Assessment of Commercially Marketed Filter Materials for Tile Drainage Outlets on Golf Courses

Kevin W. King
USDA-ARS

James F. Moore
USGA Green Section

Jim C. Balogh
Spectrum Research, Inc.

Objectives:

1. Assess the feasibility and effectiveness of commercially marketed filters designed to strip nutrients (nitrogen and phosphorus) and pesticides (chlorothalonil and metalaxyl) from drainage waters exiting managed turf areas.
2. Identify and demonstrate the efficacy of using both synthetic and natural products in a field scale application of the end-of-tile filter.

Start Date: 2005
Project Duration: four years
Total Funding: $42,200

Tile drainage and other subsurface drainage features are considered essential by turfgrass managers to maintain water tables at depths necessary for healthy plant growth, maintain sufficient water and air in soil void space, to stimulate essential microbial activity, avoid rutting and soil compaction by maintenance equipment, and to allow site use soon after heavy rains. Subsurface drainage increases the subsurface movement of excess water and facilitates infiltration.

Nutrient and pesticide transport through subsurface drainage systems may become a component of surface runoff if the drainage water discharges directly into surface water or onto the surface offsite or downslope. Subsurface drains conveying water directly into a stream or pond will bypass natural and managed filtering processes, including upland and riparian buffer zones. This research is designed to address the potential for end-of-tile filters to significantly reduce the transport of nutrients and pesticides from golf course tile drainage outlets to surface waters. In addition to the commercially available filters, other synthetic and natural by-products will be identified and used to demonstrate the effectiveness of end-of-tile filters in a managed turf setting.

The research is being conducted in two phases. The first component is a controlled laboratory experiment designed to evaluate the filter's effectiveness while operating at flow rates comparable to those measured in the field. The second component is a before-after field assessment of the filters. The field study is being conducted at two different golf courses, one located in Texas and the other in Minnesota. The Texas site is located at Ridgewood Country Club in Waco, TX. The assessment is taking place on the drainage waters from the 8,000 ft^2 chipping green. The second field site is located at Northland Country Club in Duluth, MN. The filter has been installed on a drainage pipe that collects both surface and subsurface drainage waters from a significant portion of the course.

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For the laboratory study, a hydrograph generator was created to simulate tile flow discharge. The hydrographs were generated from a supply reservoir containing a solution of nitrate nitrogen, dissolved phosphorus, chlorothalonil, and metalaxyl. The water was pumped through the filter assembly. Samples were collected prior to entering the filter and after flowing through the filter.

The filters were a blend of equal parts by weight of activated carbon, activated alumina, and zeolite. The filters substantially reduced the amount of dissolved phosphorus, chlorothalonil, and metalaxyl from the drainage water. Removal of nitrate was not as great. The removal was inversely proportional to the flow rate and varied depending on the location on the hydrograph (rising limb, peak flow, or receding limb). Preliminary findings from the field study in Minnesota indicate significant reductions in ammonium, nitrate, total nitrogen, and total phosphorus. No results are yet available for the pesticides. Filters containing newly identified materials have recently been installed at the Texas site.

Future research will investigate different activated carbons and different by-product mixes, inclusion of a denitrification barrier prior to/after the filter, long-term sorption capability, efficiency dependence on influent concentrations, optimizing contact time, and scaling for larger applications.

Summary Points

Laboratory Study

- Substantial loading reductions were measured for dissolved reactive phosphorus (51.6%) and chlorothalonil (58.2%), while intermediate reductions for metalaxyl (28.8%) and minor reductions for NO_3-N (4.7%) were measured.
- For all contaminants, the discharge flow rate was inversely related to percent removal and was consistent across all tested hydrographs.
- The efficiency of the filters varied depending on the location within the hydrograph. A greater percent removal was observed during the rising limb compared to the peak and receding limbs.

Field Study

- Preliminary data from the Minnesota field site suggests that the filter is significantly reducing the amount of ammonium, nitrate, total nitrogen, and total phosphorus.
- Additional materials have recently been identified and implemented at the field site in Texas.