GAME CHANGER
Multi-function Soil Surfactant

Numerator Technologies is excited about the introduction of its latest soil surfactant product -- Game Changer.

Game Changer is the result of a unique new strategic surfactant formulation approach for the golf course industry designed to improve total surfactant system function -- from wet to dry moisture conditions, during temperature extremes, on variable soil types and under variable degrees of water repellency.

Game Changer was developed quite differently from surfactant products in the past. The ultimate goal was to find a surfactant system solution that would significantly change what superintendents could expect from a surfactant product.

As a result of this pursuit, golf course superintendents are now being offered Game Changer -- ***a surfactant system solution that takes their water repellency management programs from ordinary to exceptional.***

GAME CHANGER TECHNOLOGY

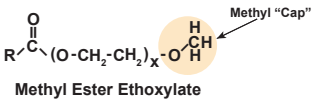
Choosing Formulation Constituents Carefully

Game Changer development started with surfactant candidates being tested and only selected if they were found to contribute to an enhanced surfactant system functional activity (such as improved hydration of sandy soil profiles, enhanced uniformity of hydration, and improved infiltration, penetration and retention of water as a consequence of irrigation or rainfall events).

Two surfactant chemistries clearly stood out. When used in combination they demonstrated exceptional and consistent improvement in the effectiveness and efficiency of substrate hydration under a wide range of environmental conditions and soil types.

Moreover, each chemistry contributed to the performance of its partner formulation constituent. These chemistries represented constructions from two leading edge surfactant classes -- "Capped" Block Surfactants and Uncapped Block Surfactants. **These two surfactants became the genesis of Game Changer.**

"Capped" Block Surfactants



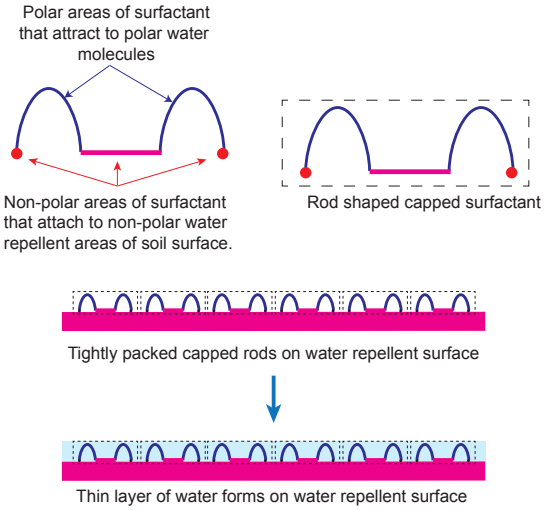
Much attention has been paid to methyl "capped" block surfactants for use on hydrophobic (water-repellent) soils.

These can be highly effective chemistries since they can form a very uniform coatings (monodispersity) of the surfactant close to the water-repellent soil surface.

This ability to form such a coating is directly related to the terminal cap reducing the tendency of the surfactant to self-assemble as complex spherical micelles. This results in the formation of rod shaped micelles with smaller hydrophilic heads.

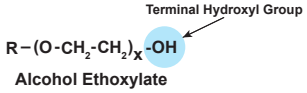
Rod-shaped molecules of capped block surfactants are often tightly packed. This can promote thin films of highly uniform levels of hydration within the soil profile.

CAPPED SURFACTANT



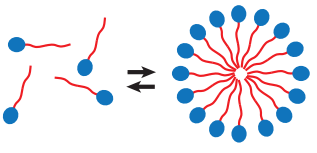
It has also be shown that capped block surfactants promote favorable air-to-water ratios in the soil profile (particularly in soils with higher clay content that generally contain smaller pore space dimensions).

"Uncapped" Block Surfactants



Uncapped block surfactants (alcohol ethoxylates) are routinely deployed to remediate soil water repellency resulting in enhanced infiltration, penetration and movement of water through the soil profile. They also are known to provide/improve water holding capacity in the soil profile.

Micelles can be formed of both monomer rods or larger spherical shapes depending on the concentration of the surfactant in the soil solution. Monomers can leave or enter other micelles.



These surfactants move easily within the bulk soil solution, dispersing to various sites and can change their form within the soil profile.

These uncapped surfactants are inherently more water soluble than capped block surfactants because they retain a terminal hydrophilic (water loving) hydroxyl group (versus the terminal methoxy group of methyl ester ethoxylates).

For this reason, they offer significant opportunities to strengthen surfactant formulations with desirable characteristics that include enhanced infiltration, penetration and retention of applied water and/or rainfall events.

THE DYNAMICS OF A BALANCED FUNCTION SURFACTANT SYSTEM

Performance Issue with "capped" surfactants:

Uniform hydration and improved air-to-water ratios are characteristic of capped block surfactants in soil profiles with higher clay percentages and small pore size.

*However, there have been reports that **sandy soil profiles (with adequate pore size and good air to water ratios) treated with methyl capped products may be subject to water and temperature stress.***

Issues of insufficient water availability and soils that are just too dry in sandy soils treated with methyl capped surfactants is often explained as due to the capped surfactant's smaller water holding (hydrophilic) heads.

Game Changer's Balanced Function:

Micelles of uncapped block surfactants with large water loving heads (hydrophilic) move easily within the bulk soil solution and disperse to various sites within the soil profile. They offer significant opportunities to strengthen surfactant formulations with desirable characteristics that include enhanced infiltration, penetration and retention of applied water and/or rainfall events.

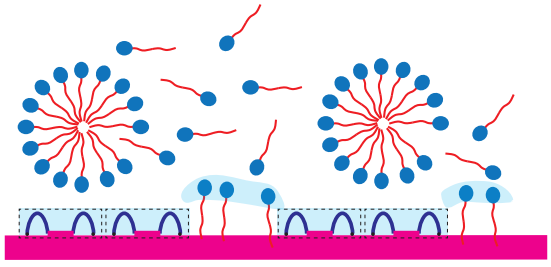
Combining the optimum ratio of capped block surfactant to uncapped block surfactant in Game Changer provides significant improvement in the uniformity, amount of hydration and air-to-water ratios under variable soil profiles and environmental extremes. Self-assembled uncapped block surfactants also can provide an enhanced vehicular transport of the capped surfactants due to their high water solubility.

Performance Issue with "uncapped" surfactants:

Block surfactants can exist as monomers (forming oriented interfacial monolayers) or can self-assemble (aggregate) into larger water holding complexes called micelles only if their concentration in the soil solution is sufficiently high).

Game Changer's Balanced Function:

Capped block surfactants cannot form large spherical micelles so their rod-like structures "pack" tightly on the water repellent soil surface. ***"Packing" promotes a higher concentration of uncapped block surfactants in this area and thus encourages micelle formation. Increased micelle formation of the uncapped block surfactants improve their hydration performance and also serve to remedy issues of water availability in soils under summer stress conditions. Monomer forms of uncapped surfactants can also seek areas where capped surfactants have not attached to water repellent surfaces -- improving hydration and contributing to uniformity.***



Puzzled by which surfactant to use on your golf course?

Do all areas on your golf course have the same soil profile, soil moisture pattern or respond in the same way to seasonal stresses?

Game Changer simply cuts through the confusion, frustrations and complication of which surfactant to use and offers a straight forward, exciting new approach – a balanced function surfactant system.

GAME CHANGER

Integrative chemistries used in Game Changer are specifically designed to balance their modes-of-action to allow for a highly flexible surfactant solution platform to be used throughout your golf course -- throughout the year -- regardless of variations in soil type, levels of water repellency and soil moisture.

But Game Changer's best feature is that it is designed to help you provide the best playing conditions possible -- conditions designed to impress and make your job a lot easier.

Following Game Changer's balanced surfactant system solution program, turfgrass managers should expect:

- **A highly flexible surfactant system that allows use throughout the golf course**
- **Significant improvement in soil air : water ratios**
- **Improved stress tolerance, color and overall turf quality**
- **Uniform distribution of soil moisture throughout the soil rootzone resulting in the ability to establish firmer, dry surfaces without concern for water stress**
- **Exceptional hydration and rehydration of existing areas showing symptoms of hydrophobicity**
- **Enhanced water use efficiency**
- **Reductions in localized dry spot (LDS)**

USE DIRECTIONS

Apply Game Changer at 4 oz. per 1000 sq. ft. in 2 gallons of water (120 ml. per 100 sq. meters in 8 liters of water). Apply every 30 days in the early spring or when wetter conditions exist or are anticipated.

Apply Game Changer for prevention of water repellency and to improve water movement in soils at 4 to 6 oz. 1000 sq. ft. in 2 gallons of water (120 ml. to180 ml. per 100 sq. meters in 8 liters of water). Apply every 30 days in the summer or when hot or dry conditions exist or are anticipated.

Can be applied every two weeks throughout the growing season with spilt rates under a prevention program. No watering is required when used at recommended rates.

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