

Does Dry-Mix Shotcrete Have to be Dusty?

By Joe Hutter

An underground environment is often fraught with hazards—some obvious and some not-so-obvious. Although the generation of dust may not have obvious, immediate effects, it is recognized as a hazard that can have long-term health effects on the personnel who work in the mining and tunneling industry. It is important to address the causes of dust generation and to recognize what we can do to minimize the effect of this common hazard.

During the development cycle, high amounts of dust can be generated through the processes of extraction, drilling, blasting, crushing, conveying, and shotcreting. With the exception of the shotcrete process, dust generated by each of these processes must be controlled by ventilation, water sprays, or dust collectors. While each of these methods of dust control can be effective, all require that dust particles be removed from the atmosphere. The problem lies in the fact that once the dust is airborne, it is always harder to control.

From the perspective of a shotcrete operation, it is safe to say that when placed by an experienced, properly trained crew using well-maintained equipment, dry-mix shotcrete can have minimal

effect on the generation of dust. This statement can be attributed to the fact that dust generation can be controlled at the source so that less dust needs to be removed from the atmosphere (Fig. 1).

Dry-Mix Shotcrete Materials and Equipment

When it comes to the production of airborne dust, not all dry-mix shotcrete materials and equipment are created equal. Doing your homework by researching a materials and equipment supplier who has the benefit of experience working in an underground environment will contribute greatly to a clean, trouble-free underground shotcrete application.

Reducing dust at the source can be achieved by adhering to the following accepted practices:

- **Bulk tote bags**—When using prepackaged materials, consider purchasing shotcrete materials in bulk tote bags, which generally release materials into the machine hopper through a chute at the bottom of the bag. One of the greatest sources of airborne dust is created when small 66 lb (30 kg) bags are broken into the hopper of a shotcrete machine.
- **Hopper hoods**—When using bulk tote bags, a hopper hood, manufactured to fit the hopper of the shotcrete machine, will seal the hopper and prevent dust from being released (Fig. 2). Most shotcrete equipment suppliers will be able to supply a hopper hood with their shotcrete machine. Otherwise, many can custom-fabricate a hopper hood to fit any machine.
- **Equipment maintenance**—Keep the shotcrete placement equipment well-maintained. Inspect wear pads and plates to ensure they are well-sealed to prevent dust from escaping the machine. Some shotcrete equipment manufacturers will supply machines with lubricating capabilities to extend the life of wear pads and wear plates and better seal the system.
- **Exhaust port**—Rotary-style dry-shotcrete machines are designed with an exhaust port



Fig. 1: When placed by an experienced, properly trained crew using well-maintained equipment, dry-mix shotcrete can have minimal effect on the generation of dust

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to allow low-pressure compressed air to escape from the rotor port prior to being charged with material as it rotates. Ensuring this port is clear and the air being discharged is contained as it is released is very important in controlling dust emissions.

- **Water ring inspection**—Occasional inspection of the water ring will ensure that the holes are not plugged with cementitious material. Plugged holes will restrict the amount of water capable of wetting the material and may lead to increased dust levels at the nozzle.
- **Equipment settings**—Keep wear pads, wear plates, and air settings properly adjusted to prevent “blow back” of dry shotcrete material from the hopper.
- **Wet/dry adjustments**—Ensure sufficient water pressure and water volume to avoid excessive wet/dry adjustments at the nozzle. Be aware when drilling operations may draw water from the same source as the shotcrete operation, causing inconsistencies in the water supply.
- **Pre-dampening equipment**—When using prepackaged material or dry site-batched aggregates, use pre-dampening equipment to reduce the amount of airborne dust at the machine and at the nozzle (Fig. 3).
- **Hydro-nozzles or semi-wet nozzles**—If pre-dampening equipment is not available, ensure that a hydromix-nozzle or semi-wet nozzle (one in which the water ring is moved back several feet from the nozzle) is used (Fig. 4).
- **Conveyance hoses**—Ensure that the size of the material hose is adequate for the material aggregate gradation and mixture design.

The Shotcrete Crew

An experienced shotcrete crew that follows proper shotcrete practices will also contribute greatly to reduced dust levels, but even crews with years of experience sometimes require updated training to ensure that they are following proper shotcrete practices and are operating the equipment as per the manufacturer’s recommendations. A good shotcrete materials and equipment supplier should have technical personnel readily available to provide proper recommendations for equipment or materials required for specific projects. Introductory and refresher training can also be a valuable tool when new personnel join the shotcrete crew. Even in cases where the new crew members have previous shotcrete experience, they may have been trained on different equipment or crew operations and may require additional training on the project’s specific operating procedures.



Fig. 2: When using bulk tote bags, a hopper hood manufactured to fit the hopper of the shotcrete machine will seal the hopper and prevent dust from being released



Fig. 3: Use pre-dampening equipment to reduce the amount of airborne dust at the machine and at the nozzle



Fig. 4: A hydromix-nozzle or semi-wet nozzle (one in which the water ring is moved back several feet from the nozzle) will also prevent the dust generation at the nozzle

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There is no doubt that over the years, the label “dusty” has been unfairly attached to dry-mix shotcrete operations, especially in the case of enclosed, underground environments. What needs to be understood, however, is that unlike many other sources of airborne dust (drilling, blasting, crushing, and conveying), dust generated through the dry-mix shotcrete process can be eliminated, or at least controlled, at the source. The first step in controlling airborne dust levels is to evaluate the dry-mix shotcrete machine. Some equipment manufacturers produce dry-mix machines that are better suited for underground environments. Investigate different manufacturers and suppliers before automatically settling on the equipment you have always used. Just like buying a car or truck, test drive a demo machine before committing to a purchase.

Expect more from your shotcrete materials and equipment suppliers. Make sure they are available after the sale to provide initial and follow-up training for the shotcrete crew. One of the most common causes of excess dust is a crew that

develops bad habits over time. Refresher training will reintroduce the dry-mix equipment operator to the proper equipment settings and proper maintenance procedures, and lead to a cleaner and more efficient dry-mix shotcrete operation.

Dry-mix shotcrete does NOT have to be dusty. With a little common sense and a little attention to detail, most dry-mix shotcrete crews can operate in an underground environment without anyone even knowing they're there!



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