# *Improving Procedures for Testing Putting Green Materials*

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**Objectives:**

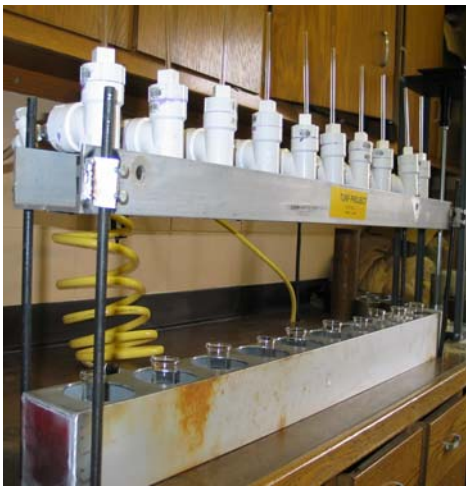
1. To evaluate new testing procedures for water and air in rootzone materials.
2. To quantify water content and movement as affected by rootzone depth, as well as rootzone materials.
3. To understand water movement in a rootzone profile as affected by grass root systems, topdressing, and organic matter/thatch layers.

**Start Date:** 2004
**Project Duration:** three years
**Total Funding**: $33,000

As a result of the research conducted in the 1950s, sand-based green specifications were generated by USGA green section. These specifications have been revised several times since they were first published. Presently, USGA recommends that total porosity be 35-55%, non-capillary porosity be 15-30% and capillary porosity be 15-25%.

The current USGA recommendation listed saturated water conductivity of 15-30 and 30-60 cm $hr^{-1}$ as normal range and accelerated range, respectively. The confidence interval for particle size analysis is +/-10 to +/- 35%, and that for water conductivity is +/- 20% using the USGA specified procedures. The inconsistency of those test results for rootzone materials between and within the labs has caused inconvenience in bidding and contracting processes during construction.

The difficulties encountered in locating quality materials plus the high price of sand materials that conform to USGA specifications forced many putting greens to have been constructed using native soil or local alternative materials. Sometimes the saturated conductivity parameter has to be dropped from the contract because of its low accuracy and feasibility during construction.



*North Dakota State University scientists have developed a device that can measure saturated water conductivity of ten samples at same time. Each sample cell has an indicator of water head to make sure that all samples are under the same water head and air bubble free.*

*Research is underway to quantify water content and movement in various putting green rootzone mixes and to document how depth of the rootzone and profile construction can affect those parameters.*

However, saturated water flow is usually only a short period during a rain event. Saturated water conductivity is only one fraction of the water movement characteristics of rootzone materials. More information is needed on the unsaturated flow of water to better understand the rootzone materials. It is also well known that water conductivity increases exponentially with degree of saturation and a small variation at the saturating point can cause dramatic differences in saturated conductivity. Thus, variation in saturation may be one of the contributors to the low repeatability of saturated water conductivity result.

Other factors affecting the accuracy of the saturated water conductivity test include the soil packing process, dissolved air in testing water, organic matter, clay type/amount in the material, etc. Little information is available on the water movement in layered soil profiles which occurs in a golf green because of topdressing practices. Research on water movement in the rootzone materials under the influence of grass roots is also needed.

We are still in the initial stage of this project to fabricate devices that realizes the goals of this study. The considerations in constructing an instrument for testing physical properties of putting green materials are not only to overcome some problems we encounter in the current procedures regarding to the principles of soil physics, but also to make it easier for testing laboratories to handle multiple samples simultaneously, as well as conveniently.

We have developed a device that can measure saturated water conductivity of ten samples at same time. Each sample cell has an indicator of water head to make sure that all samples are under the same water head and air bubble free. The system also allows checking the degree of saturation. We also constructed cells for testing water retention curves.

Our preliminary study showed that different sized sand materials and their mixtures with various amount of peat had significant impact of the water retention at different depth of rootzones. Water conductivity characteristics of those materials also showed more information at the unsaturated range of the curve.

## Summary Points

- Unsaturated water conductivity as well as saturated conductivity may be needed for better understanding of the rootzone materials.
- By measuring water conductivity, water potential, and degree of saturation simultaneously, we could simplify the testing procedure and reduce error.