MAUL FOSTER ALONGI

MEMORANDUM

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ROUTE TO:
EI #
FILE

To: Max Hueftle

Date: August 5, 2020

From: Brian Snuffer, PE

Project No.: 0461.03.01

RE: Emissions Estimate Approach for Cleaner Air Oregon

J. H. Baxter & Co. (JHB) owns and operates a wood preservation facility located at 3494 Roosevelt Boulevard in Eugene, Oregon 97402 (the facility). The facility currently operates under Standard Air Contaminant Discharge Permit No. 200502 (existing permit) issued by the Lane Regional Air Protection Agency (LRAPA) on June 6, 2018. On December 2, 2019, JHB received written notice from LRAPA that the facility was being called in to the Cleaner Air Oregon (CAO) program.

Per Oregon Administrative Rule (OAR) 340-245-0030(1)(a)(A), the next step of the CAO process is to submit the CAO emissions inventory. JHB retained Maul Foster & Alongi, Inc. (MFA) to assist the facility with each step of the CAO process, including the CAO emissions inventory. The purpose of this technical memorandum (tech memo) is to present the proposed toxic air contaminant (TAC) emissions estimate approach to LRAPA for review and approval, prior to conducting liquid sampling and developing the CAO emissions inventory. Details for the liquid sampling are not presented in this technical memorandum, but are presented in the Liquid Sampling Plan approved by LRAPA on April 10, 2020.

TOXIC EMISSION UNITS AND PROPOSED ESTIMATION APPROACH

The following subsections detail the process equipment and emissions control devices considered to be toxics emissions units (TEUs) as defined in OAR 340-245-0020(60), and the proposed approach for calculating TAC emission estimates for each TEU.

Kewanee Boiler and Stone Johnston Boiler

Two boilers (a Kewanee Boiler and a Stone Johnston Boiler) are used to supply steam for heating during the wood treatment process. The boilers can be fueled by either natural gas during normal operation or by no. 2 distillate fuel oil. The Kewanee and Stone Johnston boilers have maximum heat input capacities of 25.2 million British thermal units per hour (MMBtu/hr) and 16.8 MMBtu/hr, respectively, when fueled by natural gas-fired combustion. The Kewanee and Stone Johnston boilers have maximum hourly no. 2 distillate fuel oil usages of 0.18 thousand gallons per hour (Mgal) and 0.097 Mgal/hr, respectively, as shown in the existing permit.

Emission factors from publicly-available references will be used to estimate TAC emissions during natural gas and no. 2 distillate fuel oil usage periods.

Kiln nos. 1 and 2 and the Pole Kiln

There are three natural gas, direct-fired lumber drying kilns at the facility. The single-track Pole Kiln is located in the southeastern-most corner of the facility property. The double-track kiln, referred to as Kiln nos. 1 and 2 in the existing permit, is located north of retort 85 and south of Roosevelt Boulevard. Another former kiln exists at the facility to the west of Kiln nos. 1 and 2, but it is defunct and non-operational.

Each kiln can be used to dry green wood (douglas fir wood species) to optimum moisture content prior to the treatment process. Kiln drying after treatment (KDAT), for ammoniacal copper zinc arsenate (ACZA) treated wood only (douglas fir and ponderosa pine wood species), is conducted in Kiln nos. 1 and/or 2 depending on customer specifications. KDAT of ponderosa pine occurred during the 2018 calendar year due to the use of alkaline copper quaternary-type B (ACQ) preservative solution, but is not expected to occur in future operating scenarios. The purpose of KDAT is to drive off ammonia in the treated wood, subsequently fixing the metals in place, in order to mitigate the potential for future ammonia leachate.

The maximum heat input capacity for the natural gas burners for the Pole Kiln, Kiln no. 1 and Kiln no. 2 are 16 MMBtu/hr, 4, MMBtu/hr, and 6 MMBtu/hr, respectively. The maximum green wood kiln drying operating temperature is no greater than 200°F. The maximum KDAT operating temperature is no greater than 160°F.

Emission factors from publicly-available references will be used to estimate TAC emissions from natural gas-fired combustion and green wood drying in the kilns. KDAT emissions will be estimated using an ammonia emission factor (in units of pounds of ammonia released per cubic feet of treated wood) representative of waterborne (i.e., ammonia-based preservative) treated wood storage consistent with the Toxic Release Inventory Reporting (TRI) Form R for the facility. The KDAT process is effectively similar to the emissions that occur during storage in that excess ammonia in the treated wood is volatized and released to atmosphere. The difference is that the KDAT releases occur over a shorter time period due to the application of heat in the kilns; however, on a pound per unit of wood dried (or stored) basis, emission factors are expected to be representative.

Retort Door Openings

JHB has retained AquAeTer, Inc. (AquAeTer) to assist the facility with developing TAC emission estimates for the retort door openings. AquAeTer will also estimate TAC emissions for the drip pad and storage yard TEUs (discussed in more detail in the following section). The retort door opening TEU represents the fugitive emissions occurring when the retort doors are open to allow for loading and unloading of charges following completion of the treating cycle and after the vacuum pump is turned off (i.e., after the "crack-and-vac" cycle).

The following approach for determining emissions from retort door openings has been used previously for analysis of the vapor plume at the end of the creosote wood treatment cycle[1]. Using the empirical equation, shown below, daily naphthalene emissions can be estimated:

$$\text{Daily emissions estimate (lb/day)} = \left(53.53 + \frac{0.255}{t} * \frac{V_{void}}{V_{cylinder}} * V_{wood}\right)\left(1 - e^{-0.1307*\left(\frac{t}{3}\right)}\right) * N * \frac{1\ \text{lb}}{453.592\ \text{g}}$$

where t is the retort door opening duration for each charge in minutes, and N is the number of charges per day. The t in the equation above has units of time in minutes, however, in the calculation worksheet, the input t is referred to as minutes of door opening per charge. Volume measurements are in units of cubic feet. Daily emission estimates can be converted to the annual basis, in tons per year, by multiplying the number of operating days in a year. An example retort door opening emission calculation is attached to this tech memo, in spreadsheet-format, for LRAPA review.

This approach will be used to estimate emissions from creosote, 50/50 blends of creosote and bunker C oil (50/50 blend), and pentachlorophenol treatment retort door opening releases. Creosote and 50/50 blends are also referred to as the "heavy oil" preservative solutions in the remainder of this document.

Liquid sampling and safety data sheet composition data, representative of the creosote and pentachlorophenol (PCP) preservative solutions at the facility, will be converted to vapor mass fractions. A ratio of the specific TAC vapor mass fraction to the naphthalene vapor mass fraction can then be multiplied by the daily or annual naphthalene emissions estimate to derive the daily or annual TAC emissions estimate. Naphthalene is the most-studied and one of the most volatile components in heavy oil and PCP preservative solutions. As a result, it is appropriate for trace constituents to be derived based on volatility in relation to naphthalene.

Retort door opening TAC emission estimates for waterborne charges will be estimated using the retort void volume, maximum daily and annual number of charges, concentration of ammonia representative of ACZA and ACQ, and actual emission testing results performed at the facility in 1989.

Drip Pad and Storage Yard

After completion of the crack-and-vac cycle, the cooled tram is rolled onto the drip pad to air dry until the treatment engineer certifies that the charge is no longer dripping. The drip pad is covered from rain and direct sunlight, but is generally exposed to atmosphere (i.e., wind) on three sides. Once the treatment engineer certifies the cooled tram is no longer dripping, treated bundles are loaded onto outbound trucks or trains for customers. However, if no orders are awaiting shipment, treated bundles are moved to the storage yard for future shipment offsite.

[1] AquAeTer, Inc. May 2010. Analysis of the Vapor Plume at the End of the Creosote Wood Treatment Cycle. Brentwood, Tennessee.

As mentioned above, AquAeTer will prepare the TAC emission estimates for the drip pad and storage yard TEUs. AquAeTer will rely on the American Wood Preservers Institute[2] spreadsheet calculation model (AWPI model) to estimate TAC emissions from the drip pad and storage yard for both heavy oil and PCP preservative solutions. The AWPI model incorporates Feather River emission testing data with stacking/bundle geometry to calculate the available emitting surface area, temperature correction based on monthly average storage yard air temperature, and the treated tie age distribution.

The storage yard emission factors are functions of time. Older treated commodities (i.e., ties, poles, etc.) emit less than fresh commodities. The most conservative approach for deriving the "youngest" (i.e., highest emitting configuration), is to divide the storage yard inventory by the maximum production rate at the facility. This yields the shortest possible time the inventory could have been produced, and the maximum possible emissions scenario. As an example, assume 300,000 creosote-treated commodities are present in the storage yard at any given time. If the maximum production rate at the facility is 100,000 creosote-treated commodities per month, then the youngest configuration would be 100,000 commodities that are 3 months old, 100,000 commodities that are 2 months old, and 100,000 commodities that are 1 month old. It is impossible for 300,000 commodities to all exist in the storage yard that are less than one month old in this example.

The average representative commodity and stack geometries, monthly average ambient temperatures, and the age distribution of the commodities in the storage yard are required as inputs to the AWPI model in order to develop site-specific emission estimates. The distribution of storage yard inventory can be done manually or based on the maximum production rate scenario as described above. Monthly emission estimates using the empirically derived methodology of the Feather River Study will be adjusted by applying the appropriate correction factor for the actual creosote blend and PCP preservative solutions in use at the facility. Emission estimates integrated over a month period, using the time based N1, N2, and N3 emission factors, are added for each month to estimate the total annual emissions estimate. An example AWPI model, presenting the storage yard and drip pad emission calculations and N1, N2, and N3 emission factors, is attached to this tech memo for LRAPA review. Note that vapor mass fractions will be used to derive and estimate specific TAC emissions (similar to the retort door opening methodology in the preceding section).

Storage yard TAC emission estimates for waterborne treated wood will be estimated using an ammonia emission factor in units of pounds of ammonia released per cubic feet of treated wood consistent with the TRI Form R for the facility.

Vacuum System and Work Tanks

Multiple steaming and vacuum cycles occur during the wood treating process that vary depending upon the preservative solution in use. These cycles cause a displacement of process vapors inside the

[2] American Wood Preservers Institute. July 1995. Clean Air Act Title V Guidance Manual for Wood Preserving Facilities. Vienna, Virginia.

retort and/or work tank resulting in a working loss TAC emission. Note that steam conditioning and initial vacuum cycles only occur when treating ammonia-based charges, while Boultonizing, compressed air and the expansion bath cycles only occur when treating heavy oil (creosote and/or 50/50 blend) and PCP charges. The steaming and vacuum cycles for ammonia-based charges and heavy oil charges are controlled by the Ammonia Scrubber and the carbon ventilation system, respectively. PCP vacuum cycles exhaust to the PCP liquid/vapor separator without additional control prior to emitting to atmosphere.

TAC emission estimates for the heavy oil and PCP vacuum system and work tanks will be estimated following the calculations and methodology presented in the industry-standard spreadsheets developed the H. M. Rollins Company for TRI Form R reporting. The TAC emission estimates in the TRI Form R spreadsheets utilize the working loss emission estimation methodology detailed in AP-42 Chapter 7 "Liquid Storage Tanks." Vapor mass fractions for applicable TACs will be derived from the liquid sampling and safety data sheet composition data, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Similarly, ammonia emissions for the waterborne vacuum system and associated work tanks will be derived consistent with the calculations and procedures in the ammonia TRI Form R for the facility. These calculations primarily account for the total displaced volume, the total hours the vacuum system was in operation, and the Ammonia Scrubber control efficiency, among other factors.

Storage Tanks

Multiple storage tanks are used at the facility to store preservative solutions and fuel for onsite equipment. Storage tank emissions will follow calculations and procedures as outlined in AP-42 Chapter 7. TAC emissions generated by the heavy oil and ACZA storage and work tanks are controlled by the carbon ventilation system and ammonia scrubber, respectively. Vapor mass fractions for applicable TACs will be derived from the liquid sampling and safety data sheet composition data, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Equipment Leaks

Process piping and associated equipment containing preservative solutions and process vapors may leak causing potential emissions of TACs. TAC emission estimates for equipment leaks will be based on the "Preferred and Alternative Methods for Estimating Fugitive Emissions from Equipment Leaks Final Report" prepared by the Eastern Research Group for the USEPA Emissions Inventory Improvement Program as published in November 1996. Vapor mass fractions for applicable TACs will be derived from the liquid sampling and safety data sheet composition data, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Railcar/Truck Unloading

Railcars of P1 creosote and bunker C oil, and trucks of hydrocarbon solvent type A oil and aqueous ammonia are delivered to the facility and unloaded directly into storage or work tanks. Air agitation is not utilized to unload these solutions. As a result, only working loss emissions associated with the storage or work tanks will occur. Therefore, TAC emission estimates for railcar/truck unloading are not expected to occur and will not be included in the eventual CAO emissions inventory.

Process Water Treatment System

The process water treatment system is used to collect, treat, and recycle preservative solutions and process water. This process is primarily used to recover PCP and heavy oil preservative solutions after use in a treatment cycle. Multiple sumps, hot wells (sealed cylindrical vessels), holding tanks, oil-water separators, and an evaporator (i.e., cooling tower) make-up the process water treatment system.

VOC emission estimates for applicable equipment along the process water treatment system will be derived using TOXCHEM version 4.3 model, the USEPA-approved and DEQ-approved software for water treatment systems. Vapor mass fractions for applicable TACs will be derived from the liquid sampling and safety data sheet composition data, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates. TAC emission estimates specific to the evaporator will be derived using the evaporator flowrate and liquid sampling results collected at the inlet to the evaporator.

Stormwater Treatment System

A stormwater treatment system is used to remove metals (primarily arsenic, copper, and zinc) and VOCs from collected stormwater onsite. The stormwater treatment system is composed of the following: multiple catch basins, two collection sumps, three open, large diameter influent storage/holding tanks, a pretreatment tank, an inclined clarifier, four multi-media filter tanks, a pH adjustment tank, four activated carbon filter tanks, sludge holding tanks, a filter press, and two backwash tanks.

Similar to the process water treatment system, VOC emission estimates for applicable equipment along the stormwater treatment system will be derived using TOXCHEM version 4.3 model. Vapor mass fractions for applicable TACs will be derived from liquid sampling results, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Groundwater Treatment System

A groundwater treatment system is currently in use to remediate and prevent a PCP-contaminated groundwater plume from migrating. The groundwater treatment system is composed of the following: multiple extraction wells, a collection well tank, a sand filter tank, two carbon filter tanks, a backwash tank, and two holding tanks prior to discharge. Each tank within the groundwater treatment system is exposed to atmospheric conditions (i.e., open top tanks).

Similar to the process water treatment system, VOC emission estimates for applicable equipment along the groundwater treatment system will be derived using TOXCHEM version 4.3 model. Vapor mass fractions for applicable TACs will be derived from liquid sampling results, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Mill Pond

A historical mill pond is located in the southwest corner of the facility, adjacent to the stormwater treatment system. Rainwater and stormwater runoff represent the only inputs to the mill pond. No inlet or outlet pipe networks are connected to control the standing water level of the mill pond. Similar to the process water treatment system, VOC emission estimates for the mill pond will be derived using TOXCHEM version 4.3 model. Vapor mass fractions for applicable TACs will be derived from liquid sampling results, and applied to the total VOC emission rate in order to calculate individual TAC emission estimates.

Retort Door Opening Emission Estimates

Toxic Air Contaminant	CAS	Charge Volume (ft^3)	Retort Volume (ft^3)	Retort Void Volume (ft^3)	Emissions Estimate		
					Hourly (lbs/hr)	Daily (lbs/day)	Annual (tons/yr)
Naphthalene	91-20-3	1,750 [a]	11,781 [b]	10,031 [c]	0.21 [d]	1.06 [f]	0.19 [g]

NOTES:

(a) Charge volume (ft^3) = (cross-tie length [ft]) x (cross-tie width [ft]) x (cross-tie height [ft]) x (number of cross-ties per cart) x (number of carts per charge)

Cross-tie length (ft) = 7.00
Cross-tie width (ft) = 0.75
Cross-tie height (ft) = 0.67
Number of cross-ties per cart = 50.0
Number of carts per charge = 10.0

(b) Retort volume (ft^3) = (π) x (retort radius [ft])^2 x (retort height [ft])

Retort radius (ft) = 5.00
Retort height (ft) = 150

(c) Retort void volume (ft^3) = (retort volume [ft^3]) - (charge volume [ft^3])

(d) Hourly emissions estimate (lbs/hr) = (daily emissions estimate [lbs/day]) / (daily hours of operation [hrs/day])

Daily hours of operation (hrs/day) = 5.00 (e)

(e) Daily hours of operation (hrs/day) = (retort door opening duration [min/charge]) x (daily number of charges [charges/day]) x (hr/60 min)

Retort door opening duration (min/charge) = 30.0
Daily number of charges (charges/day) = 10.0

(f) Daily emissions estimate (lbs/day) = (53.53 + 0.255 / [retort door opening time {min}] x [retort void volume {ft^3}] / [retort volume {ft^3}] x [charge volume {ft^3}]) x (1 - $e^{-0.1307 \times \text{[retort door opening duration (min/charge) / 3]}}$) x (daily number of charges [charge/day]) x (lbs/453.592 g) (1)

Retort door opening duration (min/charge) = 30.0
Daily number of charges (charges/day) = 10.0

(g) Annual emissions estimate (tons/yr) = (daily emissions estimate [lbs/day]) x (annual days of operation [days/yr]) x (tons/2,000 lbs)

Annual days of operation (days/yr) = 365

REFERENCES:

(1) Analysis of the Vapor Plume at the End of the Creosote Wood Treatment Cycle prepared by AquAeTer, Inc. dated May 2010. See Equation (1).

ESTIMATED EMISSIONS FROM A BLACK TIE STORAGE YARD

05-Aug-20

1. FACILITY IDENTIFICATION | **REFERENCE**

FACILITY NAME			
FACILITY LOCATION			

Color Code
Input Infrequent
Input Monthly
Calculated

2. SELECT STORAGE GEOMETRY

RECTANGULAR	X	Mark with X if applicable	
TRAM BUNDLE	X	Mark with X if applicable	

3. INDIVIDUAL BLACK TIE GEOMETRY

LENGTH	7	feet	Confirmed w/plant
WIDTH	9	inches	Confirmed w/plant
HEIGHT	8	inches	Confirmed w/plant
VOLUME	3.50000	cubic feet	

4. RECTANGULAR STACKING GEOMETRY

BLACK TIES PER STACK	12356.1	ties per yard stack	Confirmed w/plant
STACK HEIGHT	28	ties tall	Confirmed w/plant
STACK HEIGHT	18.66666667	feet tall	
STACK WIDTH	441.2892857	ties wide	
STACK WIDTH	330.9669643	feet wide	
STACK SURFACE AREA	17250.97083	square feet	

5. TRAM BUNDLE STACKING GEOMETRY

NO. OF TIES IN A TRAM BUNDLE	50	ties per tram bundle	Confirmed w/plant
EQUIVALENT DIAMETER OF BUNDLE	5.64	feet	
SURFACE AREA OF A 6-TIE TRAM BUNDLE	174.07	square feet	

6. WEATHER DATA

MONTH	AVERAGE MONTHLY TEMPERATURE (°F)	AVERAGE ANNUAL TEMPERATURE (°F)	
January	36		
February	39		Monthly Temp Tab of this Workbook
March	46		
April	52		
May	59.5		
June	66.5	53.5	
July	73		
August	73		
September	65		
October	53.5		
November	42.5		
December	35.5		

7. NUMBER OF BLACK TIES ON-SITE

MONTH	NUMBER OF TIES ON-SITE 0-30 days	30-60 days	60-90 days	90-120 days	120-150 days	150-180 days	180-210 days	TOTAL	# Months Inventory	Check Inventory Delta
January	36,693	36,693	36,693	36,693	36,693	36,693	0	220,158	10.0	30,158
February	32,114	32,114	32,114	32,114	32,114	32,114	32,114	224,798	12.6	15,798
March	35,157	35,157	35,157	35,157	35,157	35,157	0	210,942	10.5	11,442
April	32,303	32,303	32,303	32,303	32,303	32,303	32,303	226,121	12.6	17,121
May	35,398	35,398	35,398	35,398	35,398	35,398	0	212,388	12.0	12,888
June	37,041	37,041	37,041	37,041	37,041	0	0	185,205	8.0	14,205
July	42,513	42,513	42,513	42,513	42,513	0	0	212,565	9.3	13,065
August	42,428	42,428	42,428	42,428	42,428	0	0	212,140	9.3	12,640
September	30,318	30,318	30,318	30,318	30,318	0	0	151,590	10.0	9,090
October	51,356	51,356	51,356	0	0	0	0	154,068	6.0	11,568
November	51,851	51,851	51,851	0	0	0	0	155,553	5.0	13,053
December	27,414	27,414	27,414	27,414	27,414	27,414	0	164,484	10.7	12,484
								2,330,012		

Month	Number of Black Ties Treated	Number of Black Ties Shipped 24 hr	Number of Black Ties To Yard	Number of Black Ties Stored	Number of 12356-Tie Stacks	Total Yard Surface Area (square feet)	Total Yard Yard Emissions (pounds)	Tram Emissions Surface Area (square feet per month)	Tram Emissions Tram Total Emissions (pounds)	Average Temperature (°F)	Temperature Correction Factor	Unadjusted Naphthalene Emissions (pounds)	Temp Adj Naphthalene Emissions (pounds)	Creo Fact Naphthalene Emissions (pounds)
January	76,000	57,000	19,000	190,000	15	265,269	355	264,589.1	125.2	36	0.159	480.12	76.57	1.65
February	66,500	49,875	16,625	209,000	17	291,795	352	231,515.5	109.5	39	0.183	461.38	84.25	1.81
March	76,000	57,000	19,000	199,500	16	278,532	373	264,589.1	125.2	46	0.249	497.87	123.93	2.66
April	66,500	49,875	16,625	209,000	17	291,795	352	231,515.5	109.5	52	0.322	461.38	148.78	3.20
May	66,500	49,875	16,625	199,500	16	278,532	373	231,515.5	109.5	59.5	0.442	482.22	213.10	4.58
June	85,500	64,125	21,375	171,000	14	238,742	363	297,662.7	140.8	66.5	0.588	504.26	296.62	6.38
July	85,500	64,125	21,375	199,500	16	278,532	424	297,662.7	140.8	73	0.762	564.83	430.41	9.25
August	85,500	64,125	21,375	199,500	16	278,532	424	297,662.7	140.8	73	0.762	564.83	430.41	9.25
September	57,000	42,750	14,250	142,500	12	198,951	303	198,441.8	93.9	65	0.554	396.74	219.64	4.72
October	95,000	71,250	23,750	142,500	12	198,951	443	330,736.4	156.5	53.5	0.344	599.67	206.11	4.43
November	114,000	85,500	28,500	142,500	12	198,951	443	396,883.6	187.8	42.5	0.213	630.97	134.67	2.90
December	57,000	42,750	14,250	152,000	12	212,215	284	198,441.8	93.9	35.5	0.156	377.84	58.90	1.27
Annual Production				**0.931**	**million ties per year**		**Emissions for maximum on-site storage of 209000-ties is:**			**Total (pounds per year)**		**6,022.11**	**2,423.39**	**52.10**
				3.259	**million cubic feet per year**					**Total (tons per year)**		**3.01**	**1.21**	**0.03**

McClaren Hart (1991) Naphthalene Liquid Mass Fraction 14.0%

Creosote Blend Naphthalene Correction Factor 0.0215

	Storage Yard																Tram Emissions	
	Percent of Ties __ Months Old							N2 Emissions 0.33 - 1 day	Rate N3(t) Emissions (pounds naphthalene per square feet treated surface area)								N1	N2
	0 months	1 month	2 months	3 months	4 months	5 months	6 months										(pounds)	(pounds)
Month	0-30 days	30-60 days	60-90 days	90-120 days	120-150 days	150-180 days	180-210 days		1.0-30 days	30-60 days	60-90 days	90-120 days	120-150 days	150-180 da	180-210 d		0-0.25 days	0.25-0.33 day
January	16.67	16.67	16.67	16.67	16.67	16.67	0.00	109.0	176.523	50.720	13.722	3.712	1.004	0.272			96.1	29.1
February	14.29	14.29	14.29	14.29	14.29	14.29	14.29	119.9	166.436	47.822	12.938	3.500	0.947	0.256	0.069		84.1	25.4
March	16.67	16.67	16.67	16.67	16.67	16.67	0.00	114.4	185.349	53.256	14.408	3.898	1.054	0.285			96.1	29.1
April	14.29	14.29	14.29	14.29	14.29	14.29	14.29	119.9	166.436	47.822	12.938	3.500	0.947	0.256	0.069		84.1	25.4
May	16.67	16.67	16.67	16.67	16.67	16.67	0.00	114.4	185.349	53.256	14.408	3.898	1.054	0.285			84.1	25.4
June	20.00	20.00	20.00	20.00	20.00	0.00	0.00	98.1	190.645	54.778	14.819	4.009	1.085				108.2	32.7
July	20.00	20.00	20.00	20.00	20.00	0.00	0.00	114.4	222.419	63.908	17.289	4.677	1.265				108.2	32.7
August	20.00	20.00	20.00	20.00	20.00	0.00	0.00	114.4	222.419	63.908	17.289	4.677	1.265				108.2	32.7
September	20.00	20.00	20.00	20.00	20.00	0.00	0.00	81.7	158.871	45.648	12.349	3.341	0.904				72.1	21.8
October	33.33	33.33	33.33	0.00	0.00	0.00	0.00	81.7	264.784	76.081	20.582						120.2	36.3
November	33.33	33.33	33.33	0.00	0.00	0.00	0.00	81.7	264.784	76.081	20.582						144.2	43.6
December	16.67	16.67	16.67	16.67	16.67	16.67	0.00	87.2	141.218	40.576	10.977	2.970	0.803	0.217			72.1	21.8

Emissions Equations

Diameter of Test Pole	11	inches				
Length of Test Pole	40	feet				
Number of Test Poles	6	poles				
Surface Area of Test Poles	699	square feet				
Emissions (milligram per hour)	N1(t)=	18104	exp	0.46683 *t)	, t<=0.25 days	
(Based on 6 poles with a	N2(t)=	36697	exp	-2.43497 *t)	, 0.25<t<=1.0 days	
699 square feet surface area)	N3(t)=	3347	exp	-0.04358 *t)	, t>1.0 days	
Emissions (pounds per day per square feet)	N1(t)=	1.370E-03	exp	0.46683 *t)	, t<=0.25 days	
(Based on 6 poles with a	N2(t)=	2.777E-03	exp	-2.43497 *t)	, 0.25<t<=1.0 days	
699 square feet surface area)	N3(t)=	2.533E-04	exp	-0.04358 *t)	, t>1.0 days	
Calculated 24-hour Average California Pole Test Temperature=			80 °F			
Temperature Correction Factor for Other Geographic Locations=			exp[-11,161.25*(1/T,oF+459.67)-1/(80+459.67)]			
Assumes 30 days/month						

Age Distribution

	Percent of Ties __ Months Old				
	0 months	1 month	2 months	3 months	4 months
	0-30 days	30-60 days	60-90 days	90-120 days	120-150 days
1	16.7	16.7	16.7	16.7	16.7
2	14.3	14.3	14.3	14.3	14.3
3	16.7	16.7	16.7	16.7	16.7
4	14.3	14.3	14.3	14.3	14.3
5	16.7	16.7	16.7	16.7	16.7
6	20.0	20.0	20.0	20.0	20.0
7	20.0	20.0	20.0	20.0	20.0
8	20.0	20.0	20.0	20.0	20.0
9	20.0	20.0	20.0	20.0	20.0
10	33.3	33.3	33.3	0.0	0.0
11	33.3	33.3	33.3	0.0	0.0
12	16.7	16.7	16.7	16.7	16.7