A Comparison of Water Drainage and Storage in Putting Greens Built Using Airfield Systems and USGA Methods of Construction

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Objectives:

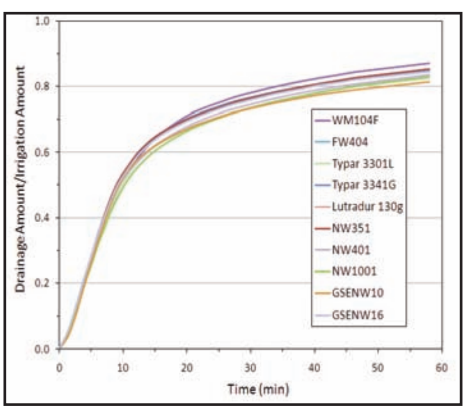
1. Investigate potential for clogging of geotextile pores from fines migrating out of the rootzone mixture.
2. Investigate the changes in the temporal distribution of drainage and spatial distribution of water holding capacity of a green constructed with a geotextile compared to a green constructed with gravel.
3. Investigate construction methods designed to reduce down-slope movement of water in sloping greens.
4. Develop criteria for selecting appropriate rootzone mixtures for putting greens constructed with geotextiles.

Start Date: 2007
Project Duration: three years
Total Funding: $90,000

This research investigates the dynamics of water movement through, and storage within, the rootzone of putting greens constructed using a geotextile atop a plastic support acting as the drainage structure (Airfield System's design) compared to a green constructed with a gravel-based drainage structure (USGA recommended).

Constructed to USGA specifications with a 100-mm layer of gravel, sand-based rootzone mixture placed over gravel holds water at the rootzone-gravel interface at tensions between 0 and 100 mm water when watered to such a degree that drainage occurs. The Airfield Systems' design replaces the gravel with a geotextile atop a 25-mm deep porous plastic support for drainage. Our laboratory observations have shown that the bottom of the rootzone in the Airfield Systems design is typically at about 50 mm less tension after drainage.

One hundred eighty permeameters were constructed from 150-mm inner diameter by 350-mm tall PVC pipe and end caps. Each permeameter was filled with 300-mm deep rootzone mixture over a geotextile supported on a 25-mm deep plastic geogrid (Airfield Systems' AirDrain). A tensiometer was placed on top of the geotextile in each test cell before it was filled with the rootzone mixture.

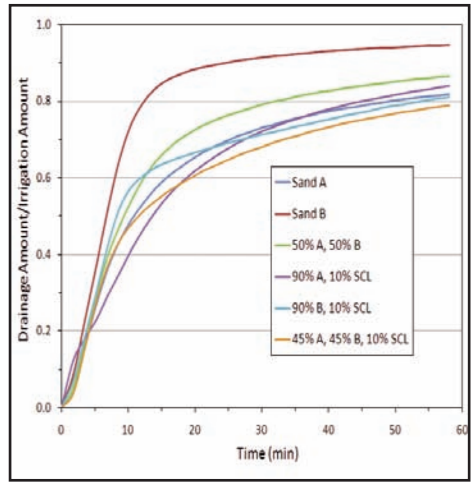


Ten geotextiles were evaluated: two woven, three spunbond, five needle punch. Permeameter tests showed that none of the geotextiles clogged during the test period using 1 inch (25 mm) of irrigation water.

Ten geotextiles were evaluated: two woven, three spunbond, five needle punch. The woven materials were WM104F (Propex) and FW404 (Tencate). The spunbond fabrics were Typar 3301L (Fiberweb), Typar 3341G (Fiberweb), and Lutradur 130g (Freudenberg). The needle punch materials were NW351 (Propex), NW401 (Propex), NW1001 (Propex), NW10 (Gundle/SLT Environmental), and NW16 (Gundle/SLT Environmental). Apparent opening sizes (AOS) of the ten geotextiles were 212, 425, 300, 250, 122, 300, 212, 150, 150, 150 micrometers, respectively.

Six rootzone mixtures with differing distributions of fines were created by blending three parent materials with differing particle size distributions, two sands and a sandy clay loam (SCL). One parent-material sand's particle size distribution fell in the middle of the USGA specifications (Sand A). The other parent-material sand exceeded the specified limits for fine and very fine sand (Sand B). Total fines <150 micrometer ranged from 6% to 39% for the six rootzone mixtures. Each geotextile was tested in combination with all six rootzone mixtures.

Test cells were irrigated at rates representative of cultural practices for establishment and maintenance of a putting green. Greater amounts of water were applied periodically to simulate storm events and to observe changes in whole-system permeability and drainage. Changes in whole-system permeability and drainage were assessed by measuring the temporal distributions of drainage rate from an instantaneous application of 25 mm (1 inch) of water to the top of the test cell.



Permeability and drainage of tests cells were affected by rootzone mixtures (above), but not through clogging of geotextiles.

We did not observe positive pressure atop the geotextiles for any appreciable time. When drainage rates from the test runs were averaged across rootzone mixtures for each of the geotextiles, no significant differences in drainage rates were observed. We conclude that geotextiles in the test cells have not clogged. When drainage rates from the test runs were averaged across geotextiles for each of the rootzone mixtures, significant differences in drainage rates were observed. We conclude that the particle size distribution of the rootzone mixtures affects drainage rate, as expected, but not through clogging of the geotextiles.

Summary Points

- Clogging of geotextiles was not observed
- Permeability and drainage of tests cells containing rootzone mixtures with total fines <150 micrometers ranging between 6 and 39% were not affected by geotextiles whose apparent opening size ranged from 150 to 400 micrometers.
- Permeability and drainage of tests cells were affected by rootzone mixtures, but not through clogging of geotextiles.