

246: HMA, Aggregate & Concrete Batching



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Overview

- Introduction
- Industry History
- Emissions and Health Impacts
- Concrete Industry Description
- Inspection Procedures
- Engineering Evaluation/Permit Process



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Constitutes



Basic Ingredients

11% Portland Cement

41% Aggregate or Course Stone

26% Sand

16% Water

Balance: Inert Material

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What is Concrete?



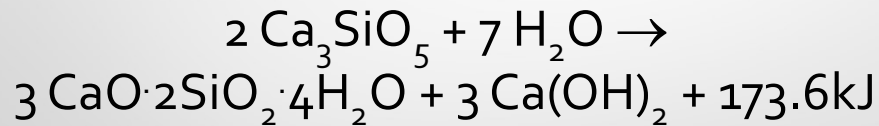
A combination of water, sand, rock, and portland cement mixed together to harden.

Composition of Portland cement with chemical composition and weight percent.

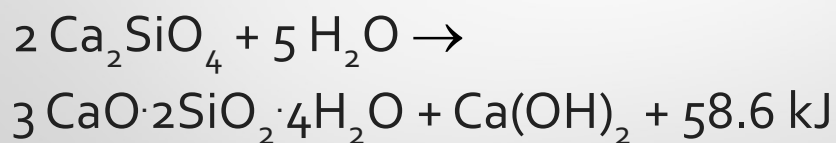
Cement Compound	Weight Percentage	Chemical Formula
Tricalcium silicate	50 %	Ca_3SiO_5 or $3\text{CaO}\cdot\text{SiO}_2$
Dicalcium silicate	25 %	Ca_2SiO_4 or $2\text{CaO}\cdot\text{SiO}_2$
Tricalcium aluminate	10 %	$\text{Ca}_3\text{Al}_2\text{O}_6$ or $3\text{CaO}\cdot\text{Al}_2\text{O}_3$
Tetracalcium aluminoferrite	10 %	$\text{Ca}_4\text{Al}_2\text{Fe}_2$ or $4\text{CaO}\cdot\text{Al}_2\text{O}_3\cdot\text{Fe}_2\text{O}_3$
Gypsum	5 %	$\text{CaSO}_4\cdot 2\text{H}_2\text{O}$

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Tricalcium silicate + Water →
Calcium silicate hydrate +
Calcium hydroxide + heat



Dicalcium silicate + Water →
Calcium silicate hydrate +
Calcium hydroxide + heat



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Concrete Batching
Operations



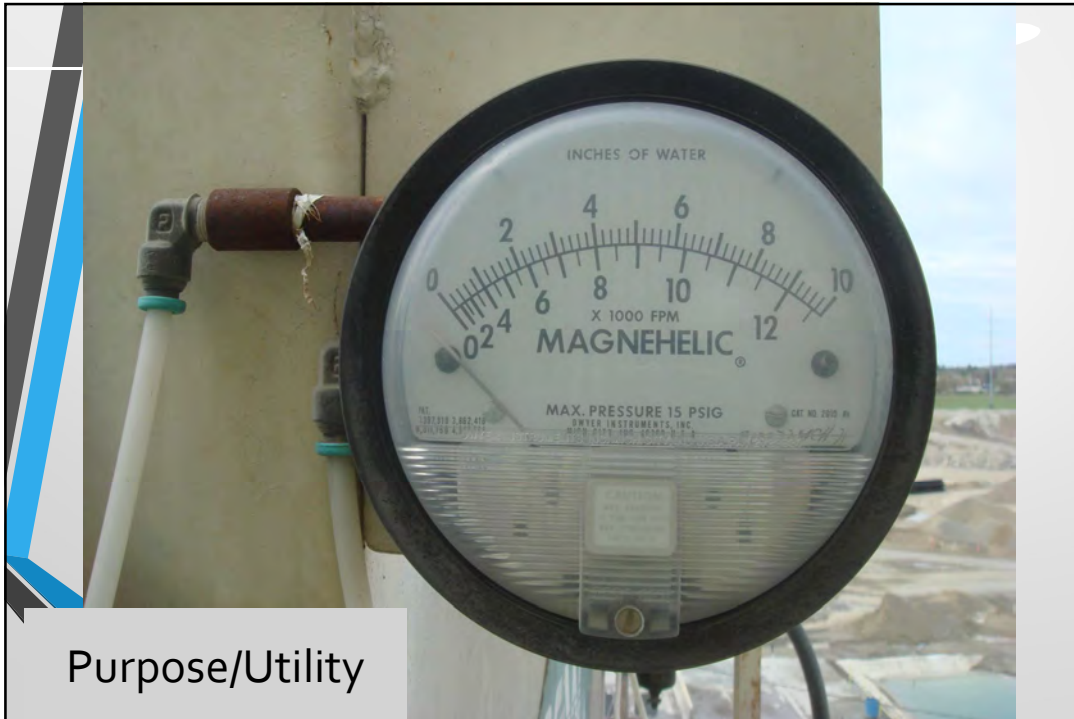
Cement Delivery
Pneumatically



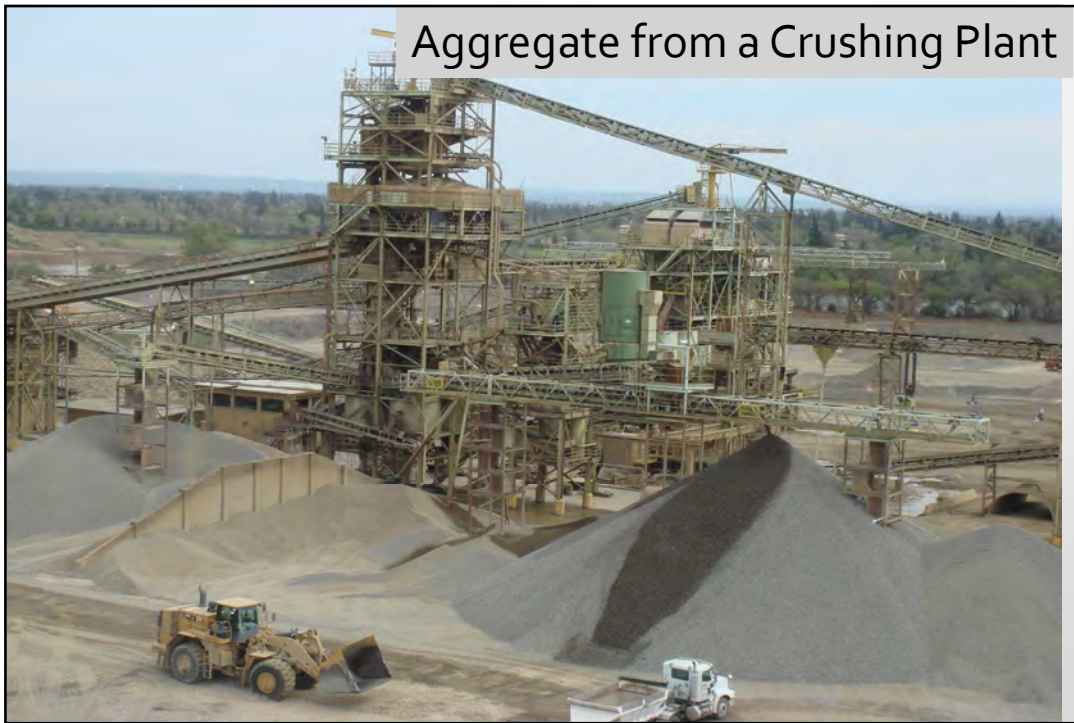
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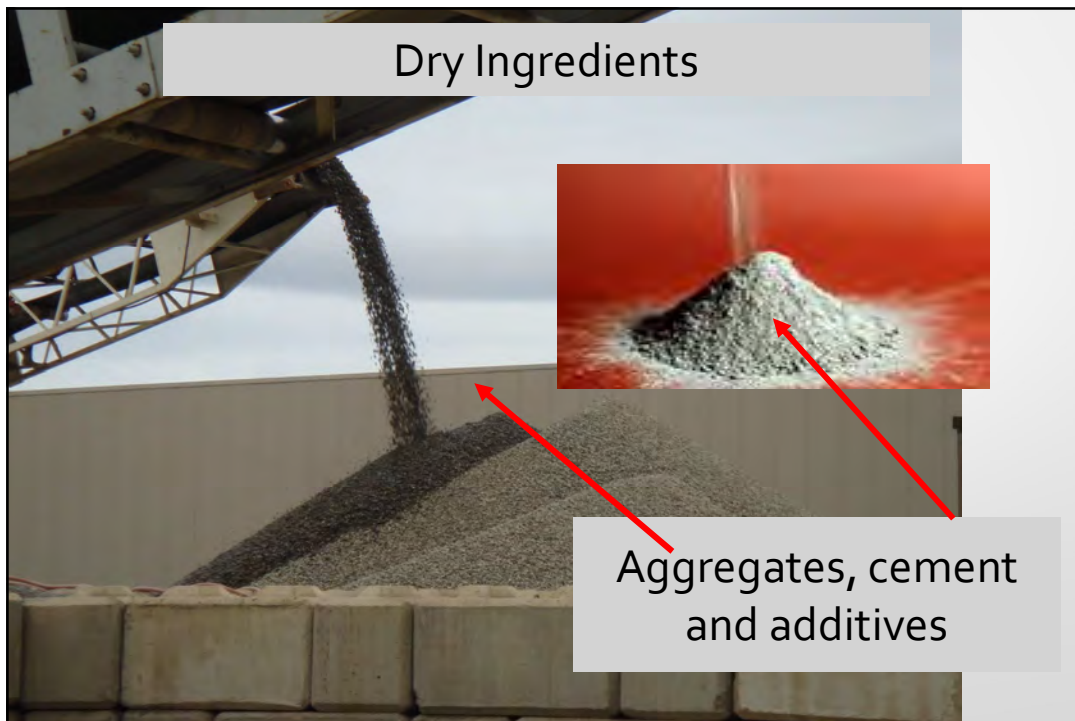
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Concrete Batching Process

- Store, convey, measure, and then discharge the ingredients to make concrete into equipment that mixes, packages, or transports the mixture for use



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Additive Ingredients



Ingredients

- Air retaining Agents - Provides resistance
- Water Reducing - Reduces the amount of water needed
- Accelerating Agents - Shortens setting or cure time
- Retarding Agents - Slows the setting/cure time
- Fungicides - Prevents fungus or bacterial growth

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Concrete Batching Process



75% of U.S. concrete is produced at plants that

1. Store
2. Convey
3. Measure
4. Mix
5. Discharge into trucks

Types of Concrete Batching Process

Transit Mix



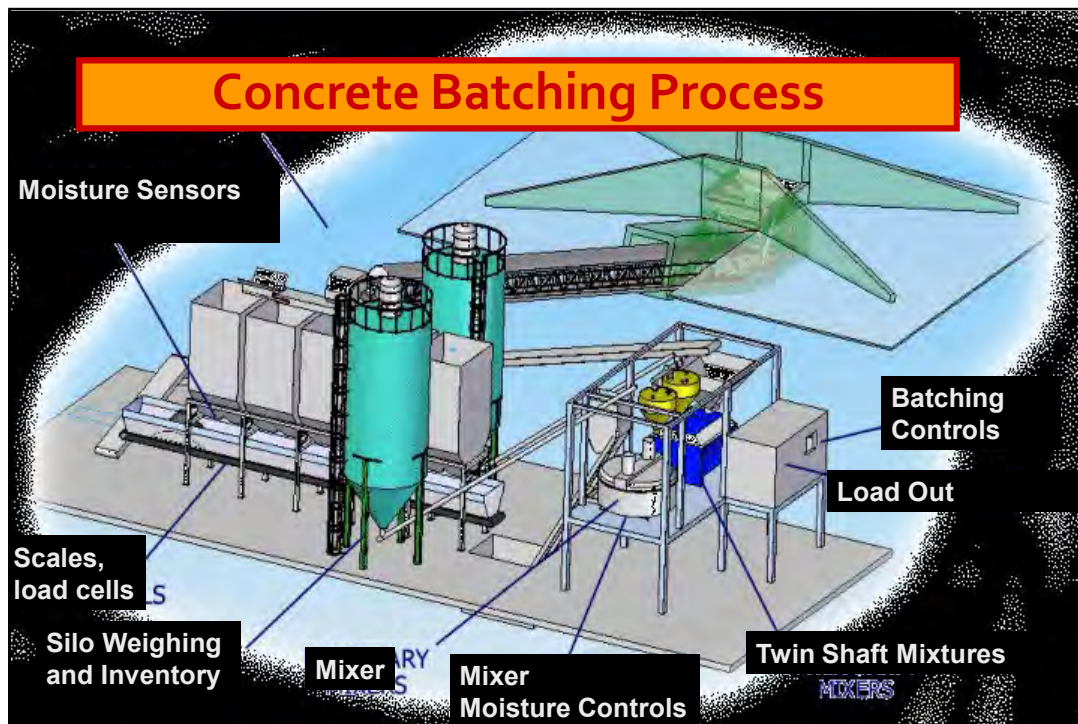
Central Mix



Ready Mix



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Concrete Batching Process: Types of Emissions

- Particulate Matter
- Combustion Emissions

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Concrete Batching Process



Concrete Batching: Stockpiles



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Concrete Batching: Storage of Dry Ingredients



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Concrete Batching: Raw Material Receiving & Storage



Concrete Batching: Raw Material Receiving & Storage



Aggregate Screen & Surge Bin

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Concrete Batching: Moisture Sensor



Concrete Batching: Cement Receiving & Storage



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Concrete Batching: Cement Receiving & Storage



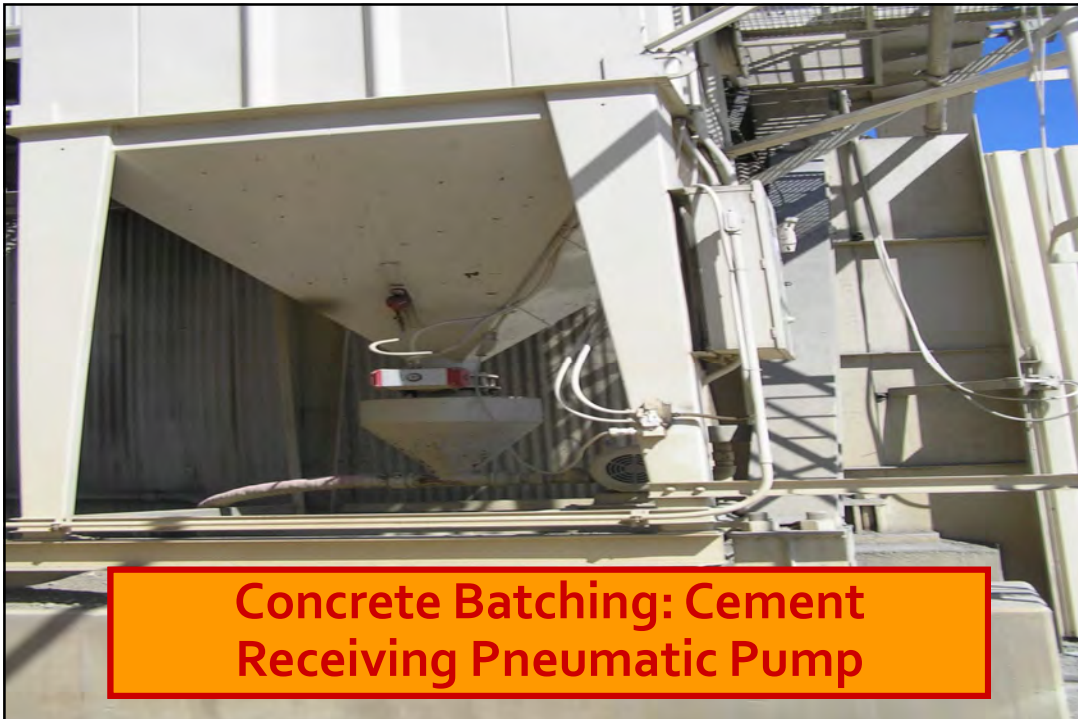
Concrete Batching: Cement Receiving Pneumatic Pumps



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Concrete Batching: Cement Receiving Pneumatic Pumps

- Dense-phase Pneumatic Conveying
 - Moves material at low velocity to prevent material degradation and equipment wear
 - Reduces segregation and promotes flow
 - Dry bulk material is typically loaded into a vessel called a *transporter*
 - Pressurized from 15 to 60 psi

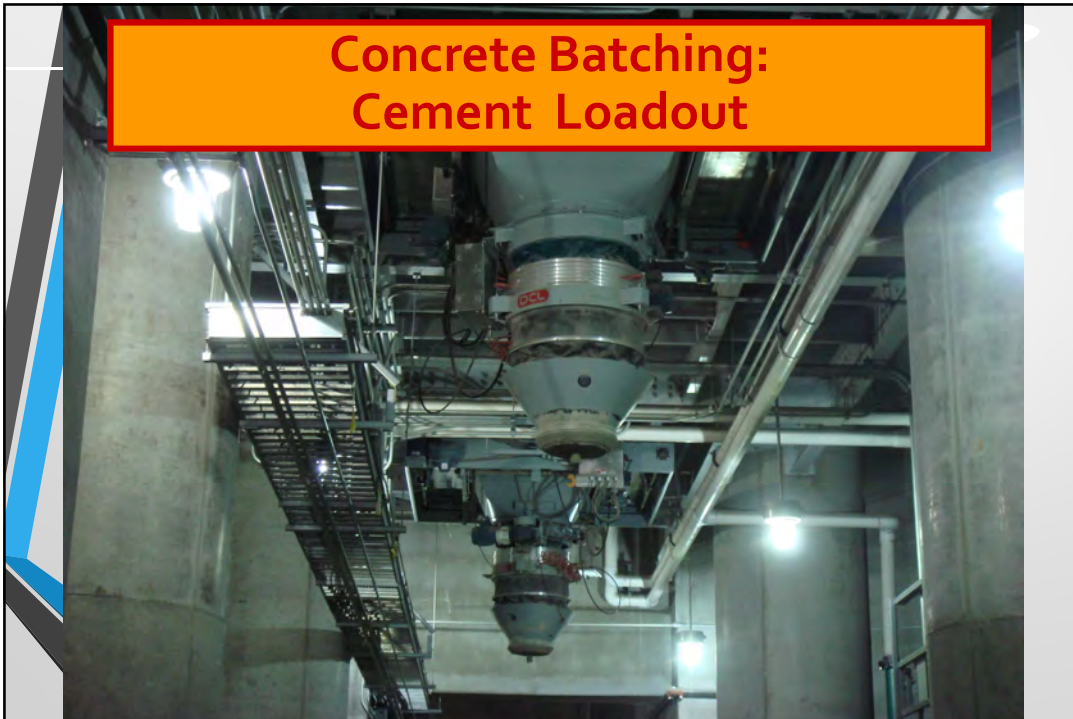


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Concrete Batching: Cement Receiving Silo



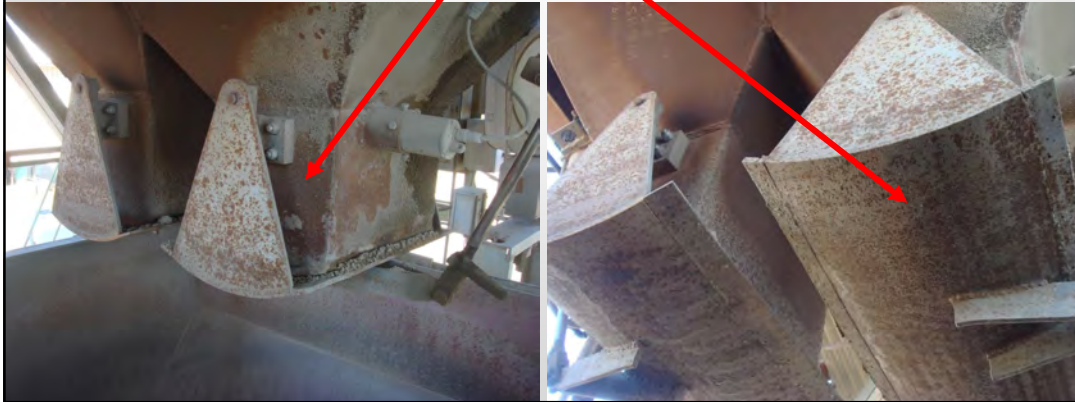
Concrete Batching: Cement Loadout



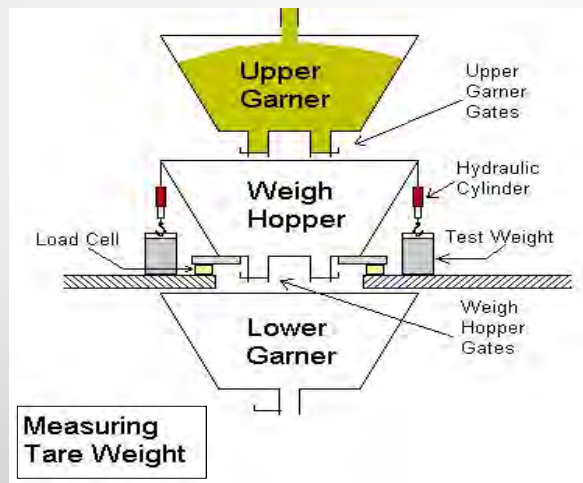
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Concrete Batching: Weigh Hopper

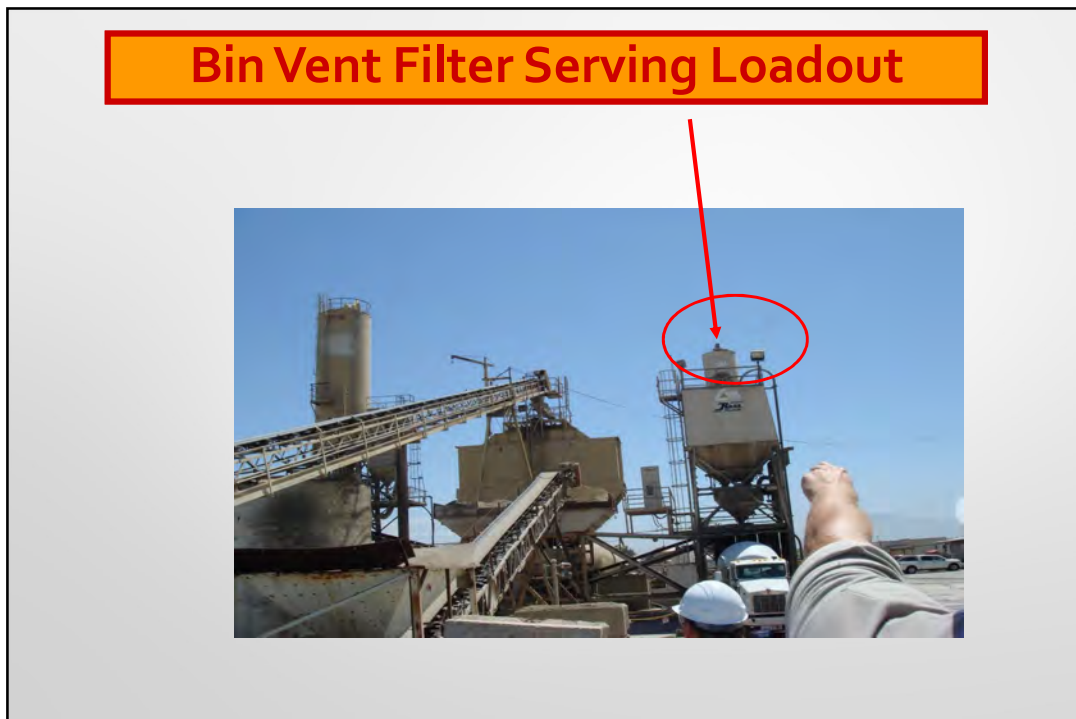
Weigh Hopper



Bulk-Weighing Scale



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Bin Vent Filters

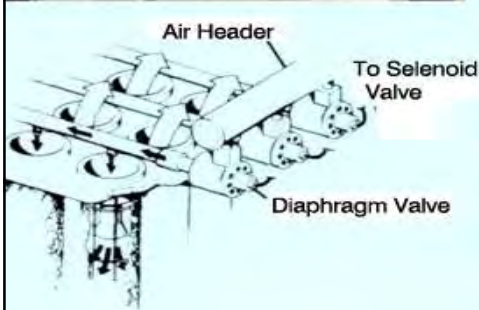


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Bin Vent Filters



Concrete Batching Process: Central Mix

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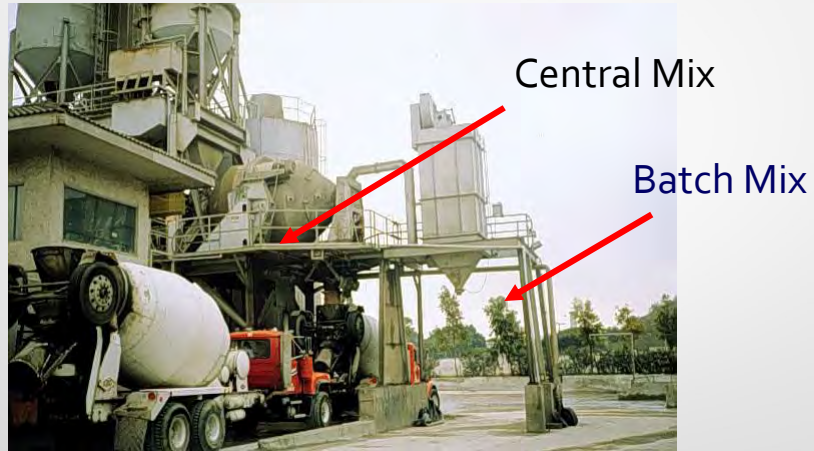


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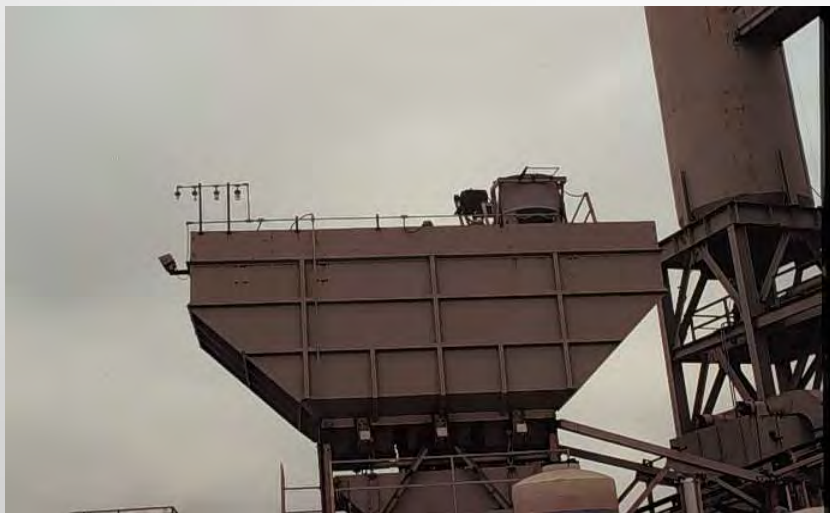


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Concrete Batching Process



Concrete Batching Process: Batch Mix



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Concrete Batching Process: Central Mix



Central Mix



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Concrete Ready Mix: Bagging Operation



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Concrete Ready Mix: Bagging Operation



Concrete Batching Operation



Portable Plant

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PERP vs Non-PERP

Not Portable Equipment

- Remains in same location more than 12 consecutive month
- Remains in same location less than 12 consecutive months, but production is equal to annual source operations (seasonal sources)
- Unit is moved and returned to the same location

Industry Description Concrete Recycling



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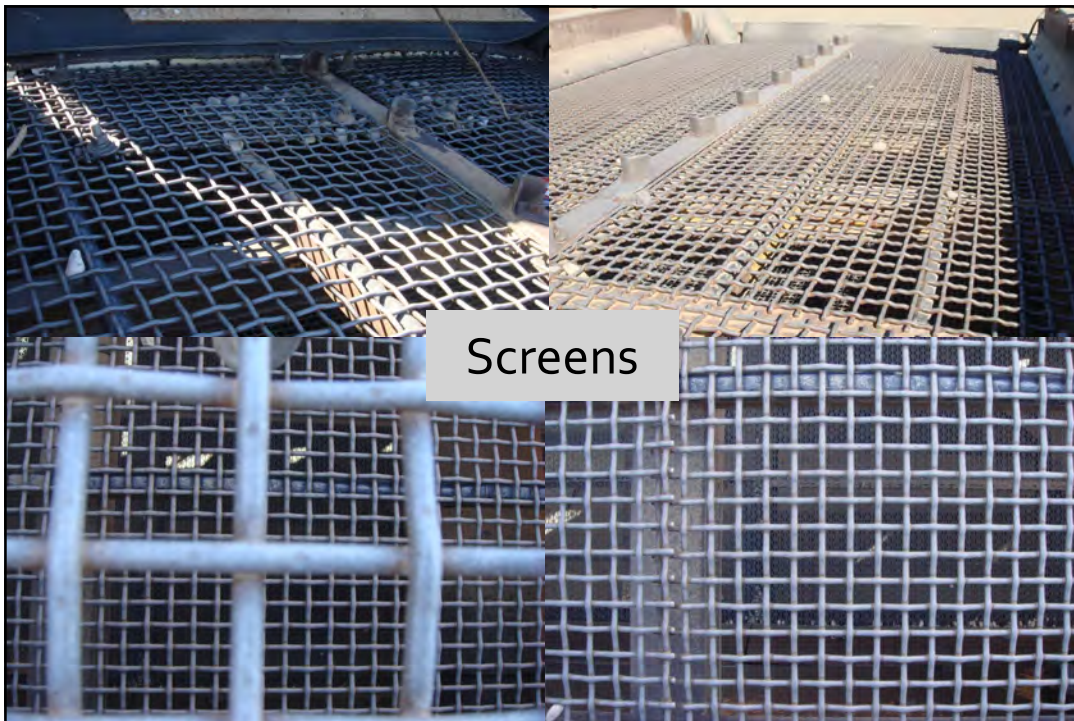


Magnate Used
to remove
material

Screens



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Aggregate Storage Piles



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Air Quality Concerns

- PM from cement dust & concrete batching process
- 10% to 20% are smaller than 5 microns in diameter
- PM₁₀ & PM_{2.5} have health impacts



Inspection Procedures: Bags



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Inspection Procedures: Puffing Due to Improper Maintenance



Inspection Procedures: Clogged Bags



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Inspection Procedures: Storage Hoppers



Inspection Procedures: Fugitive Dust

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Inspection Procedures: Preventative Measures

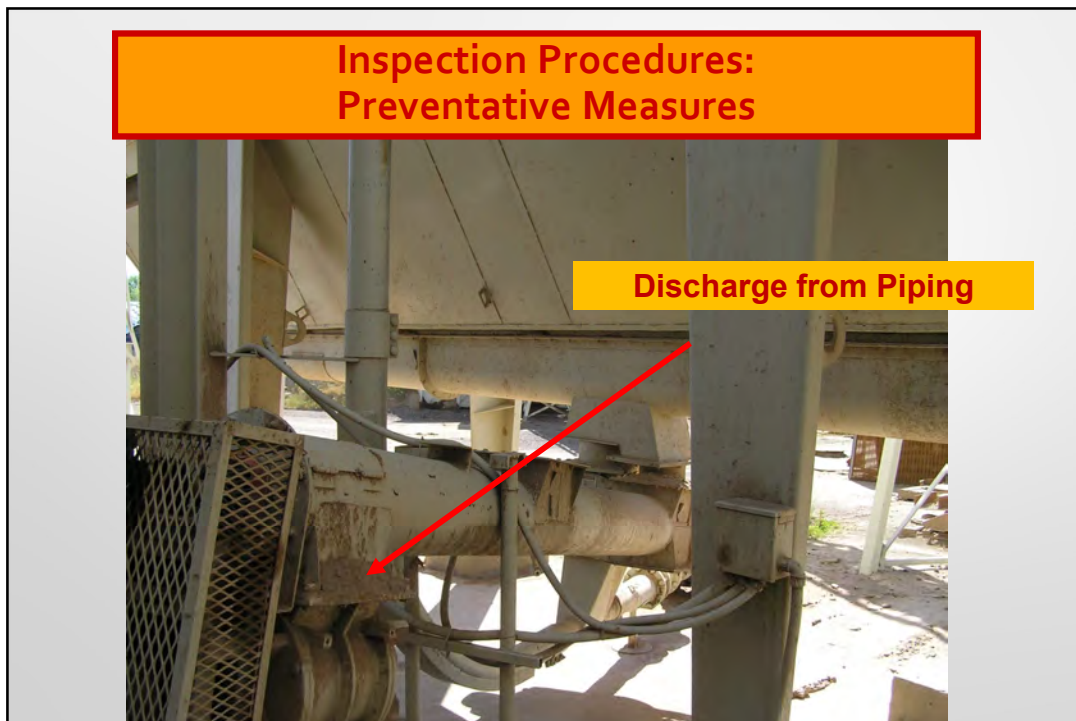
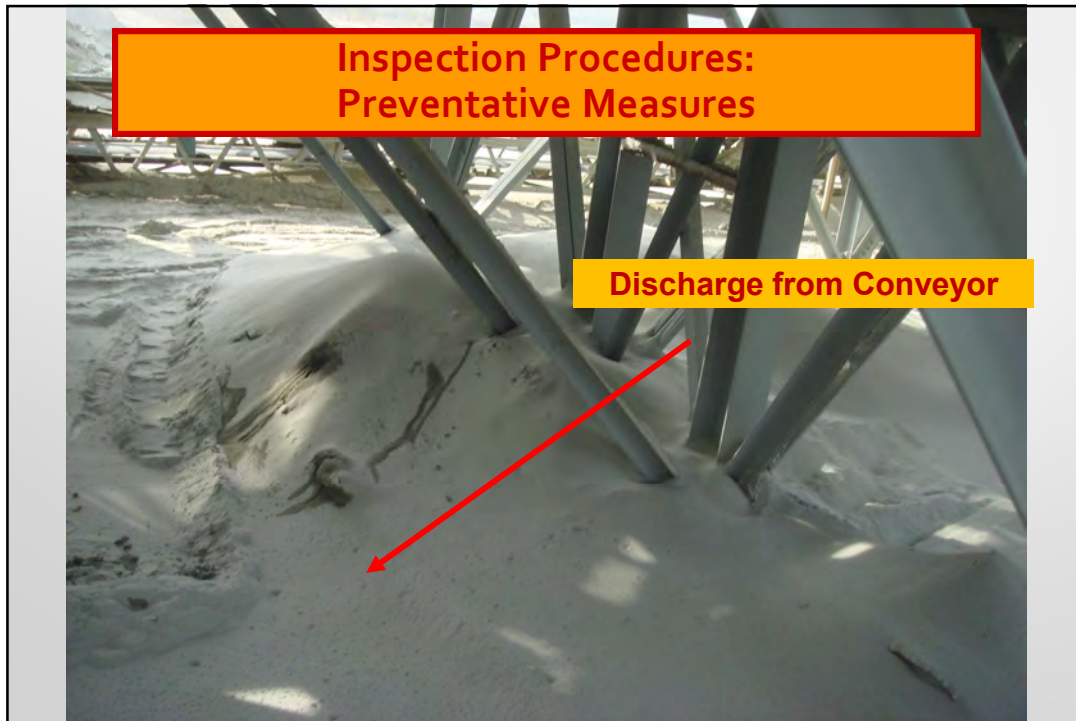
- Passive enclosures
- Wet suppression & baghouse maintenance
- Paved surfaces Work practices
- Housekeeping



Inspection Procedures: Preventative Measures

- Water sprays
- Enclosures or hooding transfer points and screening operations
- Maintaining good housekeeping
- Air pollution control systems in order
- Covers & wind barriers

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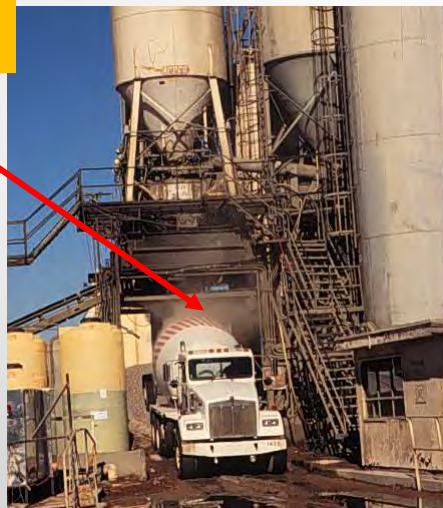
Inspection Procedures: Preventative Measures



Packaging

Inspection Procedures: Preventative Measures

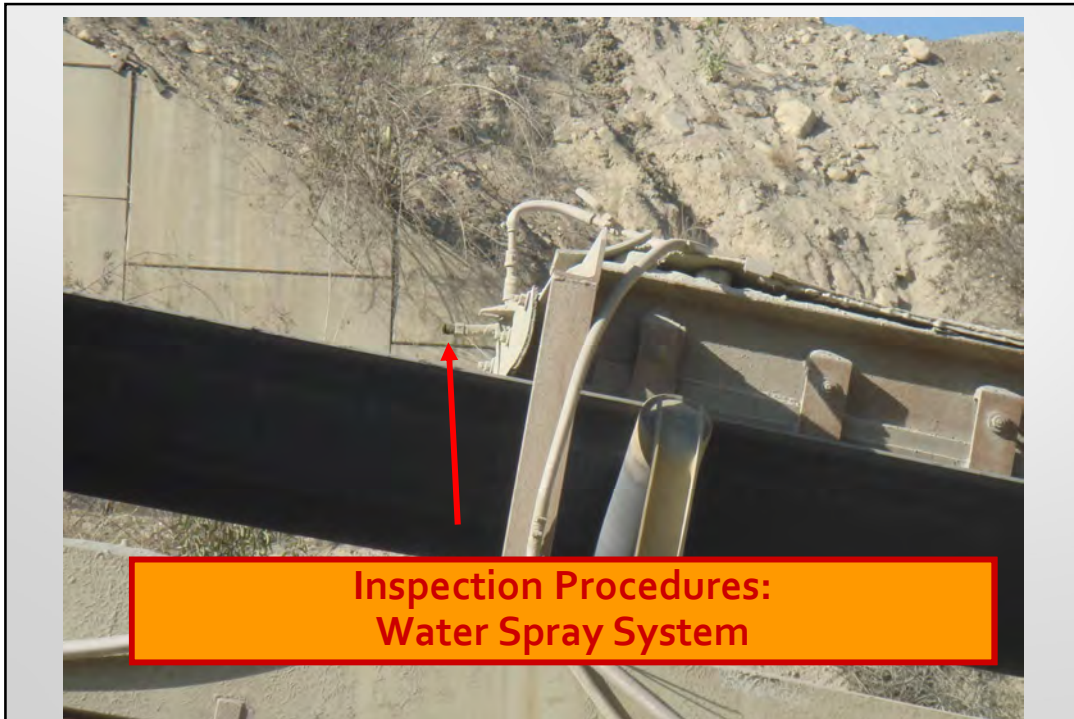
Lack of Dust Control



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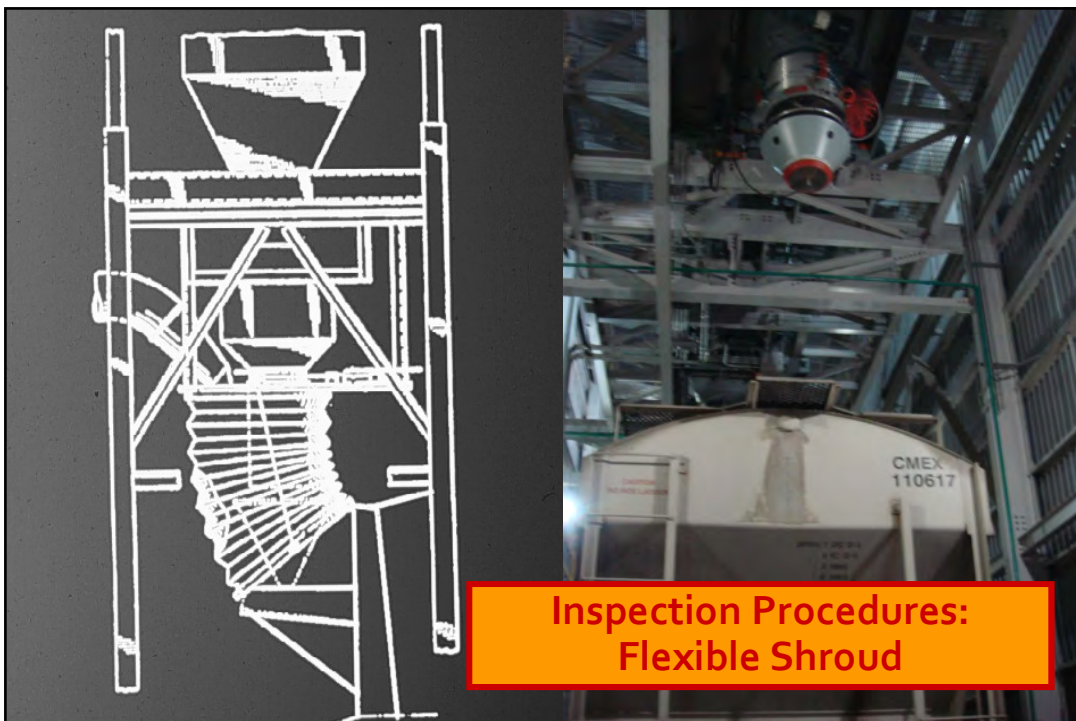
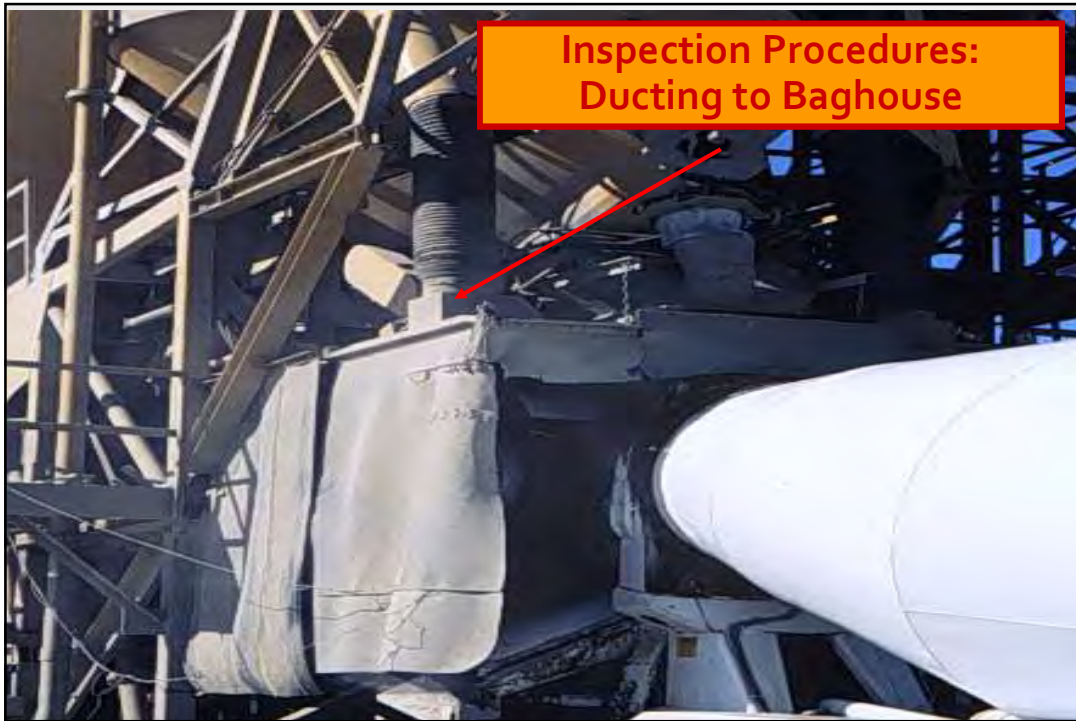
Inspection Procedures: Load out



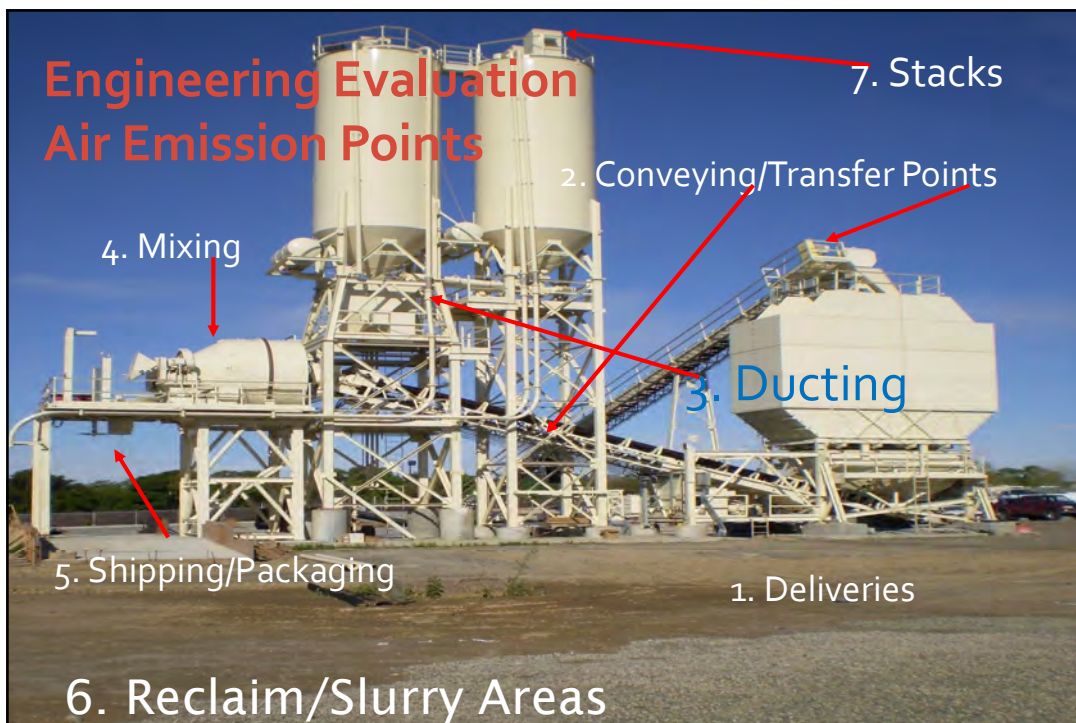
Inspection Procedures: Ducting to Baghouse



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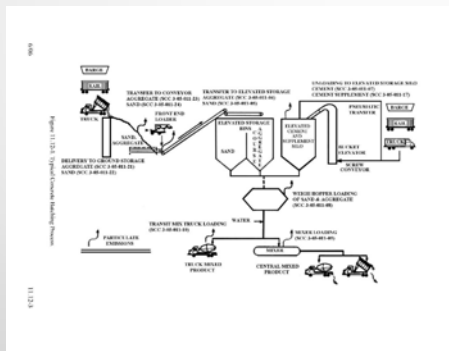


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Engineering Evaluation Typical Process With AP-42 Emission Factors



Engineering Evaluation: Composition of 1 Cubic Yard of Concrete (from AP-42)

Material	Composition by Weight (lbs/yd ³)
Coarse Aggregate	1865
Sand	1428
Cement	491
Cement Supplement	73
Water	20 gallons
Total Quantity Concrete Produced	4024

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Engineering Evaluation: PM Emissions from 1 Cubic Yard of Concrete (from AP-42)

Total PM* equation

$$\text{Total PM emissions} \left[\frac{\text{pounds}}{\text{yd}^3 \text{ of concrete}} \right] = 0.282(\text{Equation 11.12-1 or Table 11.12-2})$$

*Total PM= PM,PM₁₀,PM_{10-2.5},PM_{2.5}

Engineering Evaluation: Site Specific Emission Factor Truck Mix and Central Mix Loading*

$$E = k(0.0032) \frac{U^a}{M^b} + c$$



E = Emission factor in lbs/ton of cement and cement supplements
k = Particle size multiplier (dimensionless)
U = Wind speed at the material drop point (mph)
M = Minimum moisture (% by weight) of cement and cement supplement
a,b = Exponents
c = Constant

* (Equation 11.12-1 from Chapter 11.12 of AP-42)

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Engineering Evaluation: Unpaved Roads (added to emissions from storage piles & represent national average values)

$$E=k(5.9)(s/12)(S/30)(W/3)^{0.7}(w/4)^{0.5}(365-P/365)lb/VMT$$

Where:

E=Emission Factor (lb/VMT)

k=Particle size multiplier (dimensionless); PM10 k=0.36

s=Silt content of road surface (%); 12% average

S=Mean vehicle speed (mph); 20 mph

W=Mean vehicle weight (tons); 20 tons

w=mean number of wheels; 14 wheels

P=Number of days with greater than or equal to, 0.01 inches of precipitation per year; 50.7 days

Engineering Evaluation: Emissions from Storage Piles

- AP-42 8.19, Table 8.19.1-1.
- Loading into storage piles, equipment traffic in storage pile area and wind erosion
- Assume:
 1. 3.5lb/acre/day emission for TSP
 2. 50% or 1.7 lb/acre/day for wind blown dust



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Engineering Evaluation: Emissions Characterization



1. Only the transfer points of cement and cement supplement into the storage silos are point source
 - Storage silos abated by fabric filter, baghouse or binvent filter

Engineering Evaluation: Emissions Characterization

2. Transfer of sand & aggregate, truck loading, mixer loading, vehicle traffic, and wind erosion from sand and aggregate storage piles
 - Water sprays, enclosures, and baghouse devices and good housekeeping, maintenance and wetting of unpaved surfaces



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Engineering Evaluation: Dust Collection Systems



Baghouses are regulated in terms of

1. Grains/dry standard cubic foot of air emitted or
2. Pounds/ton of aggregate produced
3. Opacity

Engineering Evaluation: Dust Collection Control Efficiency

- $IDL - ODL / IDL \times 100 = CE$

Where:

- IDL = inlet dust loading
- ODL = outlet dust loading
- CE = collection efficiency
- Units = Grains/dry standard cubic foot

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Inspection Objectives & Safety

- Determine compliance with District, Federal regulations & permit conditions
- Fugitive emissions
- Dust Collector emissions
- Visible emissions tests
- General Maintenance
- Records & logs
- Corrective actions



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