g/m ³
n-Butane (VOC Surrogate)	0.000	g/m ³

UNCONTROLLED AIR EMISSIONS	VALUE	UNITS	EFFLUENT WATER CONCENTRATION	UNITS
Methanol	0.000161	g/s	1.000806	g/m ³
Benzene	0.084980	g/s	0.881915	g/m ³
Carbon disulfide	0.083126	g/s	0.909918	g/m ³
Methyl ethyl ketone	0.011339	g/s	0.999095	g/m ³
Naphthalene	0.011339	g/s	0.303964	g/m ³
Cumene	0.000000	g/s	0.000000	g/m ³
Ethylbenzene	0.000000	g/s	0.000000	g/m ³
Styrene	0.000000	g/s	0.000000	g/m ³
1,3-Butadiene	0.000000	g/s	0.000000	g/m ³
Ethylene glycol	0.000000	g/s	0.000000	g/m ³
Methyl isobutyl ketone	0.000000	g/s	0.000000	g/m ³
Toluene	0.000000	g/s	0.000000	g/m ³
Phenol	0.000000	g/s	0.000000	g/m ³
n-Hexane	0.000000	g/s	0.000000	g/m ³
Cresols (total)	0.000000	g/s	0.000000	g/m ³
Xylenes	0.000000	g/s	0.000000	g/m ³
Methyl tert-butyl ether	0.000000	g/s	0.000000	g/m ³
Biphenyl, 1,1-	0.000000	g/s	0.000000	g/m ³
Carbonyl sulfide	0.000000	g/s	0.000000	g/m ³
Dichloroethane, 1,2-	0.000000	g/s	0.000000	g/m ³
Diethanolamine	0.000000	g/s	0.000000	g/m ³
Trimethylpentane, 2,2,4-	0.000000	g/s	0.000000	g/m ³
Compound A	#DIV/0!	g/s	#DIV/0!	g/m ³
Compound B	#DIV/0!	g/s	#DIV/0!	g/m ³
Compound C	#DIV/0!	g/s	#DIV/0!	g/m ³
n-Butane (VOC Surrogate)	0.000000	g/s	0.000000	g/m ³

Windspeed (U _w)	4.413	m/s
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INTERMEDIATE OUTPUTS	Sc _i	K _o , m/s	Keq _i	K _o , m/s	Co, g/m ³	C _{oil} , g/m ³
Methanol	1.006E+00	1.127E-02	2.103E-03	2.370E-05	1.951E-01	3.399E+02
Benzene	1.714E+00	7.895E-03	1.585E-03	1.252E-05	1.190E+02	3.399E+03
Carbon disulfide	1.450E+00	8.819E-03	5.991E-03	5.284E-05	9.099E+01	7.866E+00
Methyl ethyl ketone	1.867E+00	7.447E-03	1.590E-03	1.184E-05	1.904E+00	5.651E-01
Naphthalene	2.556E+00	6.032E-03	1.419E-06	8.557E-09	6.963E+02	8.952E+02
Cumene	1.754E+00	7.765E-03	7.510E-05	5.631E-07	0.000E+00	0.000E+00
Ethylbenzene	2.011E+00	7.084E-03	1.602E-04	1.135E-06	0.000E+00	0.000E+00
Styrene	2.124E+00	6.829E-03	1.021E-04	6.975E-07	0.000E+00	0.000E+00
1,3-Butadiene	6.086E+01	1.580E-02	3.521E-02	5.574E-04	0.000E+00	0.000E+00
Ethylene glycol	9.865E+01	1.140E-02	2.103E-06	2.398E-08	0.000E+00	0.000E+00
Methyl isobutyl ketone	2.011E+00	7.084E-03	3.321E-04	2.353E-06	0.000E+00	0.000E+00
Toluene	1.734E+00	7.825E-03	4.740E-04	3.709E-06	0.000E+00	0.000E+00
Phenol	3.830E+00	5.521E-03	4.606E-06	3.454E-08	0.000E+00	0.000E+00
n-Hexane	7.542E+01	1.367E-02	2.520E-03	3.444E-05	0.000E+00	0.000E+00
Cresols (total)	2.173E+00	6.725E-03	5.007E-06	3.367E-08	0.000E+00	0.000E+00
Xylenes	2.113E+00	6.895E-03	1.342E-04	9.200E-07	0.000E+00	0.000E+00
Methyl tert-butyl ether	1.473E+00	8.728E-03	3.110E-03	2.702E-06	0.000E+00	0.000E+00
Biphenyl, 1,1-	3.733E+00	4.680E-03	1.609E-07	7.530E-10	0.000E+00	0.000E+00
Carbonyl sulfide	9.328E+01	1.185E-02	1.571E-01	1.862E-03	0.000E+00	0.000E+00
Dichloroethane, 1,2-	1.450E+00	8.819E-03	1.327E-03	1.170E-05	0.000E+00	0.000E+00
Diethanolamine	2.143E+00	6.790E-03	4.640E-09	3.150E-11	0.000E+00	0.000E+00
Trimethylpentane, 2,2,4-	2.058E+00	6.976E-03	8.206E-04	5.725E-06	0.000E+00	0.000E+00
Compound A	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!	0.000E+00	#DIV/0!
Compound B	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!	0.000E+00	#DIV/0!
Compound C	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!	0.000E+00	#DIV/0!
n-Butane (VOC Surrogate)	1.520E+00	8.544E-03	3.037E-02	2.595E-04	0.000E+00	0.000E+00

Pollutant	QUALITY CONTROL CHECKS			% Load with effluent	% Load air emitted
	Influent load, g/s	Effluent load, g/s	Air emission load, g/s		
Methanol	1.0000	1.001	0.000	100	0
Benzene	1.0000	0.982	0.085	88	8
Carbon disulfide	1.0000	0.910	0.083	91	8
Methyl ethyl ketone	1.0000	0.999	0.001	100	0
Naphthalene	1.0000	0.304	0.001	30	0
Cumene	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Ethylbenzene	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Styrene	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
1,3-Butadiene	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Ethylene glycol	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Methyl isobutyl ketone	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Toluene	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Phenol	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
n-Hexane	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Cresols (total)	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Xylenes	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Methyl tert-butyl ether	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Biphenyl, 1,1-	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Carbonyl sulfide	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Dichloroethane, 1,2-	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Diethanolamine	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Trimethylpentane, 2,2,4-	0.0000	0.000	0.000	#DIV/0!	#DIV/0!
Compound A	0.0000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound B	0.0000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Compound C	0.0000	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n-Butane (VOC Surrogate)	0.0000	0.000	0.000	#DIV/0!	#DIV/0!





boxes) and change if necessary; 2) record air emissions (green boxes); and 3) record effluent cor

CRITICAL INPUTS	VALUE	UNITS
Surface area (A)	20000	m ²
Temperature (T)	25	deg. C
Total pressure (P _o)	1	atm
Wastewater flow rate (Q)	0.0876	m ³ /s
Wastewater depth (D)	4	m
Biological treatment unit volatile suspended solids (C _{MLVSS})	50	g/m ³
Windspeed (U ₁₀)	4.47	m/s
Influent 5-day biochemical oxygen demand concentration (C _{BOD5,i})	20	g/m ³

Note: Set C_{MLVSS} = 0 for a non-biologically active unit

CONSTITUENT INFLUENT CONCENTRATIONS (C _o)		
Methanol	1.0000	g/m ³
Benzene	1.0000	g/m ³
Carbon disulfide	1.0000	g/m ³
Methyl ethyl ketone	1.0000	g/m ³
Naphthalene	1.0000	g/m ³
Cumene	1.0000	g/m ³
Ethylbenzene	1.0000	g/m ³
Styrene	1.0000	g/m ³
1,3-Butadiene	1.0000	g/m ³
Ethylene glycol	1.0000	g/m ³
Methyl isobutyl ketone	1.0000	g/m ³
Toluene	1.0000	g/m ³
Phenol	1.0000	g/m ³
n-Hexane	1.0000	g/m ³
Cresols (total)	1.0000	g/m ³
Xylenes	1.0000	g/m ³
Methyl tert-butyl ether	1.0000	g/m ³
Biphenyl, 1,1-	1.0000	g/m ³
Carbonyl sulfide	1.0000	g/m ³
Dichloroethane, 1,2-	1.0000	g/m ³
Diethanolamine	1.0000	g/m ³
Trimethylpentane, 2,2,4-	1.0000	g/m ³
Compound A	1.0000	g/m ³
Compound B	1.0000	g/m ³
Compound C	1.0000	g/m ³
n-Butane (VOC Surrogate)	1.0000	g/m ³

concentrations (light blue boxes) for downstream process unit emission calculations.

DEFAULT VARIABLES / CONSTANTS	VALUE
Viscosity of water (μ_w)	0.00893
Density of water (ρ_w)	1
Universal gas constant (R)	8.21E-05
Viscosity of air (μ_a)	0.000181
Density of air (ρ_a)	0.0012
Diffusivity of ether in water (D_{ether})	8.50E-06
Weight fraction of carbon in biomass (f_{oc})	0.33
Biomass volatile suspend solids yield from influent BOD (Y)	0.67

UNITS	DEFAULT VALUE
g/cm-s	0.00893
g/cm ³	1
atm-m ³ /gmol-K	8.21E-05
g/cm-s	0.000181
g/cm ³	0.0012
cm ² /sec	8.50E-06
dimensionless	0.33
g VSS/g BOD	0.67

AIR EMISSIONS	VALUE	UNITS
Methanol	0.006971	g/s
Benzene	0.005109	g/s
Carbon disulfide	0.007658	g/s
Methyl ethyl ketone	0.017050	g/s
Naphthalene	0.005579	g/s
Cumene	0.002136	g/s
Ethylbenzene	0.003076	g/s
Styrene	0.025931	g/s
1,3-Butadiene	0.009864	g/s
Ethylene glycol	0.000007	g/s
Methyl isobutyl ketone	0.010723	g/s
Toluene	0.002865	g/s
Phenol	0.000011	g/s
n-Hexane	0.004241	g/s
Cresols (total)	0.000030	g/s
Xylenes	0.003941	g/s
Methyl tert-butyl ether	0.009213	g/s
Biphenyl, 1,1-	0.004155	g/s
Carbonyl sulfide	0.008967	g/s
Dichloroethane, 1,2-	0.007129	g/s
Diethanolamine	0.000000	g/s
Trimethylpentane, 2,2,4-	0.003572	g/s
Compound A	#DIV/0!	g/s
Compound B	#DIV/0!	g/s
Compound C	#DIV/0!	g/s
n-Butane (VOC Surrogate)	0.005072	g/s

EFFLUENT WATER CONCENTRATION	UNITS
0.260782	g/m ³
0.050379	g/m ³
0.074281	g/m ³
0.231466	g/m ³
0.068503	g/m ³
0.026047	g/m ³
0.035277	g/m ³
0.293861	g/m ³
0.090859	g/m ³
0.565836	g/m ³
0.139796	g/m ³
0.030794	g/m ³
0.006032	g/m ³
0.048651	g/m ³
0.004630	g/m ³
0.040137	g/m ³
0.089420	g/m ³
0.050930	g/m ³
0.073007	g/m ³
0.070481	g/m ³
0.418925	g/m ³
0.045733	g/m ³
#DIV/0!	g/m ³
#DIV/0!	g/m ³
#DIV/0!	g/m ³
0.048212	g/m ³

Windspeed (U ₁₀)	4.47	m/s
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INTERMEDIATE OUTPUTS	Sc _L	Sc _G	k _{l,q}	k _{g,q}
Methanol	5.445E+02	1.006E+00	7.173E-06	8.838E-03
Benzene	9.112E+02	1.714E+00	5.089E-06	6.182E-03
Carbon disulfide	8.930E+02	1.450E+00	5.158E-06	6.915E-03
Methyl ethyl ketone	9.112E+02	1.867E+00	5.089E-06	5.839E-03
Naphthalene	1.191E+03	2.556E+00	4.258E-06	4.730E-03

Cumene	1.258E+03	1.754E+00	4.105E-06	6.088E-03
Ethylbenzene	1.145E+03	2.011E+00	4.370E-06	5.555E-03
Styrene	1.116E+03	2.124E+00	4.445E-06	5.354E-03
1,3-Butadiene	8.269E+02	6.058E-01	5.429E-06	1.241E-02
Ethylene glycol	6.333E+02	9.883E-01	6.485E-06	8.941E-03
Methyl isobutyl ketone	1.145E+03	2.011E+00	4.370E-06	5.555E-03
Toluene	1.038E+03	1.734E+00	4.664E-06	6.135E-03
Phenol	9.813E+02	1.839E+00	4.843E-06	5.897E-03
n-Hexane	1.149E+03	7.542E-01	4.359E-06	1.072E-02
Cresols (total)	9.602E+02	2.173E+00	4.914E-06	5.273E-03
Xylenes	9.561E+02	2.113E+00	4.928E-06	5.374E-03
Methyl tert-butyl ether	8.505E+02	1.473E+00	5.328E-06	6.843E-03
Biphenyl, 1,1-	1.089E+03	3.733E+00	4.519E-06	3.670E-03
Carbonyl sulfide	6.869E+02	9.328E-01	6.143E-06	9.294E-03
Dichloroethane, 1,2-	9.020E+02	1.450E+00	5.123E-06	6.915E-03
Diethanolamine	9.112E+02	2.143E+00	5.089E-06	5.324E-03
Trimethylpentane, 2,2,4-	1.355E+03	2.058E+00	3.906E-06	5.470E-03
Compound A	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!
Compound B	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!
Compound C	#DIV/0!	#DIV/0!	0.000E+00	#DIV/0!
n-Butane (VOC Surrogate)	8.670E+02	1.520E+00	5.260E-06	6.699E-03

F/D	3.989E+01
Effective Diameter (de)	1.596E+02
U*	1.335E-01
Predicted BOD Removal Effic.	1.000E+00

QUALITY CONTROL CHECKS

Pollutant	Influent load, g/s	Effluent load, g/s	Air emission load, g/s	Absorbed load, g/s
Methanol	0.0876	0.023	0.007	0.000
Benzene	0.0876	0.004	0.005	0.000
Carbon disulfide	0.0876	0.007	0.008	0.000
Methyl ethyl ketone	0.0876	0.020	0.017	0.000
Naphthalene	0.0876	0.006	0.006	0.000
Cumene	0.0876	0.002	0.002	0.000
Ethylbenzene	0.0876	0.003	0.003	0.000
Styrene	0.0876	0.026	0.026	0.001
1,3-Butadiene	0.0876	0.008	0.010	0.000
Ethylene glycol	0.0876	0.050	0.000	0.000
Methyl isobutyl ketone	0.0876	0.012	0.011	0.000
Toluene	0.0876	0.003	0.003	0.000
Phenol	0.0876	0.001	0.000	0.000
n-Hexane	0.0876	0.004	0.004	0.001
Cresols (total)	0.0876	0.000	0.000	0.000
Xylenes	0.0876	0.004	0.004	0.000
Methyl tert-butyl ether	0.0876	0.008	0.009	0.000
Biphenyl, 1,1-	0.0876	0.004	0.004	0.001
Carbonyl sulfide	0.0876	0.006	0.009	0.000
Dichloroethane, 1,2-	0.0876	0.006	0.007	0.000
Diethanolamine	0.0876	0.037	0.000	0.000
Trimethylpentane, 2,2,4-	0.0876	0.004	0.004	0.065
Compound A	0.0876	#DIV/0!	#DIV/0!	#DIV/0!

Compound B	0.0876	#DIV/0!	#DIV/0!	#DIV/0!
Compound C	0.0876	#DIV/0!	#DIV/0!	#DIV/0!
n-Butane (VOC Surrogate)	0.0876	0.004	0.005	0.000

Keq	K_Q	K_{OL}	k_{abs}	a1	b1	c1
1.859E-04	1.337E-06	1.337E-06	3.080E-08	1.305E+00	3.448E+02	-9.000E+01
2.279E-01	5.070E-06	5.070E-06	2.131E-05	2.158E+00	2.693E+02	-1.357E+01
1.235E+00	5.155E-06	5.155E-06	1.579E-05	2.177E+00	2.303E+02	-1.712E+01
2.284E-03	3.683E-06	3.683E-06	3.010E-07	1.841E+00	4.278E+01	-1.000E+01
1.973E-02	4.072E-06	4.072E-06	3.618E-04	1.934E+00	6.198E+02	-4.247E+01

5.965E-01	4.100E-06	4.100E-06	6.005E-04	1.944E+00	4.145E+02	-1.080E+01
3.219E-01	4.360E-06	4.360E-06	2.180E-04	1.998E+00	9.172E+01	-3.238E+00
1.123E-01	4.412E-06	4.412E-06	1.376E-04	2.009E+00	9.615E+02	-2.827E+02
3.007E+00	5.428E-06	5.428E-06	1.544E-05	2.240E+00	2.424E+02	-2.205E+01
7.354E-08	6.574E-10	6.574E-10	1.441E-09	1.000E+00	5.115E+02	-2.898E+02
5.639E-03	3.835E-06	3.835E-06	2.446E-06	1.876E+00	1.146E+01	-1.639E+00
2.713E-01	4.651E-06	4.651E-06	8.882E-05	2.063E+00	9.942E+02	-3.062E+01
1.622E-05	9.378E-08	9.378E-08	4.770E-06	1.021E+00	1.237E+03	-7.462E+00
4.984E+00	4.359E-06	4.359E-06	1.579E-03	2.016E+00	2.141E+02	-1.042E+01
6.618E-05	3.258E-07	3.258E-07	1.579E-07	1.074E+00	2.922E+02	-1.353E+00
2.468E-01	4.910E-06	4.910E-06	2.336E-04	2.124E+00	5.647E+02	-2.267E+01
2.268E-02	5.151E-06	5.151E-06	1.259E-05	2.176E+00	2.754E+02	-2.464E+01
1.144E-02	4.079E-06	4.079E-06	9.089E-04	1.944E+00	2.664E+02	-1.357E+01
2.010E+00	6.141E-06	6.141E-06	9.987E-07	2.402E+00	2.343E+02	-1.712E+01
5.719E-02	5.058E-06	5.058E-06	4.770E-06	2.155E+00	3.025E+01	-2.143E+00
1.581E-09	8.417E-12	8.417E-12	5.868E-09	1.000E+00	1.688E+02	-7.091E+01
1.238E+02	3.906E-06	3.906E-06	1.068E-01	3.323E+00	2.277E+02	-1.042E+01
0.000E+00	#DIV/0!	#DIV/0!	1.579E-07	#DIV/0!	#DIV/0!	0.000E+00
0.000E+00	#DIV/0!	#DIV/0!	1.579E-07	#DIV/0!	#DIV/0!	0.000E+00
0.000E+00	#DIV/0!	#DIV/0!	1.579E-07	#DIV/0!	#DIV/0!	0.000E+00
3.881E+01	5.260E-06	5.260E-06	1.226E-04	2.203E+00	2.160E+02	-1.042E+01

Biodegradation rate, g/s	% Load with effluent	% Load air emitted	% Biodegraded	% Load absorbed	Mass balance check
0.058	26	8	66	0.00	100
0.078	5	6	89	0.02	100
0.073	7	9	84	0.02	100
0.050	23	19	57	0.00	100
0.076	7	6	87	0.38	100
0.083	3	2	95	0.24	100
0.081	4	4	93	0.12	100
0.036	29	30	41	0.62	101
0.070	9	11	80	0.02	100
0.038	57	0	43	0.00	100
0.065	14	12	74	0.01	100
0.082	3	3	94	0.04	100
0.087	1	0	99	0.00	100
0.079	5	5	90	1.18	101
0.087	0	0	100	0.00	100
0.080	4	4	91	0.14	100
0.071	9	11	81	0.02	100
0.079	5	5	90	0.71	101
0.072	7	10	82	0.00	100
0.074	7	8	85	0.01	100
0.051	42	0	58	0.00	100
0.074	5	4	85	74.70	168
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
0.078	5	6	89	0.09	100

DEFAULT PROPERTIES									
CAS No.	Compound Name	Mol.Wt.	Vap. Press. (mmHg)	H law const. (atm-m ³ /mol)	Di,w (cm ² /sec)	Di,a (cm ² /sec)	log(Kow)	Kb,max (gVO(g-s))	Ks, (g/m ³)
67561	Methanol	32.04	1.26E+02	0.00000455	1.6E-05	1.5E-01	-0.71	0.000005	90
71432	Benzene	78.11	9.50E+01	0.00557929	9.8E-06	8.8E-02	2.13	5.277778E-06	13.57142857
75150	Carbon disulfide	76.14	3.59E+02	0.03022364	1.0E-05	1.0E-01	2	4.25E-06	17.12191373
78933	Methyl ethyl ketone	72.11	9.53E+01	0.00005590	9.8E-06	8.1E-02	0.28	###	10
91203	Naphthalene	128.17	8.50E-02	0.00048300	7.5E-06	5.9E-02	3.36	###	42.47
98828	Cumene	120.19	4.50E+00	0.01460000	7.1E-06	8.6E-02	3.58	8.638889E-06	10.79663922
100414	Ethylbenzene	106.17	9.60E+00	0.00788000	7.8E-06	7.5E-02	3.14	1.888889E-06	3.238095238
100425	Styrene	104.15	6.12E+00	0.00275000	8.0E-06	7.1E-02	2.94	###	282.7272727
106990	1,3-Butadiene	54.09	2.11E+03	0.07360000	1.1E-05	2.5E-01	1.99	4.25E-06	22.04601739
107211	Ethylene glycol	60.10	1.26E-01	0.00000000	1.4E-05	1.5E-01	-2.04	4.877778E-06	289.7689769
108101	Methyl isobutyl ketone	100.16	1.99E+01	0.00013803	7.8E-06	7.5E-02	1.19	###	1.638681384
108883	Toluene	92.14	2.84E+01	0.00664000	8.6E-06	8.7E-02	2.75	###	30.61666667
108952	Phenol	94.11	2.76E+01	0.00000040	9.1E-06	8.2E-02	1.48	###	7.461538462
110543	n-Hexane	86.18	1.51E+02	0.12200000	7.8E-06	2.0E-01	4	0.00000425	10.41967452
1319773	Cresols (total)	108.10	3.00E-01	0.00000162	9.3E-06	6.9E-02	0	6.388889E-06	1.352941176
1330207	Xylenes	106.17	8.04E+00	0.00604124	9.3E-06	7.1E-02	3.17	###	22.66666667
1634044	Methyl tert-butyl ether	88.00	1.86E+02	0.00055513	1.1E-05	1.0E-01	1.90	###	24.63925106
92524	Biphenyl, 1,1-	154.21	9.64E-03	0.00028000	8.2E-06	4.0E-02	3.76	5.277778E-06	13.57142857
463581	Carbonyl sulfide	60.07	9412	0.04920000	1.30E-05	1.6E-01	0.80	4.2534E-06	17.12191373
107062	Dichloroethane, 1,2-	98.96	79.5	0.00140000	9.90E-06	1.0E-01	1.48	5.833E-07	2.1429
111422	Diethanolamine	105.14	0.000278	0.00000000	9.80E-06	7.0E-02	-1.43	2.1667E-06	70.9091
540841	Trimethylpentane, 2,2,4-	114.23	49.172	3.03000000	6.59E-06	7.3E-02	5.83	0.00000425	10.41967452
	Compound A								4.79E-01
	Compound B								4.79E-01
	Compound C								4.79E-01
106978	n-Butane (VOC Surrogate)	58.12	1.82E+03	0.95000000	1.03E-05	9.9E-02	2.89	0.00000425	10.41967452

Calculated
Koc
9.33E-02
6.46E+01
4.79E+01
9.12E-01
1.10E+03
6.61E+02
4.17E+02
4.68E+01
4.37E-03
7.41E+00
2.69E+02
1.45E+01
4.79E+03
4.79E-01
7.08E+02
3.81E+01
2.75E+03
3.03E+00
1.45E+01
1.78E-02
3.24E+05
4.79E-01
4.79E-01
3.72E+02

Color Code:

- Data not in HWIR database; used value from CHEMDAT8 constituent input database
- Biodegradation reactions are the same as other aromatic hydrocarbons: oxygenase addition of molecular oxygen to one of the aromatic rings (Boyle, 1992). Therefore, the known values for Benzene were substituted.
- Biodegradation reactions are the same as other aliphatic compounds (McCarty and Rittman, 2001). Therefore, the known biodegradation constants for n-Hexane were substituted.
- Biodegradation reactions are the same as other alcohols (Rittman and McCarty, 2001). Therefore, the known biodegradation constants for Butanol were substituted.
- Substituted Carbon disulfide biodegradation constants.

SITE-SPECIFIC PROPERTIES									
CAS No.	Compound Name	Mol.Wt.	Vap. Press. (mmHg)	H law const. (atm-m ³ /mol)	Di,w (cm ² /sec)	Di,a (cm ² /sec)	log(Kow)	Kb,max (gVO(g-s))	Ks, (g/m ³)
67561	Methanol								
71432	Benzene								
75150	Carbon disulfide								
78933	Methyl ethyl ketone								
91203	Naphthalene								
98828	Cumene								
100414	Ethylbenzene								
100425	Styrene								
106990	1,3-Butadiene								
107211	Ethylene glycol								
108101	Methyl isobutyl ketone								
108883	Toluene								
108952	Phenol								
110543	n-Hexane								
1319773	Cresols (total)								
1330207	Xylenes								
1634044	Methyl tert-butyl ether								
92524	Biphenyl, 1,1-								
463581	Carbonyl sulfide								
107062	Dichloroethane, 1,2-								
111422	Diethanolamine								
540841	Trimethylpentane, 2,2,4-								
	Compound A								
	Compound B								
	Compound C								
106978	n-Butane (VOC Surrogate)								

References:

- Boyle, A.W., et al. (1992). "Bacterial PCB Biodegradation." *Biodegradation* 3(2/3), pp. 285-298.
- Rittman, B.E. and McCarty, P.L. (2001). "Environmental Biotechnology: Principles and Applications". McGraw-Hill, New York, NY.