Fugitive Dust Control Using "UltraFine Fog"

By
Brian Hartshorn
Hart Environmental, Inc.

"UltraFine Fog" fugitive dust suppression works like a combination of a wet scrubber and a fabric filter. The generated UltraFine Fogging blanket acts like a fabric filter in that a dust particle cannot pass through it without colliding with a droplet. Since the droplet consists of water, the dust particle does become somewhat wet as in a true flooded scrubber. This phenomenon can be called agglomeration and solving fugitive dust emission problems with UltraFine water droplet atomization begins with the theory of agglomeration. Agglomeration can be defined as the gathering of mass into a larger mass, or cluster.

This paper will discuss the gathering of air borne dust and water. The water atomized in the fogging system contains no chemicals or agents. It is atomized with a droplet size range of 1 to approximately 45 microns. This UltraFine atomization is referred to as a Dry Fog.

Agglomeration probability is greatly increased between bodies of similar size. The agglomeration of these bodies produces a large enough mass to cause settling. For example, a dust particle of 5 microns will continue to follow the air stream around a water droplet of 200 microns, therefore, avoiding collision. With the dust particle and a water droplet of similar size, the air stream is not as great and collision occurs, causing agglomeration.

Figure 1 shows the aerodynamics of what can happen when the water droplets are larger than the dust particle.

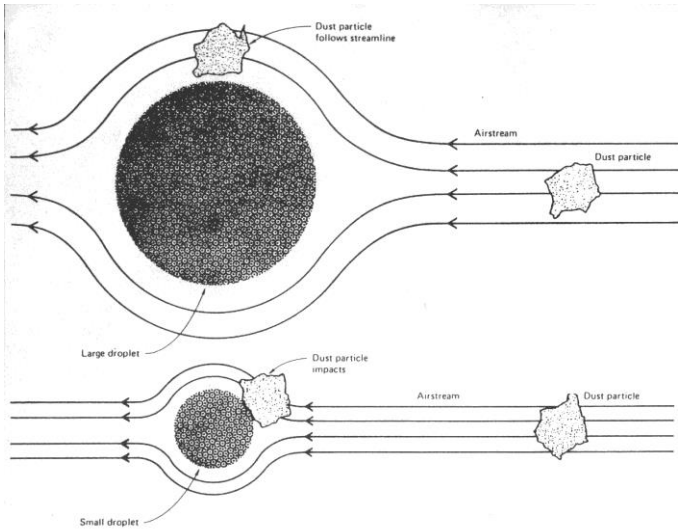

Figure 1. Theory of Agglomeration (Air Flow Around Water Droplets)

Due to the small size of the water droplet, evaporation occurs after agglomeration keeping suppressed material relatively dry. Since this application is treating the fugitive particles by suppression and wetting just the fugitive dust, less than 0.1 percent moisture is added to the product. It is also interesting to note, that the droplets of 30 microns and less will not freeze with ambient temperatures above -30ºF (-34ºC).

Since most respirable dust emissions are under 10 microns, the most effective suppression system must also produce water droplets under 10 microns. Conventional wet spray dust suppression systems water droplets are much larger than the airborne dust. Agglomeration is not obtainable, leaving the fine dust airborne and exceeding local regulations and health codes.

The placement of the fogging nozzles is the most important aspect to producing effective results with no wetting of material. The fog should be generated and contained in properly designed shrouding. This eliminates dissipation due to wind and also produces the treatment time necessary to suppress that dust. The fog is generated above the dust problem area, not on the material. As the airborne dust enters the confined UltraFine Fog, agglomeration occurs and the dust is suppressed in-Situ.

Typical conveyor transfer point and crusher shrouding along with location of the nozzles are shown in Figure 2 and Figure 3 respectively.

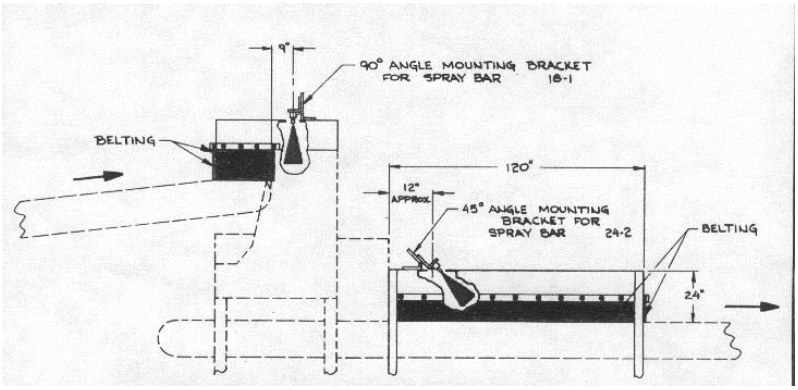

Figure 2. Typical Transfer Point Treated by Fog Nozzles

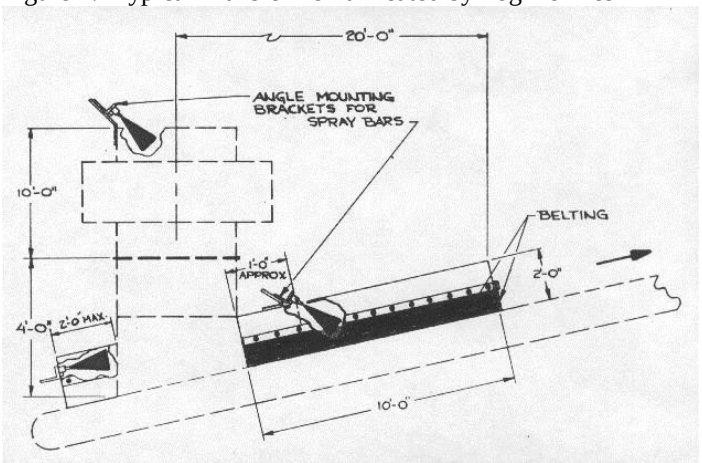

Figure 3. Typical Crusher Transfer Point Treated by Fog Nozzles

A general rule of thumb is that the height of the conveyor cover be approximately 3 feet above the product level on the belt. And, the cover length is 2 to 3 times the belt speed (FPS). The basic principles involved for location of the nozzles are as follows:

- Nozzle spray pattern must not directly impinge upon any surface.
- Nozzles should be mounted in order to maximize the ability to fill the shrouding.
- The fog should avoid direct contact with material being suppressed.
- Nozzles must be protected or shielded to avoid damage from falling material.
- Nozzles should be mounted to minimize exposure to a heavy-laden dust air stream. This will avoid erosion of the nozzle components.
- Spray pattern of nozzles should be generated so that all the fugitive dust emissions are forced to pass through the blanket of fog.

A simple system schematic is shown in Figure 4. In this picture two spray bars are mounted on the covers. They are heat traced and insulated assemblies. The enclosure has a quick release cover, which makes it easy to service the nozzles as required. This picture also shows the manual regulator assemblies, which are used to regulate the air and water pressures, along with the flex hoses, used to connect the two fluids.

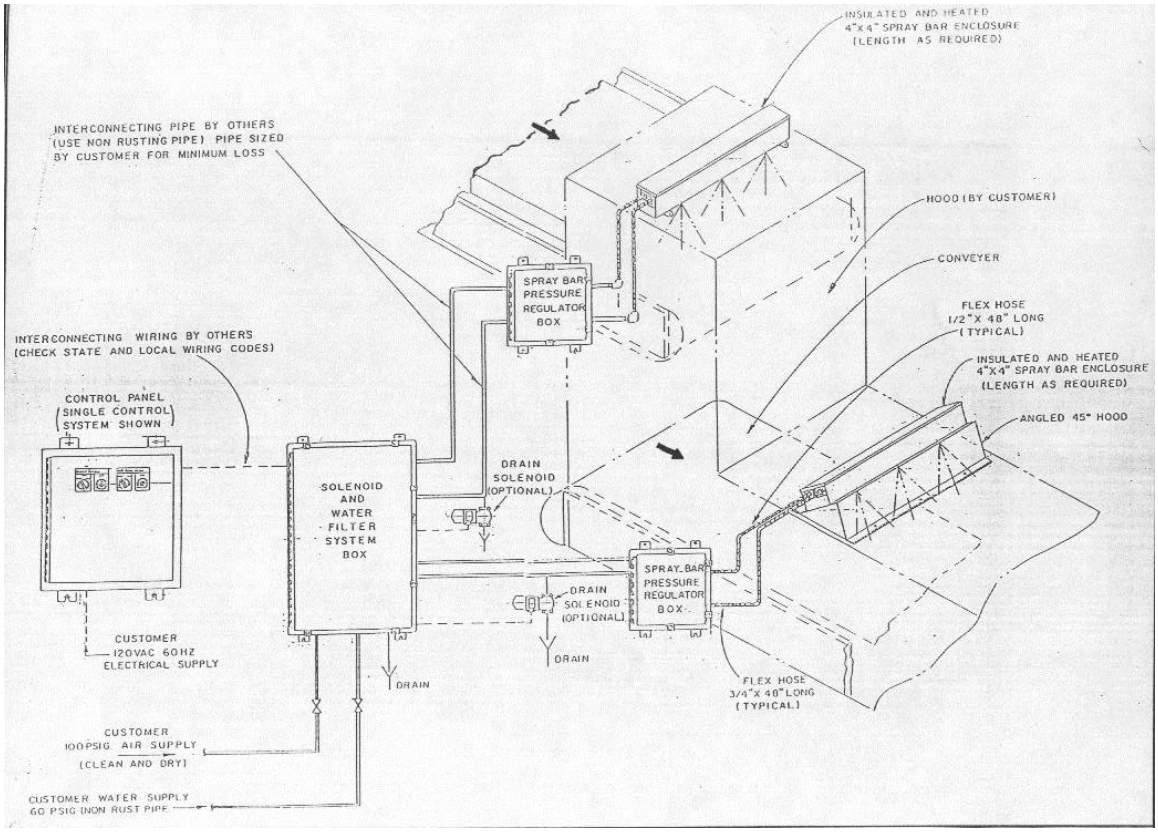

Figure 4. Typical Dust Suppression System

The heart to an UltraFine Fog dust suppression system is the Ultimix™ atomizing nozzle. Figure 5 is a picture of two sizes of Ultimix™ nozzles and adapters that are often used for

most fugitive dust control applications. The two models are referred to as an ST-47 and ST-56. The nozzles are designed to flow a range from 0 to approximately 10 GPH, but can be pushed further if a wetter spray is desired. The normal starting range is approximately 5 GPH and 3 GPH respectively. Final flow rate is determined upon commissioning of the system.

Figure 5. Ultimix™ Nozzles Used for Dust Suppression.

Figure 6 shows a typical single point spray assembly. The upper manifold is for distributing the compressed air and the lower manifold is for water distribution to the nozzle, or nozzles. The nozzle adapter (shown in brass) is provided with a rear entry air connection and a side ported liquid connection.

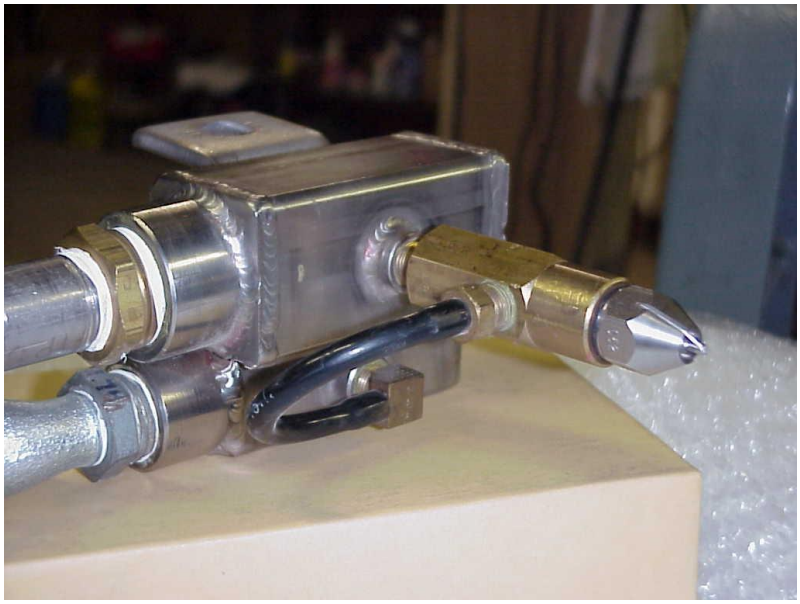

Figure 6. Typical Spray Bar Manifold with Ultimix™ Nozzle (Single Point)

This paper is a general introduction to the use of UltraFine Fog technology to suppress fugitive and/or respirable dusts. Figure 7 illustrates the UltraFine Fogging capabilities of the Ultimix™ nozzles used for fugitive dust control applications.

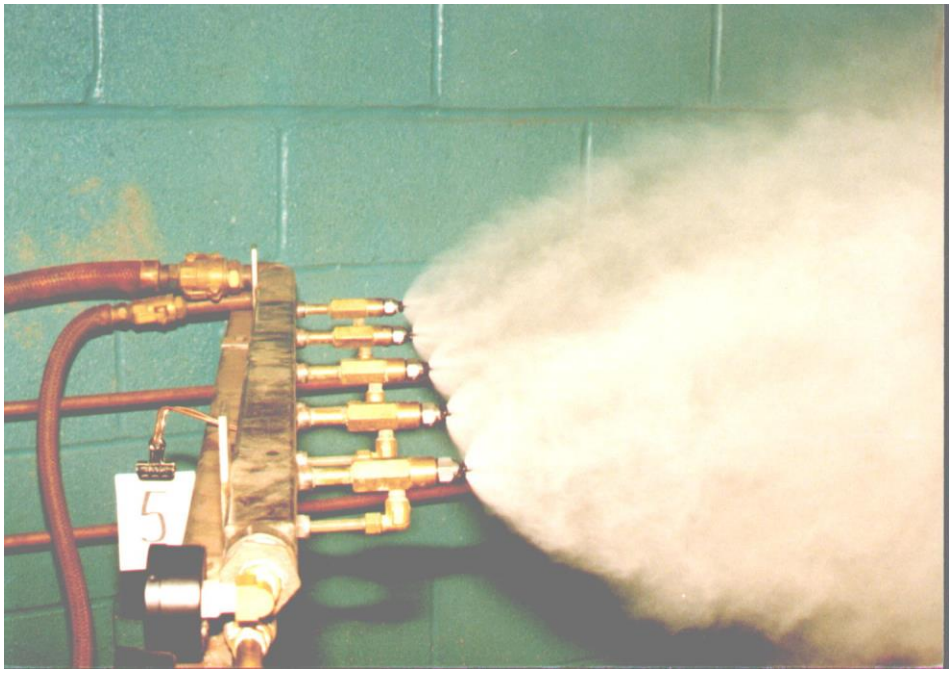

Figure 7. An array of UltraFine Fogging Nozzles.

Hart Environmental, Inc. (HEI), is located in Cumming, Georgia, USA. HEI specializes in dust and gas cleaning and handling projects for industrial facilities. The company's focus is on providing evaporative gas cooling and conditioning systems, dual fluid atomizing nozzles (Ultimix and AirSaver), HEI wet electrostatic precipitators, and air pollution control devices.
If you would like to speak to Hart Environmental, Inc. (HEI) about how we can assist you in the design, specification, and supply of fugitive dust control or gas handling systems, please contact us at hartenv@comcast.net, or (678) 456-8521.