



Aggregate Plants NACT 246

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 & PM_{2.5}

Gases

- Toxics, ROGs,
- CO, NO_x & SO_x

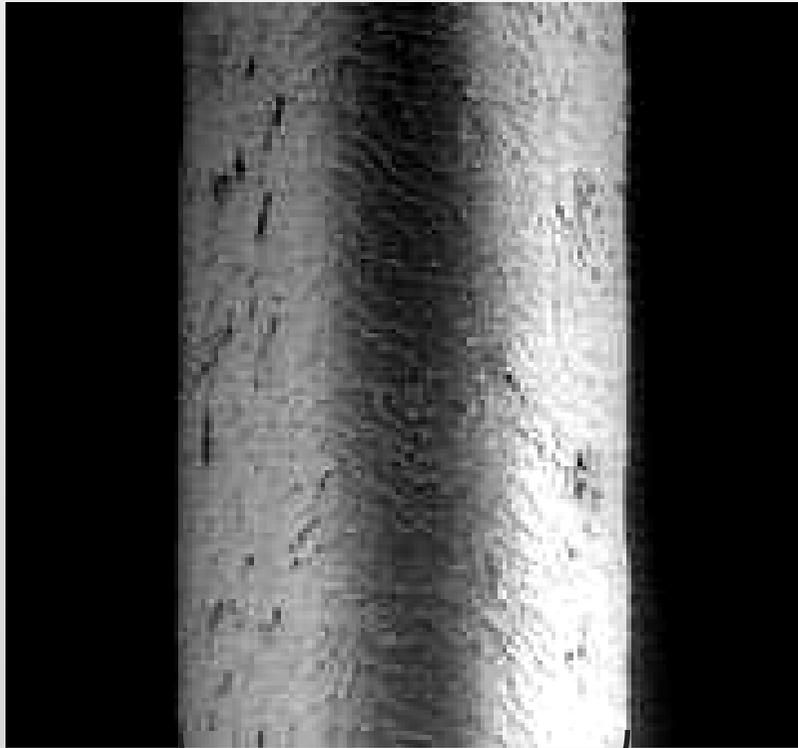
Asbestos & Heavy Metals



Emissions from Nonmetallic Mining in California (tons/day)

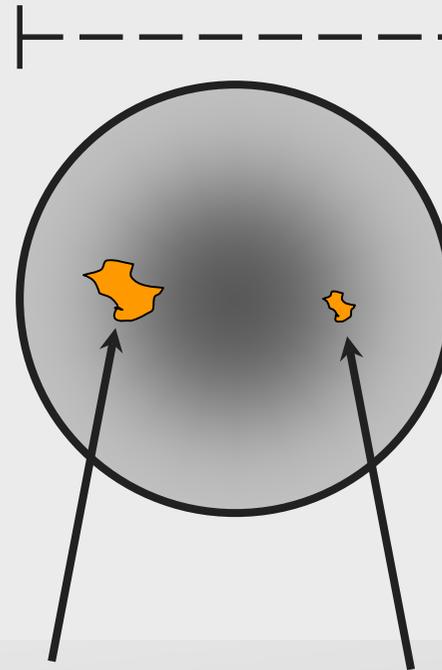
Total Organic Gases (TOG)	0.22
Reactive Organic Gases (ROG)	0.15
Carbon Monoxide (CO₂)	0.05
Oxides of Nitrogen (NO_x)	0.10
Oxides of Sulfur (SO_x)	0.01
Total Particulate Matter (PM)	25.19
Particulate Matter PM₁₀	11.73
Particulate Matter PM_{2.5}	4.46

How Small is PM?



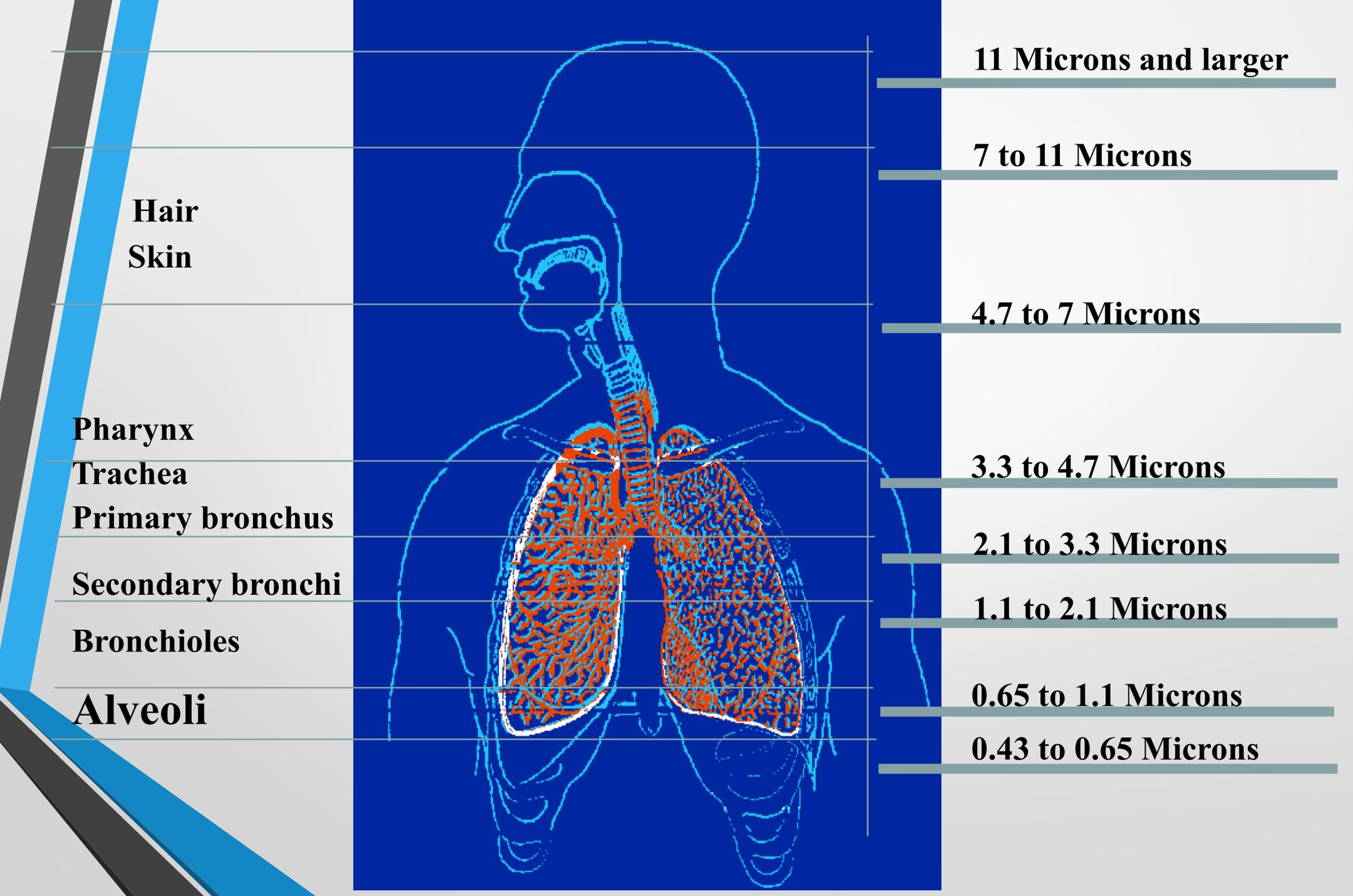
Human Hair
(60 μm diameter)

Hair cross section (60 μm)



PM₁₀
(10 μm)

PM_{2.5}
(2.5 μm)



Hair
Skin

11 Microns and larger

7 to 11 Microns

4.7 to 7 Microns

Pharynx

3.3 to 4.7 Microns

Trachea

2.1 to 3.3 Microns

Primary bronchus

1.1 to 2.1 Microns

Secondary bronchi

Bronchioles

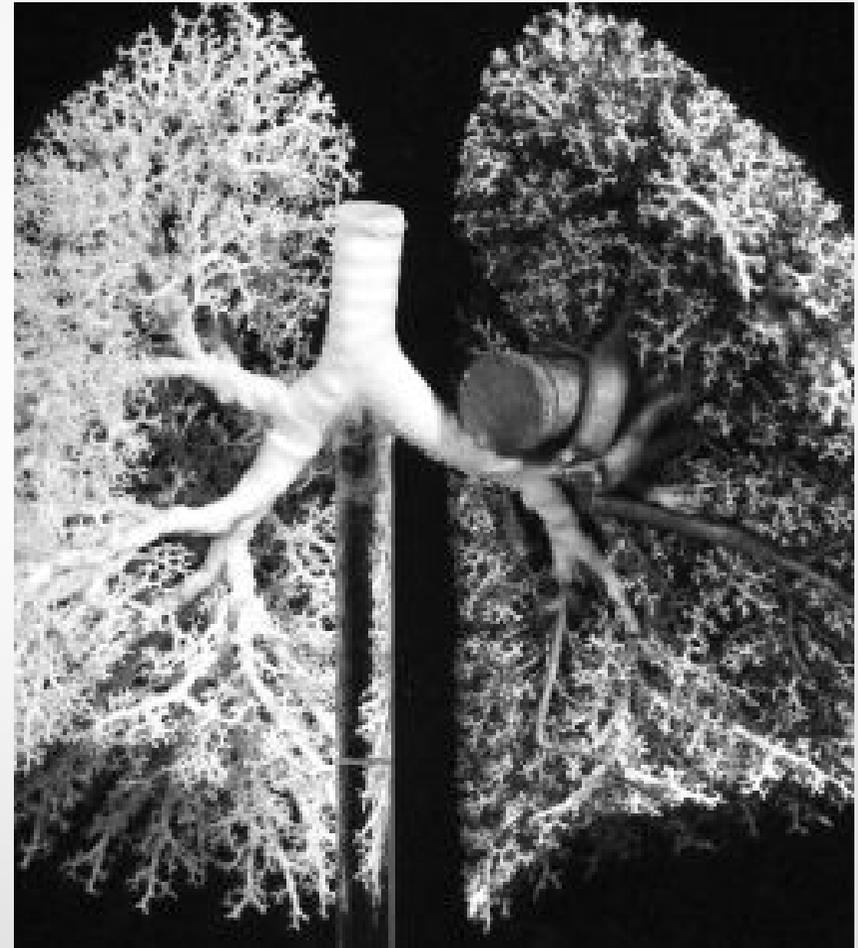
0.65 to 1.1 Microns

Alveoli

0.43 to 0.65 Microns

Health Effects of PM

**The Cilia have
been damaged
from particulate
exposure**



Emissions/Health Impacts

Asbestos



Emissions/Health Impacts

- X-ray of a lung exposed to asbestos
- Results in mesothelioma



Health Effects of PM₁₀/PM_{2.5}

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



Concerns???



Concerns???



Aggregate, Mining, Industrial and Recycling



Concerns???



Concerns???



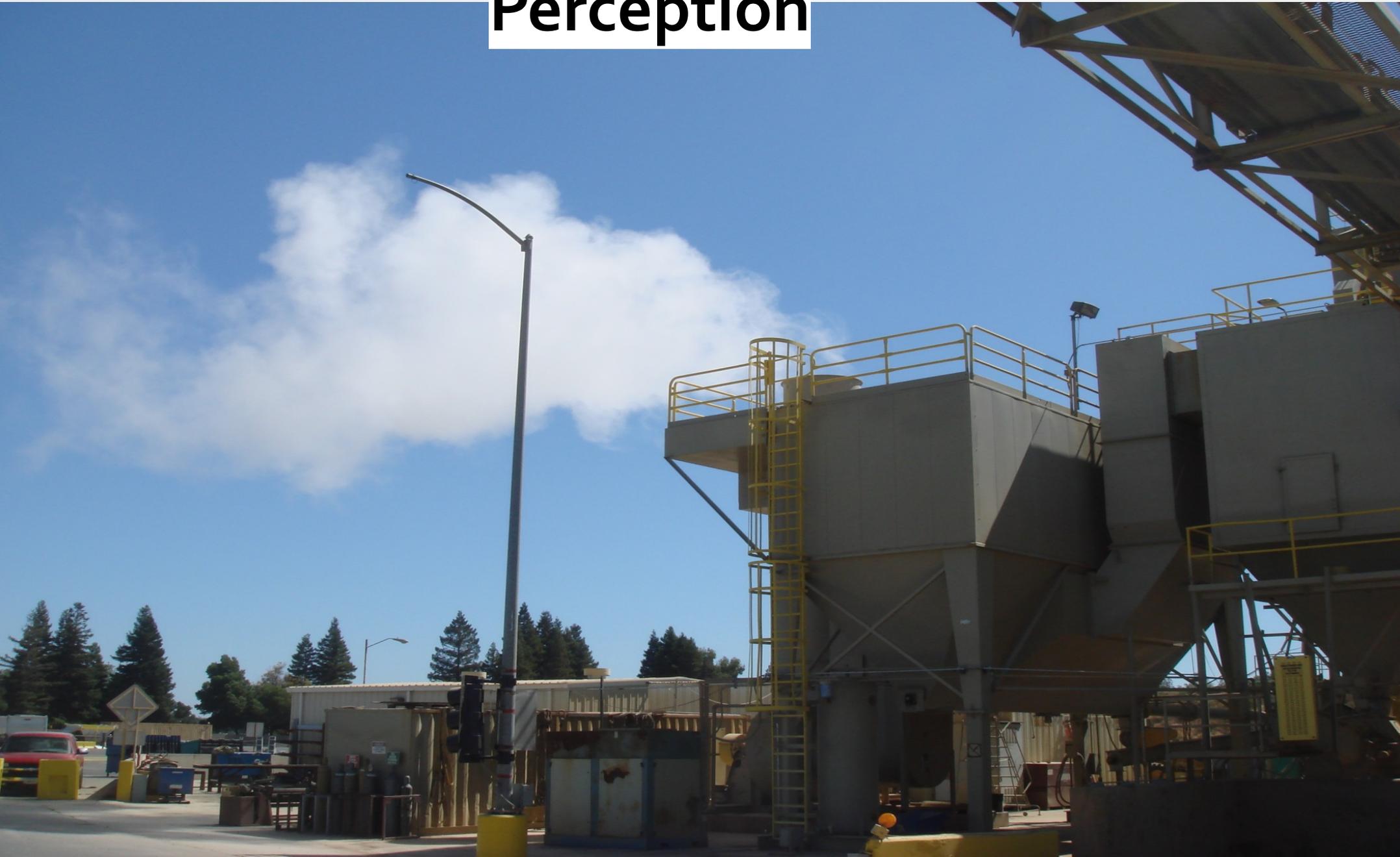
NOV?





Perception

Perception



Perception

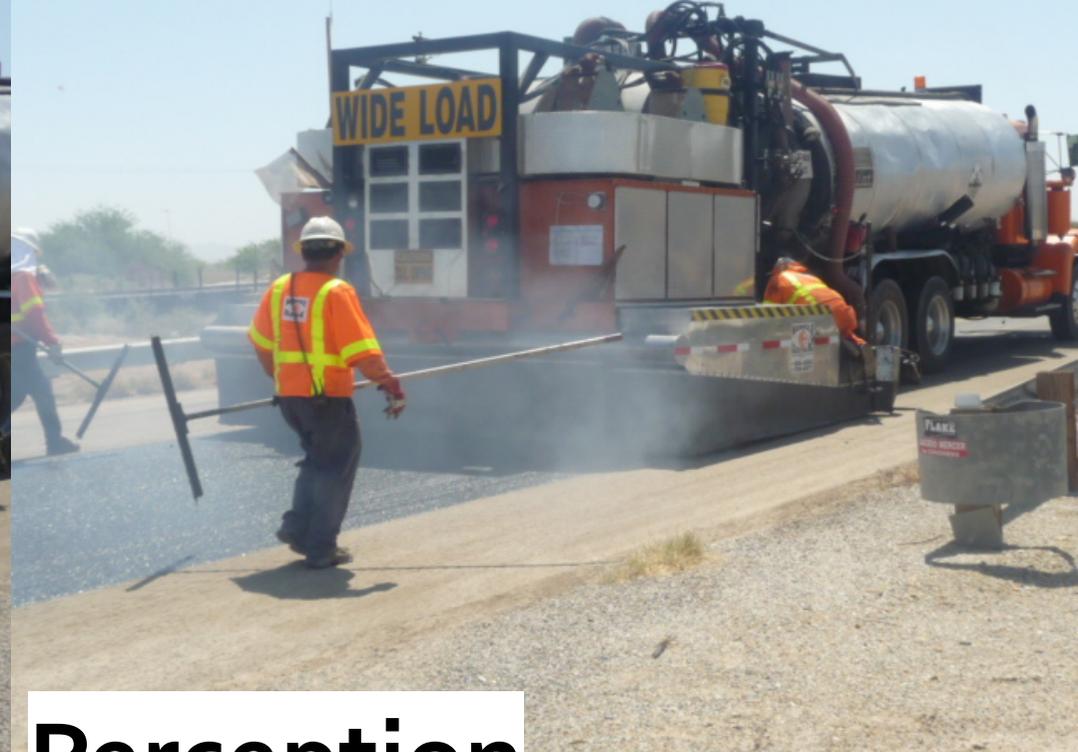


Perception





Perception



Perception



5.2.2016 10:36

5.2.2016 10:33

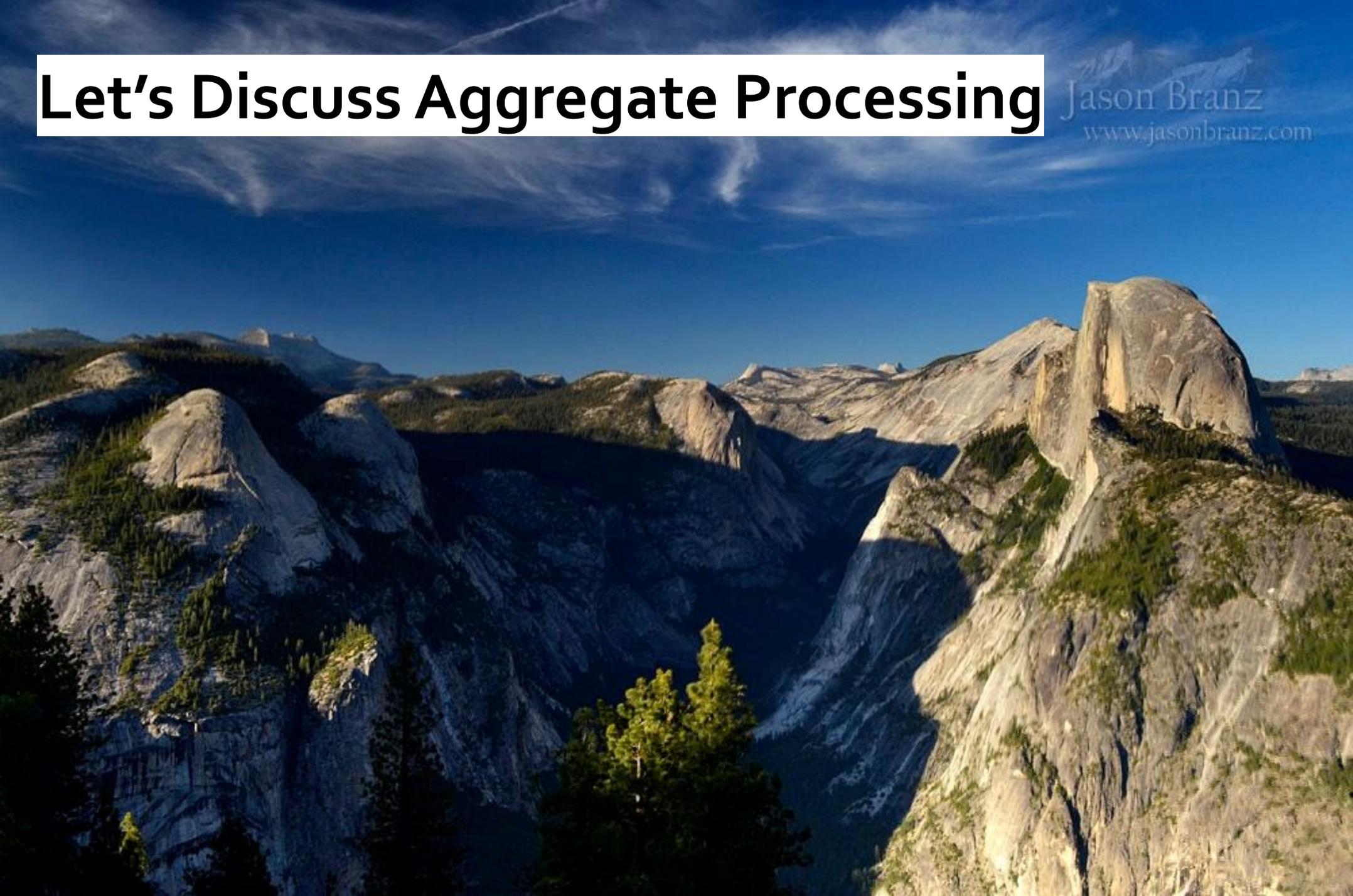


Perception



Let's Discuss Aggregate Processing

Jason Branz
www.jasonbranz.com





Let's Discuss Aggregate Processing



Aggregate Processing: Wet or Dry?



Aggregate Industry



Aggregate Industry

- Definition of Natural Aggregate:
- A material composed of rock fragments (sand, gravel, and crushed stone) that may be used in its natural state or crushed, washed and sized.



Aggregate Industry

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 $\frac{1}{4}$ inch opening (retained on a 200 mesh per square inch screen)



Aggregate Industry Type:

Natural



Crushed by
Mechanical Means

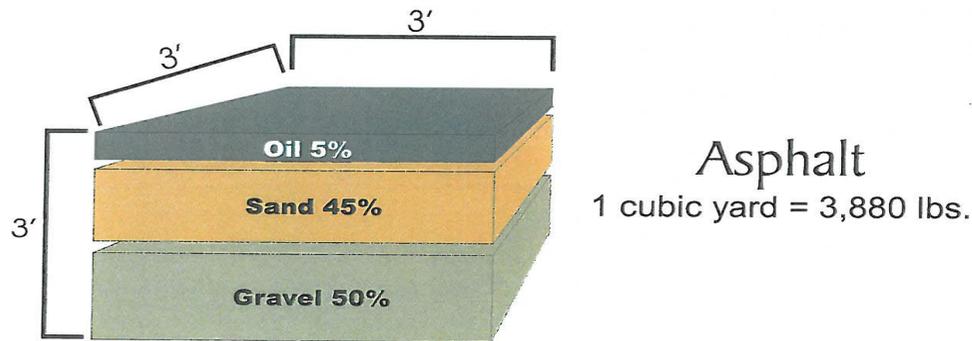
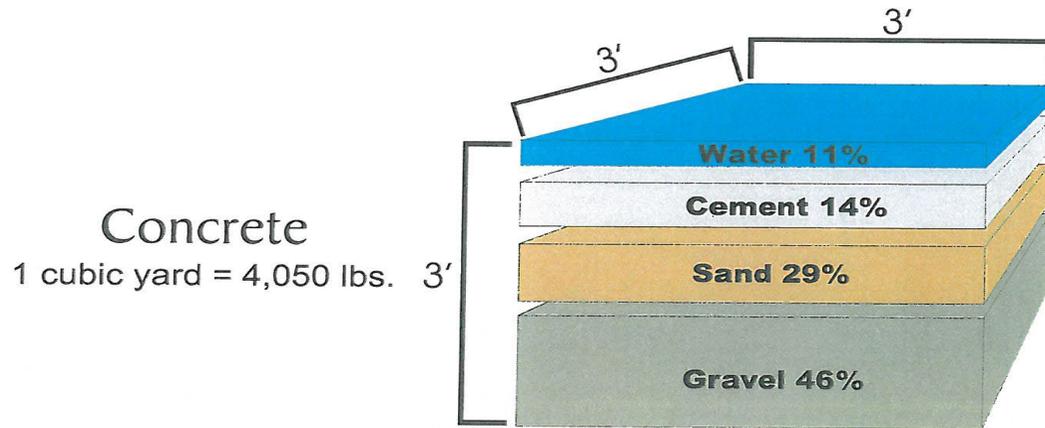




Over the top??



HOW IS AGGREGATE USED IN CONCRETE & ASPHALT?



Benefits of Aggregate Processing

Aggregate Processing and Control



Emissions and Control

Aggregate Processing and Control





Lack of Controls???



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)

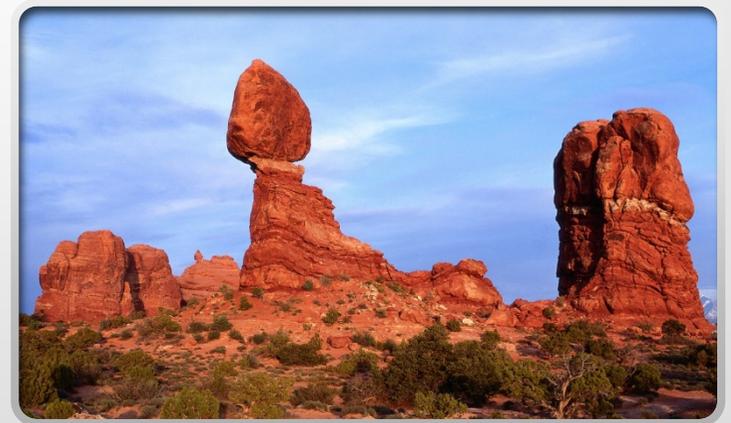
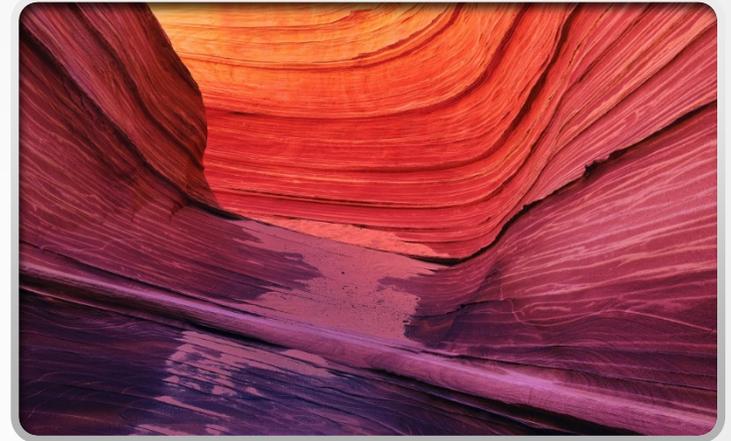
Calculating Emissions

- 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



Sand and Gravel Mining

Aggregate Mining

The image shows a large-scale aggregate mining operation. In the background, a massive, layered rock quarry rises against a clear blue sky. The rock face is light-colored with distinct horizontal strata. In the middle ground, a complex conveyor belt system is visible, consisting of multiple metal structures and rollers that transport material across the site. A large, rectangular concrete structure, likely a hopper or feeder, is positioned near the base of the quarry. In the foreground, a large pile of crushed stone and gravel is scattered across the ground. Several tall, slender light poles are spaced out across the site, providing illumination. The overall scene depicts a busy industrial mining environment.

Crushed Stone 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



Aggregate Mining



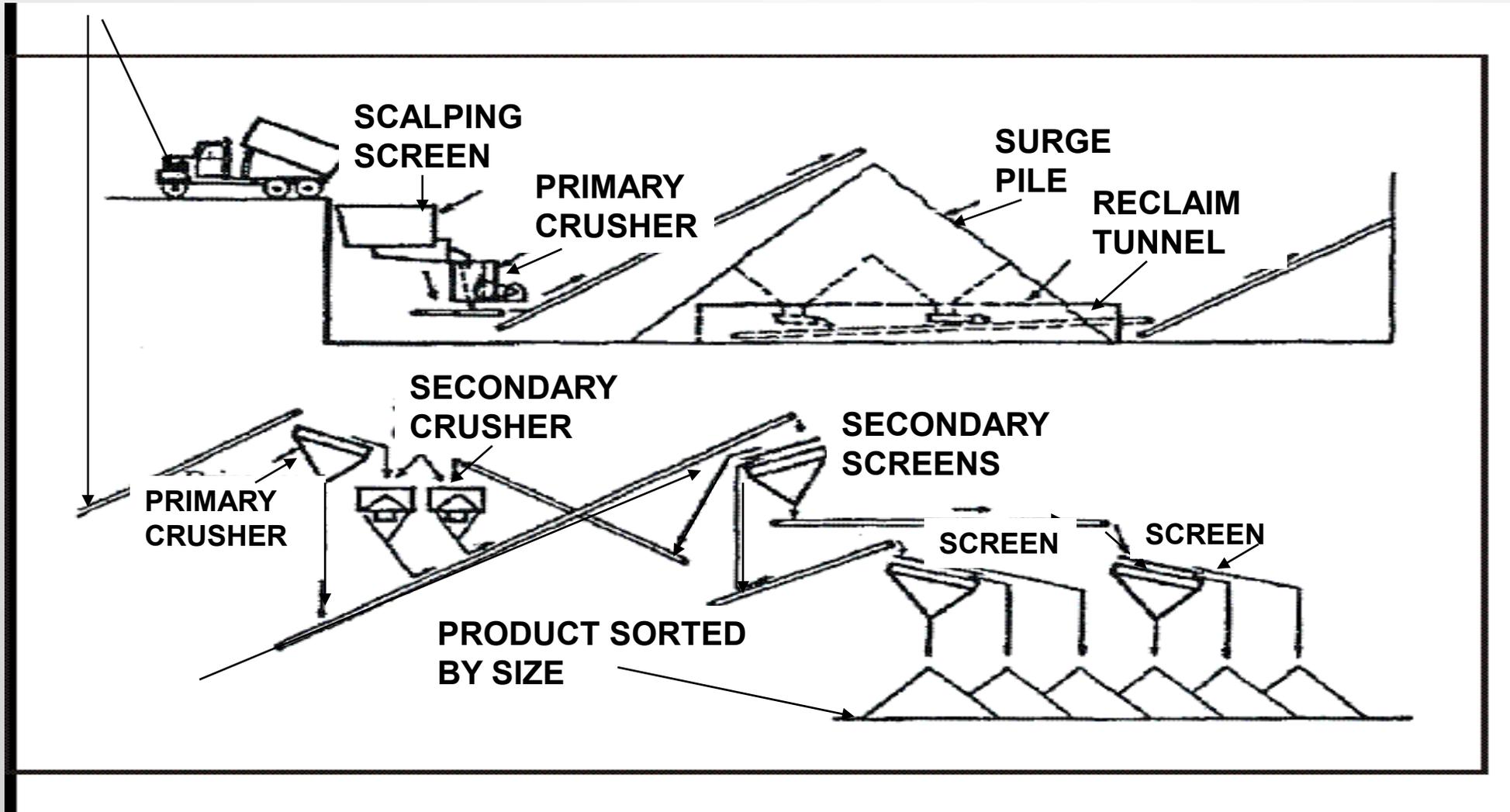


Material Dumping from Trucks



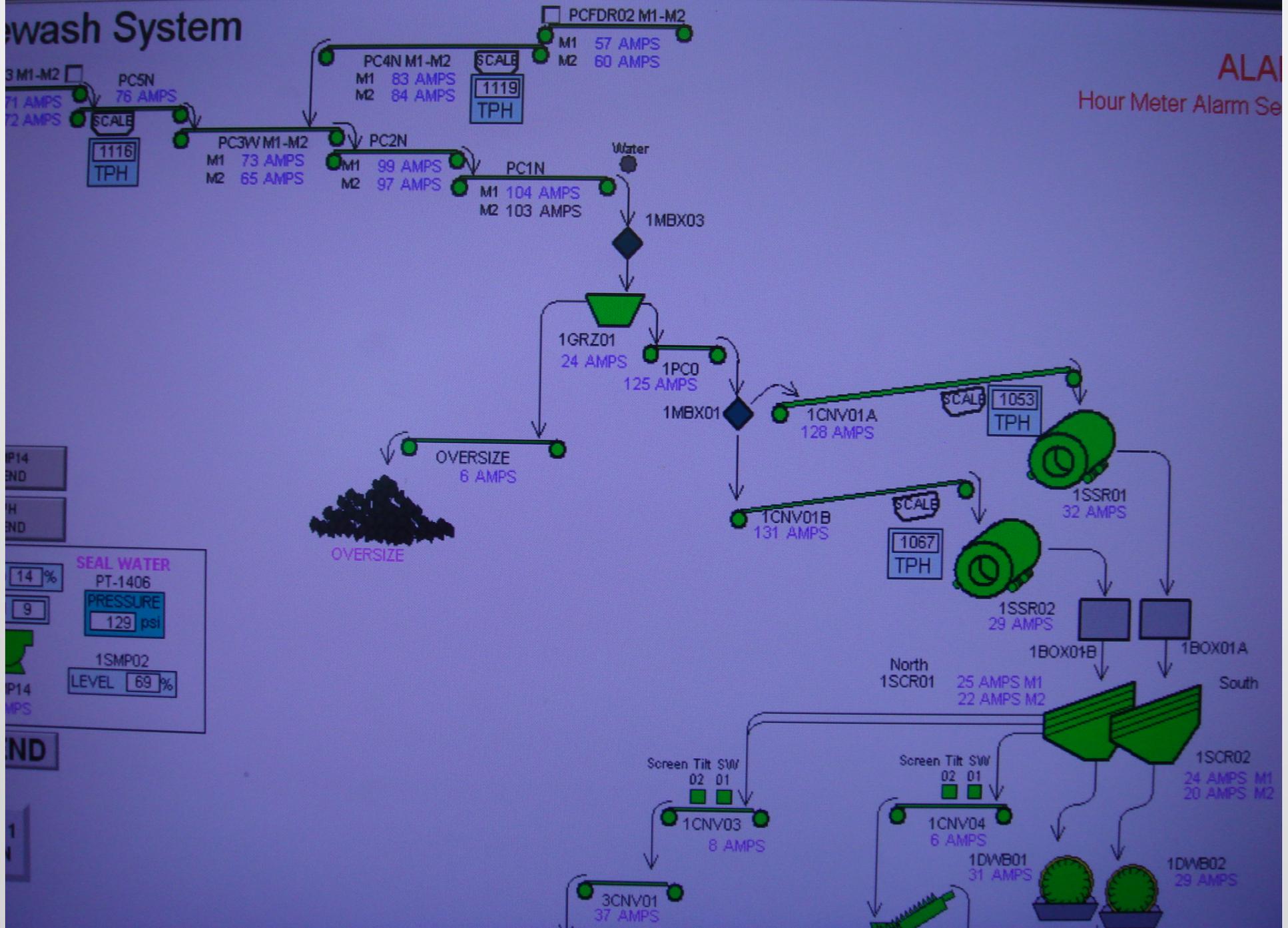
Haul Road & Emissions

Process from the Mine



Wash System

ALARM
Hour Meter Alarm Set



P14 END

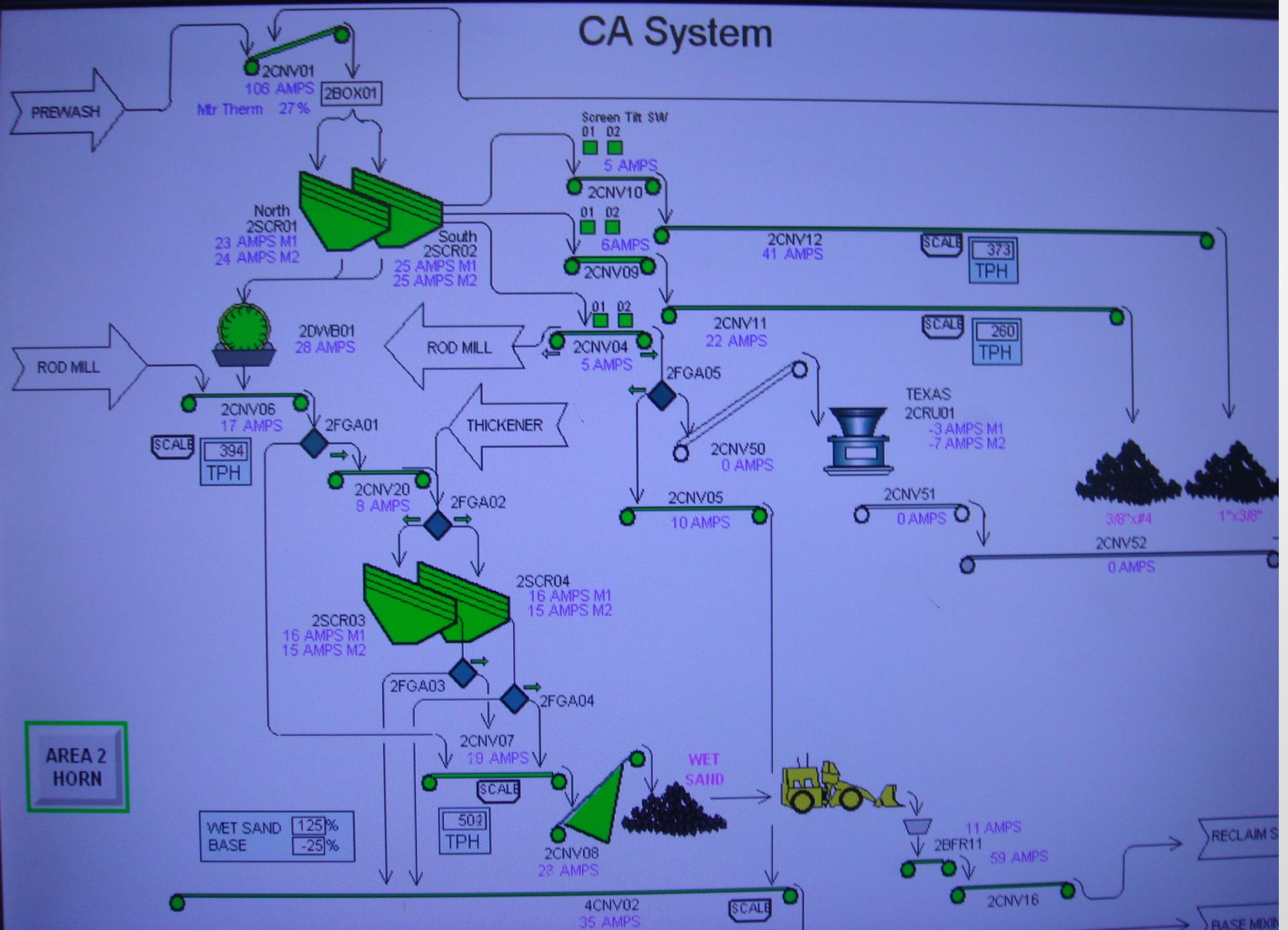
P14 END

SEAL WATER
PT-1406
PRESSURE 129 psi
1SMP02
LEVEL 69%

P14
AMPS

ND

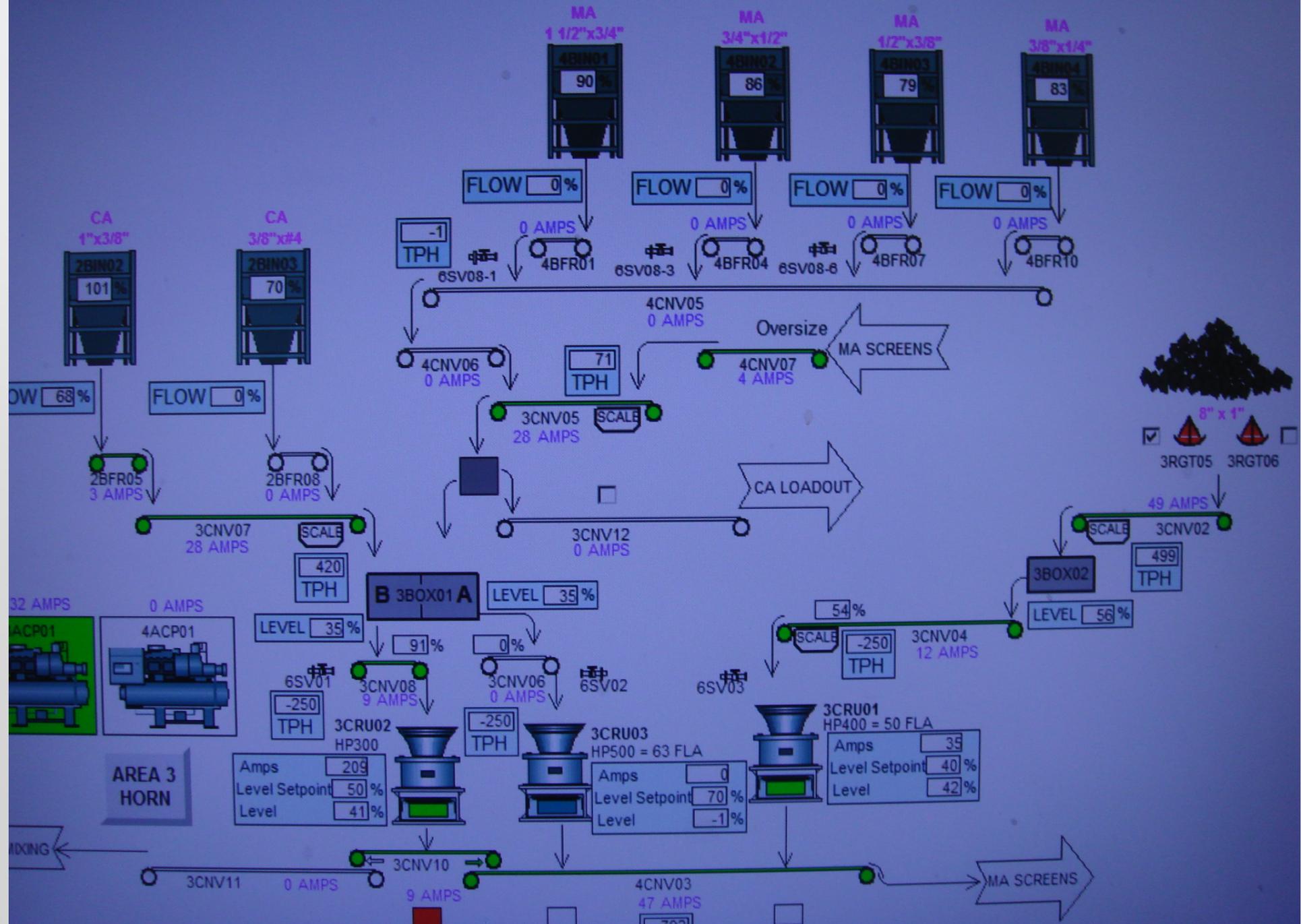
CA System



MA Crush System

Hour Meter Alarm See PMI

ALARM



Aggregate Mining

A large-scale industrial aggregate mining wash plant. The central feature is a large, rotating wheel with multiple curved segments, likely used for screening or washing aggregate. The plant is constructed from heavy-duty metal and concrete, with numerous walkways, railings, and structural beams. In the background, there are more complex structures, including what appears to be a conveyor belt system and a tall tower. The sky is clear and blue, suggesting a bright, sunny day. The overall scene depicts a complex and heavy-duty mining operation.

Wash Plant

Aggregate Mining



Wash plant with trommel screen

Aggregate Mining

Recycled water from wash plant

A photograph of an industrial aggregate mining facility. The scene is dominated by large, cylindrical storage tanks and a complex network of pipes and conveyor belts. In the background, a large pile of aggregate material is visible. The sky is clear and blue. The foreground shows a dirt area with some debris. A tall, thin metal pole stands in the middle ground, and a large metal structure is on the right side of the frame.



Wash Plant, Screen & 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 material
 - They are located ahead of large, stationary primary crushers



Application of Feeders

APPLICATION OF FEEDERS TABLE – 2A

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

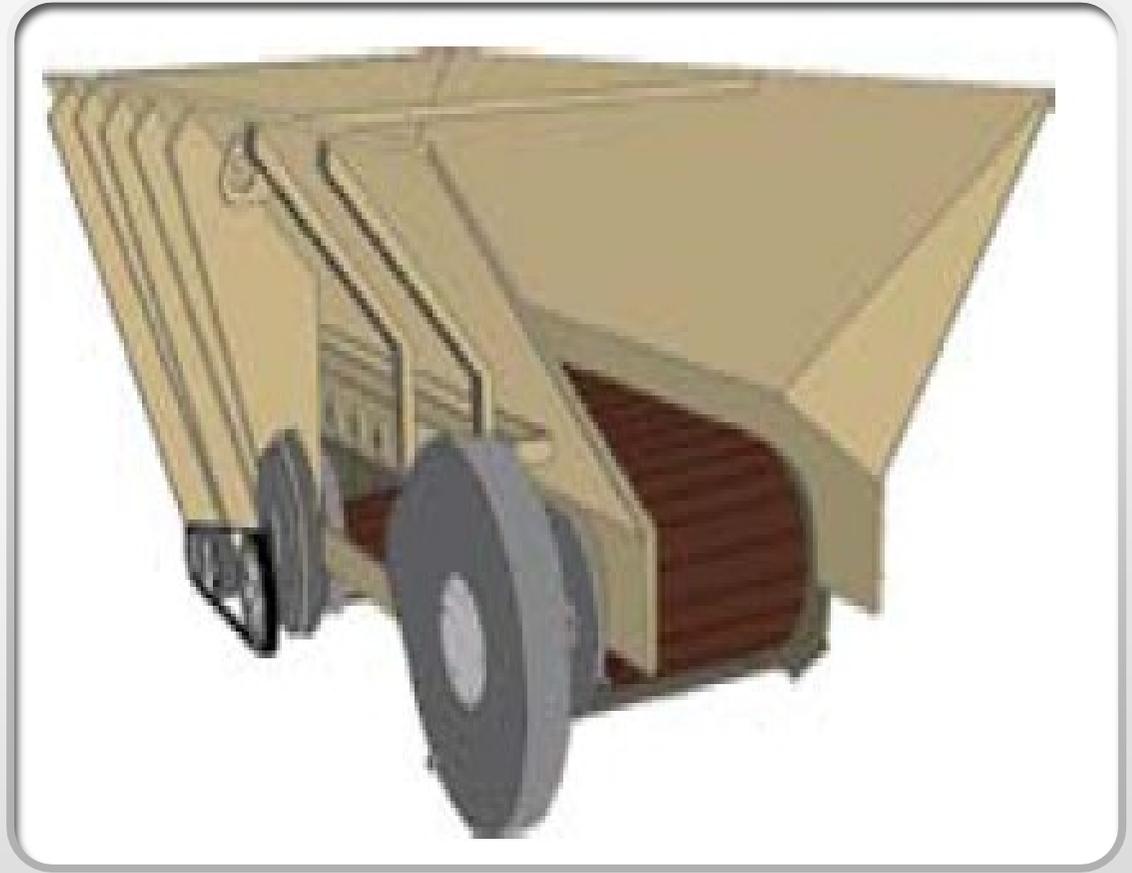
Feeders and Conveyors

- 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



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

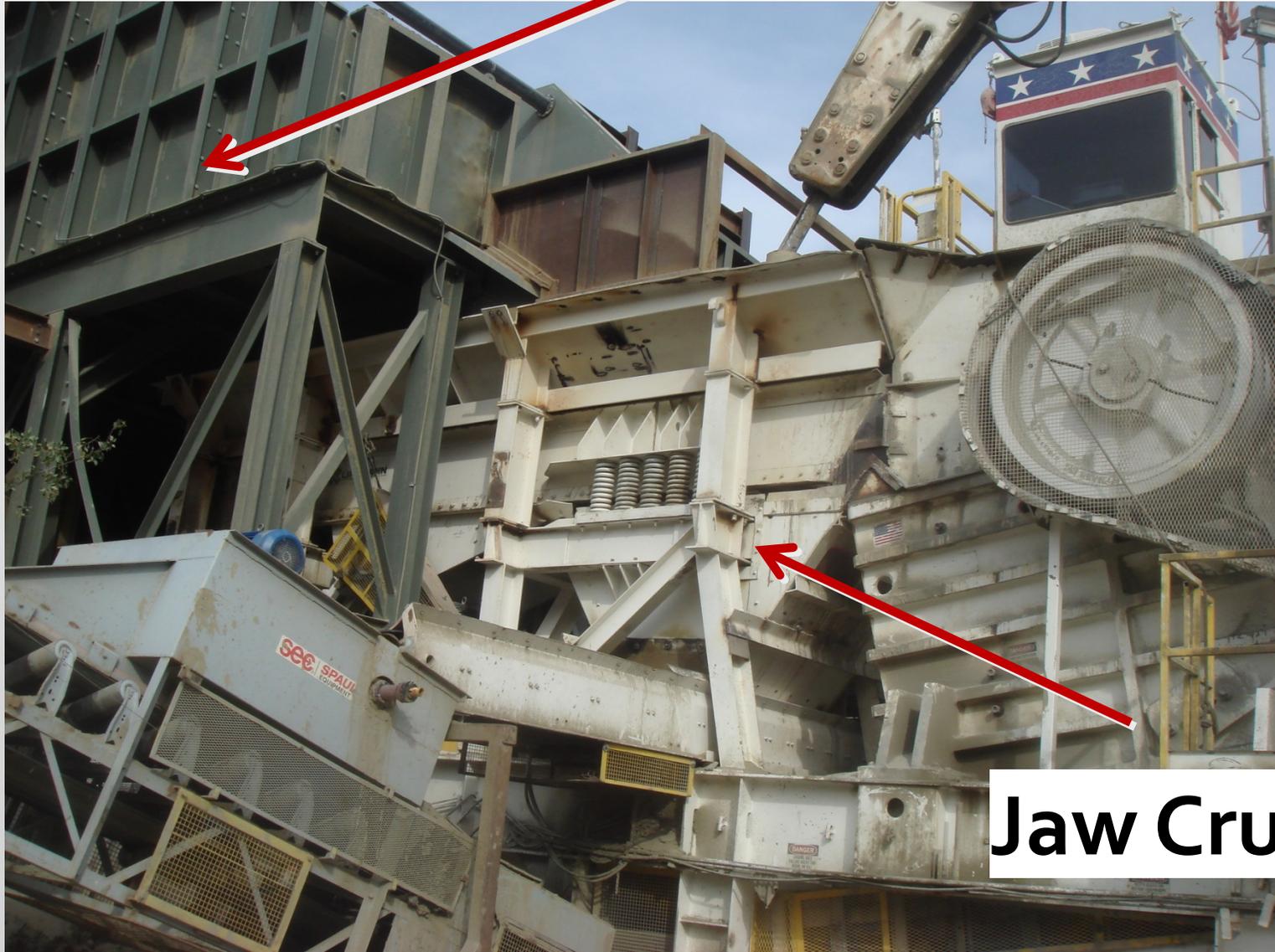
Grizzly Feeder



Grizzly Feeder



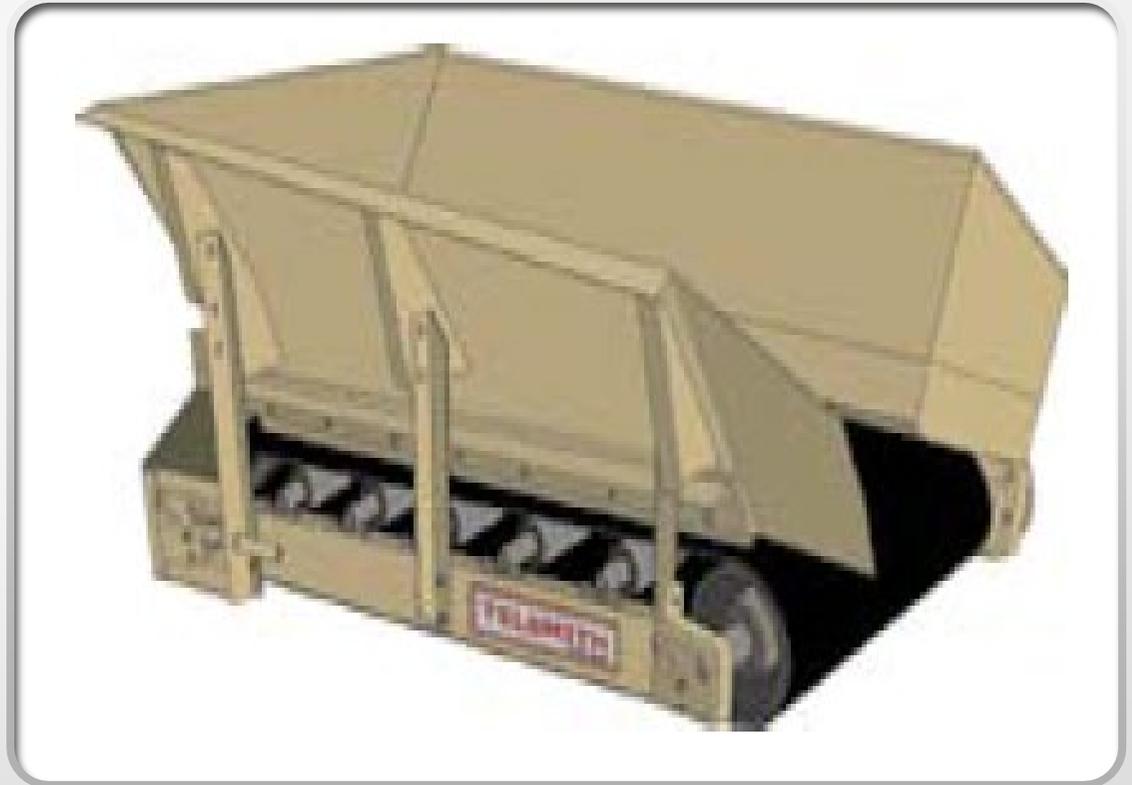
Vibrating Grizzly Feeder



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



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

Wash Plant



Secondary Wash



Conveyors



Conveyors



Conveyors with Baghouse





Conveyor with Baghouse

Conveyor Belt



- Conveyor Belt
- Belt feeder with adjustable feed gate

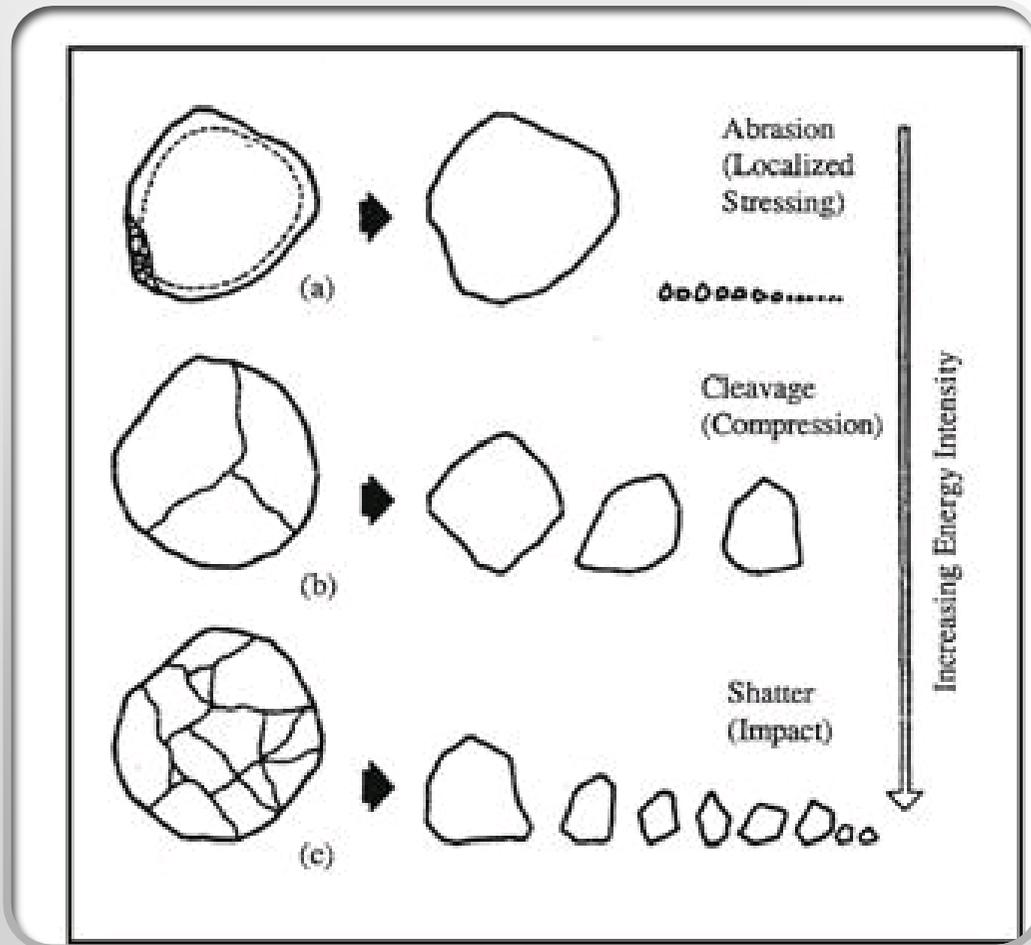


Crushing

- Fracture Mechanisms
- Crushing Equipment
- Factors Influencing Crushed Product

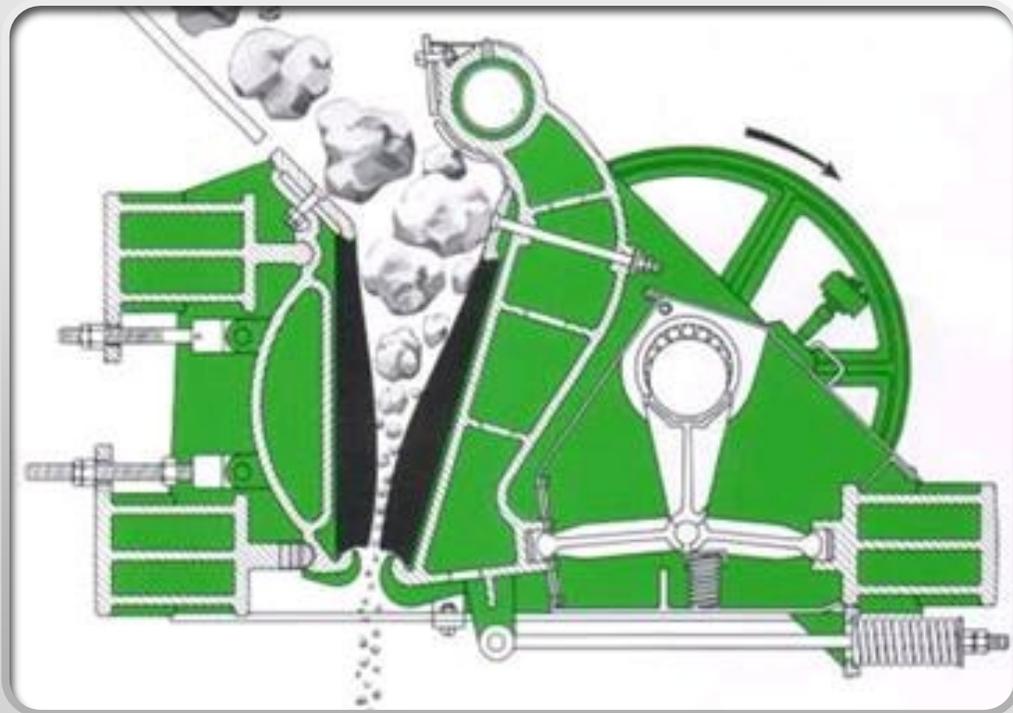


Fracture Mechanisms



- Particle Breaking:
 - Abrasion
 - Cleavage
 - Shatter

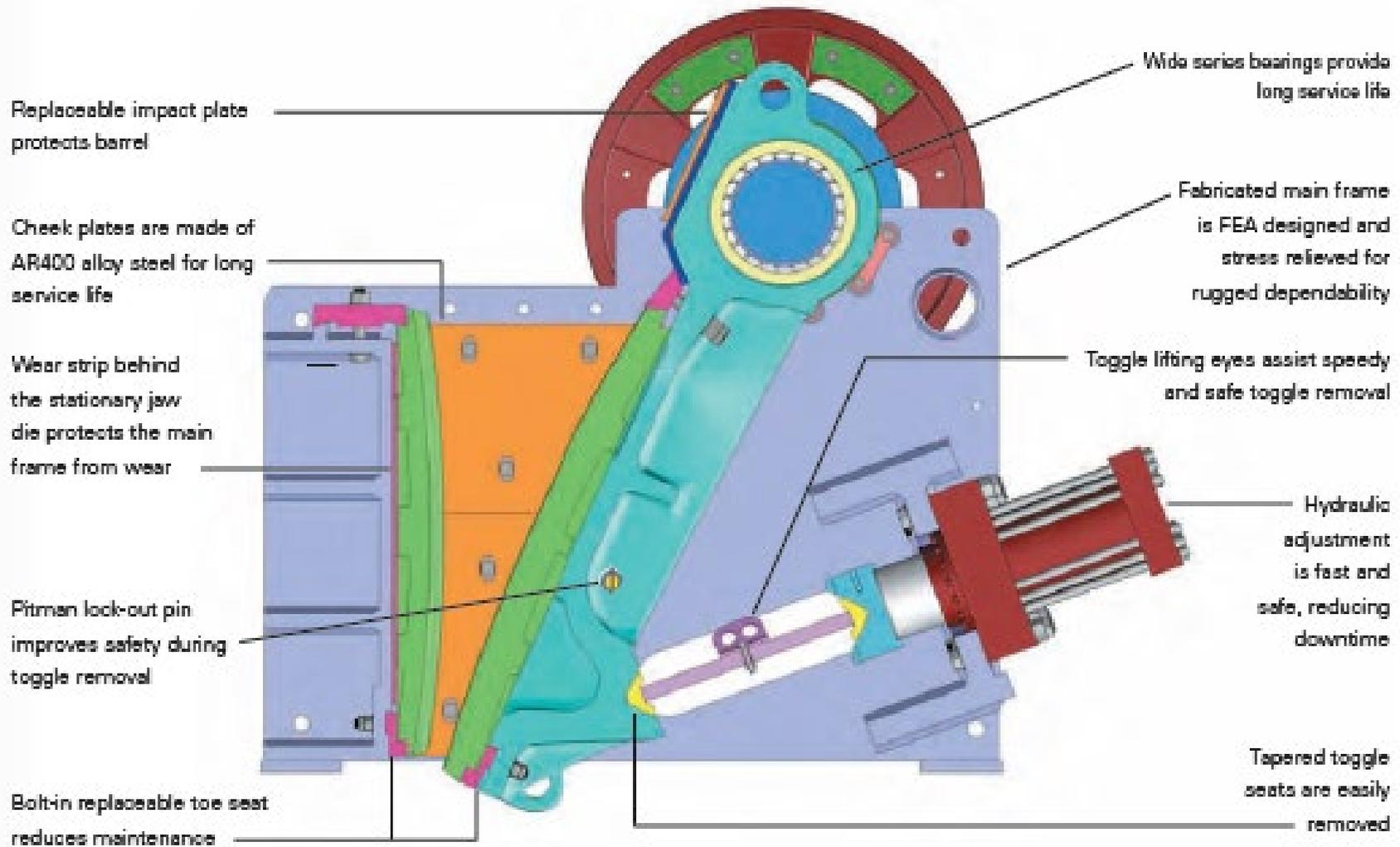
Primary or Jaw Crusher



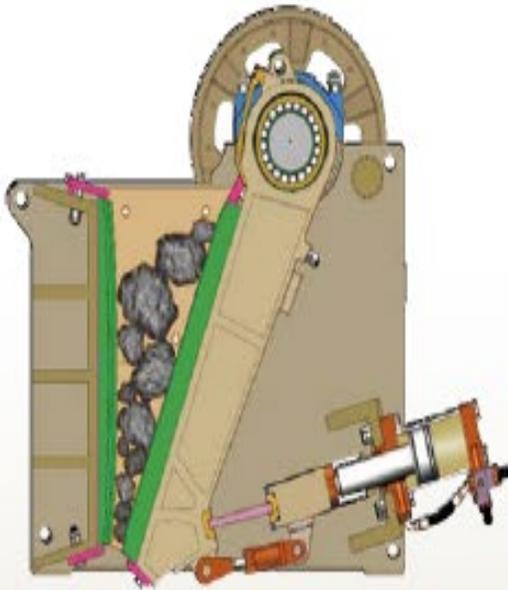
Jaw Crusher



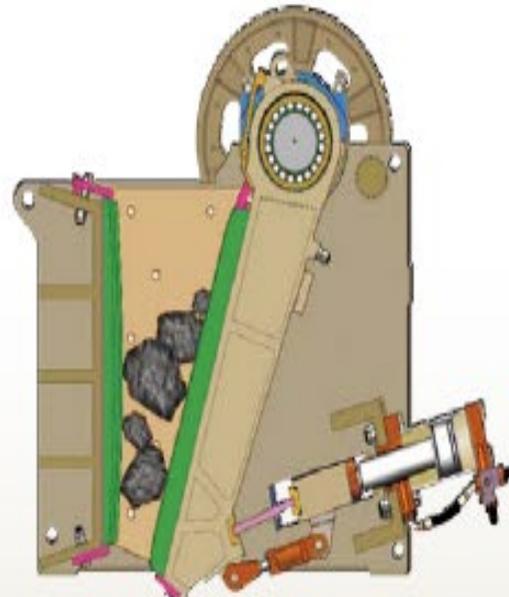
Jaw Crusher



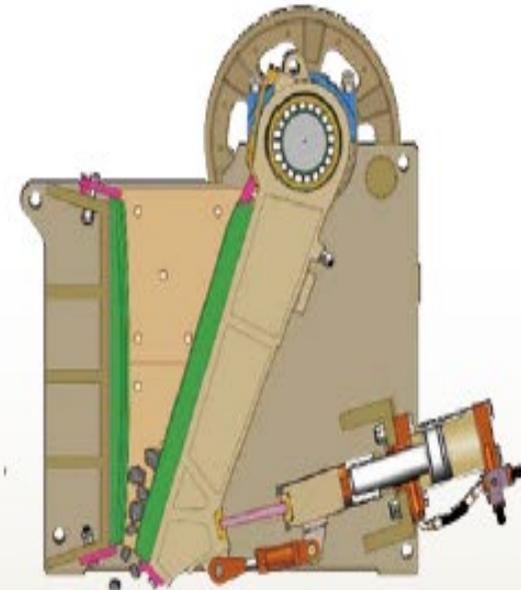
Jaw Crusher



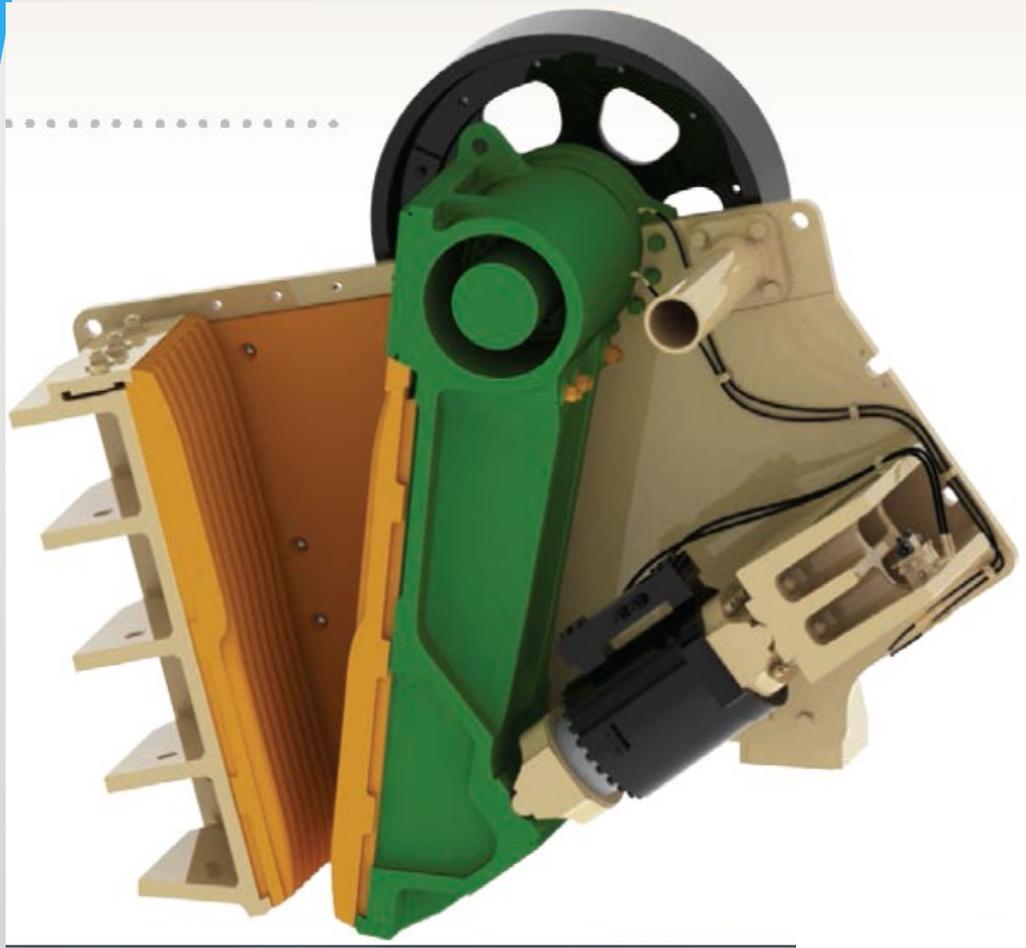
During normal crushing, hydraulic cylinders hold the toggle beam forward.



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 tone. Cycling through this process a few times clears the chamber.

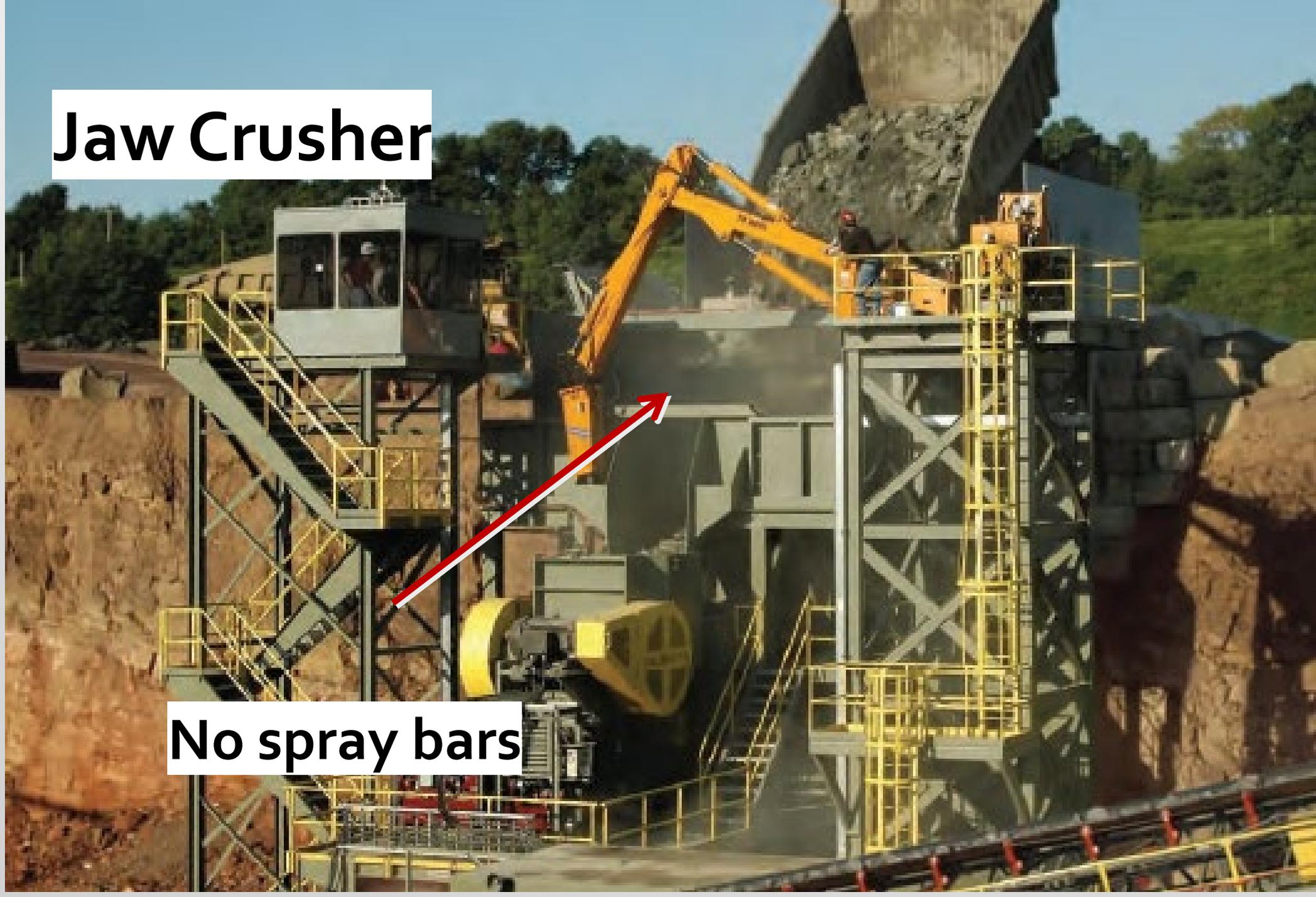


Jaw Crusher

3" to 8" Rock

Jaw Crusher

No spray bars



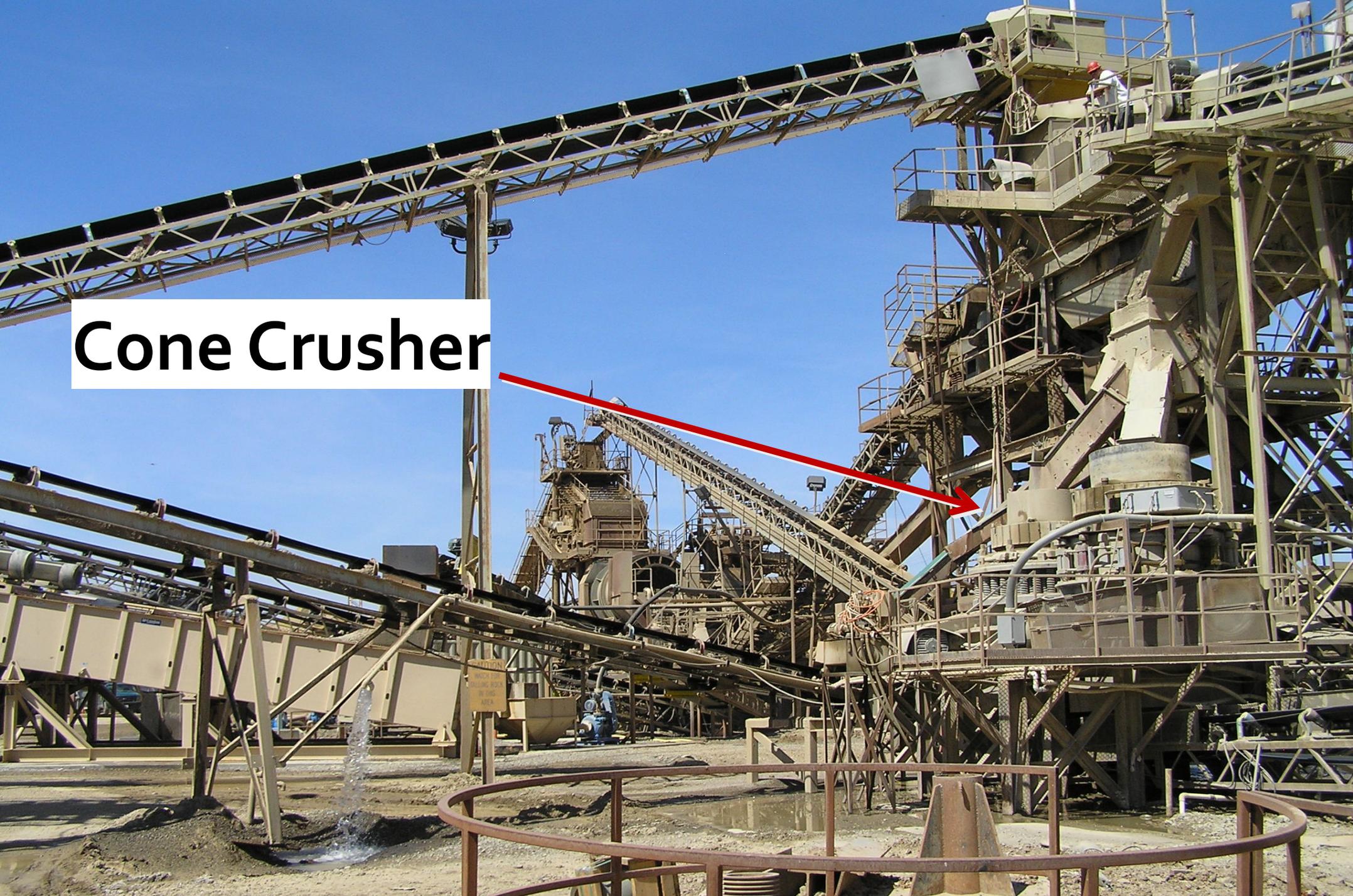
Spray bars to reduce emissions



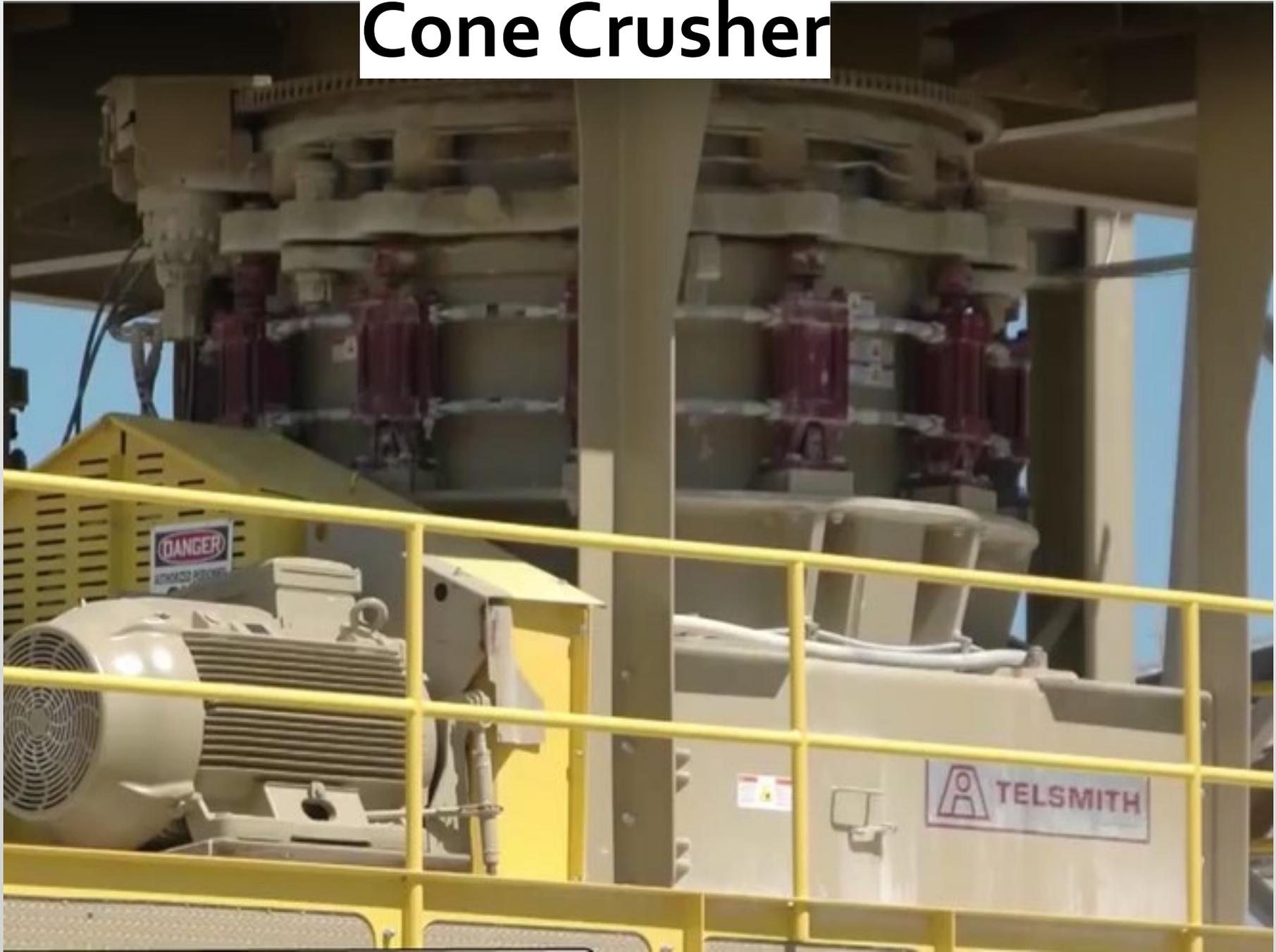
Jaw Crusher



Cone Crusher



Cone Crusher

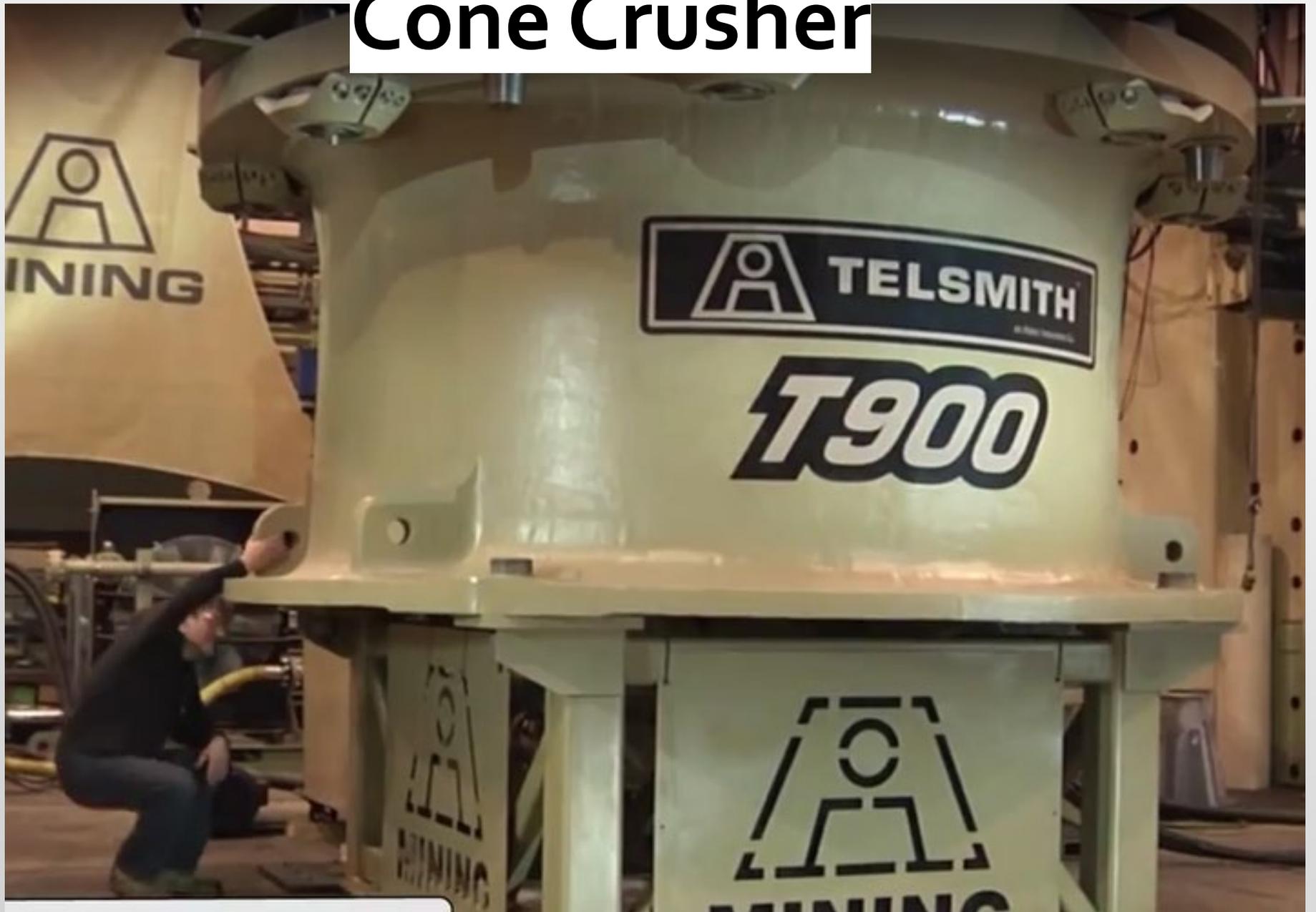


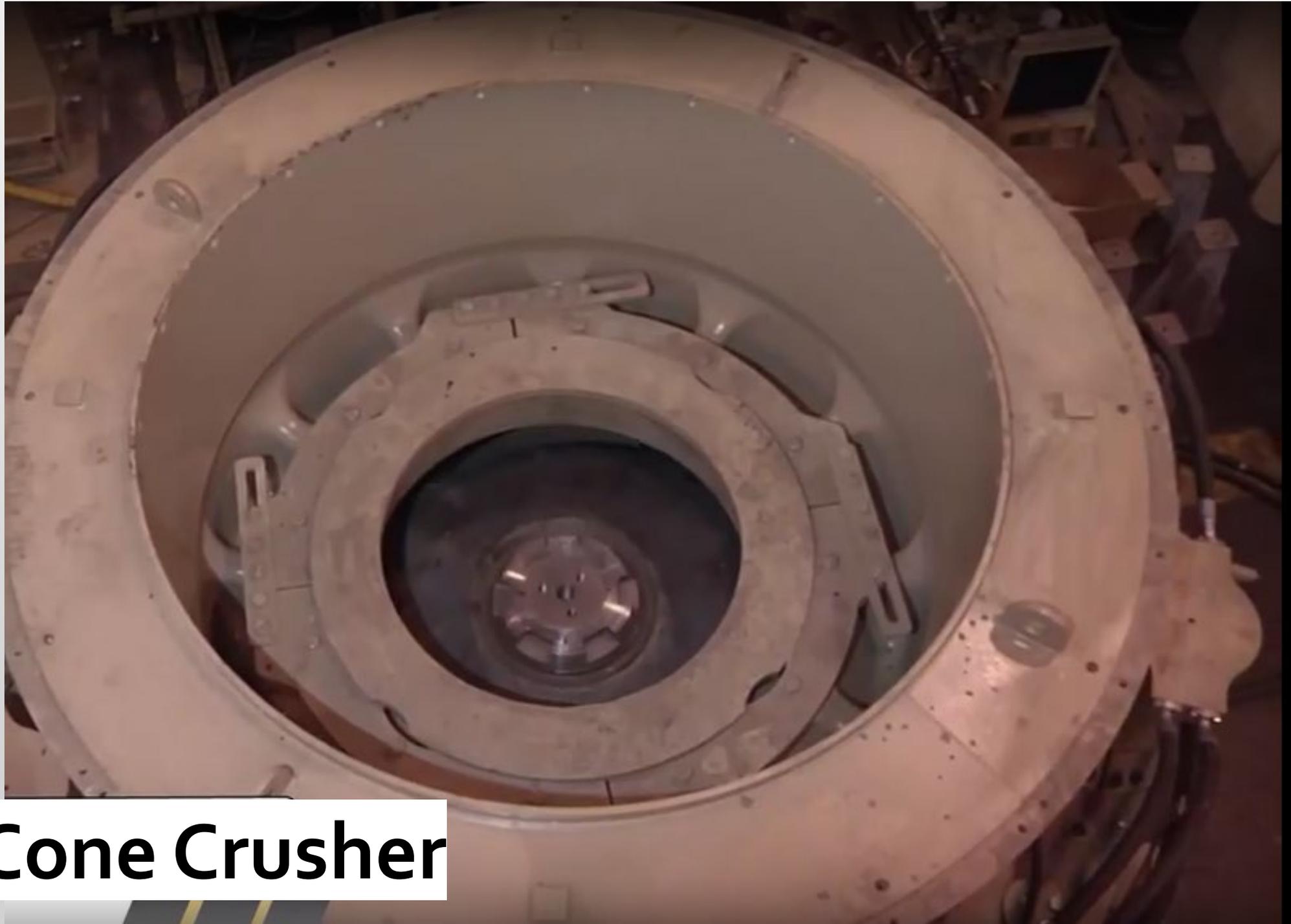


Cone Crusher



Cone Crusher

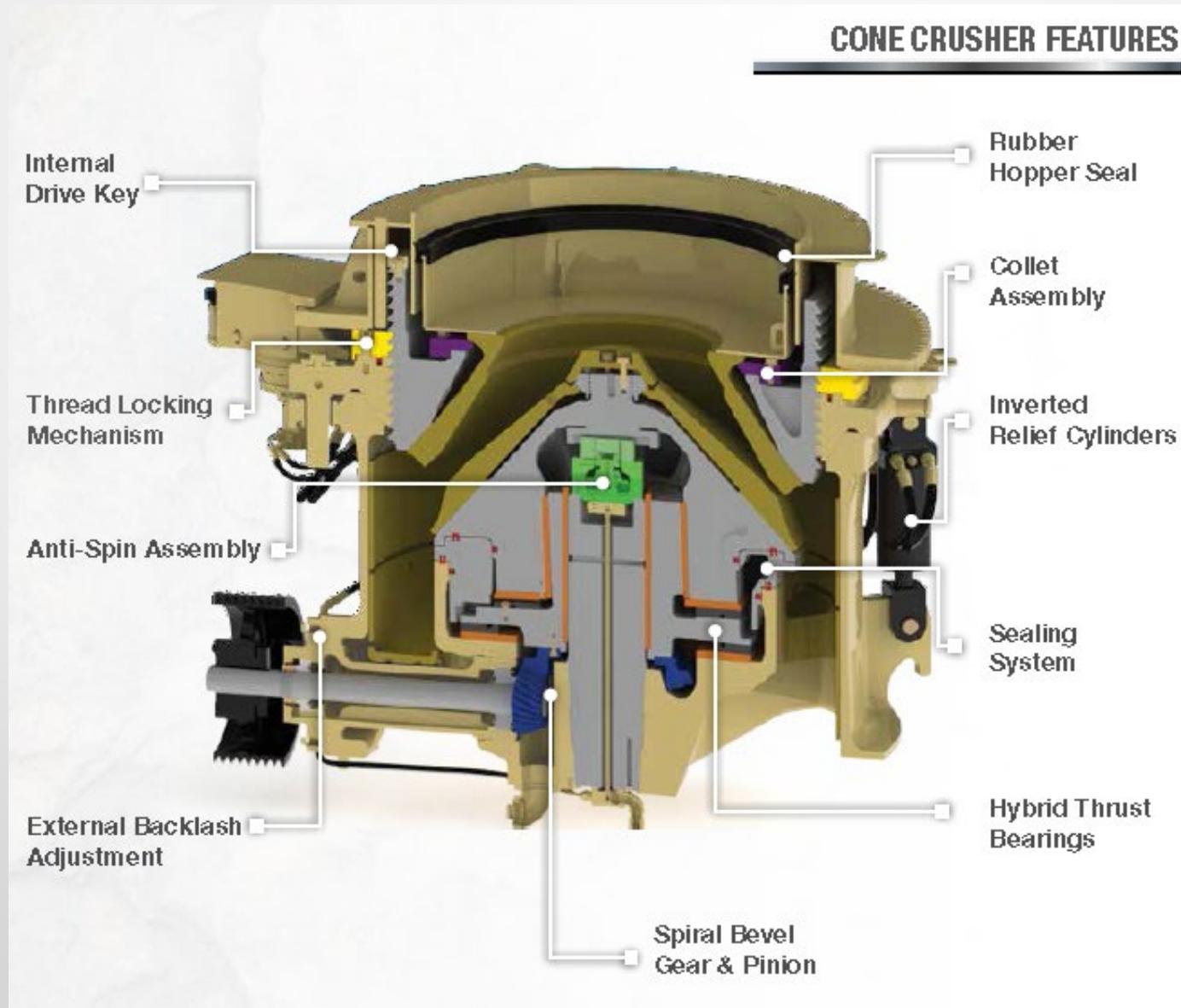




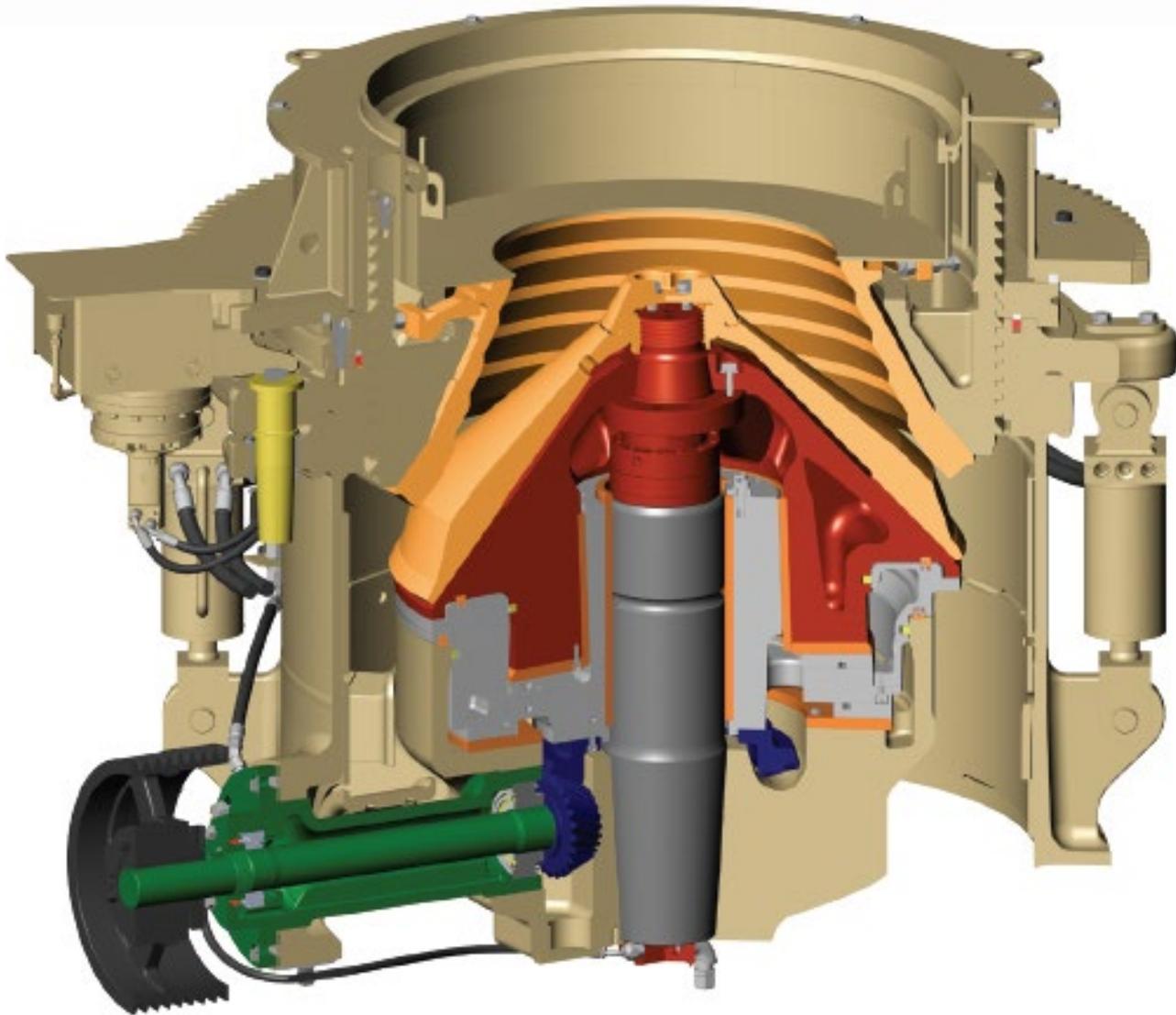
Cone Crusher

Cone Crusher

2"
1 3/4"
1 1/2"
1 1/4"
1"
3/4"
5/8"
1/2"
3/8
size
rock



Cone Crusher



Cone Crusher



Baghouse

???

Impact Crusher



Impact Crusher

Upper Apron

Adjustable Apron
Supports

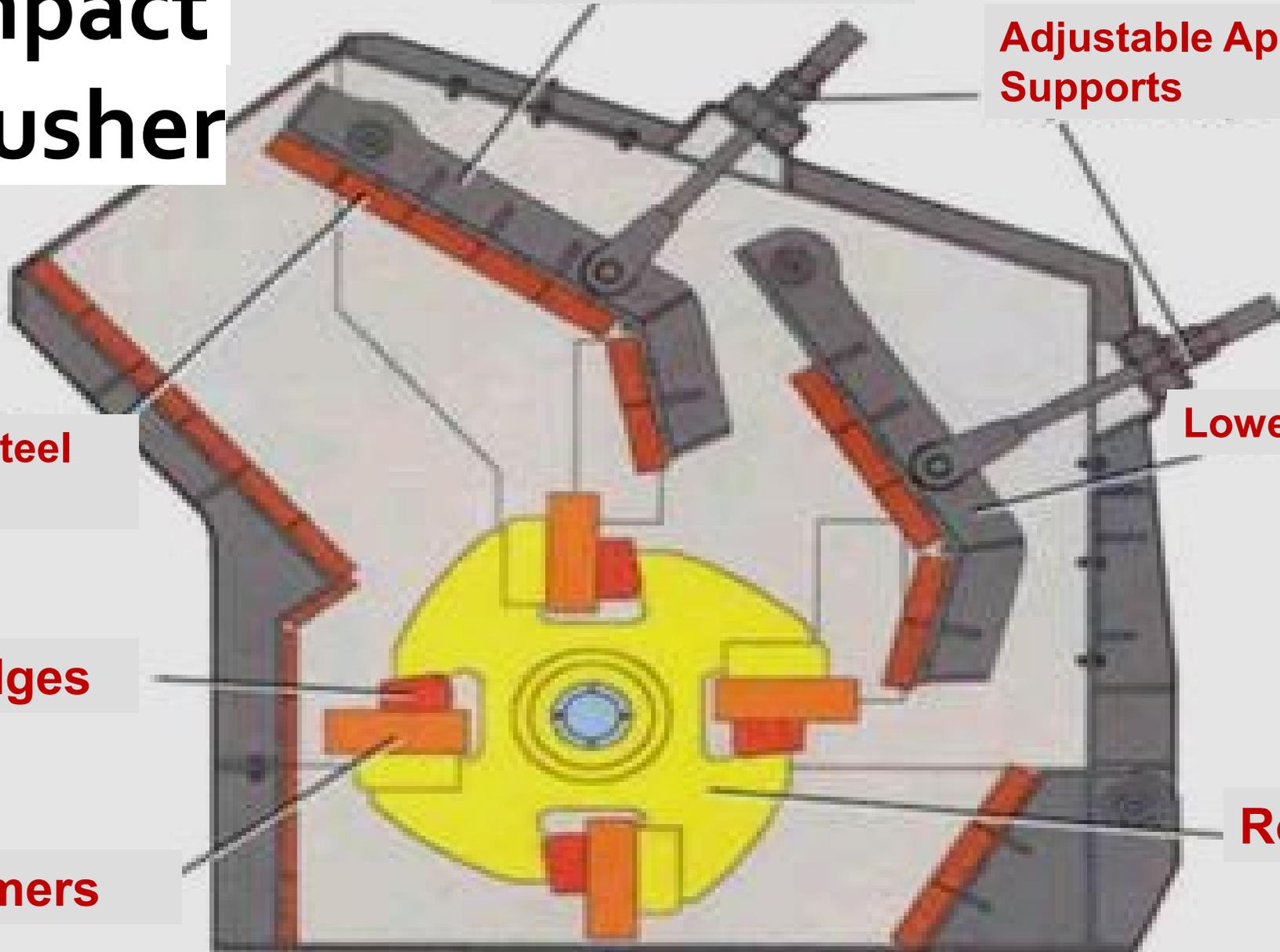
Alloy Steel
Liners

Lower Apron

Wedges

Rotor

Hammers



Tertiary Crusher

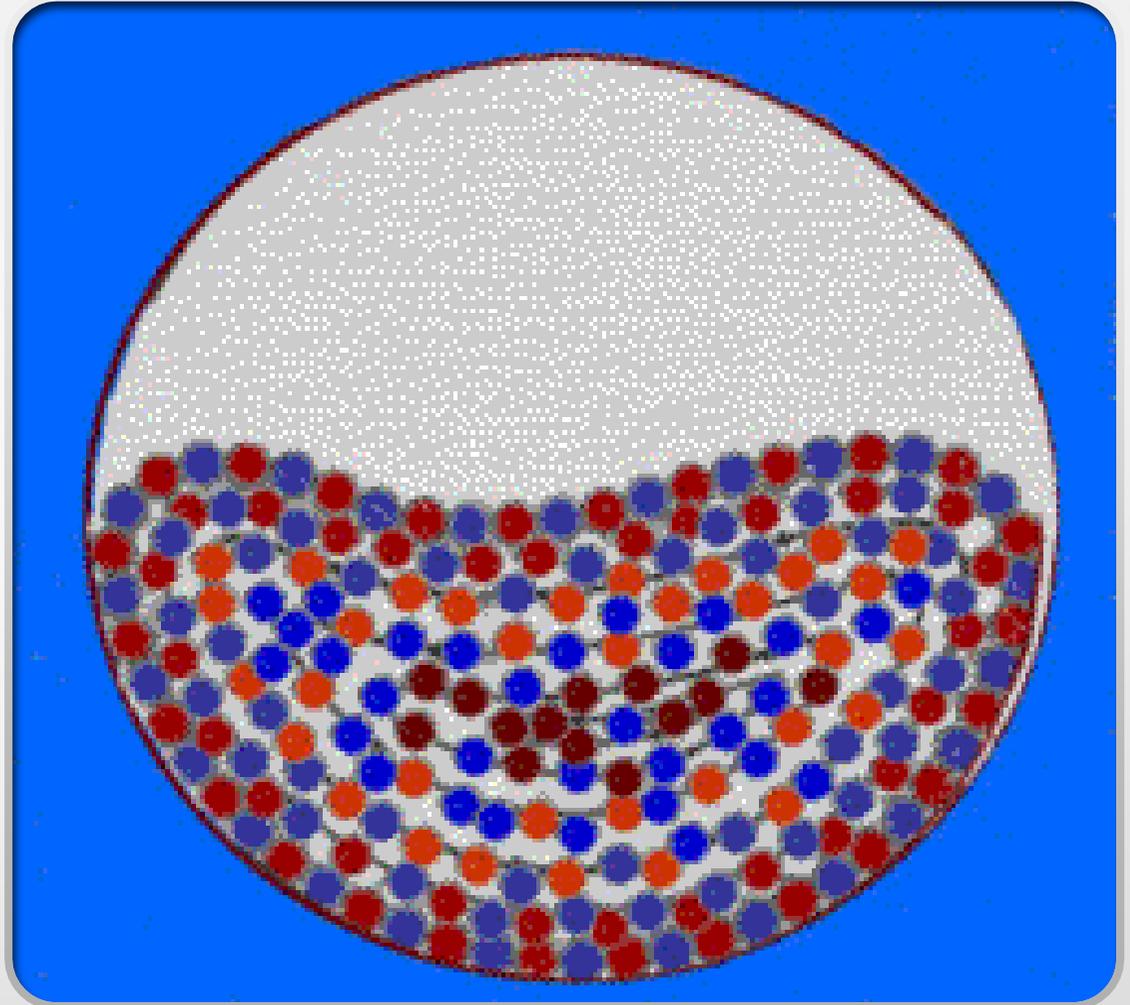


Hammer Mill



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 material
 - manufactured sand
 - cement clinker





Screening Operations

Screening Operations



Screening Operations



Screens from 4' x 8' to 8' x 24'

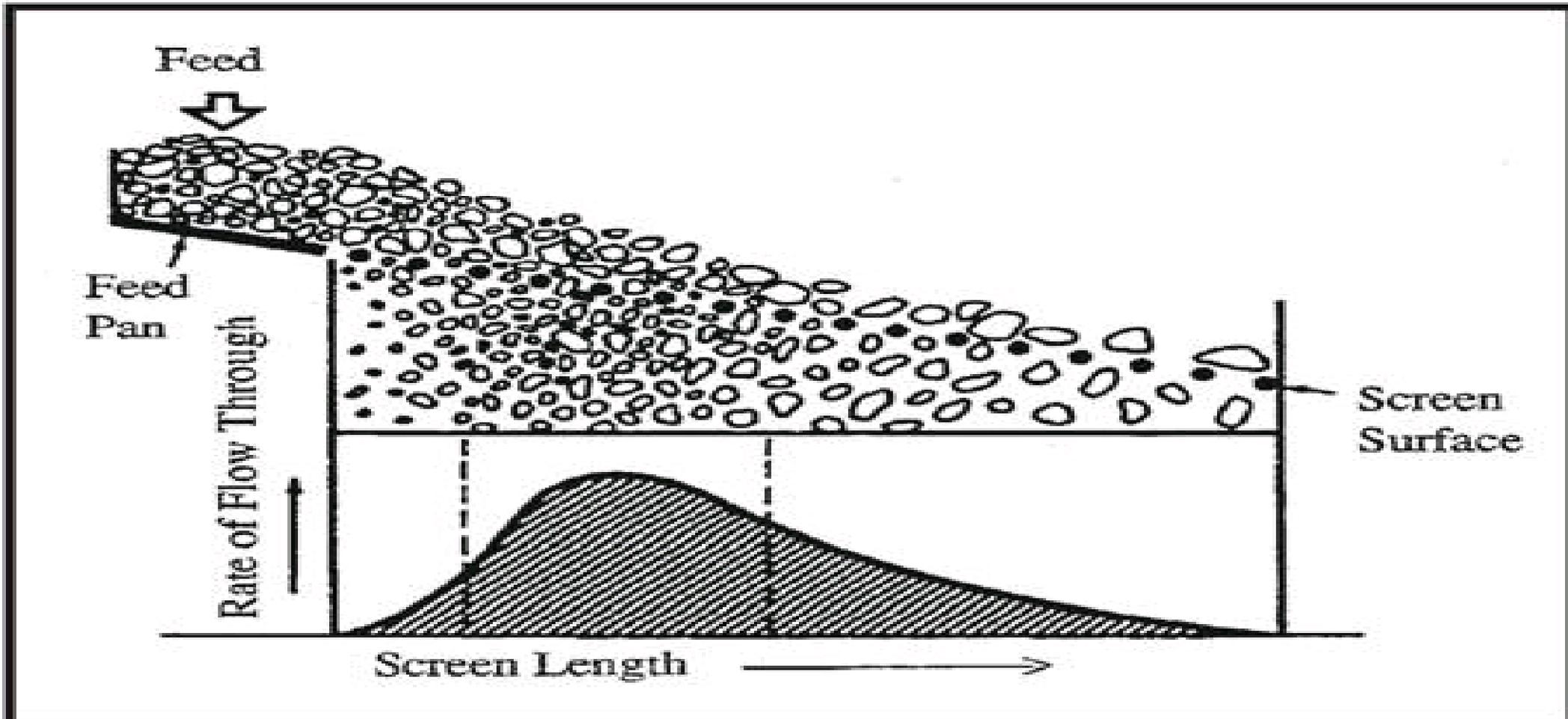
Screening Operations



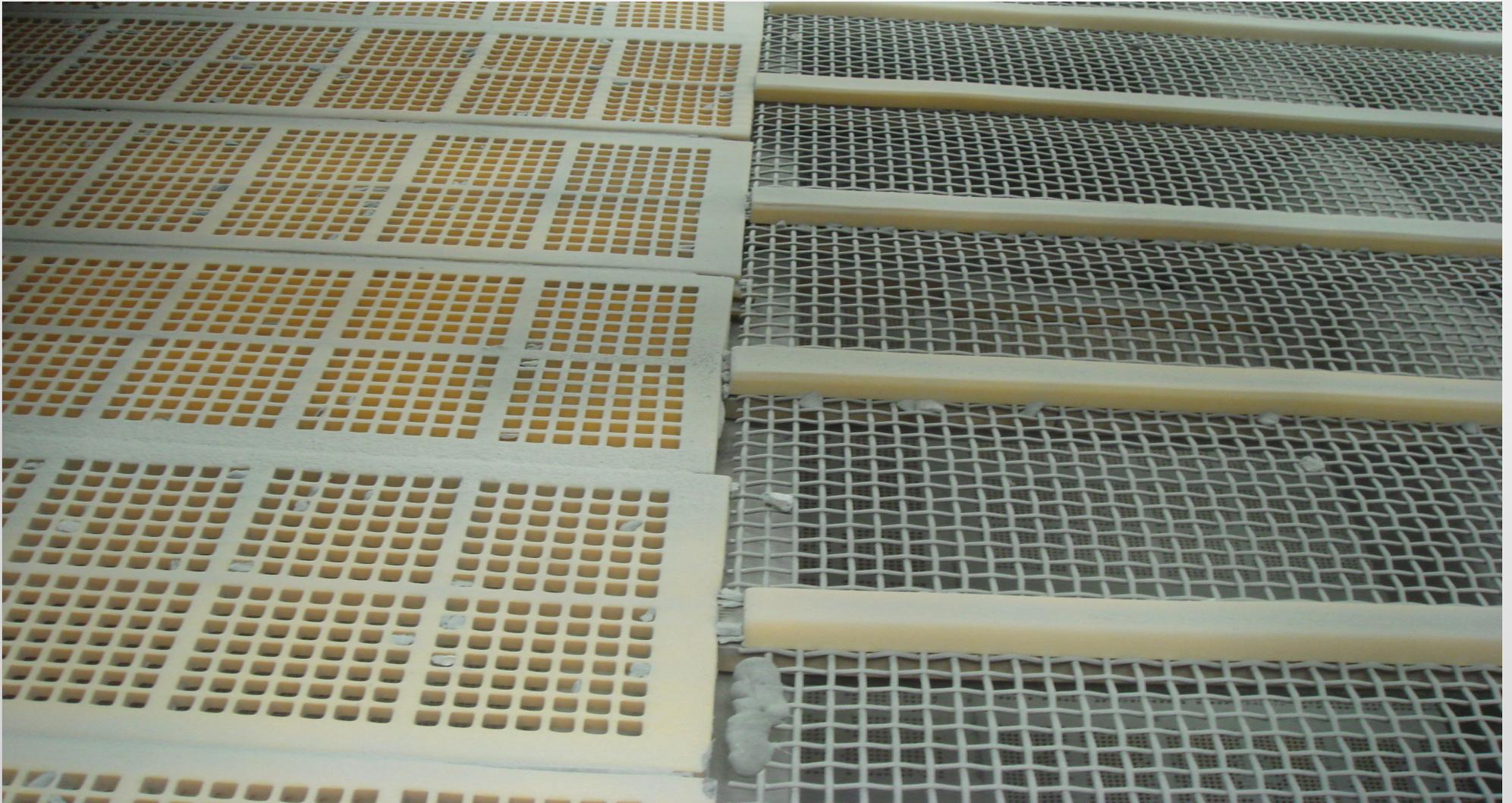
Screening Operations



Screening Surface

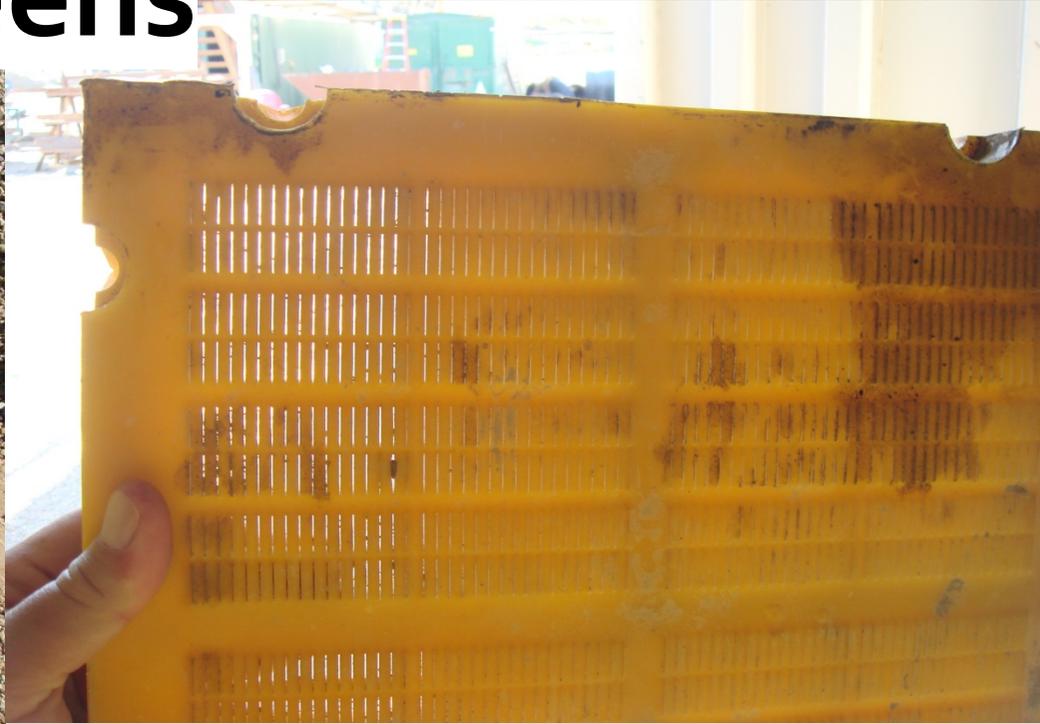


Screening Operations





Screens



Screening Operations

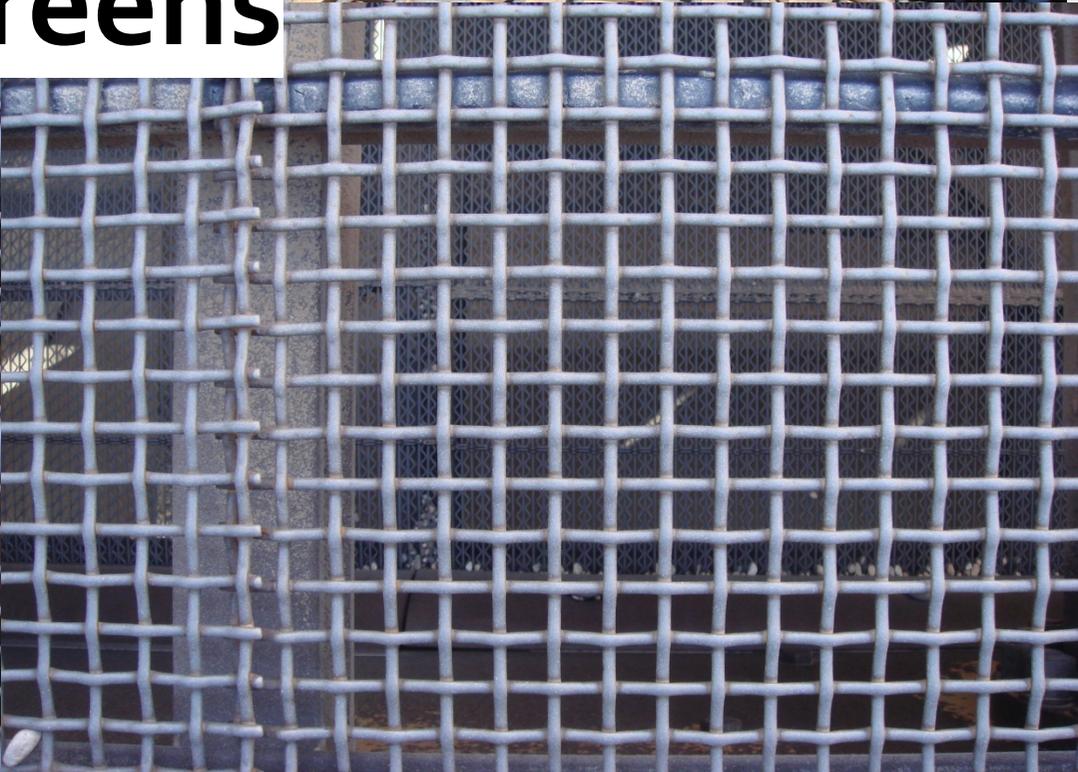




**Fugitive Dust from
Screening Operations**



Screens





Screen Tests @ Lab



Screens and Baghouses



Point Emissions

- Point emissions originate from stacks
 - Control Devices
 - Where aggregate is dried
- Stack emissions
 - Moisture
 - Gases
 - PM/PM₁₀/PM_{2.5}
 - All of the above



Point Emissions



Stock Piling



**Could be a potential source
of fugitive dust emissions**



Screening, Storage, and 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

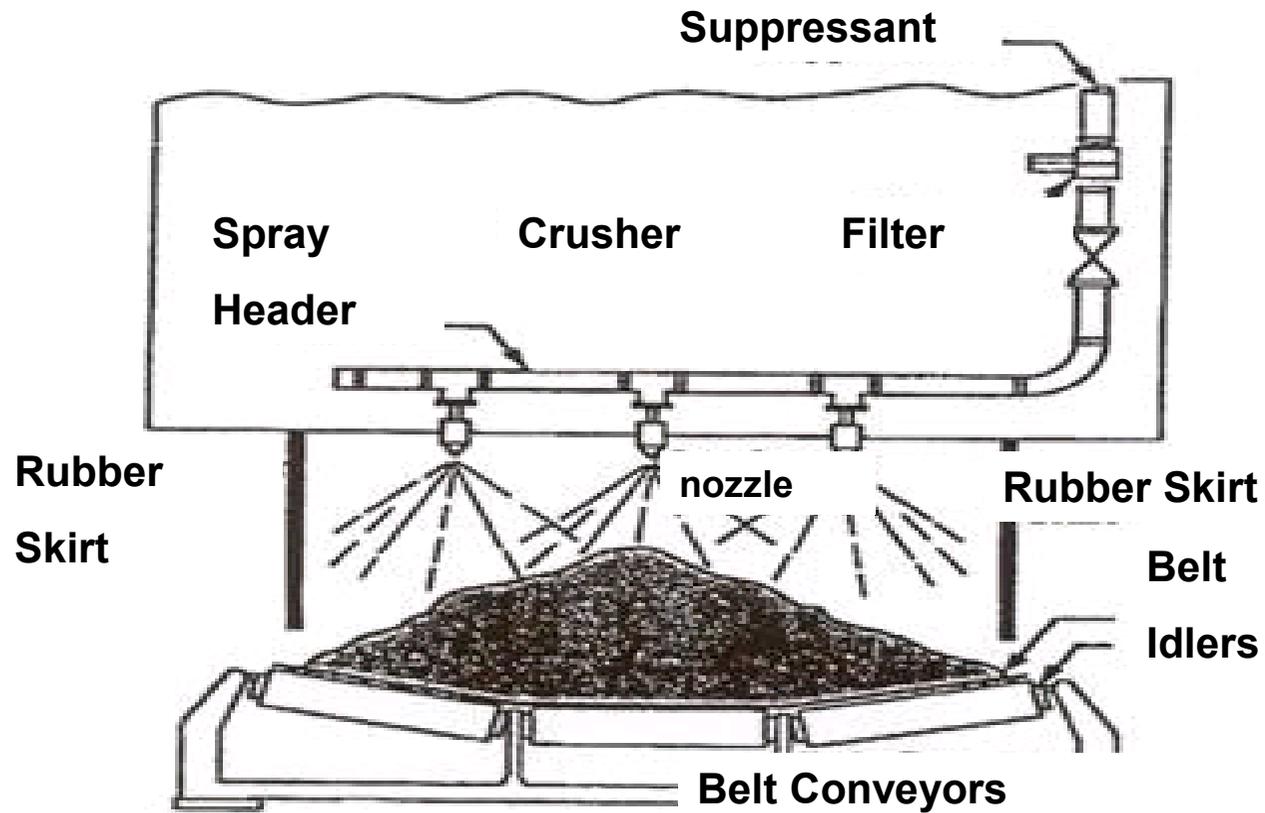
- Passive enclosures
- Wet suppression
- Stabilization of unpaved surfaces
- Minimizing drop height
- Paved surfaces cleaning
- Work practices
- Housekeeping



Preventative Measures



Preventative Measures





Dry Collection Systems



Baghouses are regulated in terms of:

- **Grains/cubic foot of 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 detector
- Pugmills
- PERP equipment
- Washing equipment
- Rotary Scrubber
- Wet classifiers
- Pumps Grinding Mills

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 goggles 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



Pre – Inspection Meeting

- State purpose of inspection and identify equipment to be inspected
- Discuss any outstanding business
- Obtain
 - Company name
 - Ownership information
 - Address
 - Contact information
 - Operating schedule, date of last source test and fuel usage

Pre-Inspection Meeting

- Date of last break down
- Determine the statuses of:
 - Dust suppression equipment
 - Air pollution control equipment
 - Monitoring and recording devices
- Check permit

Non - Compliance

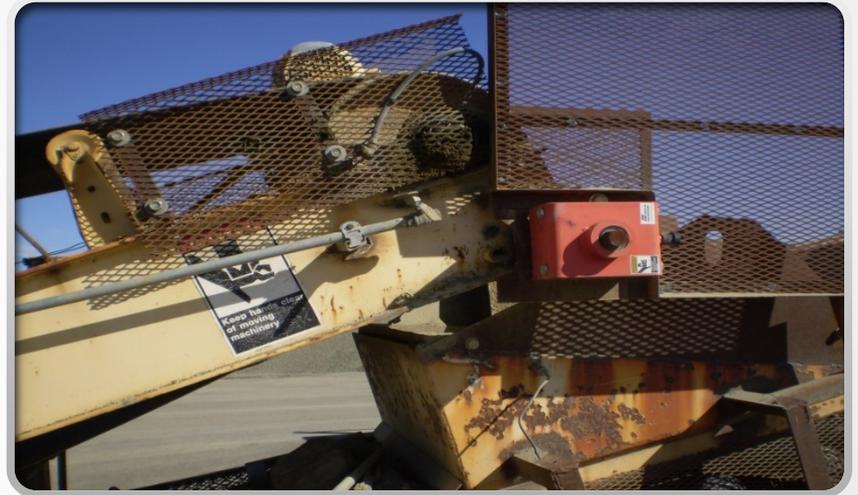
A NTC/NOV is issued
when:

- The permit is not:
 1. Current or no permit
 2. Posted properly
- Or conditions on permit are not followed
- Or blatant disregard for the permit conditions



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