

Implementation Report

Evaluation of Effectiveness and Cost-Benefits of Woolen Roadside Reclamation Products

http://www.mdt.mt.gov/research/projects/env/wool_test.shtml



Introduction and Purpose

Wool has many beneficial attributes (after scouring) including it's approximately 15-17% nitrogen content, it is weed free, hypoallergenic, nearly fire proof, and able to absorb 400% of its weight in water. Due to these excellent properties, other countries have been using wool to develop fertilizer pellets (often mixed with sheep dung), blankets to establish sod roofs, building insulation, weed barrier fabric, and other novel items. This project sought to determine if wool products provided advantages over standard erosion control products, and whether these products were cost effective alternatives.

The research project started by reviewing sixteen existing wool products that might be readily adapted for

roadside reclamation uses. None of these products showed promise either due to the difficulty in importing them to the U.S., or as a result of other performance or availability challenges. In the next stage, the research team developed new roadside reclamation products in three of the most promising areas: 1) erosion control blankets (ECBs), 2) biodegradable silt fence, and 3) small cut wool pieces as an additive to wood-based compost. All three types of products were deployed for field tests along Montana highways and the rolled woolen ECBs were also deployed on a test slope at WTI's research facility outside of Lewistown, Montana. In addition, cut wool pieces and woolen ECBs were tested in the laboratory for their material properties and capabilities.

This research project was limited in scope and was

the first U.S. investigation into the incorporation of wool fiber into rolled ECB products for the transportation sector. The field investigations were designed and focused on comparing plant establishment among ECB products currently on the market and wool-blended products specifically developed and manufactured for this project. This study clearly showed that plant establishment and canopy cover on ground treated with the wool-straw ECBs meets or exceeds results from standard straw/ coconut ECBs currently on the market.

Implementation Recommendations

Recommendation 1: Further research and development of wool as a component of 100 percent biodegradable silt fence is warranted.

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MDT Response:

There are no requirements or regulations regarding silt fence biodegradability by state or federal environmental or transportation policies or regulations. Therefore, exploring the appropriate use of wool as a possible component of biodegradable silt fencing should be left to the private sector at this time. If new regulations or policy arise requiring biodegradability of silt fence, MDT will revisit helping to develop wool silt fence as a possible solution at that time.

Recommendation 2:

This project tested only one wool-compost ratio and only one commercially available compost. It found that mean seeded vegetation canopy cover was higher on compost incorporating wool pieces versus compost alone; however, the difference was not statistically significant. Further research and development is necessary to more fully understand the ideal mix of wool as an additive to compost.

MDT Response:

Since there is a lack of understanding of the ideal ratios of wool to compost or mulch types, and uncertainty how much better such products may perform compared to mulch or compost alone, MDT will not include any requirements for wool pieces in contracts for roadside reclamation using compost or mulch. Ascertaining the

proper wool-compost or wool-mulch ratios that prove to be beneficial and cost effective would benefit from further testing and we endorse any future wool project developed by MDT, FHWA, or others that includes such a research component.

Recommendation 3:

- a. Wool - straw ECBs should be used on slopes steeper than 3 horizontal:1 vertical (18.4 degrees slope).*
- b. Wool-straw ECBs should be used on roadsides with poor soils, particularly if nitrogen is limited, and/or soils that are rocky or clayey.*
- c. Wool-straw ECBs should be used in arid areas or windy locations in Montana where water stress may challenge vegetation establishment and growth.*
- d. Future adjustments to a stronger netting might allow the woolen ECBs to meet all MDT material standards for Type II and Type III erosion control blankets (see Final Report in above link or MDT Design Guidelines for all specifications).*

MDT Response:

The results of this study indicate that various ratios of wool-straw ECBs enhance the establishment of seeded grass species, at a level equal to, or exceeding, comparable coconut-straw ECBs that

currently exist on the market. The results also indicate that a portion of the wool fibers in the ECBs are present after three growing seasons.

MDT currently employs a method of addressing soil erosion protection from surface flows based on a selection matrix detailed in the MDT Permanent Erosion and Sediment Control [PESC] Design Guidelines. During the design phase, the MDT Reclamation Specialist evaluates each construction project and determines the need for enhanced erosion control or enhanced plant establishment methods - typically on cut or fill slopes steeper than 3 horizontal:1 vertical.

At the present time, based on the results of this study, the use of a wool-straw ECB overlaps those selection criteria for a standard coconut-straw ECB constructed with biodegradable threads and/or netting. Both are consistent with MDT policy that states unless otherwise specified, all non-turf reinforced mats (TRM) rolled erosion control products must be constructed of 100% biodegradable materials.

Currently, no ECB manufacturer produces a commercial line of wool-based ECBs that is available in the United States, so it is not possible to incorporate a cost benefit analysis into any MDT decision matrix at this time. It does

seem apparent that on a fine or medium textured soil, the wool - straw ECBs might increase plant establishment and canopy cover. Thus, even at a higher initial material cost, the performance of the wool-straw ECBs may provide a greater benefit than standard coconut-straw ECBs by helping more vegetation establish that can provide greater protective canopy cover and help stabilize slopes.

Therefore, when standard coconut-straw ECBs are specified in current MDT decision matrices, the results of this study indicate that a straw-

wool ECB might provide better vegetative re-establishment in conditions suggested in the recommendations: on slopes exceeding 3:1 and in roadside locations with challenging soils or environments.

We suggest that when woolen ECBs are commercially available, the MDT reclamation specialist consider their deployment on roadside slopes steeper than 3 horizontal:1 vertical, are in harsh environments, and/or have challenging soils. Woolen ECBs could be used in erosion control situations where the MDT manual requires blankets that

are durable for 1, 2 or 3 years. MDT should encourage manufacturers of the erosion control industry to create products that incorporate wool fibers as a stand-alone matrix or replacement to other fiber blend constituents. This would include encouraging the development of stronger biodegradable threads and/or netting to expand the capabilities of a wool-straw ECBs so that they perform to standards that allow their application where surface flows increase the susceptibility to soil erosion - shear stress and soil loss - such as in ditches and along streams.

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