



October 23, 2020

Mr. Max Hueftle, PE, BCEE  
Permit Section Manager  
Lane Regional Air Protection Agency  
1010 Main Street  
Springfield, Oregon 97477

Re: Response to LRAPA September 23, 2020 Request for Information

Dear Mr. Hueftle:

J. H. Baxter & Co. (JHB) received your letter dated September 23, 2020 requesting further explanation and reference documents to support the "Emissions Estimate Approach to Cleaner Air Oregon [CAO]" technical memorandum (tech memo) prepared by Maul Foster and Alongi, Inc. (MFA) on August 5, 2020. The original intent of the tech memo was to disclose the proposed toxic air contaminant (TAC) emissions estimate approach to LRAPA for review and approval, prior to conducting liquid sampling at the facility and developing the CAO emissions inventory. The remainder of this letter outlines our responses to each item listed in your September 23 request.

Retort Door Openings:

Responses and reference documents addressing the "Retort Door Opening" section items are listed and summarized in the AquAeTer, Inc. report presented in Attachment A.

Drip Pad and Storage:

Responses and reference documents addressing the "Drip Pad and Storage" section items are listed and summarized in the AquAeTer, Inc. report presented in Attachment A.

Others:

1. *Since the [toxic release inventory] (TRI) spreadsheets will be used for the vacuum system and storage tanks, LRAPA requests versions of those files that include the formulas so that we can review and more easily track the calculations*

TRI example spreadsheets are being provided to LRAPA via email as a part of this letter. In total there are three separate TRI spreadsheets due to the different wood preservative solutions used at the facility. Each TRI spreadsheet is grouped depending on the wood preservative solution as follows: (1) the "heavy oils" TRI spreadsheet accounts for creosote, bunker C oil, and heavy oil blends of creosote and bunker C oil, (2) the pentachlorophenol (PCP) TRI spreadsheet, and (3) the "waterborne" TRI spreadsheet accounts for Ammoniacal Copper Zinc Arsenate and Alkaline Copper Quaternary—



Type B. In the heavy oil and PCP TRI example spreadsheets, please see the "pressure" sheets for relevant calculations to derive the vacuum cycle and work tank emission estimates.

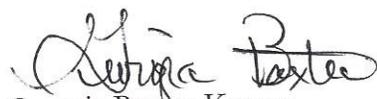
2. LRAPA asked for assurances that there are no emissions from railcar/truck unloading. We understand that the facility no longer conducts air agitation but want to know if the trucks/railcars are heated and if there are any emissions.

Upon further review of the railcar and truck unloading processes at the facility, we determined that TAC emissions may result due to the heating of delivered materials and/or open vents/hatches on the truck tanks. Railcar vessels may be heated up to 180°F prior to pumping delivered materials to a pre-specified storage tank. During this heating period, vapors in the vessel's headspace may be emitted through a small port and/or vent located atop the vessel. Note there is no heating of material for truck unloading. For truck unloading, a vent on top of the truck tank is left open during unloading and may emit directly to atmosphere.

As a result, potential TAC emissions from railcar and truck unloading will be included in the CAO emissions inventory upon submittal. Railcar and truck unloading emissions will follow the calculations and procedures as outlined in AP-42 Chapter 5.2. It is important to note that no noticeable odor has been observed by facility personnel during the unloading processes.

We trust that the above responses satisfy the LRAPA request and are sufficient, following review, for LRAPA to issue approval of the proposed CAO emissions estimate approach. We appreciate the ability to work collaboratively with LRAPA through this process in advance of the CAO emissions inventory submittal. Should LRAPA have any questions or require clarifying information about this letter, please contact me at (650) 349-0201.

Sincerely,  
J.H. Baxter & Co.



Georgia Baxter-Krause  
President, JHB

cc: Jeanne Olson, JHB  
Brian Snuffer, PE, MFA  
John Michael Corn, PE AquAeTer, Inc.

# ATTACHMENT A

AQUAETER, INC. REPORT



October 23, 2020

202603

Ms. Georgia Baxter-Krause, President  
J.H. Baxter & Company  
P.O. Box 5902  
San Mateo, CA 94402

By E-Mail: [gbaxter@jhbaxter.com](mailto:gbaxter@jhbaxter.com)

RE: Responses to LRAPA Document

Dear Ms. Baxter-Krause:

AquAeTer has prepared the following information to address some of the questions sent by LRAPA on September 23, 2020. We will address each point and will provide attachments where necessary to provide the background documentation requested. Each question is italicized to help distinguish the request from our response.

**Retort Door Openings:**

- 1. For the empirical equation, we are requesting background on the 2010 analysis used to develop the equation along with the source test data.*

AquAeTer and Shaw conducted testing on cylinder door openings at the Koppers facility in Guthrie, Kentucky in October 2004. The test results were initially reported in a Vapor Report prepared by AquAeTer for use in legal proceedings. The results and methodology were prepared in a report titled “Field Study of [polycyclic aromatic hydrocarbons] PAH Air Emissions from Creosote Wood-Treating Cylinder Door Openings”. The report is dated May 2010 and was submitted to the Kentucky Department of Environmental Protection in May 2010. The entire report, with appendices, is provided as Attachment 1 to this letter.

- 2. Please explain further how naphthalene would be used as a baseline by which other components would be multiplied using the vapor mass fraction (VMF) ratio to naphthalene.*

Creosote is a complicated mixture of compounds. For creosote and creosote mixtures, naphthalene has historically been the compound of interest, so much of the early focus was on naphthalene. In order to estimate the releases of creosote constituents, a detailed analysis of the creosote mixture was conducted. Research Triangle Institute (RTI) conducted creosote chemical analyses for Koppers in 1999 as part of the recertification of creosote. They tested for 157

compounds of which 48 compounds were at or above the method detection limit of 0.1%. These 48 compounds accounted for more than 80% of the total mass of the creosote mixture. Out of four samples of P2 creosote, the average naphthalene content was 7.43% by weight. Out of five samples of P1/P13 creosote, the average naphthalene content was 6.20% by weight.

Some of the emission studies measured creosote constituent emissions (i.e., the complicated mixture of compounds), some measured surrogates like carbon, while other studies measured specific constituents, such as naphthalene. In order to relate the emissions from creosote constituents to measured values of naphthalene, the VMF of the creosote mixture was determined using Raoult's Law. Raoult's Law is a principle of science that was derived empirically. General chemistry classes teach that Raoult's Law is only applicable for ideal gases. However, research has shown that for mixtures of PAH's, Raoult's Law is applicable when the mixture is made up of many small fractions of constituents. The study also demonstrated that the vapor pressure of mixtures of PAH's does not deviate until temperatures in excess of 3000 Kelvin, much greater than the wood treating operating temperatures<sup>1</sup>. The citation is given so that the paper may be reviewed, but we do not have permission to use the paper.

Another paper describes the effects of relative humidity on the vapor pressure of a solution and determines that Raoult's Law is in line with accurately measured vapor pressures above the solution. That paper is provided in Attachment 2.

By understanding the content of naphthalene present in the emissions plume, the other individual constituents emitted from the creosote mixture can be calculated. Many of the individual constituents are not able to be measured due to their significantly low volatilities. Therefore, the Raoult's Law method provides a conservative approach to estimating the individual Toxic Air Contaminants (TACs) emitted from creosote treating operations. If measurements alone were utilized, many of the compounds on the TAC list would not be reported, since they would not likely be measured.

For creosote, benzene, toluene, ethylbenzene and xylenes (BTEX) are not present. A detailed analysis regarding the absence of benzene in creosote is provided as Attachment 3. Because of its vapor pressure relative to other PAHs in creosote, naphthalene is expected to be 50% or more of the total VMF, making it the appropriate PAH with which to ratio the other PAHs in the emissions. To derive emissions for individual process steps, the naphthalene VMF can be used to speciate the individual TACs.

To use the VMF, the total creosote constituents released are multiplied by the individual VMF of each constituent. For process steps based on naphthalene measurements, the naphthalene VMF is used to determine the total creosote constituents, which can then be speciated for the entire

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<sup>1</sup> Rice, James. W., Fu, Jinxia, Suuberg, Eric M. "Thermodynamics of Multicomponent PAH Mixtures and Development of Tarlike Behavior" *Ind. Eng. Chem. Res.* 2011, 50, 6, 3613–3620

list of TACs. Note naphthalene should not be used as a surrogate for treating solutions that do not contain naphthalene.

The equations are as follows:

$$\text{Emissions of Compound X} = \text{Creosote Constituents} * \text{VMF of X} \quad \mathbf{1}$$

$$\text{Emissions of Creosote Constituents} \quad \mathbf{2}$$

$$= \sum_{i=1}^{i=n} \frac{\text{Naphthalene Emissions}}{\text{VMF of Naphthalene}} * \text{VMF}_{\text{component},i}$$

where: i = individual component of creosote  
 n = total number of identified constituents

3. LRAPA is concerned that the approach may underestimate emissions. 1 lb naphthalene per opening from Guthrie Koppers 2012 data vs. 0.1 lb/opening using the equation.

The difference in the emissions from the testing stems from the purpose of the testing. Both tests, the 2012 study (i.e., 1 lb naphthalene per opening) and the 2004 study (i.e., 0.1 lb naphthalene per opening), were completed at the Koppers facility in Guthrie, Kentucky. The first test was intended to measure the emissions from the process equipment separately from the emissions from the trams. The second test was completed to test the emissions from the process during a treatment cycle that included the full process. The door emissions measured during the 2012 test included emissions from the trams resulting in an overestimation of emissions from the retort door openings emission unit.

To help explain the process, we have provided a brief summary of the process in Table 1.

Table 1. Process Steps (Not All Steps May Be Used for Each Treatment Cycle)

PROCESS STEP	TIME	PURPOSE	EMISSIONS BEFORE CONTROL(S)
Load Cylinders, Close Door	30 Seconds	Seal Cylinder	None – Door Opening Counted at End of Cycle
Steam	8-15 Hours	Remove Water	To Blowdown Tank
Initial Air	10 Minutes	Fills Empty Cells (Dry Wood) with Air	None
Fill	0.25 Hours	Adds Treating Solution to Cylinder	Emissions from Cylinder
Vacuum	6-24 Hours	Removes Water from Wood	Emissions from Cylinder
Pumpback	0.25 to 0.5 Hours	Returns Creosote and Water to Work Tank	Emissions from Work Tank
Fill	0.25 Hours	Adds Treating Solution to Cylinder	Emissions from Cylinder
Pressurize Cylinder	3-6 Hours	Forces Treating Solution into Wood	Fugitive emissions only - ~ None

Table 1. Process Steps (Not All Steps May Be Used for Each Treatment Cycle) (cont.)

Depressurize and Pumpback	0.25 to 0.5 Hours	Returns unused Treating Solution and Water to Work Tank	Emissions from air volume in work tank displaced by returning creosote
Final Vacuum “crac and vac”	0.5 to 2 Hours or More	Reduces Wood Temperature, Reducing Drillage from Wood	Emissions from Cylinder
Pump Drips	0.5 Hours	Recover more Liquid	Emissions at Work Tank
Door Open	15 – 60 Minutes	To Remove Treated Wood	Emissions at Door
Tram Emissions	0-24 Hours	Initial Storage on Drip Pad	Emissions from Tram Bundles begins after initial crac and vac
Yard	>1 Day	Storage Yard Emissions	Emissions from Stacks decrease significantly after the first 24 hours

The original AWPI model developed to estimate emissions relied upon available data from studies conducted on wood treaters and USEPA emissions models. The emissions estimate for the door opening were originally based on an emissions study conducted at Avoca, PA. That study utilized a surrogate to measure total carbon rather than individual constituents and extended the door opening time. The results were used in the original AWPI model and have been kept in the Rollins TRI model. The emissions collected included those from cylinders with wood remaining in the cylinder. In so doing, the tram emissions are actually double counted, since they are accounted for separately in the drip pad and storage yard emissions.

In 2004, a study was conducted at the Koppers, Guthrie facility to test the emissions from the door opening in an effort to improve upon the previous study conducted at the Kerr McGee facility in Avoca, Pennsylvania. The 2004 sampling event is reported in the 2010 report, and is provided as Attachment 1. This study was specifically designed to separate the emissions from the trams and the emissions from the retort cylinder door opening. Three tests were conducted. The first was for the cylinder door following a treating cycle with wood remaining in the cylinder. The second test was conducted on the cylinder door on a cylinder without wood in place. The third test was conducted on the vacuum system at the end of the empty cylinder event. These tests were thus able to accurately determine the emissions related to the process separately from the emissions related to the product. The result of this equation, cited in LRAPA’s question as the 0.1 lb/charge is accurately counting the emissions from the cylinder itself and are therefore not double counting the emissions from the trams.

The testing equipment used in the 2004 previous sampling event did not allow for testing during an actual treatment cycle due to the collection device blocking the cylinder door. The 2012 sampling event was conducted on the actual treating cycle. For the 2012 sampling event, a different collection device was constructed that allowed for the test to be conducted on the full treatment cycle. Thus, the sampling of the cylinder door in 2012 included emissions from the

trams. If we utilized the 2012 Guthrie dataset, we would be double counting the emissions from the trams, similar to what the AWPI model is doing. The 2004 study is representative of the emissions from the cylinder during the door opening.

In summary, using either the TRI calculation or the 2012 dataset includes the emissions from the trams and from the cylinder door. The process emissions from the cylinder door opening are accurately reported based on the 2010 data report's equation. The tram emissions are accounted for in a separate calculation and are no longer double counted.

*4. There are concerns with the study's use of Tedlar bags in lieu of SW-846 Method 0010 modified EPA Method 5 sample train.*

SW-846 Method 0010 Modified Method 5 Sampling Train was not chosen for the 2004 sampling event (2010 Report) known problems with the measurement of naphthalene, which was the primary component of interest. This method specifies the use of XAD-2 or equivalent as the adsorbent resin. This resin is not recommended for the measurement of naphthalene. Naphthalene sublimates and is therefore not guaranteed to be fully captured on the adsorbent media. The recommendation against the use of XAD is stated in the April 15, 1999 Addendum to the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Second Edition, provided in Attachment 4.

Another issue with this method with respect to the capture of creosote constituents is the tendency to plug the condensers and resin traps. The water vapor released from the wood also plugs the line that is intended to capture organic compounds. This makes this method much more difficult to conduct correctly, as the sampling requires constant monitoring and frequent switching of parts of the sampling train.

Tedlar bags were selected for the 2004 study based upon the ability to analyze the data in a mobile laboratory. For quality control, one sample was also collected and submitted to an off-site laboratory. For this reason, we do not believe the sampling was biased or that it resulted in an underreporting of constituents.

*5. LRAPA asked if the the "crac and vac" procedure would be reflected in the "t" part of the equation for time, and provided the caveat that CAO permit compliance monitoring may increase with increasing degrees of complexity in the emission estimation approach.*

The "crack and vac" process step occurs following the pump back and prior to the full door opening. Although the door is "cracked", this step is not part of the retort door opening emissions. Emissions during the "crac and vac" step are directed through the vacuum system. They are therefore accounted for in the final vacuum step and should not be included in the Retort Door Opening emission. The time for the "crac and vac" is an input into the TRI final vacuums step.

**Drip Pad and Storage:**

1. *Since this the approach is heavily dependent on temperature corrections, LRAPA is requesting assurances and considerations to other approaches that do not underestimate emissions; LRAPA is requesting clarification on how the 24-hr California Pole Test Temp was used to calculate temperature corrections.*

The Feather River testing was conducted at ambient temperatures, with lows in the 50's and highs up to 90°F. The daily average temperature during the test was 80°F. The weather was sunny and dry. Additional temperature data for treated ties were collected at the Kerr McGee Avoca and Indianapolis sites and the Koppers Grenada facility. These data were presented to the USEPA in October 1994. The presentation given at that time, which includes the temperature measurements, is provided in Attachment 5. This presentation was given to ODEQ in July 1998 during a previous permit discussion concerning The Dalles facility, which was operated by Kerr McGee at the time.

The temperature correction factor was based on the exponential increase in naphthalene's vapor pressure as temperature increases. The equation is given in Equation 3. The derivation of the temperature correction factor begins on Page 5 of Attachment 5. If the daily average temperature is less than 80°F, the temperature correction factor is less than 1. If the daily average temperature is greater than 80°F, the temperature correction factor is greater than 1.

$$\text{Temperature Correction Factor} = e^{-11,161.25\left(\frac{1}{T_{\text{avg}}^{\circ}\text{F}+460} - \frac{1}{80^{\circ}\text{F}+460}\right)} \quad 3$$

where:  $T_{\text{avg}}$  = daily average temperature, in degrees Fahrenheit.

The temperature correction factor was accepted as valid by the USEPA in a letter dated November 4, 1994. This letter is provided in Attachment 5.

2. *LRAPA believes the Feather River study is generally good but are concerned that it may not be representative of other facilities and other treatment solutions at other facilities (e.g., 50/50 and ammonia-based).*

The Feather River study can be related to other treatment facilities through the use of known, accepted methods. For plants using creosote only, the relationship is direct, with adjustments made based on known constituent analyses.

The use of blends for the wood treatment can also be related. For heavy oils like Number 6 oil, the emissions tended to be less than those from 100% creosote due to the lower vapor pressure of the heavy oil.

If a lighter oil was used as the blend with creosote, then a VMF analysis should be done for the components used.

This methodology has been used for more than 20 years and has been reviewed and accepted by the United States Environmental Protection Agency and multiple State agencies during the course of emissions reporting prepared by AquAeTer or Stephen Smith (California). A list of States and Commonwealths that have accepted this analysis for creosote wood treating facilities is given as follows.

- Oregon
- Alabama
- Arkansas
- California
- Colorado
- Florida
- Georgia
- Illinois, Indiana
- Kentucky
- Louisiana
- Maryland
- New Jersey
- Ohio
- Pennsylvania
- Tennessee, Texas
- Virginia
- Washington
- West Virginia
- Wisconsin

The VMF analysis for creosote has also been presented in both state and Federal courts by AquAeTer.

The VMF analysis of various additional petroleum products was prepared by AquAeTer and has been submitted for air emissions estimates and has been accepted in the following states.

- Arkansas
- Colorado
- Utah
- Wyoming

As stated previously, the use of the VMF allows the calculation of emissions of all known TACs that are present in the creosote treating solution. If a sample was collected, some of these TACs would likely be reported as non-detect, making the calculation of the risk less precise.

3. *Representative stacking geometries is also a concern LRAPA has and is requesting assurances that the test results are representative of the stacking geometries at the facility (including gaps in treated product, etc.). There are acute concerns with the use of “average” stacking geometries.*

A detailed history of the treated tie storage calculations is included in Attachment 5. A short summary of the highlights of that analysis are as follows.

The USEPA initially included creosote wood treating as an industry requiring Maximum Achievable Control Technology, based on the calculations made by the USEPA on the emissions from the storage yard. Stacking geometry was not considered in the USEPA calculation. In other words, the USEPA assumed that the entire surface area of a tie was emitting. The initial listing is included in Attachment 5.

The AWPI hired AquAeTer to assess the emissions from creosote treated wood from the time the cylinder door was opened until the wood left the site. An emissions calculation method that represented the storage of the wood was developed. The emissions were calculated based on the exposed surface area. Wood surfaces that were in close contact with each other are restricted from emissions. This method was presented to Mr. Eugene P. Crumpler, Jr. with the Minerals and Inorganic Chemicals Group, Emissions Standards Division of the USEPA (Attachment 5). Mr. Crumpler provided comments on the method, including questions about the geometry calculation utilized (Attachment 5).

Modifications to the original stacking geometries were made to more accurately account for the stacking geometries utilized. AquAeTer worked with Mr. Crumpler in determining the modifications, resulting in the current form of the calculation, which was accepted by the USEPA and has been accepted by multiple agencies, previously listed, for permitting purposes.

Following this work, the USEPA removed the creosote wood treating industry from the industries that were required to meet MACT, published in the Federal Register on June 4, 1996, provided in Attachment 5.

The stacking geometry is an input into the model and is based on each individual plant's method of stacking and counting total ties and total stacks. The age of the stacks is also input since older treated ties produce lower emissions. It was agreed in the meeting with Mr. Crumpler that the stacks were counted as continuous if they were stacked within 1 to 2 ft of each other. This stacking arrangement has been adopted by most creosote treating facilities. The use of an average stacking geometry accounts for the stacks being in close proximity to each other.

The exposed surface area calculated for a rectangular stack of ties is greater than the exposed surface area of a group of poles with nearly equivalent volume stacked in a triangular arrangement. This calculation is therefore conservative for the same volume of treated wood. In other words, the triangular stacking geometry has one plane facing the ground, two planes that are

exposed to the atmosphere, and one plane on each end. A rectangular stack has one plane facing the ground, two planes facing out, one plane on each end of the stack, and one plane at the top.

4. *Biggest concern and uncertainty are the water corrections. LRAPA understands that there is essentially a water correction in working solution and a water correction again to the VMF which may result in sort of double counting of water.*

The VMF analysis that includes water will only affect those calculations that utilize the VMF to calculate individual (or a group of) constituents from the predicted total creosote constituents. In theory, the vapor pressure used in the TRI calculation should be adjusted based on the reduced vapor pressure of the creosote constituents within the working process. However, the default vapor pressure for creosote used is based on the creosote vapor pressure without water. The TRI emissions are therefore overpredicting the emissions from sources in which the creosote or blended creosote treating solution contains water.

The door opening calculation from the 2010 report calculates the naphthalene emissions. This is based on empirically derived naphthalene emissions. To calculate the other creosote constituents, the naphthalene VMF is used. Regardless of the presence of water, the ratio of the VMF for naphthalene at a given temperature to the other creosote constituents is the same. The effects of water on the VMF do not affect the constituents calculated from the door openings.

As an example of this calculation, the following table gives the VMF for naphthalene and for two other compounds at 157°F. One VMF is calculated using 1.5% water. The other VMF assumes no water present.

Table 2. Calculation of Other Constituents from Door Opening based on 2010 Report

Constituent	VMF at 157°F, 1.5% Water	VMF at 157°F, 0% Water	Calculated Emissions with water (lb/hr)	Calculated Emissions without water (lb/hr)
Naphthalene*	0.040635	0.322751	0.21	
Acenaphthene	0.006649	0.05281	0.020	0.020
Dibenzofuran	0.008504	0.067546	0.0041	0.0041
Total TAC	0.092085	0.731393	0.35	0.35

Note: \*: Naphthalene emissions are calculated based on 2010 Equation

For creosote solutions, the water is not part of the product, but is a residual from the wood itself. Due to the recycling of treating solution, water can remain in the treating solution, gradually increasing in content which is why water vapor becomes the dominant emission measured. With

regards to water, the specification for treatment is that water makes up no more than 3% of the solution.

The working solution contains water because it is removed from the wood during the treatment cycle. With respect to emissions based on the volume of creosote/treating solution, the volume of water does not come into the calculation. The TRI calculation completed to estimate emissions for the process does not take into account any water. It is therefore overestimating the emissions from process devices where water has entered the solution.

The main effect of water is on the vapor pressure of the treating solution. The presence of water is significant in the solution, since its vapor pressure at ambient and at operating temperatures is many times greater than the semi-volatile compounds that make up creosote.

Water is inherently part of the process following any treatment of the wood. Multiple tests have indicated that the water vapor becomes the dominant emission from the cylinder door. AquaAeTer prepared an analysis of this phenomenon from test data and submitted this report to Kentucky DEP on May 10, 2010. The report is included as Attachment 6.

If you have questions or comments pertaining to this proposal, please contact us by telephone at (615) 373-8532 or by e-mail at [jmcom@aquaeter.com](mailto:jmcom@aquaeter.com). We appreciate the opportunity to assist you on this project.

Sincerely,

**AquaAeTer, Inc.**



John Michael Corn, P.E.  
President



Michael R. Corn, P.E. (OR), BCEE  
Senior Technical Advisor

ATTACHMENTS

Attachment 1. “Field Study of PAH Air Emissions from Creosote Wood-Treating Cylinder Door Openings” May 2010.

Attachment 2. Raoult’s Law Papers

Attachment 3. “Analysis of the Benzene Content in Creosote” November 2008

Attachment 4. Addendum to the Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air – Second Edition

Attachment 5. History of Black Tie Storage Calculations

Attachment 6. Water Vapor Report, 2010.