
Hot Mix Asphalt (HMA)
Facilities


Overview
Introduction
Emissions
Process
Control
Permit Requirements
Inspection Procedures

Introduction

Industry Background

- Hot Mix Asphalt (HMA) facilities
  - ✓ Stationary
  - ✓ Some transportable
- HMA is combination of
  - ✓ Hot aggregate,
  - ✓ Hot liquid asphalt binder
  - ✓ Filler
- Recycled Hot Mix (RHM) is HMA with
  - ✓ Crumb rubber (rubberized asphalt concrete)
  - ✓ Reclaimed asphalt

Introduction

Industry Background

- Two basic processes
  - ✓ Batch
  - ✓ Continuous mix
- Batch change recipe based on customers order
- Continuous mix one recipe at a time stored for up to 7 days in insulated silo

Introduction

Permit Process Requirements

- District issues an "Authority to Construct"
- Inspection conducted
  - ✓Usually includes a source test
- All conditions met "Permit to Operate" is issued

Emissions and Effects

- HMA facilities emit pollutants such as PM, CO, NOx, SOx, VOCs and other toxic substances
- NOx and VOCs are Ozone (O_3) precursors each reacts with sunlight to form O_3

HMA Emissions in CA

(OVER 125 Facilities)

Typical HMA Pollutants	Emissions (tons/yr)
PM (total for all size categories)	1500
PM10	700
PM2.5	400
CO	800
NOx	450
Total Organic Compounds	200
Reactive Organic Gas	200
SOx	100
VOCs	200

Emissions

Criteria and Precursor Pollutants

- Created during production, storage, and transport of HMA
- PM from aggregate

Emissions

Criteria and Precursor Pollutants (cont.)

- PM, CO, NOx, VOCs, and SOx from fuel combustion and storage of asphalt binder and HMA
- Blue Smoke (VOCs) from production and loading

NSPS – Standards of Performance HMA Facilities

(40 CFR Part 60 Subpart I)

Applies to HMA Facilities Comprised of:

- ✓ Dryers
- ✓ Screening, Handling, Storing and Weighing Hot Aggregate Systems
- ✓ Loading, Transferring, and Storing Mineral Filler Systems
- ✓ Mixing HMA Systems
- ✓ Loading, Transfer, and Storage for APC Systems

Applies to HMA Facilities that:

Commence Construction or Modification after June 11, 1973

Particulate Matter Standard

- ✓ No discharge in excess of 90 mg/dscm (0.04 gr/dscf)
- ✓ Not to exceed 20 % Opacity or Greater

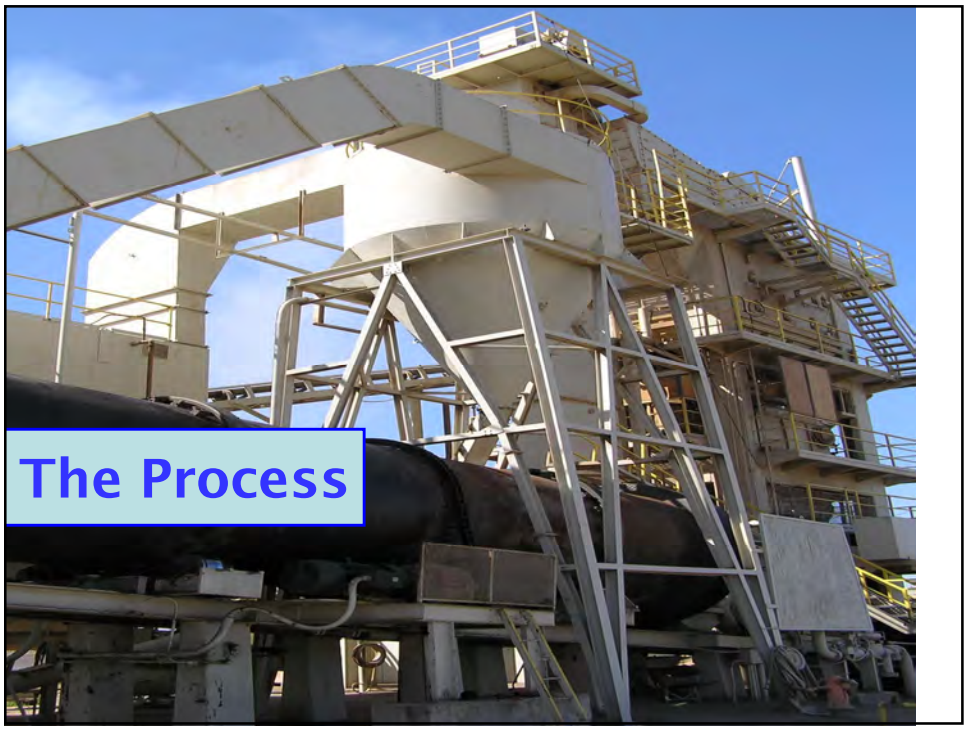
NSPS – Standard of Performance for Nonmetalic Mineral Processing Plants

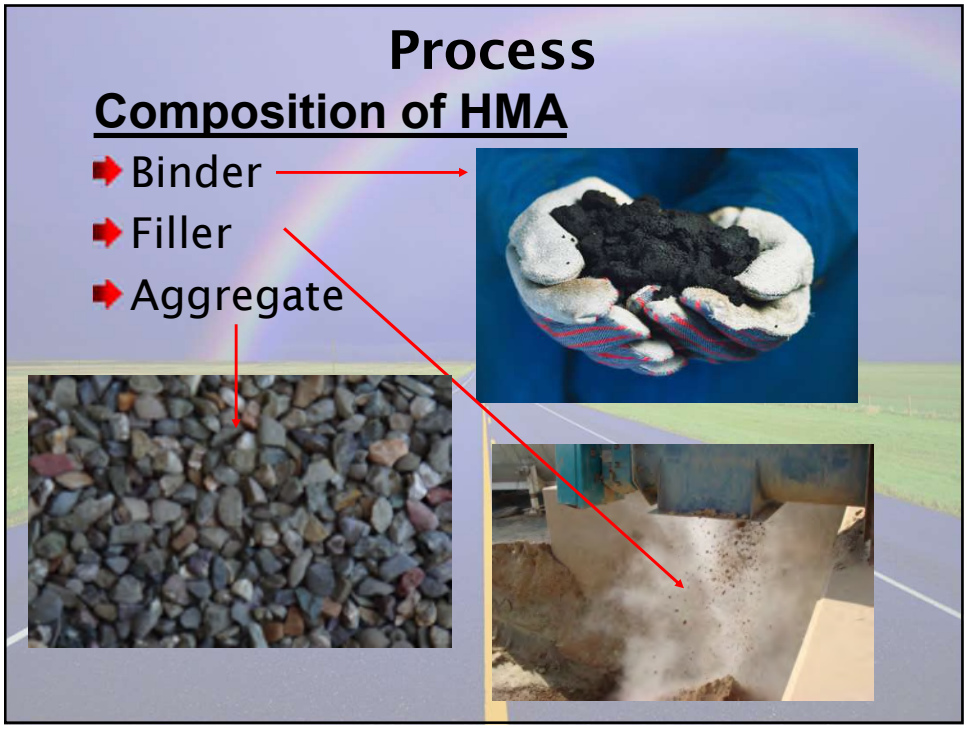
(40 CFR Part 60 Subpart OOO)

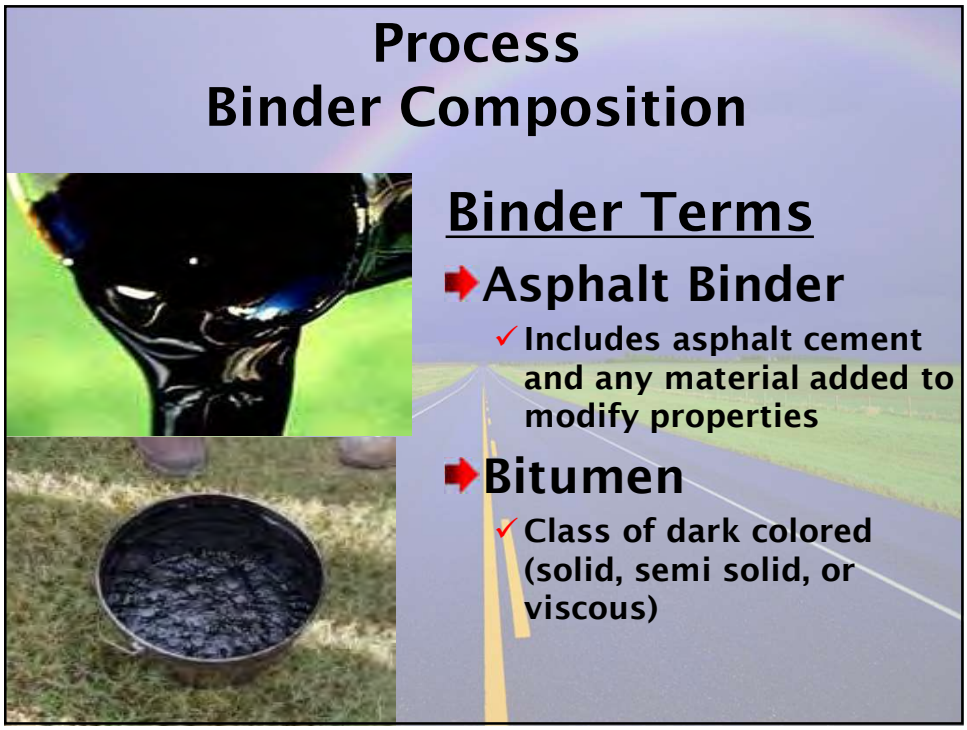
HMA Facilities are also Regulated Under Subpart OOO for Crushers & Grinding Mills

Process/Control

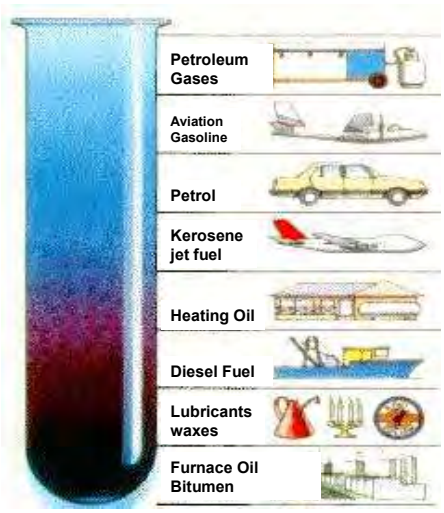
- ✓How much aggregate is processed
- ✓Moisture content of the processed material
- ✓Control efficiency of the air pollution control equipment
- ✓Opacity




Process
Composition of HMA
Binder
Filler
Aggregate


Process
Binder Composition
Binder Terms
Asphalt Binder
Includes asphalt cement and any material added to modify properties
Bitumen
Class of dark colored (solid, semi solid, or viscous)

Process
Binder Composition



Crude Petroleum Distillation Fractions

Process
Asphalt Grading

- Two grading methods
  - ✓Viscosity Grading of Binder
  - ✓Superpave Performance Grade (PG)

Process

Viscosity Grading of Binder

- Viscosity test developed during the early part of the 20th century.
  - ✓AC
    - Tests viscosity of binder to characterize viscosity as supplied (simulating condition before used)
  - ✓AR
    - Tests viscosity of binder aged in a rolling thin-film oven (simulating HMA production)

Process

Viscosity Grading of Binder (cont'd.)

- PG (Superpave Performance Grade)
  - ✓Test developed in 1980-1990
  - ✓Based on performance of binder in relation to climate
  - ✓Temperature range is 115 to 180 F
  - ✓Address rutting, fatigue cracking, and thermal cracking

Process

Conventional HMA Binder

- Solid at room temperature
- 250 and 325 F from point of origin to the final destination
- Softening binder adds VOCs by
  1. Adding softer grade asphalt
  2. Adding lighter petroleum oils

Process

Typical Alternative Asphalt Binder

- Reclaimed asphalt pavement (RAP)
- Used tires (crumb rubber)
- Proprietary polymers
- Anti-stripping agents (hydrated lime)
- Recycled baghouse dust

Figure 2.16: RAP in Aggregate-Sized Chunks

Process

Polymer Modified Binders

- proprietary blends added to bitumen
- Formula varies depending on desired result of end product

Process

Filler

- Dust added to asphalt binder and aggregate to improve adhesion

Process

RECIPE FOR HOT MIX ASPHALT

Process

Hydrated Lime

- Caltrans requires a lime-slurry-marination (LSM) where climate promotes stripping
- Requires that mixture be stockpiled for 24 hours before use "marinated"

Process

Hydrated Lime

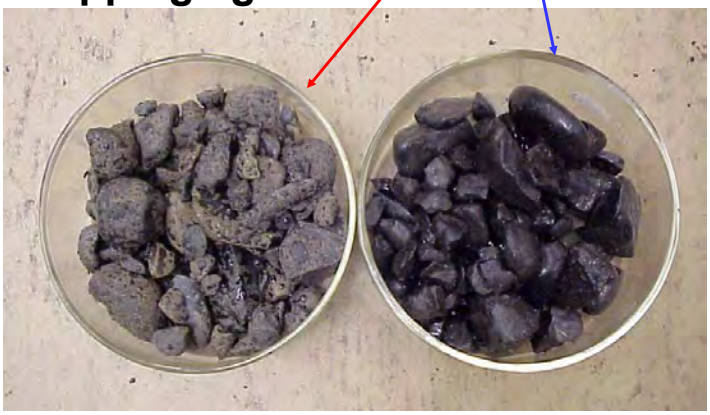
- Anti-stripping agent:

1. Added dry with binder
2. Added dry to wet or dry aggregate and "marinated" for several days
3. Added as lime slurry for immediate use or "marinated"

Process

Anit-stripping Agents

Illustration of binder with anti-stripping agent and without anti-stripping agent



Process

Alternative Binders

- Kept at temperatures higher than conventional binder
- Two types
  1. Polymer-modified asphalt cement
  2. Crumb rubber modified

Process

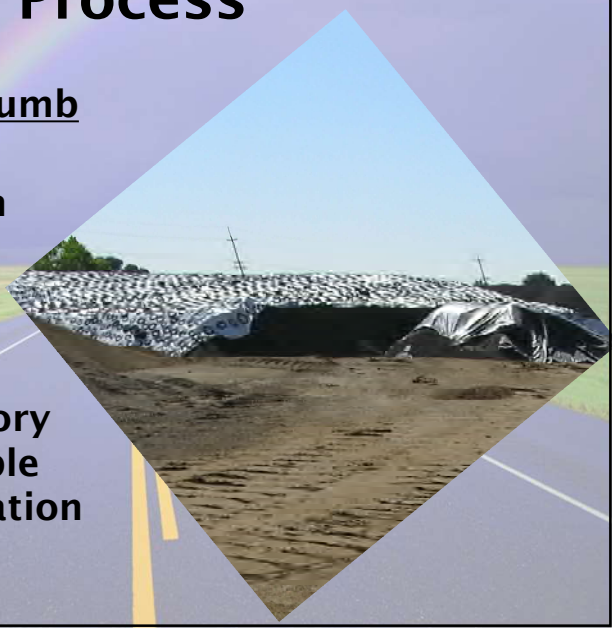
Crumb Rubber

- Added to binder to make crumb rubber modified (CRM)
- 75% scrap tire and 25% virgin rubber
- Non-hazardous hydrocarbon polymer
- Rubber-modified asphalt concrete (RAC)

Process

Advantages of Crumb Rubber

- Waste reduction
- Less water
- Quiet
- Lasts Longer
- BUT No regulatory relief from visible emission evaluation (VEE)



Process

RECIPE FOR RAC

Process
Reclaimed Asphalt Pavement

- RAP is
  - ✓ Top layer of asphalt pavement removed
- Developed because of energy, economic, and environmental concerns
- RAP could be 30% of mix
- Increases asphalt lifetime
- May increase generation of Blue Smoke

Process
RAP

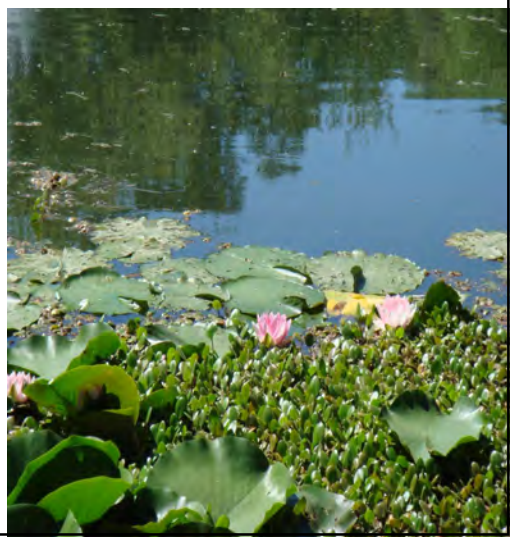
- Production temp of virgin aggregate is 500-800 F
- RAP is heated through conductive heat transfer
- RHM is 350 F

Process

RECIPE FOR RECYCLED HOT MIX

Process

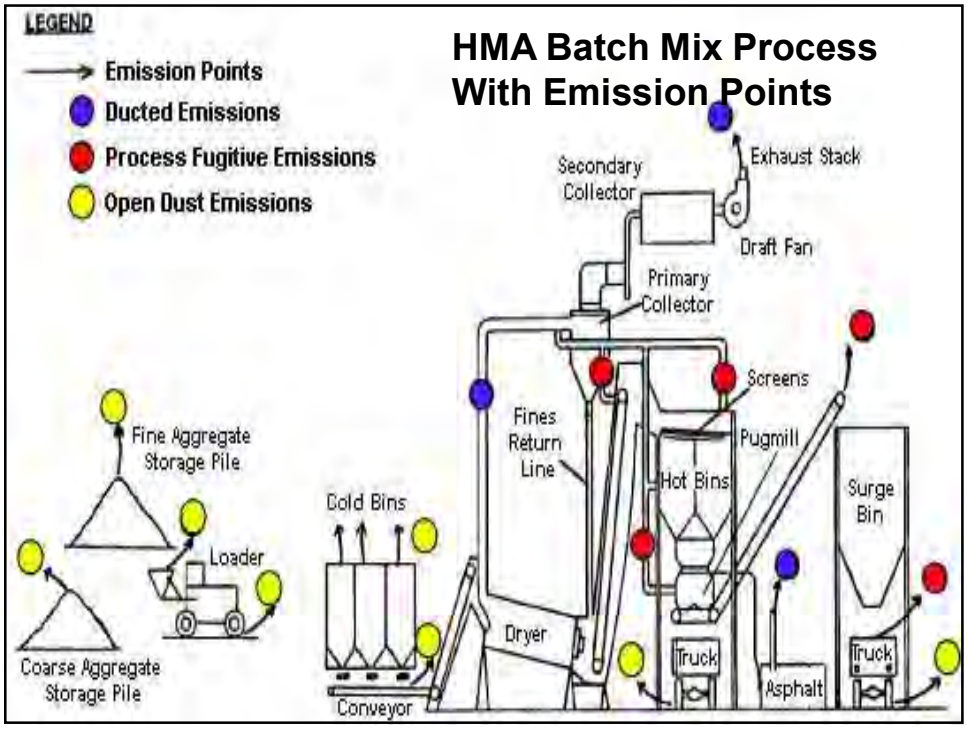
- Warm Mix Asphalt
- Advantages
  - ✓ Lower Production temp. 220 to 275 F
  - ✓ Less energy
  - ✓ Reduced cracking
- Disadvantages
  - ✓ Further testing to ensure QA/QC
  - ✓ Rutting
  - ✓ Workability
  - ✓ Longer setting=traffic delays



Process
HMA Facility Types

- Batch
- Continuous Mix

Process
Batch Mix


LEGEND
Emission Points
Ducted Emissions
Process Fugitive Emissions
Open Dust Emissions
HMA Batch Mix Process
With Emission Points
Secondary Collector
Exhaust Stack
Draft Fan
Primary Collector
Screens
Fines Return Line
Pugmill
Hot Bins
Surge Bin
Fine Aggregate Storage Pile
Loader
Cold Bins
Dryer
Truck
Asphalt
Truck
Coarse Aggregate Storage Pile
Conveyor

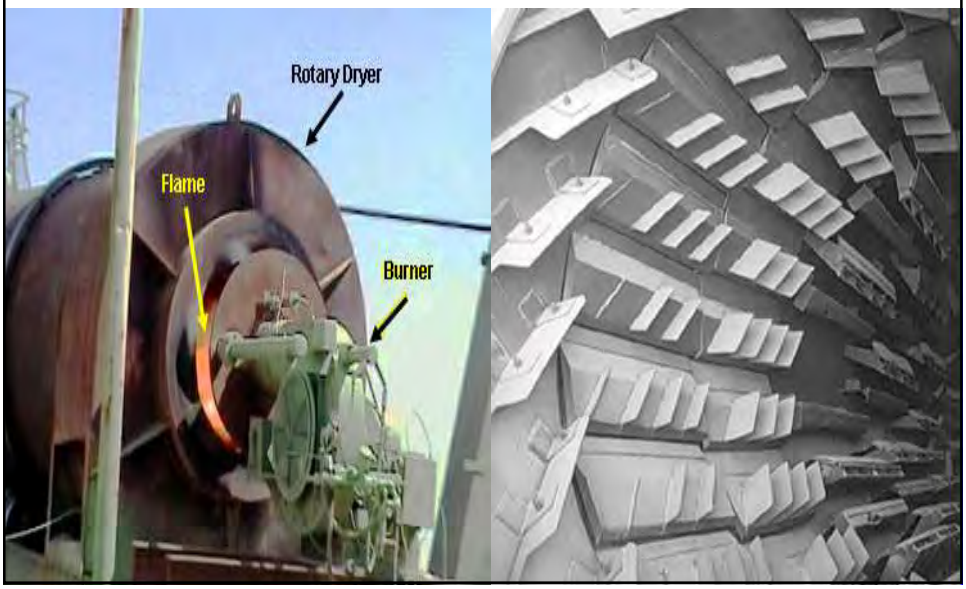

Process
Batch Facility
Aggregate
✓Stored in cold bins
✓Moved by conveyor
✓Sorted and weighted
✓Dropped into dryer
✓Elevated to top of batch tower and
✓Separated

Process
Cold Bins
Aggregate Stockpiles

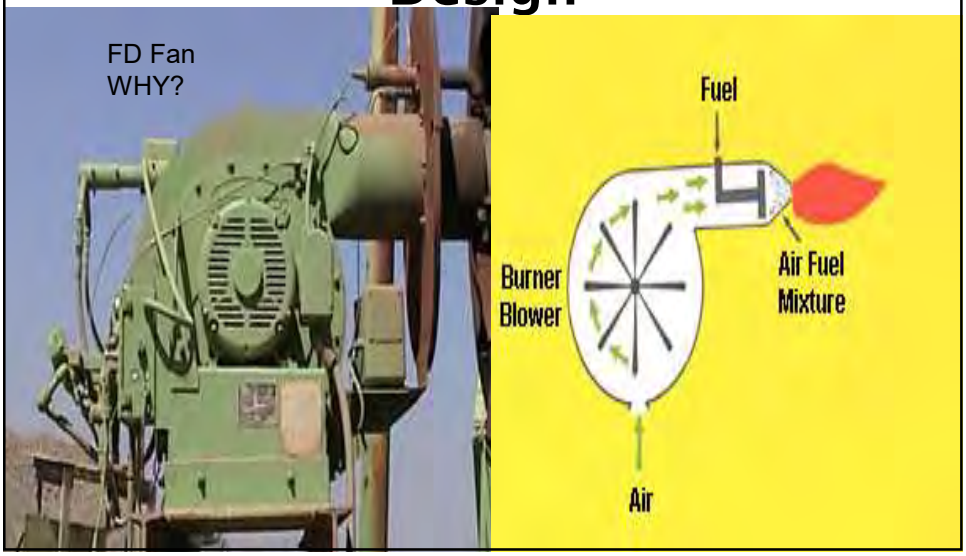
Process
Cold Bins and Conveyors

Batch Process
Aggregate Dryer

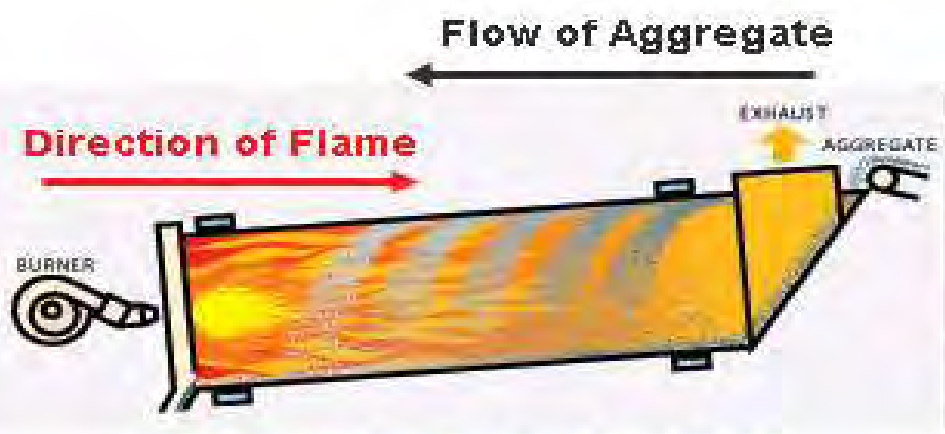
Batch Process
Rotary Dryer



Process
Combustion and Basic Burner Design



Batch Process
Rotary Dryer Counterflow Design

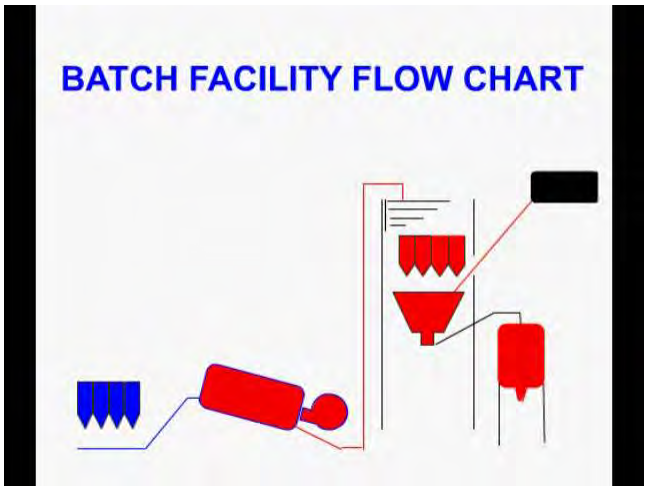


COUNTERFLOW DESIGN

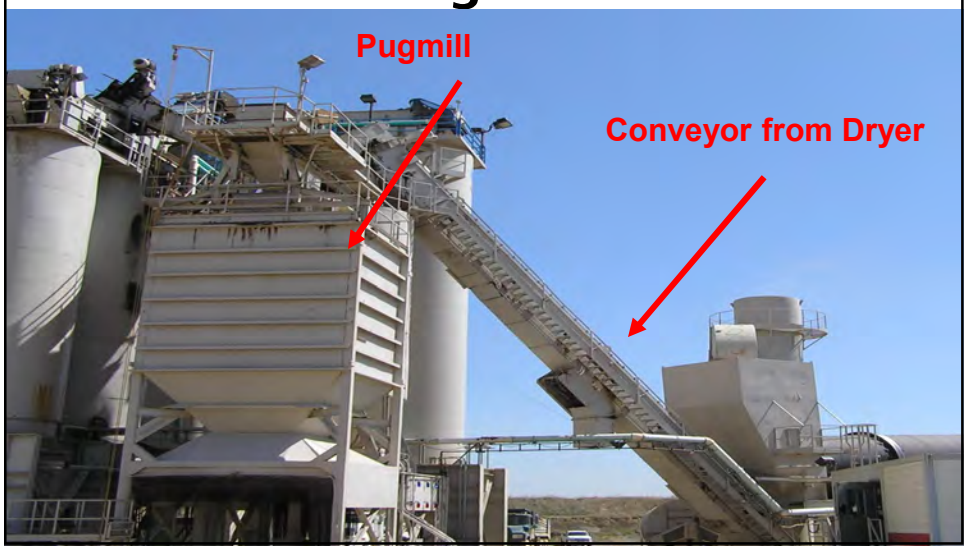
Batch Process
(cont'd)

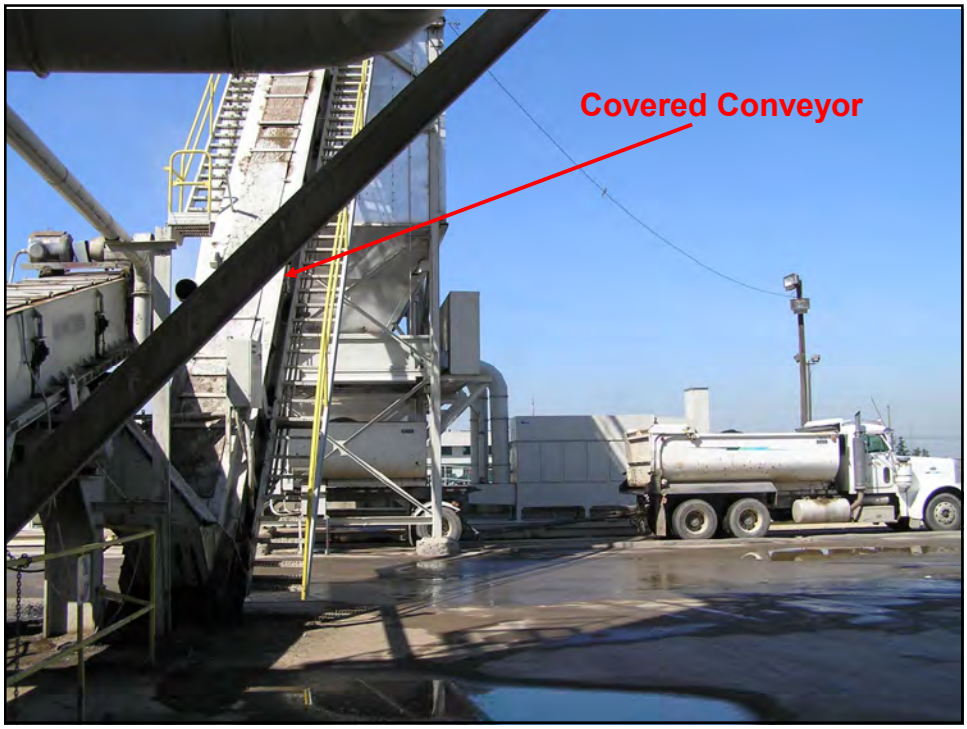
- Hot aggregate dropped from elevator to vibrating screens, sorted by size
- Weighed, and dropped into pugmill for mixing with
- Hot liquid asphalt binder and filler until coated
- Dropped into truck for delivery

Process



Batch Process
Hot Aggregate Conveyor to Pugmill




Covered Conveyor

Batch Process
View of Pugmills

Batch Mix Process without Pugmill

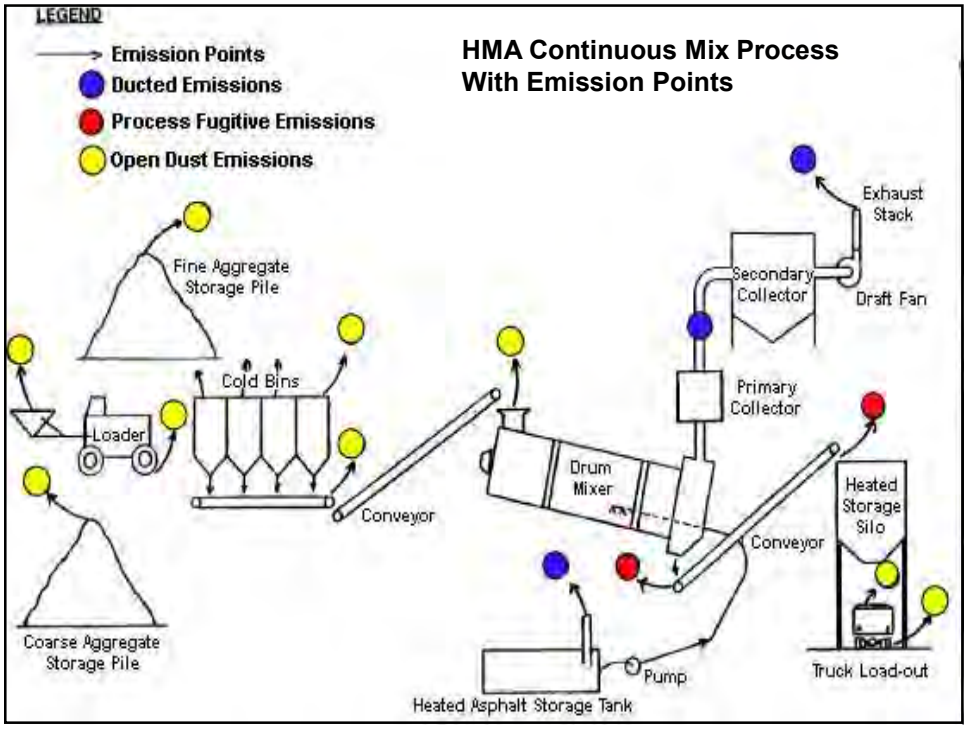
- Newer design
- All ingredients are mixed together in the drum and sent to silos
- Better controls

Batch Process Rotary Dryer/Mixer Combined

View of Batch Operated Double Drum Mixer Down for Maintenance

Inside View of Double Drum Mixer

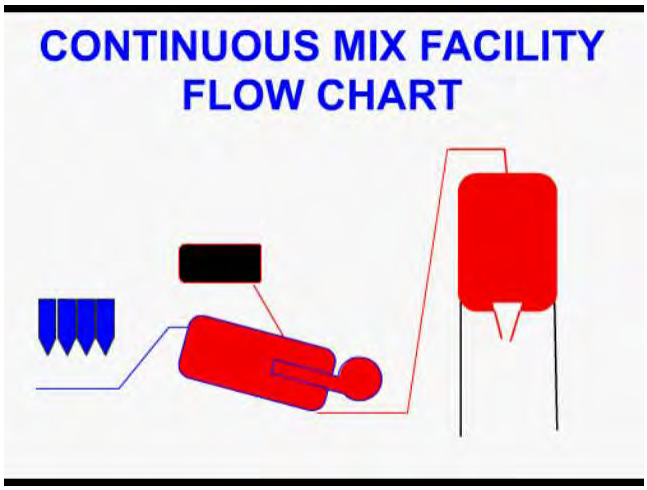
Continuous Mix Process



Process
Continuous Mix Facility Characteristics

1. HMA is continuously produced
2. No batch towers to segregate hot aggregate
3. Insulated heated storage silos are used instead of surge bins to store HMA
4. Production is horizontal verses vertical

Process

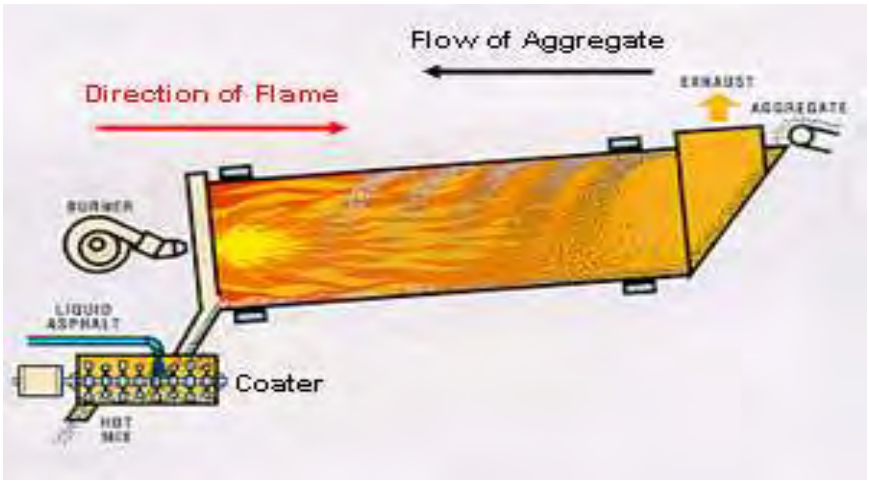


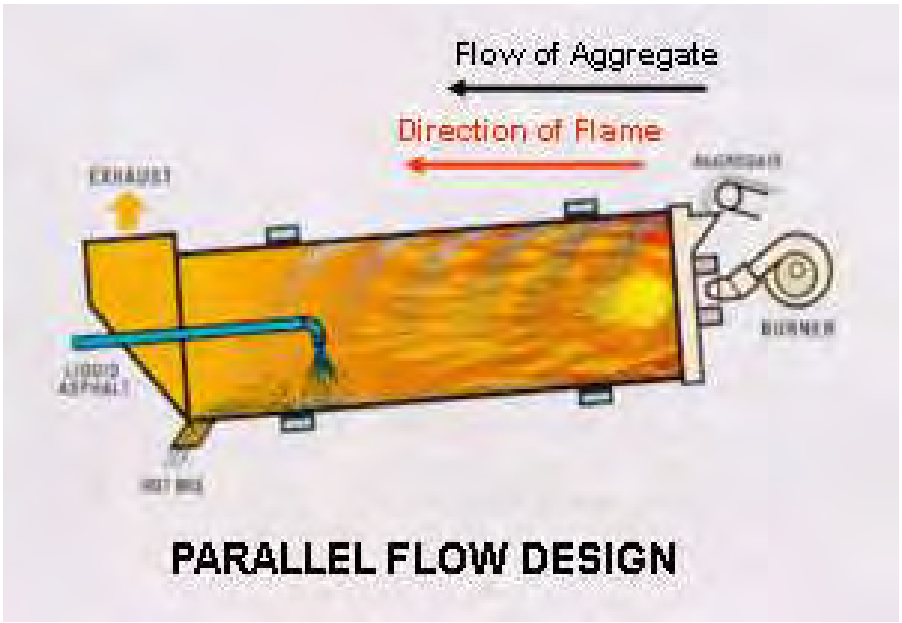
Process
HMA Drum Design

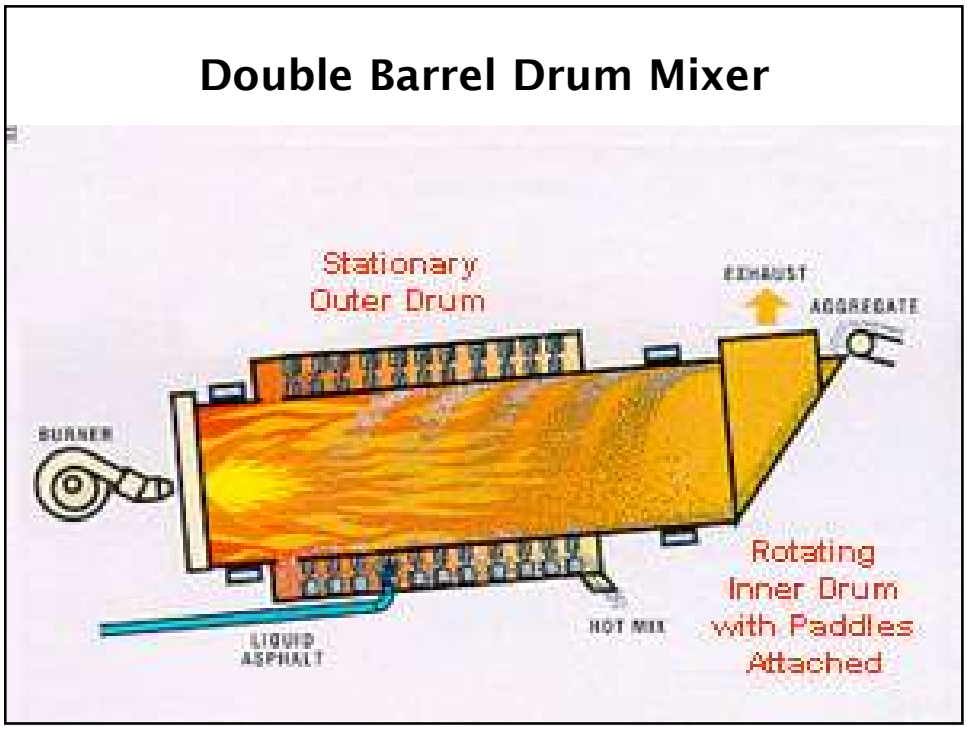
Process Drum Design

- 4 general designs
  - ✓ Counter Flow Dryer Coater
  - ✓ Parallel Flow Drum Mixer
  - ✓ Double Barrel Drum Mixer
  - ✓ Triple-Drum™ Mixer
- Drum mixers two zones:
  - ✓ primary for aggregate drying and heating
  - ✓ secondary for mixing heated aggregate with binder and filler

Counterflow Dryer and Coater

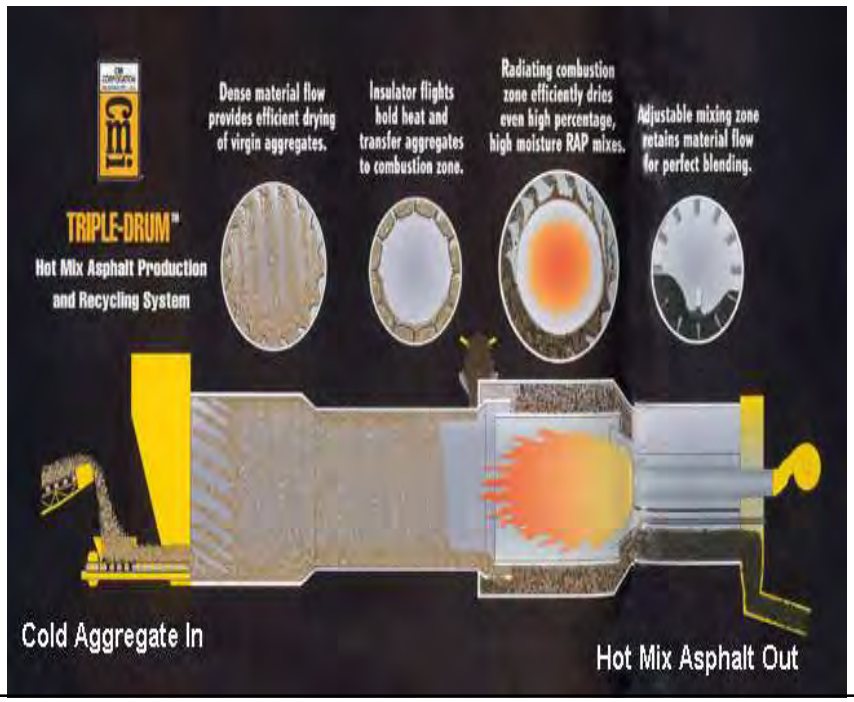



Flow of Aggregate
Direction of Flame
EXHAUST
BURNER
PARALLEL FLOW DESIGN


Double Barrel Drum Mixer
Stationary
Outer Drum
EXHAUST
AGGREGATE
BURNER
HOT MIX
LIQUID
ASPHALT
Rotating
Inner Drum
with Paddles
Attached

Inside View of Double Drum Dryer Section

Inside View of Double Drum Mixer Section


Dense material flow provides efficient drying of virgin aggregates.
Insulator flights hold heat and transfer aggregates to combustion zone.
Radiating combustion zone efficiently dries even high percentage, high moisture RAP mixes.
Adjustable mixing zone retains material flow for perfect blending.
TRIPLE-DRUM™
Hot Mix Asphalt Production and Recycling System
Cold Aggregate In
Hot Mix Asphalt Out

Triple-Drum


Triple-Drum Mixer

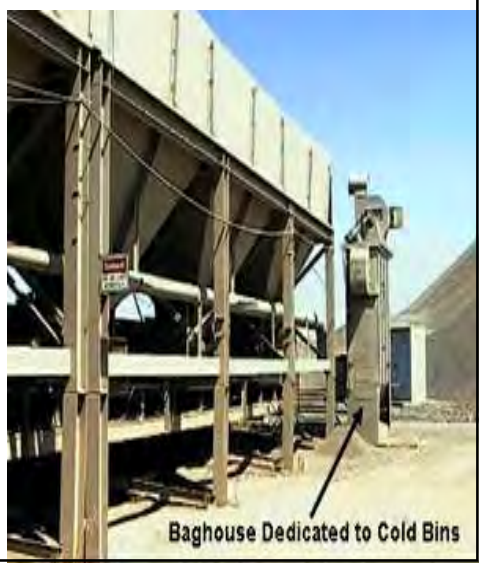

WARNING
CHECK WITH
SPHALT PLANT
EFORE
UNLOADING
RIVERS
NOT WEAR
LY GLOVES
WHEN
BING LADDERS
NING VALVES
RTING PUMPS
R 8000
AR 4000
Process
Asphalt
Binder
Storage

Emission Controls

Control Aggregate

- Wind-blown dust
- Fugitive dust
- Common Control methods

Process
Cold Bin Dust Collection System

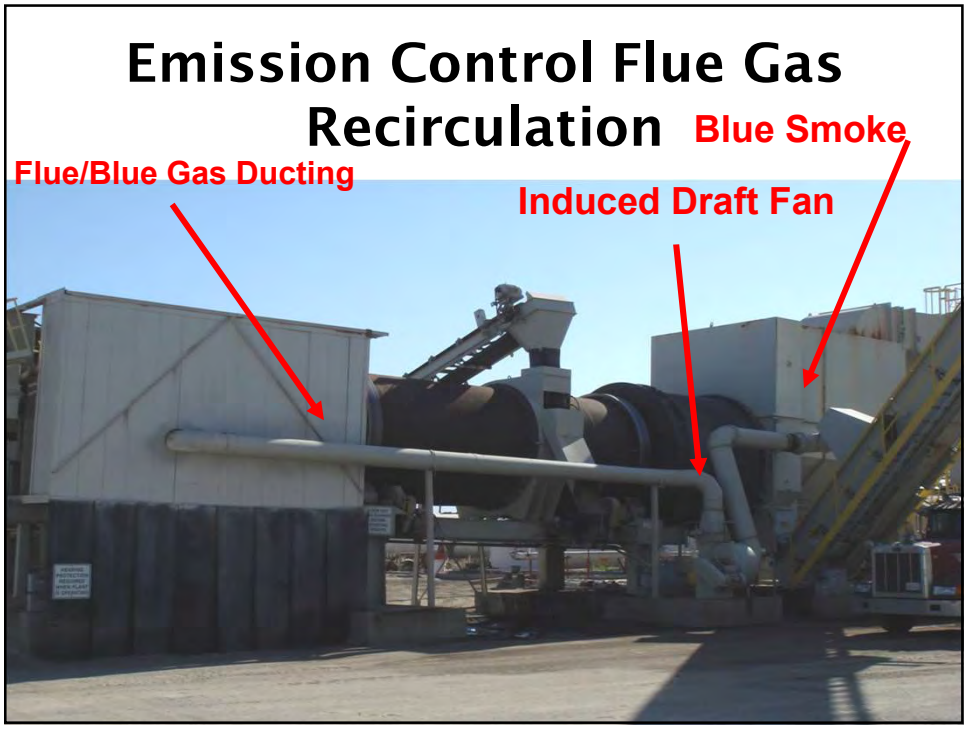



Dust Suppression?

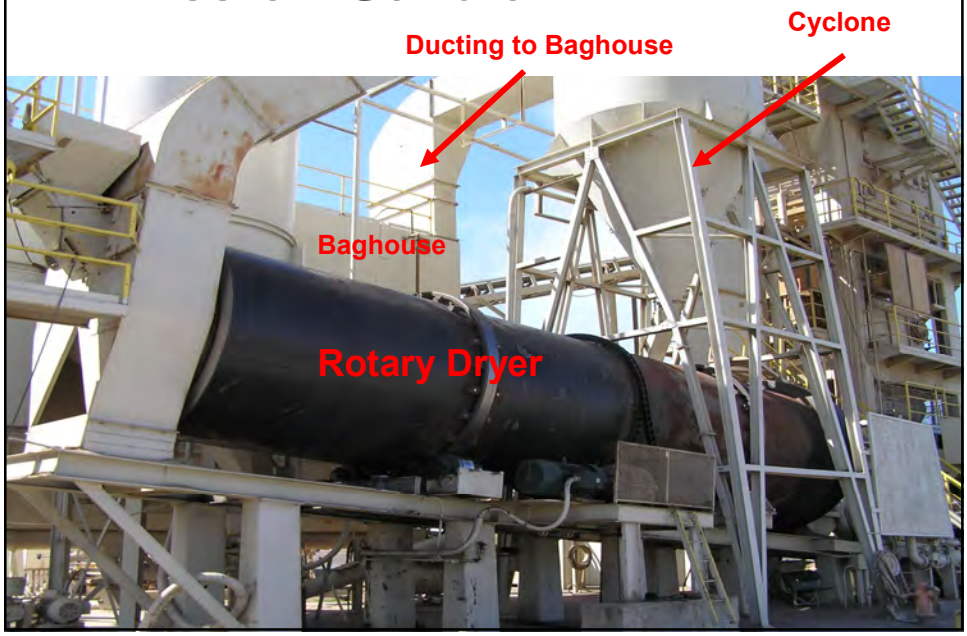
Emission Control
Hot Aggregate Handling

Emission Control
Hot Aggregate Handling

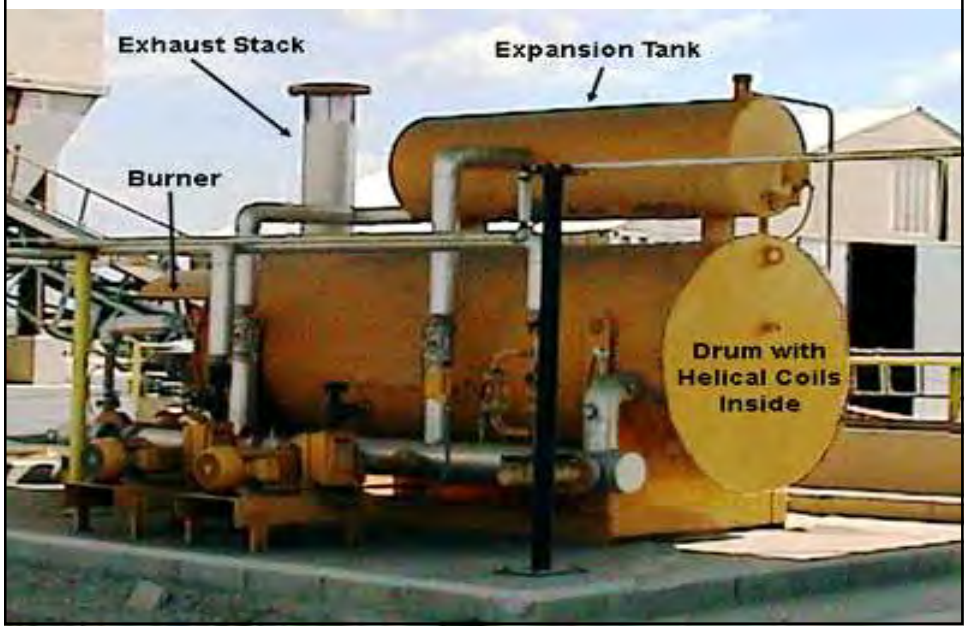
Emission Control Flue Gas Recirculation



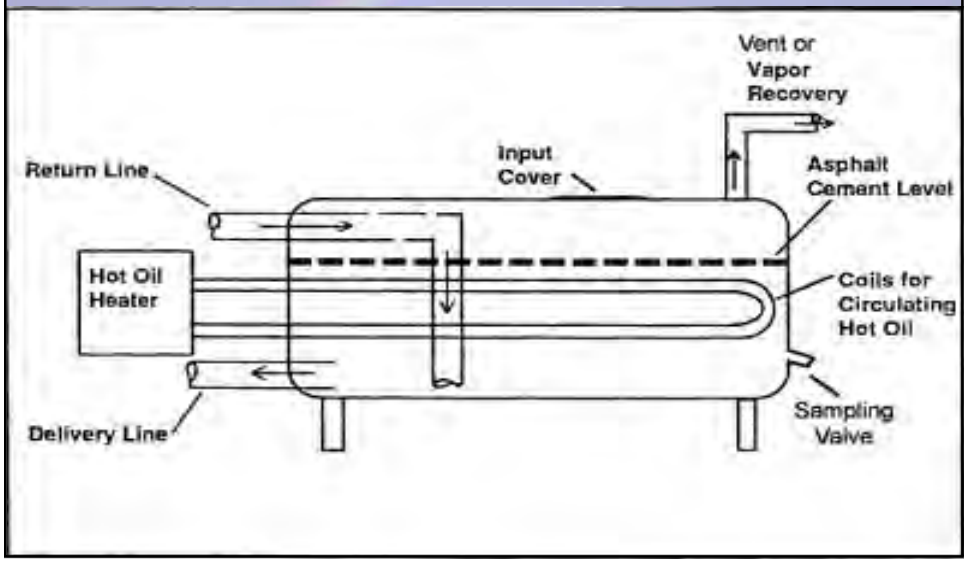
Emission Control



Small Binder Storage Tank

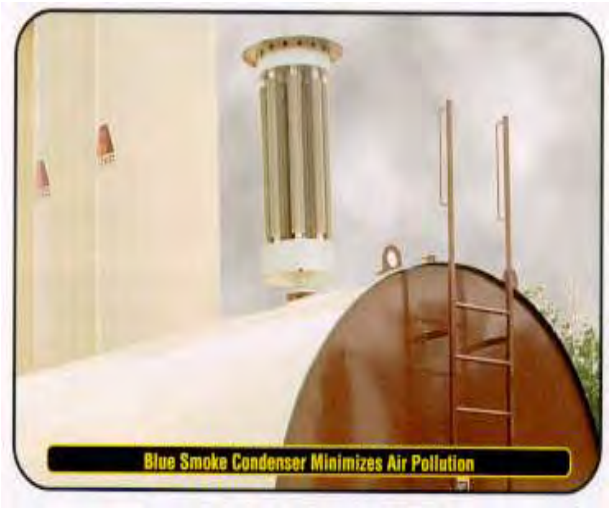


Hot Oil Heater Coils



Process
Underground Storage Tanks

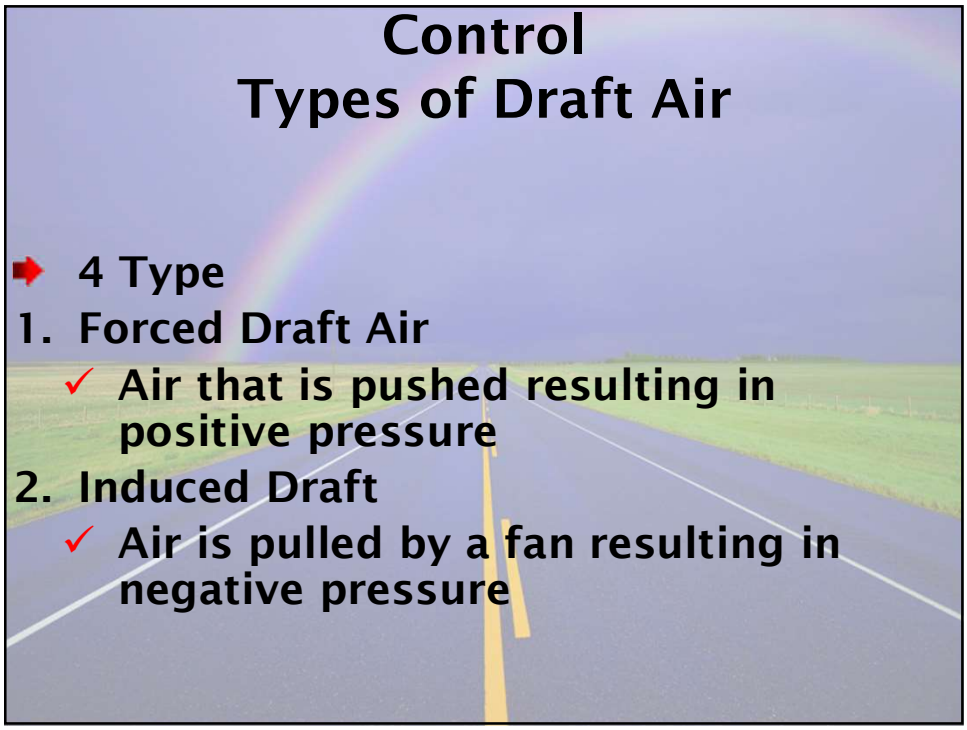
Controlled Binder Storage Tank Vent Condenser

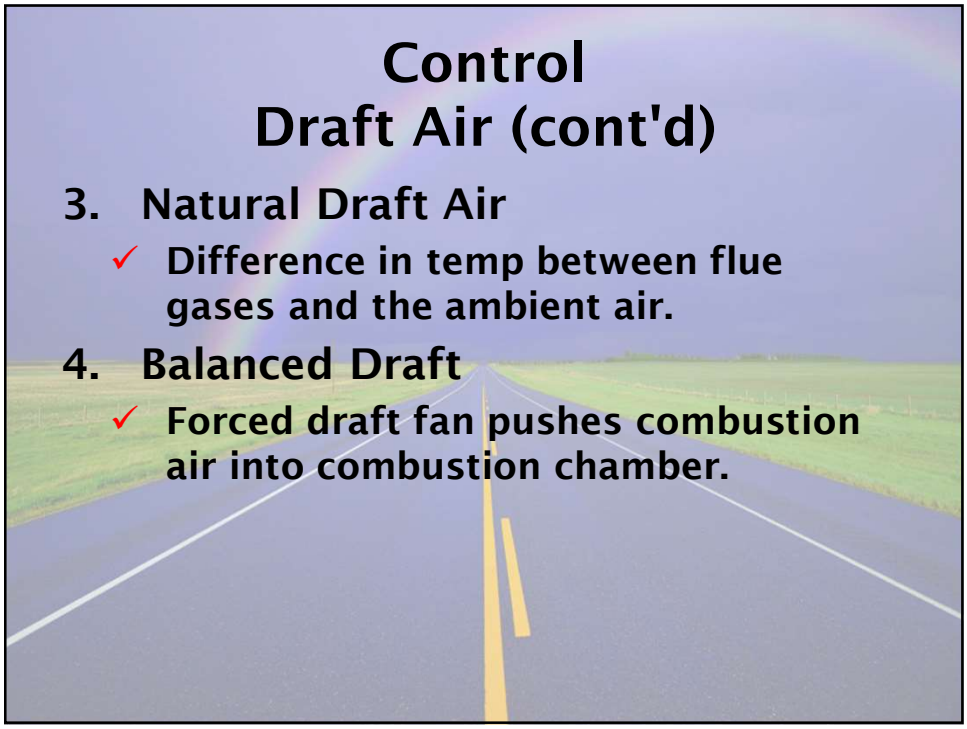


Dust Silo

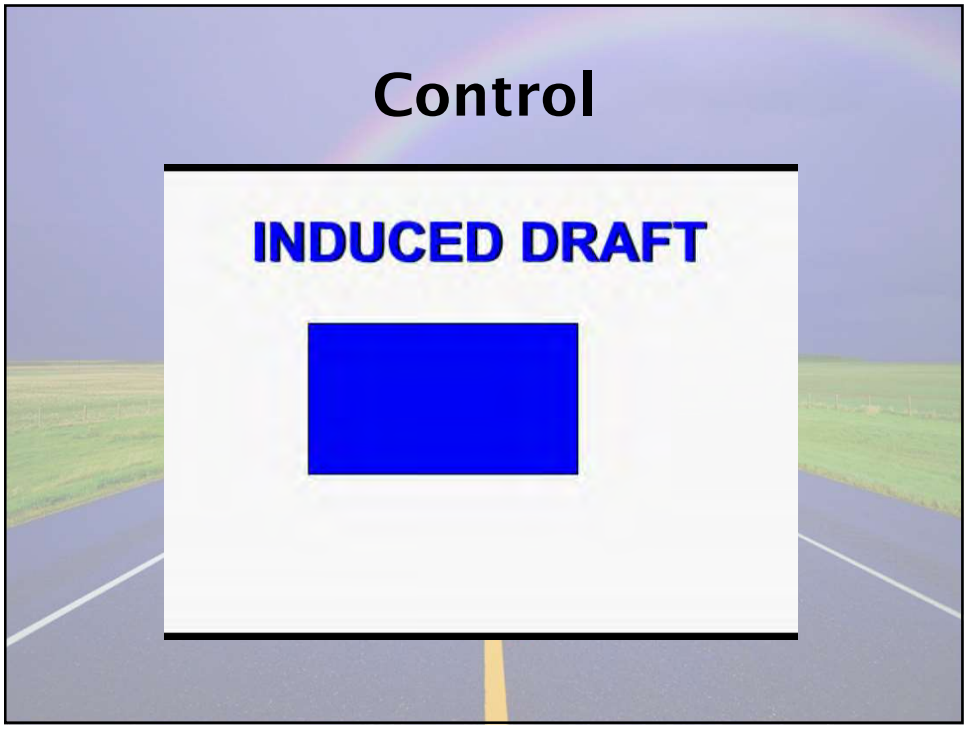
Control Draft Air


Control
Draft Air
Draft air passes through ducting due to pressure differential
Draft air affects
1. Combustion efficiency
2. How a system develops leaks
3. Control effectiveness


Control
Types of Draft Air
4 Type
1. Forced Draft Air
✓ Air that is pushed resulting in positive pressure
2. Induced Draft
✓ Air is pulled by a fan resulting in negative pressure

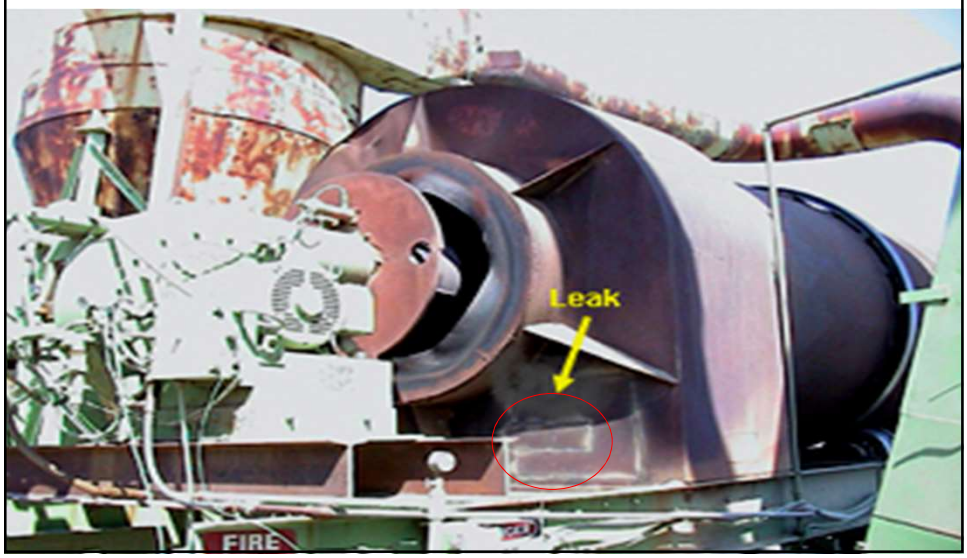

Control
Draft Air (cont'd)
3. Natural Draft Air
✓ Difference in temp between flue gases and the ambient air.
4. Balanced Draft
✓ Forced draft fan pushes combustion air into combustion chamber.

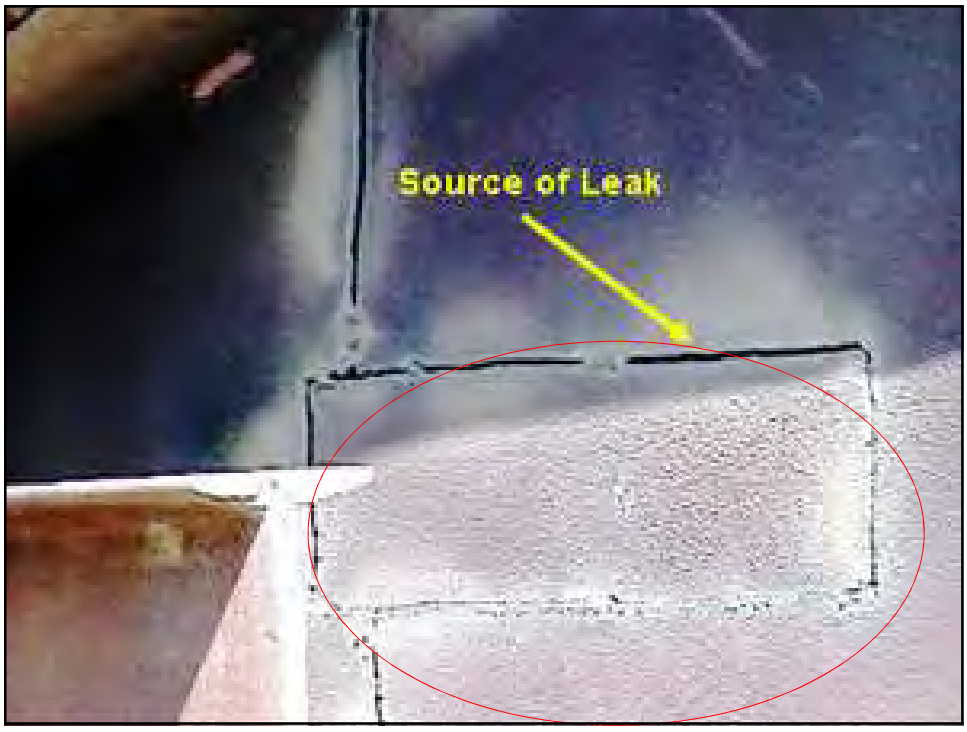

Control
FORCED DRAFT


Control
INDUCED DRAFT


Control
NATURAL DRAFT

Leak in a Rotary Dryer

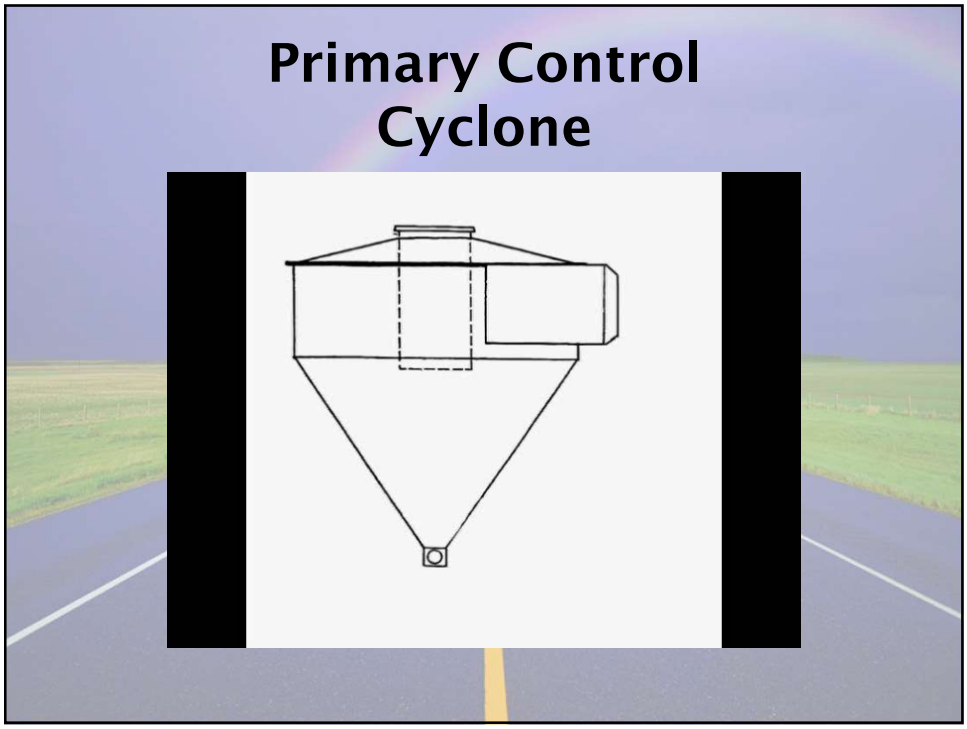


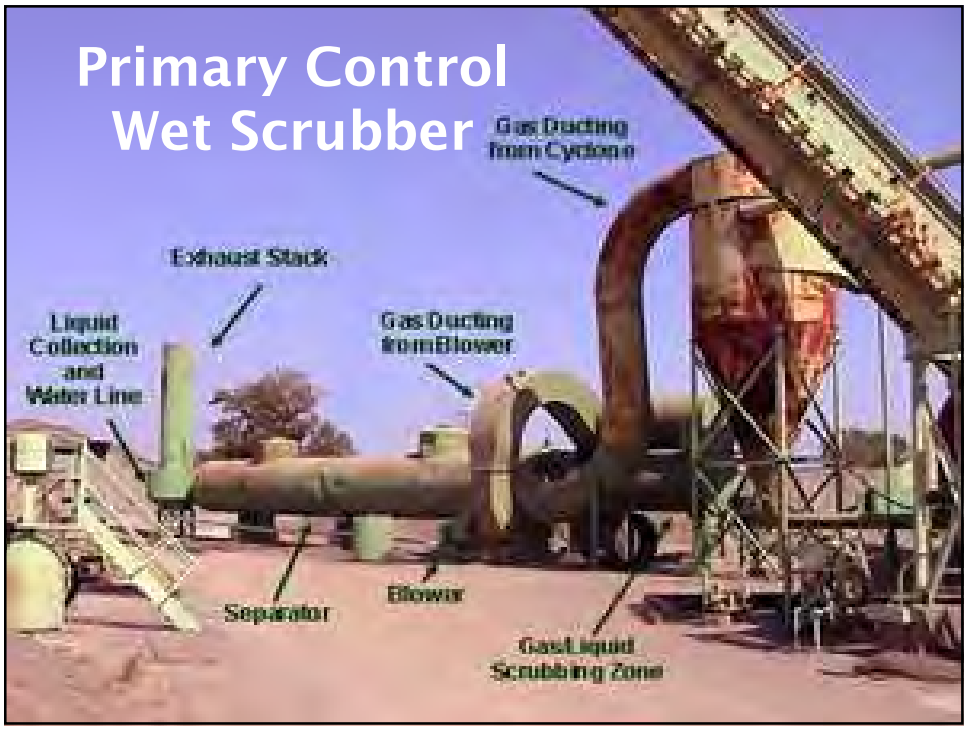


Control Drum/Dryer Emission

- Drum/Dryer produce large amounts of PM
- Two control devices
  - ✓Primary for large particles and
  - ✓Secondary for small particles
- Combined efficiency is 99% or greater
- Ask for manufacturer or facility guarantee

Primary Controls Cyclone


Primary Control
Cyclone


Primary Control
Wet Scrubber
Gas Ducting from Cyclone
Exhaust Stack
Liquid Collection and Water Line
Gas Ducting from Blower
Blower
Separator
Gas/Liquid Scrubbing Zone

Process/Control Wet Scrubber

- Used to control stack emissions
  - ✓Must meet the emission requirements specified in Subpart OOO
  - ✓Continuous emissions pressure monitor
    - ± 250 pascals ± 1inch water gauge pressure
  - ✓Continuous measurement of scrubbing liquid flow rate to scrubber

Control Techniques Wet Scrubber

- General description
  - ✓Particles get trapped in liquids
    - Inertial impaction and diffusion
  - ✓Liquids must contact particles and dirty liquids must be removed from exhaust gas

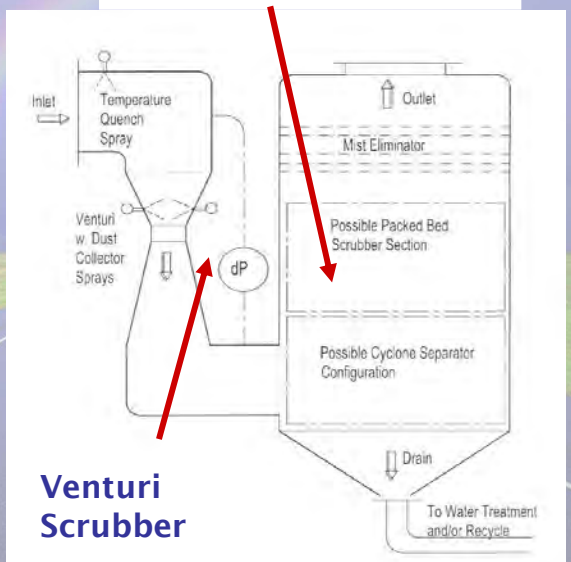
Particle Scrubbers

- Initial quench – use clean water
- Water drops and particles must contact (impact)
  - ✓Requires water flow and mixing energy
- Dirty water collection
- Water treatment & recirculation

Wet Scrubber Operation

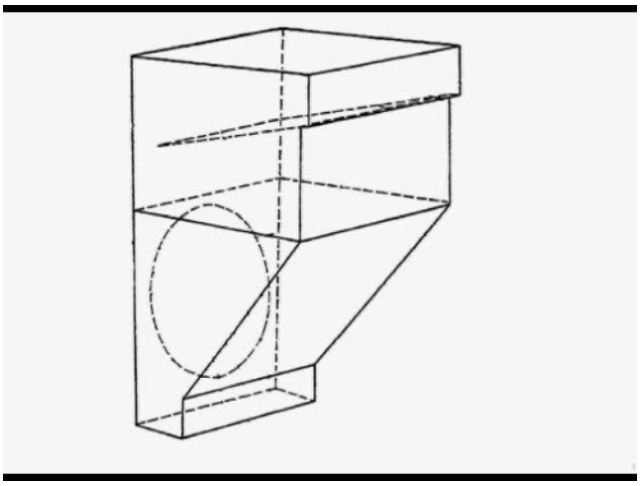
- Particles collected by impaction
- Gasses collected by diffusion & absorption

Packed Bed Scrubber

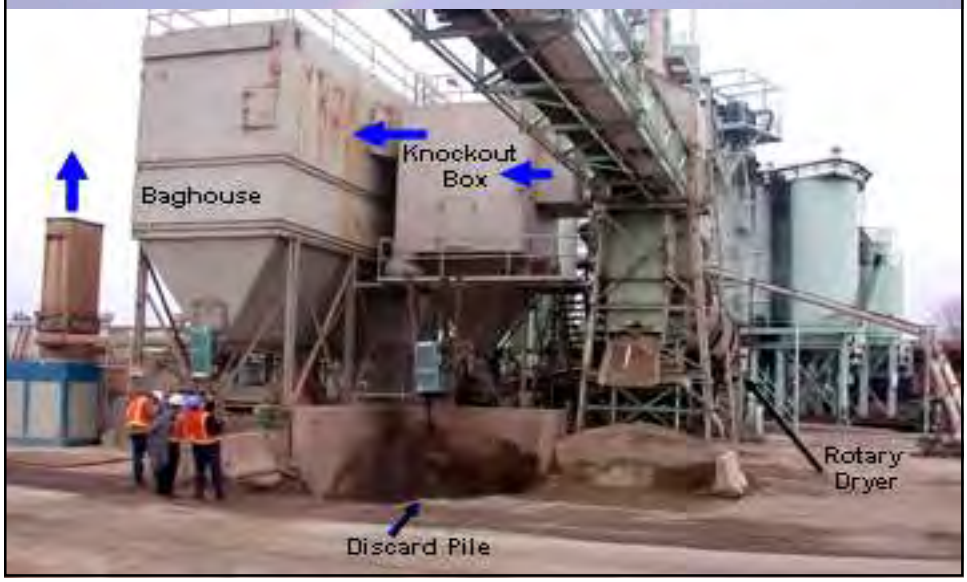


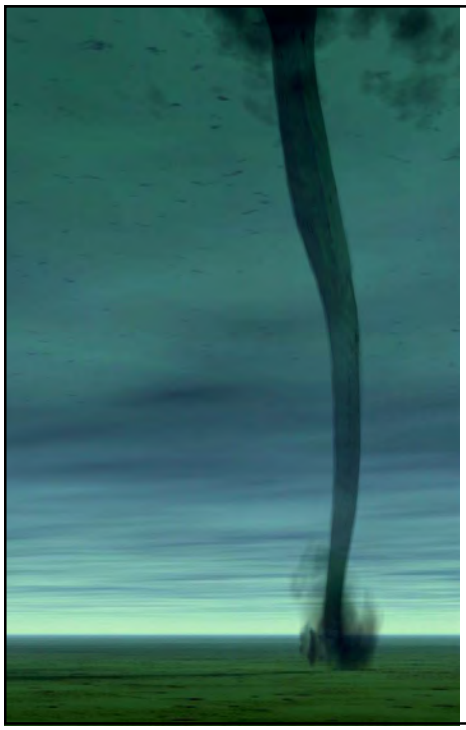
Venturi Scrubber

Primary Control Knock Out Box



Primary Controls Knock-out Box

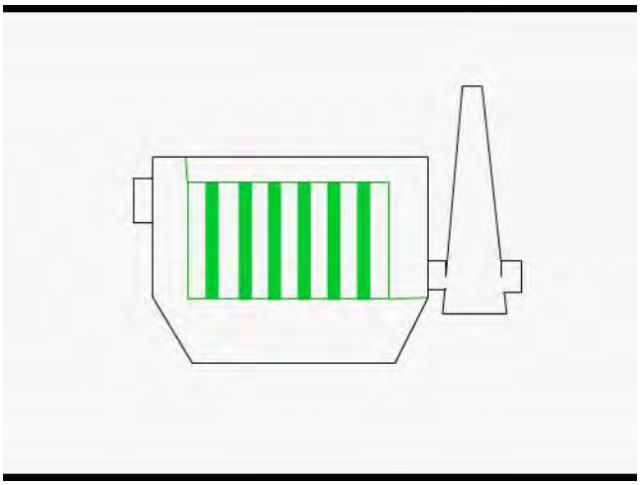


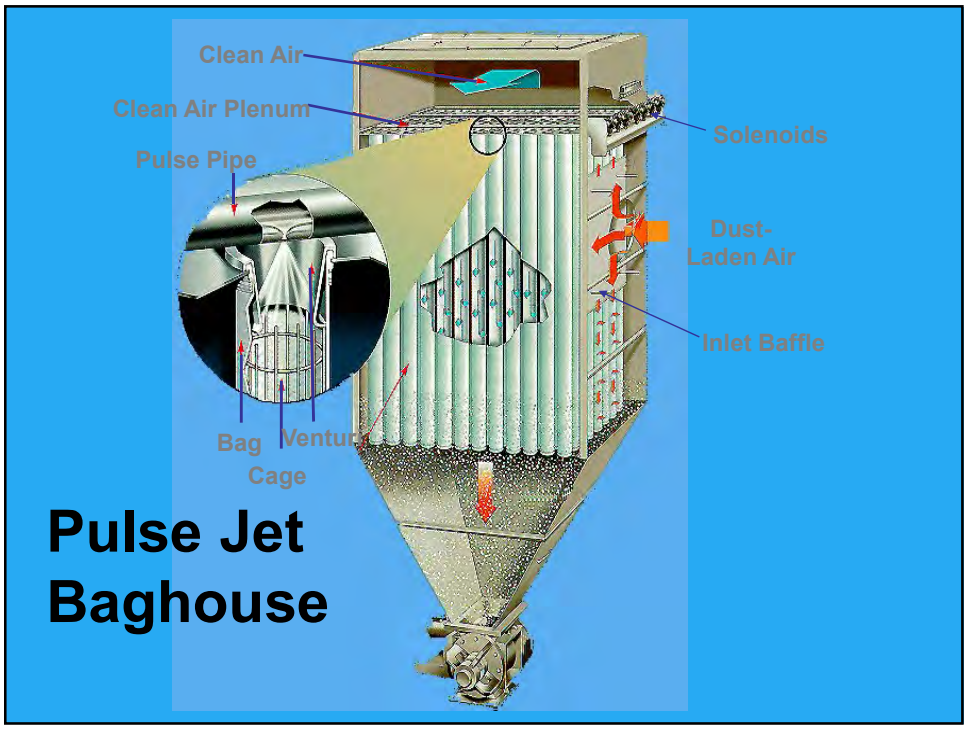


Secondary Control Baghouses

- General description
  - ✓ Particles trapped on filter media, then removed
  - ✓ Either interior or exterior filtration systems
  - ✓ Up to 99.9% efficiency
  - ✓ Fabric filters are big vacuum cleaners with a cleaning mechanism

Secondary Control Baghouse

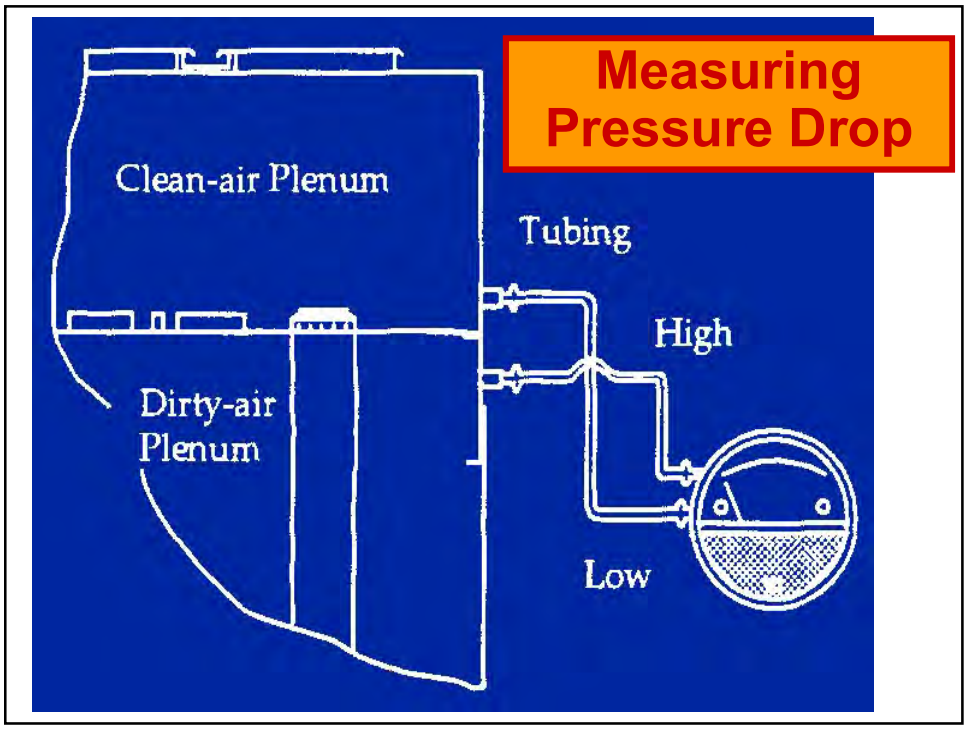





Secondary Control
Pulse Jet Baghouse

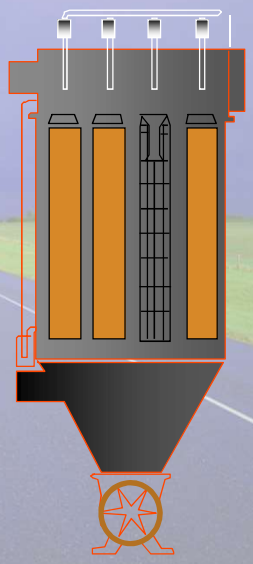

Secondary Control
Inside a Pulse Jet Baghouse


Pulse Jet
Bag

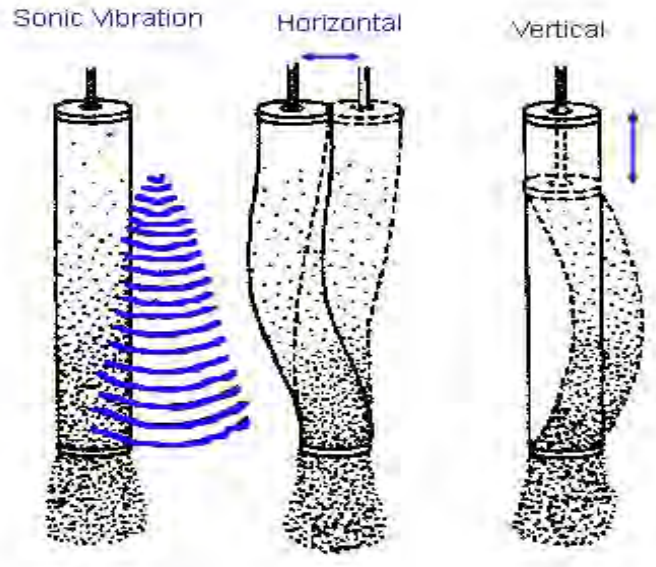

Measuring
Pressure Drop
Clean-air Plenum
Tubing
High
Dirty-air
Plenum
Low

Baghouse Design Considerations

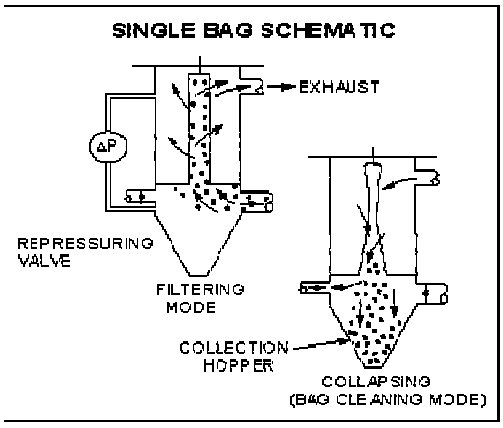
- Pressure Drop
- Air-To-Cloth Ratio
- Collection Efficiency
- Fabric Type
- Cleaning
- Temperature Control
- Bag Spacing
- Compartment Design
- Space and Cost

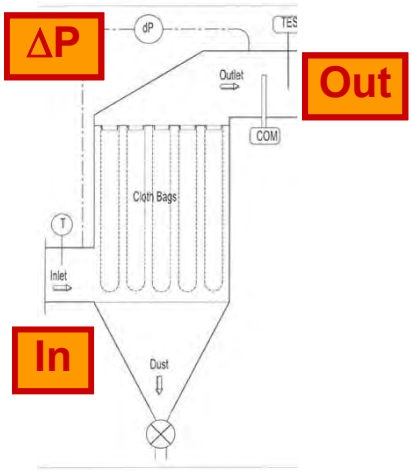


Secondary Control Shaker Method



Secondary Control PM Control Techniques – Fabric Filter

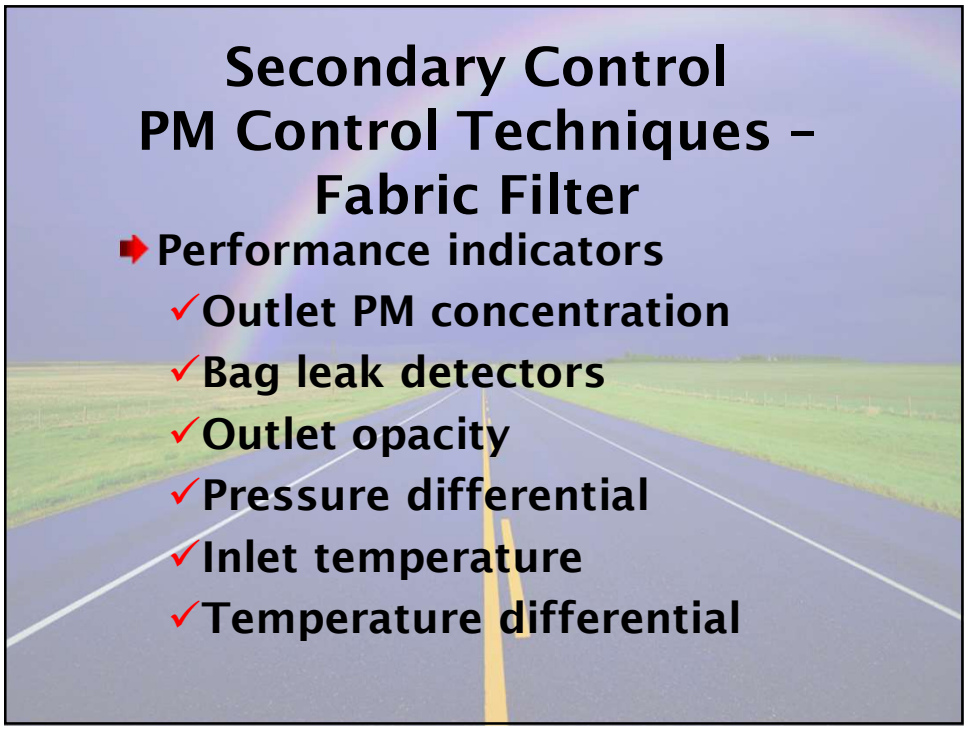




Secondary Control PM Control Techniques – Fabric Filter

- Factors affecting efficiency
  - ✓Filter media
    - Abrasion
    - High temperature
    - Chemical attack
  - ✓Gas flow
  - ✓Broken or worn-out bags


Secondary Control
PM Control Techniques –
Fabric Filter
Factors affecting efficiency (continued)
✓Cleaning system failure
✓Leaks
✓Re-entrainment
✓Damper or discharge equipment malfunction
✓Corrosion


Secondary Control
PM Control Techniques –
Fabric Filter
Performance indicators
✓Outlet PM concentration
✓Bag leak detectors
✓Outlet opacity
✓Pressure differential
✓Inlet temperature
✓Temperature differential

Secondary Control PM Control Techniques – Fabric Filter

- Performance indicators (cont'd)
  - ✓Exhaust gas flow rate
  - ✓Cleaning mechanism operation
  - ✓Fan current
  - ✓Inspections and maintenance

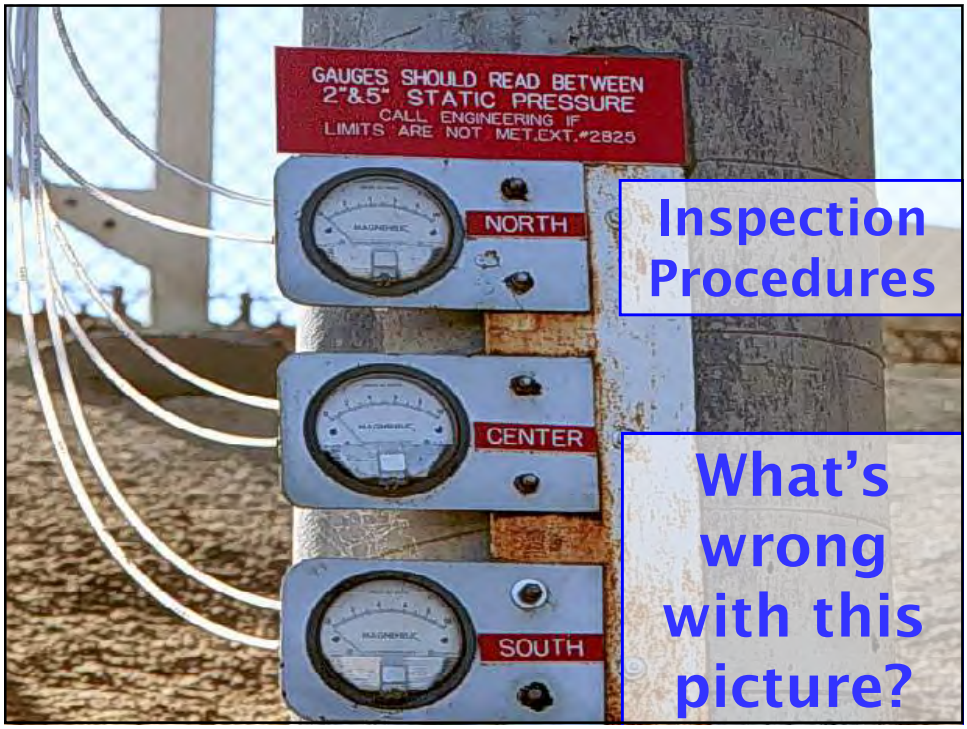
Secondary Control Bag House Monitoring

- Normal bag house emissions are very low.
  - ✓Opacity sensors Continuous Opacity Monitor (COM) aren't very good below 1-2%, so they don't detect initial problems.
  - ✓Opacity will show a major particulate emissions increase.
  - ✓COM or Method 9 may be OK for loose emission limits.

Inspection Procedures Instrumentation

- What types of instruments are being used to monitor for permit conditions?
  - ✓Magnehelic Gauge
  - ✓Triboelectric Monitor

Inspection Procedures Magnehelic Gauge



Baghouse Monitoring Triboelectric Sensor (TES)

- TESs are a newer technology
  - ✓Primary use in cement, coal fired power plants, and food manufacturing
  - ✓US EPA encourages use of TESs as CAM (compliance assistance monitoring, 40 CFR 64) or
  - ✓As a performance indicator in lieu of a source test
- Districts are adopting TES as BACT or compliance measurement tool

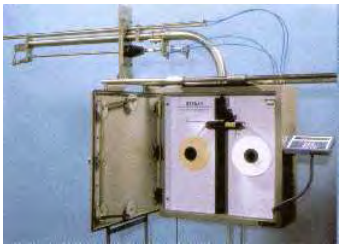
Baghouse Monitoring Triboelectric Sensor

- Triboelectric sensors (TES) work well at very low particle concentrations (very sensitive).
- TES detects micro amp current from particles hitting a metal probe.
- TES is simple and inexpensive.
- TES is an effective monitor when a small to moderate increase in emissions is of concern.

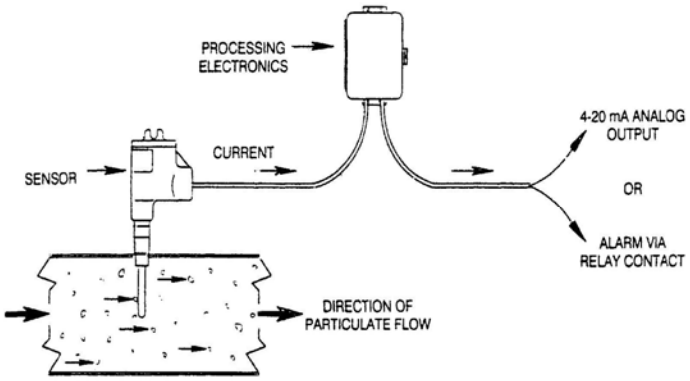
Baghouse Monitoring Triboelectric Sensor

- Operates on the principle of electric conductivity
  - ✓Triboelectric Principle: When 2 solids contact an electrical charge is transferred between the 2
  - ✓Current generated is proportional to the particulate mass flow rate
  - ✓Instrument tuned to produce continuous analog output and/or an alarm at a specific signal level

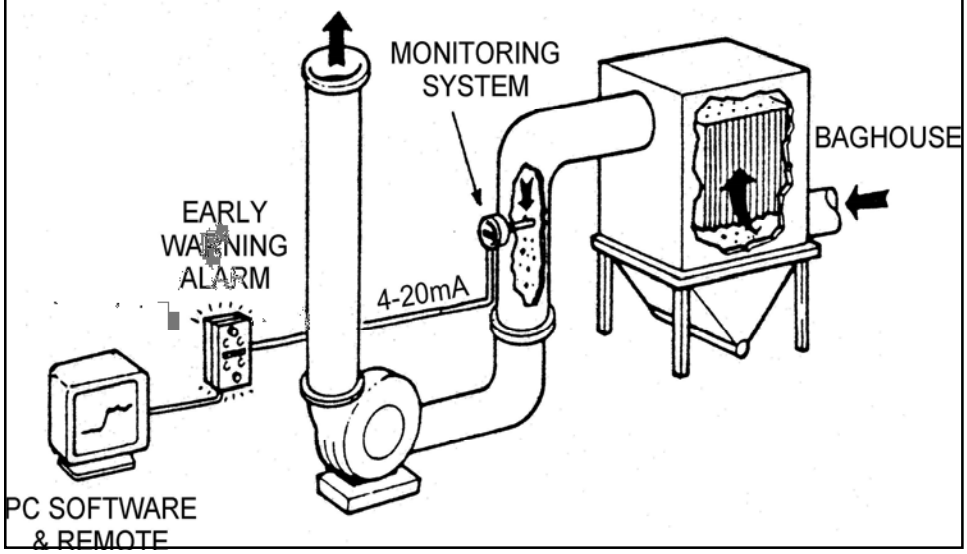
Control Devices
PM CEMS/TES Devices



Control Device
Triboelectric Sensor
Schematic



Triboelectric Sensor Installation for a Negative Pressure Monitoring System



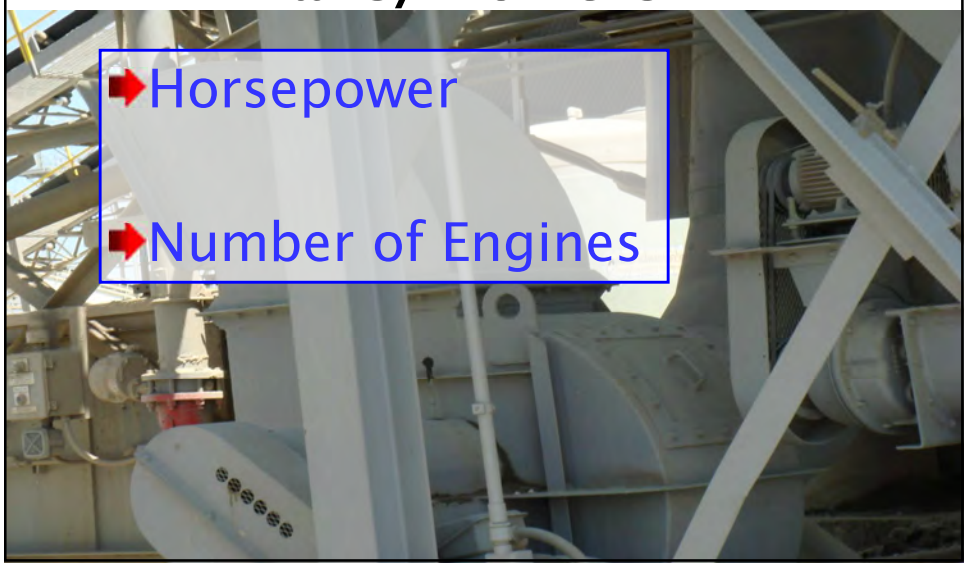
Monitoring Device Triboelectric Sensor

- TES works well at low particulate concentrations
- Detects micro amp current from particles hitting a metal probe
- Simple and inexpensive
- Effective monitor when a small to moderate increase in emissions is of concern

Baghouse Monitoring Device Triboelectric Sensor

- Establish baseline
- Monitor detects gradual or instantaneous increases in the signal from baseline
- Baseline emissions can be as low as 0.1 mg/dscm (0.00005 gr/dscf)

Inspection Procedures Fans/Blowers



- Horsepower
- Number of Engines

Control Scavenger System

- Collects fugitive emissions from:
  - ✓Hot aggregate elevator
  - ✓Vibrating screens
  - ✓Hot bins

Control Asphalt Binder Storage

- May or may not be controlled
- Controls include
  - ✓Condensers,
  - ✓Vapor recovery system (similar to gas station)
    - Vapors returned to refinery for incineration
- Delivery truck lines are flushed with non-hazardous cleaners

Control
Asphalt Binder Storage

Control Blue Smoke

Control Blue Smoke

- An aerosol of condensed organic particles adsorbed to dust or water particles

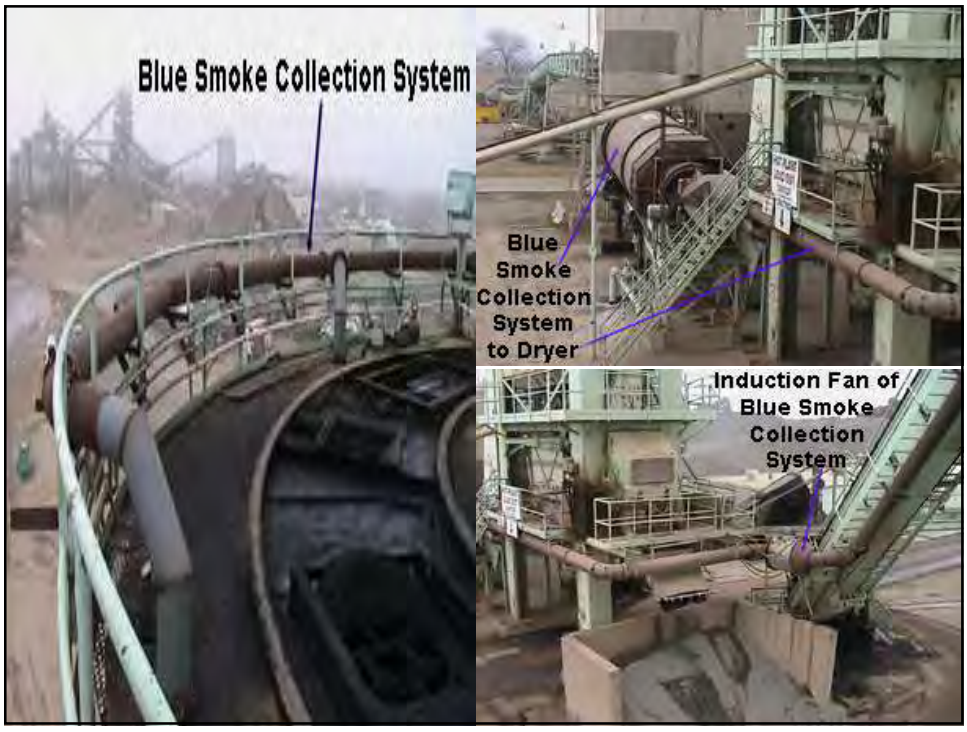
Control Blue Smoke

- Some organic compounds begin to
1. vaporize at 300 F
2. Condense in ambient air
3. Adsorb to dust and water particles
- To form visible emissions
- Visible emissions are formed until the air becomes saturated

Control
Blue Smoke Emissions Points

- Drop points of HMA from pugmill
- On top of surge bins/silos
- At the base of surge bins/silos
- Drag slat conveyors
- Truck load out

- Challenge to capture and control
- Primary reason for complaints
- Perception !!




Blue Smoke Control Device??
1/26/2021
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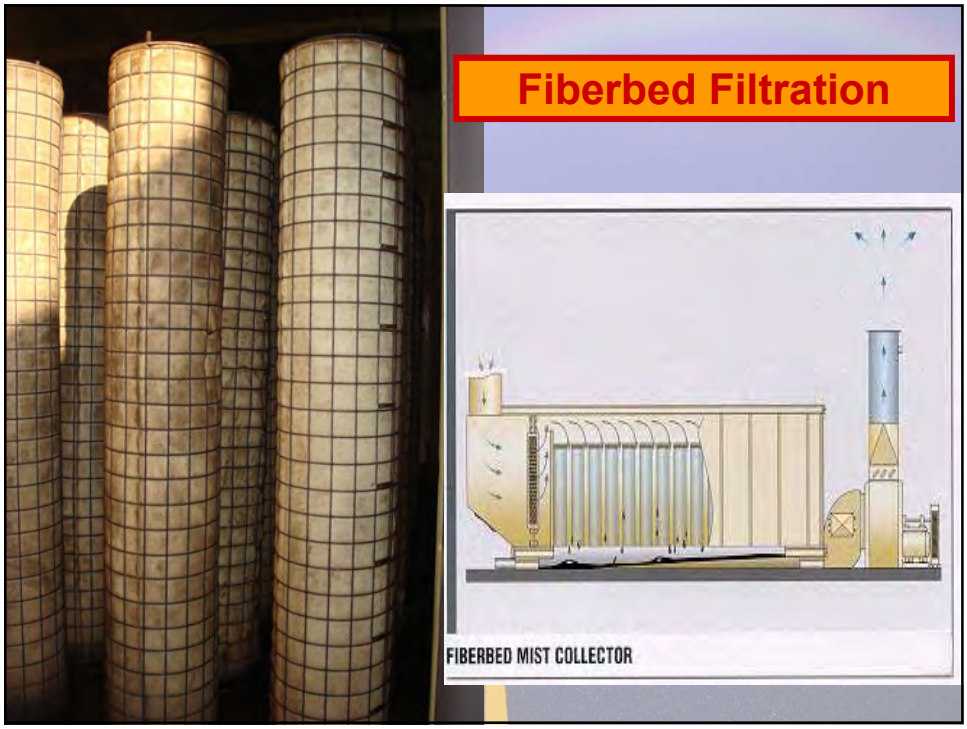
Blue Smoke Controls


Truck Load Out & Blue Smoke Controls


Silo/Truck Load Out & Blue Smoke Controls??


PowerGuard
Blue Smoke Controls


Blue Smoke Control Device


Fiberbed Filtration
FIBERBED MIST COLLECTOR

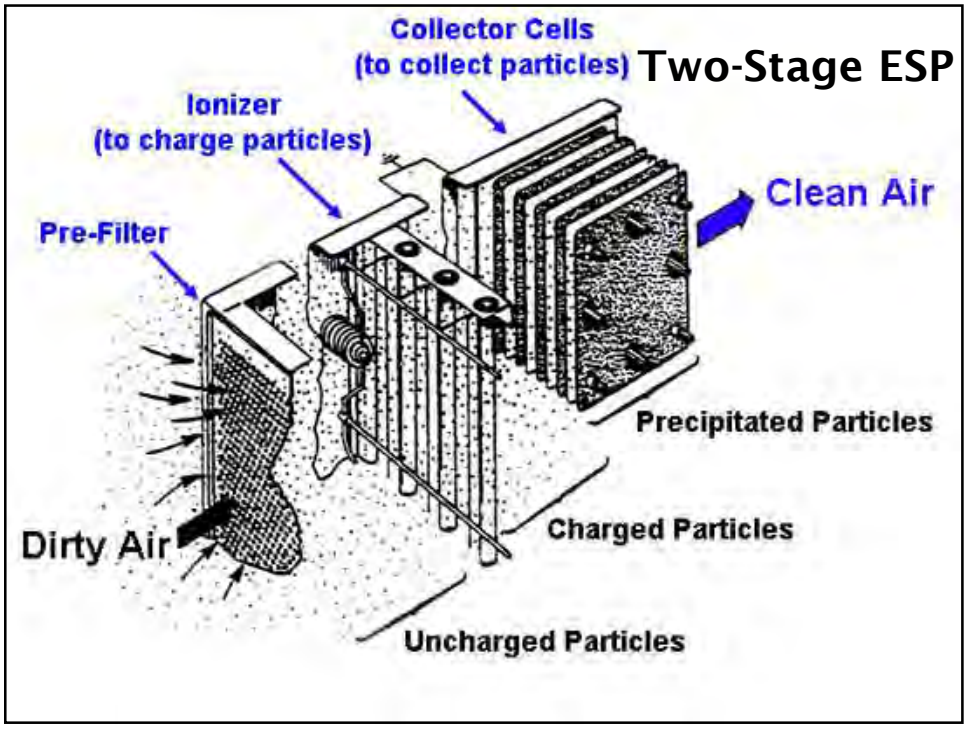

Fiberbed Filtration

Control of Blue Smoke Truck Entrance

Control Blue Smoke Enclosed Load Out

Control
Side View of HMA Drop with ESP/Smog Hog for Blue Smoke

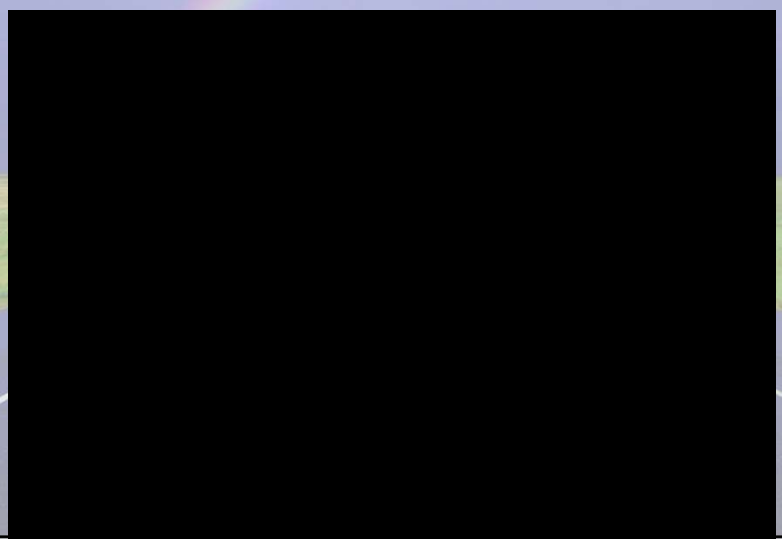
Control
Ducting to ESP/Smog Hog


Two-Stage ESP
Collector Cells
(to collect particles)
Ionizer
(to charge particles)
Pre-Filter
Clean Air
Precipitated Particles
Charged Particles
Dirty Air
Uncharged Particles


Controls
Innovations in HMA
Production
Four areas where the technology has improved
burner design,
fuels,
dryer/drum design, and
blue smoke controls

Controls
Triple-Drum Mixer

Moving Source



Permit Conditions

- Emission Controls
  - ✓Emission Limits
  - ✓Process Limits
  - ✓Emission Rate Limits
  - ✓Requirements to Minimize Emissions
  - ✓Source Test
  - ✓CAM (gauges on baghouse)

Permit Conditions (cont'd)

- Fuel Requirements
  - ✓Type
  - ✓Nitrogen or Sulfur content
  - ✓Amount of fuel
  - ✓Type of backup fuel
  - ✓Method of measurement
  - ✓Recordkeeping of fuels purchased and used

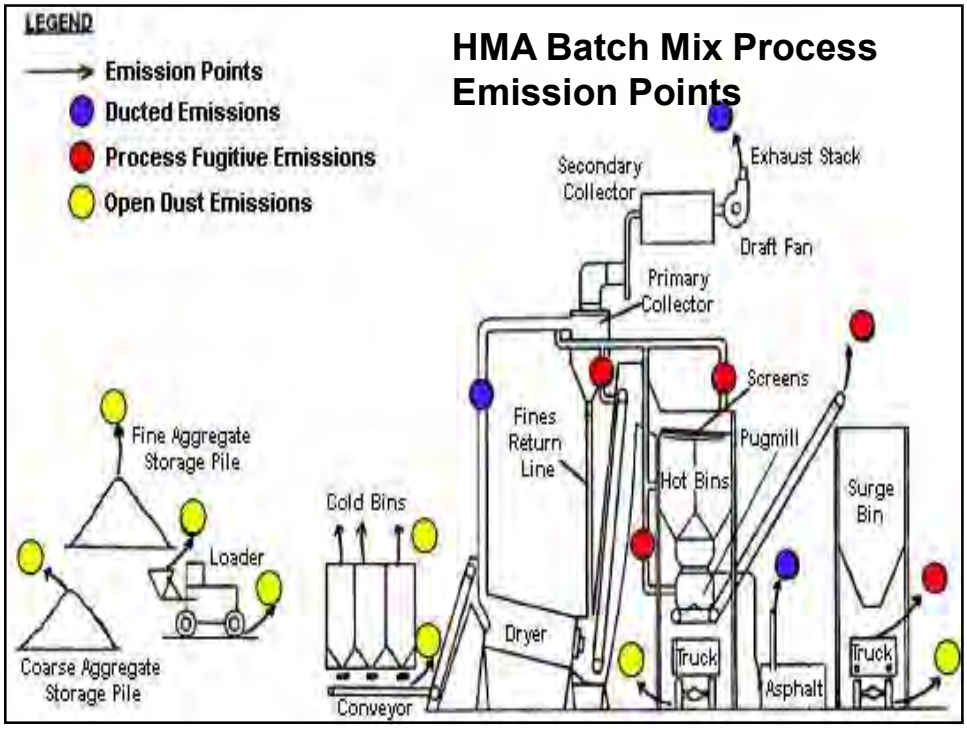
Permit Conditions (cont'd)

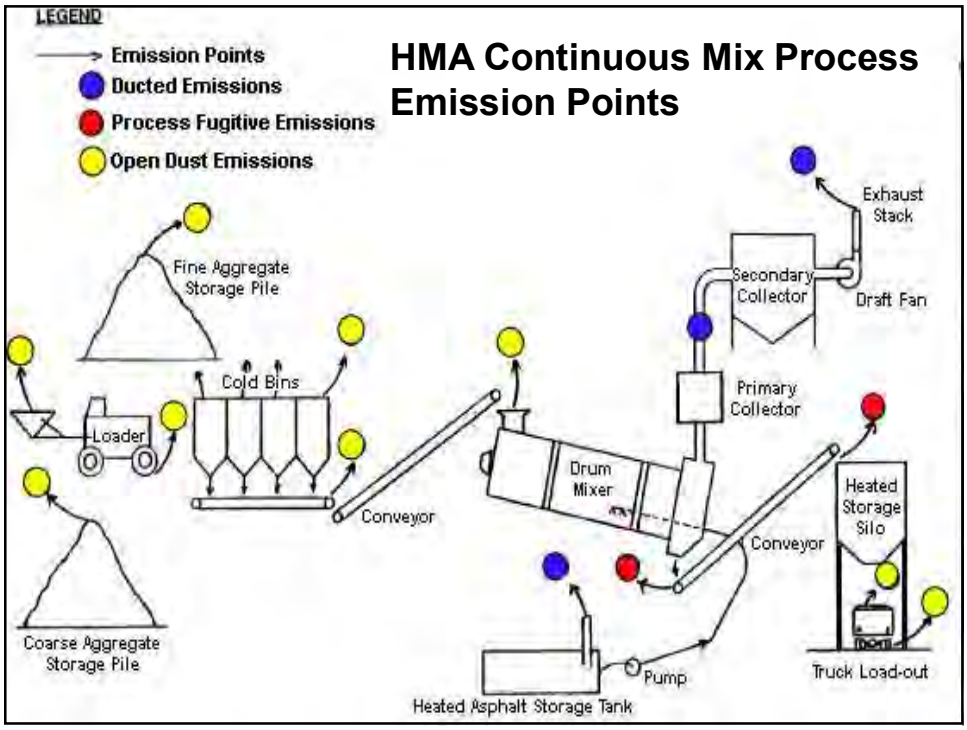
- Visible Emissions Limits
  - ✓NSR lists are 20% or No. 1 on Ringleman
  - ✓Sources permitted before NSR maybe 40% or No. 2 on Ringleman

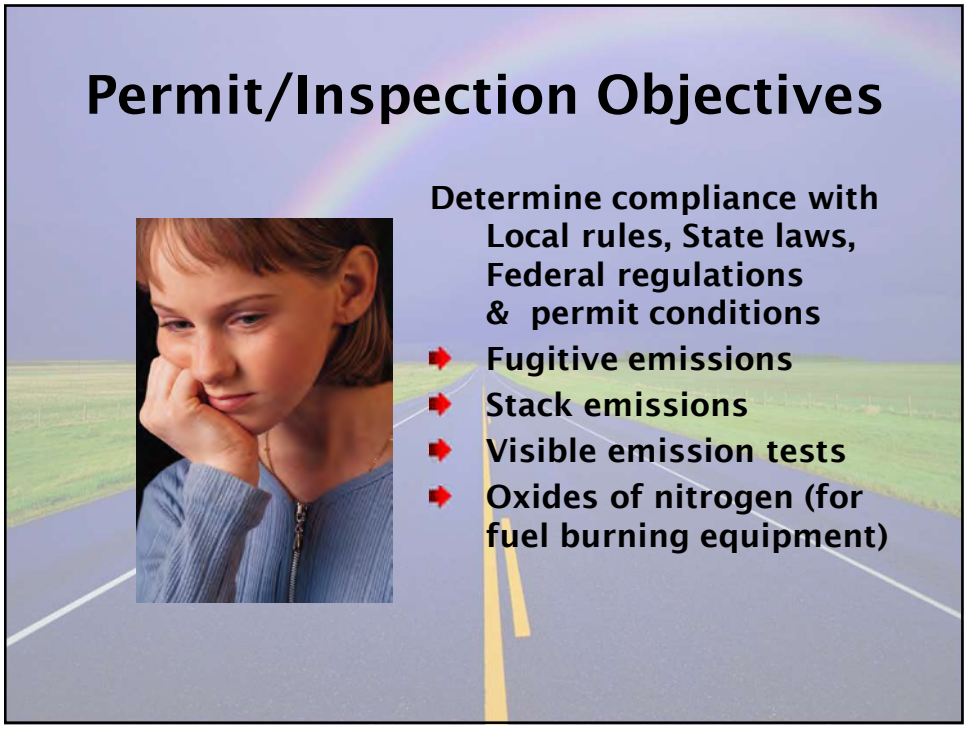
Process/Control
Dry Collection Systems

- Baghouses are regulated in terms of
  - ✓ Source Test Requirements and Methods
  - ✓ Visual Test Method?

Permitting/Inspection
HMA Source Test


LEGEND
Emission Points
Ducted Emissions
Process Fugitive Emissions
Open Dust Emissions
HMA Batch Mix Process
Emission Points
Secondary
Collector
Exhaust Stack
Draft Fan
Primary
Collector
Screens
Fines
Return
Line
Pugmill
Hot Bins
Surge
Bin
Fine Aggregate
Storage Pile
Cold Bins
Loader
Dryer
Truck
Asphalt
Truck
Coarse Aggregate
Storage Pile
Conveyor


LEGEND
Emission Points
Ducted Emissions
Process Fugitive Emissions
Open Dust Emissions
HMA Continuous Mix Process
Emission Points
Exhaust
Stack
Fine Aggregate
Storage Pile
Secondary
Collector
Draft Fan
Cold Bins
Primary
Collector
Loader
Drum
Mixer
Heated
Storage
Silo
Conveyor
Conveyor
Coarse Aggregate
Storage Pile
Pump
Truck Load-out
Heated Asphalt Storage Tank


Permit/Inspection Objectives
Determine compliance with
Local rules, State laws,
Federal regulations
& permit conditions
Fugitive emissions
Stack emissions
Visible emission tests
Oxides of nitrogen (for
fuel burning equipment)