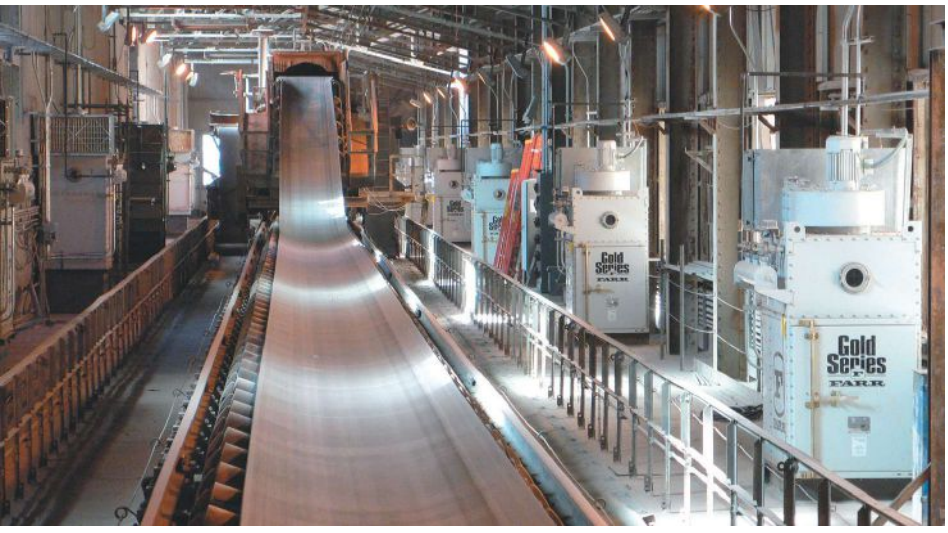
# Dust Control Decisions for Metal Mining Applications

*Some of the best approaches include wet suppression and dry collection*

**By Pablo Rocasermeño**




A tripper car installation uses seals, ventilation and collection systems to contain dust.

When mining for metals, safely controlling dust is extremely important because mining companies must meet both occupational health and environmental regulations. In addition to protecting workers and the environment, proper dust control enables mines to reclaim valuable metals contained in dust. Furthermore, controlling dust also protects electrical, pneumatic and mechanical equipment from particles that can cause wear or premature failure.

Miners often ask whether using a wet technology (water) is better than using dust collection systems for controlling dust. Actually, the ideal dust control solution is to use a combination of both technologies — customized for the specific environment and application.

The industry adage about dust, "once it escapes, it's gone," is true. If dust is not properly controlled at its source, it creates a facility-wide safety, production and maintenance problem. When these microscopic metallic and non-metallic particles are released and become airborne, they cause health and safety hazards, damage equipment and reduce productivity.

Dust is inevitably generated when the mined material is crushed into smaller pieces or powder as part of the process to extract the metal(s). Dust is also created when chutes or bins are loaded with material. As the ore moves through the processes, it pushes air out, dragging the dust with it. Therefore, the sole act of moving rock from one point to another, depending on the conditions, can generate dust. An average operation can generate about 5 tons of fugitive dust a day through processes like crushing, grinding, milling, screening, conveying, loading and storing.

The following actions are key components to a comprehensive dust control strategy for metallic mining operations.

## Analyze Operational Processes

To effectively control fugitive dust, it is important to analyze a facility's design and operational processes. For example, are the facility components sized correctly for the production volume and the type of ore? Many facilities experience an increase in production from the time the facility was originally designed. That additional workload can generate much more dust in that same space. Therefore, it may be necessary to upgrade some equipment or verify for design modifications.

The type of ore mined varies during the life of a mine. Some rocks are more abrasive than others, have different hardness and fracture differently. The different physical properties of the ore must be taken into consideration to design the dust control plan, and the design must be flexible enough or adjustable to adapt to changing conditions.

In addition, a facility analysis could also determine where and when workers are exposed to respirable dust, as well as the dust control systems in place and their effectiveness. Dust control systems should be evaluated periodically and modified to optimize performance. Dust control systems are complex and it would be wise to consult with a professional who has experience with mineral processing.

## Contain the Dust

As materials move from point A to point B, they create a significant amount of dust. Adding chutes, lids and conveyor covers or enclosures contains the dust. They also facilitate mitigation and capture, which keep dust control systems at a reasonable, cost-effective size for an operation, as large open spaces normally require a greater amount of energy and resources to control airborne particles.

Transfer chutes should be sized so the material can flow without clogging and minimize the falls (distance) to reduce air displacement and air velocities inside the chutes. Recently, dust control specialists have been implementing settling chambers or raised boxes over typical chutes and conveyor enclosures to reduce the air velocities created inside enclosed spaces, allowing dust to settle, be captured or be suppressed more easily. This technique also prevents excessive pressure buildup inside those enclosures, which prevents premature seal failure.

Seals, curtains and skirting are key to keeping the material on the belt after a transfer or a chute discharge. Skirting keeps the ore and dust particles con-

tained until they settle or are extracted. Regardless of the skirting and dust seal combination selected, the key is maintaining them in good working condition, so they perform effectively. Small gaps allow rapid dust selected.

Always make sure the containment equipment is in good working condition and free from holes that can allow dust to escape. Many times, dust problems are created by small holes and openings. Basic procedures such as placing a cover over screens or enclosing the crushers are sometimes neglected, causing rapid fugitive dust accumulation.

## Conditioning the Ore

The next step in controlling the dust is conditioning the ore. It is common knowledge that adding humidity (water) to the rocks prevents excess dust generation. The water binds the dust particles to the ore or to one another, and it also adds weight, causing them to drop rather than stay airborne. The effect of water can be seen when it rains. Although many times considered problematic or scarce, water is a key component of a good overall engineered dust-control solution.

It is important to note that as ore characteristics change, the recommended percentage of water to "condition the ore" and reduce dust generation changes as well. Analyzing the rock composition and clay content may help quantify the optimal moisture percentage for the operation, but always remember to employ a flexible design, so it can be adjusted. Typically, we see that a good percentage of mining operations find the "sweet spot" to be between 2% and 4% moisture — but this varies and most of the time answered by trial and correction.

Water addition systems can be rather inexpensive to implement. However, caution must be taken to avoid over-wetting the product, which causes other sorts of problems such as plugged chutes, blind screens and safety hazards. A good practice is to add moisture in stages to allow water to soak into the material. Remember that although rocks may seem wet on the outside, the inside is still dry, so as rocks are crushed or broken, dust is released into the air. A good technique is to add water after material is crushed, separated or turned. Adding water at multiple stages will allow a better use of this precious resource and help maintain the moisture addition under control to avoid the previously described complications.

It's important to clarify that "dry fog" systems are designed to suppress or "capture" airborne dust with the use of high-pressure water and/or a mix of water with compressed air, creating a moisture cloud of very small droplets. But as the name suggests, they do not add much moisture to the material and therefore are not recommended as a way to condition the ore.

Using water in any mining operation can also be problematic because most of the time it's recycled, dirty and often quite hard. The water clogs nozzles easily, which leads to much more time spent maintaining the spraying system. To minimize maintenance, try to use simple plastic nozzles with big holes and low-pressure systems.

The pattern in which water is sprayed is just as important as when and how much. Different spray patterns are more effective depending on the stage of the mining process, how the material is moving, and what size material is being conditioned.

## Dry Dust Collection

Dust collection systems are another essential part of a dust control strategy. Typically, they capture dust-laden air and filter it, separating the dust from the air. Contrary to the belief that the dust collection system should collect as much dust as possible, miners want the dust to stay in the process because it contains minerals. Dust extraction systems should only capture particles that stay airborne and are not capable of dropping on their own. At the same time, dust collection systems should vent and alleviate the pressure inside the equipment or the enclosures. This will prevent particles from escaping.

There are two primary types of dry systems used to control dust at mine processing sites: baghouse collectors that use rows of large filter bags and cartridge-style collectors that use much smaller pleated filter elements. Although baghouses have been the traditional choice, cartridge collectors have gained popularity because they offer several major advantages.

A cartridge collector has a much smaller footprint than a conventional baghouse and can achieve significantly higher filtration efficiencies. Higher efficiencies improve employee health and help meet increasingly stringent regulations. High-efficiency filter media cartridges capture large quantities of dust. In addition, they have a longer life span.

When selecting a dust collector, engineers should pay attention to the filter media as well as the whole design of the equipment. Some designs will promote a pre-separation stage and allow filters to last longer. In a properly designed dust collector, dust-laden air enters the collector

A conveyor transfer combines dust control techniques using containment and a collector along with water sprays.

Fugitive dust emissions not only represent a safety hazard, but a loss of valuable product.

through a baffled inlet and gets "pre-separated" before reaching the filter media.

Normally, dust collectors for mining use a jet pulse system to clean the filters using periodic bursts of compressed air. The dust from the media then falls into a hopper, and from the hopper, the dust is discharged into a slurry system or directly to a conveyor or another part of the process.

Designing an effective dust collection system for a mineral processing operation involves understanding factors like air flow, air velocity, static pressure, velocity pressure and fan curves. Knowledge of fan inlets and outlets and duct entries and transitions is important as well.

## Ventilation and Dilution

Proper ventilation is also an integral part of an overall dust control system. Without proper air exchanges, dust accumulates over time, becoming a safety and maintenance hazard. Effective ventilation dilutes the dust concentration in the air, improving the air quality in the processing spaces.

The dilution method for dust control is often used in large spaces where typical dust collection is not effective or cost viable. It is also useful for places with no natural air currents, where leaked dust accumulates to undesirable levels. A good example of this situation is commonly found in stockpile tunnels, where, due to the lack of natural air movement, dust spillages tend to accumulate.

It's nearly impossible to guarantee a perfect seal in any mining operation. Abrasion causes holes in chutes, belts lose alignment over time, and skirting simply wears out. For example, a brand-new conveyor belt is smooth, and at startup, dust appears to be well under control. Over time, the conveyor becomes scratched due to abrasion and the surface holds light dust. The motion of the idlers and conveyor causes these light dust particles to become airborne in a tunnel with no air exchange, and the accumulations of these particles creates a safety concern. Therefore, a good ventilation system will aid toward maintaining the air quality in the working spaces.

Dust collection and ventilation systems should work together to achieve the desired conditions, but they usually operate independently. The dust collection system's goal should be capturing the airborne particles, while the ventilation system's goal is to replenish or replace the air in an enclosed area using fresh clean air to improve the air quality for the workers.

If the clean air is drawn from an area that does not have adequate air quality, an additional filtration system may be used. This can be done using standard HVAC-grade filters or a rather recent technique that uses a dust collector to filter the air before injecting it into the space. High-efficiency cartridge dust collectors are ideal for injecting clean air, as they withstand high quantities of dust while guaranteeing very high filtration efficiencies. The cleaner the air used, the better.

## Regular Cleaning

Regularly scheduled facility housekeeping is an important part of any air quality plan. Always remember spills are frequent in any mining operation. Without proper cleaning, the dust will accumulate in the air and cover floors and surfaces, causing health and safety problems. It also causes unnecessary equipment wear and downtime. When housekeeping is performed properly and on a scheduled time frame, it can be a key factor in minimizing respirable dust exposures to workers.

There are multiple ways to perform adequate housekeeping. Vacuum trucks and central vacuum systems are commonly used in mining. This equipment uses low quantities of air at high pressure to pull dust from floors and transport it to a filtration system, which, similar to a dust collector, separates the dust from the air. The facility should have an adequate plan for disposing of the dust collected.

Housekeeping is sometimes the more neglected part of the dust control strategy. Unless it becomes a problem for production, it seldom receives the appropriate attention. The author cited a time when he was walking with a customer a few months ago in a tertiary crushing facility while maintenance was being performed. The newly installed dust collection systems and containment and conditioning measures that had recently been implemented were being reviewed. Everything looked good, but when the plant restarted, the building shook and a snowstorm-like cloud of dust fell from all beams and upper floors, causing it to seem as if the dust control systems were not working at all. People consider mines to be dusty places and therefore ignore the fact that dust builds up over time.

The reality is, if an operation has not gotten rid of the accumulated dust, it will cause the same problems as the processing dust that operations are trying to address with dust control equipment. Therefore, for the best return on investment of a dust control system, be sure to remove all accumulated dust before installation.

Although it's impossible to completely eliminate dust in mineral mining and processing facilities, it is possible to effectively control fugitive particles using a custom-engineered system with a well-designed strategy. This solution should include both water suppression and dry dust collection systems customized for an application. A complete dust control plan will reduce the exposure to hazardous contaminants, make indoor environments healthier, protect equipment and improve production. With the help of engineering consultants and experienced equipment suppliers, mineral processing facilities can minimize dust-related risk factors and maximize safety.

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