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Using Rainfall Simulators To Test Wood Shreddings for Erosion Control

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The U.S. Department of Agriculture, Forest Service is considering alternative methods of erosion control when constructing roads, decommissioning roads, protecting lands burned by wildland fires, and reclaiming lands disturbed by other activities. This article is the second in a series of tech tips that discuss the use of wood shreddings for erosion control. The first tech tip, *Shredding Small Trees To Create Mulch for Erosion Control* (0471–2335–MTDC, *http://www.fs.fed.us/t-d/pubs/htmlpubs/htm04712335/index.htm*) discussed the benefits of using wood shreddings rather than straw for erosion control, described three commercially available pieces of equipment that could manufacture shreddings, and presented information on a project that used this technology.

The first tech tip did not present quantitative data to show how much shreddings reduce sedimentation and erosion. This tech tip discusses tests of shreddings using a rainfall simulator built at the Rocky Mountain Research Station (RMRS) laboratory in Moscow, ID. The testing was completed in the spring of 2005.

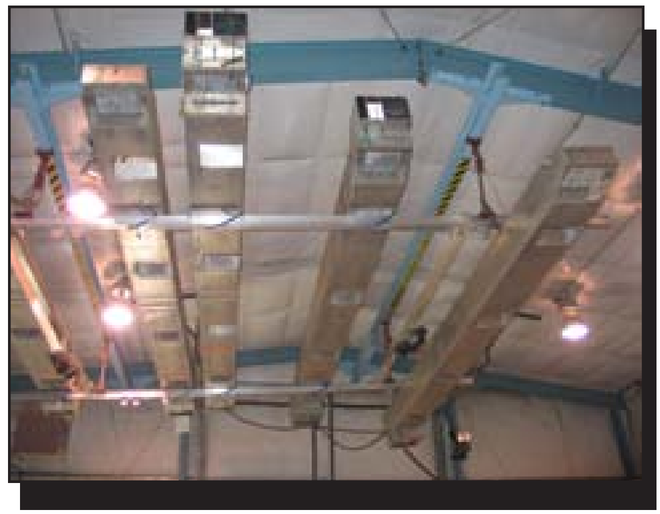

Figure 1—A Purdue-style rain simulator mounted on the ceiling of the Rocky Mountain Research Station's laboratory in Moscow, ID.

Highlights...

- Wood shreddings applied at 30-percent coverage reduce sediment as much as straw applied at a 70-percent coverage, according to published estimates for straw (Burroughs and King 1989).
- Wood shreddings do not introduce weeds, are not eaten by deer and elk, generate less dust than straw, and can make use of wood that might otherwise fuel wildland fires.
- Shreddings will be tested during the summer of 2005 on several projects to decommission roads in Idaho.

Equipment Used To Simulate Rainfall

The rainfall simulator is a Purdue-type simulator (figure 1) mounted to the ceiling above the steel plot frame. It is designed to simulate rainfall of 50 millimeters per hour. A flow distributor is mounted at the top of the soil plot frame to simulate overland flow. The soil plot frame is 1.25 meters wide by 5 meters long by 0.20 meters deep. It is positioned at a 30-percent slope (figure 2).

The procedure for testing erosion is to run the rain simulator continuously for 25 minutes at 50 millimeters per hour

Figure 2—A steel frame with a soil test plot ready for wood shreddings.

(2 inches per hour) of simulated rainfall. After 15 minutes, the flow distributor adds overland flow of 0.25 liter per minute. After 20 minutes, the overland flow is increased to 1 liter per minute. For further information, refer to *Wood Strands as an Alternative to Agricultural Straw for Erosion Control* by Randy B. Foltz and James H. Dooley (0423–1302P–SDTDC, *http://www.fs.fed.us/eng/pubs/html/04231302/04231302 .html*).

Sample Testing for Erosion Control

This evaluation used a sandy-loam soil that has been used previously when testing erosion control materials. The soil was dried and conditioned to a constant moisture (figure

Figure 3—Sandy loam soil being dried and conditioned for testing.

3) before being compacted uniformly in the plot frame. The wood shreddings (figure 4) were produced using lodgepole pine logging slash from the Mill Creek Drainage near

Figure 4—Sampling wood shreddings to be tested.

Missoula, MT. The material was sampled and a graph was developed showing the relationship between percent coverage and the weight of the shreddings. The shreddings sample was

Figure 5—Samples of wood shreddings sorted by size.

sorted by size to determine its size distribution (figure 5).

The soil test plot was covered with the estimated weight of shreddings that would be needed for the desired coverage (figure 6). The coverage rate was determined with a 910- by 910-millimeter Plexiglas sheet with points placed 25 millimeters apart (figure 7). If a point was over any portion of a

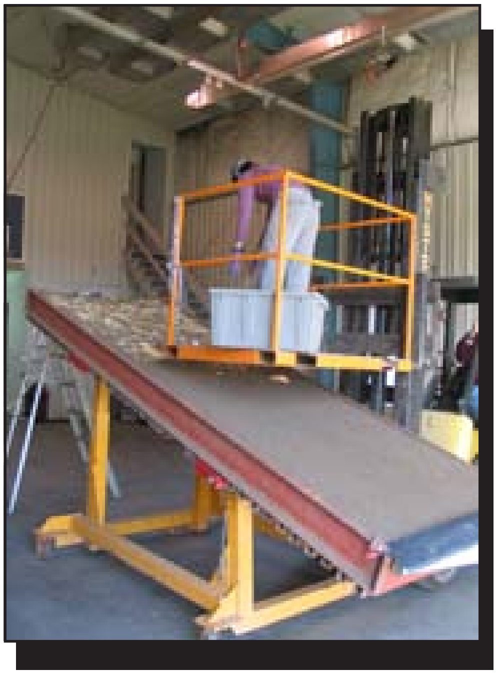

Figure 6—Spreading wood shreddings on the soil test plot.

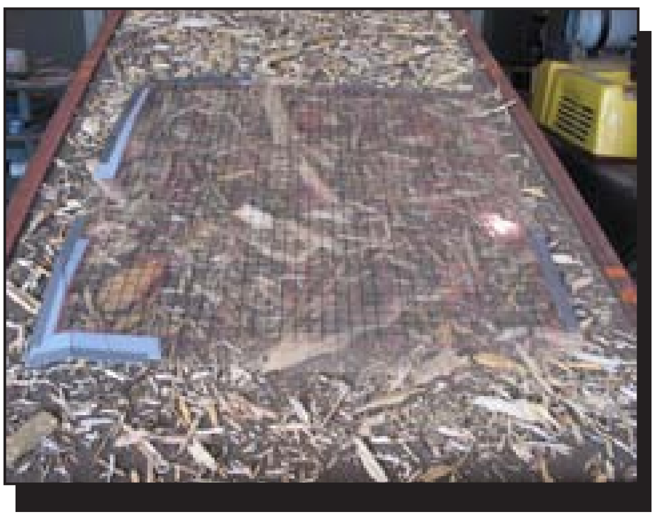

Figure 7—A Plexiglas sheet was used to determine the percent coverage of shreddings.

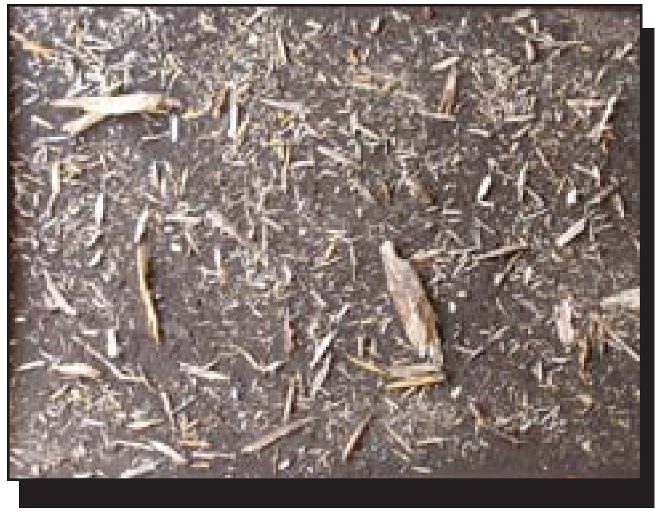

Figure 8—Shreddings providing 30-percent coverage.

Figure 9—Shreddings providing 50-percent coverage.

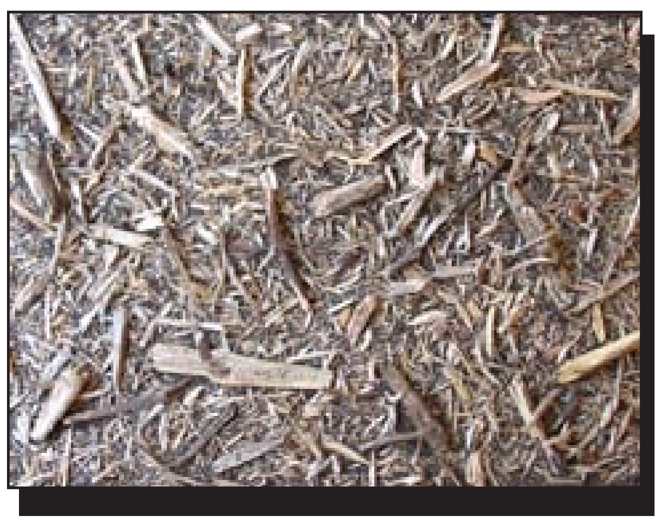

Figure 10—Shreddings providing 70-percent coverage.

shredding, that point was *covered*. The percent coverage is calculated by counting points covered by wood shredding material and dividing by the total number of points. Rainfall simulations were performed on coverages of 30, 50, and 70 percent (figures 8, 9, and 10) and tested with three repetitions. The results for each coverage rate were averaged.

The results showed that the shreddings at 70-percent coverage reduced sediment loss by 98 percent. Burroughs and King (1989) estimated that straw mulch at 70-percent coverage would reduce sediment loss by 72 percent for this soil. Shreddings at 50-percent coverage reduced sediment loss by 92 percent, while shreddings at 30-percent coverage reduced sediment loss by 79 percent.

Conclusions and Future Work

The shreddings did a good job of controlling erosion when tested by the rainfall simulator at the RMRS laboratory in Moscow, ID. The results show that wood shreddings are a viable solution for erosion control. Shreddings at 30-percent coverage performed as well as published estimates for straw mulch at 70-percent coverage. The advantages of shreddings over straw are that shreddings do not introduce new weeds, deer and elk do not eat them, they generate less dust than straw, the material is native to the area, and they use wood sources on the ground, reducing wildland fire fuels.

Additional studies using wood shreddings are planned for roads decommissioned on the Idaho Panhandle and the Payette National Forests during the late summer of 2005. The projects will consist of three repetitions of treatments on 600-square-foot plots comparing wood shreddings, a manufactured wood material, straw mulch, and bare soil. The plots will be monitored twice a year to measure the coverage of shreddings during the 3-year study. The Idaho Panhandle National Forests site (Priest Lake Ranger District) has a glacial till soil. The Payette National Forest site (New Meadows Ranger District) has decomposed basalt soil.

Investigations are being completed to see whether shreddings can be dropped from helicopters using standard cargo nets, similar to the way that straw is dropped during burned area emergency restoration (BAER) projects. Future work will include review of different systems for collecting shreddings and of other systems for distributing them.

References

Burroughs, Edward R., Jr.; King, John G. 1989. Reduction of soil erosion on forest roads. Gen. Tech. Rep. INT GTR 264. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Research Station.

About the Authors

James Scott Groenier, professional engineer, began working for MTDC as a project leader in 2003. Groenier earned a bachelor's degree in civil and environmental engineering from the University of Wisconsin at Madison and a master's degree in civil engineering from Montana State University. He worked for the Wisconsin and Illinois State Departments of Transportation and with an engineering consulting firm before joining the Forest Service in 1992. He worked as the east zone structural engineer for the Eastern Region and as a civil engineer for the Ashley and Tongass National Forests before coming to MTDC.

Randy B. Foltz is a research engineer with the USDA Forest Service. His current research is on the environmental impact of forest road removal (road obliteration), the use of wood-based materials to reduce erosion, and the impacts of all-terrain vehicles on erosion and the infiltration of water into the soil. Other research topics have included the erodibility of road aggregates and the benefits of lowered tire pressure in reducing erosion from forest roads.

Charles Showers, professional engineer, became engineering program leader at MTDC in the spring of 2002 after serving 2 years as operations program leader. Showers came to MTDC after 9 years as assistant forest engineer on the Payette National Forest. He began his Forest Service career on the Boise National Forest after completing 8 years as a construction project engineer with the Idaho Transportation Department.

Library Card

Groenier, James Scott; Foltz, Randy; Showers, Charles. 2005. Using rainfall simulators to test wood shreddings for erosion control. Tech Tip 0571–2329P–MTDC. Missoula, MT: U.S. Department of Agriculture Forest Service, Missoula Technology and Development Center. 6 p.

Describes the use of a Purdue-type rainfall simulator to test erosion control when wood shreddings were applied to a sandy loam soil in a soil plot frame positioned at a 30-percent slope. When shreddings were applied at 70-percent coverage, they reduced erosion from simulated rainfall and overland flows by five times compared to bare soil. The advantages of shreddings compared to straw are that they do not introduce new weeds to an area, are not eaten by deer and elk, generate less dust than straw, and can make use of wood that might otherwise fuel wildland fires. This tech tip is part of a series that includes *Shredding Small Trees To Create Mulch for Erosion Control* (0471–2335–MTDC) and *Wood Strands as an Alternative to Agricultural Straw for Erosion Control* (0423–1302P–SDTDC).

Keywords: BAER, Burned Area Emergency Response, overland flow, Purdue-type simulators, rain damage, rainfall simulators, simulations, soil conservation

Single copies of this document may be ordered from:

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For additional information about using wood shreddings for erosion control, contact MTDC.

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For additional information about testing using rainfall simulators, contact Randy Foltz at the RMRS Moscow Forestry Sciences Laboratory.

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