DUST MITIGATION FOR BULK CARGO

USING ATOMIZED MIST TECHNOLOGY

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When unloading bulk commodities from cargo ships, there are several major challenges to consider in mitigating fugitive dust emissions, including: wind velocity, type of cargo, height of the ship, unloading method and the port's proximity to residential and commercial areas. All of these factors can impact air quality compliance and workplace safety, as well as community relations. As local, state and federal air quality regulations get stricter, the issue of fugitive dust control and resulting runoff of water used to surpress fugitive dust becomes an increasing concern for port operators. In response, ports are seeking versatile, economic technologies that mitigate fugitive emissions from the hold to the storage yard and back.

This paper examines dust caused by the handling of bulk cargo and illustrates one port's use of one dust suppression technology to economically control airborne emissions, while mitigating wastewater runoff across all port operations.

While industries that produce grain, coal, clinker, fly ash, etc. are able to create dust control plans focused on the unique characteristics of a single material, ports generally handle a host of bulk materials, making it harder to implement a single plan.

Since outdoor dust suppression is typically delivered using water, and some substances react better to surface suppression and others require airborne dust control, port operators are finding that they must use dust management technology that addresses the needs of several types of cargo.

Moreover, various cargo types are often stored in piles near the port, exposed to wind and disrupted by machinery, creating dust while waiting for the next logistical phase. Different bulk materials can possess distinctive properties such as hydrophobicity (water repellency), a wide range of particle sizes and weights, and extremely different physical properties that can impact dust suppression efforts.

DUST AND EXPOSURE

Bulk cargo can contain various harmful elements, ranging from trace metals to respirable crystalline silica (RCS), see Figure 1. Measured in microns (also "micrometers" or µm) in diameter, typical dust particles can range from 5µm to as large as 200µm.

CAUSES OF FUGITIVE DUST

There are five main causes of fugitive dust in ports:

1. Wind at all phases of bulk handling.
2. Moving cargo to/from hold or to/from storage pile.
3. Conveying, transfer points and discharge points.
4. Physical disruption of storage piles by machinery.
5. Movement of vehicles and machinery on unpaved surfaces.

Aside from completely enclosing production and extracting particles using a filtered ventilation system, one of the most effective ways to suppress fugitive

inhalable or respirable dust once it has become airborne is to use atomized mist or chemically treated water.

AIRBORNE DUST SUPPRESSION

As explained above, dust comes in many sizes, and respirable particulates are roughly 1/10th the size of the largest airborne inhalable particle. Extensive field testing has shown that the size of mist droplets emitted by an airborne dust suppression unit must correspond closely with the size of the particle it is meant to capture. The reason for this is the slipstream effect that is experienced when large droplets approach smaller particles, see Figure 2.

The force of the slipstream is relative to the size and speed of the droplet. When smaller airborne particles encounter a large droplet, they can get caught in the slipstream, causing them to move around the droplet rather than being absorbed by it. By utilizing atomized dust suppression in various operational problem areas, similar-sized droplets are able to travel with dust particles on natural air currents, increasing the chances of collision and absorption, allowing their collective weight to drive them to the ground.

SURFACE DUST SUPPRESSION

Material surface saturation has historically been a common way to prevent dust at many logistical stages. However, once the surface has dried or is disrupted, fugitive dust can return. Surface saturation also requires a large amount of water and can cause serious problems with wastewater runoff, product loss and belt fouling when wet material is conveyed. In addition, commodities such as petcoke, that are tested for water content, can fluctuate in price as a result of elevated moisture levels.

Using hoses, water cannons, industrial sprinklers, spray trucks and similar methods that depend on large volumes of highly pressurized water to provide the proper coverage can require between 75 and 500 gallons per minute (GPM) (284 – 1892 lpm). Atomized mist offers more effective surface suppression, with even the largest designs typically using ≤40 gpm (≤151 lpm) and distributing liquid more uniformly and gently than hoses. Droplets land with less force, allowing them to be more easily absorbed by surface material with little runoff or product loss.

CASE STUDY – PORT OF COEYMANS

The Port of Coeymans and Coeymans Industrial Park are located on the Hudson River in New York, 10 miles south of Albany and 110 miles north of Manhattan. Intended to relieve the burden on the congested New York City ports and offer the Northeast better access to waterways, the port loads and unloads many ships per day transporting bulk commodities such as clinker, fly ash, gypsum, bauxite, salt, grains and corn. It also acts as a major transfer point for bridge fabrication and building materials, including precast concrete and steel headed for large urban construction projects.

Dust cannon in use at the Port of Coeymans on the Hudson River in New York, US


Dust cannons can use filtered river water to cause dust to settle in a contained area

Operators started having concerns with air quality when the port began to regularly receive large vessels transporting clinker, a dry chalky substance used as a binder in cement products. Approximately 40-50 vessels per year arrive from Greece, Turkey, Egypt and Spain, delivering nearly 33,000 tons (30,000 metric tons) per week of the substance.

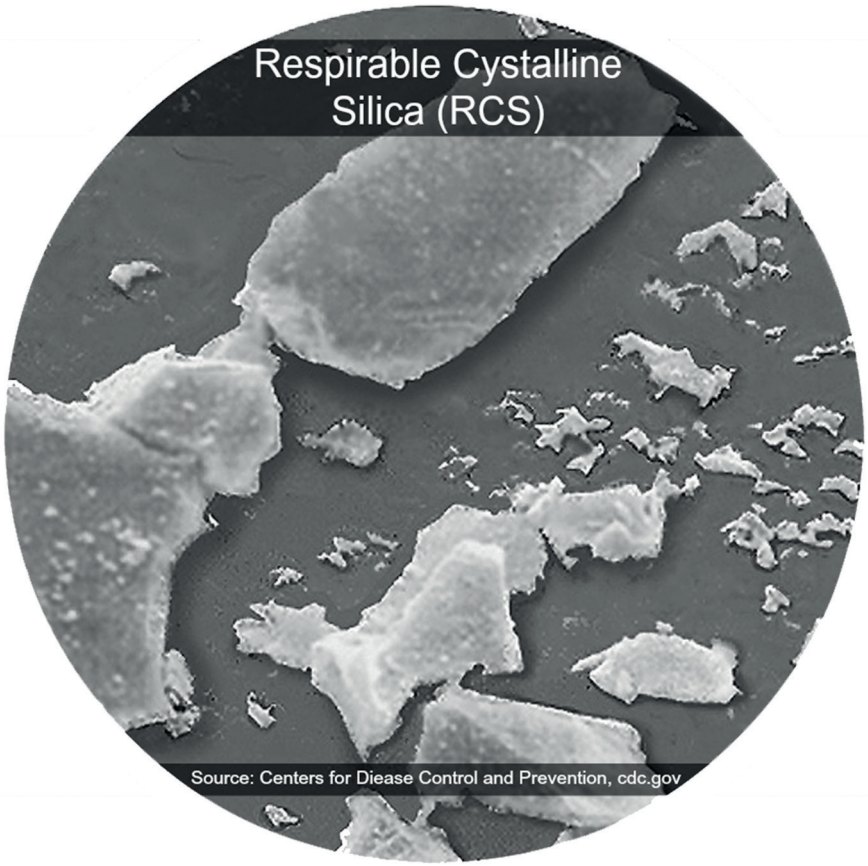
CAPACITY AND FACILITY

The 91.4 metre (300-foot) wide dock receives vessels of up to 228.6 metres (750 feet) LOA, with no beam restrictions, and a draft of 9.4 metres (31 feet) or less. In addition, a 91.4-metre (300-foot) by 18.3-metre (60-foot) inlet channel with a 4.5 metre (15 foot) draft allows loading/unloading from both sides.

DUST GENERATION

When the ships arrive, large clamshell shovels controlled by tower cranes unload the material from the cargo hold, over the deck -- from 7.5 meters to as high as 36.5 meters in the air -- to a 6 meter high hopper, which discharges into a 40-ton (36 metric ton) haul truck. The truck drives the material the short distance to the adjacent industrial park, where it is stored for further transport.

Operators observed that dust emissions were generated particularly when the substance was dropped into the hopper. Although a bag house was attached, a



Source: Centres for Disease Control

Figure 1: Respirable Cystalline Silica

percentage would still escape. In addition, the facility needed dust suppression for scrap metal storage and other operations in the industrial park. According to port managers, production growth has been followed by an increase in dust-causing activity, necessitating improved air quality.

With dust a potential issue throughout the port and storage area, operators realized that they needed a versatile and mobile solution which could deliver dependable suppression at a variety of locations. The goal was to improve air quality for the safety of personnel and inhabitants of the surrounding community.

DUST MANAGEMENT FOR PORTS

Whether disrupted by wind or machinery, substances such as clinker and fly ash release small, lightweight dust particles. Like many other facilities handling bulk materials, the Port of Coeymans limits fugitive dust emissions by employing some simple methods:

1) Crane operators limit the distance the dust-emitting cargo travels from the ship's hold to the dock. This is done by using a clamshell shovel suspended from a crane to slowly unload the material into a tall portable hopper with a baghouse dust collection system.
2) Crane operators further mitigate dust by reducing the amount of material collected by the shovel in each pass. Although this extends the unloading time, it curbs the amount of material escaping from the top or sides of the shovel and thus further limits dust emissions.

MOBILE DUST CONTROL

Port managers decided to rent two of the mid-sized DustBoss DB-60 cannons from BossTek to test them out, eventually deciding to purchase both units. The cannons are mounted on heavy-duty wheeled carriages with a pintle hitch towing attachment.

A 25 HP fan producing 30,000 CFM (849.50 CMM) of air flow propels the engineered mist in a 200-foot (60 metre) long cone that reaches high over the deck of ships. This type of coverage delivers simultaneous surface suppression to material in the cargo hold and airborne suppression through the shovel's path from the hold to the hopper.

Approximately the height and length of a standard golf cart and weighing around 1800 pounds (816 kilograms), the cannon is easily moved by pickup truck from the port to the industrial park. There, operators can cover more than 125,000 square feet (11,613 square metres) of the storage and traffic area by using full oscillation. Port of Coeymans uses municipal water supplied through a hose with a cam-and-groove quick disconnect coupling. The booster pump raises the pressure to approximately 160 PSI (11.03 BAR).

There are some clear benefits over the use of hoses. The DB-60 uses only 26.7 GPM (101.1 lpm) of water, delivering a much larger coverage area and requiring no labor for ongoing operation. Workers at the Port of Coeymans simply place it in the desired location, point it in the right direction, hook up the hose and power, turn it on and walk away.

ATOMIZED MIST CANNON POSITIONING

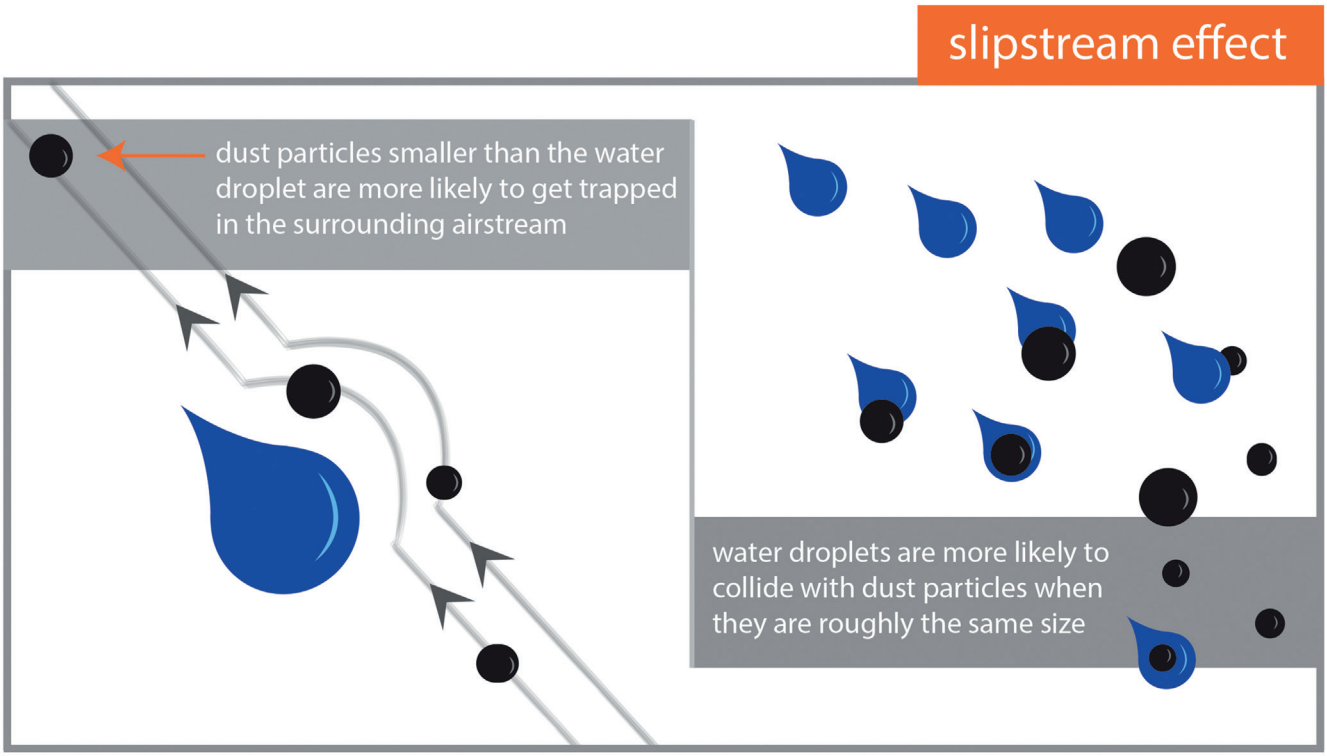
When raw commodities are being unloaded, one DustBoss is positioned to cover the long path of the crane shovel from the hold to the hopper. Located upwind and shooting atomized mist over the ship, the wind current is used to direct larger droplets to settle gently on cargo in the hold, offering surface suppression to mitigate dust production caused by the disruption of the shovel. The wind also carries smaller droplets in the path of the dust where particles are most prone to become airborne, providing effective suppression virtually at the point of emission.

Also, mounted on its wheeled carriage, the other DustBoss is secured on a 12-foot tall (3.6 metre) platform overlooking the dock. Along with the tower's ability to rotate, the cannon uses 180 degrees of oscillation to suppress airborne particles. Fugitive dust emissions are immediately met with atomized mist droplets that prevent the particles from traveling long distances. Like the unloading scenario above, the heavier droplets settle quickly, offering surface suppression without saturation, standing water or excessive creation of mud as workers, machinery and vehicles move through the area.

CLINKER UNLOADING RESULTS

Operators report that air quality at the port has significantly improved during the unloading of clinker and other dusty materials, and that fugitive emissions have not been seen leaving the site since adding the units to the facility's dust management plan. The cannons are easily positioned on the dock, taking up little room and covering a large area, allowing crane operators to transfer material from hold to hopper more efficiently.

The industrial park has also experienced a noticeable improvement in air quality, especially when the DustBoss model DB-60 is in operation during dry and windy



Source: BossTek

Figure 2 The slipstream effect mean drops of dust supressing substances must be the same size as the dust particles it is meant to capture

periods. Surface suppression allows trucks, front loaders and haulers to move more freely and with less concern for dust creation. Overall, dust caused by disruption of material being loaded or unloaded has been drastically decreased, while no extra labor is needed to handle hoses.

WIDE APPLICATIONS

For most port operations, plain or chemically treated water is currently the only practical method of suppressing airborne dust in outdoor operations. When handling bulk cargo in a port and industrial storage setting, mobile atomized mist technology propelled by powerful fans has displayed the ability to suppress fugitive emissions for nearly all bulk materials in normal weather conditions, both at the terminal and in the storage yard.

Consuming considerably less water and producing smaller droplet sizes than competing sprinklers and hoses, industrial atomized mist helps operators stay compliant with both air quality and wastewater runoff regulations.

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ABOUT THE ORGANIZATION

BossTek is a global leader in dust and odor control solutions for the storage and handling of clinker, petcoke, coal, rock and aggregate, as well as controlling air quality during port unloading, recycling and scrap processing, mining, earth moving, and construction demolition. The company's DustBoss product line utilizes atomized mist technology propelled by powerful fans to capture fugitive particles over a wide area.

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