Batch Plant - Stationary Source Emissions

Concrete Batch Plant Emission Factors per Yard of Truck Mix Concrete (lb/yd produced)

Operation	PM	PM10	PM2.5	Arsenic	Beryllium	Cadmium	Chlorine	Total Chromium	Crystalline Silica	Lead	Manganese	Nickel	Phos-phorous	Selenium
Aggregate Delivery	0.0064	0.0031	0.0031						4.48E-05					
Sand Delivery	0.0015	0.00070	0.0007						3.43E-05					
Aggregate Transfer to Conveyor	0.0064	0.0031	0.0031						4.48E-05					
Sand Transfer to Conveyor	0.0015	0.0007	0.0007						3.43E-05					
Aggregate Transfer to Elevated Storage	0.0064	0.0031	0.0031						4.48E-05					
Sand Transfer to Elevated Storage	0.0015	0.00070	0.0007						3.43E-05					
Cement Delivery to Silo	0.0002	0.00010	0.0001	1.041E-09	1.19E-10	1.15E-09	1.15E-09	7.12E-09		2.68E-09	2.87E-08	1.03E-08	5.79E-08	0
Cement Supplement Delivery to Silo	0.0003	0.00020	0.0002	3.65E-08	3.3E-09	7.23E-12		4.45E-08		1.90E-08	9.34E-09	8.32E-08	1.29E-07	2.64E-09
Weigh Hopper Loading	0.0079	0.0038	0.0038											
Truck mix Loading	0.03	0.007	0.001	8.488E-08	1.46E-08	1.28E-09		5.78E-07		2.16E-07	2.93E-06	6.74E-07	1.74E-06	1.59E-08
Total	**0.06**	**0.023**	**0.017**	**1.224E-07**	**1.8E-08**	**2.43E-09**	**1.15E-09**	**6.3E-07**	**0.000237**	**2.38E-07**	**2.97E-06**	**7.67E-07**	**1.92E-06**	**1.85E-08**

Ref: U.S. EPA AP-42 Tables 11.12-5 and 11-12.8 dated 6/06. Factors reflect fabric filter control for cement and supplement delivery to silo and truck loading.

Data and Assumptions

Concrete produced

Daily Average =	50	yards
Maximum Output =	125	yards
Annual =	17800	yards

List of Equipment on-site

- Dry batch plant with conveyor belt
- Storage bins and scales for aggregate
- Dust collector and misting system
- 1 front-end loader
- 7 cement trucks
- 1 powder truck/trailer
- 1 dump truck
- 1 bobcat with quick connect sweeper with sprayer
- 1 tennant sweeper

Weight of aggregate base = 4,000 lb per cubic yard (http://www.dot.state.oh.us/spec/304.htm

Concrete Composition (1 yard)

Coarse Aggregate	1865	lbs
Sand	1428	lbs
Cement	491	lbs
Cement supplement	73	lbs
Water	167	lbs (20 gallons)
Total	4024	lbs

Reference: Footnote 'a' to AP-42 Table 11.12-8

Metal emission factors are provided in AP-42 in units of lbs per ton of ingredient. Therefore, the composition data above were used to convert emission factors from lb/ton ingredien to lbs/yd of concrete produced. (e.g. truck mix loading factors are reported in lbs emitted per ton of cement+supplement
Each yard of concrete contains 491+73= 564 lbs of these ingredients. Therefore (lb/ton ingred)*(564/2000) = lb/yd concrete

Example Calculations

Total PM10 emissions from Batch Plant

$$\frac{17{,}800 \text{ yd produced}}{} \quad \frac{0.023 \text{ lbs PM}}{\text{yd produced}} = 408 \text{ lb PM emitted}$$

Lead emissions from the Batch Plant

$$\frac{17{,}800 \text{ yd produced}}{} \quad \frac{0.00000024 \text{ lb lead}}{\text{yd produced}} = 0.004 \text{ lb Lead emitted}$$

Calculation of Criteria Pollutant Emissions

Annual

ID	Purpose	Activity	Units	Total PM Emissions (lb/yr)	PM-10 Emissions (lb/yr)	PM-2.5 Emissions (lb/yr)
Batch Plant	Concrete Batch Plant	17,800	yd	1,063	408	298
			Totals	**1,063**	**408**	**298**

Peak Day

ID	Purpose	Activity	Units	Total PM Emissions (lb)	PM-10 Emissions (lb)	PM-2.5 Emissions (lb)
Batch Plant	Concrete Batch Plant	125	yd	7.5	2.9	2.1
			Totals	**7.5**	**2.9**	**2.1**

Calculation of Hazardous Air Pollutant Emissions

ID	Total Yards Produced per year	Arsenic 7440382 (lb/yr)	Beryllium 7440417 (lb/yr)	Cadmium 7440439 (lb/yr)	Chlorine 7782505 (lb/yr)	Chromium 7440473 (lb/yr)	Crystalline Silica (lb/yr)	Lead 7439921 (lb/yr)	Manganese 7439965 (lb/yr)	Nickel 7440020 (lb/yr)	Phos-phorous 7723140 (lb/yr)	Selenium 7782492 (lb/yr)
Batch Plant	17,800	0.002	0.000	0.000	0.000	0.011	4.220	0.004	0.053	0.014	0.034	0.000
	17,800	0.002	0.000	0.000	0.000	0.011	4.220	0.004	0.053	0.014	0.034	0.000

ID	Total Yards Produced per hour	Arsenic 7440382 (lb/hr)	Beryllium 7440417 (lb/hr)	Cadmium 7440439 (lb/hr)	Chlorine 7782505 (lb/hr)	Chromium 7440473 (lb/hr)	Crystalline Silica (lb/hr)	Lead 7439921 (lb/hr)	Manganese 7439965 (lb/hr)	Nickel 7440020 (lb/hr)	Phos-phorous 7723140 (lb/hr)	Selenium 7782492 (lb/hr)
Batch Plant	40	0.00000	0.00000	0.00000	0.00000	0.00003	0.00948	0.00001	0.00012	0.00003	0.00008	0.00000
	40	0.000	0.000	0.000	0.000	0.000	0.009	0.000	0.000	0.000	0.000	0.000

Emissions Summary

Pollutant	CAS	Project lb/yr	Annual Screening Level at 75m (lb/year)	Project lb/hr	Hourly Screening Level at 25m (lb/hr)	PSIp
PM10	PM10	407.92	NA	0.36		
PM2.5	PM2.5	297.89	NA	0.26		
Arsenic	7440382	0.0021791	0.0027	4.90E-06	4.42E-05	0.80
Beryllium	7440417	0.0003209	0.038	7.21E-07	NA	0.01
Cadmium	7440439	0.0000433	0.021	9.73E-08	NA	0.00
Chlorine	7782505	0.0000205	43.200	4.60E-08	4.64E-02	0.00
Chromium	7440473	0.0112095	NA	2.52E-05	NA	
Chromium (VI)		0.0001681	0.00039	3.78E-07	NA	0.43
Crystalline Silica		4.2203088	NA	9.48E-03	NA	
Lead	7439921	0.0042355	0.0666	9.52E-06	NA	0.06
Manganese	7439965	0.0528814	8.7550	1.19E-04	NA	0.01
Nickel	7440020	0.0136608	0.3505	3.07E-05	4.42E-05	0.04
Phosphorous	7723140	0.0342520	NA	7.70E-05	NA	
Selenium	7782492	0.0003301	22.1000	7.42E-07	NA	0.00
Total HAPs	HAPS	4.3396101		9.75E-03		
					Totel PSIp	1.34

Chronic and Acute Trigger Levels are from the SCAQMD
http://www.aqmd.gov/docs/default-source/rule-book/Proposed-Rules/1401/attachmentn_080717.pdf
Crystalline Silica emissions were calculated using the rates listed in: John R. Richards , Todd T. Brozell , Charles Rea , Geoff Boraston & John Hayden (2009) PM4 Crystalline Silica Emission Factors and Ambient Concentrations at Aggregate Producing Sources in California, Journal of the Air & Waste Management Association, 59:11, 1287-1295

On- and Off-site Mobile Source Emissions

On-site emission sources
- 1 front-end loader (Tier 4) operaing 2 hours per day
- 1 sweeper (bobcat) operating 1 hour per day

Off-site Emissions

- 29 truck trips (30 mile round trip) =	870	miles
- 16 employee commute trips (50 mile round trip) =	800	miles

Emission Rates (g/mile) - EMFAC2017

	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Trucks	0.129886	0.505607	5.219644	0.015607	0.135149	0.07125	1635.8273
Passenger Vehicles	0.056083	2.234177	0.213497	0.003703	0.048527	0.021226	367.24865

Emission Rates (lb/hr)

	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Loader	0.0125	0.0088	0.2355	0.0005	0.0011	0.000982	37.0
Bobcat	0.00793	0.01518	0.17935	0.00030	0.00068	0.000623	23.50

Daily Emissions (pounds)

	ROG	**CO**	**NOx**	**SOx**	**PM10**	**PM2.5**	**CO2**
Truck Trips	0.249121	0.969749	10.01122	0.029933	0.259214	0.136657	3137.4994
Employee Trips	0.022032	0.01548	0.415257	0.000827	0.001882	0.001731	65.283066
Loader	0.024985	0.017554	0.470902	0.000938	0.002134	0.001963	74.030996
Bobcat	0.00793	0.015178	0.179352	0.000298	0.000677	0.000623	23.496795
Total	**0.30**	**1.02**	**11.08**	**0.03**	**0.26**	**0.14**	**3300.31**
Annual (tons)	0.054124	0.181197	1.971658	0.005695	0.046976	0.025094	587.45522

Tier 4 Emission Rates

Adjusted EF = Steady State EF x TAF x DF

Where:

EF = Emission Factor
TAF = Transient Adjustment Factor
DF = Deterioration Factor

Note: TAF = 1.0 for Tier 4 equipment

Deterioration "A"

ROG	0.027
CO	0.151
NOx	0.008
PM10	0.473

DF

ROG	1.0135
CO	1.0755
NOx	1.004
PM10	1.2365

			Steady State Emission Factors (g/bhphr)						Adjusted Emission Factors (g/bhphr)						Adjusted Emission Factors (lb/hr)						
Equipment	**HP Rating**	**Load Factor**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**ROG**	**CO**	**NOX**	**SOX**	**PM**	**CO2**	**CH4**
Front End Loader	115	0.37	0.13	0.09	2.50	0.0050	0.01	394.60	0.133174	0.093569	2.51	0.0050	0.011376	394.60	0.01	0.01	0.24	0.000	0.00	37.02	0.00074
Skid Steer	73	0.37	0.13	0.24	3.00	0.0050	0.01	394.60	0.133174	0.254894	3.012	0.0050	0.011376	394.60	0.01	0.02	0.18	0.000	0.00	23.50	0.00047

Fugitive Dust Emissions

Aggregate and Sand Piles (EPA AP-42 13.2)

PM10	6.3	lb/acre
PM2.5	1.323	lb/acre

Sand and Gravel Storage Area =	1,800	sf
	0.041322	acres

Daily Emissions:

PM10	0.260331
PM2.5	0.054669

Truck and Loader Travel (EPA AP-42 13.2)

Truck Average Weight =	30	tons
Loader Weight =	10	tons
Silt Load =	5.5	g/m2

Emission Factor (lb/vmt)

	PM10	PM2.5
Truck	0.327652	0.080424
Loader	0.106844	0.026225

On-site Road Dust

	VMT	PM10	PM2.5
Truck	1.5	0.491478	0.120635
Loader	1.5	0.160266	0.039338
total		0.651744	0.159973

On-site Emissions (Unmitigated)

Source	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Loader	0.025	0.018	0.471	0.001	0.002	0.002	74.031
Bobcat	0.008	0.015	0.179	0.000	0.001	0.001	23.497
Trucks	0.000	0.002	0.017	0.000	0.000	0.000	5.409
Employee	0.000	0.001	0.000	0.000	0.000	0.000	0.202
Batch Plant					2.865	2.092	
Storage Piles					0.260	0.055	
Road Dust					0.652	0.160	
Total	0.033	0.036	0.668	0.001	3.780	2.309	103.14
Annual dust					732.6139	374.2987	

On-site Emissions (Mitigated)

Source	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Loader	0.025	0.018	0.471	0.001	0.002	0.002	74.031
Bobcat	0.008	0.015	0.179	0.000	0.001	0.001	23.497
Trucks	0.000	0.002	0.017	0.000	0.000	0.000	5.409
Employee	0.000	0.001	0.000	0.000	0.000	0.000	0.202
Batch Plant					1.089	0.795	
Storage Piles					0.065	0.014	
Road Dust					0.652	0.160	
Total	0.033	0.036	0.668	0.001	1.809	0.971	103.14
Annual dust					410.198	175.0127	

Total Emissions (Unmitigated)

Source	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Loader	0.025	0.018	0.471	0.001	0.002	0.002	74.031
Bobcat	0.008	0.015	0.179	0.000	0.001	0.001	23.497
Trucks	0.249	0.970	10.011	0.030	0.259	0.137	3137.499
Employee	0.022	0.015	0.415	0.001	0.002	0.002	65.283
Batch Plant					2.865	2.092	
Storage Piles					0.260	0.055	
Road Dust					0.652	0.160	
Total	0.304	1.018	11.077	0.032	4.041	2.448	3300.310

Total Emissions (Mitigated)

Source	ROG	CO	NOx	SOx	PM10	PM2.5	CO2
Loader	0.025	0.018	0.471	0.001	0.002	0.002	74.031
Bobcat	0.008	0.015	0.179	0.000	0.001	0.001	23.497
Trucks	0.249	0.970	10.011	0.030	0.259	0.137	3137.499
Employee	0.022	0.015	0.415	0.001	0.002	0.002	65.283
Batch Plant					1.089	0.795	
Storage Piles					0.065	0.014	
Road Dust					0.652	0.160	
Total	0.304	1.018	11.077	0.032	2.069	1.110	3300.310