PRODUCED WATER STORAGE TANK EMISSIONS

Operator: Chaco Energy Company
Facility Name: Some State
Emission Point Description: (1) 300 bbl and (1) 500 bbl liquid manifolded storage tank

Actual W&B Emissions (lb/yr)	5% of Actual W&B Emissions (lb/yr)
315.1635	15.758175

Actual Throughput (gal)	Throughput (bbl)	PTE Throughput (bbl)
3,066,000	73,000	73,000

Storage Vessel 1

Capacity (bbl)	Annual Throughput (gal/yr)	W&B Emissions (lb/yr)
300	1,149,750	136.0792

Storage Vessel 2

Capacity (bbl)	Annual Throughput (gal/yr)	W&B Emissions (lb/yr)
500	1,916,250	179.0843

EMISSION FACTORS & EMISSIONS SUMMARY

	Emission Factors			Actual Emissions		Potential to Emit	
Criteria Pollutant	Uncontrolled	Units	Estimation Method	Uncontrolled (tons/year)	Controlled (tons/year)	Uncontrolled (tons/year)	Controlled (tons/year)
VOC	0.0035	lb/bbl	PS Memo 17-01, AP-42	0.13	0.13	0.13	0.13
Greenhouse Gas	Uncontrolled	Units	Estimation Method	Uncontrolled (tons/year)	Controlled (tons/year)	Uncontrolled (tons/year)	Controlled (tons/year)
CO_2	0.0217	lb/bbl	PS Memo 17-01, AP-42	0.79	0.79	0.79	0.79
Methane	0.0091	lb/bbl	PS Memo 17-01, AP-42	0.33	0.33	0.33	0.33
Ethane	0.0006	lb/bbl	PS Memo 17-01, AP-42	0.02	0.02	0.02	0.02
Hazardous Air Pollutant	Uncontrolled	Units	Estimation Method	Uncontrolled (lb/year)	Controlled (lb/year)	Uncontrolled (lb/year)	Controlled (lb/year)
Benzene	0.00006	lb/bbl	PS Memo 17-01, AP-42	4	4	4	4
Toluene	0.00021	lb/bbl	PS Memo 17-01, AP-42	15	15	15	15
Ethylbenzene	0.00006	lb/bbl	PS Memo 17-01, AP-42	4	4	4	4
Xylene	0.00023	lb/bbl	PS Memo 17-01, AP-42	17	17	17	17
n-Hexane	0.00012	lb/bbl	PS Memo 17-01, AP-42	9	9	9	9
2,2,4 Trimethylpentane	0.00000	lb/bbl	PS Memo 17-01, AP-42	0	0	0	0

ACTUAL ANNUAL EMISSION TOTALS

		Working & Breathing		Flash		Working & Breathing + Flash	
Pollutant	Mass Fraction	Uncontrolled (lb/year)	Controlled (lb/year)	Uncontrolled (lb/year)	Controlled (lb/year)	Uncontrolled (lb/year)	Controlled (lb/year)
VOC	0.0853	1.34	1.34	250.90	250.90	252.25	252.25
CO_2	0.5350	8.43	8.43	1574.18	1574.18	1582.61	1582.61
Methane	0.2246	3.54	3.54	661.06	661.06	664.60	664.60
Ethane	0.0158	0.25	0.25	46.63	46.63	46.88	46.88
Benzene	0.0015	0.02	0.02	4.27	4.27	4.30	4.30
Toluene	0.0052	0.08	0.08	15.32	15.32	15.40	15.40
Ethylbenzene	0.0015	0.02	0.02	4.38	4.38	4.40	4.40
Xylene	0.0058	0.09	0.09	16.93	16.93	17.02	17.02
n-Hexane	0.0030	0.05	0.05	8.79	8.79	8.84	8.84
2,2,4 Trimethylpentane	0.0000	0.00	0.00	0.00	0.00	0.00	0.00

Working & Breathing emissions calculated using AP-42 Section 7.1 (June 2020).

FLASH LIBERATION ANALYSIS

Actual or Representative Sample	Sample Collection Point	Sample Date	Gas to Water Ratio (scf/bbl)	Sample Molecular Weight (lb/lb-mole)	Flash Gas Volume (scf/yr)	Gas Molar Volume (scf/lb-mole)
Actual	Heater Treater	5/4/2021	0.5	30.5553	36,500	379

Flash Gas Extended Analysis

Constituent	Weight %	Mass Fraction$_x$	Uncontrolled Emissions$_x$ (lb/year)	Emission Factor$_x$ (lb/bbl)
Hydrogen Sulfide	0.0000	0.0000	0.0000	0.0000
Carbon Dioxide	53.4952	0.5350	1574.1836	0.0216
Nitrogen	13.9291	0.1393	409.8851	0.0056
Methane	22.4648	0.2246	661.0625	0.0091
Ethane	1.5845	0.0158	46.6262	0.0006
Propane	0.4807	0.0048	14.1466	0.0002
Isobutane	2.1038	0.0210	61.9075	0.0008
n-Butane	0.2372	0.0024	6.9809	0.0001
Isopentane	0.2760	0.0028	8.1211	0.0001
n-Pentane	0.0920	0.0009	2.7076	0.0000
Cyclopentane	0.0243	0.0002	0.7161	0.0000
n-Hexane	0.2988	0.0030	8.7916	0.0001
Cyclohexane	0.1158	0.0012	3.4067	0.0000
Other Hexanes	0.6256	0.0063	18.4108	0.0003
Heptanes	0.4340	0.0043	12.7697	0.0002
Methylcyclohexane	0.1834	0.0018	5.3968	0.0001
2,2,4 Trimethylpentane	0.0000	0.0000	0.0000	0.0000
Benzene	0.1452	0.0015	4.2724	0.0001
Toluene	0.5207	0.0052	15.3229	0.0002
Ethylbenzene	0.1488	0.0015	4.3794	0.0001
Xylenes	0.5753	0.0058	16.9304	0.0002
Octanes	0.6094	0.0061	17.9318	0.0002
Nonanes	0.3203	0.0032	9.4249	0.0001
Decanes Plus	1.3351	0.0134	39.2865	0.0005

Emission factors calculated using guidance from APCD PS-Memo 17-01, Section 5.2 (May 31, 2017).

CGRS SOLUTIONS DELIVERED

Alliance
SOURCE TESTING

5530 Marshall Street
Arvada, Colorado 80002
Phone: 303-420-5949
Fax: 303-420-5920

FLASH LIBERATION ANALYSIS OF SEPARATOR WATER

SAMPLE DATA

PROJECT NO	OG-2021-0245	SAMPLE ID	Pressurized Water
COMPANY NAME	CGRS	ANALYSIS DATE	5/6/2021
SITE	Some State	SAMPLE DATE	5/4/2021
UNIT ID	Heater Treater	CYLINDER NO	37525
SAMPLED BY	AJM	LAB ANALYST	CLB

FIELD DATA

SAMPLE PRESSURE	16.1 psig	SAMPLE TEMP	127 F
AMBIENT PRESSURE	12.7 psi	AMBIENT TEMP	60 F

COMMENTS: _____

Flash Liberation of Pressurized Water

	Pressure	Temperature
Separator Produced Water	16 psig	127 ºF
Stock Tank	12.7 psia	60 ºF
Base Conditions	14.65 psi	60 ºF

Flash Liberation Results

	Result	Units
Gas Water Ratio	<0.5	SCF flashed gas/bbl stock tank liquid
Gas Specific Gravity	1.0550	Air = 1.00

Quality Assurance

	Result
Duplicate GWR RSD (20% max.)	0.00%

Alliance
SOURCE TESTING

5530 Marshall Street
Arvada, Colorado 80002
Phone: 303-420-5949
Fax: 303-420-5920

Flashed Gas Extended Analysis

SAMPLE DATA

PROJECT NO.	OG-2021-0245	SAMPLE ID.	Flashed Gas
COMPANY NAME.	CGRS	ANALYSIS DATE.	5/6/2021
SITE.	Some State	SAMPLE DATE.	5/4/2021
UNIT ID.	Heater Treater	CYLINDER NO.	37525
SAMPLED BY.	AJM	LAB ANALYST.	CLB

LAB CONDITIONS

PRESSURE.	12.2 psi	TEMPERATURE.	72 F

COMMENTS: _____

LABORATORY DATA

COMPONENT	MOLE %	WT%	GPM
HYDROGEN SULFIDE	0.0000	0.0000	0.0000
CARBON DIOXIDE	37.1412	53.4952	6.3432
NITROGEN	15.1930	13.9291	1.6727
METHANE	42.7876	22.4648	7.2592
ETHANE	1.6101	1.5845	0.4309
PROPANE	0.3331	0.4807	0.0918
ISOBUTANE	1.1060	2.1038	0.3622
N-BUTANE	0.1247	0.2372	0.0393
ISOPENTANE	0.1169	0.2760	0.0428
N-PENTANE	0.0390	0.0920	0.0141
CYCLOPENTANE	0.0106	0.0243	0.0031
N-HEXANE	0.1059	0.2988	0.0436
CYCLOHEXANE	0.0420	0.1158	0.0143
OTHER HEXANES	0.2234	0.6256	0.0879
HEPTANES	0.1337	0.4340	0.0584
METHYLCYCLOHEXANE	0.0571	0.1834	0.0229
2,2,4 TRIMETHYLPENTANE	0.0000	0.0000	0.0000
BENZENE	0.0568	0.1452	0.0159
TOLUENE	0.1727	0.5207	0.0578
ETHYLBENZENE	0.0428	0.1488	0.0165
XYLENES	0.1656	0.5753	0.0642
OCTANES	0.1692	0.6094	0.0721
NONANES	0.0799	0.3203	0.0375
DECANES PLUS	0.2887	1.3351	0.1728
SUBTOTAL	100.0000	100.0000	16.9235
OXYGEN/ARGON	0.0000	0.0000	0.0000
TOTAL	100	100	16.9235

		BTU @	
MOLECULAR WEIGHT.	30.5553	NET DRY REAL	545.2928 ***/scf***
RELATIVE DENSITY (AIR=1).	1.0550		
COMPRESSIBILITY FACTOR.	0.9967	GROSS DRY REAL	602.2606 ***/scf***
		GROSS WET REAL	591.6867 ***/scf***

ANALYTICAL PROCEDURES TAKEN FROM GPA 2286-95

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
AQD Storage Tank Calculation Tool (21294)
Calculation Report
Based on AP-42 (06/2020) Section 7.1: Organic Liquid Storage Tanks

Print this page

INPUT SUMMARY

Identification

Tank type		Vertical Fixed Roof
Tank identifier		300 bbl water tank

Meteorological Data:

Nearest major city:		Denver, CO

Tank Contents:

Data source		Manual Entry
Liquid category		Crude Oil
Liquid name		
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Reid vapor pressure, psia	RVP	1.1000

Tank Dimensions:

Tank shell height, ft	H_S	15.0000
Tank diameter, ft	D	12.0000
Maximum liquid height, ft	H_{LX}	14.0000
Minimum liquid height, ft	H_{LN}	1.0000
Liquid height, ft	H_L	7.5000
Number of turnovers per year, dimensionless	N	104.5276
Annual net throughput, gal/yr		1,149,750.0000
Annual net throughput, bbl/yr	Q	27,375.0000
Flashing/vapor balanced unloading?		No

Paint Characteristics:

Shell color/shade		Aluminum: Diffuse
Shell condition		Average
Roof color/shade		Aluminum: Diffuse
Roof condition		Average

Roof Characteristics:

Roof type		Dome Roof
Tank roof height, ft	H_R	0.0000
Tank dome roof radius, ft	R_R	12

Breather Vent Settings:

Breather vent vacuum setting, psig	P_{BV}	-0.0300
Breather vent pressure setting, psig	P_{BP}	0.0300

Insulation Characteristics:

Tank insulation	None
Tank heating	No

METEOROLOGICAL DATA

Nearest major city:		Denver, CO
Average daily ambient temperature, °R	T_{AA}	510.4000
Average daily minimum ambient temperature, °R	T_{AN}	497.6000
Average daily maximum ambient temperature, °R	T_{AX}	523.2000
Average daily ambient temperature range, °R	ΔT_A	25.6000
Average wind speed, mph	v	9.4000
Average daily total insolation factor, Btu/ft^2•d	I	1,491.0000
Atmospheric pressure, psi	P_A	12.0800

LIQUID DATA

Liquid category		Crude Oil
Liquid name		
Liquid bulk temperature, °R	T_B	513.2627
Average daily liquid surface temperature, °R	T_{LA}	515.8997
Average daily minimum liquid surface temperature, °R	T_{LN}	506.7787
Average daily maximum liquid surface temperature, °R	T_{LX}	525.0207
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3256
Vapor pressure at the average daily minimum liquid surface temperature, psia	P_{VN}	0.2538
Vapor pressure at the average daily maximum liquid surface temperature, psia	P_{VX}	0.4142
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Reid vapor pressure, psia	RVP	1.1000
Constant in vapor pressure equation, dimensionless	A	12.7278
Constant in vapor pressure equation, °R	B	7,145.1028

CALCULATION DETAILS

Standing Losses

Standing losses, lb/yr	L_S	42.5754

Vapor space volume, ft^3	V_V	941.1960
Vapor density, lb/ft^3	W_V	0.0018
Vapor space expansion factor, per day	K_E	0.0793
Vented vapor saturation factor, dimensionless	K_S	0.8744

Vapor Space Volume

Vapor space volume, ft^3	V_V	941.1960
Tank diameter, ft	D	12.0000
Vapor space outage, ft	H_{VO}	8.3220

Vapor Space Outage

Vapor space outage, ft	H_{VO}	8.3220
Tank shell height, ft	H_S	15.0000
Liquid height, ft	H_L	7.5000
Roof outage, ft	H_{RO}	0.8220

Roof Outage

Roof outage, ft	H_{RO}	0.8220
Tank roof height, ft	H_R	1.6080
Tank shell radius, ft	R_S	6.0000
Tank dome roof radius, ft	R_R	12.0000

Vapor Density

Vapor density, lb/ft^3	W_V	0.0018
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3256
Ideal gas constant, $psia \cdot ft^3/lb\text{-}mole \cdot °R$	R	10.7310
Average vapor temperature, °R	T_V	518.5367
Tank roof surface solar absorptance, dimensionless	α_R	0.6400
Tank shell surface solar absorptance, dimensionless	α_S	0.6400
Average daily total insolation factor, $Btu/ft^2 \cdot d$	I	1,491.0000

Vapor Space Expansion Factor

Vapor space expansion factor, per day	K_E	0.0793
Average daily vapor temperature range, °R	ΔT_V	36.4841
Average daily vapor pressure range, psi	ΔP_V	0.1604
Breather vent pressure setting range, psig	ΔP_B	0.0600
Atmospheric pressure, psi	P_A	12.0800
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3256
Average daily liquid surface temperature, °R	T_{LA}	515.8997

Vented Vapor Saturation Factor

Vented vapor saturation factor, dimensionless	K_S	0.8744
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3256
Vapor space outage, ft	H_{VO}	8.3220

Working Losses

Working losses, lb/yr	L_W	93.5039
Net working loss throughput, ft^3/yr	V_Q	153,683.2500
Turnover factor, dimensionless	K_N	0.4537
Working loss product factor for fixed roof tanks, dimensionless	K_P	0.7500
Vapor density, lb/ft^3	W_V	0.0018
Vent setting correction factor, dimensionless	K_B	1.0000

EMISSIONS SUMMARY

Total Losses

Standing losses, lb/yr	L_S	42.5754
Working losses, lb/yr	L_W	93.5039
Total routine losses, lb/yr	L_T	136.0792

OKLAHOMA DEPARTMENT OF ENVIRONMENTAL QUALITY
AQD Storage Tank Calculation Tool (21294)
Calculation Report
Based on AP-42 (06/2020) Section 7.1: Organic Liquid Storage Tanks

Print this page

INPUT SUMMARY

Identification

Tank type		Vertical Fixed Roof
Tank identifier		500 bbl water tank

Meteorological Data:

Nearest major city:		Denver, CO

Tank Contents:

Data source		Manual Entry
Liquid category		Crude Oil
Liquid name		
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Reid vapor pressure, psia	RVP	1.1000

Tank Dimensions:

Tank shell height, ft	H_S	20.0000
Tank diameter, ft	D	12.0000
Maximum liquid height, ft	H_{LX}	14.0000
Minimum liquid height, ft	H_{LN}	1.0000
Liquid height, ft	H_L	7.5000
Number of turnovers per year, dimensionless	N	174.2126
Annual net throughput, gal/yr		1,916,250.0000
Annual net throughput, bbl/yr	Q	45,625.0000
Flashing/vapor balanced unloading?		No

Paint Characteristics:

Shell color/shade		Aluminum: Diffuse
Shell condition		Average
Roof color/shade		Aluminum: Diffuse
Roof condition		Average

Roof Characteristics:

Roof type		Dome Roof
Tank roof height, ft	H_R	0.0000
Tank dome roof radius, ft	R_R	12

Breather Vent Settings:

Breather vent vacuum setting, psig	P_{BV}	-0.0300
Breather vent pressure setting, psig	P_{BP}	0.0300

Insulation Characteristics:

Tank insulation	None
Tank heating	No

METEOROLOGICAL DATA

Nearest major city:		Denver, CO
Average daily ambient temperature, °R	T_{AA}	510.4000
Average daily minimum ambient temperature, °R	T_{AN}	497.6000
Average daily maximum ambient temperature, °R	T_{AX}	523.2000
Average daily ambient temperature range, °R	ΔT_A	25.6000
Average wind speed, mph	v	9.4000
Average daily total insolation factor, Btu/ft^2•d	I	1,491.0000
Atmospheric pressure, psi	P_A	12.0800

LIQUID DATA

Liquid category		Crude Oil
Liquid name		
Liquid bulk temperature, °R	T_B	513.2627
Average daily liquid surface temperature, °R	T_{LA}	515.6940
Average daily minimum liquid surface temperature, °R	T_{LN}	506.5568
Average daily maximum liquid surface temperature, °R	T_{LX}	524.8312
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3238
Vapor pressure at the average daily minimum liquid surface temperature, psia	P_{VN}	0.2522
Vapor pressure at the average daily maximum liquid surface temperature, psia	P_{VX}	0.4122
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Reid vapor pressure, psia	RVP	1.1000
Constant in vapor pressure equation, dimensionless	A	12.7278
Constant in vapor pressure equation, °R	B	7,145.1028

CALCULATION DETAILS

Standing Losses

Standing losses, lb/yr	L_S	63.2292

Vapor space volume, ft^3	V_V	1,506.6827
Vapor density, lb/ft^3	W_V	0.0018
Vapor space expansion factor, per day	K_E	0.0794
Vented vapor saturation factor, dimensionless	K_S	0.8139

Vapor Space Volume

Vapor space volume, ft^3	V_V	1,506.6827
Tank diameter, ft	D	12.0000
Vapor space outage, ft	H_{VO}	13.3220

Vapor Space Outage

Vapor space outage, ft	H_{VO}	13.3220
Tank shell height, ft	H_S	20.0000
Liquid height, ft	H_L	7.5000
Roof outage, ft	H_{RO}	0.8220

Roof Outage

Roof outage, ft	H_{RO}	0.8220
Tank roof height, ft	H_R	1.6080
Tank shell radius, ft	R_S	6.0000
Tank dome roof radius, ft	R_R	12.0000

Vapor Density

Vapor density, lb/ft^3	W_V	0.0018
Vapor molecular weight, lb/lb-mole	M_V	30.5553
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3238
Ideal gas constant, $psia \cdot ft^3/lb\text{-}mole \cdot °R$	R	10.7310
Average vapor temperature, °R	T_V	518.1253
Tank roof surface solar absorptance, dimensionless	α_R	0.6400
Tank shell surface solar absorptance, dimensionless	α_S	0.6400
Average daily total insolation factor, $Btu/ft^2 \cdot d$	I	1,491.0000

Vapor Space Expansion Factor

Vapor space expansion factor, per day	K_E	0.0794
Average daily vapor temperature range, °R	ΔT_V	36.5488
Average daily vapor pressure range, psi	ΔP_V	0.1600
Breather vent pressure setting range, psig	ΔP_B	0.0600
Atmospheric pressure, psi	P_A	12.0800
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3238
Average daily liquid surface temperature, °R	T_{LA}	515.6940

Vented Vapor Saturation Factor

Vented vapor saturation factor, dimensionless	K_S	0.8139
Vapor pressure at average daily liquid surface temperature, psia	P_{VA}	0.3238
Vapor space outage, ft	H_{VO}	13.3220

Working Losses

Working losses, lb/yr	L_W	115.8551
Net working loss throughput, ft^3/yr	V_Q	256,138.7500
Turnover factor, dimensionless	K_N	0.3389
Working loss product factor for fixed roof tanks, dimensionless	K_P	0.7500
Vapor density, lb/ft^3	W_V	0.0018
Vent setting correction factor, dimensionless	K_B	1.0000

EMISSIONS SUMMARY

Total Losses

Standing losses, lb/yr	L_S	63.2292
Working losses, lb/yr	L_W	115.8551
Total routine losses, lb/yr	L_T	179.0843