# HOW FORMULATED DUST SUPPRESSANTS FUNCTION

## Overview

Dust can create problems that impact operational efficiency, impair visibility, increase accident risk, and have detrimental effects on the health of workers and the environment. To address these issues, companies in different industries use water as a dust suppression, which is a continuous and costly activity. Communities and regulatory agencies are putting pressure on companies to improve their methods of dust suppression because of the many problems dust is likely to generate.

Dust suppressants vary in their formulations and in the way they function. Some have multiple functions to reduce fugitive dust. This sheet provides an overview of the various mechanisms of how dust suppressants function and is intended to help decision makers choose the correct type of dust suppressant for their specific dust problem.


Photo courtesy of Joy

## Surface Wetting

This mechanism is the process when a liquid spreads onto a surface. An example is water spreading over an area of perfectly clean glass. The degree of wetting is a balance between two forces within the liquid. The liquid's adhesive force (attraction to another substance), encourages it to spread onto the glass while the liquid's cohesive force (attraction to the same substance) tries to form into a ball. Surfactants (also known as wetting agents) have a direct effect on these forces. Surfactants increase the adhesive force and lower the cohesive force which allows the liquid to easily spread. The effects any surfactant has on these forces can be measured by determining the surface tension of the liquid. Dust suppressants used during longwall operations have multiple functions including surface wetting.

## Minimizing Liquid Droplet Size

This mechanism is primarily used when airborne dust must be controlled at the origin of the dust source. Examples of when this mechanism is needed are dust suppressants being sprayed onto a conveyor discharge point or onto a hard mineral surface as it is being mechanically broken loose or crushed. The size of a liquid droplet is dependent on the size of the opening from which the droplet exits, and the surface tension of the liquid. As mentioned above, surface tension measurements of a liquid can determine the effect surfactants have on the liquid and droplet size. As the droplets decrease size, the smaller droplets have more surface area to attract dust in the air. This principle can be understood by comparing the surface area of one basketball to that of 100 ping pong balls. The smaller droplets reduce the chance that dust will pass by the water molecule with a slip-stream-effect.

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## Hygroscopic Performance

This mechanism is the process in which a substance absorbs water vapor from the atmosphere and allows the water to bond to dust particles. Water helps dust particles to connect to each other, to increase in weight, and become less likely to be airborne. Hygroscopic substances include sugar, glycerol, ethanol, methanol, diesel fuel and many salts. Sodium chloride, calcium chloride, and magnesium chloride are hygroscopic and will "cake" when damp, or when exposed to moist air. Dust suppressants which function by this mechanism are normally dissolved in water before being applied. As the water in the application solution evaporates, the hygroscopic substances absorb additional atmospheric moisture. Ideal conditions for this process to occur are high humidity environments. Some dust suppressants used on unpaved roads function this way.

## Bonding Dust Particles

This is an important mechanism of most dust suppressants. Bonding small dust particles together increases their collective mass and prevents them from becoming airborne. This is the way water functions when sprayed onto dust particles. Water will migrate down between fine particles, connecting them, and prevents them from becoming airborne. However, this process stops after the water evaporates. Bonding agents, such as gum resin and lignin, do this much more efficiently by acting as glue and remaining bonded to small particles.

## Film Formation

This mechanism occurs when dust suppressant ingredients bond together to form a continuous film. The film gradually forms as the carrier liquids, commonly water or another volatile liquid, evaporate over time, leaving other ingredients behind. Polymer containing dust suppressants function this way, acting as a blanket to prevent fugitive dust from becoming airborne.
As the film forms, it becomes attached to dust particles which will generate a dust particle and film matrix that prevents particles from escaping. Polymer type dust suppressants also contain coalescent additives that help the polymer particles fuse together after all of the water has evaporated.

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