PROJECT REPORT
Cadman Materials / Kenmore Asphalt Plant

Notice of Construction For Aggregate Dryer

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October 2020

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EXECUTIVE SUMMARY

Cadman Materials (Cadman) operates a asphalt batch plant located at 6431 NE 175th Street, Kenmore, WA 98028 (the Kenmore plant). The plant has operated since the 1960s under various owners. Cadman purchased the plant in July 2017 from CEMEX. Equipment at the Kenmore plant has operated under three prior Orders of Approval (OACs) issued by the Puget Sound Clean Air Agency (PSCAA).

- OAC 939 (issued April 4, 1973): Installation of particulate emission controls (baghouse with cyclones) to control batch plant emissions;
- OAC 1938 (issued August 8, 1979): Installation of fume scavenging system to control emissions from flight conveyor and two storage silos; and
- OAC 3536 (issued June 14, 1990): Approved use of nuisance soils in raw materials of the asphalt batch plant.

Over many years, the Kenmore plant has made various changes to its aggregate dryer, including the following changes that have recently been the subject of discussions with PSCAA:

- Replacement of the existing 103 MMBtu/hr dryer burner with a new 100 MMBtu/hr burner in 2003
- Alterations to the existing dryer baghouse to accommodate longer bags (2006), to replace the exhaust fan (2007), and to replace the tube sheet and shorten the baghouse body (2016);
- Routing the scavenger duct from truck loading process to the dryer baghouse in 2009; and
- Replacement of the dryer shell and several internal stages in 2018.

In an August 17, 2020 email from Brian Renninger, PSCAA stated its opinion that because the primary emission creating components of the dryer (drum shell and burner) were replaced, it considers the dryer itself to be replaced and to have triggered New Source Review (i.e., the Notice of Construction (NOC) permitting process).

This report provides information for the New Source Review process, as requested in PSCAA's August 17, 2020 email:

- Emission inventory of criteria pollutants, hazardous air pollutants (HAP), and toxic air pollutants (TAP);
- Best Available Control Technology (BACT) review for NO_X, CO, VOC, PM, toxics, and odor; and
- TAP review under WAC 173-460.

Cadman requests that the Order of Approval issued by PSCAA for the aggregate dryer include limits of 200,000 tons per year asphalt production and 4,380 hours per year of dryer operation. The aggregate dryer consistently operates below these levels, and establishing these limits will clarify the potential-to-emit of the dryer.

In the same email, PSCAA requested additional information about various equipment replacements at the Kenmore plant and their associated costs to assess whether those changes constituted "reconstruction" under the applicability provisions of New Source Performance Standards (NSPS) Subpart I (Standards of Performance for Hot Mix Asphalt Facilities).[1] Due to changes in facility ownership, and the long history of the plant, the detailed costs requested by PSCAA are difficult to obtain. Cadman had provided information in previous correspondence with PSCAA supporting its position that the asphalt plant had not triggered NSPS

[1] 40 CFR 60, Subpart I

Subpart I by reconstruction.[2] Nevertheless, Cadman is now deciding to accept applicability of NSPS Subpart I requirements to the Kenmore facility. Because Cadman is accepting applicability of the standard, further information regarding previous equipment replacements is moot, and therefore not included in this response.

[2] June 19, 2020 letter from Trinity Consultants to PSCAA, on behalf of Cadman.

AGGREGATE DRYER DESCRIPTION

The Kenmore asphalt plant produces a hot mix asphalt paving mixture by blending aggregate and an asphalt binder. A key component of this process is the dryer, in which aggregate is heated and moisture is driven off. The dryer at the Kenmore plant is a rotary type. In this design, liquid asphalt binder is not mixed with aggregate until after the aggregate leaves the dryer.

Aggregate is introduced to the feed end of the dryer by conveyor. The dryer is an H&R Mechanical rotary dryer (8' x 30'), consisting of a rotary drum at a slight angle. As the drum rotates, aggregate moves gravitationally from the upper to lower end of the drum through a series of internal stages, or flights. At the lower end of the dryer is a Hauck Eco-Star ES-100 natural gas burner rated at 100 MMBtu/hr. As the aggregate material tumbles through the dryer stages, heat from the burner dries the aggregate material. The burner exhaust gasses and moisture are routed through a knock-out box and baghouse to filter and remove particulate matter before exiting the stack. Hot dried aggregate is discharged into the hot stone elevator from the lower end of the dryer.

The nominal capacity of the dryer is 200 tons per hour, with a maximum production of 200,000 tons per year.

EMISSION CALCULATION METHODS

The following emission calculation methods and assumptions are used to estimate emissions from the dryer:

- Emissions from the dryer are based on the proposed operating limits for hourly (200 tons per hour) and annual (200,000 tons per year) asphalt production.
- Emissions of pollutants with concentration-based emission limits are based on the proposed operating limit of 4,380 hours per year at the maximum exhaust flow rate of the dryer. Note that annual emission rate estimates for pollutants calculated on this basis are conservatively high compared to pollutants with emissions based on tonnage of product. The difference results from the fact that the calculations based on flow rate assume that the dryer operates at maximum flow during all operating hours, and do not account for the reduced flow that takes place when the dryer operates below full capacity.
- Volatile Organic Compound (VOC) and Sulfur Dioxide (SO_2) emissions from the dryer are calculated using emission factors obtained from AP-42 Section 11.1, Tables 11.1-5 and 11.1-6.
- In the absence of a site-specific emission factor for the dryer, emissions of Nitrogen Oxides (NO_x) and Carbon Monoxide (CO) are based on the proposed BACT limits of 32 and 311 ppm, respectively, corrected to 7% O_2.
- Particulate Matter (PM) emissions from the dryer are controlled by a fabric filter. Filterable PM emissions from the dryer are quantified using the design flow rate and outlet grain loading of the baghouse at 68,000 acfm and 0.014 grains per dry standard cubic foot (gr/dscf), respectively. Condensable particulate emissions are based on an estimated emission rate of 0.013 gr/dscf.
- The particle size distribution for particulate emissions from the fabric filter is obtained from AP-42 Section 11.1, Table 11.1-2, and is used to determine the portion of filterable PM emissions that are less than 10 µm in aerodynamic diameter (PM_{10}) and the portion of PM emissions that are less than 2.5 µm in aerodynamic diameter ($PM_{2.5}$).
- Speciated TAP and HAP emissions are calculated using emission factors from AP-42 Section 11.1, Tables 11.1-9 and 11.1-11.

Detailed emission calculations are provided in Appendix A**.**

The Kenmore plant is located in an attainment area for all criteria pollutants. This section of the report reviews the regulatory requirements potentially applicable to the dryer.

New Source Performance Standards (NSPS)

WAC 173-400-115 adopts federal NSPS in 40 CFR 60 by reference. NSPS apply to certain types of equipment that are newly constructed, modified, or reconstructed after a given applicability date. NSPS Subpart I applies to hot mix asphalt facilities. According to 40 CFR 60.90:

> *For the purpose of this subpart, a hot mix asphalt facility is comprised only of any combination of the following: dryers; systems for screening, handling, storing, and weighing hot aggregate; systems for loading, transferring, and storing mineral filler, systems for mixing hot mix asphalt; and the loading, transfer, and storage systems associated with emission control systems.*

The Kenmore plant has historically not been subject to NSPS Subpart I. PSCAA has recently requested information to assess whether changes at the plant over many years may have constituted "reconstruction" under NSPS rules and triggered NSPS Subpart I requirements. However, based on discussions with PSCAA in an August 28, 2020 meeting, as part of this submittal Cadman has decided to accept applicability of NSPS Subpart I requirements to the Kenmore plant in the future. The requirements of Subpart I are less stringent than the proposed BACT limitation in this report. By accepting applicability of the standard, further information regarding previous equipment replacements is now moot, and therefore not included in this response.

Subpart I sets an emission limit of 0.04 grain per dry standard cubic foot (gr/dscf) for particulate matter and a 20% opacity limit on equipment at the asphalt plant.

National Emission Standards for Hazardous Air Pollutants

There is no applicable source category under 40 CFR Part 61 or 63 for a hot mix asphalt plant. Therefore, NESHAP requirements do not apply to the Kenmore plant.

State and Local Regulatory Applicability

Washington Toxic Air Pollutant Regulations

PSCAA adopts by reference the requirements of the current Washington TAP program provided in WAC 173-460, excluding references to de minimis emission values in WAC 173-460-150. WAC 173-460 establishes a small quantity emission rate (SQER) and an acceptable source impact level (ASIL) for each listed TAP. If the total project-related TAP emissions increase exceeds its respective SQER, further determination of compliance with the ASIL is required.

TAP emissions from the dryer are quantified in Appendix A, using the methods outlined in this report.

New Source Review was triggered by the replacement of parts of the dryer and not by a modification that resulted in an emission increase. Per WAC 173-460-080(3), when comparing TAP emissions from the dryer

to the respective SQER, an applicant may include any reductions in emissions of a particular TAP at the source for the purpose of offsetting emissions of the TAP. The current dryer is considered by PSCAA as a replacement of earlier equipment; therefore, emissions from the "old" dryer may be used to offset the emissions from the "new" dryer. Because the changes to the dryer only replaced components but did not increase dryer capacity or emissions, the pre-permit project emissions fully offset the post-permit emissions. The net increase in emissions of each TAP is zero, which is below the respective SQER for each TAP.

Local Regulatory Applicability

The following general regulations from PSCAA Regulation I are applicable to the Kenmore plant dryer:

- Section 9.03
  (a): It shall be unlawful for any person to cause or allow the emission of any air contaminant for a period or periods aggregating more than 3 minutes in any 1 hour, which is:
  (1) Darker in shade than that designated as No. 1 (20% density) on the Ringelmann Chart, as published by the United States Bureau of Mines; or
  (2) Of such opacity as to obscure an observer's view to a degree equal to or greater than does smoke described in Section 9.03(a)(1).
  (b) The density or opacity of an air contaminant shall be measured at the point of its emission, except when the point of emission cannot be readily observed, it may be measured at an observable point of the plume nearest the point of emission.
  (c) This section shall not apply when the presence of uncombined water is the only reason for the failure of the emission to meet the requirements of this section.
- Section 9.09 General Particulate Matter (PM) Standard. It shall be unlawful for any person to cause or allow the emission of particulate matter in excess of the following concentrations:
  Equipment Used in a Manufacturing Process: 0.05 gr/dscf
- Section 9.11: It shall be unlawful for any person to cause or allow the emission of any air contaminant in sufficient quantities and of such characteristics and duration as is, or is likely to be, injurious to human health, plant or animal life, or property, or which unreasonably interferes with enjoyment of life and property.
- Section 9.13: It shall be unlawful for any person to cause or allow the installation or use of any device or use of any means designed to mask the emission of an air contaminant which causes detriment to health, safety or welfare of any person.
- Section 9.20(a): It shall be unlawful for any person to cause or allow the operation of any features, machines or devices constituting parts of or called for by plans, specifications, or other information submitted pursuant to Article 6 of Regulation I unless such features, machines or devices are maintained in good working order.

PSCAA requires new sources to implement BACT for all pollutants not previously emitted or whose emissions would increase as a result of the new source. Per PSCAA's request, a BACT analysis for PM, NO_X, VOC, CO, opacity, odor, and TAPs from the dryer is provided in this section.

BACT Limits in Recent PSCAA Permits

In the past several years PSCAA has issued orders of approval for dryers/mixers at three other asphalt plants in its jurisdiction. The BACT limits in these orders are summarized in Table 1 below.

Table 1. Recent BACT Limits in PSCAA Permits for Asphalt Plant Dryers/Mixers

Plant	Permit #	Dryer Production (tons/hr)	Total PM Limit (gr/dscf)	Filterable PM Limit (gr/dscf)	Opacity Limit (%)	NO_X Limit (ppmdv at 7% O_2)	VOC Limit (lb/ton)	CO Limit (ppmdv at 7% O_2)
Cadman North Everett	11812	400	0.027	0.014	5	26	0.032	311
Icon Materials Seattle	11328	375	0.027	0.014	5	32	0.032	311
Lakeside Issaquah	11175	300	N/A	0.02	5	32 [1]	N/A	311 [1]

1 The NO_X and CO emissions in the Lakeside permit are written as 41 ppmdv NO_X at 3% oxygen and 400 ppm CO at 3% oxygen. In this table, these limits are converted to a 7 percent oxygen basis consistent with the limits of the other permits to allow for a direct comparison between the permits.

Note that there are several important design differences between the three units listed in Table 1 and the dryer at the Kenmore plant:

- The Kenmore plant dryer has a substantially lower production capacity (200 tons/hr) than the three other dryers (which range from 300 to 400 tons/hr)
- Unlike the other asphalt plants, the Kenmore plant does not process reclaimed asphalt pavement (RAP) or reclaimed asphalt shingles (RAS).
- The Kenmore plant dryer is a batch mix rotary drum dryer rather than a drum mixer. In the batch mix process at the Kenmore plant, liquid asphalt is not mixed with the aggregate inside the dryer, but is instead mixed with the hot aggregate downstream of the dryer. The other three facilities have drum mixers in which both drying and mixing take place within the same unit.
- The Kenmore dryer is substantially older than the new equipment listed in recent permits. The age of the dryer and its ancillary equipment makes retrofitting emission controls more challenging and expensive than for a new dryer/mixer.

Proposed BACT for the Kenmore Plant Dryer

As a general rule, it is less cost-effective in terms of cost per ton of pollutant removed to apply stringent environmental control technologies to older equipment (due to additional retrofit costs) and equipment with lower production capacities (due to economies of scale). For this reason, BACT emission limits appropriate for the dryer at the Kenmore facility should be no more (and perhaps less) stringent than the limits issued by PSCAA for the larger and newer facilities described above.

For each pollutant, Cadman is proposing a BACT emission limit that is equivalent to the limit of at least one of the recently permitted units. Cadman is cautiously optimistic that the existing dryer and baghouse can meet these proposed limits. However, due to the unusual nature of this permitting process, in which BACT is applied to existing unmodified equipment, there remains the possibility that the dryer will not meet the new limits in its current configuration. Cadman therefore requests that any BACT limits established for the Kenmore dryer allow a period of time from the date of the initial compliance test for Cadman to make process changes, if needed, to meet the BACT limits.

The dryer at the Kenmore facility is currently equipped with a baghouse for control of particulate matter and opacity. Use of a baghouse is the same particulate control method used at recently permitted facilities.

Available control technologies for NO_X emissions from a combustion source typically include low NO_X burners, using natural gas as the fuel, best management practices to ensure efficient combustion. Add-on controls, such as selective catalytic reduction (SCR) or selective non-catalytic reduction (SNCR) are also available. However, these types of add-on controls are not typically applied to hot mix asphalt plants, and have not been required for the much larger dryers and mixers recently permitted by PSCAA. The proposed BACT limit for NO_X in this report is representative of a dryer with low-NO_X burners, operating with good combustion practices.

Available control technologies for CO emissions typically include good combustion practices to ensure complete combustion. The proposed BACT limit for NO_X in this report is representative of a dryer operating with good combustion practices.

Emissions of VOC and odors from asphalt plant dryers are a lesser concern for batch mix aggregate dryers than for plants that use a drum mixer design. At the Kenmore plant, aggregate does not come in contact with liquid asphalt until after leaving the dryer. As a result, emissions of VOC from aggregate dryers are only about 25 percent of the emissions from a comparably sized drum mixer.[3] Plants that use drum mixers often have temperature management requirements in their permits to minimize vaporization of compounds in the asphalt mix. At the Kenmore plant, because liquid asphalt is not added to the aggregate until downstream of the dryer, management of the mix temperature would not be relevant to controlling VOC emissions from the dryer. For the Kenmore plant dryer, emissions of VOC are estimated at 0.82 tons per year using AP-42 emission factors. Considering the low level of VOC emissions and related odors from the dryer, Cadman proposes that the dryer design and good combustion practices represents BACT for VOC and odor from the dryer, without a numerical emission limit.

Each TAP emitted from the dryer (other than criteria pollutants that are also TAPs) is either a form of particulate (in the case of metal compound TAPs) or a form of VOC (in the case of organic TAPs). The proposed BACT requirement for TAPs is to comply with the BACT limits for total particulate, filterable particulate, and VOC, which indirectly serve to restrict TAP emissions.

[3] EPA's Compliation of Air Pollutant Emission Factors (AP-42) Section 11.1 cites emission factors of 0.0082 lbs VOC per ton of hot mix asphalt for batch mix plants, compared to 0.032 lbs VOC / ton of hot mix asphalt for drum mixers.

The proposed numerical BACT limits for criteria pollutants are summarized in Table 2 below.

Table 2. Proposed BACT Limits for the Kenmore Aggregate Dryer.

Pollutant	Method	Limit	Test Method
Total PM	Baghouse	0.027 gr/dscf (corrected to 7% O_2)	US EPA Method 5, as modified by PSCAA Board Resolution 540. Average of three 60-minute test runs.
Filterable PM	Baghouse	0.014 gr/dscf (corrected to 7% O_2)	US EPA Method 5, as modified by PSCAA Board Resolution 540. Average of three 60-minute test runs.
Opacity	Baghouse	No more than 5% for a period or periods aggregating more than 3 minutes during any one hour.	Washington Department of Ecology Method 9A
NOx	Good combustion practices	32.0 ppmvd (corrected to 7% O_2)	EPA Methods 1, 3A, 4, and 7E. Average of three 60-minute test runs.
CO	Good combustion practices	311.0 ppmvd (corrected to 7% O_2)	EPA Methods 1, 3A, 4, and 10. Average of three 60-minute test runs.

APPENDIX A: EMISSION CALCULATIONS

Cadman Kenmore Aggregate Dryer Emissions

Table 1. Production and Equipment Capacities

Parameter	Value
Asphalt maximum production rate	200 tons/hr
Asphalt production rate	200,000 tons/yr
NG burner capacity	100 MMBtu/hr
Exhaust flow capacity	68,000 acfm
Exhaust temperature	250 degrees F
Exhaust oxygen percentage	14.5 %
Exhaust moisture	15 %
Baghouse exit concentration (filterable)	0.014 gr/dscf
Baghouse exit concentration (condensable)	0.013 gr/dscf
Maximum Hours of Operation	4,380 hours/year

Table 2. Aggregate Dryer Emissions - Criteria Pollutants

Pollutant	Emission Factor	Units	Emissions (lb/hr)	Emissions (tpy) [4]
PM (filterable)	0.014	gr/dscf	5.2	11.3
PM (condensable)	0.013	gr/dscf	4.8	10.5
PM_{10} [1]	0.018	gr/dscf	6.8	14.9
$PM_{2.5}$ [1]	0.018	gr/dscf	6.5	14.2
SO_2 [2]	0.0046	lb/ton	0.9	0.5
NO_x [3]	32.0	ppmdv @ 7% O_2	4.6	10.0
VOC [2]	0.0082	lb/ton	1.6	0.8
CO [3]	311.0	ppmdv @ 7% O2	27.1	59.2

[1] Particle size distribution for dust emissions from batch mix dryer controlled by fabric filter are obtained from AP-42 Chapter 11.1, Table 11.1-2.

PM_{10} 39%

$PM_{2.5}$ 33%

[2] Emission factors obtained from AP-42 Chapter 11.1, Tables 11.1-5 and 11.1-6 for emissions from a batch mix dryer with a natural gas-fired dryer.

[3] Emission factors for NO_x and CO are based on BACT limits of 32 and 311 ppm, respectively, corrected to 7% O_2.

[4] Note that annual emission rate estimates for pollutants with emissions based on exhaust flow (i.e., particulate, NOx and CO) are conservatively high compared to pollutants with emissions based on tonnage of product. The difference results from the fact that calculations based on flow rate do not account for the reduced flow that occurs when the dryer operates below its maximum capacity, and thus overestimate emissions.

Cadman Kenmore Aggregate Dryer Emissions

Table 3. Aggregate Dryer TAP Emisisons

Pollutant	CAS No.	HAP?	TAP?	Emission Factor [1] (lb/ton)	Dryer Emissions (lb/hr)	Dryer Emissions (tpy)
2-Methylnaphthalene	91-57-6	Yes - PAH	No	7.1E-05	1.42E-02	7.10E-03
Acenaphthene	83-32-9	Yes - PAH	No	9.0E-07	1.80E-04	9.00E-05
Acenaphthylene	208-96-8	Yes - PAH	No	5.8E-07	1.16E-04	5.80E-05
Acetaldehyde	75-07-0	Yes	Yes	3.2E-04	0.06	0.03
Anthracene	120-12-7	Yes - PAH	No	2.1E-07	4.20E-05	2.10E-05
Benzene	71-43-2	Yes	Yes	2.8E-04	0.06	0.03
Benzo(a)anthracene	56-55-3	Yes - PAH	Yes	4.6E-09	9.20E-07	4.60E-07
Benzo(a)pyrene	50-32-8	Yes - PAH	Yes	3.1E-10	6.20E-08	3.10E-08
Benzo(b)fluoranthene	205-99-2	Yes - PAH	Yes	9.4E-09	1.88E-06	9.40E-07
Benzo(g,h,i)perylene	191-24-2	Yes - PAH	No	5.0E-10	1.00E-07	5.00E-08
Benzo(k)fluoranthene	207-08-9	Yes - PAH	Yes	1.3E-08	2.60E-06	1.30E-06
Chrysene	218-01-9	Yes - PAH	Yes	3.8E-09	7.60E-07	3.80E-07
Dibenz(a,h)anthracene	53-70-3	Yes - PAH	Yes	9.5E-11	1.90E-08	9.50E-09
Ethyl Benzene	100-41-4	Yes	Yes	2.2E-03	0.44	0.22
Fluoranthene	206-44-0	Yes - PAH	No	1.6E-07	3.20E-05	1.60E-05
Fluorene	86-73-7	Yes - PAH	No	1.6E-06	3.20E-04	1.60E-04
Formaldehyde	50-00-0	Yes	Yes	7.4E-04	0.15	0.07
Indeno(1,2,3-cd)pyrene	193-39-5	Yes - PAH	Yes	3.0E-10	6.00E-08	3.00E-08
Naphthalene	91-20-3	Yes - PAH	Yes	3.6E-05	7.20E-03	3.60E-03
Phenanthrene	85-01-8	Yes - PAH	No	2.6E-06	5.20E-04	2.60E-04
Pyrene	129-00-0	Yes - PAH	No	6.2E-08	1.24E-05	6.20E-06
Quinone	106-51-4	Yes	No	2.7E-04	0.05	0.03
Toluene	108-88-3	Yes	Yes	1.0E-03	0.20	0.10
Xylene, mixed or all isomers	1330-20-7	Yes	Yes	2.7E-03	0.54	0.27
Arsenic	7440-38-2	Yes	No	4.6E-07	9.20E-05	4.60E-05
Beryllium	7440-41-7	Yes	No	1.5E-07	3.00E-05	1.50E-05
Cadmium	7440-43-9	Yes	No	6.1E-07	1.22E-04	6.10E-05
Chromium	7440-47-3	Yes	No	5.7E-07	1.14E-04	5.70E-05
Lead	7439-92-1	Yes	No	8.9E-07	1.78E-04	8.90E-05
Manganese	7439-96-5	Yes	No	6.9E-06	1.38E-03	6.90E-04
Mercury	7439-97-6	Yes	Yes	4.1E-07	8.20E-05	4.10E-05
Nickel	7440-02-0	Yes	No	3.0E-06	6.00E-04	3.00E-04
Selenium	7782-49-2	Yes	No	4.9E-07	9.80E-05	4.90E-05
				Total HAP:	**1.53**	**0.76**
SO2	7446-09-05	No	Yes	--	0.92	0.46
NO_x	10102-44-0	No	Yes	--	4.57	10.01
CO	630-08-0	No	Yes	--	27.05	59.24

[1] Speciated emission factors for emissions from the dryer are obtained from U.S. EPA, Hot Mix Asphalt Plants, AP-42 Section 11.1, March 2004, Tables 11.1-9 and 11.1-11. Emission factors for natural gas-fired dryer with fabric filter are used. Emissions of criteria pollutants that are also TAPs are based on the calculation shown in Table 2.