

Engineering Evaluation: Portable Soil Vapor Extraction
EBA Engineering
320 Tesconi Circle, Santa Rosa, CA
Application No. 30279; Plant No. 24606

Background

EBA Engineering has applied for an Authority to Construct for a portable soil vapor extraction (SVE) system. The first proposed site for the system is to be located at 627 East Washington Street, Petaluma, CA.

S-1 Portable Soil Vapor Extraction System consisting of a 300 max scfm 20 hp RF2 300TCMLRT Vacuum Blower abated by;

A-1 0.4 MMBtu/hr Thermal Oxidizer or Three (3) 2,000 lb max capacity Granulated Activated Carbon Adsorption (GAC) Vessels arranged in series.

EBA engineering has proposed to use the Portable SVE system to extract petroleum hydrocarbons and chlorinated hydrocarbons at leaking gasoline underground storage tank sites and dry-cleaning facilities. The system consists of max 300 cfm vacuum blower with either three 500 to 2,000 lb carbon vessel in series or a 0.4 MMBtu/hr thermal oxidizer. The applicant will not be using the oxidizer in catalytic mode. Table 2.5.1 Toxic trigger levels in Regulation 2 Rule 5 will be used to estimate emissions.

The applicant will be conditioned to provide written notification at the start of the operation. Procedures are outlined in the conditions found below. Effluent VOC concentrations will be monitored with a on a schedule reflecting current loading rates and predicted Carbon capacity. Monitoring schedule changes will be allowed only after District review of concentration measurements and subsequent receipt of District approval.

The proposed initial site for this system is located within 1,000 feet of the outer boundary of McKinley Elementary School, and as such this application requires Public Notification per Reg. 2-1-412.

Emission Calculations

For a conservative estimate of yearly emissions, we shall assume that the system is operated for an entire year within an inlet concentration corresponding to the initial soil concentration level. Generalized assumptions follow:

- Operating conditions: Pressure = 1 Atm; Inlet Temperature = 21°C; 1 mole occupies 24.15L
- Total Petroleum Hydrocarbons (TPH) will be considered as non-toxic POCs.
- S-1 petroleum hydrocarbons emissions will be calculated with the thermal oxidizer as the abatement device.
- Influent parameters are based off maximum blower capacity of 300 scfm and maximum TPH operating concentration of 10,000 ppmv for the thermal oxidizer. Table 2.5.1 Toxic trigger levels will be used to estimate Benzene and Ethyl Benzene emissions. Toluene and Xylene are assumed 35% of TPH each as the worst-case scenario.
- S-1 Chlorinated hydrocarbons will be abated by three 12, 000 lb GAC Adsorbers in series. Table 2.5.1 Toxic trigger levels will be used to estimate Tetrachloroethylene (PCE) and Trichloroethylene (TCE) emissions.
- Overall Abatement efficiency of 98.5% was used in the calculations.
- Molecular weight of 88.5 g/mol was used to calculate influent concentration (ug/m³) for TPH. This was derived from literature: "Hydrocarbon compositions and physicochemical characteristics for the determination of gasoline quality: An implication from gas chromatographic fingerprints" by Elkhateeb et. al. 2017.

Table 1 – Emissions from S-1 SVE System

| Pollutant | Max Influent vapor concentration [µg/m ³] | Max Influent vapor concentration [ppmv] | Effluent vapor concentration [ppmv] | Unabated Emission [lb/day] | Abated Emission [lb/day] | Abated Emission [lb/yr] |
|---------------------|---|---|-------------------------------------|----------------------------|--------------------------|-------------------------|
| TPH | 36,813,644 | 10,000 | 150 | 874 | 13.1 | 4,786 |
| Benzene | 14,296 | 4.4 | 0.066 | 0.52 | 0.008 | 2.86 |
| Ethylbenzene | 220,819 | 50.0 | 0.750 | 5.94 | 0.089 | 32.5 |
| Xylene | 15,455,907 | 3,500 | 53 | 361 | 5.4 | 1,975 |
| Toluene | 13,408,902 | 3,500 | 53 | 347 | 5.2 | 1,898 |
| Tetrachloroethylene | 49,698 | 13.50 | 0.203 | 2.5 | 0.04 | 13.7 |
| Trichloroethylene | 344,904 | 50.00 | 0.750 | 7.4 | 0.11 | 40.3 |

Table 2 – A-1 Thermal Oxidizer Emissions

| Pollutant | Emission Factor lb/10 ³ gallon | Emission Factor lb/MMBtu | Hourly Emissions lb/hr | Daily Emissions lb/day | Annual Emissions lb/yr | TPY |
|------------------|---|--------------------------|------------------------|------------------------|------------------------|-------|
| NO _x | 13 | 0.142 | 0.057 | 1.364 | 497.8 | 0.249 |
| CO | 7.5 | 0.082 | 0.033 | 0.787 | 287.2 | 0.144 |
| PM ₁₀ | 0.7 | 0.008 | 0.003 | 0.073 | 26.8 | 0.013 |
| *SO ₂ | 0.15 | 0.001 | 0.000 | 0.010 | 3.8 | 0.002 |
| POC | 1 | 0.011 | 0.004 | 0.105 | 38.3 | 0.019 |

*As a worst-case scenario, the Sulfur content in the fuel for the oxidizer is assumed to be 1 grain/100 ft³ (S=1)

AP-42 Table 1.5-1 emission factors for propane combustion were used to calculate A-1 emissions in Table 2.

Table 3 – S-1 Criteria Organic Emissions (TPY)

| Compound | lb/day | lb/yr | TPY |
|----------|--------|-------|-------|
| POCs | 23.9 | 8735 | 4.4 |
| NPOCs | 0.04 | 13.7 | 0.007 |

All compounds in Table 1 are considered to be pre-cursor organic compounds (POC).

Cumulative Increase

Table 4- Plant Cumulative Emissions

| Compound | Current Permitted Emissions, Post 4/5/91 (TPY) | New Emission Increase with A/N 30171 (TPY) | Cumulative Emissions (TPY) |
|----------|--|--|----------------------------|
| POCs | 0 | 4.4 | 4.4 |
| NPOCs | 0 | .007 | .007 |

PCE is considered to be non-precursor organic compound (NPOCs) per Regulation 1-234 and 40 CFR 51.100(s)(1).

Toxic Risk Screening

Table 5 – S-1 Regulation 2 Rule 5 Toxic Review

| Toxic Pollutant | Abated Emission (lb/hr) | Abated Emission (lb/yr) | Acute Trigger lb/hr | Chronic Trigger lb/yr | HRA required |
|------------------------|--------------------------------|--------------------------------|----------------------------|------------------------------|---------------------|
| Benzene | 3.27E-04 | 2.86E+00 | 6.00E-02 | 2.90E+00 | N |
| Ethylbenzene | 3.71E-03 | 3.25E+01 | - | 3.30E+01 | N |
| Xylene | 2.25E-01 | 1.98E+03 | 4.90E+01 | 2.70E+04 | N |
| Toluene | 2.17E-01 | 1.90E+03 | 8.20E+01 | 1.20E+04 | N |
| Tetrachloroethylene | 1.57E-03 | 1.37E+01 | 4.40E+01 | 1.40E+01 | N |
| Trichloroethylene | 4.60E-03 | 4.03E+01 | - | 4.10E+01 | N |

Estimates in Table 5 are considered the worst-case scenario for this project. This source is not expected to exceed applicable toxic trigger levels per Table 2-5-1. This will be enforced by the permit conditions below.

New Source Review

In accordance with Regulation 2-2-301, BACT is triggered for any new or modified source with the potential to emit 10 pounds or more per highest day of POC, NPOC, nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxides (SO₂), particulate matter less than 10 micrometer (PM₁₀) and particulate matter less than 2.5 micrometer (PM_{2.5}).

The proposed project has potential to emit more than 10 lb/day of POC. The equipment proposed does meet BACT requirements per Reg 2-2-301. Offsets are not applicable for this application, as emissions do not exceed 10 tons/yr. Facility is not subject to Reg 2-2-302.

CEQA

The project is considered to be ministerial under the Districts proposed CEQA Regulation 2-1-311 and therefore is not subject to CEQA review. The engineering review for this project requires only the application of standard permit conditions and standard emission factors and therefore is not discretionary as defined by CEQA. This project is in compliance with Chapter 9.2 of the permit handbook.

Compliance

Based on the information submitted, this operation is expected to be in compliance with Regulation 8-47-301, Emission Control Requirements, Specific compounds, and 8-47-302, Organic compounds. The POC emissions will be vented through a Carbon adsorption system at all times of operation.

This project is within 1,000 ft from the nearest public school and is subject to the public notification requirements of Regulation 2-1-412. PSD, NSPS, and NESHAPS are not triggered.

Permit Conditions

Permit Condition # 27182

1. The operator of this source shall notify the District at least 3 days prior to start-up of operation at any new location. The notification shall include:
 - a. Application Number 30279 and Plant Number 24606
 - b. Street address, including zip code, for the location where the equipment will be operated.
 - c. The name and telephone number of a contact person where the equipment will be operated.
 - d. The date of initial start-up and estimated duration of operations at that location.
 - e. The distance from the source to the outer boundary of the nearest K-12 school, or indication that the distance is greater than 1000 feet.
 - f. If only one of the two abatement equipment mentioned in A-1 is utilized in the system, only the parts of condition applicable to the particular abatement equipment shall apply.

In the event that the start-up is delayed less than 5 days, the operator may provide telephone notice of said change to the assigned Plant Engineer in the Permit Services Division. If the start-up is delayed more than 5 days, written notification must be resubmitted.

2. The owner/operator of this source shall not operate or retain it at any single location for a period in excess of 12 consecutive months, following the date of initial operation. If this portable source remains at any fixed location for more than 12 months, the multi-location permit will automatically revert to a conventional permanent location permit and will lose its portability. [Basis: Regulation 2-1-403]
3. The owner/operator shall operate this portable equipment, S-1, at all times in conformance with the eligibility requirements set forth in Regulation 2-1-413 for portable equipment. [Basis: Regulation 2-1-413]
4. The owner/operator shall not operate this equipment within 1000 feet of the outer boundary of any K-12 school, unless the applicable requirements of the California Health and Safety Code Section 42301.6 have been met. This will require a submittal of an application for a revised permit to operate. [Basis: Regulation 2-1-413.3]
5. The owner/operator shall use the thermal oxidizer abatement exclusively for the removal of non-chlorinated volatile organic compounds associated with petroleum products from extracted soil vapor. This shall be demonstrated by onsite sampling required in condition 10 below. [Basis: Regulation 2-5]
6. The owner/operator shall abate the Non-Precursor Organic Compound (NPOC) and Precursor Organic Compound (POC) emissions from Source S-1 with A-1, SVE abatement system, consisting of either a Thermal Oxidizer or at least three (500 lbs minimum capacity) Activated Carbon Vessels during all periods of operations. Startup and subsequent operation of each abatement device shall take only after written notification of same has been received by the District's Engineering Division. Influent vapor flow rate shall not exceed 300 scfm. [Basis: Regulation 8-47-301.1,2]

7. The owner/operator shall operate A-1 Thermal Oxidizer abatement efficiency of abatement device A-1 shall be maintained at a minimum of 98.5% by weight for inlet NPOC/POC concentrations greater than or equal to 2000 ppmv (measured as hexane). For inlet concentrations below 2000 ppmv and greater than or equal to 200 ppmv, a minimum abatement efficiency of 97% shall be maintained by the owner/operator. For inlet concentrations below 200 ppmv, a minimum abatement efficiency of 90% shall be maintained by owner/operator. The minimum abatement efficiency shall be waived if outlet NPOC/POC concentrations are shown to be less than 10 ppmv (measured as hexane). In no event shall the Toxic Air Contaminants (TACs) emissions to the atmosphere from S-1 exceed the respective chronic trigger levels in District's Regulation 2-5, Table 2-5-1. [Basis: Cumulative Increase, Regulation 2-5].
8. The owner/operator shall not operate A-1 oxidizer below the minimum operating temperature of 1,400 degrees Fahrenheit.
9. To determine compliance with Condition Number 8, the owner/operator shall equip the A-1 thermal oxidizer with continuous measuring and temperature recording instrumentation. The owner/operator shall collect and maintain the temperature data collected from the temperature recorder in a file which shall be available for District inspection for a period of at least 2 years following the date on which such data are recorded.
10. To determine compliance with Condition 7, within 24 hours after start-up of the thermal oxidizer at any new location, the operator of this source shall:
 - a. Analyze the inlet gas to determine the vapor flow rate and concentration of NPOC/POC present.
 - b. Analyze exhaust gas to determine the flow rate, and the concentration of Benzene and NPOC/POC present.
 - c. Calculate the benzene emission rates in pounds per day based on the exhaust gas analysis and the operating exhaust flow rate. The soil vapor flow rate shall be decreased, if necessary, to demonstrate compliance with Condition 7.
 - d. Calculate the NPOC/POC abatement efficiency based on the inlet and outlet gas sampling analysis. For the purpose of determining compliance with condition 7, the NPOC/POC concentration shall be reported as hexane.
 - e. Submit to the District's Permit Services Division the test results and emission calculations within one month from the testing date. Samples shall be analyzed according to modified EPA test methods 8015 and 8020 or their equivalent to determine the concentrations of Benzene and NPOC/POC concentrations.
11. The owner/operator of this source shall maintain the following records for each month of operation of the thermal oxidizer:
 - a. Days and hours of operation.
 - b. Each emission test, analysis or monitoring results logged-in for the day of operation they were taken.Such records shall be retained for two years and made available for inspection by the District following the date the data is recorded. [Basis: Reg. 1-523]
12. Within 30 days of the completion of each treatment operation at a given location, the owner/operator of this source shall provide the assigned Permit Engineer in the Engineering Division with a summary showing the following information:
 - a. The dates and total number of days that the equipment was at that location and the dates, and total number of days that the equipment was operated at that location.

- b. A summary of the abatement efficiency and benzene emission rate as determined and reported in the start-up sampling report required by condition 10e above.
 - c. The results of any additionally performed emission test, analysis, or monitoring result logged in for the day of operation they were taken.
 - d. The total throughput of contaminated soil vapor processed by S-1 at that location (indicated in cubic feet).
 - e. The total emissions of benzene at that location based on the sampling results required by conditions 10 above (indicated in pounds).
13. During operation of A-1 Activated Carbon Vessels, the owner/operator of this source shall monitor with a photo-ionization detector (PID), flame-ionization detector (FID), or other method approved in writing by the District's Source Test Manager at the following locations:
- a. At the inlet to the second to last Carbon vessel in series.
 - b. At the inlet to the last Carbon vessel in series.
 - c. At the outlet of the Carbon vessel that is last in series prior to venting to the atmosphere.
- When using an FID to monitor breakthrough, readings may be taken with and without a Carbon filter tip fitted on the FID probe. Concentrations measured with the Carbon filter tip in place shall be considered methane for the purposes of these permit conditions.
14. The owner/operator shall record these monitor readings in a monitoring log at the time they are taken. The owner/operator shall use the monitoring results to estimate the frequency of carbon change-out necessary to maintain compliance with conditions number 4 and 5, and shall be conducted on a daily basis for the first week of operation. After demonstrating continuous compliance for the first week, the owner/operator may switch to monitoring to a weekly schedule. The owner/operator of this source may propose for District review, based on actual measurements taken at the site during operation of the source, that the monitoring schedule be changed based on the decline in organic emissions and/or the demonstrated breakthrough rates of the carbon vessels. Written approval by the District's Engineering Division must be received by the owner/operator prior to a change to the monitoring schedule. [Basis: Cumulative Increase, Regulation 2-5, TBACT]
15. The second to last Carbon vessel shall be immediately changed out with unspent carbon upon breakthrough, defined as the detection at its outlet in excess of the higher of the following limits:
- a. 10 % of the inlet stream concentration to the carbon bed.
 - b. 10 ppmv (measured as hexane).
 - c. 10 ppmv (measured as isobutylene)
16. The last Carbon vessel shall be immediately changed out with unspent Carbon upon detection at its outlet of 10 ppmv or greater (measured as hexane) and/or 3.5 ppmv or greater (measured as isobutylene).
17. The owner/operator shall take air samples of effluent at the outlet of the last Carbon vessel in series for laboratory analysis upon start-up. Effluent tetrachloroethylene concentration shall not exceed 2.0 ppmv at the outlet of the last carbon vessel. In the event of an exceedance, the owner/operator shall shutdown all operations and notify the District's Engineering Division. [Basis: Cumulative Increase, Regulation 2-5].
18. The operator of this source shall maintain the following information for each month of operation of the Activated Carbon Vessels:
- a. Hours and time of operation.
 - b. Each emission test, analysis or monitoring results logged in for the day of operation they were taken.

- c. Tetrachloroethylene and Trichloroethylene emissions in pounds.
- d. The number of Carbon vessels removed from service.

Such records shall be retained and made available for inspection by the District for two years following the date the data is recorded. [Basis: Regulation 1-523]

19. Within 30 days after the end of every calendar year, the operator of this source shall provide the assigned Plant Engineer in the Permit Services Division a year end summary showing the following information:
 - a. The location(s) at which the equipment was operated including the dates operated at each location.
 - b. The total throughput of contaminated soil vapor for the previous four quarters (indicated in cubic feet).
 - c. The total benzene emissions for the previous four quarters (indicated in pounds).
[Basis: Regulation 1-523]
20. The owner/operator shall maintain a file containing all measurements, records and other data that are required to be collected pursuant to the various provisions of this conditional Permit to Operate. All measurements, records and data required to be maintained by the operator shall be retained for at least two years following the date the data is recorded. [Basis: Regulation 1-523]
21. Any non-compliance with these conditions shall be reported to the Compliance and Enforcement Division at the time that it is first discovered. The submittal shall detail the corrective action taken and shall include the data showing the exceedance as well as the time of occurrence.
22. Upon final completion of the remediation project, the operator of Source S-1 shall notify the Engineering Division within two weeks of decommissioning the operation. [Basis: Cumulative Increase, Regulation 2-5, TBACT]

Recommendation

The District has reviewed the material contained in the permit application for the proposed project and has made a preliminary determination that the project is expected to comply with all applicable requirements of District, state, and federal air quality-related regulations. The preliminary recommendation is to issue an Authority to Construct for the equipment listed below. However, the proposed source is located within 1000 feet of a school, which triggers the public notification requirements of District Regulation 2-1-412.6. After the comments are received from the public and reviewed, the District will make a final determination on the permit.

I recommend that the District initiate a public notice and consider any comments received prior to taking any final action on issuance an Authority to Construct for the following source:

S-1 Portable Soil Vapor Extraction System consisting of a 300 max scfm 20 hp RF2 300TCMLRT Vacuum Blower abated by;

A-1 0.4 MMBtu/hr Thermal Oxidizer or Three (3) 2,000 lb max capacity Granulated Activated Carbon Adsorption (GAC) Vessels arranged in series.

by _____

Ali Roohani

March 6, 2020