Industrial Hygiene From Mining Research

Dust Control From Foam Additives

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Since foam requires adding a surfactant or foaming agent to water, it is a more expensive means of dust control than water alone. This raises the question of when to use foam instead of water. Working with dust control in mines has taught us that water can be very effective and is widely used. For example, a recent test compared foam versus water when used on a face drill in a gypsum mine. About 0.2 gpm of water flowed through the drill rod to the bit in a 2-inch diameter hole. Dust reductions averaged 93 percent. Foam used on another drill gave dust reductions averaging 95 percent. The foam system required three times the liquid flowrate to gain only a 2 percent increase in dust reduction efficiency. Water alone was quite capable of controlling dust in this application due to the extreme confinement of the dust source.

Whenever a water-only dust control is not effective, the first approach considered should be to optimize the existing system in terms of spray orientations, patterns, pressures, or by adding more water. If more efficiency was required in the above example, it would be a good bet that adding more water would do it.

There are times when adding more water is not the answer. It may even be desirable to reduce the water used. This is where foam enters the picture. Foam offers several advantages over water alone; however, for successful foam application, there are certain application requirements which must be considered.

One of these requirements is the need for uniform moisture distribution. A decade ago, we tried the "foam blanket" approach on a continuous mining machine. The miner drum was deluged with a blanket of foam as the drum cut into the coal seam. The foam blanket reduced dust by only 20 percent compared to water sprays only. The marginal improvement in effectiveness happened because the foam was not being mixed with the coal.

The importance of this mixing process, both for foam and for water alone, is highlighted in a number of recent studies.

One of these was a series of tests conducted by the German coal mining industry. The cutting drum of a longwall shearer mining machine was modified to vary the number of water sprays. Changes were made in the nozzle orifice diameter to hold water pressure and total flow to the drum constant. When the number of nozzles decreased from 46 to 17, dust levels rose by a factor of 2-½. Using more nozzles spread out evenly over the drum gained significantly higher dust control efficiencies. These experiments showed that how you apply the liquid may be as important as how much you apply.

The Bureau of Mines had a similar result when applying foam to a longwall shearer. Foam applied as a blanket from nozzles located several feet away from the cutting drum gave a dust reduction of about 20 percent. Foam released from nozzles *in* the cutting drum, mixing it with the coal as it was cut, gave dust reductions of 70–80 percent. Also, the quantity of water required was decreased by 30–50 percent. The foam cost was $0.07 per ton of raw coal.

Foam can distribute a given quantity of moisture much more evenly over a large surface area. This occurs since expanding a liquid droplet with compressed air significantly increases the ratio of surface area to droplet volume. Then, to achieve a given dust control efficiency, less total moisture is needed. This is important for the instances where moisture addition to the product is critical.

Another instance where we obtained successful foam results was in the handling of silica sand. We measured respirable dust reductions over 90 percent at bulk loadout facilities by applying small quantities of foam at a belt transfer point early in the plant transfer cycle. This procedure allowed for enough mixing and we were also able to measure increasing dust reductions as the material moved through and mixed more at each successive transfer point. We also tried plain water and water with unexpanded surfactant, and neither worked as well. The only explanation we had for the higher foam performance was a more effective moisture distribution.

Foam may be useful to many industrial hygienists dealing with dust problems in a wide range of industries. However, any health hazard associated with the use of the surfactant has to be addressed. It must be determined if the application involves either external or internal exposure of personnel. External exposures to some foams can cause skin irritation. Although foam application does not produce mists like water sprays, there is still the risk of internal exposure by inhalation or ingestion. Fortunately, foams are available which have little to no toxicity. ♦

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