TRP Coker 3 Emission Estimates

	Venting	Cutting	Draining	Venting+Cutting+Draining
	TPY	TPY	TPY	TPY
Toledo Coker 3 Past Emissions				
H2S	2.81	0.06	0.40	3.27
VOC	7.56	0.17	0.92	8.65
CO	0.23	0.01		0.24
PM	1.91			1.91
CH4	35.94	0.80		36.74
CO2	7.11	0.16		7.27
CO2e	761.93	16.85		778.79
Toledo Coker 3 Future Emissions				
H2S	2.87	0.09	0.60	3.56
VOC	7.73	0.25	1.36	9.35
CO	0.24	0.01		0.24
PM	1.96			1.96
CH4	36.78	1.17		37.96
CO2	7.28	0.23		7.51
CO2e	779.72	24.90		804.62
Increases				
H2S	0.07	0.03	0.19	0.29
VOC	0.18	0.08	0.44	0.70
CO	0.01	0.00		0.01
CH4	0.84	0.38		1.22
CO2	0.17	0.08		0.24
CO2e	17.79	8.05		25.84

Avg - 2004-2005

cycles/y		psig	
423.5	r	3	venting

TFO Design

cycles/y		psig	
626	r	2	venting

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Potential to Emit (TFO Project) Estimates

MLL-01/19/10 =Data needed from each BP Site

MRK 7/Apr/2010 =Assumptions

ARA for TRP June 2012 = Input Variable

Variable	Units	Toledo K3	
Drum ID	ft	27.0	
T/T Length	ft	78.0	
Coke Outage from Top Flange	ft	28.6	
Top Flange Height	ft	3.0	
Top Flange ID (Vapor)	ft	2.5	
Top Eliptical Head Height	ft	6.8	
Coke Outage from Top T/L	ft	18.9	
Coke Height in Cylinder	ft	59.1	
Bottom Cone Height	ft	20.0	
Bottom Flange Height	ft	1.5	
Bottom Flange ID	ft	6.0	
Total Coke Drum Height	ft	109.3	
Bottom Flange Volume	ft3	42	
Bottom Cone Volume	ft3	4854	
Coke Volume in Cylinder	ft3	33838	
Total Volume in Cylinder	ft3	44659	
Top Eliptical Head Volume	ft3	2576	
Top Flange Volume (Vapor)	ft3	15	
Total Volume of Coke with void spaces	ft3	38734	
Coke Density in Coke Drum	lb/ft3	56.0	
Total Coke in Coke Drum	tons	1085	
Total Coke Drum Volume	ft3	52147	
Void Volume of Coke	ft3/ft3	0.50	
Volume of Water Covering Coke	ft3	19367	
Additional Water Height over Coke Bed	ft	6	
Additional Water Volume over Coke Bed	ft3	3654	
Total Water Vol in Coke Drum before Vent	ft3	23021	
Water Density before Venting	lb/ft3	59.6	
Mass of Water in Coke Drum	klb	1373	
Vapor Space Volume	ft3	9758	
Material in Vapor Space = PV/RT	lb-moles	22.4	
Pressure in Drum Before Venting	psig	2.0	
Temp in Drum Before Venting	degF	218.4	
Vapor Generated from Water Flashing	wt%	0.67	
Vapor Generated from Water Flashing	lbs	9155	
Vapor from Vent Mole Weight	lb/lb-mol	18.1	
Vapor Generated from Water Flashing	lb-mol	506	
Vapor Generated per Event	lb-mol	528	
The rows below were added to calculate the average volume vented per cycle needed for Green House Gas calculations.			
Conversion factor kg - moles to scf	scf/kg mole	836.6	From GHG MRR regulation for standard temp of 60 F
Conversion factor lb - moles to scf	scf/lb mole	379.8	0.454 kg = 1 lb

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Potential to Emit (TFO Project) Estimates

MLL-01/19/10 =*Data needed from each BP Site*

MRK 7/Apr/2010 =*Assumptions*

ARA for TRP June 2012 = *Input Variable*

Variable	Units	Toledo K3	
Volume per cycle	scf/cycle	200,730	lb moles vented * conversion factor
Average cycle time from open to atmosphere to drum open for cutting	hours	1.50	Coker 3 from "Drum Times" worksheet cell R1.
Average vented rate	scf/hr	133,820	volume vented/ cycle time
% Water in Coke Drum Vent	mol%	98.2	
CH4 in Vent Vapor (wet)	mPPM	13867	Updated w/July Vent Testing
C2s in Vent Vapor (wet)	mPPM	1712	Updated w/July Vent Testing
H2S in Vent Vapor (wet)	mPPM	510	Updated w/July Vent Testing
VOCs in Vent Vapor (wet)	mPPM	1063	Updated w/July Vent Testing
CO in Vent Vapor (wet)	mPPM	51	Updated w/July Vent Testing
CO2 in Vent Vapor (wet)	mPPM	1000	GHG
PM in Vent Vapor (dry)	gr/DSCF	12	Updated w/July Vent Testing
CH4 Emissions per Event	lb-mol	7.3	
C2H6 Emissions per Event	lb-mol	0.9	
H2S Emissions per Event	lb-mol	0.3	
VOC Emissions per Event	lb-mol	0.6	
CO Emissions per Event	lb-mol	0.0	
CO2 Emissions per Event	lb-mol	0.5	
CH4 Mole Weight	lb/lb-mol	16.0	
C2H6 Mole Weight	lb/lb-mol	30.1	
H2S Mole Weight	lb/lb-mol	34.1	
VOC Mole Weight	lb/lb-mol	44.0	Updated w/July Vent Testing
CO Mole Weight	lb/lb-mol	28.0	
CO2 Mole Weight	lb/lb-mol	44.0	
CH4 Emissions per Event	lbs	117.6	
C2H6 Emissions per Event	lbs	27.2	

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Potential to Emit (TFO Project) Estimates

MLL-01/19/10 =Data needed from each BP Site

MRK 7/Apr/2010 =Assumptions

ARA for TRP June 2012 = Input Variable

Variable	Units	Toledo K3
H2S Emissions per Event	lbs	9.2
VOC Emissions per Event	lbs	24.7
CO Emissions per Event	lbs	0.8
CO2 Emissions per Event	lbs	23.3
PM Emissions per Event	lbs	6.3
Coke Drum Cycle Time	hrs	14.0
# of Coke Drum Pairs	#	1
Theoretical Drums Vented per Year	Events/yr	626
Actual Drums Vented per Year	Events/yr	626
CH4 Emissions Per Year	TPY	36.8
C2H6 Emissions Per Year	TPY	8.5
H2S Emissions Per Year	TPY	2.9
VOC Emissions Per Year	TPY	7.7
CO Emissions Per Year	TPY	0.2
CO2 Emissions Per Year	TPY	7.3
PM Emissions Per Year	TPY	2.0

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10 =*Data needed from each BP Site*
MRK 7/Apr/2010 =*Assumptions*
ARA for TRP June 2012 = *Input Variable*

Variable	Units	Toledo K3
Drum ID	ft	27.0
T/T Length	ft	78.0
Coke Outage from Top Flange	ft	28.6
Top Flange Height	ft	3.0
Top Flange ID (Vapor)	ft	2.5
Top Eliptical Head Height	ft	6.8
Coke Outage from Top T/L	ft	18.9
Coke Height in Cylinder	ft	59.1
Bottom Cone Height	ft	20.0
Bottom Flange Height	ft	1.5
Bottom Flange ID	ft	6.0
Total Coke Drum Height	ft	109.3
Bottom Flange Volume	ft3	42
Bottom Cone Volume	ft3	4854
Coke Volume in Cylinder	ft3	33838
Total Volume in Cylinder	ft3	44659
Top Eliptical Head Volume	ft3	2576
Top Flange Volume (Vapor)	ft3	15
Total Volume of Coke with void spaces	ft3	38734
Coke Density in Coke Drum	lb/ft3	56.0
Total Coke in Coke Drum	tons	1085
Total Coke Drum Volume	ft3	52147
Void Volume of Coke	ft3/ft3	0.50
Volume of Water Covering Coke	ft3	19367
Additional Water Height over Coke Bed	ft	6
Additional Water Volume over Coke Bed	ft3	3654
Total Water Vol in Coke Drum before Vent	ft3	23021
Water Density before Venting	lb/ft3	59.6
Mass of Water in Coke Drum	klb	1371
Vapor Space Volume	ft3	9758
Material in Vapor Space = PV/RT	lb-moles	23.6
Pressure in Drum Before Venting	psig	3.0
Temp in Drum Before Venting	degF	221.4
Vapor Generated from Water Flashing	wt%	0.98
Vapor Generated from Water Flashing	lbs	13376
Vapor from Vent Mole Weight	lb/lb-mol	18.1
Vapor Generated from Water Flashing	lb-mol	739
Vapor Generated per Event	lb-mol	763
The rows below were added to calculate the average volume vented per cycle needed for Green House Gas calculations.		

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10 =*Data needed from each BP Site*
MRK 7/Apr/2010 =*Assumptions*
ARA for TRP June 2012 = *Input Variable*

Variable	Units	Toledo K3	
Conversion factor kg - moles to scf	scf/kg mole	836.6	From GHG MRR regulation for standard temp of 60 F
Conversion factor lb - moles to scf	scf/lb mole	379.8	0.454 kg = 1 lb
Volume per cycle	scf/cycle	289,808	lb moles vented * conversion factor
Average cycle time from open to atmosphere to drum open for cutting	hours	1.50	Coker 3 from "Drum Times" worksheet cell R1.
Average vented rate	scf/hr	193,205	volume vented/ cycle time
% Water in Coke Drum Vent	mol%	98.2	
CH4 in Vent Vapor (wet)	mPPM	13867	Updated w/July Vent Testing
C2s in Vent Vapor (wet)	mPPM	1712	Updated w/July Vent Testing
H2S in Vent Vapor (wet)	mPPM	510	Updated w/July Vent Testing
VOCs in Vent Vapor (wet)	mPPM	1063	Updated w/July Vent Testing
CO in Vent Vapor (wet)	mPPM	51	Updated w/July Vent Testing
CO2 in Vent Vapor (wet)	mPPM	1000	GHG

Coke Drum Venting Emissions - Industry Data with Known Water Vaporization

Past Actual Baseline (2004-2005) Estimates

MLL-01/19/10 =*Data needed from each BP Site*
MRK 7/Apr/2010 =*Assumptions*
ARA for TRP June 2012 = *Input Variable*

Variable	Units	Toledo K3	
PM in Vent Vapor (dry)	gr/DSCF	12	Updated w/July Vent Testing
CH4 Emissions per Event	lb-mol	10.6	
C2H6 Emissions per Event	lb-mol	1.3	
H2S Emissions per Event	lb-mol	0.4	
VOC Emissions per Event	lb-mol	0.8	
CO Emissions per Event	lb-mol	0.0	
CO2 Emissions per Event	lb-mol	0.8	
CH4 Mole Weight	lb/lb-mol	16.0	
C2H6 Mole Weight	lb/lb-mol	30.1	
H2S Mole Weight	lb/lb-mol	34.1	
VOC Mole Weight	lb/lb-mol	44.0	Updated w/July Vent Testing
CO Mole Weight	lb/lb-mol	28.0	
CO2 Mole Weight	lb/lb-mol	44.0	
CH4 Emissions per Event	lbs	169.7	
C2H6 Emissions per Event	lbs	39.3	
H2S Emissions per Event	lbs	13.3	
VOC Emissions per Event	lbs	35.7	
CO Emissions per Event	lbs	1.1	
CO2 Emissions per Event	lbs	33.6	
PM Emissions per Event	lbs	9.0	
Coke Drum Cycle Time	hrs	18.0	
# of Coke Drum Pairs	#	1	
Theoretical Drums Vented per Year	Events/yr	487	
Actual Drums Vented per Year	Events/yr	424	
CH4 Emissions Per Year	TPY	35.9	
C2H6 Emissions Per Year	TPY	8.3	
H2S Emissions Per Year	TPY	2.8	
VOC Emissions Per Year	TPY	7.6	
CO Emissions Per Year	TPY	0.2	
CO2 Emissions Per Year	TPY	7.1	
PM Emissions Per Year	TPY	1.9	

Coke Drum Cutting Emissions - Industry Data with Known Water Vaporization

MLL-01/19/10 *=Data needed from each BP Site*

MRK 7/Apr/2010 *=Assumptions*

Coker - Enthalpy Balance Method

Variable	Units	Comments	Toledo K3 - Past	Toledo K3 PTE	
N	#/year	Number of Vessel Openings	424	626	
Mc	tons	Mass of Coke per drum	1085	1085	
Md	tons	Mass of Individual Coke Drum	260	260	
Cpc	Btu/lb-F	Specific Heat of Coke, Perry's ChemE Handbook	0.265	0.265	
Cpd	Btu/lb-F	Specific Heat of Steel	0.12	0.12	
Cpw	Btu/lb-F	Specific Heat of Water	1	1	
T1	degF	Initial Temp of Coke (stm sat at 12psig)	213	213	
T2	degF	Final Temp of Coke (where water stops boiling)	212	212	
Tcw	degF	Temp of the cutting water (cooling circuit)	75	75	
Qc	MMBtu	Heat available from Coke	0.3	0.3	
Qd	MMBtu	Heat available from Coke Drum	0.0	0.0	
Qtot	MMBtu	Total Heat available from Coke/Coke Drum	0.3	0.3	
Pi	psig	Initial Pressure before Venting	0.1	0.1	
Pf	psig	Final Pressure	0	0	
Pave	psig	Average Pressure for Latent Heat	0.05	0.05	
Hv	Btu/lb	Heat of vaporization of water	970	970	
Hs	Btu/lb	Sensible Heat of Water	137	137	
Mw	lb	Water Vaporized per drum	304	304	
Mw	lbs/yr	Water Vaporized per year	128770.147	190255.774	
MWw	lb/lb-mol	Mole weight of vent	18.0	18.0	
Nw	lb-mol/yr	Water Vaporized per year	7147.94042	10560.9644	
MF CH4	mol frac	Mole Fraction of CH4	0.0139	0.0139	Updated w/stack testing
MF C2H6	mol frac	Mole Fraction of C2H6	0.001712	0.001712	Updated w/stack testing
MF H2S	mol frac	Mole Fraction of H2S	0.00051	0.00051	Updated w/stack testing
MF VOC	mol frac	Mole Fraction of VOC	0.001063	0.001063	Updated w/stack testing
MF CO	mol frac	Mole Fraction of CO	0.000051	0.000051	Updated w/stack testing
MF CO2	mol frac	Mole Fraction of CO2	0.001	0.001	
Nch4	lb-mol/yr	CH4/yr	99	146	
Nc2h6	lb-mol/yr	C2H6/yr	12	18	
Nh2s	lb-mol/yr	H2S/yr	4	5	
Nvoc	lb-mol/yr	VOC/yr	8	11	
Nco	lb-mol/yr	CO/yr	0	1	
Nco2	lb-mol/yr	CO2/yr	7	11	
MWch4	lb/lb-mol	Mole Weight of CH4	16.0	16.0	
MWc2H6	lb/lb-mol	Mole Weight of C2H6	30.1	30.1	
MWh2S	lb/lb-mol	Mole Weight of H2S	34.1	34.1	
MWvoc	lb/lb-mol	Mole Weight of VOC	44.0	44.0	Updated w/stack testing
MWco	lb/lb-mol	Mole Weight of CO	28.0	28.0	
MWco2	lb/lb-mol	Mole Weight of CO2	44.0	44.0	
Mch4	TPY	CH4/yr	0.8	1.2	
Mc2h6	TPY	C2H6/yr	0.2	0.3	
Mh2S	TPY	H2S/yr	0.1	0.1	
Mvoc	TPY	VOC/yr	0.2	0.2	
Mco	TPY	CO/yr	0.0	0.0	
Mco2	TPY	CO2/yr	0.2	0.2	

Coke Drum Draining Emissions - BP Data with Simplified Evaporative Emissions
MRK 12/Apr/2010

Variable	Units	Toledo K3 -Past	Toledo K3 PTE
Mass of Water in Coke Drum	klb	1371.3	1372.8
Vapor Generated from Water Flashing	wt%	0.98	0.67
Mass of Water Drained from Drum	k lbs	1357.9	1363.7
Actual Drums Vented per Year	Events/yr	424	626
Drilling water flow rate	gpm	1000	1000
Time required to drill a coke drum	hrs	3.5	3.5
Water used to drill a coke drum	k lbs	1751.4	1751.4
Water analysis based on Toledo K3 data			
VOC's in water drained from drum	mg/L	3	3
VOC's in water from drum while drilling	mg/L	1.4	1.4
VOC's in water base line	mg/L	0.7	0.7
Pounds of VOC's per drum draining	lbs	3.123	3.136
Pounds of VOC's per drum drilling	lbs	1.226	1.226
Tons/yr VOC's total	T/yr	0.92	1.36

Note: Above material balance approach assumes that decrease in VOC content of baseline water versus water drained from drum is due solely to evaporative losses of VOC. In fact, an additinoal signfiicant factor is the dilution effect of makeup water. Ignoring this affect increases estimated emissions, and is therefore conservative.

H_2S emissions from Coker Cutting Water System

Cutting Water drained from the Coke drums collects first in a "Maze Sump", flows next to one of two "Water Drums", and then flows to a "Surge Tank" (where makup water is added) before recirculating to the Coker

- **The Maze Sump and Surge tank are open top containers and have been characterized using EPA WATER9 program.**
- **The Water Drums are enclosed with a vent pipe. They have been characterized using EPA TANKS 4.09d prgram as a fixed roof tank.**

Emissions Calculated from US EPA WATER9

										Coking Cycles/yr =>	**424**	**626**	202
	Baseline Operations Input Parameters for WATER9 Program							**Water9 Output**					
Water Storage Equip	**Average Flow**	**Vessel Temp**	**Inlet Temp**	**Length**	**Width**	**Depth**	**Avg. H_2S[1]**	**Emissions**	**Emissions**	**Baseline Emission**	**Future Emissions[2]**	**TFO Project Increase**
	gal/min	°F	°F	ft	ft	ft	ppm	g/s	lb/hr	tons/yr	tons/yr	tons/yr
Maze Sump	302	145	145	47	24	10	10	8.317E-03	0.066	0.29	0.43	0.14
Surge Tank	395	100	100	25 ft diameter		48	5.5	2.514E-03	0.020	0.09	0.13	0.04

Emissions Calculated from US EPA TANKS 4.0.9d

	Baseline Operations Input Parameters for TANKS 4.09d Program							**TANKS Output**		**Baseline Emission**	**Future Emissions**	**Project Increase**
Water Storage Equip	**Flow**	**Height**	**Diameter**	**H_2S**	**H_2S[3]**	**Temp**	**Vap. Pres.[4]**	**Emissions**	**Emissions**			
	gal/min	ft	ft	ppm	wt. %	°F	psia	lbs/yr	lb/hr	tons/yr	tons/yr	tons/yr
Coker Water Drum	151	65	19.58	9	0.0009	145	3.3221	27.28	0.0031	0.014	0.020	0.006
Coker Water Drum	151	65	19.58	9	0.0009	145	3.3221	27.28	0.0031	0.014	0.020	0.006

1) H_2S ppmw in coker drum water based on Toledo Testing in 2010

2) Future emissions calculated by multiplying baseline emissions times ratio of future cycles/yr vs baseline cycles/yr

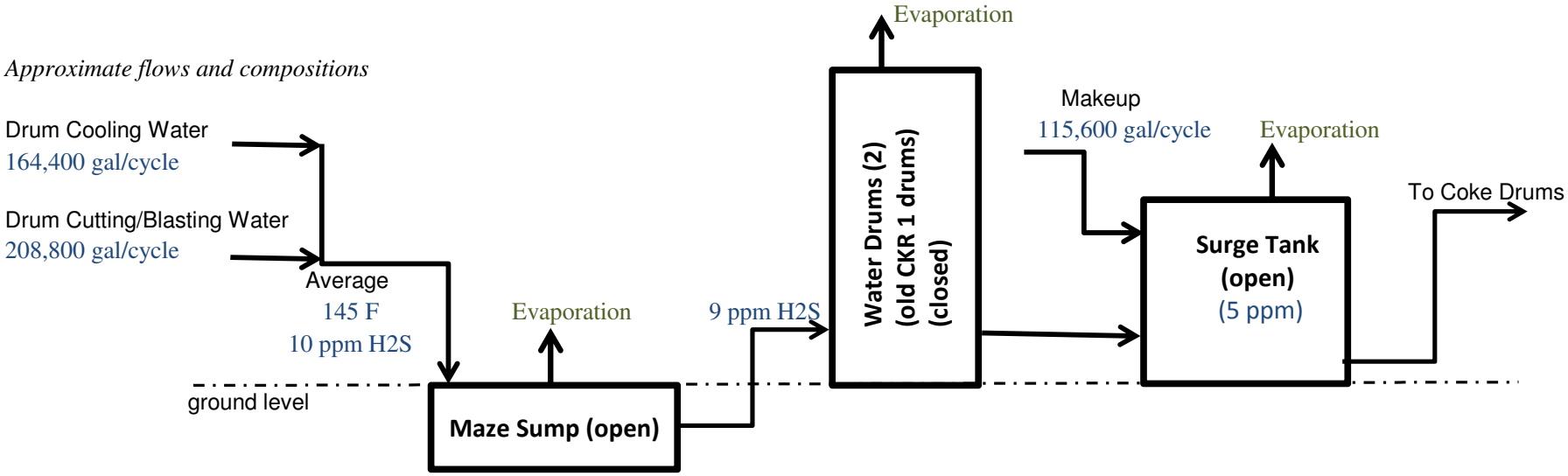
3) Coker Water Drum solution - H_2S percent of total liquid weight

4) Vapor pressures were determined using Antoine Coefficients obtained from the National Institute of Standards and Technology [NIST], and adjusted to correspond to the units required for EPA's program, TANKS 4.0.9d (http://www.epa.gov/ttnchie1/faq/tanksfaq.html#5). Temperature range for water is 255.9 - 373 K, and hydrogen sulfide is 212.8 - 349.5 K.

H_2S Emissions Summary	**Baseline Emission**	**Future Emissions**	**Project Increase**
	tons/yr	tons/yr	tons/yr
Maze Sump	0.29	0.43	0.14
Surge Tank	0.09	0.13	0.04
2 Water Drums	0.027	0.040	0.013
Total Cutting Water H2S tpy	**0.40**	**0.60**	**0.19**

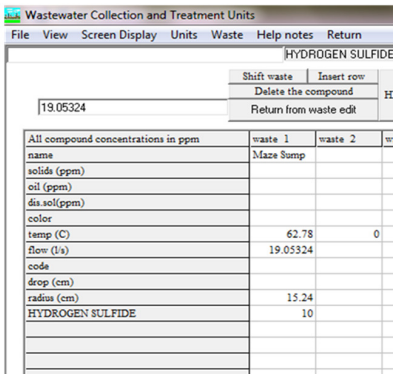
Coker 3 Cutting and Cooling Water Handling

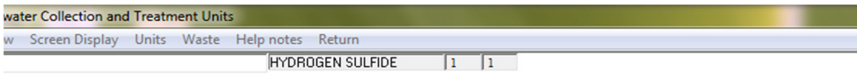
Approximate flows and compositions

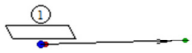


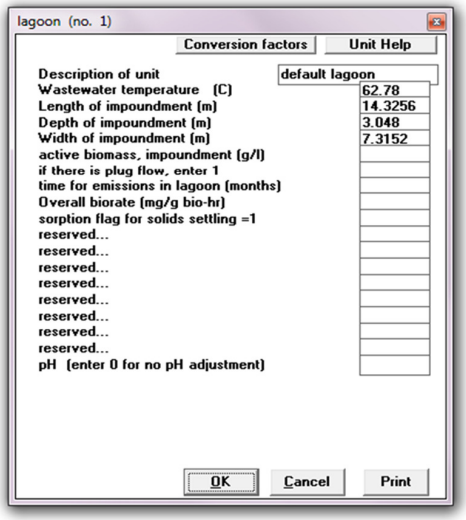
Calculation of H_2S emissions from Coker Cutting Water System

Water 9 Input Data for Maze Sump (Screen Prints)

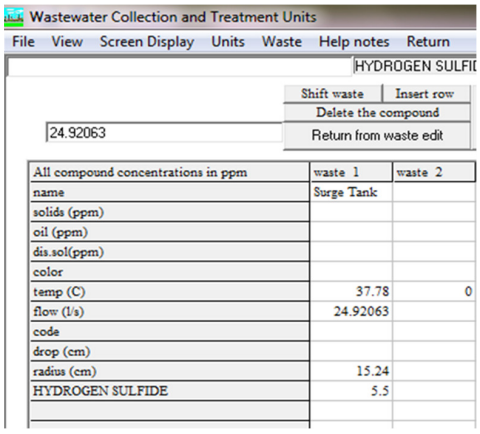


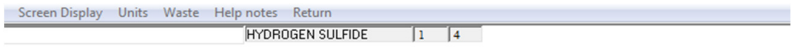


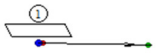


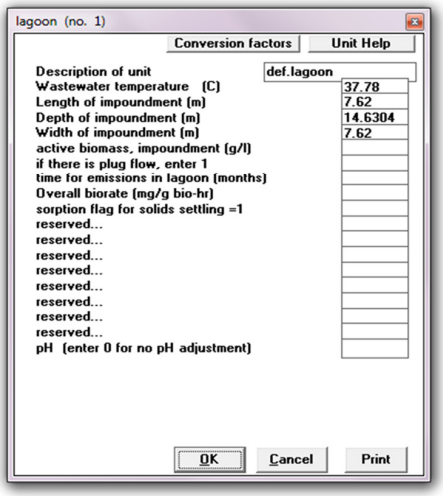


Water 9 Input Data for Surge Tank(Screen Prints)









Calculation of H_2S emissions from Coker Cutting Water System

TANKS 4.09d Output and Input for Coker Water Storage Drums (Modeled as Fixed roof Tanks.) (Screen Prints)

Emissions Report for: Annual

Coker 1 Drums - Vertical Fixed Roof Tank
Toledo, Ohio

	Losses(lbs)		
Components	Working Loss	Breathing Loss	Total Emissions
Coker Drum H2S	25,113.23	0.00	25,113.23
Hydrogen Sulfide	27.28	0.00	27.28
Water	25,085.96	0.00	25,085.96

TANKS 4.0.9d
Emissions Report - Detail Format
Tank Indentification and Physical Characteristics

Identification

User Identification:	Coker 1 Drums
City:	Toledo
State:	Ohio
Company:	BP Husky
Type of Tank:	Vertical Fixed Roof Tank
Description:	Coker 1 Drums used as surge capacity for other Cokers

Tank Dimensions

Shell Height (ft):	65.00
Diameter (ft):	19.58
Liquid Height (ft) :	65.00
Avg. Liquid Height (ft):	32.50
Volume (gallons):	146,406.99
Turnovers:	542.09
Net Throughput(gal/yr):	79,365,600.00
Is Tank Heated (y/n):	Y

Paint Characteristics

Shell Color/Shade:	Gray/Medium
Shell Condition	Good
Roof Color/Shade:	Gray/Medium
Roof Condition:	Good

Roof Characteristics

Type:	Dome	
Height (ft)		0.00
Radius (ft) (Dome Roof)		0.00

Breather Vent Settings

Vacuum Settings (psig):	0.00
Pressure Settings (psig)	0.00

Meterological Data used in Emissions Calculations: Toledo, Ohio (Avg Atmospheric Pressure = 14.38 psia)

Coker 1 Drums - Vertical Fixed Roof Tank
Toledo, Ohio

Annual Emission Calcaulations

Standing Losses (lb):	0.0000
Vapor Space Volume (cu ft):	10,190.2332
Vapor Density (lb/cu ft):	0.0092
Vapor Space Expansion Factor:	0.0000
Vented Vapor Saturation Factor:	0.1437
Tank Vapor Space Volume:	
Vapor Space Volume (cu ft):	10,190.2332
Tank Diameter (ft):	19.5800
Vapor Space Outage (ft):	33.8430
Tank Shell Height (ft):	65.0000
Average Liquid Height (ft):	32.5000
Roof Outage (ft):	1.3430
Roof Outage (Dome Roof)	
Roof Outage (ft):	1.3430
Dome Radius (ft):	19.5800
Shell Radius (ft):	9.7900
Vapor Density	
Vapor Density (lb/cu ft):	0.0092
Vapor Molecular Weight (lb/lb-mole):	18.0192
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.3221
Daily Avg. Liquid Surface Temp. (deg. R):	604.6700
Daily Average Ambient Temp. (deg. F):	48.4875
Ideal Gas Constant R (psia cuft / (lb-mol-deg R)):	10.731
Liquid Bulk Temperature (deg. R):	604.6700
Tank Paint Solar Absorptance (Shell):	0.6800
Tank Paint Solar Absorptance (Roof):	0.6800
Daily Total Solar Insulation Factor (Btu/sqft day):	1,233.2285
Vapor Space Expansion Factor	
Vapor Space Expansion Factor:	0.0000
Daily Vapor Temperature Range (deg. R):	0.0000
Daily Vapor Pressure Range (psia):	0.0000
Breather Vent Press. Setting Range(psia):	0.0000
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.3221
Vapor Pressure at Daily Minimum Liquid Surface Temperature (psia):	3.3221
Vapor Pressure at Daily Maximum Liquid Surface Temperature (psia):	3.3221
Daily Avg. Liquid Surface Temp. (deg R):	604.6700
Daily Min. Liquid Surface Temp. (deg R):	604.6700
Daily Max. Liquid Surface Temp. (deg R):	604.6700
Daily Ambient Temp. Range (deg. R):	20.2583
Vented Vapor Saturation Factor	
Vented Vapor Saturation Factor:	0.1437
Vapor Pressure at Daily Average Liquid: Surface Temperature (psia):	3.3221
Vapor Space Outage (ft):	33.8430
Working Losses (lb):	25,113.2316
Vapor Molecular Weight (lb/lb-mole):	18.0192
Vapor Pressure at Daily Average Liquid Surface Temperature (psia):	3.3221
Annual Net Throughput (gal/yr.):	79,365,600.0000
Annual Turnovers:	542.0889
Turnover Factor:	0.2220
Maximum Liquid Volume (gal):	146,406.9891
Maximum Liquid Height (ft):	65.0000
Tank Diameter (ft):	19.5800
Working Loss Product Factor:	1.0000
Total Losses (lb):	25,113.2316

Coker 1 Drums - Vertical Fixed Roof Tank
Toledo, Ohio

Mixture/Component	Month	Daily Liquid Surf. Temperature (deg F) Avg.	Min.	Max.	Liquid Bulk Temp (deg F)	Vapor Pressure (psia) Avg.	Min.	Max.	Vapor Mol. Weight.	Liquid Mass Fract.	Vapor Mass Fract.	Mol. Weight	Basis for Vapor Pressure Calculations
Coker Drum H2S	All	145.00	145.00	145.00	145.00	3.3221	3.3221	3.3221	18.0192			18.01	
Hydrogen Sulfide						401.1213	401.1213	401.1213	34.0810	0.0000	0.0011	34.08	Option 2: A=7.40397, B=958.587, C=247.738
Water						3.3202	3.3202	3.3202	18.0100	1.0000	0.9989	18.01	Option 2: A=7.5294, B=1435.264, C=208.302