

11.3 COFFEE ROASTING OPERATIONS

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Process Description

The roasting of coffee beans is a common activity that occurs throughout the Bay Area at a wide variety of facilities ranging from small gourmet coffee shops to medium-sized commercial operations with locally distributed products to large facilities with national product distribution that operate 24 hours per day. The associated coffee roasting equipment ranges from small 25 pound per hour batch roasters located at gourmet coffee shops to industrial, 4 ton per hour, recirculating, continuous roasters located at large facilities.

The coffee roasting process consists essentially of cleaning, roasting, cooling, grinding, and packaging operations. Bags of green coffee beans are hand- or machine-opened, dumped into a hopper, and screened to remove debris. The green beans are then weighed and transferred by belt or pneumatic conveyor to storage hoppers. From the storage hoppers, the green beans are conveyed to the roaster. At the end of the roasting cycle, water sprays are used to “quench” the beans. Following the roasting, the beans are cooled and run through a “destoner”. Destoners remove stones, metal fragments, and other waste not removed during initial screening from the beans.

The air pollutant emissions resulting from coffee roasting operations include particulate matter, volatile organic compounds, organic acids, and natural gas combustion products. The odorous and visible emissions (smoke) resulting from the roasting process have the most obvious and direct impact on the public. A thorough explanation of coffee roasting is available from [Chapter 9.13.2, Coffee Roasting](#), of [AP-42 \(Fifth Edition, Volume I\)](#). Generally, a District permit is required for any coffee roaster, which processes 15 or more pounds of coffee per hour, per [Regulation 2-1-117.8](#). In addition, separate coolers/destoners, if used, should be permitted as sources of particulate.

Completeness Determination

The following District forms should be completed and fees provided for coffee roasting operations. Use the [Completeness Determination Checklist](#) to verify completeness. Use the [Data Form Guidance](#) to ensure that the forms are completed correctly. Use the [Fee Calculation Guidance](#) to ensure that the fees are calculated accurately.

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| <ol style="list-style-type: none"> 1. Form 101-B (one for facility). 2. Form G (one per source). 3. Form C (one per coffee roaster and afterburner) for the combustion of fuel. 4. If Health Risk Screening is triggered, Form HRSA (one per source). 5. The higher of the following: fees, calculated per Regulation 3 (Schedule F) and fees, calculated for combustion of fuel per Regulation 3 (Schedule B). All sources at | <p>coffee roasting facilities will be subject to Fee Schedules F, "Miscellaneous Sources." Combustion equipment may also be subject to Fee Schedule B, "Combustion of Fuel." When sources are subject to two Fee Schedules, the schedule resulting in the highest fee is used. Abatement equipment is not subject to fee requirements, if they are permitted at the same time as the source that it will be abating.</p> |
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Emission Calculations

The coffee roaster is the main source of gaseous pollutants, including alcohols, aldehydes, organic acids, and nitrogen and sulfur compounds. Because roasters are typically natural gas fired, carbon monoxide (CO) and carbon dioxide (CO₂) emissions are expected as a result of fuel combustion. Particulate emission factors for coffee roasting are given in Tables 9.13.2-1 and 9.13.2-2 in [Chapter 9.13.2, Coffee Roasting](#), of [AP-42 \(Fifth Edition, Volume I\)](#).

Table 9.13.2-1 and 9.13.2-2 from AP-42 Chapter 9.13.2 (Coffee Roasting) provides the following emission factors for particulate (as PM10), volatile organics (VOC), and carbon monoxide from the coffee roasting process.

Emission Factors for Coffee Roasting Operations

Green coffee bean screening, handling, and storage System with fabric filter	PM10 = 0.059 lb/ton
Batch roaster	VOC = 0.86 lb/ton
Batch roaster with thermal oxidizer	VOC = 0.047 lb/ton
	PM10 = 0.12 lb/ton
Continuous roaster	VOC = 1.4 lb/ton
	PM10 = 0.66 lb/ton
Continuous roaster with thermal oxidizer	VOC = 0.16 lb/ton
	PM10 = 0.19 lb/ton

However, an alternative method is to use the grain loading rates and exhaust rates from the particulate abatement devices to calculate particulate emissions.

$$E_{PM10} = Q_{dry}(gr)(60 \text{ min/hr})/7000 \text{ gr/lb}$$

where,

- E = emissions of PM10 (lb/hr)
- Q_{dry} = dry volumetric flow rate (cfm)
- gr = grain loading rate (gr/dscf)

The standard cubic feet of dry air exhaust can be calculated from actual exhaust rates using the following equation:

$$Q_{dry} = Q_{act}[(68 + 460)/(T_{act} + 460)](1 - \%H_2O)$$

where,

- Q_{dry} = dry volumetric flow rate (cfm)
- Q_{act} = actual volumetric flow rate (cfm), including water vapor
- T_{act} = actual temperature of exhaust (°F)
- %H₂O = weight fraction of water vapor

Because there are no specific emission factors available for nitrogen oxides and sulfur dioxides from coffee roasters, Table 1.4-1 and 1.4-2 from AP-42 [Chapter 1.4 \(Natural Gas Combustion\)](#) shall be used to obtain the emission factors for nitrogen oxides and sulfur dioxides:

$$\begin{aligned} \text{Nitrogen oxides (< 100 MMBTU/hr)} &= 100 \text{ lbs}/10^6 \text{ scf} \\ \text{Sulfur Dioxides} &= 0.6 \text{ lbs}/10^6 \text{ scf} \end{aligned}$$

If the applicant has more representative emission factors (i.e., from manufacturer’s specifications or guarantees), those factors should be used.

The requirement to apply Reasonably Available Control Technology (RACT) to secondary pollutants from thermal oxidizers is contained in Regulation 2-2-112, which state that emissions of secondary pollutants from an abatement device are subject to RACT requirements, when the abatement device is being used to meet Best Available Control Technology (BACT) or Best Available Retrofit Technology (BARCT) requirements for a source or sources. The District [policy \(dated April 13, 1999\)](#) requires the following RACT control levels for afterburners:

$$\begin{aligned} 50 \text{ ppmvd NO}_x \text{ @ } 15\% \text{ O}_2 &[0.2 \text{ lb/MMBTU}] \\ 350 \text{ ppmvd CO @ } 15\% \text{ O}_2 &[0.8 \text{ lb/MMBTU}] \end{aligned}$$

AIR TOXICS

According to [Chapter 9.13.2, Coffee Roasting](#) of AP-42, the roaster is the main source of gaseous pollutants, including aldehydes and acrolein. However, the California Air Resources Board has invalidated the source test method for acrolein. Until CARB approves a new test method and acrolein emissions are estimated from factors developed using the new test method, the District is not evaluating risk for acrolein. There are no California Air Toxics Emission Factors (CATEF) factors for the aldehydes from coffee roasting. However, source testing was performed at Peets Coffee and Tea, Inc. and determined the following toxic emission factors:

Formaldehyde = 0.0008 lb/ton
 Acetaldehyde = 0.0005 lb/ton

Based on these emission factors a risk screening can be performed. If the applicant has more representative toxic emission factors (i.e., from manufacturer’s specifications or guarantees), those factors should be used. Whatever values are determined to pass the risk screening should be used as limits in the permit conditions and verified by source testing.

Based on these emission factors and the maximum projected throughput for the coffee roasting operations, emissions can be calculated. The combustion emissions are based on estimated usage of the burners at their estimated firing rates or maximum projected natural gas usage.

Applicable Requirements

District Rules and Regulations

In general, the particulate sources at coffee roasting facilities are subject to the operating standards of [Regulation 6](#). With the proper operation and abatement of the coffee roasters and its destoning/cooling operations, particulate emissions should comply with the operating standards of [Regulation 6](#). Permit conditions are imposed to ensure compliance with [Regulation 6](#).

Best Available Control Technology (BACT)

BACT for the coffee roasters (including its handling) is specified in the [BACT/TBACT Workbook](#). The following are applicable BACT requirements for:

Coffee Roasters

- [Coffee Roasting < 110,000 Btu/hr](#)
- [Coffee Roasting 110,000 Btu/hr to 3.5 MM Btu/hr](#)
- [Coffee Roasting Handling Equipment < 1,590 lb/hr](#)
- [Coffee Roasting Handling Equipment >= 1,590 lb/hr](#)

Inform the [BACT Coordinator](#) of updates to the BACT/TBACT Workbook.

California Environmental Quality Act (CEQA)

Permit applications which are reviewed following the specific procedures, fixed standards and objective measurements set forth in this chapter (11.5) are classified as ministerial and will accordingly be exempt from CEQA review per [Regulation 2-1-311](#).

In addition to the above-mentioned source-specific applicable requirements, other requirements may also be applicable depending on the facility, its application emissions, and its source location:

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| <input type="checkbox"/> Offsets | <input type="checkbox"/> School Notification |
| <input type="checkbox"/> Prevention of Significant Deterioration | <input type="checkbox"/> Risk Screening Analysis |

Permit Conditions

Standardized conditions for coffee roasters are available from the [Permit Condition Guidance](#). Refer to the [Evaluation Report Template Guidance](#) to obtain the Microsoft Word formatted permit conditions for this source category.