11.12 Concrete Batching

11.12.1 Process Description[1-4]

Concrete is composed essentially of water, cement, sand (fine aggregate), and coarse aggregate. Coarse aggregate may consist of gravel, crushed stone, or iron blast furnace slag. Some specialty aggregate products could be either heavyweight aggregate (of barite, magnetite, limonite, ilmenite, iron, or steel) or lightweight aggregate (with sintered clay, shale, slate, diatomaceous shale, perlite, vermiculite, slag, pumice, cinders, or sintered fly ash). Concrete batching plants store, convey, measure, and discharge these constituents into trucks for transport to a job site. In some cases, concrete is prepared at a building construction site or for the manufacture of concrete products such as pipes and prefabricated construction parts. Figure 11.12-1 is a generalized process diagram for concrete batching.

The raw materials can be delivered to a plant by rail, truck, or barge. The cement is transferred to elevated storage silos pneumatically or by bucket elevator. The sand and coarse aggregate are transferred to elevated bins by front end loader, clam shell crane, belt conveyor, or bucket elevator. From these elevated bins, the constituents are fed by gravity or screw conveyor to weigh hoppers, which combine the proper amounts of each material.

Truck mixed (transit mixed) concrete involves approximately 75 percent of U. S. concrete batching plants. At these plants, sand, aggregate, cement, and water are all gravity fed from the weigh hopper into the mixer trucks. The concrete is mixed on the way to the site where the concrete is to be poured. Central mix facilities (including shrink mixed) constitute the other one-fourth of the industry. With these, concrete is mixed and then transferred to either an open bed dump truck or an agitator truck for transport to the job site. Shrink mixed concrete is concrete that is partially mixed at the central mix plant and then completely mixed in a truck mixer on the way to the job site. Dry batching, with concrete mixed and hauled to the construction site in dry form, is seldom, if ever, used.

11.12.2 Emissions And Controls[5-7]

Emission factors for concrete batching are given in Tables 11.12-1 and 11.12-2, with potential air pollutant emission points shown. Particulate matter, consisting primarily of cement dust but including some aggregate and sand dust emissions, is the only pollutant of concern. All but one of the emission points are fugitive in nature. The only point source is the transfer of cement to the silo, and this is usually vented to a fabric filter or "sock". Fugitive sources include the transfer of sand and aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from sand and aggregate storage piles. The amount of fugitive emissions generated during the transfer of sand and aggregate depends primarily on the surface moisture content of these materials. The extent of fugitive emission control varies widely from plant to plant.

Types of controls used may include water sprays, enclosures, hoods, curtains, shrouds, movable and telescoping chutes, and the like. A major source of potential emissions, the movement of heavy trucks over unpaved or dusty surfaces in and around the plant, can be controlled by good maintenance and wetting of the road surface.

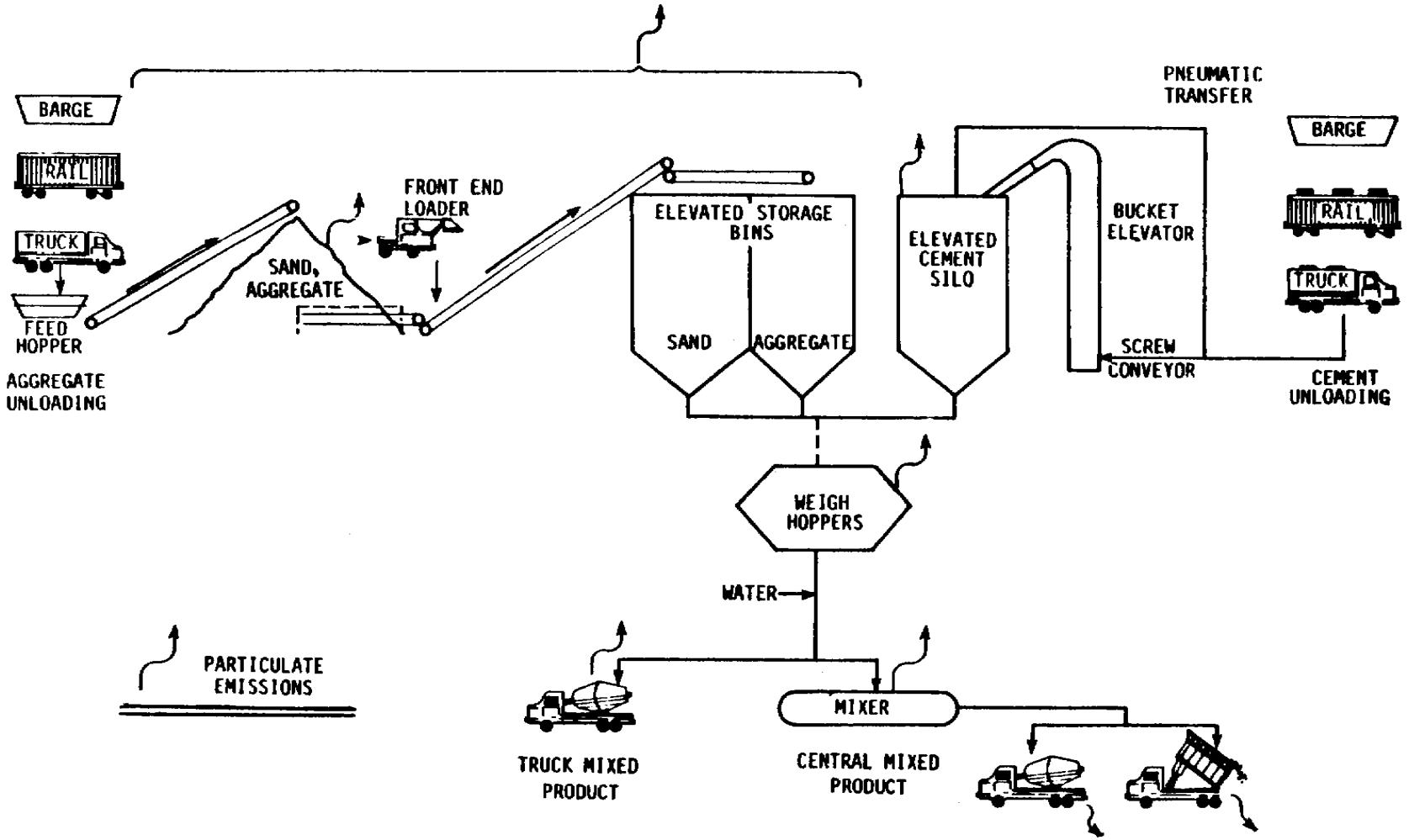

Figure 11.12-1. Typical concrete batching process.

Table 11.12-1 (Metric Units). EMISSION FACTORS FOR CONCRETE BATCHING[a]

Source (SCC)	Filterable[b]			Condensable PM[c]	
	PM	RATING	PM-10	Inorganic	Organic
Sand and aggregate transfer to elevated bin (3-05-011-06)[d]	0.014	E	ND	ND	ND
Cement unloading to elevated storage silo					
Pneumatic[e]	0.13	D	ND	ND	ND
Bucket elevator (3-05-011-07)[f]	0.12	E	ND	ND	ND
Weigh hopper loading (3-05-011-8)[g]	0.01	E	ND	ND	ND
Mixer loading (central mix) (3-05-011-09)[g]	0.02	E	ND	ND	ND
Truck loading (truck mix) (3-05-011-10)[g]	0.01	E	ND	ND	ND
Vehicle traffic (unpaved roads) (3-05-011-__)[h]	4.5	C	ND	ND	ND
Wind erosion from sand and aggregate storage piles (3-05-011__)[i]	3.9	D	ND	ND	ND
Total process emissions (truck mix)(3-05-011-_)[j]	0.05	E	ND	ND	ND

[a] Factors represent uncontrolled emissions unless otherwise noted. All emission factors are in kg/Mg of material mixed unless noted. Based on a typical yd^3 weighing 1.818 kg (4,000 lb) and containing 227 kg (500 lb) cement, 564 kg (1,240 lb) sand, 864 kg (1,900 lb) coarse aggregate, and 164 kg (360 lb) water. SCC = Source Classification Code. ND = no data.

[b] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

[c] Condensable PM is that PM collected in the impinger portion of a PM sampling train.

[d] Reference 6.

[e] For uncontrolled emissions measured before filter. Based on 2 tests on pneumatic conveying controlled by a fabric filter.

[f] Reference 7. From test of mechanical unloading to hopper and subsequent transport of cement by enclosed bucket elevator to elevated bins with fabric socks over bin vent.

[g] Reference 5. Engineering judgment, based on observations and emissions tests of similar controlled sources.

[h] From Section 13.2-1, with k = 0.8, s = 12, S = 20, W = 20, w = 14, and p = 100; units of kg/vehicle kilometers traveled; based on facility producing 23,100 m^3/yr (30,000 yd^3/yr) of concrete, with average truck load of 6.2 m^3 (8 yd^3) and plant road length of 161 meters (0.1 mile).

[i] From Section 11.19-1, for emissions <30 micrometers from inactive storage piles; units of kg/hectare/day.

[j] Based on pneumatic conveying of cement at a truck mix facility. Does not include vehicle traffic or wind erosion from storage piles.

Table 11.12-2 (English Units). EMISSION FACTORS FOR CONCRETE BATCHING[a,b]

Source (SCC)	Filterable[c]			Condensable PM[d]	
	PM	RATING	PM-10	Inorganic	Organic
Sand and aggregate transfer to elevated bin (3-05-011-06)[e]	0.029 (0.05)	E	ND	ND	ND
Cement unloading to elevated storage silo					
Pneumatic[f]	0.27 (0.07)	D	ND	ND	ND
Bucket elevator (3-05-011-07)[g]	0.24 (0.06)	E	ND	ND	ND
Weigh hopper loading (3-05-011-08)[h]	0.02 (0.04)	E	ND	ND	ND
Mixer loading (central mix) (3-05-011-09)[h]	0.04 (0.07)	E	ND	ND	ND
Truck loading (truck mix) (3-05-011-10)[h]	0.02 (0.04)	E	ND	ND	ND
Vehicle traffic (unpaved roads) (3-05-011-__)[i]	16 (0.02)	C	ND	ND	ND
Wind erosion from sand and aggregate storage piles (3-05-011-__)[j]	3.5[k] (0.1)[l]	D	ND	ND	ND
Total process emissions (truck mix) (3-05-011-__)[m]	0.1 (0.2)	E	ND	ND	ND

[a] Factors represent uncontrolled emissions unless otherwise noted. All emission factors are in lb/ton (lb/yd^3) of material mixed unless noted. SCC = Source Classification Code. ND = no data.

[b] Based on a typical yd^3 weighing 1.818 kg (4,000 lb) and containing 227 kg (500 lb) cement, 564 kg (1,240 lb) sand, 864 kg (1,900 lb) coarse aggregate, and 164 kg (360 lb) water.

[c] Filterable PM is that PM collected on or prior to the filter of an EPA Method 5 (or equivalent) sampling train.

[d] Condensable PM is that PM collected in the impinger portion of a PM sampling train.

[e] Reference 6.

[f] For uncontrolled emissions measured before filter. Based on 2 tests on pneumatic conveying controlled by a fabric filter.

[g] Reference 7. From test of mechanical unloading to hopper and subsequent transport of cement by enclosed bucket elevator to elevated bins with fabric socks over bin vent.

[h] Reference 5. Engineering judgment, based on observations and emission tests of similar controlled sources.

[i] From Section 13.2.1, with k = 0.8, s = 12, S = 20, W = 20, w = 14, and p = 100; units of lb/vehicle miles traveled; based on facility producing 23,100 m^3/yr (30,000 yd^3/yr) of concrete, with average truck load of 6.2 m^3 (8 yd^3) and plant road length of 161 meters (0.1 mile).

[j] From Section 11.19.1, for emissions <30 micrometers from inactive storage piles.

[k] Units of lb/acre/day.

[l] Assumes 1,011 m^2 (1/4 acre) of sand and aggregate storage at plant with production of 23,000 m^3/yr (30,000 yd^3/yr).

[m] Based on pneumatic conveying of cement at a truck mix facility; does not include vehicle traffic or wind erosion from storage piles.

Predictive equations that allow for emission factor adjustment based on plant-specific conditions are given in Chapter 13. Whenever plant specific data are available, they should be used in lieu of the fugitive emission factors presented in Table 11.12-1.

References For Section 11.12

1. *Air Pollutant Emission Factors*, APTD-0923, U. S. Environmental Protection Agency, Research Triangle Park, NC, April 1970.

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3. Telephone and written communication between Edwin A. Pfetzing, PEDCo Environmental, Inc., Cincinnati, OH, and Richard Morris and Richard Meininger, National Ready Mix Concrete Association, Silver Spring, MD, May 1984.

4. *Development Document For Effluent Limitations Guidelines And Standards Of Performance, The Concrete Products Industries, Draft*, U. S. Environmental Protection Agency, Washington, DC, August 1975.

5. *Technical Guidance For Control Of Industrial Process Fugitive Particulate Emissions*, EPA-450/3-77-010, U. S. Environmental Protection Agency, Research Triangle Park, NC, March 1977.

6. *Fugitive Dust Assessment At Rock And Sand Facilities In The South Coast Air Basin*, Southern California Rock Products Association and Southern California Ready Mix Concrete Association, Santa Monica, CA, November 1979.

7. Telephone communication between T. R. Blackwood, Monsanto Research Corp., Dayton, OH, and John Zoller, PEDCo Environmental, Inc., Cincinnati, OH, October 18, 1976.