TECHNICAL COMPARISON

Erosion Control Blankets *vs* Profile Products' Hydraulically-applied Erosion Control Products

Introduction

This comparison offers a comprehensive technical review of advantages and disadvantages to be considered in the selection of the two most common categories of erosion control products: Hydraulically-applied Erosion Control Products (HECPs) and Erosion Control Blankets (ECBs).

Below is a list of criteria that will be covered in more detail in this comparison.

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Environmental Concerns

1. Wildlife Entanglement

Growing concerns over wildlife entanglement have led to many states introducing strict limitations or even bans on "degradable" plastic mesh used in erosion control blankets. It is important to select products, when protecting the environment from erosion, that are not inadvertently causing separate environmental issues. Non-Toxic HECPs, verified by EPA 2021.0 testing, pose no reported negative impacts to the environment or wildlife. There are no loose plastic nettings, threads or staples, which are inherent to many blankets. Nettings found in many rolled erosion control blankets have a long history of wildlife entanglement. Countless snakes, lizards, birds, and other small animals are killed every year due to becoming entangled or trapped in the netting found in erosion control blankets. When selecting ECBs it is important to select either net-less products or products that incorporate netting designed to minimize entanglement issues. If the site is environmentally sensitive due to possible presence of threatened or endangered species and avoidance measures are required, it is advisable to eliminate the introduction of any netting to the site.

2. Introduction of Plastics and Microplastics

Each layer of polypropylene net on a typical erosion control blanket weighs approximately 2.65 lb/1,000 square feet (1.29 kg/100 sq. m.). When installed according to manufacturer specifications a double-net blanket, with a conservative 5% waste assumption for overlap and trenching, yields **242 lb** of plastic per acre (271 kg/ha). This is the equivalent amount of plastic as **11,106** single-use, 16.9 ounce water bottles (9.9 g/bottle). Further, as the plastic nettings in erosion control blankets break down into smaller pieces and are deposited in receiving water bodies, they will directly contribute to the accumulation of microplastics in the environment. Widespread accumulation of microplastics in the environment and their associated negative effects in soils and watersheds are well known. However, the long-term consequences of plastic accumulation in the environment, as poorly reversible pollutants, are just beginning to be researched and quantified.

Project Site Evaluation

1. Site Safety

The ultimate goal of every construction project should be to close out the project efficiently and safely. If injuries are plaguing a work site, it can negatively affect many aspects of the project, company, and the perceptions that others have of the entire operation. When applying HECPs it is extremely important that machine operators are familiar with the equipment and practice safe operating procedures at all times. Although machinery is typically not directly related to ECB installation it is important to exercise caution when other large machinery is operating in the same vicinity. Additionally, installing ECBs may require installers to maneuver on steep inclines and position themselves near harmful wildlife and/or vegetation. Ensuring seeding and erosion control installations are efficient, without adding inherent dangers of rushing to finish, is vital to project success.

2. Soil Preparation and Existing Conditions

In the Revised Universal Soil Loss Equation (RUSLE), the Practice Factor (P-Factor) of the calculation, or how the substrate is prepared prior to any erosion control product installation, can greatly influence the anticipated annual soil loss on a site. Table 1 shows some of the most common soil and substrate preparation practices, their corresponding P-Factors, and the potential soil loss relative to a neutral P-Factor of 1.0.

Table 1 - P-Factors and Corresponding Soil Loss

P-Factor Practice	P-Factor Value	Potential Annual Soil Loss Relative to P-Factor
Compact and Smooth Surface	1.2	120,000 lb/ac (134,500 kg/ha)
Loose – Disked Plowed Slope	1.0	100,000 lb/ac (112,100 kg/ha)
Rough Surface with Tracks in all Directions	0.9	90,000 lb/ac (100,900 kg/ha)
Tracked Up and Down Slope	0.7	70,000 lb/ac (78,500 kg/ha)

ASTM D8298 - Type 1 — Large Scale testing conducted at Utah Water Research Laboratory.

As noted in Table 1, a loose/disk-plowed slope has a default P-Factor of 1.0 versus a compact and smooth surface P-Factor of 1.2, or 20% greater potential for soil erosion. Rough cat-tracked slopes decrease the P-Factor to 0.7 resulting in a 30% reduction in potential soil loss versus disk plowed slopes. Soil surfaces must be smooth graded to accommodate ECBs as any debris or rough subgrade can potentially cause a rolled blanket to bridge or tent over the soil and lose intimate contact. This suggests a significant increase in potential soil loss when smooth grading slopes to accommodate ECBs versus the less costly practice of rough grading or tracking slopes. Roughened and/or tracked slopes can also increase infiltration and reduce the total amount of water leaving the site. Applying HECPs over tracked slopes and/or rough subgrades will further enhance erosion protection as they form an intimate bond with the roughened soil surface while utilizing the benefits of increased moisture concentration in the furrows.

3. Topography

Prior to creating a plan for erosion and sediment control, it is important to understand topographical features surrounding the site. This can be accomplished by viewing a topographical map, but to gain an idea of site specifics and possible issues, an inspection must be executed. Important topographic characteristics include slope length (L-Factor in soil loss equations), slope gradient (S-Factor in soil loss equations), areas where water will concentrate and any benches or slope interruptions on the site. Most erosion control products have limits for each of these parameters, which will dictate product selection. These site characteristics will not only allow a specifier to decipher whether a low or high performance erosion control product is needed, but also whether an HECP or ECB would be better suited.

4. Site Location and Access

Site location is important when selecting an erosion control/revegetation product. Location will dictate anticipated rainfall quantities, seasonality and intensity of storm events. There are databases available which have accumulated years of rainfall frequency and intensity data to calculate localized values for rainfall erosivity (R-Factor in soil loss equations). These R-Factors are used to accurately calculate the quantity of soil loss for specific locations and conditions. Site specific R-Factors must be taken into consideration to ensure performance properties are sufficient to meet the climatic conditions. This will provide realistic insights on the success of selected Best Management Practices (BMPs).

Site access can also play a large role when selecting erosion control products. Although a majority of disturbed areas are accessible by heavy equipment, there are scenarios where locations may be inaccessible by standard hydroseeding equipment. In these instances, ECBs may be the most cost-effective option. Some projects have such extreme slopes that the only way to ensure worker safety, when installing ECBs, is for workers to use safety harnesses. In these extreme circumstances, HECPs may be safer if the application area is within reach of the tower on a hydroseeder. Newer high-volume hydroseeding equipment is often capable of reaching distances of 300 feet (90 m). HECPs may be aerially applied using helicopters or fixed wing aircraft on sites with extreme slopes or poor access.

5. Soil Properties

Physical and chemical soil properties are often overlooked when selecting erosion control materials but typically play a critical role in how successful the selected product will be. If substrates are rocky and/or difficult to prepare, HECPs are a clear choice. As discussed earlier, ECBs require completely smooth surfaces and installing pins or trenches into a rocky substrate is extremely difficult and often completely ineffective. Sandy soils are typically ideal for ECBs as the slopes are easy to prepare and staples and pins are easy to install. However, staples and pins may not have as strong of a hold in sandy substrates.

When reviewing the agronomic potential of onsite soils, it is important to get an idea of how quickly vegetation may become established. If the soils are being treated with a pH neutralizer, it may take some time for the soil to reach a pH that is viable for vegetation establishment. In this scenario, it would be important to select a product that has a long functional longevity. Furthermore, if the soil needs additional amendments to correct imbalances, HECPs can typically be applied with many of these products in the same application.

Product Performance Criteria

1. Erosion Control Effectiveness

As the main purpose of any erosion control product installation is to minimize sediment detachment and transportation, erosion control effectiveness must be a primary consideration. Percent Effectiveness (PE) is a measure of the ability of an HECP or ECB to protect the soil from erosion due to rain drop impact and overland flow. Percent effectiveness is inversely related to the Cover Factor (C-Factor) from the Revised Universal Soil Loss Equation (RUSLE) and can be calculated by the following relationship:

$$PE = (1\text{-}C) \times 100\%$$

The C-Factor is commonly evaluated using large-scale testing with rainfall simulators at universities and private test labs. It is the ratio of soil loss on the unprotected control slope versus soil loss on the treated slope when evaluated under identical conditions. Typical rainfall intensities range from 2-6 in./hr. (51-152 mm/hr.) with testing durations ranging from 20-60 minutes. C-Factors can be variable and depend on duration of the rainfall event, intensity of the event, size of the raindrops, soil type, slope gradient, slope length and HECP application rate. Unless field conditions match those evaluated in the laboratory, the use of this testing parameter to quantify actual field performance can be difficult and subjective. However, evaluating C-Factors in a controlled environment does provide the ability to directly compare performance between different erosion control materials when tested under identical conditions at the same laboratory. Erosion control effectiveness results for a variety of both HECPs and ECBs under laboratory conditions are shown in Table 2.

Table 2 - Product C-Factor and Percent Effectiveness

Product Type	Product	C-Factor [1,3]	% Effectiveness [2]
HECP	Flexterra® HP-FGM™	≤ 0.01	≥ 99%
ECB	Double Net Excelsior	≤ 0.03	≥ 97%
HECP	ProMatrix® EFM & HydroStraw® HE BFM	≤ 0.05	≥ 95%
ECB	Single Net Excelsior	≤ 0.08	≥ 92%
ECB	Double Net Straw	≤ 0.10	≥ 90%
HECP	Profile® Wood with Tack & HydroStraw® HE Plus	≤ 0.25	≥ 75%
ECB	Single Net Straw	≤ 0.25	≥ 75%
HECP	Profile® Wood & HydroStraw® HE Original	≤ 0.30	≥ 70%

1. Cover Factor is calculated as soil loss ratio of treated surface versus an untreated control surface.
2. % Effectiveness = One minus Cover Factor multiplied by 100%.
3. ASTM D8298 - Type 1

As displayed in Table 2, erosion control effectiveness varies greatly from product to product. These meticulously prepared test slopes are perfect to test these products side-by-side and allow for direct comparisons, but in the field perfectly smooth slope conditions are a rarity.

2. Vegetative Establishment

Vegetative establishment is the measure of an erosion control material's ability to increase seed germination and plant growth and is evaluated using ASTM D7322 for ECBs or a slightly modified version of ASTM D7322 to accommodate HECPs. This method compares the ability of an erosion control product to establish vegetation relative to a bare soil control. The higher the value for vegetative establishment, the faster the desired cover of vegetation may be achieved. This property is highly dependent on the water-holding capacity of the medium. Table 3 provides ASTM D7322 results for a variety of common erosion control products and shows great variability by product and product type.

Table 3 - Vegetative Establishment

Product Type	Product	Vegetative Establishment (ASTM D7322)
HECP	Flexterra® HP-FGM™	800%
HECP	ProMatrix® EFM	600%
ECB	Double Net Excelsior	500%
HECP	HydroStraw® HE BFM	450%
ECB	Double Net Straw	350%
ECB	Single Net Excelsior	330%
HECP	Profile® Wood with Tack & HydroStraw® HE Plus	250%
HECP	Profile® Wood & HydroStraw® HE Original	200%
ECB	Single Net Straw	200%

3. Functional Longevity

Functional longevity is a measure of how long an ECB or HECP can be expected to adequately protect seed and soil from splash and overland flow caused by rainfall. Varying from region to region, functional longevity depends primarily on climatic conditions such as the intensity, duration and frequency of precipitation events, incoming solar radiation, temperature, and microbial activity. Other parameters affecting functional longevity include slope aspect, gradient, and length as well as soil type, vegetation type and density. Functional longevity can typically be correlated with percent effectiveness, but the best method of determination is field experience and judgment by a qualified professional in conjunction with ASTM D5338. Longevity of a product is an important consideration on challenging slopes and sites with high erosion potential or the possibility of delayed germination, which is common with many native plant species or when the climate is arid. Most HECPs have a functional longevity between 3 and 24 months. Typically, ECBs can have functional longevities between 3 and 36 months as the plastic netting on a blanket can often outlast the mechanical and chemical bonds of HECPs. The functional longevity of a product is not as important of a factor if vegetation is expected to rapidly cover the site and provide long-term erosion control.

Installation Considerations

1. Seed Dispersion

Seed dispersion is an extremely important factor to consider when deciding how to seed and install erosion control products on a project site. HECP applications that include seed are extremely effective at randomly dispersing seed of various sizes and weights and keeping them in the location that they were applied; as no additional site disturbances are required. If seed is broadcasted and installers place ECBs over the completely smooth slope, seeds tend to migrate down the slope during installation. This can be minimized through drill seeding.

2. Installation Efficiency

By selecting the most efficient erosion control solution one can decrease labor cost, minimize site traffic and allow vegetation to start establishing earlier. Considerations that affect installation efficiency, and are critical when deciding between ECBs and HECPs, are listed and described below:

- Site Size - On larger sites, HECPs can typically be applied at a faster rate with less workers on the site. If the site is very small, it may not be effective to mobilize and mix a large quantity of HECP slurry. On projects with minimal disturbance one may want to incorporate ECBs or pelletized mulches, however, other site conditions must also be factored in.

- One Step Application - Applying seed, amendments, fertilizer, and an HECP in one application is much more efficient than the multiple applications required during an ECB installation.
- Site Access - Site access for an erosion control application can often be a deciding factor for which solution will be more efficient. There are instances where sites can not be accessed safely by hydroseeder or foot and helicopter applications of HECPs have been made.
- Site Safety - There are instances, such as an extreme slope gradients, where installing ECBs can be dangerous and direct site access should be limited. HECPs can be applied from a distance using both hose and tower applications.
- Water Access - If water is inaccessible on a site, hydroseeding may not be cost effective.
- Substrate - Rocky, hard, or frozen substrates can be extremely difficult to penetrate with staples and pins. Additionally, these substrates are very difficult to prepare completely smooth, which is necessary for blankets to effectively contact the substrate.

Inspection and Maintenance

1. Ease of Follow-up Inspections

When an ECB is improperly installed it may not be apparent to a site inspector. If there is tenting on a site, it may still appear that the site is sufficiently covered. Inspecting installations for staples that are flush to the surface and in an adequate pattern and frequency, according to the specifications, and that they are sufficiently holding must be made. When inspecting sites that have been covered with an HECP it is important to ensure that the site has received 100% cover from the HECP. If bare soil is still visible, the product was likely under applied. When inspecting HECPs, it is important to inspect the site from multiple angles. This will ensure that on rough graded slopes "shadowing" was not an issue and 100% coverage was achieved.

2. Maintenance Issues

If a revegetated area is to be mowed after vegetation is established, it is important to note which type of erosion control product has been used on the site. If site maintenance calls for an area to be mowed once it is established, HECPs will not cause any issues. ECBs may not cause issues, but it is possible that netting may be ripped out of the ground and mower blades may become tangled. Even netting that is photodegradable can take many years to degrade and speed of degradation is extremely dependent on site conditions. Once "degraded" the remnants will remain in the soil or transport into receiving waterbodies as previously noted. Additionally, if the pins or staples are not inserted flush into the substrate, the mower can hit them, damaging blades or creating projectiles. The same can be true for loose staples or pins which can also puncture vehicle tires.

Conclusion

With so many variables to consider when selecting proper erosion control products it is often difficult to weigh the pros and cons of each. Table 4 breaks down some of the benefits that were covered in this technical note and more clearly show the major differentiating factors.

Table 4 - HECP and ECB Benefits

Benefit	HECPs	ECBs
Minimal site preparation	YES	NO
Labor savings on installation	YES	NO
No machine required	NO	YES
Easily applied on frozen substrates	YES	NO
Easily applied on rocky soils	YES	NO
May be applied in areas of concentrated flow	NO	YES
No netting or staples	YES	NO
No water needed for install	NO	YES
Install seed, amendments, & fertilizer at same time	YES	NO
Plastic-Free	YES	NO

There may not always be a perfect solution for every site; but by weighing product options, researching new technologies, and taking an in-depth look at all of the possible limiting parameters of each site one will maximize success on each site with proper product selection.