Development of Phosphorus Filtering Systems for Environmental Protection

Chad J. Penn and Gregory E. Bell
Oklahoma State University

Objectives:

1. Test steel slag material for its dissolved P-reduction potential in both active and passive filtering systems.
2. To determine approximately how much runoff P from a mature bermudagrass site is due to natural causes (rainfall, soil, plant material) and how much can be attributed to synthetic fertilizer.
3. To identify standard expectations for use in evaluating P-sorbing materials.

Start Date: 2011
Project Duration: 2 years
Total Funding: $20,000

Excessive concentrations of phosphorus can cause deterioration of surface waters through eutrophication. A traditional method for reducing dissolved phosphorus (P) is to apply P-sorbing materials (PSMs) directly to targeted water bodies. However, the effects of surface applied PSMs are often temporary since sorbed and precipitated P can desorb and dissolve with time.

Industrial byproducts have been considered for use as P-sorbing materials. Industrial byproducts show promise for removal of dissolved P when used as filtering components in filter structures. Filter structures have advantages compared to surface applied P-sorbing materials. The structure can separate dissolved P from runoff, and the saturated P-sorbing material can be removed from the site and replaced with fresh PSM when necessary. These byproducts may work equally well when used to fill runoff collection trenches in locations where a trench would be more effective than a ditch filter. The PSMs may also have potential for replacing the typical gravel used to surround subsurface drain pipes.

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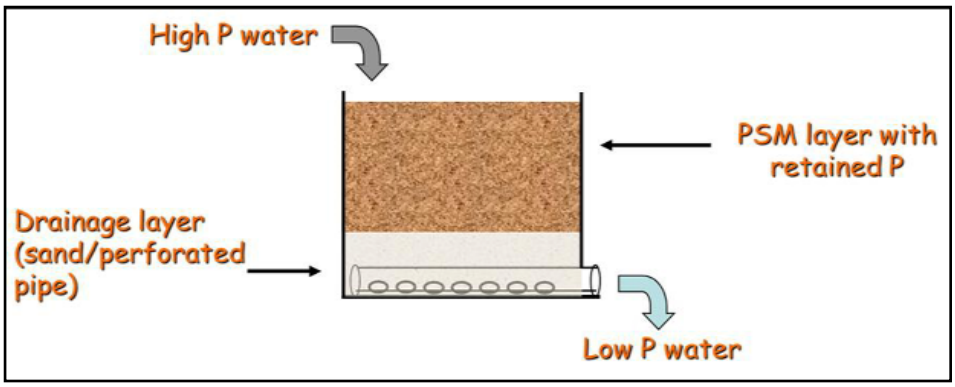

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The study is proceeding at the OSU Turfgrass Runoff Research Site. Each of 12 plots measures 17 ft. x 35 ft. and is supported by its own automatic sampler and flow meter. Plastic containers filled with steel slag are placed in trenches at the bottom of 'U3' bermudagrass [*Cynodon dactylon* L. (Pers.)] plots located on a 5% slope.

Plastic containers in half the experimental units will be filled with pea gravel instead of slag for use as an experimental control. Studies are initiated when either natural rainfall or irrigation runoff collects in the tubs. Runoff is collected and filtered then conducted by subsurface drain pipes to Parshall flumes. Isco 6700 series (Isco, Lincoln, NE) automatic samplers measure flow rates each minute and collect filtered runoff samples every 5 minutes. Pre-filtered runoff is collected continuously before it flows into the filter structure.

Preliminary testing has focused on determining whether or not washed river gravel is an effective non-P-removing control for comparison with a steel slag PSM. Runoff collected in empty trenches was compared with runoff collected in gravel-filled trenches. Plots were not fertilized nor had they been fertilized for at least two years prior to this portion of the study. By September 17, 2011 runoff from four simulated runoff events caused by sprinkler irrigation and one natural rainfall event were collected.

Statistical comparisons of each runoff event indicated that the empty and gravel-filled trenches did not differ in P concentrations in runoff suggesting that the gravel had no ability to filter P. A single natural rainfall event approximately 10 hours after the application of P fertilizer occurred on September 22, 2011. Statistical analysis of that event indicated that P concentrations in runoff from fertilized plots were significantly greater than non-fertilized plots, but P concentrations in runoff from empty trenches did not differ from P concentrations in runoff from gravel-filled trenches.

Summary Points

- Construction of filter sites on the existing OSU Turfgrass Runoff Research Site was completed in Aug 2011.
- Preliminary tests in September and October indicated that ½-inch river gravel could be used as an effective control for testing steel slag as a PSM.
- Phosphorus in runoff from fertilized plots was substantially greater than that from non-fertilized plots when an application of 0.44 lb. P in superphosphate form was followed by a severe storm approximately 10 hours later.