Eco-friendly Sediment Control in Construction Sites

RoLanka International, Inc.
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Abstract

Effective sediment control has become a major task in construction sites. As enforcement of sediment control regulations has increased, the demand for sediment control devices has risen. Various types of sediment control devices are now available. Efficiency, eco-friendliness, and cost are important factors to consider when selecting sediment control devices. Until proper test methods, specifications, and standards are developed, sediment control product acceptance will be based on evaluation of their efficiency, eco-friendliness, and cost by trial-and-error.

Efficiency of a sediment control device relates to how well it blocks or traps sediment while allowing sediment free water to pass through and length of its functional life. Failure to account for functional life of a sediment control device could lead to serious problems during its applications.

Eco-friendliness of a sediment control device pertains to how well it blends with the environment during its use as well as when it is disposed of or left on site at the end of its functional life or the end of the project. Since most sediment control devices are installed for temporary use, they are required to be removed and disposed of at the end of the project. Most sediment control devices used for check dams, continuous barriers, and diversion dikes get buried in the sediment as they accumulate sediment. In general, all buried sediment control devices are required to be removed unless they are 100 percent biodegradable. Removal of these devices is expensive and takes up landfill space when disposed of.

Cost of a sediment control device can be divided into direct cost and hidden cost. Direct cost of a sediment control device is related to cost of the actual product, installation, maintenance and its reusability. Each time a sediment control product fails, it produces irreversible environmental damage by allowing sediment to move away from the site and, in some instances, into nearby water bodies. Such harm to environment can be identified as a hidden cost of the failed sediment control product. Similarly, sediment control products that require disposal in a landfill entail a hidden cost in the form of the space they occupy in the landfill.

Introduction

Erosion control and sediment control go hand-in-hand. Consequently, many erosion control professionals are also involved in controlling sediment, which has become a major challenge at construction sites. As enforcement of the regulations for strict sediment control practices has increased, the demand for sediment control devices has risen. Various types of sediment control devices are now available and more new and improved sediment control devices are introduced each year.

Standards, specifications, and test procedures for erosion control products and applications have advanced significantly in recent years. However, because the sediment control industry is fairly new, such practices for sediment control products and applications have not yet reached comparable levels. As it was with erosion control products, sediment control products will go through phases of industry acceptance before well-established standards, specifications, and test procedures are developed.

Typically, when there is no field performance or test data to support a new erosion or sediment control product, a specifier, contractor or project owner has to rely on information provided by the marketing literature. Often, the most suitable product for an application is identified through trial and error.

Fiber roving systems (FRS) for controlling erosion in channels and slopes offer an example from the erosion control industry. FRS consists of spraying asphalt emulsion on the soil surface and then spraying synthetic fibers on top. FRS was introduced over 10 years ago with a strong marketing program. Initially, thousands of square yards of FRS were applied. Over time, alternative products were developed and end users began favoring them over FRS. As a result, usage of FRS declined over the years. Table 1 shows annual erosion control product usage for Georgia Department of Transportation (GDOT) for the past five years (1). The data show significant decrease in FRS (Bituminous Treated Roving) usage during the past five years. On the other hand data show significant increases in erosion control mats and wood fiber blankets usage. In the GDOT sprayed on mats or bonded fiber matrix product is referred to as wood fiber blankets. If end users were properly educated about the advantages and disadvantages of FRS at the beginning, most probably would not have used it in the first place. Similarly, with time, end users of sediment control products will identify those best suited for their applications.

Table 1: Annual Erosion Control Product Usage for Georgia Department of Transportation

	1999	2000	2001	2002	2003
Permanent Soil Reinforcing Mat (TRM), SY (% compared to 1999)	163,465 (100%)	126,424 (77%)	46,359 (28%)	36,772 (22%)	61,628 (38%)
Bituminous Treated Roving (FRS), SY (% compared to 1999)	223,153 (100%)	143,221 (64%)	92,756 (42%)	151,700 (68%)	157,294 (70%)
Erosion Control Mat (RECP), SY (% compared to 1999)	785,748 (100%)	1,130,520 (144%)	564,617 (72%)	1,187,874 (151%)	916,874 (117%)
Wood Fiber Blanket I&II (BFM), SY (% compared to 2000)	0	1,034,395 (100%)	868,521 (84%)	2,724,936 (263%)	2,593,236 (251%)

Note: Wood fiber blanket usage started in year 2000

Objectives

Since there are no established guidelines for selecting sediment control products, many end users are going through a period of trial-and-error in choosing them. This paper presents some major factors to consider in selecting sediment control products. This information may be also helpful

to those who develop new and improved sediment control products. By looking at the evolution of erosion control products, this paper is designed to highlight possible harm to the environment by developing and using non-degradable sediment control products.

Important Features in a Sediment Control Device

There is a major difference between erosion control products and sediment control products. Erosion control products are use to control erosion in either the short term or long-term, depending on the project. For example, degradable blankets control erosion until vegetation can become established to control erosion permanently. Permanent turf reinforcement mats (TRMs) control erosion after installation and assist vegetation in controlling erosion permanently once vegetation is established. Erosion control products are not required to be removed at the end of the project.

On the other hand, most sediment control products in construction applications are used on a temporary basis. The function of a sediment control product is to prevent sediment from washing off a construction site and into nearby water bodies. At the end of the construction project, permanent measures are installed to prevent erosion. This eliminates dislodging of sediment that can wash off the site to pollute water bodies. It is important to recognize this fundamental difference – the temporary use of sediment control products and the permanent use of most erosion control products – in the development and application of these two types of products.

The key factors in selecting a sediment control device are efficiency, eco-friendliness, and cost.

Efficiency

Efficiency of a sediment control device relates to how well it blocks or traps sediment while allowing sediment free water to pass through, and the length of its functional life. Failure to account for functional life of a sediment control device could lead to serious problems. If a sediment control device performs well for a short time and gets clogged with accumulating sediment, it can quickly loose its filtering capability and fail. This failure can be flooding or collapse of the device or both. On the other hand, if the device fails to trap any sediment, it's of no value. Until proper test methods and specifications are develop to measure the efficiency of sediment control devices, it is important to have some general idea on how the device traps sediment.

Eco-friendliness

Eco-friendliness of a sediment control device pertains to how well it blends with the environment during and after its use. Since most sediment control devices are designed for temporary use, they are required to be removed and disposed of at the end of the project. In terms of eco-friendliness, it makes sense to use biodegradable sediment control products if possible. Most sediment control devices used as check dams, continuous barriers, and diversion dikes get buried as they accumulate sediment. In general, all buried sediment control devices are required to be removed unless they are 100 percent biodegradable. Removal of these devices is expensive and disposal takes up limited space at landfills. In addition, most of the biodegradable sediment control products create an aesthetically-pleasing appearance in their applications (Figure 1).

Figure 1. Most of the biodegradable natural fiber sediment control products create an aesthetically pleasant appearance in their applications

Cost

Cost of a sediment control device can be divided into direct cost and hidden cost. Direct costs of a sediment control device include costs of the actual product, installation, maintenance, and its reusability. Material costs of some traditional sediment control products, such as hay bales, are less than many manufactured products. But the installation and maintenance costs of hay bales are fairly high. Past experience shows that products with high maintenance cost frequently fail in the field (Figure 2). Each time a sediment control product fails, it produces irreversible environmental damage by allowing sediment to move away from the site and, in some instances, into nearby water bodies. Such harm to environment can be identified as a hidden cost of the failed sediment control product. Similarly, sediment control products that require disposal in a landfill entail a hidden cost in the form of the space they occupy in the landfill (Figure 3). Other hidden costs can include the extra work involved with removing and/or transporting products to the landfill. Usually, these hidden costs are passed on the taxpayers.

Figure 2. Failed silt fence check dam.

Figure 3. End of a project non-degradable sediment control products heading to a landfill.

The costs of silt fence

Silt fence is used in various ways to control sediment. They vary from plain silt fence with wooden stakes to stronger fabric with metal wire backing and metal posts. All silt fence fabric used in a project is required to be removed and properly disposed of at the end of the project. In addition, if metal posts and wire meshes can't be re-used, they also must be disposed of. Recently, prices of metal posts and wire backing have increased due to high demand for scrap metal in the world market. The use of eco-friendly sediment control products can avoid the material and hidden costs of non-degradable sediment control products.

Eco-friendly Sediment Control

Based on the development and use of degradable products in the erosion control industry and recent trends, eco-friendly products are likely to attract much more attention from end users in the future. Therefore, it is sensible for sediment control product manufacturers to consider eco-friendly raw material in developing their product. The availability of efficient, eco-friendly, and cost effective sediment control products will encourage greater use throughout the industry.

Currently, eco-friendly sediment control products are attracting increasing interest by end users. The raw materials used in these eco-friendly sediment control products are mainly natural fibers, such as straw, wood, jute and coir. The type of raw material used in these products is directly related to functional life of the products. For example, those made of straw have shorter functional life than coir-based products. Reusability is also related to functional life. Most coir-based sediment control products are reusable while straw-based products are a one-time use item. On the other hand, straw products cost less than those made of coir. Therefore, end users should identify what is best for their needs. Products manufactured from natural raw materials, like straw and coir, also provide a market for abundant byproducts.

End User Acceptance of Sediment Control Product through Trial-And-Error

Preventing sediment from entering curb-side stormwater inlets in new development projects is critical for protecting water quality. However, to protect inlets effectively, a sediment control devices must achieve several goals:

Allow stormwater to flow through it

Using an inlet protection product with no filtering capability can cause flooding during and after a storm event.

Trap sediment

A product with no ability to trap sediment fails to accomplish its purpose. *Withstand damage from construction vehicle traffic*

Many inlet protection devices are exposed to truck traffic. They must be able to continue functioning even if run over by a vehicle.

In addition to above described goals some product may require extra labor for installation and also require disposal in a landfill at the end of the project (Figure 4).

Figure 4. Two types of sediment control products for curb side inlet protection. Classic examples for inlet protection devices with low efficiency, poor eco-friendliness, and high cost.

Chris Masaschi is the Project Manager with Vintage Communities, a home builder in Lawrenceville, Georgia and David Walker is the President of Walker Erosion Control in Jackson, Georgia. The following except is from an unpublished article (2) where Masachi and Walker describe their trial-and-error experiences to identify a cost-effective product for their curb side inlet protection applications (Figure 5).

Figure 5. Before and after rainstorm pictures of a coir wattle curb side inlet protection device.

At one time, Masaschi placed a pig-in-a-blanket – four masonry blocks spaced a few inches apart and wrapped in silt fence fabric -- around a storm drain inlet to keep sediment from washing into catch basins. He likes using a 9-in. diameter, 15-ft. long coir wattle to do the job a whole lot better.

"To protect 30 catch basins in a subdivision, we needed 120 blocks," he says. "Also, we had to cut fabric and wrap the blocks for each basin. It would take two or three guys all day

long to complete the job. Even then, these structures weren't very effective because water would wash underneath the gaps between the blocks, dumping sediment into the basins."

The coir wattles are much easier to install and maintain. "We just lay a coir wattle around the inlet and scoop the mud out from in front of it after each storm," Masaschi says. "When it becomes loaded with sediment, we'll dispose of it or put it behind the curb to biodegrade."

Unlike the masonry blocks, the coir wattles don't break when run over by trucks. "They may flatten a little, but I've never had to replace one," he says.

Even more important, coir wattles are much more effective in trapping sediment than masonry blocks and fabric, Masaschi notes. "Coir wattles keep about 95 percent of the sediment from getting inside the catch basin," he says. "I'm absolutely satisfied with them."

In addition to fabric-wrapped masonry blocks, Walker has tried other materials for keeping sediment from washing into catch basins. They include wood fiber enclosed in a netting, rock-filled plastic bags and straw wattles. None have been as effective or as durable as the coir wattles, he says.

Cleaning out sediment from around the masonry blocks was difficult, he notes. The wood fiber rolls and plastic bags often broke when run over by vehicles, while the straw wattles would fill completely with sediment after just three or four storms.

"When sediment builds up in the coir wattle I can wash it out with hose, let it dry and it's almost as good as new," he says. "They'll last about 6 months before I have to replace them."

Walker uses coir wattles that are 15 ft long and 9-in. in diameter. "That's big enough to catch the sediment but not so big that much water backs up over the curb," he says.

Most importantly, the coir wattles control sediment, he notes. "I've had streets covered with sediment after a storm and when I pull the wattles away the inside of the catch basins are absolutely clean," he says. "I couldn't ask for a better job."

Conclusions

1. Until proper test methods, specifications, and standards are developed, acceptance of sediment control product will be based on trial-and-error evaluation of their efficiency, eco-friendliness, and cost.
2. A major fundamental difference between erosion control and sediment control products is the permanent nature of erosion control product applications versus the temporary nature of sediment control product applications. The temporary use of most sediment control products must be acknowledged in their applications as well as in their-development.
3. When selecting sediment control products it is important to take into account their associated hidden costs due to possible harm to the environment and disposal in landfills.

Reference

1. Georgia Department of Transportation, "Annual item mean summary reports".
2. Northcutt, Greg 2004 "Versatile Coir Wattles Offer Cost-Effective Sediment Control at Construction Sites" Unpublished Article.