Devising an Effective and Affordable Dust Control Strategy Using Water Sprays

Dealing with dust is no longer optional in most regions of the world but when it comes to dust control systems, options abound. Making the best choice for your operations can get complicated since there are dozens of factors to consider. The more you know about dust and the various techniques to control it, the greater your chances are of specifying a system that will get the job done at the lowest possible cost.

No one knows more about spray nozzles for dust suppression than Monitor. We have been involved in supplying nozzles for dust suppression and assisting with dust control system design for more than 50 years.

Our offerings include:

- Spray Nozzle Supply
- Dust Control Kits – (Including spray headers) for low, medium & high pressure systems
- In house test facilities to view various spray nozzle performance
- Strainers & Accessories
- High & Low Pressure Pumps
- Dust Suppression System Design
- Complete Installation

Ensuring Successful Dust Suppression

Following these strategies and guidelines can help you specify a wet dust control system. However, because every operation that generates dust is different and there are so many variables, it is always wise to get expert advice. The leading spray technology manufacturers typically offer on-site evaluations and proposals. In addition, we can provide more detailed information on spray nozzle performance than is available in supply house catalogs. Investing time with us before you finalize your system specifications can yield big dividends and is highly recommended.
Dust Control Applications

1. Hopper Discharge
2. Crushers
3. Belt Conveyor Discharge
4. Chute Discharge
5. Stockpiles
6. Loading
7. Silo Discharge
8. Screens
9. Shearing
10. Rail Cars
11. Tipplers
12. Continuous Miners

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General Pictures
1. Drop size

Drop size refers to the size of the individual drops that comprise a nozzle’s spray pattern. Each spray pattern provides a range of liquid drop sizes. Many factors can affect drop size such as liquid properties, nozzle capacity, spray pressure and spray angle.

Air atomizing nozzles produce the smallest drop sizes (+/- 10 micron) followed by hydraulic fine spray, hollow cone, flat fan, and full cone nozzles. For dust suppression, drops between 20 and 200 µm are typically required as airborne dust particles are usually in this size range. To produce this very small drop size, a higher degree of atomization is required. Atomization is achieved by pumping water through nozzles at high pressure or by using a combination of compressed air and water pumped at lower pressure to produce very small drops or fog.

If compressed air is available and economically feasible, air atomizing nozzles are generally a better choice. They produce smaller drops and have larger flow passages than hydraulic fine spray nozzles which helps to reduce clogging.

**FIGURE 3: Spray nozzle patterns**

- Air atomizing
- Hydraulic fine spray
- Hollow cone
- Flat fan
- Full cone
When dust is airborne and needs to be suppressed (also referred to as captured or knocked down), it is important to match liquid drop size to the particle size of the dust. Drops that are larger than the dust particle avoid collision with the dust. When drops are smaller than the dust particle, they may collide, but the drops evaporate too quickly and release the captured particles. The greatest chance for suppression occurs when the diameter of the drop size and dust particle are comparable. See Figure 2. Also keep in mind that dust suppression is most effective in areas where there is little air turbulence.
2. Application of Moisture

Dust Control: Prevention, Suppression or a Bit of Both

Wet dust control systems use spray nozzles to apply humidity, water, and/or chemicals to:

- The dust source to prevent the dust from becoming airborne (wetting)
- Airborne dust particles to suppress or capture the dust and minimize the distance it travels

The system requirements for dust prevention are very different than the requirements for dust suppression even though both are applying moisture. It’s important to understand the differences between the two to ensure optimal performance.

When the goal is to prevent dust, the following factors must be considered to ensure a positive result

- Materials respond to moisture differently. For example, when applying moisture to ore, 3.5 liters per ton usually provides adequate wetting. On the other hand, coal repels water and will require the use of more moisture and chemical additives to increase absorption. Precision application of moisture is essential. Too little moisture results in airborne dust. Too much moisture may compromise the integrity of the material, cause costly production problems and equipment damage and create dangerous sludge – a maintenance nightmare.

- Most dust particles created during breakage are not released into the air. The dust stays attached to the material and adequate wetting is required to ensure it stays attached. Keep in mind that partially processed minerals and coal may be more sensitive to moisture than unprocessed material.

- If the material being sprayed is stationary, as on a storage pile, drop size and spray angle are critical. If the material is moving, as on a conveyor, drop size and drop velocity are the top concerns.
The spray nozzle at the top is suppressing airborne dust. The nozzle at the bottom of the hopper is applying moisture to the material to prevent dust from becoming airborne.
3. Spray pattern & Nozzle Type

Your specific operating conditions will ultimately determine which nozzle style and spray pattern should be used. Figure 4 provides an overview of the options and some guidelines for use but be sure to check published performance data to verify flow rates and drop size at the operating pressures you’ll be using.

<table>
<thead>
<tr>
<th>TYPE</th>
<th>DESCRIPTION</th>
<th>DROP SIZE</th>
<th>COMMON USES</th>
<th>TYPICAL APPLICATIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydraulic hollow cone</td>
<td>Circular ring of water</td>
<td>Small</td>
<td>Used in areas where dust is widely dispersed</td>
<td>Transfer points, Transport roads, Jaw crushers</td>
</tr>
<tr>
<td>Hydraulic flat fan</td>
<td>Tapered edge, rectangular or even spray</td>
<td>Small to medium</td>
<td>Used in narrow or enclosed spaces</td>
<td>Stockpiles</td>
</tr>
<tr>
<td>Hydraulic full cone</td>
<td>Round pattern</td>
<td>Medium to large</td>
<td>Used in areas where nozzles must be located a good distance from the dust source</td>
<td>Stackers, reclaimers, Transfer points</td>
</tr>
<tr>
<td>Air atomizing</td>
<td>Round, full or flat</td>
<td>Very small</td>
<td>Used in enclosed areas to minimize drift</td>
<td>Jaw crushers, Loading terminals, Dump hopper, Transfer points</td>
</tr>
<tr>
<td>Hydraulic fine spray</td>
<td>Round pattern or circular ring</td>
<td>Very small</td>
<td>Used in enclosed areas to minimize drift and when a light fog is required</td>
<td>Stackers, reclaimers, Transfer points, Jaw crushers, Loading terminals, Dump hopper</td>
</tr>
</tbody>
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Spray angle

Spray angles range from 0° to 175°. The angle you need will be determined by the spray pattern, the number of nozzles used and the nozzle placement.

Operating pressure

Operating pressure and flow rate will be determined by how much moisture you need to apply. Keep these simple rules in mind:

- Increasing pressure decreases drop size
- High pressure sprays are better suited for enclosed areas
- Nozzles operating at higher pressures should be placed close to the dust source to minimize the amount of air set in motion along the spray path
4. Spray Nozzle Location

Spray nozzles being used for dust prevention should be placed as close to the beginning of the transfer point as possible. The force of the moving material helps the water penetrate the material as it moves through the transfer point.

Nozzles in airborne dust suppression systems treat the air around the material and are generally placed at the end of transfer points so the material load can settle. Nozzles are positioned so they are spraying above the material and not on it.

Additional considerations

Keep nozzles out of the range of equipment or falling debris that could cause damage.

Installation/Operation

- In operations using feed chutes, keep water pressure below 4 bar to avoid pressurization and forcing dust from the enclosure.
- Using more nozzles at lower flow rates and positioning them closer to the material is usually more effective than using fewer sprays at higher flow rates.
- Use flexible plastic strips around areas with water sprays for containment and inadvertent wetting of non-target areas.
- Keep conveyor belts clean. Use a water wash system to spray and scrape build-up from belts and spray the bottom of return belts to reduce dust from a dry belt.
- Use water instead of brooms to clean plant floors.
5. Maintenance

Without the correct maintenance procedures in place your investment in a dust suppression system will be a waste. Spray nozzles are designed for long-lasting, trouble-free performance, however, like all precision components, spray nozzles do wear over time. Spray performance can suffer and costs can rise. The best strategy is to inspect nozzles on a regular basis and replace them when needed.

Watch for:

• Plugging/clogging: Use water clarification devices and strainers as needed

• Corrosion: Specify nozzles in the appropriate materials for the solutions being sprayed

• Scale build-up: Control hardness level of the water and use chemical additives if necessary

• Caking: Clean nozzles before build-up interferes with performance. Soak nozzles in water to loosen debris before cleaning