How to Control Dust

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BENEFITS OF DUST CONTROL

1. MORE PRODUCTION – Good dust control is good process control. If it doesn’t go up in the air or spills on the ground, it goes into a truck and across the scale.

2. HIGHER PROFITS – Water added for dust control goes across the scale and can pay for a system in 6 to 18 months.

3. MACHINERY LASTS LONGER – Idlers, rollers, bearings and other machine components last longer when they aren’t spinning in dust.

4. BETTER MORALE – Employees don’t like working in dusty environments

5. FEWER ACCIDENTS – It’s safer to work in a cleaner environment where employees can see what they’re doing. Insurance companies may reduce rates for plants that install dust control.

6. BETTER HEALTH – Fewer sick days mean improved productivity

GOOD DUST CONTROL = GOOD PROCESS CONTROL

Good dust control and good process control are two sides of the same coin. By combining good operating and engineering practices with properly designed wet suppression and dry collection systems, it is possible to comply with air quality standards and improve productivity.
Developing a Dust Control Plan

• **Conduct a Site Survey** – listing all the dust sources on the property

• **Estimate Uncontrolled Dust Emissions** – using EPA AP-42, “Compilation of Emission Factors”

• **Specify RACM (Reasonably Available Control Measures)** – appropriate for your facility for each source.

• **Estimate Controlled Dust Emissions** – set a goal for control efficiency.

• **Establish a Budget** – use least expensive controls first.

• **Implement the Plan** – with accountability for results.

• **Monitor Performance** – keep dust and $$ under control with records to verify compliance with air standards and budgets.

Dust Sources

• **PAVED ROADS** – Carryout of silt onto paved surface becomes airborne

• **UNPAVED ROADS** - Produce dust by the action of tires on surface silt.

• **PILES** – Wind erosion, stacking and reclaim operations produce emissions

• **MATERIAL HANDLING** – Processing operations like crushing, screening and conveying all produce visible dust.
Reasonably Available Control Measures

- **Operational Controls:** Train operators to minimize dust. Speed control is a good example.
- **Engineered Controls:** Enclosing and containing dust sources can often be done with in-house labor and material.
- **Wet Suppression Systems:** Water is the most common dust suppressant to control dust from roads, piles and processing.
- **Collection Systems:** Baghouses, cyclones and other collection devices are high efficiency and may be the only alternative for hazardous or reactive dusts.

*Use the least expensive controls first!*

RACM for Paved Roads

- **Housekeeping** – Clean up spills promptly.
- **Prevent Carryout** - from unpaved roads
  - Restrict access from unpaved routes
  - Rumble grates to loosen and remove rock
  - Wheel washes clean truck tires before they enter paved surface
- **Mechanical sweeping** – Brooms are not very effective unless road is watered first. Dry sweeping may actually aggravate visible dust emissions.
- **Flushing** – washes silt from surface. Can be done manually for small areas like plant entrance or by mobile tanker for entire route.
- **Vacuum Sweeping** – can be effective in removing silt. Use a wet vacuum sweeper with spray nozzles in front of the brooms to avoid visible dust. Vacuum sweeping may be the only alternative in freezing weather.

*EPA Recommendation: Wet vacuum and flush for highest control efficiency.*
Rumble grates loosen mud and dirt but have to be cleaned frequently to prevent build-up in channels.

Wheel washes keep paved roads clean

- **Basins** – Vehicles drive through a flooded basin. Require frequent cleaning to keep rock and silt from accumulating.

- **Pressurized spray** – Vehicles drive through a wash zone using water sprays at 40 to 200 psi. Water drains to storm sewer, collection basin or pond.

Important: Locate the wheel wash at transition from unpaved to paved surface. Set back 1000 ft. to allow tires to dry before they travel onto public roads.
At sites with high truck volumes, recycling clean water to the wheel wash can require the use of multiple settlement basins and weirs.

RACM for Unpaved Roads

- **Speed Control** – low speed means less dust. For haul vehicles, keep speeds just high enough to maintain production. 15 mph for all others.
- **Housekeeping** – Clean up spills promptly by flushing or sweeping.
- **Shorten routes** – Less vehicle-miles traveled means less dust.
- **Proper Gradation** – Too much silt on the surface means more dust. Put down chips or larger aggregate to decrease the percentage of surface silt.
- **Dust Suppressants** – Used to stabilize the surface
  - Water – Low cost but evaporates
  - Surfactants – Help water to penetrate faster
  - Brines – Help unpaved surface retain moisture
  - Binders – Chemicals like lignins, latex, and cutback asphalt emulsions create a new surface. May require scarification and compaction.
- **Paving** – Most effective way to prevent dust but only if kept clean. Not feasible for most haul roads and stockyards.
Dust from unpaved roads can account for more than 30% of the total emissions from the property. Higher silt contents and vehicle speeds increase visible dust.

Watering is the most common method of unpaved road dust control. Use chemicals only if they reduce the frequency of treatment to the point where they become more cost-effective than watering.
Stationary sprinkler systems can reduce costs compared to mobile equipment.

RACM for Piles

• Methods to Protect Pile Surface
  - Training – Instruct operators to minimize dust.
  - Minimize Pile Height – Piles over 10 meters high are exposed to the “winds aloft” and more susceptible to wind erosion.
  - Shelter Pile from the wind – in-pit or on lee side of hill/berm.
  - Wind Screens and Barricades – screens reduce wind speed across the pile while barricades push wind up and over pile.

• Methods to Stabilize Pile Surface
  - Watering – control efficiency of about 50% depending on evaporation rate and frequency of application.
  - Chemical Suppressants – used to form a crust that resists wind erosion. Many of the same suppressants used for haul roads are used for piles.
Stacking material into piles causes visible dust. Dryer and finer materials produce more emissions.

Wind erosion blows fines from the surface which destabilizes larger lumps that roll to the base of the pile exposing fresh surface to the wind.
Aerial water cannons wet down pile surfaces to protect them from wind erosion. Automate to spray on a timed cycle to optimize water consumption.

A water tanker with a cannon can not only water road surface but also wet down piles and wash down the plant superstructure.
Axial fans equipped with fine spray nozzles can be used to control dust from piles and work areas.

RACM for Material Handling and Processing

- **Implement Good Operating Practices** – Train operators to take personal responsibility for minimizing dust.
- **Employ Good Engineering Practice** – Enclose and contain dust. Transfer points should be enclosed on three sides, fitted with a dust curtain and covered.
- **Use Spray Systems to Control Visible Dust** – High pressure spray systems are the work horse of dust control in most plants. Fog, surfactant, and foam systems can offer advantages in special applications.
- **Install a Dust Collector** – Baghouses are the most efficient method for the collection of -10 micron particulate (PM10). They may be the only alternative for reactive (cement) or hazardous (silica) dusts.
Believe It or Not!

Good dust control and good process control are not mutually exclusive. Good operating practice can minimize dust and maximize production. Examples:

- **Choke Feed Crushers** – pushing more stone through a crusher means moving less air and results in less dust. This is especially true of impact crushers and hammermills.

- **Avoid Interruptions in Process Flow** – production equipment can produce more than ten times the airborne dust when it is empty and “windmilling”.

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Good Engineering Practice

- **Enclose Dust Sources**
  - Examples:
    - Enclose transfer points on three sides and cover
    - Install dust curtains at discharges to conveyors
    - Install dust skirts that provide a tight seal to conveyor. Use dual skirts if necessary

- **Landscape**
  - Examples:
    - Put the plant “in-pit”. Out of sight is out of mind
    - Use berms, fencing or vegetation to shelter plant from the wind.
    - Vegetate barren areas
Spillage indicates poor enclosure and seals. Workers that clean this material out can be exposed to high levels of respirable dust.

Unenclosed transfer points allow dust and spillage to escape.
Load points should be enclosed on three sides, covered and equipped with a dust curtain.

Belt Skirting

Simple Edge Sealing System
A single skirtboard is used to contain material. This is the most common but least effective seal.

Multi-Layer Sealing System
A rigid skirtboard and flexible seal provide much better containment. Wear plates protect the skirting.
Impact beds support the conveyor at the load point and improve the seal to the chute. This helps to reduce dust and spillage.

Conveyor covers help to reduce dust emissions and protect the material from the elements.
Wet Suppression Systems

Advantages:
- Low capital costs
- Low maintenance costs
- Prevent dust by reducing the potential of the substrate to emit particles

Disadvantages
- Can cause wet handling problems like belt carryback or screen blinding
- May increase crusher wear
- Cannot be used on water soluble or reactive materials
- Hard to use in freezing weather

Types of Spray Systems for Roads and Piles

- **Water Tankers** – used to water unpaved roads and flush paved surfaces
- **Water Cannons** – stationary cannons are used to water piles. Water tankers equipped with a cannon can be used to water piles, clean off production equipment or flush paved roads.
- **Stationary Sprinklers** – manual or automatic systems to water unpaved roads. Can be more cost-effective than mobile tankers for longer unpaved routes.
- **Fog Fans** – Modified snowmaking machines can throw mist up to 250 ft. Used to simulate rainfall but effectiveness on piles decreases with increasing wind speed.
Types of Spray Systems for Material Handling and Processing

- **Water Spray Systems** – produce an atomized spray to suppress airborne dust and add water to prevent emissions downstream.
- **Fog Systems** – high pressure (>1000 psi) produces -10 micron droplets. Suppress only airborne dust and require high degree of enclosure.
- **Air Atomizing Systems** – use water and compressed air to produce atomized mist. Designed to suppress only airborne dust and require high degree of source enclosure.
- **Surfactant Systems** – improve the rate at which water droplets wet dust particles. Control dust from hard to wet materials like coal and coke.
- **Foam Systems** – use water, foaming agent and compressed air to produce a low expansion, “dry” foam. Designed primarily for use with crushers where water sprays are not effective or hard to wet substances.

Spray Treatment Points

- **Hoppers** – Hoppers require a brief but high volume burst of spray when trucks, loaders, or railcars dump.
- **Crushers** – Spray treatment at crushers is critical. Spray treatment controls emissions and relies on the mixing action of the machine to distribute moisture uniformly.
- **Screen Discharge Chutes** – Avoid spraying on top of screen decks. Treat the sized material as it comes off the screen.
- **Stacking Conveyors** – Stackers handling finer sizes require spray treatment of the material as it falls onto piles.
- **Transfer Points** – Treat at transfer points as necessary. Upstream spray treatment should generally control emission.
Water Spray System Design

- **Use High Pressure** – Higher pressure results in better atomization and the lower water consumption. 200 psi is about the max. for conventional pipe and hose fittings.

- **Size Pump to Add a Maximum of 0.5% Water** - This corresponds to 20 gpm per 1000 tph of process flow. More than 0.5% can result in reduced screen efficiency and off-spec products.

- **Adjust Water Flow in Response to Dust Levels**. Add just enough water to control the dust but not so much as to adversely affect production.

- **Use Electronic Control** - Automation helps to reduce operator error and water consumption.

- **Use Heavy-Duty Construction** – Cheap pumps and parts will not hold up. If spray system breaks down, you may violate your permit conditions if plant continues to operate.
How Not to Design a Spray System

Low spray pressure and plugged nozzles reduce control efficiency. Spraying water onto empty belts causes “carryback”.
High Pressure Sprays Save Water

High pressure spray systems can control dust and minimize water consumption. At 200 psi, a spray system can be expected to add from 0.2% to 0.5% by weight to the process. Spray systems operating at less than 100 psi will require double that amount of water for the same level of dust control because they lack the atomizing and penetrating power required.

High Pressure Spray System

Typical pump module uses a 200 psi pump and motor integrated with an electronic control system.

Electronic control enables the operator to control the system remotely. Systems can be automated and equipped with air and glycol purge systems for cold weather.
Remote Control

Enables operator to adjust water consumption in response to dust levels and switch off water immediately when process flow is interrupted or production equipment is taken out of service.

Spray System Automation

Automate the spray system by providing:

- Interlocking signals from switches or sensors. A common example is interlocking spray nozzle operation with a signal light or sensor at a truck hopper that alerts the operator to dump.

- Input signals (i.e. drive motor amps) from the plant’s MCC to pump module control relays or PLC.
Spray Nozzle Installation

Spray nozzles should be:

• Targeted at the Dust Source – nozzles that spray onto belts or steelwork cause wet handling problems.

• Able to be seen – operators need to be able to see nozzles to verify they are working properly. Nozzles stuck into chutes or behind curtains won’t get inspected.

• Easy to reach – nozzles that are hard to access won’t get cleaned or replaced. Poor nozzle maintenance results in poor dust control.

Spray Bar Construction

Typical spray manifolds are made from galvanized pipe and brass hose fittings. The spray bar is secured to the superstructure with unistrut.
Nozzles Must be Visible

Keep nozzles outside of chutes so that operators can see them. If they can’t be seen and easily accessed, they won’t be maintained.

Nozzle Pluggage

Most nozzle pluggage occurs due to deposition on spray bars resulting from poor source enclosure.

Install dust curtains to prevent deposition due to “blowback” of mist and wet fines.
**Spray System Operation Guidelines**

- **Turn spray lines on only when you see dust.** Do not turn on the spray system if there are no visible dust emissions.
- **Use water sparingly.** Use the minimum number of nozzles to control dust.
- **Turn spray lines off when process flow is interrupted.** Nozzles that continue to spray on empty belts cause wet handling problems.
- **Add water as early in the process as possible.** Using water in a primary circuit will help to reduce water addition rates in a secondary or tertiary plant where screens are more susceptible to blinding.
- **Operate at 200 psi.** High spray pressure makes more efficient use of water and keeps water consumption down. Install a pressure gauge. Any decrease in spray pressure is usually the result of a dirty strainer or filter.

**Cold Weather Operation**

- **Install a thermometer** to alert the operator to freezing temperatures.
- **Inspect spray nozzles daily** make sure that they are not plugged or frozen.
- **Inspect the pump daily.** Verify the heater is working and that water lines are not frozen.
- **Minimize the number of spray lines in service.** Use only essential spray nozzles.
- **Make sure that nozzles are properly targeted.** Nozzles should not spray on steelwork or conveyor belting.
- **Drain hose lines immediately** after they are taken out of service.
- **Keep all drain valves open after the system has been drained** to prevent any residual water from freezing and cracking the valve.
- **Make sure that hose lines run straight and true and that drain valves are located at all low points.** Bends, loops, and kinks in hose lines will make lines more difficult to drain in cold weather.
- **Heat tape, insulate and jacket spray lines** for continuous use in sub-freezing weather.
Baghouses

When high collection efficiency on small particle sizes is required, the most widely used method is a baghouse.

Dry Collection

Advantages:
- High efficiency for finer particle sizes
- Able to operate in any weather
- Can collect water soluble or reactive dusts
- BACT (Best Available Control Technology)

Disadvantages
- High capital cost
- High operating and maintenance costs
- Dust disposal can create secondary emissions
Dry Collection Systems

There are three major types of fabric filters or baghouses:

- **Mechanical Shaker** – Use vibration to shake off the dust cake.

- **Reverse Air** - Are compartmentalized to allow continuous operation. Filtration is stopped in the compartment to be cleaned. Clean air is injected in a reverse direction, causing the dust cake to fall into the hopper.

- **Pulse Jet** - Can be operated continuously and cleaned without interruption of flow because the burst of compressed air is very small compared with the total volume of dusty air through the collector.
Selecting a Dust Collector

- **Dust concentration and particle size** - For mineral processing operations, the dust concentration can range from 0.23 to 11.44 grams per standard cubic meter, and the particle size can vary from 0.5 to 100 µm.

- **Degree of dust collection required** - depends on potential as health hazard or nuisance, the plant location, the allowable emission rate, the nature of the dust, and its salvage value.

- **Characteristics of airstream** - High temperature or condensation of water vapor can damage bags or cause corrosion.

- **Characteristics of dust** – Many dusts can be abrasive. Hygroscopic material can blind bag collectors. Sticky material can adhere to collector elements and plug passages.

- **Methods of disposal** - Methods of dust removal and disposal vary with the material, plant process, volume, and type of collector used. Disposal can create secondary dust problems.

Common Problems

- **Undersized fans** that do not have the capacity to maintain the minimum velocity required to prevent dust from settling in ductwork.

- **Sharp bends** in ductwork that cause turbulence that aggravates wear or eddies where dust can settle out.

- **Too many pick-up points** can make it impossible to balance air flows.
Preventive Maintenance
Key to Long-term Compliance

When you find dust controls that work, keep them working!

• Institute a program of routine preventive maintenance for all dust control equipment.

• Poor maintenance of dust control equipment is the main reason for fines and citations. Pollution control equipment must be maintained just like production machinery.

• If dust control equipment is not in good operating condition, your permit may require you to shut-down or risk fines of up to $25,000 per day.