Let's Talk Rock

Course Overview: Aggregate Plants

- Introduction
- Emissions and Health Impacts
- Aggregate Industry
- Aggregate Process
- Engineering Evaluation
- Inspection Procedures

Aggregate Plants
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>Emissions</th>
<th>Amount</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$_{2.5}$ (2.5 μm)

PM$_{10}$ (10 μm)

Hair cross section (60 μm)

How Small is PM?

<table>
<thead>
<tr>
<th>Hair</th>
<th>Skin</th>
</tr>
</thead>
<tbody>
<tr>
<td>11 Microns and larger</td>
<td>7 to 11 Microns</td>
</tr>
<tr>
<td>7 to 11 Microns</td>
<td>4.7 to 7 Microns</td>
</tr>
<tr>
<td>4.7 to 7 Microns</td>
<td>3.3 to 4.7 Microns</td>
</tr>
<tr>
<td>3.3 to 4.7 Microns</td>
<td>2.1 to 3.3 Microns</td>
</tr>
<tr>
<td>2.1 to 3.3 Microns</td>
<td>1.1 to 2.1 Microns</td>
</tr>
<tr>
<td>1.1 to 2.1 Microns</td>
<td>0.43 to 1.1 Microns</td>
</tr>
<tr>
<td>0.43 to 1.1 Microns</td>
<td>0.65 to 1.1 Microns</td>
</tr>
</tbody>
</table>

Health Effects of PM

The Filial have been damaged from particulate exposure
Asbestos Emissions/Health Impacts

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

Health Effects of PM/PM2.5

- X-ray of a lung exposed to asbestos
- Result: Mesothelaoma
Concerns???

Proximity to homes/parks?
Let’s Discuss Aggregate Processing
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

Aggregate Industry Type

Natural

Crushed by Mechanical Means

Over the top??
Emission Sources

• Plant Generated Dust
  – Drilling
  – Crushing
  – Conveying
  – Screening
  – Stockpiling
• Fugitive Dust
  – Geologic material generated by:
    • Wind
    • Human activity

Process & Controls

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)
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

Calculating Emissions

 Aggregate Mining

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

Aggregate Mining

Sand & Gravel Mining
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
246: HMA, Aggregate & Concrete Batching

Aggregate Mining

Wash Plant with trommel screen
5/30/2017

Aggregate Mining

Recycled Water from Wash Plant

Wash Plant, Screens & Truck Loadout
Aggregate Mining

Process/Control, Crushing, Screening & Transfer Points

Materials Handling

- Feeders/Conveyors
  - Primary
  - Secondary
- Crushers
  - Primary
  - Secondary
  - Tertiary
Feeders

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 materials
• They are located ahead of large, stationary primary crushers

Application of Feeders

<table>
<thead>
<tr>
<th>DUTY</th>
<th>RECOMMENDED TYPE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Truck dumping or direct feeding by Dozer, Shovel or Grader MaintenanceMarshalls</td>
<td>Super Heavy Duty Apron Feeder with interlocking flights</td>
</tr>
<tr>
<td>Under hopper or bin, handling non-adhesive material. Maintenance required to exceed 75 percent of feeder width</td>
<td>Super Heavy Duty Apron Feeder</td>
</tr>
<tr>
<td>Truck dumping or direct feeding by Dozer, Shovel or Grader MaintenanceMarshalls</td>
<td>Heavy Duty Apron Feeder</td>
</tr>
<tr>
<td>Under hopper or bin, handling non-adhesive material. Maximum tipping load not to exceed 75 percent of feeder width.</td>
<td>Heavy Duty Apron Feeder</td>
</tr>
<tr>
<td>Under Primary Crusher to protect belt conveyors</td>
<td>Vibrating Feeder or Grizzly Feeder</td>
</tr>
<tr>
<td>Under bars, hoppers or surge piles. Maximum tipping load not to exceed 20 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

Vibrating Feeders 36" to 72" wide, 12" to 36" high
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

Vibrating Feeder & Vibrating Grizzly Feeders

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
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

Belt Feeders & Conveyors

Feeder with Spray bar
Vibrating Pan

Primary Conveyor

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

- Fracture Mechanisms
- Crushing Equipment
- Factors Influencing Crushed Product

Fracture Mechanisms

Particle Breaking:
1. Abrasion
2. Cleavage
3. Shatter

Primary or Jaw Crusher
Jaw Crusher

3” – 8” size rock

Jaw Crusher

No Spray bars

Spray bars to reduce emissions
246: HMA, Aggregate & Concrete Batching

Cone Crusher

Cone Crusher

Cone Crusher

Cone Crusher
Grinding Mill or Ball Mill

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

Media are rods or balls

- Rods are for coarse-like manufactured sand or cement klinker

Screening Operations
**Screening Operations**

FROM THE MINE

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

Screens from 8' x 8' to 8' x 24'
Fugitive Dust from Screening Operations

Screens

Screen Test @ Lab
• 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

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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

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Baghouses are regulated in terms of:

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

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**Other Processing Equipment**

- Rock Breaker
- Magnets
- Metal Detectors
- Pugmills
- PERP Equipment
- Washing equipment
- Rotary Scrubber
- Wet Classifiers
- Pumps
- Grinding Mills

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**Inspection Objectives**

Determine compliance with:
- District regulations & permit conditions
- Fugitive dust
- Visible emissions
- Oxides of nitrogen (for fuel burning equipment)
- Control devices

**Pre-Inspection**

- Regulation Review
- Equipment Check
  - Safety goggle and earplugs
  - Safety shoes, hard hat, and gloves
  - ID and business cards
### 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

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### 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