METER

INJECTABLE SOIL SURFACTANT

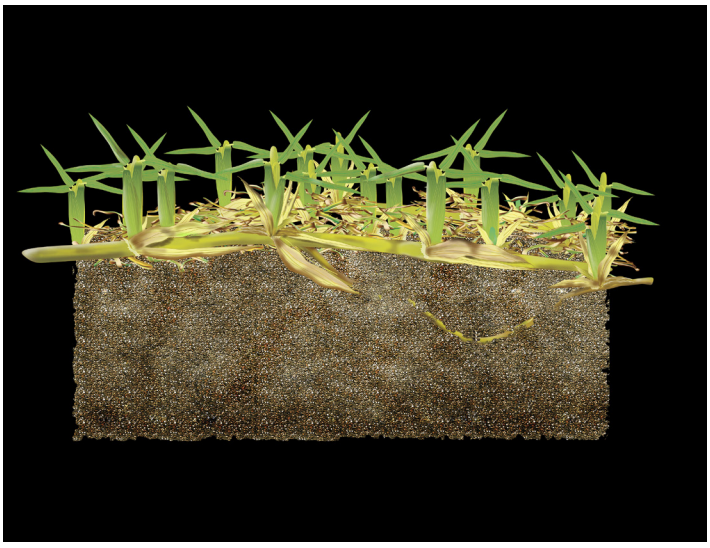
TECHNICAL INFORMATION BULLETIN

METER is a highly specialized injectable soil surfactant designed to overcome problems with penetration and infiltration of water into the soil profile due to the variability of the soil matrix and water repellency at or near the surface of the soil profile. Unlike many "soil penetrants," METER's unique blend of soil surfactants will also help correct soil water repellency conditions that disrupt the uniform distribution, hydration, retention and drainage of turfgrass rootzones.

Problems with Penetration, Infiltration Capacity and Water Repellency

The effectiveness and efficiency of golf course irrigation "systems" cannot be base solely on the optimal distribution and uniform placement of water on the surface of turfgrass. Regardless of how uniform the application of water, it does not ensure maximum efficiency. Water applied to the turfgrass may have difficulty penetrating through thatch, soil litter and the soil surface as well as moving uniformly into and through the soil profile.

Penetration. On highly maintained turfgrass, water repellency (hydrophobicity) is commonplace on thatch/mat, surface litter and soil particle surfaces found on, at or near the soil surface (0 – 2 inches).



Cross section of soil profile showing turfgrass, thatch and surface litter.

When water comes in contact with these hydrophobic (non-polar) surfaces, the water molecules on the boundary with the non-polar interface will rotate and move inward – **away from the non-polar surface and towards other water molecules**. This inward movement by boundary water molecules is called surface tension and causes water to "bead."

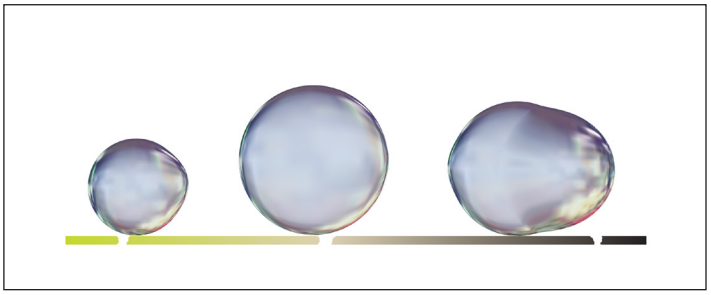


Illustration of water droplets "beading" on hydrophobic surface of partially decomposed organic litter (thatch, etc.) — preventing penetration of applied water.

The larger size of these compacted water droplets often prevent penetration of water through spaces or openings in thatch, surface litter and the soil surface.

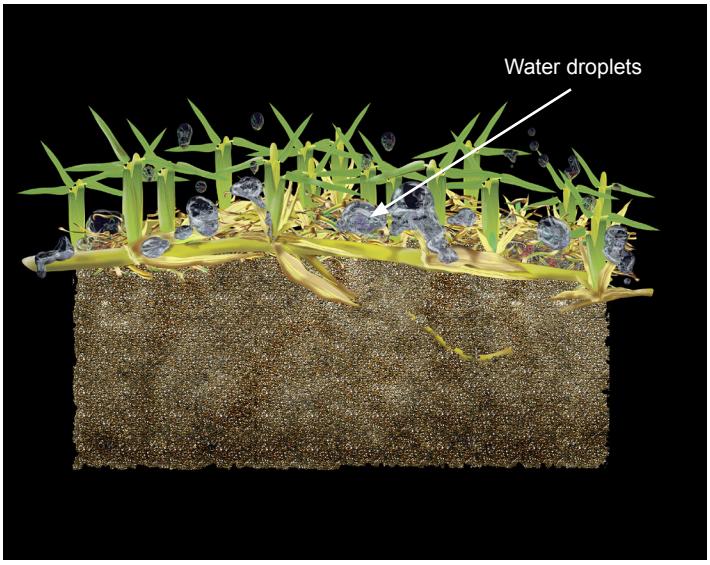
The inability of water to penetrate the soil surface can result in:

- Excessive runoff and evaporation
- A reduction in the amount of water that will enter the soil

Infiltration. Infiltration is the initial process of water movement into an unsaturated zone through the soil surface. However, what is important to professional turfgrass managers is the soil's **infiltration capacity**. Infiltration capacity is defined as the maximum rate that water will move into the soil profile. As a soil becomes saturated, its infiltration capacity is reduced.

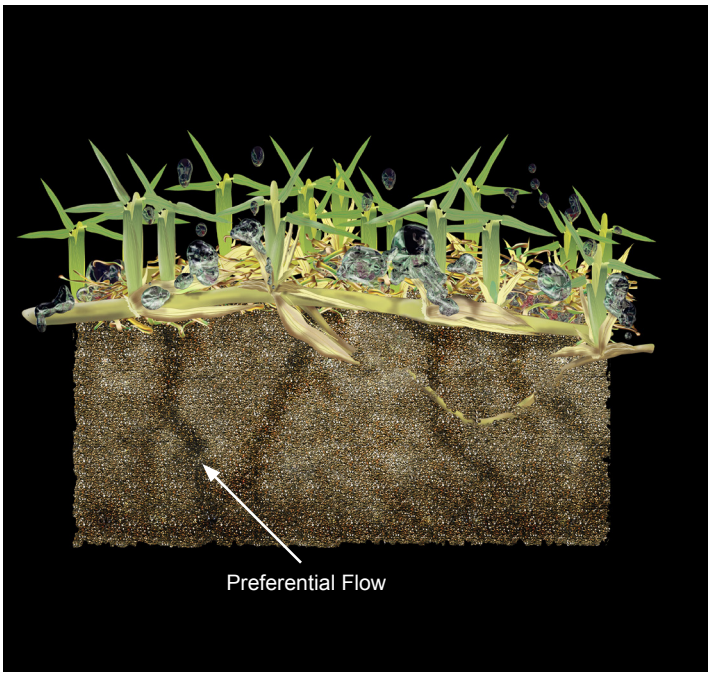
Adhesion occurs as water molecules at the wetting front attach to negative sites on the soil surface. Adhesion is required to "wet" or hydrate the soil and to provide the tension for capillary suction ("pull") of water (vertically and horizontally) **through pores in the soil matrix.**

When soil particle surfaces become water repellent (non-polar), adhesion is reduced because water molecules cannot attach to a non-polar surface. Further, surface tension is also increased that can further prevent water from entering or exiting soils. If water repellency is widely distributed, the infiltration capacity of the soil can be reduced to the point where the amount of water that can move into the soil matrix is severely limited.



Cross section of soil profile showing "beads" of water sitting on thatch, litter and soil surface.

Uniform Flow. Ideally, turfgrass managers want applied water to move uniformly through the soil profile (particularly in the root zone). Uniform flow (matrix flow) is dependent on maintaining a uniform wetting front as water flows into and through the soil profile. Maintaining a uniform wetting front is dependent on adhesion. If water repellent conditions exist below the soil surface, non-polar surfaces will disrupt the wetting front and promote uneven hydration patterns such as preferential flow or fingered flow. This can result in poor distribution of water, fertilizer, pesticides, and other important amendments required for healthy turfgrass conditions.



Cross section of soil profile showing non-uniform wetting front – resulting in preferential flow of water.

METER Technology

The use of injectable soil surfactants to improve the movement of water into the soil from irrigation systems and rainfall is not only an accepted practice, but it is also encouraged as an injection protocol to conserve water. However, the variability of soft surface (thatch and surface litter) and hard surface (soil matrix) interfaces can impact surfactant performance as water makes its journey into and through the soil profile.

The METER Injectable Soil Surfactant construction consists of two high performance block copolymers. Both surfactants in the METER formulation contain non-polar "anchors" that the surfactants use to adhere to the water repellent surfaces on and within the soil profile. Once attached to the non-polar surfaces, negative sites on the surfactants serve as sites for water molecules attachment (adhesion). Attachment of water molecules to the surfactants in METER promote hydration of the surfaces and reduce surface tension that enhances penetration, infiltration and contributes to uniform flow in the soil.

The first constituent of METER is a tri-block copolymer. It was chosen for its exceptional ability to establish or restore adhesion sites (negative sites) on soft surfaces such as thatch or surface litter. It should be noted that the tri-block copolymer's performance profile also extends to hydration of hard surfaces (soil particles) as well.

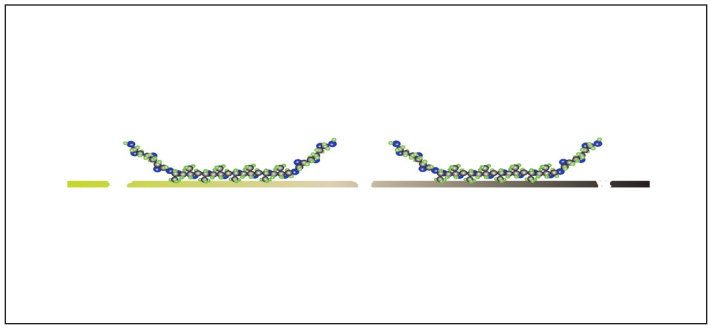
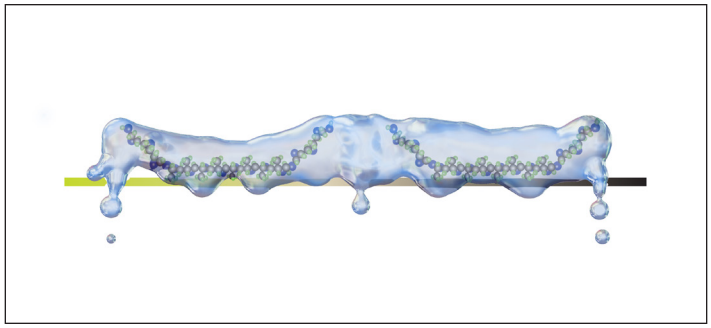


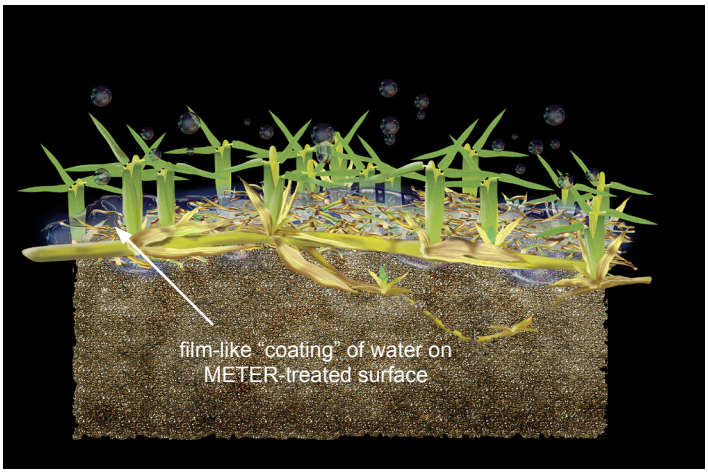
Illustration of one of METER's triblock copolymers on hydrophobic surface of partially decomposed organic litter (thatch, etc.).



As water is applied, the triblock copolymers provide adhesion sites that reduce surface tension — preventing the "beading" of water that restricts or prevents penetration and infiltration into the soil profile.

In addition to its tri-block copolymer, the METER formulation contains a high molecular weight, complex difunctional block copolymer surfactant proven to promote uniform vertical and lateral movement of water and solutes into and through the soil profile.

Penetration. As adhesion sites are reestablished (principally with the tri-block copolymer) on thatch, litter and fine soil particles on the soil surface, "beading" of water is replaced with a film-like "coating" action that facilitates hydration of, and penetration (water movement) through these areas to the soil surface.



Reduction in surface tension results in a film-like "coating" of applied water that quickly hydrates the thatch area and facilitates penetration and infiltration of water into the soil.

Infiltration Capacity. Once adhesion of water molecules is restored on the water repellent soil surface, gravity has a chance to exert its downward force on water from irrigation/rainfall sources (facilitated by reduced surface tension). This results in an unobstructed downward flow of water into the unsaturated soil matrix. Infiltration is further enhanced as water molecules are attracted to negative sites on soil particle surfaces as well as negative sites on METER surfactants that have attached to non-polar areas on water repellent areas of the soil matrix.

Uniform Flow. METER's best-in-class non-ionic surfactants are designed to overcome hydrophobic conditions and promote a consistent and effective pattern of hydration and re-hydration of the soil profile. But METER goes a step further by promoting a uniform movement of water through the soil profile. This is accomplished by the complementary action of its two block copolymer surfactants.

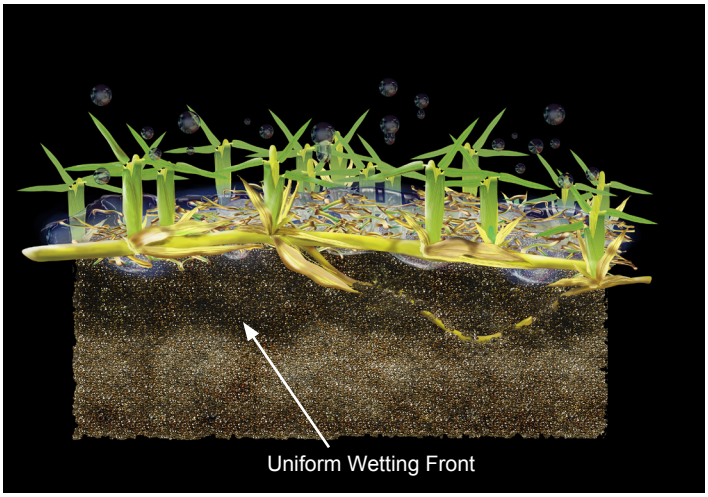


Illustration of a uniform wetting front being established as water moves through the METER-treated soil profile.

Both surfactants contribute to preventing disruption of the wetting front by creating sites for water attachment (reducing surface tension). The larger, more complex difunctional copolymer surfactant also promotes downward and lateral movement of water (matrix flow).

The METER blend of chemistries results in a multi-functional surfactant complex with a range of chemical and physical properties that will address the demand by turfgrass managers for a surfactant solution that will:

- Offer exceptional penetration of applied or natural irrigation events through thatch, litter, and mineral particle fines on the soil surface
- Increase infiltration rates and reduce runoff
- Improve wetting and water movement into and throughout the soil profile
- Increase irrigation effectiveness and efficiency
- Reduce stress conditions and improve recovery from stress

As both the quality and quantity of irrigation water is becoming a limiting factor in turfgrass management, research has increased with regard to the use of surfactants in irrigation systems. While soil profiles may vary, studies have shown that use of surfactants in irrigation systems can reduce water requirements by as much as 50%. Further, the volumetric water content of soil profiles have also shown significant improvement with the use of surfactants in irrigation systems. Isn't it time for you to consider the use of METER in your irrigation protocol?

USE DIRECTIONS

DIRECTIONS FOR GENERAL TURF USE

GREENS, TEES, FAIRWAYS, LAWNS AND SPORTS TURF

Injection: For optimum results, inject METER Injectable Soil Surfactant at a rate of 12-24 fl. oz. per acre (1– 2 L per hectare) every 1 – 2 weeks or as needed.

It is highly recommended that METER Injectable Soil Surfactant be applied prior to the development of environmental conditions that promote plant stress and water repellency on thatch and soil particle surfaces.

NUMERATOR
TECHNOLOGIES, INC.
P.O. Box 868
Sarasota, Florida 34230
941.807.5333
www.numeratortech.com