



ECOLOGY S.r.l.

Via Buonarroti N. 43/A

IT-20064 Gorgonzola (MI)



Fog Cannon Field Concepts:

Hygroscopy is the ability of a substance to attract water molecules from the surrounding environment through either absorption or adsorption.

Hygroscopic substances include sugar, honey, glycerol, ethanol, methanol, sulfuric acid, methamphetamine, iodine, many chloride and hydroxide salts, and a variety of other substances. Sodium chloride is not hygroscopic. The hygroscopy of table salt is caused by traces of magnesium chloride or other innocuous impurities.[citation needed]

Zinc chloride and calcium chloride, as well as potassium hydroxide and sodium hydroxide (and many different salts) are so hygroscopic that they readily dissolve in the water they absorb: this property is called deliquescence (see below). Sulfuric acid is not only hygroscopic in high concentrated form, its solutions are hygroscopic down to concentrations of 10 Vol-% or below.

Because of their affinity for atmospheric moisture, hygroscopic materials may need to be stored in sealed containers. When added to foods or other materials for the express purpose of maintaining moisture content, such substances are known as humectants.

Materials and compounds exhibit different hygroscopic properties, and this difference can lead to detrimental effects, such as stress concentration in composite materials. The amount a particular material or compound is affected by ambient moisture may be considered its coefficient of hygroscopic expansion (CHE) (also referred to as CME, coefficient of moisture expansion) or coefficient of hygroscopic contraction (CHC)—the difference between the two terms being a difference in sign convention and a difference in point of view as to whether the difference in moisture leads to contraction or expansion.

Deliquescent materials are substances (mostly salts) that have a strong affinity for moisture and will absorb relatively large amounts of water from the atmosphere if exposed to it, forming a liquid solution. Deliquescent salts include calcium chloride, magnesium chloride, zinc chloride, potassium carbonate, potassium hydroxide, carnallite and the strong base sodium hydroxide. Due to their very high affinity for water, these substances are often used as desiccants, which is also an application for concentrated sulfuric and phosphoric acids. These compounds are used in the chemical industry to remove the water produced by chemical reactions, to increase the yields.

Hydrophobicity (from the combining form of water in Attic Greek hydro- and for fear phobos) refers to the physical property of a molecule (known as a hydrophobe) that is repelled from a mass of water [1].

Hydrophobic molecules tend to be non-polar and thus prefer other neutral molecules and nonpolar solvents. Hydrophobic molecules in water often cluster together forming micelles. Water on hydrophobic surfaces will exhibit a high contact angle.

Examples of hydrophobic molecules include the alkanes, oils, fats, and greasy substances in general. Hydrophobic materials are used for oil removal from water, the management of oil spills, and chemical separation processes to remove non-polar from polar compounds.

Hydrophobic is often used interchangeably with lipophilic, "fat loving." However, the two terms are not synonymous. While hydrophobic substances are usually lipophilic, there are exceptions — the silicones, for instance.

Surfactants are wetting agents that lower the surface tension of a liquid, allowing easier spreading, and lower the interfacial tension between two liquids.

The term 'surfactant' is a blend of "surface acting agent". Surfactants are usually organic compounds that are amphiphilic, meaning they contain both hydrophobic groups (their "tails") and hydrophilic groups (their "heads"). Therefore, they are soluble in both organic solvents and water. The term surfactant was coined by Antara Products in 1950.

In Index Medicus and the United States National Library of Medicine, "surfactant" is reserved for the meaning *pulmonary* surfactant (see "alveoli" link below). For the more general meaning, "surface active agent" is the heading.

Telefono +39.02.95383831
Fax +39.02.95383813
e-mail mpassoni@ecology.it
web site www.ecology.it



Partita. Iva e Codice Fiscale
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The most common biological example of surfactant is that coating the surfaces of the alveoli, the small air sacs of the lungs that serve as the site of gas exchange.

Surfactants reduce the surface tension of water by adsorbing at the liquid-gas interface. They also reduce the interfacial tension between oil and water by adsorbing at the liquid-liquid interface. Many surfactants can also assemble in the bulk solution into aggregates. Examples of such aggregates are vesicles and micelles. The concentration at which surfactants begin to form micelles is known as the critical micelle concentration or CMC. When micelles form in water, their tails form a core that can encapsulate an oil droplet, and their (ionic/polar) heads form an outer shell that maintains favorable contact with water. When surfactants assemble in oil, the aggregate is referred to as a reverse micelle. In a reverse micelle, the heads are in the core and the tails maintain favorable contact with oil. Surfactants are also often classified into four primary groups; anionic, cationic, non-ionic, and zwitterionic (dual charge).

Thermodynamics of the surfactant systems are of great importance, theoretically and practically. This is because surfactant systems represent systems between ordered and disordered states of matter. Surfactant solutions may contain an ordered phase (micelles) and a disordered phase (free surfactant molecules and/or ions in the solution).

Ordinary washing up (dishwashing) detergent, for example, will promote water penetration in soil, but the effect would only last a few days (although many standard laundry detergent powders contain levels of chemicals such as sodium and boron, which can be damaging to plants, so these should not be applied to soils). Commercial soil wetting agents will continue to work for a considerable period, but they will eventually be degraded by soil micro-organisms. Some can, however, interfere with the life-cycles of some aquatic organisms, so care should be taken to prevent run-off of these products into streams, and excess product should not be washed down gutters.

Surfactants play an important role in many practical applications and products, including:

- Detergents
- Fabric softener
- Emulsifiers
- Paints
- Adhesives
- Inks
- Anti-fogging
- Soil remediation
- Wetting
- Ski wax



- Deinking (particularly during the enzymatic deinking of used paper during the recycling and repulping process)
- Snowboard wax
- Foaming
- Defoaming
- Laxatives
- Agrochemical formulations
 - Herbicides
 - Insecticides
- Quantum dot coating
- Biocides (sanitizers)
- Hair conditioners (after shampoo)
- Spermicide (nonoxynol-9)
- Used as an additive in 2.5 gallon fire extinguishers
- Pipeline, Liquid drag reducing agent
- Alkali Surfactant Polymers (used to mobilize oil in oil wells)

Surfactants are also naturally secreted by type II cells of the lung alveoli in mammals.

A surfactant can be classified by the presence of formally charged groups in its head. A non-ionic surfactant has no charge groups in its head. The head of an ionic surfactant carries a net charge. If the charge is negative, the surfactant is more specifically called anionic; if the charge is positive, it is called cationic. If a surfactant contains a head with two oppositely charged groups, it is termed zwitterionic.

Some commonly encountered surfactants of each type include:

- Ionic
 - Anionic (based on sulfate, sulfonate or carboxylate anions)
 - Sodium dodecyl sulfate (SDS), ammonium lauryl sulfate, and other alkyl sulfate salts
 - Sodium laureth sulfate, also known as sodium lauryl ether sulfate (SLES)
 - Alkyl benzene sulfonate
 - Soaps, or fatty acid salts
 - Cationic (based on quaternary ammonium cations)
 - Cetyl trimethylammonium bromide (CTAB) a.k.a. hexadecyl trimethyl ammonium bromide, and other alkyltrimethylammonium salts



- Cetylpyridinium chloride (CPC)
- Polyethoxylated tallow amine (POEA)
- Benzalkonium chloride (BAC)
- Benzethonium chloride (BZT)
- Zwitterionic (amphoteric)
 - Dodecyl betaine
 - Dodecyl dimethylamine oxide
 - Cocamidopropyl betaine
 - Coco ampho glycinate
- Nonionic
 - Alkyl poly(ethylene oxide)
 - Copolymers of poly(ethylene oxide) and poly(propylene oxide) (commercially called Poloxamers or Poloxamines)
 - Alkyl polyglucosides, including:
 - Octyl glucoside
 - Decyl maltoside
 - Fatty alcohols
 - Cetyl alcohol
 - Oleyl alcohol
 - Cocamide MEA, cocamide DEA
 - Polysorbates: Tween 20, Tween 80

Some surfactants are known to be toxic to animals, ecosystems and humans, and can increase the diffusion of other environmental contaminants ^{[1][2][3]}. Despite this, they are routinely deposited in numerous ways on land and into water systems, whether as part of an intended process or as industrial and household waste.

How does it work ?

When the Fog Cannon needs to reach performances of 90 – 95 % of efficiency we suggest to consider some additives generally dosed in proportion of 1:400, but adjusted in field as the customer experience and test.

When is needed extra catching capacity of the fog because the powder is too much hydrophobic we suggest to add surfactant, generally soap.

When is needed more permanency of moisture on the ground or on the piles of material we suggest to add deliquescent, generally salt.

When is needed a crust over the material to keep its powder down we suggest polymer glue.

Telefono +39.02.95383831
Telefax +39.02.95383813

e-mail info@ecology.it
web site www.ecology.it



For glue we intend there are many adhesive substances that are considered or commonly referred to as "glue":

- Cyanoacrylate ("Superglue", "Krazy Glue")
- Casein glue (protein glue)
- Postage stamp gum
- Cement glues:
 - Contact cement
 - Rubber cement
 - Pyroxylin cement
- Resin glues:
 - Epoxy resins
 - Acrylic resin
 - Phenol formaldehyde resin
 - Polyvinyl acetate (PVA) Includes white glue (e.g., Elmer's Glue) and yellow carpenter's glue (Aliphatic resin) (Brands include Titebond and Lepage)
 - Glue sticks (PVP or PVA based)
 - Polyester resin
 - Resorcinol resin
 - Urea-resin glue (plastic-resin)
 - Urea-formaldehyde resin
- Canada balsam
- Pastes:
 - Latex pastes
- Vegetable-based glues:
 - Mucilage
 - Starch glue
 - Soybean glue
 - Tapioca paste (commonly known as "vegetable glue")
- Wood glue
- Animal glues
 - Hide glue (flake and liquid versions)



- Bone glue
- Fish glue
- Meat glue
- Rabbit skin glue
- Horse
- Hoof glue
- Hot melt glue
 - Polyethylene hot melt
- Acrylonitrile
- Cellulose nitrate
- Latex combo
- Neoprene base
- Polysulfide
- Polyurethane
- Polyvinyl chloride (PVC)
- Rubber base
- Silicon base
- Albumin glue
- Ceramic adhesive
- Ultraviolet glue
- Solvent can bond by welding material together
 - Plastic cement