

The Role of Chemicals in Controlling Coal Dust Emissions

By

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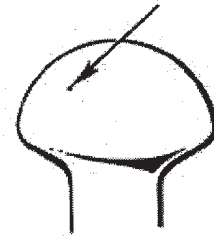
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Defining the Dust Issue

Dust consists of solid particles carried by air currents. Coal dust originates at impact points (including crushing and grinding), from previous accumulations, or from weathering. A wide range of particle sizes can be produced during a dust generating process. Larger particles settle more quickly than smaller particles, and the smallest particles can remain in the air indefinitely. Dust is typically measured in micrometers (commonly known as microns). Coal dust can range in size from over 100 μm to less than 2 μm . As a comparison, red blood cells are typical 8 μm and human hair ranges from 50-75 μm in size.



**A Micron-Size Dust Particle
on a Pin Head**

In coal processing operations, dust is generated-

- When coal is broken by impact, abrasion, crushing, grinding, etc.
- Through release of previously generated dust during operations such as loading, dumping, and transferring
- Through recirculation of previously generated dust by wind or by the movement of workers and machinery

The amount of dust emitted by these activities depends on the physical characteristics of the material and the way in which the material is handled.

Fibrogenic dust, such as free crystalline silica or asbestos, is biologically toxic and, if retained in the lungs, can form scar tissue and impair the lungs' ability to function properly. PRB coal dust exceeds this 1% silica content as is regulated by OSHA to a level not to exceed 2.0 $\mu\text{m}/\text{m}^3$ of air volume. Furthermore, excessive concentrations of dust in the workplace may reduce visibility, may cause unpleasant deposits in eyes and nasal passages, and may cause injury to the skin or mucous membranes by chemical or mechanical action. From an occupational health view point, dust is classified by size into three primary categories:

- Respirable dust
- Inhalable dust
- Total dust

Respirable dust refers to those dust particles that are small enough to penetrate the nose, upper respiratory system, and travel deep into the lungs. Generally, the body has little ability to remove this respirable dust from the lungs. IMHA defines respirable dust as the fraction of airborne dust that passes through a sieve, with 100% passing through 10 μm . The EPA describes inhalable dust as that size fraction of dust which

enters the body, but is trapped in the nose, throat, and upper respiratory tract. The diameter of this dust is about 10 µm and greater. Total dust includes all airborne particles, regardless of their size or composition.

Excessive dust emissions can cause both health and work place problems including:

- Health hazards
 - Occupational respiratory diseases
 - Irritation to eyes, ears, nose and throat
 - Irritation to skin
- Risk of dust explosions and fire
- Damage to equipment
- Impaired visibility and accidents
- Unpleasant odors
- Problems in community relations
- Regulatory citations and fines



Healthy Lung Contaminated Lung

Excessive or long-term exposure to harmful respirable dusts may result in a respiratory disease called pneumoconiosis. Pneumoconiosis is a general name for a number of dust-related lung diseases including:

- **Silicosis** - Silicosis is a form of pneumoconiosis caused by the dust of quartz and other silicates. The condition of the lungs is marked by nodular fibrosis (scarring of the lung tissue), resulting in shortness of breath. Silicosis is an irreversible disease; advanced stages are progressive even if the individual is removed from the exposure.
- **Black Lung** - Black lung is a form of pneumoconiosis in which respirable coal dust particles accumulate in the lungs and darken the tissue. This disease is progressive. Although this disease is commonly known as black lung, its official name is coal worker's pneumoconiosis (CWP).
- **Asbestosis** - Asbestosis is a form of pneumoconiosis caused by asbestos fibers. This disease is also irreversible.

Chemical Dust Suppression Systems

Chemical Dust suppression systems can be used to reduce dust emissions. Although installing a dust control system does not assure total prevention of dust emissions, a well-designed dust control system can further protect workers and often provide other benefits such as:

- Reducing cleanup and maintenance costs
- Reducing equipment wear, especially for components such as bearings and pulleys on which fine dust can cause a "grinding" effect and increase wear or abrasion rates
- Increasing worker morale and productivity
- Assure continuous compliance with existing health and environmental regulations
- Increase plant availability and reliability
- Reduce plant water use relative to water only systems

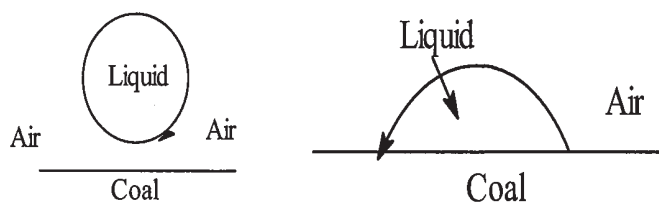
Proper planning, design, installation, operation, and maintenance are essential for an efficient, cost-effective, and reliable chemical dust suppression system. Applications for chemical dust suppression systems in the coal yard include:

- Coal transfer points
- Coal pile and car top residual, sealers & encrusting agents
- Haul road dust control
- Flow enhancers
- Washdown systems
- Yard spray systems

Application Issues

Surface Tension

Coal dust suppression is a complex phenomena; necessitating the use of surface active agents. Coal is water hating (hydrophobic), repelling water from the coal surface. In order to make the coal surface less hydrophobic, a surface active material is added to the water. The surface active material lowers the surface tension of the water to a value closer to that of the coal allowing it to be adsorbed on the surface of the coal. The water, by adsorbing on the coal surface, renders it less hydrophobic. The following figure depicts the phenomena.



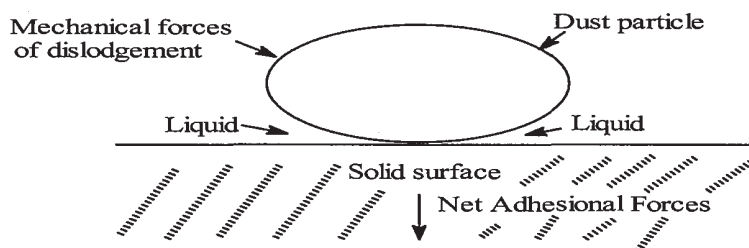
Untreated coal on the left and wet coal on the right.

The surface active agent forms a microscopic liquid film as a means of increasing the adhesion of the coal dust particles. An effective dust suppressant must wet (making it less water hating) the surface of the coal, maintaining a moist environment, and bind the coal dust particles to the coal to prevent regeneration of the dust. Benetech offers a full range of optimized dust suppression products based on our expertise in surface science. These non-flammable, non-toxic, non-explosive and biodegradable products can be used to suppress dust via wetting, foaming, residual, or emulsification processes.

By evaluating contact angles and spreading coefficients of numerous surfactant molecules, Benetech has identified the structure/ property relationships of commercial surfactants and their interaction, contributing to optimum wetting and adhesion. All Benetech formulations contain synergistic combinations of wetting agents, necessary for providing fast, efficient, and effective dust suppression as well as agents to enhance foam quality and overcome problems associated with hard or brackish waters.

The figure below depicts the adsorption and adhesion phenomena associated with effective dust suppression. The wetting of the coal involves the displacement of air from

the surface by a liquid; namely, water or an aqueous solution. The addition of a surfactant to the water, by reducing the surface tension of water and perhaps the interfacial tension between the water and the coal particle making spontaneous spreading possible. This occurs in three steps involving adhesion (solid liquid interface at the expense of both liquid - gas and solid - gas) spreading (formation of liquid - gas and liquid - solid at the expense of solid - gas) and immersion (solid - gas interface is replaced by a solid - liquid) wetting.



Adsorption and adhesion phenomena associated with effective dust suppression.

Effective wetting of the coal dust can be achieved by-

- **Static Spreading** - The material is wetted while stationary. Important factors include the diameter and contact angle of water droplets. In general, surface coverage can be increased by reducing either the contact angle or droplet diameter.
- **Dynamic Spreading** - The material is wetted while moving. The droplet impact velocity, surface tension of the liquid, the material size, and the droplet diameter are important variables in dynamic spreading. The surface coverage can be increased by increasing the surface coverage can be achieved either by reducing the surface tension or by increasing the impact velocity.

Both static and dynamic spreading of a droplet can be increased by reducing the surface tension and thus decreasing the droplet diameter. However, the impact velocity of smaller droplets decreases faster due to frictional drag and less momentum, which, in turn, reduces dynamic spreading. An optimum droplet diameter for maximum material surface coverage must therefore be determined.

Factors Affecting Surface Wetting

Droplet Size

Surface wetting can be increased by reducing the droplet diameter and increasing the number of droplets. This can be achieved by reducing the surface tension/contact angle. The surface tension of pure water is 72.6 dyne/cm. It can be reduced from 72.6 to 28 dyne/cm by adding minute quantities of surfactants. This reduction in surface tension (or contact angle) results in-

- Reduced droplet diameter
- An increase in the number of droplets

- A decrease in the contact angle

Impact Velocity

Surface wetting can be increased by increasing the impact velocity. Impact velocity can be increased by increasing the system's operating pressure. Due to the frictional drag of the turbulent air, the impact velocity of the droplet is less than its discharge velocity from the nozzle. Smaller droplets lose velocity faster than larger ones. To cover the greatest surface area, the best impact velocity for a given droplet diameter must be determined for each operation.

Factors Affecting Collision

The collision between dust particles and water droplets occurs due to the following three factors:

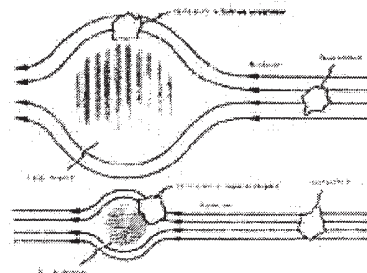
- Impaction/interception
- Droplet size/particle size
- Electrostatic forces

Impaction/Interception

When a dust particle approaches a water droplet, the airflow may sweep the particle around the droplet or, depending on its size, trajectory, and velocity; the dust particle may strike the droplet directly, or barely graze the droplet, forming an aggregate.

Droplet Size/Particle Size

Droplets and particles that are similar in size have the best chance of colliding. Droplets or dust particles that are smaller in size relative to the particle or droplet being impacted may never collide but just be swept around one another.



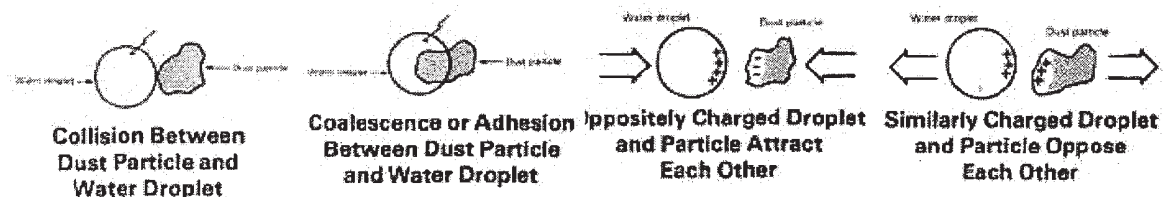
Effect of Droplet Size
Schowengerdt and Brown

Electrostatic Forces

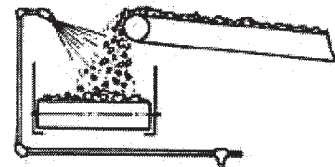
The presence of an electrical charge on a droplet affects the path of a particle around the droplet. When particles have an opposite or neutral charge, collision efficiency is increased.

Airborne Dust Capture

When fine droplets are sprayed into the airborne dust, the droplets and dust particles collide and agglomerates are formed. When these agglomerates become too heavy to remain airborne, they settle. Wetting the bulk material also lowers the tendency to generate dust. Keeping the material damp immobilizes the dust, and very little material becomes airborne.



Finely atomized water sprays are normally used at transfer points without excessive turbulence or when the velocity of dust dispersion is less than 200 ft/min. The optimum droplet size, water usage, relative velocity, and number and location of nozzles depend on the conditions at individual transfer points.



Wet Dust Suppression System

Types of Dust Suppression Systems

Chemical Dust Suppression Systems fall into four broad categories:

- **Water Sprays with Surfactant** - This method uses surfactants to lower the surface tension of water. The droplets spread further and penetrate deeper into the coal. Surfactants can also be used to reduce the friction factor between wet coal particles and transfer surfaces to mitigate pluggage issues.
- **Foam** - Water and a special blend of surfactant make the foam. The foam increases the surface area per unit volume, which increases wetting efficiency.
- **Water Sprays with Binders, Humectants, and Surfactants** - This method uses a binder to create a longer residual suppression effect. The purpose of the humectant is to retard the moisture evaporation process. The surfactant enhances wetting.
- **Emulsions** - Emulsions of water and surfactants are used to suspend normally immiscible binders to create a residual effect suppressant. Oil and latex based emulsions are examples of suppression agents used as car top and pile sealers and road haul suppressants.

Suppression Chemicals

Based on its' expertise in surface science, Benetech offers a wide range of optimized dust suppression products in all of the above categories. These products are non-flammable, non-toxic, non-explosive and biodegradable and can be used to suppress dust via either foam or wetting action.

Coal dust suppression is a complex phenomena; necessitating the use of surface active agents. Coal is water hating (hydrophobic), repelling water from the coal surface. In order to make the coal surface less hydrophobic, a surface active material is added to the water. The surface active material lowers the surface tension of the water to a value closer to that of the coal allowing it to be adsorbed on the surface of the coal. The water by adsorbing on the coal surface renders it less hydrophobic.

The surface active agent forms a microscopic liquid film as a means of increasing the adhesion of the coal dust particles. An effective dust suppressant must wet (making it less water hating) the surface of the coal, maintaining a moist environment, and bind the coal dust particles to the coal to prevent regeneration of the dust. By evaluating contact angles and spreading coefficients of numerous surfactant molecules, Benetech has

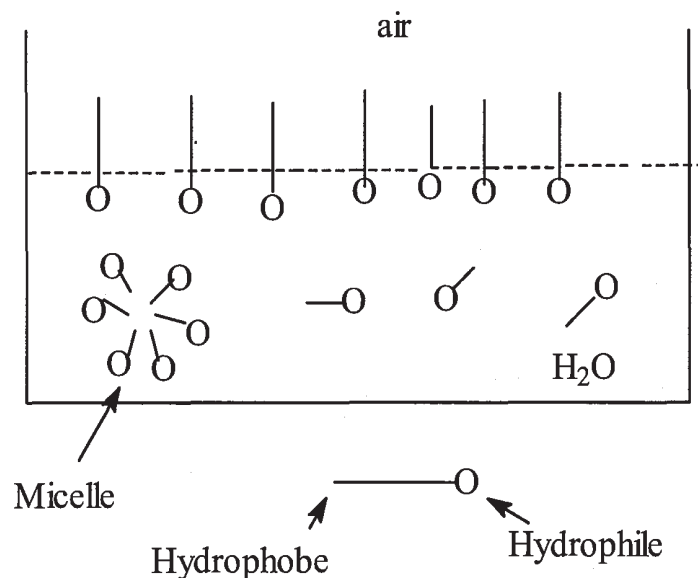
identified the structure/ property relationships of commercial surfactants and their interaction, contributing to optimum wetting and adhesion. All Benetech formulations contain synergistic combinations of wetting agents, necessary for providing fast, efficient, and effective dust suppression for a variety of coal types under both hard and brackish water conditions.

Wetters

Coal, a hydrophobic substance, is difficult to be wet with hydrophilic water. In order to wet the surface of coal a surface active agent that lowers the coal air/ air water surface tension is required. A surfactant is a material that, when present at low concentration in a system, has the property of adsorbing onto the surface of the system and of altering to a marked degree the surface properties of the system. A surfactant molecule is a molecule containing two diverse groups. It is composed of a hydrophilic (water loving) head and a hydrophobic (water hating) tail. Two fundamentally dissimilar groups within a single molecule is the most fundamental characteristic of a surfactant. The surface activity is determined by the structural makeup of the two groups. Water is a highly structured substance because of the strong hydrogen bonds between hydrogen and oxygen. When added to water the hydrophobic tail is incompatible and is rejected by the water and is ejected to the surface or interface where it forms a monolayer, thereby lowering the surface tension (See Figure). If the molecule did not contain the water loving head, it would be completely ejected and form a separate immiscible phase. Upon saturation of the solid/ air interface the surfactant forms micelles in the water solution. The concentration of the surfactant at which micelles begin to form is known as the critical micelle concentration (CMC).

The most common hydrophobe is a hydrocarbon, specifically an eight to eighteen carbon chain. The hydrophile can be anionic, cationic or nonionic. Surfactants in which the hydrophilic moiety is a sulfate or sulfonate are anionic. When the hydrophilic group is a polyether group the surfactant is nonionic.

Wet dust suppression requires the formation of microscopic liquid films as a means of increasing the adhesion of coal dust particles through hydrogen bonding. The wetting agent, because of the large surface area must adsorb on the coal particles spontaneously and efficiently. This requires the surfactant to be a highly branched and symmetrical molecule such that it diffuses rapidly from the hydrophilic water environment to the interface where it is adsorbed at the coal/air interface. The highly branched hydrophobe makes micelle formation difficult, hence increasing the number of monomers in solution making diffusion to the interface more rapid and promoting better wetting.



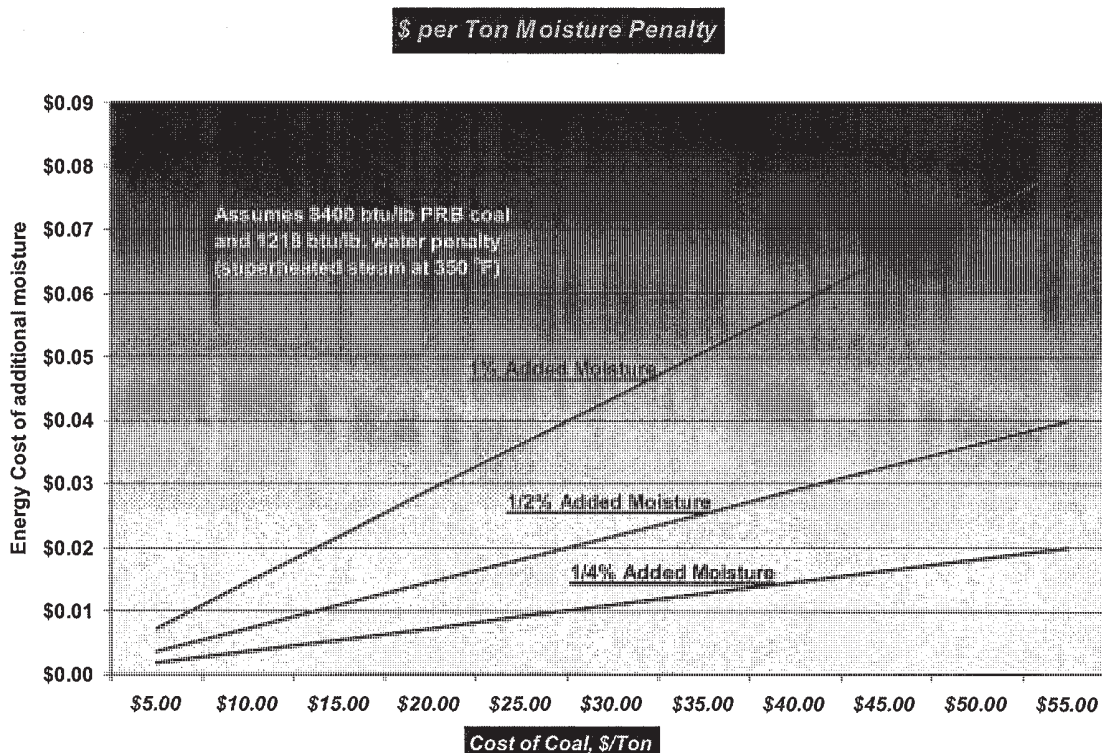
Foamers

Aqueous foamable compositions can be used to suppress coal dust particles. A unique property of foam is its ability to blanket a mass of coal, thereby forming a physical barrier against the dispersion of dust. The foam barrier makes it difficult for the coal dust particles to get airborne. It is preferable to trap the particles before they get airborne. Foam suppression is useful in situations where the quantity of available water is limited or it is desirable to limit the amount of water applied to the coal. The penalty for excess water addition is presented in the following Figure.

Foaming agent formulations frequently contain a wetting agent and a polymer to give body to the foam and reduce the chances of the coal particles becoming airborne after the foam has collapsed. The foam generated is preferably a small bubble foam (100 to 200 microns) allowing efficient trapping of dust particles. A stream of foam interacts with coal particles especially the larger fines. When the foam bubbles impact the coal dust particles, the particles are wetted by the imploding bubbles and captured. Many fine droplets are also released from the collapsing foam, which scrub more fine coal particles. The same principles governing the interaction of coal dust particles with surfactant solutions also govern their action with foam systems.

Foam is a non-equilibrium dispersion of gas bubbles in a relatively smaller volume of liquid. Pure liquids do not foam. Foam is produced when a gas is introduced into a solution whose surface film has viscoelastic properties. The resulting foam possesses a honeycomb arrangement. An essential ingredient in liquid based foam is surface active molecules. These materials reside at the air/ liquid interface and are responsible for both the tendency of a liquid to foam and the stability of the resulting dispersion of gas bubbles. Just as surfactants self-organize (form micelles) in the bulk solution as a result of their hydrophilic and hydrophobic segments, they also preferentially adsorb and

organize at the solution – vapor interface. In the case of the aqueous surfactant solution, the tails protrude into the vapor and leave only the hydrophilic heads in contact with the solution. The favorable energetics of the arrangement can be observed and measured by the reduction in the interfacial surface tension. The surfactant concentration is at or slightly above the CMC in most optimized foam situations. At concentrations below the CMC the liquid/ air surface is not saturated and the foam effectiveness is reduced. At concentrations considerably above the CMC the solution loses its film elasticity and the bubbles will collapse. While, the reduced surface tension is not in itself responsible for the foaming; the primary benefit is that less mechanical energy need be supplied to create the large interfacial area in foam.



Many factors promote foam formation. Low equilibrium surface tension, the smaller the cross sectional area the molecule occupies at the air/liquid interface the lower the surface tension and the closer packed the film. A high bulk phase viscosity promotes a slow draining rate for the bubbles and hence more foam. A moderate surface phase viscosity, a moderate rate of attaining equilibrium surface tension and presence of electrical double layer in the surface film also contribute to increased foam. The design of an efficient foam dust suppressant formulation requires a delicate balance of foam wetting properties, as well as consideration of water hardness.

Residual Suppressants

In order to maintain the suppression of the dust for long periods of time, a polymeric hydrophilic material is added. The polymer whether it is anionic or nonionic forms mixed micelles and mixed monolayers with the primary wetting agent. The mixed monolayers are then adsorbed onto the coal. The high molecular weight polymeric material effectively forms a shield preventing the escape of the moisture and ensures that dust particles remain stuck or adhered to each other and to the bulk coal. The polymer also acts as a nucleating agent allowing the micelles to more efficiently form and holding them in the area of the coal. Due to the large molecular weight of the polymers and the presence of hydrophilic groups, they can bind with several coal particles increasing the effective density of the coal particles preventing dusting. Typical polymers include compounds such as ligninsulfonate and polyacrylamides. It is thought that polyacrylamides may serve to reduce the rate of evaporation of water and thereby extend the life of the treatment. In addition to ligninsulfonates, a wide range of other binding agents has been used for long term coal dust control. These major classes of binders include:

- Polymer solutions
- Polymer emulsions
- Oils and oil emulsions
- Asphalt and asphalt emulsions

Humectants

Residual dust suppressant systems must also maintain the moisture content to prevent regeneration of dust. Consequently, the Benetech formulation contains both a humectant and a binder. The humectant is a water loving material which forms strong hydrogen bonds with water making its removal from the system difficult. When humectants are used alone, such as salts (commonly used for haul road dust control), they have to be used in large amounts. Commonly employed salts include calcium, magnesium, and sodium chlorides and their mixtures. Surfactants are frequently combined with hygroscopic salts to improve the extent of coal dust capture and binding.

Emulsions

Polymer Emulsions

The largest single application of polymer emulsions is for pile sealing and railcar top coating prior to shipment to prevent dust formation and coal loss from the car tops. Latex emulsions, similar to those used in the paint industry are typically deployed. Surfactants are usually added to improve its coal wetting ability.

Asphalt and Asphalt Emulsions

Asphalt or asphalt emulsions have also been used in coal dust control. The use of an asphalt emulsion, in combination with surfactants to wet the coal rapidly, has also been used for rail car top coating and stackout pile sealing. An interesting aspect of these emulsions is their ready ability to "break". Certain surfactant solutions can be used to pre-wet the coal, so that a subsequently applied asphalt emulsion will break to leave a dust suppressing film on the coal surface.

Oils and Oil Emulsions

The use of oil as a coal surface treatment has a long history. Not only does a thin oil film provide an antidusting effect, it also adds heating value to the coal and improves the coal's bulk density – a factor of importance in coke making. Oil emulsions have the advantage that they can be diluted with water for better dispersion. Oil-soluble surfactants can also improve the antidusting properties of oils for treating coal. Oil emulsions can also “break” when they come into contact with certain surfactants.

Laboratory Testing

The effectiveness of a surfactant in modifying the wetting properties of a liquid can be evaluated by determining the spreading coefficient of the surfactant solution. This can be done by measuring both the surface tension of the surfactant solution, and the contact angle the solution makes with the substrate. The Walker and “Drop Box” test represent other common methods for evaluating surfactant effectiveness. The Walker test, first proposed by Walker and co-workers in 1952 was the first laboratory procedure to measure coal dust wetting. In this procedure, approximately 1 gram (1/4 teaspoon) of <200 mesh coal is gently floated on the surface of an aqueous solution of water plus the wetting agent. The time it takes for the coal dust to completely sink is measured and reported. Pure water shows wetting times measured in hours, where even small concentrations of some wetting agents will give wetting times of less than five minutes. This test is useful for evaluating in the laboratory the effectiveness of a given wetting or residual formulation. There is a strong inverse correlation between wetting time and initial dust suppression.

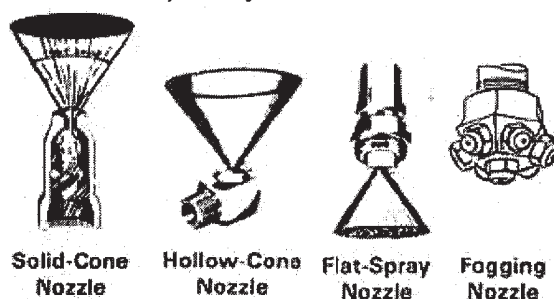
Surfactants are also known to interact with each other producing synergistic enhancement of wetting effects. Wetting agents, especially anionic and nonionic surfactants exhibit synergistic behavior, promoting a more rapid diffusion to the wetting front. Preferred surfactant systems have an optimized ratio of several surfactants. By using mixtures of surfactants one can use less surfactant than would be required for a single surfactant system.

Design of a Water-Spray System

Dust particles need to be trapped in the air and before they become airborne. An important factor in trapping air borne dust particles is the droplet size of the sprayed formulation. Droplets with a clean surface have higher capture efficiencies for dust particles than droplets already containing a trapped particle. The best surfactant system will rapidly remove the trapped dust particle to the interior of the droplet. Consequently, a coarse droplet will more efficiently capture dust than a smaller droplet. The droplet size must also be optimized with the surfactant wetting system for effective suppression. It is easiest and most desirable to knockdown the coal dust particles before they become airborne. This is accomplished by the wet dust suppression formulations.

The spray nozzle is the heart of a water-spray system. Therefore, the physical characteristics of the spray are critical. Factors such as droplet size distribution and velocity, spray pattern and angle, and water flow rate and pressure all vary depending on the nozzle selected. Following is a general discussion of these important factors:

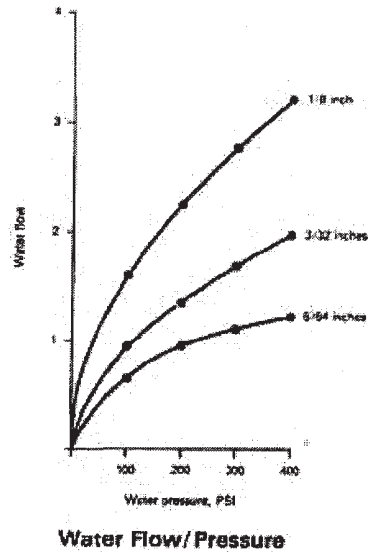
- **Droplet Size**- The nozzle's droplet size distribution is the most important variable for proper dust control. The droplet size decreases as the operating pressure increases. Information about the droplet size data at various operating pressures can be obtained from the nozzle manufacturer. For wet dust suppression systems, coarse droplets (200-500 μm) are recommended. For airborne dust capture systems, very fine droplets (10-150 μm) may be required. The fine droplets usually are generated by fogging nozzles, which may use either compressed air or high-pressure water to atomize water in the desired droplet range.
- **Droplet Velocity** - Normally, higher droplet velocities are desirable for both types of dust control through water sprays. Information on the droplet velocity can be obtained from the nozzle manufacturer.
- **Spray Pattern** - Nozzles are categorized by the spray patterns they produce:
 - Solid-cone nozzles product droplets that maintain a high velocity over a distance. They are useful for providing a high-velocity spray when the nozzle is located distant from the area where dust control is desired.
 - Hollow-cone nozzles produce a spray patten in the form of circular ring. Droplet range is normally smaller than the other types of nozzles. They are useful for operations where dust is widely dispersed.
 - Flat-spray nozzles produce relatively large droplets that are delivered at a high pressure. These nozzles are normally useful for wet dust suppression systems.
 - Fogging nozzles produce a very fine mist (a droplet size distribution ranging from submicron to micron). They are useful for airborne dust control systems.



- **Spray Angle** - Each nozzle has a jet spray angle. The size of this angle is normally available from the manufacturer. A knowledge of spray angle and spray pattern is essential to determine the area of coverage and, therefore, the total number of nozzles needed.
- **Flow Rate** - The flow rate of water through a nozzle depends on the operating pressure. The flow rate and operating pressure are related as follows:

$$\text{Water flow rate} = K \sqrt{\text{operating pressure}}$$

where K = nozzle constant



Knowledge of the water flow rate through the nozzle is necessary to determine the percentage of moisture added to the material stream. The following factors should be considered in selecting the nozzle location:

- It should be readily accessible for maintenance.
- It should not be in the path of flying material.
- For wet dust suppression systems, nozzles should be **upstream** of the transfer point where dust emissions are being created. Care should be taken to locate nozzles for best mixing of material and water. For airborne dust capture, nozzles should be located to provide **maximum time** for the water droplets to interact with the airborne dust.

Water Flow and Compressed Airflow Rates

Once the nozzle is selected, its spray pattern and area of coverage can be used to determine water flow rate and/or compressed airflow rates and pressure requirements. These must be carefully coordinated with the maximum allowable water usage. Water flow rates will be highly variable depending on the size and type of coal, the application location, and the throughput of coal.

Piping Design

The piping should be designed so that each nozzle receives water or compressed air at specified flow rates and pressures. Drains must be provided at the lowest point in each sub circuit of the piping system to flush the air and water lines in winter months. Heat trace and insulation must also be provided at locations where the temperature may drop below 32° F. The heat tracing should be able to provide approximately 5 watts per linear foot for water pipes up to 2 in. in diameter. The pump and other hardware, such as valves and gauges, should also be placed in a heated enclosure or heat traced and insulated to prevent freezing during winter months.

Instruments

Pressure and flow gauges are recommended to monitor system performance. These instruments should be located as close to the point of application as possible. For situations where it is desirable to activate wet suppression systems only when the material is flowing (for example, if the belt conveyor is running empty, water sprays need not be on), a solenoid-activated valve may be installed in the water line. The solenoid can be activated by instruments such as the level controller or zero speed switch. This approach will reduce water usage, reduce maintenance and cleanup, and reduce or prevent freeze up problems. It is important that electrical, control, and instrumentation meet local condition electrical code requirements. This is typically NEMA 4/9 and Class 2, Div 1, Groups F for dust.

Application Locations

Chemical dust suppressants can be used to control dust at a number of locations. These include:

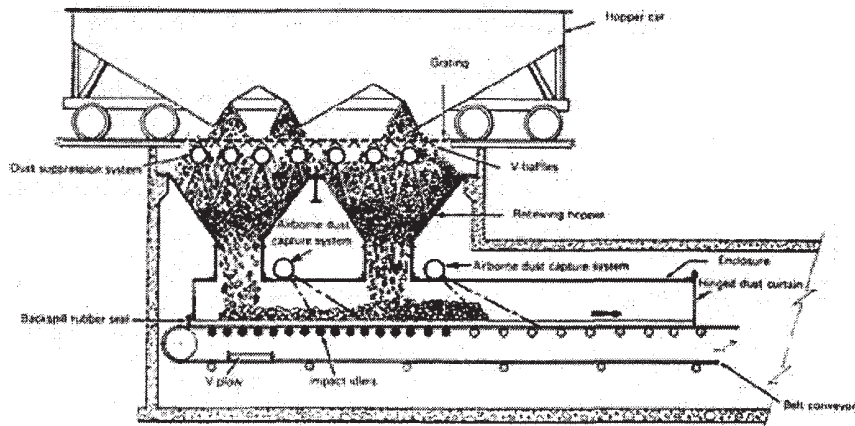
- Coal Transfer Points
- Coal Pile, Car Top, Residual, Sealers and Encrusting Agents
- Haul Road Dust Control
- Flow Enhancers
- Washdown Systems
- Yard Spray Systems
- Flyash Pug Mills

Selection of the application points will be based on a number of factors such as degree of needed dust control, need for downstream dust control, desire for residual control especially on piles and haul roads, restriction on water use, proper spray access to material, availability of support utilities (i.e., water, air, electricity), ease of support equipment placement (i.e., sheds, chemical storage tanks), and length of required supply piping.

In the coal yard, typical application locations include:

- Rail unloading system hopper area
- Barge unloading system hopper area
- Trestle rail unloading area
- Truck / payloader unloading hopper area
- Hopper reclaim feeders/transfer points
- Transfer chutes within towers
- Prior to stackout for stackout dust control as residual dust control from piles
- Bucket reclaim area on stacker / reclaimers
- Yard spray systems to provide residual effectiveness
- Sizing and crushing areas
- Washdown systems to enhance cleaning and reduce water consumption
- In chute areas to reduce wet coal pluggage
- At trippers, cascade, and reversing decks to control dust emissions within the plant and in bunkers and silos

The following diagram presents a typical chemical dust suppression arrangement at a bottom dump rail unloading system. As with all applications, site specific conditions will influence exact spray nozzle header locations to maximize contact with airborne dust and the bulk coal material. Good chemical dust suppression systems can reduce dust levels over 90%, reduce respirable dust below OSHA requirements of $2.0 \mu\text{m}/\text{m}^3$, and maintain opacity levels below 10%.



Railroad Dump to Conveyor

