

Comparison of Erosion Control Technologies: Blown Straw vs. Erosion Control Blankets



Blown straw (on left) and RECP (right) during testing.

by Chad M. Lipscomb, Tony Johnson, Roy Nelsen and Tim Lancaster

Introduction

GREATER societal awareness of the costs of pollution and regulatory emphasis on maintaining clean, beneficial waterways have resulted in a need for quantifiable performance in erosion and sediment control practices. As lands are disturbed, erosion and sediment control professionals are demanding best management practices (BMPs) that can be specified, installed, and inspected with confidence. To that end, manufacturers of Rolled Erosion Control Products (RECPs) and various other stakeholders within the erosion control community formed the Erosion Control Technology Council (ECTC). The ECTC endeavors

to develop testing protocols, installation guidelines, and application specifications from a non-biased industry perspective. Further, ECTC provides distributors, contractors, and specifiers technical information and product application information as to the state of the practice of RECPs.

Challenges in providing adequate erosion control in the field require a diverse toolbox of solutions. BMPs refer to the individual tools available to the erosion control professional in stabilizing and minimizing soil erosion. Included in any standard toolbox of BMPs should be solutions intended to provide varying levels of performance and economy. In determining the most cost-effective solution to any particular field challenge, an understanding of the expected performance and overall value of alternative

practices must be obtained. The ECTC has reviewed research for a series of BMPs to evaluate common technologies. Within the framework of a dedicated study, the practice typically referred to as “Blown Straw” and a typical, degradable RECP were compared. This article presents the results of the study which show RECPs as a more cost-effective BMP on steep slopes, compared to Blown Straw.

Erosion Control Practices, Materials and Products

The United States Environmental Protection Agency (USEPA) defines a BMP as “A practice used to reduce impacts from a particular land use.” BMPs may consist of a practice applied in the field, application of material, or installation of a manufactured product.

Of the three methods, expense and performance increase with the level of engineering. Field practices, such as slope interruption, represent the least expensive and least reliable form of erosion control. An application of a loose or hydraulically applied mulch cover represents an upgraded level of performance. Finally, manufactured and performance verified products provide the highest level of erosion protection and confidence.

One advantage RECPs offer specifiers, contractors and project owners is the level of confidence in the quality, consistency, and performance. Manufactured products are held to the highest standard of evaluation and regulation. Thus, manufactured products tend

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to be the most costly, however, most reliable tool in the toolbox. Manufactured products are designed and produced from various materials to meet the varying requirements and challenges found in the field. In particular, RECPs are available in a variety of compositions and roll sizes to provide maximum erosion protection, increased infiltration, and/or enhanced mulching capability. Further, RECPs are designed to have expected longevity ranging from forty-five days to over three years. Thus, RECPs can afford an erosion control professional an acceptable solution to nearly every design challenge.

Conversely, Blown Straw has limited longevity, utilized only as a temporary practice. Materials such as loose straw and hydraulically applied mulch rely upon the contractor for consistent, uniform application and coverage of the soil

surface. If the application of straw or mulch is inconsistent, the performance of the installation will be compromised.

Quantifying Costs

Regulations require appropriate technologies be applied to ensure performance within an acceptable tolerance of risk. It is of critical importance to ascertain the overall cost and performance of each method to determine the value of the practice. All erosion control

Quantification of the expected level of performance, coupled with monitored quality control in manufacturing, decreases the risk and maintenance of any given installation. Table 1 presents a summary of typical costs and a qualitative level of confidence for Blown Straw and RECPs.

Quantifying Performance

In order to develop confidence in expected results, erosion control practices must be tested. Testing procedures are

Table 1

Practice	Approximate Cost (\$/yd ²)	Longevity	Field Performance
Blown Straw	0.60 – 1.00	0 - 3 Months	Low
Temporary, Degradable RECP	1.00 – 1.50	3 - 12 Months	Excellent
Extended Term, Degradable RECP	1.50 – 3.00	12 - 24 Months	Excellent

practices and products require monitoring and maintenance after installation. Practices that are initially inexpensive may incur additional expense in maintenance which could potentially exceed the initial savings. Thus, in quantifying the total cost of an erosion control plan, the expected performance of the specified treatment must be considered. Costs of manufactured products, whether hydraulically applied or rolled onto the soil surface, can vary depending on scope, product and location. However, manufactured products are typically required to be evaluated in laboratory or field trials.

developed to quantify parameters critical to performance that can not be theoretically derived. Over the course of time, BMPs have been identified, developed, and tested. However, testing methodologies have not remained constant. Technologies and practices were evaluated as per the state of the practice at the time.

In the case of RECPs, a very rigorous series of evaluations has been developed and implemented. Testing and research that the RECP industry utilizes has proven to be a major catalyst in the overall increase in confidence and use of the technology. Detailed testing has been



Blown straw installed for testing.

conducted on virtually hundreds of products under various conditions and protocols. Testing for slope installations has focused on the ability of the RECP to mitigate the forces rainfall and runoff while maintaining soil in place. Several facilities throughout the country are configured and utilized for testing. ASTM International maintains a refereed standard (D6459) for the large-scale evaluation of RECPs performance on a slope. The ASTM standard requires the product to be tested on a 3:1 (H:V) slope and be subjected to a series of controlled rainfall events while monitoring sediment migration and runoff. The ASTM standard provides

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a consistent methodology for testing and a means of comparison to evaluate competing products and technologies. In addition to the ASTM standard, implementation of approved product programs on the state and federal level typically requires testing by alternate protocols.

Conversely, practices utilizing non-manufactured materials or in-field techniques have not been evaluated under the same scrutiny. Many states do not require quantified performance testing of non-manufactured techniques, nor associate any performance limits to the practice. However, over the course of the development of erosion control techniques, many practices have been evaluated by field trials or simulated conditions applied to field installations. Testing of many practices has been conducted on available plots of land, subjected to whatever storms nature provided. In the case of Blown Straw, values for the performance of the technique have been published by the Center for Watershed Protection (CWP), referenced from Harding (1990) and Horner (1990). According to the

research conducted, Blown Straw reduced erosion by up to 93.2%. Two specific tests were cited utilizing differing evaluation methods. Performance of an erosion control practice on a slope typically is dependent on the rainfall energy, slope grade, slope length and the soil type utilized for testing. Further, performance may vary if the application is exposed to minimal rainfall.

A study was conducted to evaluate the performance of Blown Straw versus a typical RECP, utilizing identical testing methods. In order to determine the potential for Blown Straw to be used as a replacement for RECPs, the RECP testing protocol, ASTM D6459 was employed.

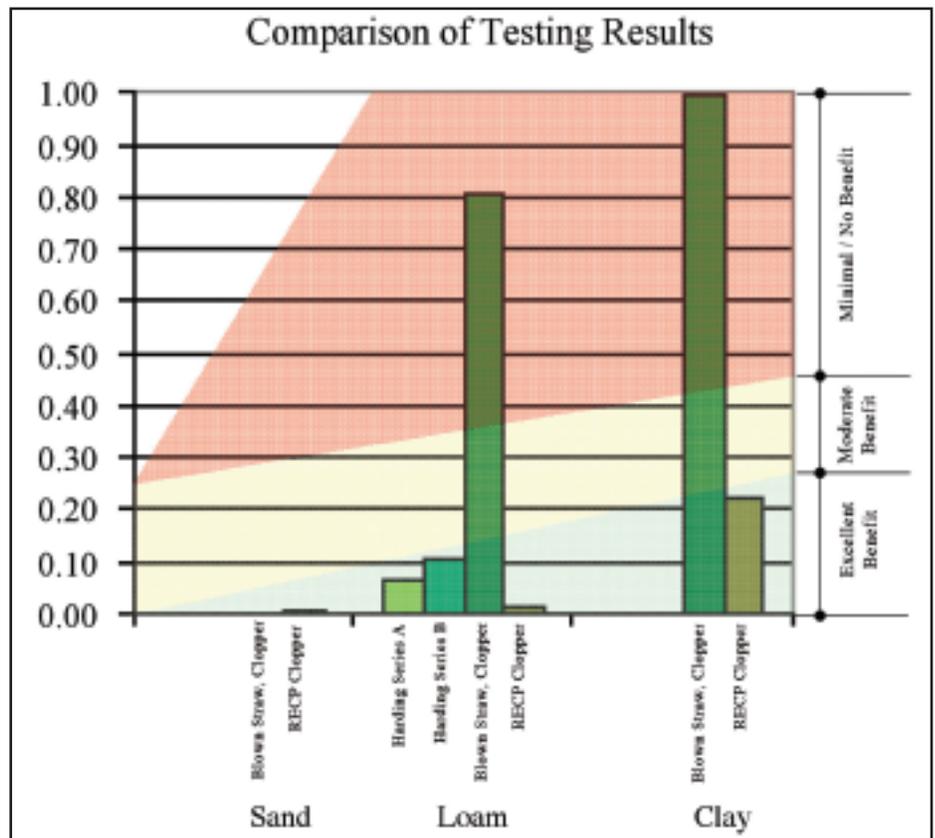
Blown Straw was applied to the test plot at a rate of 2,837 kg/Ha (2,500 pounds per acre). An RECP consisting of a single netted, temporary Erosion Control Blanket (ECB) was utilized for the comparison. The ECB was rolled onto the plot and secured to the ground surface using metal U-staples. Staples were positioned in accordance with the manufacturer's guidelines. Each practice was evaluated under identical conditions,

on three soil types. Simulated rainfall was produced at three intensities 51, 102 and 154 mm/hr (2, 4 and 6 inches per hour). Each installation was exposed to increasing rainfall intensities to allow for the quantification of performance.

As each simulated rainfall event was generated, runoff from each test plot was collected. Runoff was evaluated to determine the total sediment yield and water volume from each plot. Unprotected plots were tested identically as a reference. Sediment yield from each protected plot was compared to the reference plot of the same soil type to determine the percentage sediment yield reduction. Sediment yield reduction was normalized with respect to the actual recorded volume and duration of the simulated rainfall event for each plot. Figure 2 provides a visual graphic of the results as presented by Clopper et al compared with values reported by Harding and Horner.

The dramatic difference in performance of the two systems is evident in Figure 2. Blown Straw was effective on the sand soil and on shallow slopes consisting of loam soil. However, Blown Straw provided little benefit on the steep

Figure 2





Rill erosion and blown straw.

slopes, and no measurable benefit on clay soil. Blown Straw showed an overall lack of utility on slopes without the potential to freely drain, which was contradictory to other work. Typically, Blown Straw is specified as a very effective erosion control practice. In testing Blown Straw by more rigorous methodologies, the thresholds of performance for Blown Straw become apparent. Comparing the results from testing of the two methodologies, it becomes evident that the field usefulness of Blown Straw is restricted to shallow slope, low risk environments. Applied to steeper slopes and exposed to significant rainfall and runoff, Blown Straw provides minimal benefit as an erosion control practice.

In contrast, the RECP was over 98% effective on both the sand and loam plots and reduced erosion on the clay plot by nearly 80%. As RECPs represent a technology that is developed from intelligence in engineering and consistency in quality, the benefits realized where the raindrops meet the slope were not surprising. RECPs provide mechanical restraint to the incorporated mulch material and are secured to the soil surface. Thus, RECPs afford greater resistance to runoff and minimize displacement of mulch material.

Conclusion

It is often difficult for designers and

specifiers to distinguish between erosion control technologies. It is further difficult to make informed choices with the variety of information available and the ever-evolving state of standards and testing. Direct comparison of technologies under identical conditions and utilizing state of the practice methods, provides the single best means of delineating the performance of competing technologies. As RECPs are many times utilized in extremely demanding field conditions, RECPs are subjected to the scrutiny of testing, evaluation, and regulatory compliance of engineered products.

Evaluation of the research conducted and reviewed, shows the advantage and improved performance of manufactured materials compared to Blown Straw. Comparison of testing results showed significantly greater performance of manufactured materials when installed on slopes developing runoff. Further, RECPs were shown to have greater utility on steep slopes. Considering the performance advantages, flexibility in design and application, manufactured quality control and minimal cost difference, RECPs show significant value as erosion control practice compared to Blown Straw. **L&W**

For more information or an unedited version of this paper, including all tables, contact Laurie Honningford, e-mail: laurie@ectc.org.

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References

American Society for the Testing of Materials (ASTM), 2000. "ASTM D-6459: Standard Test Method for Determination of Erosion Control Blanket (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion." ASTM, West Conshohocken, PA. January.

Clopper, P.E., Vielleux, M., Johnson, T., "Quantifying the Performance of Hillslope Erosion Control Best Management Practices", ASCE 2001.

The Practice of Watershed Protection, "Article 55, Keeping Soil in Its Place", editors Thomas R. Schueler and Heather K. Holland, published 2000 by the Center for Watershed Protection (CWP), Ellicott City, MD.

Harding, M.V. 1990. "Erosion Control Effectiveness: Comparative Studies of Alternative Mulching Techniques.", In: Environmental Restoration: Science and Strategies for Restoring the Earth. Island Press. Covello, CA 149-156.

Horner, R.R. J. Guedry and M.H. Kortenog. 1990. "Improving the Cost Effectiveness of Highway Construction Site Erosion and Pollution Control.", Washington State Transportation Center. Federal Highway Administration. Seattle, WA. 79 pp.