



SOIL WATER REPELLENCY
MANAGEMENT SYSTEM

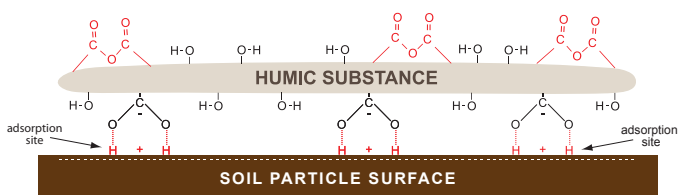
MANAGING SUMMER STRESS

Many scientists point to humic substances, non-polar organic coatings on mineral surfaces in the upper rootzone, as the primary cause of soil water repellency. RETRO Soil Water Repellency Management System represents a new proactive approach to address the cause and problems associated with soil water repellency (SWR) – a combination of a best-in-class surfactant complex with a blend of organic coating removal agents. RETRO has proven to be highly effective in reducing soil hydrophobicity and soil moisture problems during extreme heat and drought conditions associated with summer stress.

MANAGING WATER REPELLENT SOILS

Highly managed turfgrass produce large quantities of soil organic matter (plant materials, humic substances, root exudates, thatch, and roots). Once subjected to microbial action, soil organic matter (SOM) becomes the primary source of problematic hydrophobic compounds that coat the surface of soil particles.

HYDRPHOBIC HUMIC SUBSTANCE
ADSORBED TO SOIL PARTICLE SURFACE



Development of these water repellent organic coatings on soil particles is progressive in nature. As a result, these coatings exist as thin films on the particle surface (early stages of development) that progress to a layer-on-layer build up (“caking”) of water repellent organic substances during later stages of development.

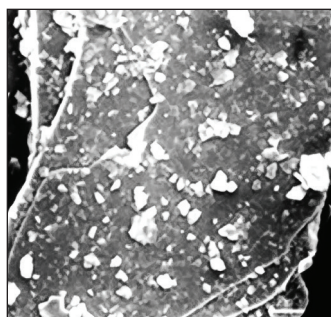
The standard practice for treating water-repellent sand root zones is the systematic application of non-ionic soil surfactants. The use of block copolymers have become the preferred surfactant treatment chemistries.

However, these chemistries/treatments are used to treat or prevent the symptoms of water repellency – localized dry spot, infiltration and water movement problems.

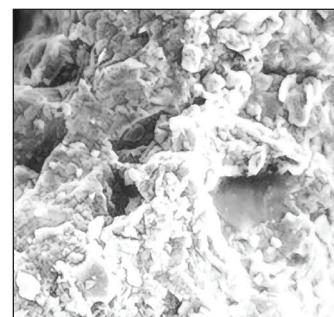
But many golf course superintendents are equally concerned about how wetting agent applications will effect soil moisture distribution throughout the rootzone. This is particularly important during extended heat and drought conditions commonly encountered during summer stress periods. Will the hydration and retention characteristics of the soil profile be improved? Does the surfactant work well under low moisture conditions? Is the product safe to apply during summer stress periods?

RETRO TECHNOLOGY

In RETRO’s Soil Water Repellency Management System, both its surfactant complex and its **DEPRO¹²⁹⁹** organic coating removal agents participate in the dissolution of hydrophobic organic coatings on particle surfaces – both the tightly bound early stage “films” and the layer-on-layer build up (“caking”) of organic polymers during later stages of hydrophobic development.



Electron micrograph of wettable (hydrophilic) soil particle. Little humic substance is visible.



Electron micrograph of non-wettable (hydrophobic) soil particle. Layer-on-layer deposition of humic substances is very visible.

DEPRO¹²⁹⁹ Organic coating removal agents. The DEPRO¹²⁹⁹ organic coating removal agents in RETRO deprotonate (remove) critical hydrogen atoms from areas on humic substances. Removal of the hydrogen atoms promotes conformational decay that leads to *separation and dissolution of organic layers due to repulsive forces*.

Surfactant Complex. The surfactant complex used in the RETRO formulation are included to enhance the removal process by loosening and solubilizing the humic substances into the bulk solution as well as to facilitate the movement the coating removal agents in a uniform manner throughout the rootzone.

The surfactants also stay attached to water repellent areas that remain on the particle surface. Subsequent irrigations will rehydrate the surfactants and aid in additional removal of humic substances as well as contribute to a return of uniform patterns of infiltration, percolation, retention and favorable soil moisture distribution throughout the rootzone.

Under heat and drought conditions, RETRO can be safely applied to all turfgrasses and is particularly effective under low moisture conditions.

30-Day Strategy For Relief of Heat and Drought Stress

PERFORMANCE VERIFIED

RETRO was tested on a 8-year-old 'L-93' at the University of Arkansas on sand based putting green that was constructed according to USGA recommendations. The study was conducted from May through September in 2011.

Irrigation was applied judiciously in May, moderately in June and July, and only to avoid drought and heat stress symptoms in August and September, so that the RETRO wetting agent effects may be evaluated across a range of irrigation regimes. NOTE: In July, there were 11 days of temperatures over 100 ° F.

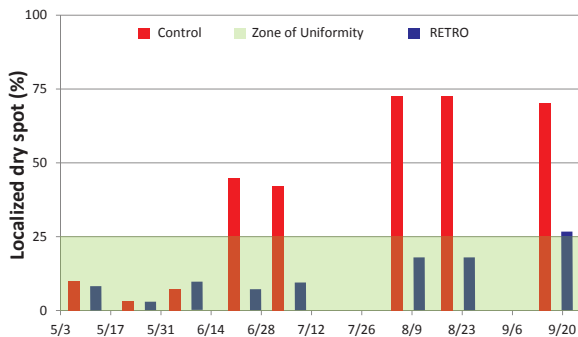
Phytotoxicity: Plots were evaluated for phytotoxicity 24 hours following wetting agent application using digital image analysis.

LDS formation: Plots were evaluated biweekly for the formation of localized dry spot. Data were recorded as a percentage of the plot affected by LDS.

Volumetric soil moisture was evaluated twice monthly. Twenty five measurements were taken on each plot using a 5 x 5 ft. grid (1 ft. centers) at three depths (1.5, 3, and 5 inches).

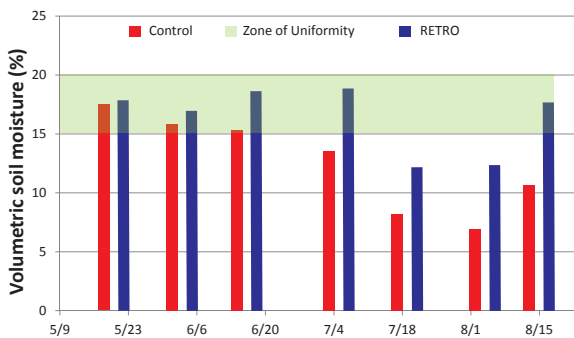
Results are illustrated below:

1. Phytotoxicity: There was no phytotoxicity observed throughout the trial; so no data are presented.
2. Localized Dry Spot (LDS): On the final five evaluation dates, the untreated control consistently had the most localized dry spot, which was significantly greater than RETRO.



Effect of wetting agent application localized dry spot incidence - Fayetteville, AR, 2011.

3. RETRO significantly affected average volumetric soil moisture retention on three of the final four evaluation dates of the trial (5 July, 4 and 18 August). The untreated control consistently had the driest average soil moisture content.



Effect of wetting agent application average volumetric soil moisture content - Fayetteville, AR, 2011.

SAFE AND EASY TO USE

The use of RETRO poses no additional management resources than those associated with surfactant applications used to treat symptoms of water repellency in soils. RETRO is safe to apply to turf under the most severe summer stress conditions.

When used on a monthly basis, it's best-in-class non-ionic surfactants will overcome hydrophobic conditions and promote a consistent and effective pattern of hydration and re-hydration of the soil profile.

RETRO's proprietary blend of organic substance removal agents have been shown to be very successful in disrupting key bonds that bind the hydrophobic organic substances to soil particle and other hydrophobic substances (layer-on-layer deposition).

Following its use in a well-designed rootzone management program, turfgrass managers should expect:

- Uniform distribution of soil moisture throughout the soil rootzone
- Reductions in localized dry spot (LDS)
- Exceptional hydration and rehydration of existing areas showing symptoms of hydrophobicity
- Improved stress tolerance, color and overall turf quality
- Significant improvement in soil air:water ratios
- Safe to use in high heat and drought conditions
- Reduced surfactant and labor costs associated with application
- Enhanced water use efficiency
- Healthier roots

USE DIRECTIONS

Apply RETRO at 6 oz. per 1000 sq. ft. in 2 gallons of water (180 ml. per 100 sq. meters in 8 liters of water). For best results, apply monthly throughout the growing season. No watering is required when used at recommended rates.



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Surfactant performance that can stand up to summer stress!

NUMERATOR

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