Fountainhead
MEDIA SURFACTANT

TECHNICAL INFORMATION BULLETIN

Fountainhead is a specialized long-term media surfactant formulation designed to improve and maintain uniform water movement, distribution, retention, drainage and air : water ratios in water repellent container mixes. Fountainhead incorporates a blend of two uniquely different, but highly complementary block surfactants in combination with a novel graft polymer surfactant that is capable of significantly extending the performance and efficiency envelope of Fountainhead's surfactant activity. This unique surfactant combination is ideally suited for growers looking for a longer lasting solution for water repellent container media.

Container nursery production remains a significant sector of the U.S. nursery industry. **Successful nursery transplant production is largely dependent on the quality and stability of component materials as well as the chemical and physical properties of the finished growing media**.

Media aeration and drainage are the most important consideration in container planting. There must be adequate small pore space (micropores or capillary pores) to hold water for plant uptake and sufficient larger pores (macropores or noncapillary pores) to allow exchange of air in the medium to maintain critical oxygen concentrations. Indeed, **inadequate aeration and drainage in container media is a major limiting factor in the production of container crops**.

The amount of total pore space in a root medium is inversely proportional to the bulk density. Therefore, i**n order to increase drainage and aeration in containers, growers often use organic media components with large particle sizes and aggregate materials such as perlite to increase the pore space and make the substrate texture coarser** (for drainage and aeration). To compensate for the reduction in the capacity of the coarse medium to hold water, absorbent organic materials are selected to hold water.

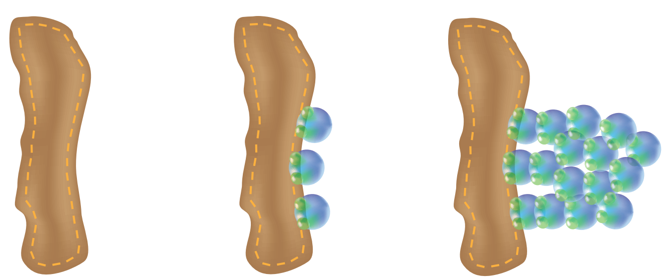
Heterogeneity

As a result of efforts to manage the dynamic nature of air : water : solid ratios, most container mixes are comprised of varying ratios of bark, sphagnum peat moss, perlite, vermiculite, sand and media components.

This **heterogeneity of components can be problematic for the grower when components age and undergo physical and chemical changes**. As changes in component substrate properties occur, dynamic properties such as the storage and flows of water and air in the root environment will change as well. Furthermore, reorganization of the solid phase of the media due to shrinking and swelling can also be expected to alter air and water bioavailability within the root environment.

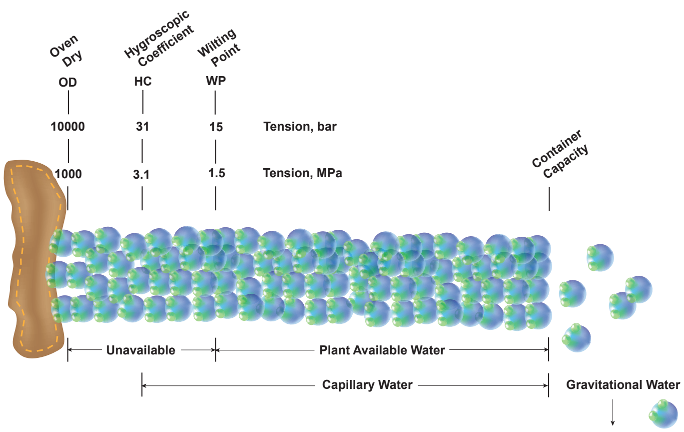
Water Movement, Retention and Drainage in Containers

When water is added to a container medium, it is drawn downward through pore spaces because of capillarity and gravity. Water moves in a "front," pushing air out of pore spaces in front of it and drawing air into pore spaces behind. **Water is retained and becomes available to the plant in the medium through adhesion (water molecules attaching to negative sites on the surface of organic solids) and cohesion (the electrostatic attraction between water molecules)**.



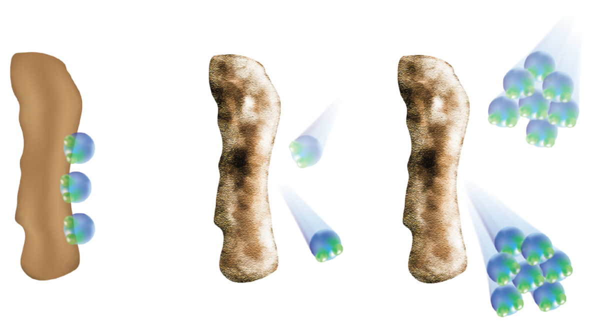
Organic Matter (with negative sites on surface) — **Adhesion** (water molecules attach to negative sites on organic matter) — **Cohesion** (water molecules attach to other water molecules)

Water builds on negatively charged organic surfaces like a series of beads. As water builds and accumulates further from the surface, cohesive forces weaken and excess water moves by gravity further down the container (gravitational water) and eventually drains out of the container. Keeping water movement, retention, drainage and aeration in balance is dependent on the attraction of polar water molecules to negatives sites on particle surfaces.



Water Repellency

Organic media components contain a number of water repellent chemicals and precursors that when exposed to dry conditions, can render areas on the surface of the organic components non-polar (without charge) -- water repellent. The low surface area of the organic materials also contributes to the ease by which they are rendered water repellent (hydrophobic). Release of these hydrophobic chemicals can also occur as organic components age and decompose.



Water molecules attaching to hydrophillic (water loving) organic medium particle

Water molecules being repelled by hydrophobic (water repellent) media particle

Clusters of water molecules being repelled by hydrophobic (water repellent) media particle

Water repellent components in the media mix compromise the root medium's physical properties. Dry, water repellent media components resist or retard water infiltration into and through the media matrix. Media water repellency also promotes run-off and the development of unstable wetting fronts and preferential flow paths.

The balance between water holding capacity and aeration in the growth medium that is essential for healthy growth is undermined by water repellency and will likely result in:

- Increased frequency and duration of watering
- Shorter intervals between irrigation
- Increased labor costs
- Non uniform crop production
- Increased hand watering

Media Surfactant Performance Loss

Although the performance and structural characteristics of surfactants can differ dramatically, they are all subject to degradation and disassociation by microbes and chemical interaction that exist in the container medium.

Once media surfactants are applied and attach to water repellent matter in the container mix, they become susceptible to microbial attack and degradation. Microbes that proliferate in the rootzone of plants treat surfactants as a viable food (carbon) source they need to provide the energy necessary to sustain life.

It is common for microbes found in container media to begin their degradation of surfactants through enzymatic cleavage of the surfactant polymer chain. This can result in the rapid separation of the hydrophobic part of the surfactant molecule that attaches to the water repellent surface of the media particle from its hydrophilic ("water loving") molecular counterpart. As a result of this separation, the surfactant performance is lost. The biodegradation sequence is usually completed with a stepwise degradation of remaining molecular chains.

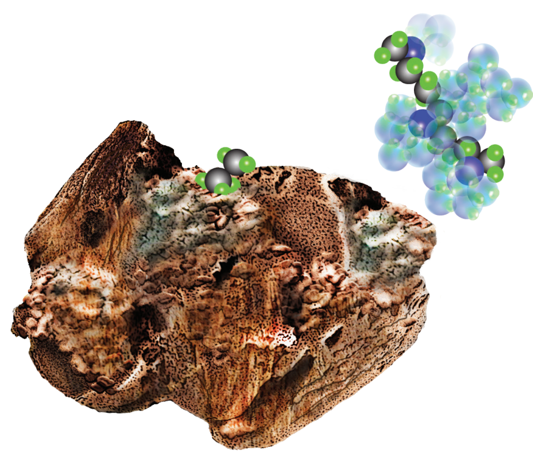


Illustration showing cleavage and disassociation of surfactant molecule from a media particle. This destroys the functionality of the surfactant and returns the site to its previous water repellent state.

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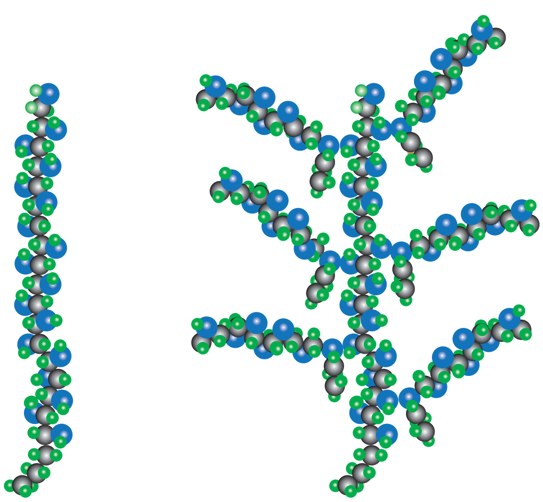
Fountainhead represents a truly innovative product at the forefront of longer lasting surfactant technologies. It combines novel surfactant structures ideally suited to extend the performance and efficiency of media over a longer period of time when compared to media treated with older soil surfactant technologies.

A New Approach to Extended Surfactant Performance and Improved Media Efficiency

At the heart of the Fountainhead surfactant technology are new copolymerization processes that allow selected surfactant candidates to be grafted onto a large fully functional surfactant parent molecule in a manner similar to branches on a tree. In Fountainhead, this branched sequence of independent copolymer surfactants is used to increase hydration characteristics of the medium as well as provide a means to compensate for microbial degradation of the surfactant's structure -- the primary cause of performance decay.



Unlike traditional surfactants technologies, whose surfactant characteristics are terminated when disassociated by the cleavage of their molecular structure, the Fountainhead formulation maintains a viable surfactant presence in the media profile much longer than traditional surfactant formulations.

Fountainhead's branched chain molecule is constructed to allow its surfactant branches to be removed from the parent surfactant molecule. The branch surfactant molecules can then attach to water repellent (non-polar) sites on media particles to establish new sites of hydration. Even when the parent surfactant molecule is stripped of its branch surfactant molecules, it will retain its surfactant characteristics.

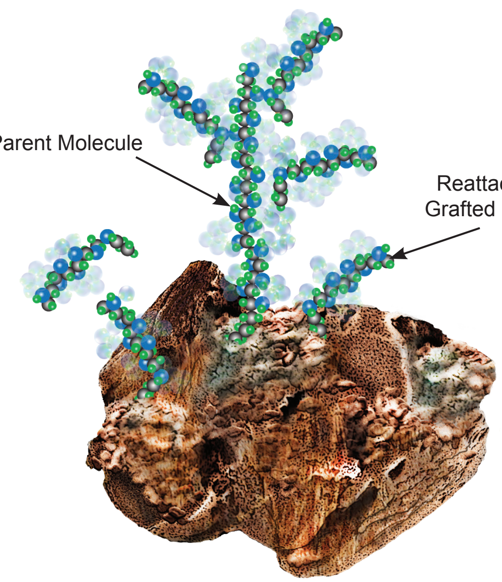


Illustration showing cleavage, disassociation and reattachment of branched copolymer surfactants on water repellent media particle surface.

Leading Edge Hydration Strategy

Addressing the Variability of the Medium's Components

The variability of the medium's components also present a problem for traditional or "older" media surfactants. Use of only a single surfactant in these formulations may not be adequate to provide acceptable hydration to various components throughout the container mix. A surfactant that demonstrates superior hydration characteristics on peat moss, may fall short in how well it and how long it works on bark, perlite or other materials in the mix.

Fountainhead makes use of an advanced combination of three surfactant technologies –two block polymer surfactants in addition to its longer lasting branch copolymer surfactant. These surfactants have been selected specifically for their unique hydration properties, their impact on water movement into and within the media and their overall contribution to improved air-to-water ratios.

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The use of a triad of surfactants in the Fountainhead formulation is a key element in the product's hydration strategy. Used in combination, these surfactants create a hydration matrix that promotes a more effective and efficient use of applied water. Truly, Fountainhead puts state-of-the-art technology to work for you for unsurpassed performance.

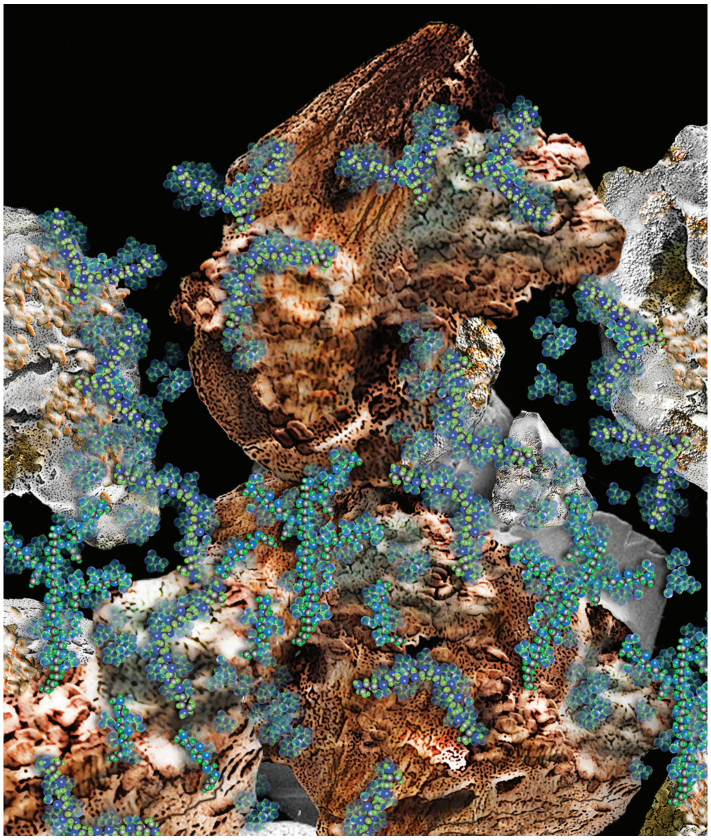

Illustration showing surfactant matrix on heterogeneous mix formed from three surfactants found in Fountainhead. Not only is hydration enhanced, but movement of water moves uniformly throughout media profile.

Growers will experience a product that gives them an exceptional, longer lasting treatment for water repellency in container mixes. Growers will find that using Fountainhead's leading edge surfactant technology will result in:

- Uniform hydration and rehydration of heterogeneous container mix components showing symptoms of hydrophobicity
- Decreased frequency and duration of watering
- Significant improvement in air : water ratios of the container medium
- More uniform plant production
- Lowers input costs and increases profitability
- Reduced labor costs
- Less leaching and runoff. Less hand watering
- Improved performance of fertilizers and pesticides

USE DIRECTIONS

General Substrate Applications: Apply Fountainhead at 2 – 4 fl oz. per cubic yard (45 – 90 ml. per cubic meter). Apply Fountainhead in enough water to ensure uniform coverage thru out the substrate. Fountainhead can be applied in 2 gallons solution per cubic yard (6 liters per cubic meter). Spray surfactant solution uniformly during blending of media.

For Harder to Wet Substrates: Apply Fountainhead at 4 – 7 fl oz per cubic yard (90 – 160 ml. per cubic meter). Thoroughly mix the Fountainhead in a 2 gallon solution per cubic yard (1.5 liter solution per cubic meter) and spray surfactant solution uniformly during blending of media.

Ornamentals Production Use Rates: When required, Fountainhead should be applied in a 400 to 600 PPM (5.1 – 7.6 fl oz. /100 gal of water or 150-225 ml. / 400 liters of water) drench procedure. Fountainhead can be reapplied at a 400 to 600 PPM drench every 6 weeks or as needed.

For Untreated Substrates or Harder to Wet Substrates during production: Apply Fountainhead at 500 to 600 PPM (6.3 – 7.6 fl oz. /100 gal of water or 190-225 ml. / 400 liters of water). Reapply Fountainhead on a 7 to 10 day intervals.

For Treatment Prior to shipment: Apply Fountainhead at 400 to 600 PPM (5.1 – 7.6 fl oz. /100 gal of water or 150-225 ml. / 400 liters of water) 1 to 2 weeks before shipment of plant material.

Fountainhead can be applied thru fertilizer and irrigation injection systems.

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