Course Overview: Aggregate Plants

- Introduction
- Emissions and Health Impacts
- Aggregate Industry
- Aggregate Process
- Engineering Evaluation
- Inspection Procedures
Let’s Talk Rock

Emissions and Health Impacts

Who?

How?
Emissions from Nonmetallic Mining

- **Particulate Matter**
  - PM, PM10 & PM2.5

- **Gases**
  - Toxic, Reactive,
  - CO, NOx & SOx

- **Asbestos & Heavy Metals**

Emissions from Nonmetallic Mining in California (tons/day)

<table>
<thead>
<tr>
<th>Emission Type</th>
<th>Quantity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toxic Organic Gases (TOG)</td>
<td>0.22</td>
</tr>
<tr>
<td>Reactive Organic Gases (ROG)</td>
<td>0.15</td>
</tr>
<tr>
<td>Carbon Monoxide (CO₂)</td>
<td>0.05</td>
</tr>
<tr>
<td>Oxides of Nitrogen (NOx)</td>
<td>0.10</td>
</tr>
<tr>
<td>Oxides of Sulfur (SOx)</td>
<td>0.01</td>
</tr>
<tr>
<td>Total Particulate Matter (PM)</td>
<td>25.19</td>
</tr>
<tr>
<td>Particulate Matter PM10</td>
<td>11.73</td>
</tr>
<tr>
<td>Particulate Matter PM2.5</td>
<td>4.46</td>
</tr>
</tbody>
</table>
How Small is PM?

Human Hair (60 μm diameter)

PM$_{10}$ (10 μm)

PM$_{2.5}$ (2.5 μm)

11 Microns and larger
7 to 11 Microns
4.7 to 7 Microns
3.3 to 4.7 Microns
2.1 to 3.3 Microns
1.1 to 2.1 Microns
0.65 to 1.1 Microns
0.43 to 0.65 Microns
**Health Effects of PM**

The Filial have been damaged from particulate exposure.

**Emissions/Health Impacts**

Asbestos
Emissions/Health Impacts

X-ray of a lung exposed to asbestos

Result:

Mesothilaoma

Health Effects of PM/PM2.5

- Aggravated asthma
- Respiratory Distress
- Decreased Lung Function
- Chronic Bronchitis
Concerns???

Concerns???

Aggregate, Mining, Industrial and Recycling
Concerns?

Proximity to homes/parks?

Concerns???
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Perception

Perception
Let's Discuss Aggregate Processing
Let’s Discuss Aggregate Processing

Aggregate Processing: Wet or Dry?
Definition of Natural Aggregate:

A material composed of rock fragment (sand, gravel, and crushed stone) that may be used in its natural state or crushed, washed and sized.
Sand and Aggregate are:
- Loose mineral and rock particles
- Transported by water and erosion

Key Differences:
- Aggregate...passes through 2 inch screen
- Sand...passes through 1/4 inch opening (retained on a 200 mesh per square inch screen)

Aggregate Industry Types:
- Natural
- Crushed by Mechanical Means
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Over the top??

How is Aggregate Used in Concrete & Asphalt?

Concrete
1 cubic yard = 4,060 lbs.

Asphalt
1 cubic yard = 3,880 lbs.

Benefits of Aggregate Processing
Aggregate Process & Control

Emissions & Control

Aggregate Process & Control
Emission Sources

- **Plant Generated Dust**
  - Drilling
  - Crushing
  - Conveying
  - Screening
  - Stockpiling
- **Fugitive Dust**
  - Geologic material generated by:
    - Wind
    - Human activity
Emissions are measured by knowing:

- How much aggregate is processed over time?
- How much moisture is in the material being processed?
- The control efficiency of the air pollution control device...

Resulting in:

- Total Emissions (mass based...pounds/day or tons/year)

**Calculating Emissions**

*General equation from EPA AP-42 is:*

\[
E = A \times EF \times (1 - ER/100)
\]

**where:**

- \(E\) = emissions
- \(A\) = activity rate
- \(EF\) = emission factor
- \(ER\) = % overall emission reduction efficiency
Aggregate Mining

- Two General Types:
  - Sand and Gravel & Crushed Stone
Aggregate Mining

Crushed Stone Mining

- Drilling
- Blasting
**Heavy Metals**

- Associated with quartz or volcanic deposits
- Metals include nickel, cadmium and antimony
- Become airborne during blasting or crushing
- Questionable sources should be sampled for presence of heavy metals
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Batching

Material Dumping from Trucks

Haul Road & Emissions
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Aggregate Mining

Wash Plant
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Batching

Aggregate Mining

Wash Plant with trommel screen

Aggregate Mining

Recycled Water from Wash Plant
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Batching

Wash Plant, Screens & Truck Loadout

Aggregate Mining

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Process/Control, Crushing, Screening & Transfer Points

Materials Handling

- Feeders/Conveyors
  - Primary
  - Secondary
- Crushers
  - Primary
  - Secondary
  - Tertiary
Feeders are used to:

- Absorb the impact from dumping large quarried stone
- Feed the plant with a controlled, steady stream of raw material
- Used to handle muddy or sticky material
- They are located ahead of large, stationary primary crushers

**Application of Feeders**

### APPLICATION OF FEEDERS TABLE – 2A

<table>
<thead>
<tr>
<th>DUTY</th>
<th>RECOMMENDED TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck dumping or direct loading by Dozer, Shovel or Dragline. Maximum lump size not to exceed 75 percent of feeder width.</td>
<td>Super Heavy-Duty Apron Feeder with manganese flights.</td>
</tr>
<tr>
<td>Under hopper or bin, handling non-abrasive material. Maximum lump size not to exceed 75 percent of feeder width.</td>
<td>Super Heavy-Duty Apron Feeder with pressed steel flights.</td>
</tr>
<tr>
<td>Truck dumping or direct loading by Dozer, Shovel or Dragline.</td>
<td>Heavy-Duty Apron Feeder</td>
</tr>
<tr>
<td>Under hopper or bin, handling non-abrasive material. Maximum lump size not to exceed 30 percent of feeder width.</td>
<td>Heavy-Duty Apron Feeder</td>
</tr>
<tr>
<td>Under Primary Crusher to protect belt conveyor.</td>
<td>Vibrating Feeder or Grizzly Feeder.</td>
</tr>
<tr>
<td>Under bins, hoppers or storage piles. Maximum lump size not to exceed 30 percent of feeder width.</td>
<td>Belt Feeder</td>
</tr>
<tr>
<td>Under Large Primary Crushers.</td>
<td>Heavy-Duty Apron Feeder</td>
</tr>
</tbody>
</table>
Feeders & Conveyors

- Primary
  - Apron
  - Grizzly/Belt

Apron Feeders

**Apron feeders are used where:**

- Extremely rugged machines handling large feed are required
- Used to handle muddy or sticky material
- They are located ahead of large, stationary primary crushers
These feeders are used where:

- Used where a compact feeder with variable speed control is required
- Vibrating Grizzly feeder is similar plus grizzly bars for separating fines the crushed feed
- They help bypass fines around the primary crushers increasing production & reduces crusher liner wear.

Vibrating Grizzly Feeders

- Grizzly
  - Vibrating Grizzly
  - Step deck Grizzly
Vibrating Grizzly Feeders

Reduces crusher liner wear

Grizzly Feeder
Grizzly Feeder

Vibrating Grizzly Feeders

Jaw crusher
Belt Feeders

*Belt feeders are used:*

- Under a hopper or trap with 6” maximum feed size
- They have an infinite variable speed control for optimum plant feed rate

Feeder with Spray bar
Vibrating Pan

Primary Conveyor

Conveyor with Spray bar
Wobble Feeder

- Combined feeder and scalper
- Effective in handling clay or fine sticky feed material

Wash Plant
Wash Plant

Wash Plant w/trommel screen
Recycled Water from Wash Plant

Wash Plant, Screens & Truck Loadout
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Wash Plant

Secondary Wash
Conveyors
Conveyor with Baghouse
Conveyor Belt Feeder

- Conveyor Belt
- Belt feeder with adjustable feed gate

Crushing

- Fracture Mechanisms
- Crushing Equipment
- Factors Influencing Crushed Product
Particle Breaking:
1. Abrasion
2. Cleavage
3. Shatter

Fracture Mechanisms

Primary or Jaw Crusher
Jaw Crusher

During normal crushing, hydraulic cylinders hold the toggle beam forward.

Clearing is achieved using push button controls. Cylinders retract the toggle beam and pitman, allowing the stone to fall.

Cylinders push the toggle beam and pitman forward, crushing the remaining stone. Cycling through this process a few times clears the chamber.

3” – 8” size rock
Jaw Crusher

No Spray bars

Spray bars to reduce emissions
Jaw Crusher

Cone Crusher
Cone Crusher

Cone Crusher

Cone Crusher
Cone Crusher
Cone Crusher

2"
1 ¾"
1 ½"
1 ¼"
1"
¾"
5/8"
½"
3/8
size rock

Cone Crusher

Internal Drive Key
Thread Locking Mechanism
Anti-Spin Assembly
External Backlash Adjustment

Rubber Hopper Seal
Collet Assembly
Inverted Relief Cylinders
Sealing System
Hybrid Thrust Bearings
Spiral Bevel Gear & Pinion
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Cone Crusher

Baghouse

Impact Crusher
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Impact Crusher

- Upper Apron
- Adjustable Apron Supports
- Lower Apron
- Rotor
- Wedges
- Hammers
- Alloy Steel Liners

Tertiary Crusher

Hammer Mill
Grinding Mill or Ball Mill

- Dry ball mills most popular, due to economics
- Used for finer material separation

Grinding Mill or Ball Mill

- Media are rods or balls
- Rods are for coarse-like manufactured sand or cement klinker
Screening Operations

FROM THE MINE

Screening

SCALPING SCREEN
PRIMARY CRUSHER
SURGE PILE
RECLAIM TUNNEL
PRIMARY CRUSHER
SECONDARY CRUSHER
SECONDARY SCREENS
PRODUCT SORTED BY SIZE
SCREENS
Screening Surface

Screening Operations
Fugitive Dust from Screening Operations

Screens
Point Emissions

- **Point emissions originate from stacks**
  - Control Devices
  - Where aggregate is dried
- **Stack emissions**
  - Moisture
  - Gases
  - PM/PM10/PM2.5
  - All of the above
Stockpiling

Could be a potential source of fugitive dust emissions

Screening, Storage & Loadout Operations
Storage & Loadout Operations

Air Pollution Control Measures

- Preventative Measures
  - Passive Enclosures
  - Wet/Chemical Suppression
  - Paved Surface/Cleaning

- Dry Collection Systems
  - baghouse
  - cyclone
Process & Control Measures

**Control**
Moving conveyors or trucks (Passive control is wind screens)

**Operations**
- Crushing (active control is water)
- Transfer (active control is water)

Air Pollution & Control Measures

- Water sprays
- Maintaining good housekeeping
- Covers
- Enclosure or cover at transfer points and screening operations
- Exhausting air to air pollution control systems
Preventative Measures

- Passive enclosures
- Wet suppression
- Stabilization of unpaved surfaces
- Minimizing drop height
- Paved surfaces cleaning
- Work practices
- Housekeeping
Preventative Measures

- Spray Header
- Crusher
- Filter
- Rubber Skirt
- nozzle
- Belt Conveyors
- Belt Idlers
- Suppressant

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Dry Collection Systems

Baghouses are regulated in terms of:

- Grains/cubic foot or air emitted (gr./dscf)
- Pounds/Ton of Aggregate produced
- Opacity

Baghouse in Disrepair
Combination Systems

- **Dry collection and wet suppression**
  - When fine particulates have an economic value in addition to meeting air pollution control laws
  - Due to screen blinding
  - Due to plant location or local pollution control codes, which is not economically feasible

Other Processing Equipment

- Rock Breaker
- Magnets
- Metal Detectors
- Pugmills
- PERP Equipment
- Washing equipment
- Rotary Scrubber
- Wet Classifiers
- Pumps
- Grinding Mills
Determine compliance with:
- District regulations & permit conditions
- Fugitive dust
- Visible emissions
- Oxides of nitrogen (for fuel burning equipment)
- Control devices

**Pre-Inspection File Review**

1. Permit application
2. Approved permit
3. Equipment
4. Permit condition for each unit
5. Previous inspection reports
6. NTC/NOV
7. Compliance action
8. Complaints
9. Variance history
10. Abatement orders
11. Date of last source test
Pre - Entry & Entry

- Observe the site
  - Note odors or visible emissions
  - Size and layout
  - Environmental demeanor
- ID potential problem areas
- Enter through normal public access
- Introduce yourself, ask to see contact listed in file, & present business card

Pre - Inspection Meeting

- State purpose of inspection and identify equipment to be inspected
- Obtain:
  - company name, ownership, address, contact name
  - operating schedule, date of last source test, fuel usage
- Discuss any outstanding business
- Date of last breakdown
- Status of:
  - dust suppression equipment
  - Air pollution control equipment
  - Monitoring and recording devices
- Check Permit
Non - Compliance

A NTC/NOV is issued when the permit is not:
1. Current or no permit
2. Posted properly
3. Or conditions on permit are not followed
4. Blatant disregard

Post - Inspection

- Make compliance determination
- Inform site of inspection (NOVs, and advise on areas of concern
- Document pending NOVs due to additional info request etc.
Safety

DANGER

UNSTABLE STOCKPILES
FOLLOW OSHA / MSHA
SAFETY PROCEDURES