Sediment is the number one pollutant of US water resources even though erosion and sediment control best management practices (BMPs) are now commonly used. A large amount of information on BMP types exists, though the majority of this is currently with slope and channel rolled erosion control products (RECPs) and hydraulically applied erosion control products (HECPs). Less information is available for sediment retention devices (SRDs), but, as readers will see, new testing protocols are helping address this imbalance.

The responsibility for determining how well specific BMPs will perform, quantitatively, has increasingly fallen to regulatory agencies and site designers.

The National Transportation Product Evaluation Program (NTPEP) was developed to provide quality and responsive engineering to the testing and evaluation of products, materials, and devices that are commonly used by the AASHTO Member Departments of Transportation. One of the critical objectives of the program is to improve the nation’s transportation system by elevating the quality of available products and encouraging product innovation. NTPEP test reports assist users in approving products based on specification conformance and/or objective performance evaluations. NTPEP test reports contain data collected according to laboratory testing protocols selected through a consensus-based decision by AASHTO’s NTPEP Committee (NTPEP 2011).

What follows is a summary of how NTPEP’s system is structured and the current full-scale testing protocols offered, including the newer SRD protocols.

The NTPEP Approach

NTPEP only tests products that have been voluntarily submitted by manufacturers. Manufacturers pay testing fees to reimburse AASHTO for conducting testing and reporting results. AASHTO member departments provide voluntary, yearly contributions to support the administrative functions of the program. AASHTO/NTPEP does not endorse any manufacturer’s product, and there is no implied approval or disapproval in the results; rather, test data is furnished for the user’s evaluation, such as for prequalification or approval with a transportation agency.

It’s important to note that NTPEP is not intended as a tool for manufacturing R&D. Rather, submitted products should already be commercialized and have a record of being manufactured under standard operating procedures (SOPs) and rigorous quality control. Transportation agencies may request documentation of the SOPs and quality controls followed, and that documentation must be provided.
upon request.

NTPEP’s large scale tests for hydraulically applied erosion control products (HECP) and rolled erosion control products (RECP), channel tests for RECPs and slope and channels tests for sediment retention devices (SRD) are design level tests that states can rely upon for consistent and unbiased results. In this way, agencies may use NTPEP information to determine a product’s acceptability for their approved products list and for related projects.

**NTPEPs Large-Scale Performance Tests**

Standardized, large-scale performance tests simulate expected field conditions. They provide a way to evaluate “as installed” BMP performance. Products are installed per the product manufacturer’s published installation recommendations. The results of these tests are indicative of actual ECP field performance and are acceptable for use in performance specifications and, often, in design calculations.

Tests to evaluate products in both erosion control and sediment retention applications have been selected by NTPEP for product testing. The standards (or modified standards) selected by NTPEP for full-scale evaluations of BMPs currently include:

Erosion Control Product Performance:

RECP-protected soil loss is compared to soil loss of the bare soil control.

Sediment Retention Device Performance:
• ASTM D7208, “Determination of Temporary Ditch Check Performance in Protecting Earthen Channels from Stormwater-Induced Erosion”
• TM11340, “Standard Test Method for Determination of Sediment Retention Device (SRDs) Performance in Reducing Sediment Loss from Rainfall-Induced Erosion during Perimeter Control Applications” (Georgia Soil and Water Conservation Commission)

Erosion Control Product Testing
Conventional erosion control BMPs (e.g., crimped or tacked loose straw, rock riprap) continue to be used extensively, but the continual development and market use of alternative approaches—RECPs and HECPs—underscored the usefulness of large-scale testing for product/system comparison.

NTPEP began offering large-scale performance testing in 2009 of erosion control products to complement the commonly used index and bench-scale tests.

As noted, NTPEP selects test protocols that reasonably simulate expected field conditions in order to evaluate the “as-installed” performance. These tests are standardized.

The slope erosion test (ASTM D6459), for example, is conducted on one bare soil control and three replicate RECP-protected soil 3:1 slopes. Rainfall is simulated at target intensities of 2, 4, and 6 inches per hour, which are applied in sequence for 20 minutes each. Runoff from each slope is collected and soil loss is measured. From this data, an appropriate C-factor can be calculated by comparing the RECP-protected soil loss to the soil loss of the bare soil control.

For channel erosion (ASTM D6460), the test is conducted in a rectangular flume with at least four sequential increasing flows applied for 30 minutes each (unvegetated conditions) or 60 minutes each (vegetated conditions). Unvegetated RECP-protected channel testing is typically performed in a 10% slope flume. Vegetated RECP-protected channel tests are typically performed in a 20% slope flume. The limiting or permissible shear stress is defined as the shear stress necessary to cause an average of 0.5 inch of cumulative soil loss over the entire subject test area.

NTPEP Large-Scale Erosion Control Product Testing to Date
NTPEP now publishes large-scale performance testing information online at www.ntpep.org. The data is useful for better characterizing and differentiating between various RECP and HECP types.
The data shows the average results by product group of independent large-scale slope and channel testing done under the NTPEP program and demonstrates quite convincingly that there is a hierarchy of performance among the commonly available product types.

SEDIMENT RETENTION DEVICE TESTING

Sediment retention devices (SRDs) offer the potential to limit the migration of eroded sediments in runoff and in so doing to lessen the large area requirement and safety concerns of a sediment pond. The need for or value of SRDs has been recognized in the field, but, unfortunately, an independent quantitative means of testing performance has not been available.

In October 2014, NTPEP began offering independently verified large-scale performance testing of SRDs to complement the established large-scale RECP and HECP testing.

For SRDs, the initial large-scale tests include sheet flow, channel check, perimeter control, and inlet protection applications. As with the other large-scale tests, SRDs are installed per the manufacturer’s published recommendations. The results of these tests are similarly considered indicative of actual field performance.

Testing is applicable to a wide range of sediment SRDs, including silt fence, wattles, filter logs, compost socks, compost and earth berms, and various types of
SRD material components can be accurately evaluated for hydraulic properties using test method ASTM D5141, but the effectiveness of many SRDs is system or installation dependent. Therefore, large-scale tests that can incorporate the full-system are also offered.

ASTM D7351 is a large-scale standard test method for SRD sheet flow evaluation. It quantifies both sediment removal and associated flow rate through an SRD, so the potential for either excessive sediment loss or the back-up of runoff can be assessed.

Sprague and Lacina (2010) provided a strong example of how the component test and the system test complement one another while yielding different results (hence, underscoring the importance of each test). The test method ASTM D5141, was able to identify the clogging potential of different fabric types, while the test method ASTM D7351 was able to fully characterize the “installed” silt fence performance. This testing supports the use of both tests in concert with each other for routine product acceptance and large-scale system performance.

Check Dams & Perimeter Controls

Check dams have been used to slow concentrated flows in channels to make them less erosive until the associated channel can vegetate sufficiently to resist soil loss during concentrated flow events. Critical elements of this protection are the ability of the temporary check structure to (a) slow and/or pond runoff to encourage sedimentation, thereby reducing soil particle transport downstream, (b) trap soil particles upstream of a structure, and (c) decrease soil erosion.

ASTM D 7208 has established a full-scale test for evaluation of temporary ditch check performance. The procedure uses full-scale channel flow (up to 3 ft³/s) in a trapezoidal channel with check structure(s) installed. Continuous flow is maintained for 30 minutes, or until catastrophic failure of the check structure is experienced. Soil erosion and sediment deposition is measured along the channel and compared to an eroded control bare soil control (no SRD installed) channel to quantify the effectiveness of the check structure.

Sprague, et al (2015, submitted) reports on a check dam testing program. In the program, a range of check dams were tested in accordance with ASTM D 7208 with replicates one each at 0.5, 1.0, and 2.0 ft³/s. Systems tested included compost socks, straw bales, 2–10 inch rock checks, and a wire-backed silt fence check. In general, as a check dam gets taller it must provide greater structural integrity and adjacent scour resistance. The original straw bale system and the silt fence system configuration tested both offered taller damming, but even at the lowest flow level they provide insufficient structural integrity and scour resistance to function effectively. Conversely, the compost sock, rock check, and the enhanced (NRCS) straw bale systems provided the necessary balance between damming and scour resistance to perform effectively under all flow levels.

As silt fences and wattles are also used often as “perimeter devices” around con-
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systems, while High Flow systems typically have higher seepage rates. Generally, the test results suggest that it is possible to specify high retention systems for applications that can accommodate the associated ponding and high flow systems where ponding would create a hazard or exceed the available area.

Inlet Protection

Another new addition to NTPEP’s full-scale testing protocols for product performance verification is one for inlet protection evaluation. The protocol is a modification of the ASTM D7351 protocol and setup. The modification is to discharge the initial sediment laden water as concentrated flow to a simulated inlet instead of as sheet flow to a toe-of-slope installation. The simulated inlet is comprised of an approximate 24 in x 24 in manhole opening positioned at the center of a containment area. The SRD is installed adjacent to, or inside, the opening. Sediment-laden water is piped and discharged into the fully contained area around the inlet opening and allowed to run up to and seep through, over, and/or under the SRD protecting the inlet. The amount of sediment-laden flow is measured both upstream and downstream of the SRD. The measurement of sediment and seepage that passes the SRD compared to the amount in the upstream flow is used to quantify the effectiveness of the SRD in retaining sediments while allowing continued seepage. A complete test on each installed SRD with each type of runoff includes 3 repeat flows, or events, separated by not less than 4 hours. The test procedure requires the same relatively large equipment as is used in ASTM D7351.

The test results suggest that in both paved and unpaved applications, it is possible to differentiate between SRDs that provide maximum sediment retention and those providing maximum seepage.

This area of research is also to be more fully reported in Sprague, et al (2015, submitted). The test results suggest that in both paved and unpaved applications, it is possible to differentiate between SRDs that provide maximum sediment retention and those providing maximum seepage. For unpaved applications, the silt fence on posts SRD provides maximum sediment retention while the gravel-based SRDs provide maximum seepage. For paved applications, it appears that the more determinant height of concrete block assures maximum ponding prior to eventual overtopping. Thus, the so-called “pigs-in-a-blanket” – geotextile wrapped blocks – would appear to be a more dependable choice than geotextile-wrapped stone for curb inlet protection based solely on retention and seepage effectiveness.

For a full discussion of SRD testing protocols and their results, Land and Water readers should see the Geosynthetics 2015 proceedings. That event will be co-located with Environmental Connection 2015 (15 – 18 February 2015, Portland, Oregon).

NTPEP Continues To Define Product Performance

Just as the slope and channel evaluations initiated in 2009 are now producing a wealth of valuable information to the field, the 2014 NTPEP protocols for SRDs...
SEDIMENT CONTROL BMPS

are opening a new chapter for testing and product evaluation.

The results of the standard (and proposed standard) testing procedures now implemented by the NTPEP are readily available to assist the users of erosion and sediment control BMPs in establishing improved construction specifications that will guide owners and contractors to install the correct BMP for the expected site conditions. Not only do these test methods enable product manufacturers to confidently establish relevant product capabilities, they can be used outside of NTPEP to develop new, higher performing products.

by C. Joel Sprague, Peter Kemp & Katheryn Malusky

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References & Recommended Reading


How NTPEP’s Testing Protocol Ensures Independence

• Product specimens are selected randomly
• State transportation agency personnel oversee specimen collection
• Samples are collected directly from manufacturing plants
• Multiple rolls/bales/units are selected from different lots or production dates and shipped to an independent laboratory
• Qualifying laboratories are annually audited by the independent Geosynthetic Accreditation Institute

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