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TECHNICAL GUIDANCE FOR CONTROL OF INDUSTRIAL PROCESS FUGITIVE PARTICULATE EMISSIONS

by

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2.10 CONCRETE BATCHING

2.10.1 Process Description

Concrete batching plants store, convey, measure, and discharge the constituents for making concrete to transportation equipment. Plants are of three basic types: wet batching, dry batching, and central mix plants. The plants are similar in the method by which the solid raw materials (sand, aggregate, and cement) are received, stored, transferred and blended, but differ with respect to where the water is added to the mix.

The raw materials are delivered to the plant by rail or truck. The cement is transferred pneumatically (most common) or by bucket elevator to elevated storage silos, while the sand and aggregate are generally stored on the ground and transferred to elevated bins via belt conveyor or bucket elevator in preparation for mixing. From the overhead bins, they go to weigh hoppers which weigh out the proper amount of each material. The wet batching plant mixes sand, aggregate, cement and water in the proper proportions (from the weigh hopper), and dumps the mixture into transit mix trucks which mix the batch en route to the site where the concrete is to be poured. Dry batching plants mix the sand, aggregate and cement and then dump this dry mix into flat bed trucks which transport the batch to paving machines at the job site where water is added and mixing takes place. A central mix plant uses a central mixer to make the wet concrete for transfer by open bed dump trucks to the job site.

A process flow diagram for concrete batching is shown in Figure 2-20. Each potential fugitive emission point is identified and quantified by emission factors in Table 2-55. A dust source common to all concrete batch plants, but not

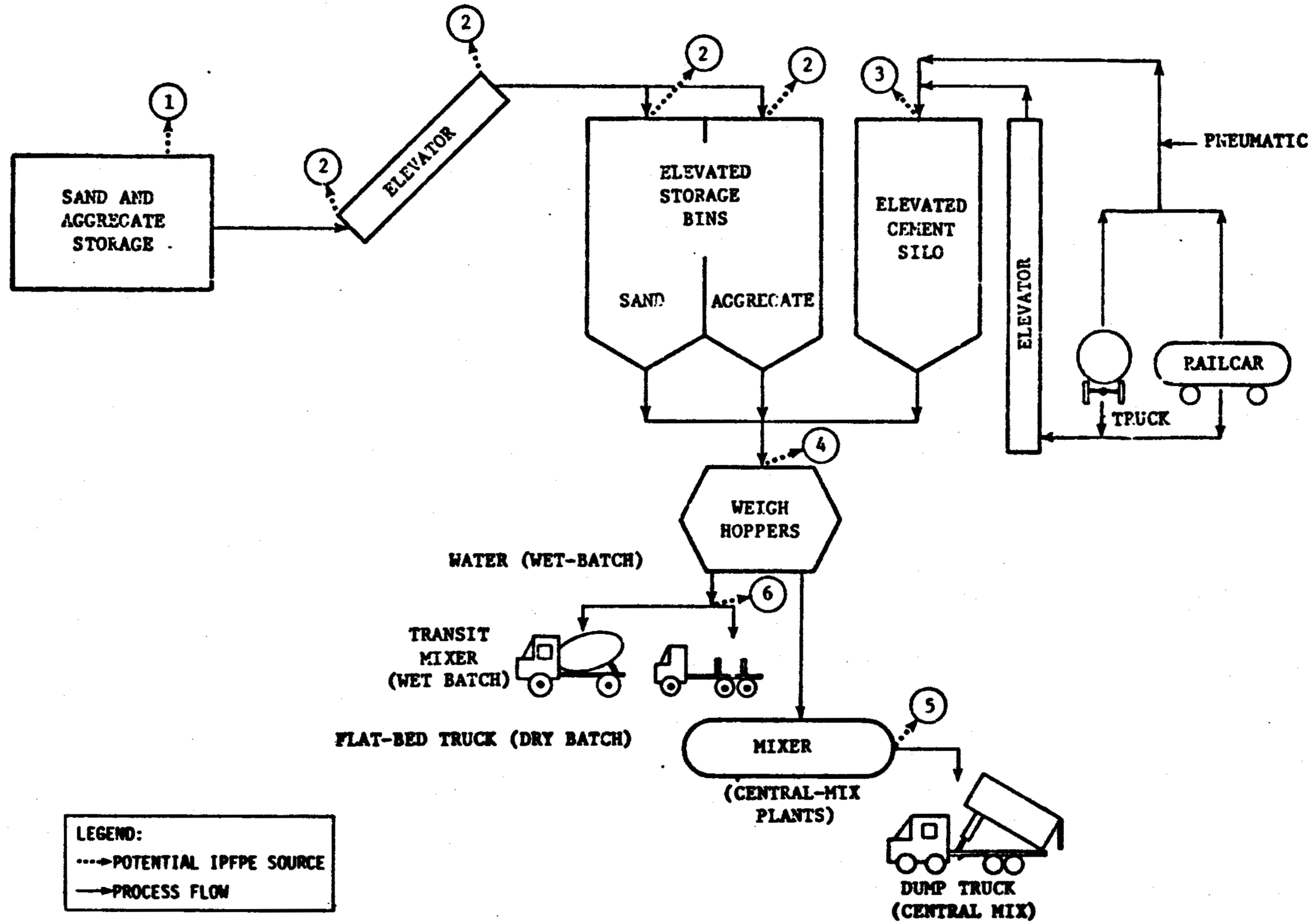

Figure 2-20. Process flow diagram for concrete batching showing potential industrial process fugitive particulate emission points.

Table 2-55. IDENTIFICATION AND QUANTIFICATION OF POTENTIAL FUGITIVE PARTICULATE EMISSION POINTS FOR CONCRETE BATCHING

Source of IPFPE	Uncontrolled fugitive emission factor	Emission factor reliability rating	Model plant fugitive emission inventory: Operating parameter, Mg/yr (tons/year)	Model plant fugitive emission inventory: Uncontrolled emissions Mg/yr (tons/yr)
1. Sand aggregate storage				
Loading onto pile	$\frac{(0.02)\ (K_1)\ (S/1.5)}{(PE/100)^2}$ kg/Mg material loaded onto pile[b] $\left(\frac{(0.04)\ (K_1)\ (S/1.5)}{(PE/100)^2}\right.$ lb/ton material loaded onto pile)	D	Sand and aggregate loaded 20,000 (22,000)	negligible
Vehicular traffic	$\frac{(0.065)\ (K_2)\ (S/1.5)}{(PE/100)^2}$ kg/Mg material stored[b] $\left(\frac{(0.13)\ (K_2)\ (S/1.5)}{(PE/100)^2}\right.$ lb/ton material stored)	D	Sand and aggregate stored 20,000 (22,000)	1 (1)
Loading out	$\frac{(0.025)\ (K_3)\ (S/1.5)}{(PE/100)^2}$ kg/Mg material loaded out[b] $\left(\frac{(0.05)\ (K_3)\ (S/1.5)}{(PE/100)^2}\right.$ lb/ton material loaded out)	D	Sand and aggreate loaded out 20,000 (22,000)	negligible
Wind erosion	$\frac{(0.055)\ (S/1.5)}{(PE/100)^2}\ (\frac{D}{90})$ kg/Mg material stored[b] $\left(\frac{(0.11)\ (S/1.5)}{(PE/100)^2}\ (\frac{D}{90})\right.$ lb ton material stored)	D	Sand and aggregate stored 20,000 (22,000)	1 (1)

Table 2-55 (continued). IDENTIFICATION AND QUANTIFICATION OF POTENTIAL FUGITIVE PARTICULATE EMISSION POINTS FOR CONCRETE BATCHING

Source of IPFPE	Uncontrolled fugitive emission factor	Emission factor reliability rating	Model plant fugitive emission inventory: Operating parameter, Mg/yr (tons/year)	Model plant fugitive emission inventory: Uncontrolled emissions Mg/yr (tons/yr)
2. Transfer of sand and aggregate to elevated bins	0.02 kg/Mg of sand and aggregate transferred[c] (0.04 lb/ton of sand and aggregate transferred)	E	Sand and aggregate transferred 60,000 (66,000)	1.2 (1.3)
3. Cement unloading to elevated storage silos	0.118 kg/Mg of cement unloaded[d] (0.236 lb/ton of cement unloaded)	D	Cement transferred to storage silo 7,000 (7,700)	0.8 (0.9)
4. Weigh hopper loading of cement, sand, and aggregate	0.01 kg/Mg of cement, sand and aggregate[c] (0.02 lb/ton of cement, sand and aggregate)	E	Cement, sand, and aggregate loaded 67,000 (73,700)	0.7 (0.8)
5. Mixer loading of cement, sand and aggregate (central mix plant)	0.02 kg/Mg of cement, sand and aggregate[c] (0.04 lb/ton of cement, sand and aggregate)	E	-	-
6. Loading of transit mix (wet-batching) truck	0.01 kg/Mg of cement, sand and aggregate[c] (0.02 lb/ton of cement, sand and aggregate)	E	Cement, sand, and aggregate loaded 67,000 (73,700)	0.7 (0.8)
7. Loading of dry-batch truck	0.02 kg/Mg of sand and aggregate[c] (0.04 lb/ton of sand and aggregate)	E	-	-

[a] AP-42 (Reference 2) reports total plant uncontrolled emission factor of 0.05 kg/Mg (0.1 lb/ton) of concrete produced.

[b] For complete development of this factor, refer to Section 2.1.4. For their example is was assumed that S = 1.5, D = 90, PE = 100, and K_1, K_2, and K_3 = 1. Reference 3.

[c] Reference 4.

[d] Reference 5. From testing of mechanical unloading to hopper and subsequent transport of cement by enclosed bucket elevator to elevated bins with a fabric sock over the bin vent.

specifically included in this section is plant roads. Discussion of this fugitive dust source is presented in Section 2.1.

2.10.2 IPFPE Emission Rates

Table 2-55 presents a summary of uncontrolled emission factors for concrete batching plant IPFPE sources. Since these are potential uncontrolled emission rates, the site-specific level of control must be considered for application to a specific plant. Also included are reliability factors for each estimate.

The largest potential source of uncontrolled fugitive emissions at concrete batching plants is cement unloading to elevated storage silos.

2.10.3 Example Plant Inventory

The example plant inventory for concrete batching shown in Table 2-55 presents potential fugitive emission quantities from the various uncontrolled sources within the process. The inventory represents a wet-batch plant which produces approximately 30,000 m^3 (40,000 yd^3) of concrete per year. The plant inventory is not meant to display a typical plant, but merely a model plant with an arbitrarily chosen production rate.

Raw material constituents were based on the following proportions:

sand and aggregate:	85% by weight
cement:	10-15% by weight
water:	5% by weight
density of concrete:	2.4 Mg/m^3 (4,000 lb/yd^3)

Not included in the inventory are fugitive emissions from plant haul roads. Emission factors for these sources are listed in Section 2.1. Total model plant uncontrolled process fugitive particulate emissions are 5.4 Mg (5.8 tons) per year.

2.10.4 Characteristics of Fugitive Emissions

In a wet concrete batching plant, practically all the dust generated is cement dust since most of the sand and aggregate used is damp. Particle size characteristics of the dust vary according to the grade of cement. A range of 10 to 20 percent by weight <5 μm is typical for the various grades of cement. The dust generated from dry concrete batching plants has characteristics similar to those of the cement dust discussed for wet concrete batching plants.

2.10.5 Control Technology

Control technology options, with the exception of unpaved roads and storage of sand and aggregate discussed in Section 2.1, are presented in Table 2-56. This section discusses the major fugitive emission sources and their related control technology.

The amount of fugitive emissions generated during transfer of sand and aggregate from storage to elevated storage bins depends primarily on the surface moisture content of these materials. Water sprays applied at the feed, transfer, and discharge points of the belt conveyor or bucket elevator system will ensure that the material is sufficiently moist to prevent dusting. In addition, most plants partially or completely enclose the conveyor system to prevent windage losses. Transfer points may also be exhausted to fabric filters for control. Section 2.1.1 discusses transfer and conveying sources in detail.

Pneumatic transfer of cement to elevated storage silos from trucks and rail cars equipped with compressors are finding increased application over cement transfer by bucket elevator. Pneumatic transfer eliminates emissions between the truck or railcar and the cement silo and requires control only at the cement silo vent by fabric filter. In the

Table 2-56. CONTROL TECHNIQUES FOR CONCRETE BATCHING IPFPE SOURCES

Industry: Concrete Batching			FUGITIVE EMISSIONS CAPTURE AND CONTROL METHODS														
				Preventative procedures and operating changes							Capture methods				Removal equipment		
	Negligible emissions	IPFPE source typically uncontrolled	Control technologies identified in Section 2.1	Wet suppression (water and/or chemical)	Confinement by enclosure	Better control of raw material quality	Better control of operating parameters and procedures	Improved maintenance and/or construction program	Increase exhaust rate of primary control system		Fixed hoods, curtains, partitions, covers, etc.	Movable hoods with flexible ducts	Closed buildings with evacuation		Fabric filter	Scrubber	Fabric "sock"
1. Sand and aggregate storage			✓														
2. Transfer of sand and aggregate to elevated bins			✓														
3. Cement transfer to elevated storage silos[b] and silo vents					x[a]										o		o
4. Weigh hopper loading of cement, sand, and aggregate											o				o	o	
5. Mixer loading of cement, sand, and aggregate (central mix plant)												o			o	o	
6. Loading of transit mix (wet batching) truck					x						o	o			o	o	
7. Loading of flat-bed (dry batch) truck					x						o	o			o	o	

x Typical control technique.

o In use (but not typical) control technique.

+ Technically feasible control technique.

[a] For bucket elevators.

pneumatic delivery system a volume of conveying air required is about 0.165 to 0.330 m^3 per second (350 cfm to 700 cfm) depending on the loading cycle, etc. Since the air is being forced into the silo the baghouse will require a blower in order to relieve the pressure inside the silo, and allow flow through the fabric filter. A vent rate in the neighborhood of 0.566 to 0.613 m^3 per second (1200 to 1300 cfm) is generally required. The negative pressure created also prevents cement dust leakage around access doors, and other openings which would not be the case if the cement silo was under a positive pressure during filling.

The cement receiving storage system for a bucket elevator is at or below ground level. The hopper is designed to fit a canvas discharge tube from the hopper of the truck or railcar, which practically eliminates cement emissions. The bucket elevator is usually completely enclosed. As with pneumatic conveying, the cement silo vent emissions caused by the air displaced in the silo during loading must be controlled. Control can be accomplished by venting to a central dust collecting system or a single collector placed on top of each silo. A fabric type of collector is most often used to vent the cement silo as well as other dust collecting points in concrete batching plants. The single type of filter that is placed on each silo can be operated without an exhauster when the material is delivered to the silo by bucket elevators because it is simply used to filter the air that is forced out.

The emissions generated from the rapid discharge of sand, aggregate, and cement into the weigh hopper may be controlled by venting the displaced air to the individual storage bins and silo or by venting it directly to a central collecting system.

Fugitive emissions from air displaced as dry materials are discharged from the weigh hopper into the mixer at a central mix plant can be considerable. Effective control can be accomplished by a mobile hood placed over the outlet of the discharge end of the mixer. This hydraulically operated hood is swung away from the discharge end when the mixer is dumped. For a hood of this type the indraft face velocity should be approximately 5-8 m/sec (1000-1500 ft/min) in order to overcome the velocities that are created when the dry aggregate and cement fall into the mixer.

Fugitive emissions generated when the weighed amount of sand, aggregate, and cement is dumped from the weigh hoppers into the receiving hopper of the transit mix truck can be controlled by several different methods: (1) employment of a telescopic shroud which encompasses the rear of the mixer which can be controlled mechanically or by air cylinders. The flexible shroud is lowered over the rear of the truck when the truck is in place; (2) stationary type of hood where the trucks have to back into it. This is a good design but the fact that the trucks have to back into it may be a disadvantage; (3) hood made of sheet metal which totally encloses the transit mix truck receiving hopper when in place. After the truck is filled, the panels are raised. The side panels of the hood are actuated by air cylinders. Most plants that do dry batching also do wet batching, therefore, the weigh hoppers must be set high enough to accomodate the transit mix trucks used in wet batching. Since the receiving hopper of most transit mix trucks is several feet higher than the top of flat bed trucks used to haul the material in dry batching, there are considerable fugitive emissions from the fall of material when a dry batch is discharged. Because the plant operator must view the operation and because the truck must also have freedom of movement, this is a difficult operation to hood. The truck bed is usually divided into several compartments and the batch is dropped into each compartment. This necessitates moving the truck after each drop in one compartment so another compartment of the truck can be moved into place. A canopy type hood just large enough to cover one compartment at a time provides effective dust pickup and affords adequate visibility. The sides can be made of heavy rubber to give the hood some flexibility so that it will not be damaged if a truck hits it. The hood is sometimes mounted on rails to permit it to be withdrawn and allow wet batching into transit mix trucks. The exhaust volume varies with the shape of the hood and is usually in the neighborhood of 2.83 to 3.30 m^3 per second (6000 to 7000 cfm).

A conscientious housekeeping program which includes such measures as prompt clean-up of spills, maintenance of conveyor equipment to prevent leaks and proper handling and disposal of the material collected by fabric filters, is necessary to complete the overall effective control of fugitive emissions at cement batching plants.

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