Erosion Control
Technology Council

FACT SHEET:

HYDRAULIC EROSION CONTROL PRODUCTS (HECPS)

Stormwater Technology Fact Sheet

Hydraulic Erosion Control Products (HECPs)

Subcategory: *Erosion Control*

Description

This fact sheet describes the use of hydraulic erosion control products (HECPs).

HECPs are mixed with water and spray-applied to soil for erosion control and to assist in establishing vegetation. Over the past 55 years, hydraulically applied erosion control products have gone through significant changes and technical advancements to meet the needs of the erosion control, revegetation, and reclamation industries. They provide the convenience of quick and easy application where seed, fertilizer, and soil amendments are mixed with the HECP and sprayed together using hydraulic seeding equipment.

HECPs are typically composed of a mulch component such as wood, wood cellulose, recycled newsprint, straw, cotton, and other plant fibers, along with tackifiers and polymers. The tackifier and polymer components are typically incorporated to provide increased viscosity and adhesion of the hydraulic slurry to soil. ECTC categorizes HECPs into five different types based on erosion control performance, vegetation establishment and estimated functional longevity. ECTC Type 1 HECPs are designed for use on relatively flat areas for an ultra-short term lasting up to 1 month; ECTC Type 2 HECPs are designed for use on minimal slopes area and for short term lasting up to two months; ECTC Type 3 HECPs are designed for moderate slopes and moderate term lasting up to three months, and ECTC Types 4 HECPs are designed for steep slopes and extended term sites needing erosion protection for 6 months; ECTC Type 5 HECPs are designed for steeper slopes (as compared to other HECPs) and erosion control needs of 12 months.

HECPs accommodate a vast array of site requirements ranging from temporary stabilization where no long-term cover is desired, to the most challenging revegetation conditions. For instance, ECTC recommends that Type 1 HECP (basic hydraulic erosion control material) for applications where erosion protection is needed for one month or less, on slope gradients and lengths not exceeding 4:1 (H:V) and 20 ft. (6 m) length. Products meeting this category must demonstrate an acceptable maximum C-factor of 0.75 on large-scale slope performance testing, such as ASTM D6459 as well as a minimum vegetation establishment of 150% based on ASTM D7322 testing protocol.

ECTC Type 5 HECPs may be used on slopes up to 1:1: (V:H) with lengths of 75 feet to 100 feet (22.9 meters to 30.5meters) with an estimated functional longevity of 12 months.   Products meeting this category must demonstrate an acceptable maximum C-factor of 0.02 on large-scale slope performance testing, such as ASTM D6459. As well as a minimum vegetation establishment of 400% based on ASTM D7322 testing protocol.

Although the industry historically used generic category names based on component makeup of the HECP products, ECTC has lead the change to a performance-based naming and specifications to better serve designing needs and requirements.   General guidelines for the naming transition are as follows: Base mulch is classified ECTC type 1, Mulch plus Tack is ECTC type 2, Stabilized Mulch Matrix (SMM) is ECTC type 3, Bonded fiber matrices (BFM), or other high-performance HECPs are ECTC Type 4, and Fiber reinforced matrices or other long-lasting, high-performance HECPs, are ECTC Type 5 category. Independent third-party performance testing should be reported to meet this updated industry standard naming practice. For further information on HECP classification, please refer to Standard Specification for Hydraulic Erosion Control Products published by Erosion Control Technology Council www.ectc.org/toolbox.

Figure 1: Measure the Area to be Treated to Calculate the Amount of HECP Needed at the Desired Application Rate.

Applicability

The two primary goals when using HECPs are erosion control and vegetation establishment. HECPs can provide immediate erosion protection while creating an environment that assists in accelerating seed germination and plant growth. Vegetation then provides the long-term erosion protection while improving site aesthetics and acting as a filter to prevent sediment and other undesirable stormwater constituents from entering receiving water bodies.

HECPs can be applied to an uneven surface to help facilitate vegetation growth. Modern hydraulic equipment can pump HECP slurries over 1000 feet (305 meter) or can be applied with a cannon-mounted on top of hydraulic seeding equipment to distances of 300 of feet. This too is the case for remote or hard to safely access sites that need stabilization, erosion control or revegetation.

Advantages & Limitations

HECP installation requires several steps to be followed properly for successful applications. Some of these important steps include proper water to dry HECP mixture, proper mixing time, proper mixing equipment, water source, application of slurry in at least two directions by a trained applicator, even application of slurry across surface, etc. Application by helicopter/airplane can provide protections to areas inaccessible by traditional methods. Properly planned aerial applications can also cover large areas in less time. Other benefits include increased germination by the introduction of water and seed at application and HECPs are visually pleasing immediately after application to a site.

HECPs can offer both chemical and physical fiber-to-fiber bond and achieve performance for stability upon installation. HECPs shall be nontoxic and safe for wildlife.

HECPs do have limitations and ECTC does not recommend the use of HECP alone in areas of concentrated flows such as channels. Please refer to ECTC Channel specifications https://www.ectc.org/product-selection-tool-for-channel. HECPs are not designed to have foot or vehicle traffic on them after application. A nontoxic water source is required for use with HECPs.

Table 1. ECTC Hydraulic Erosion Control Products (HECPs) Specifications

Hydraulic Erosion Control								
			Typical Application Rates	Typical Maximum Slope Gradient	Maximum Uninterrupted Slope Length	Maximum C Factor[4, 5]	Minimum Vegetation	
Type [2]	Term	Functional Longevity[3]	Lb./acre (kg/ha)	(H:V)	(ft.)	(3:1 test)	Establishment[6]
1	Ultra Short	1 month	1500—2500 (1700—2800)	$\leq$ 5:1	20	0.3	150 %
2	Short Term	2 month	2000—3000 (2250—3400)	$\leq$ 4:1	25	0.2	150 %
3	Moderate Term	3 month	2000—3500 (2250—3900)	$\leq$ 3:1	50	0.1	200 %
4	Extended Term	6 month	2500—4000 (2800—4500)	$\leq$ 2:1	75	0.05	300 %
5	Long Term	12 month	3000—4500 (3400—5100)	$\leq$ 2:1	100	0.02	300 %

1 This table is for general guidelines only. Refer to manufacturer for application rates, instructions, gradients, maximum continuous slope lengths and other site specific recommendations.

2 These categories are independent of rolled erosion control products (RECPs) categories, despite the identical names.

3 A manufacturer's estimated time period, based upon field observations, that a material can be anticipated to provide erosion control as influenced by it composition and site-specific conditions.

4 "C" Factor calculated as ratio of soil loss from HECP protected slope (tested at specified or greater gradient, h:v) to ratio of soil loss from unprotected (control) plot based on large-scale testing.

5 Acceptable large-scale test methods may include ASTM D 6459, or other independent testing deemed acceptable by the engineer.

6 Minimum vegetation establishment is calculated as outlined in ASTM D 7322 being a percentage by dividing the plant mass per area of the protected plot by the plant mass per area of the control plot.

Design Considerations

Soil, water, and vegetation must be carefully considered to achieve effective erosion control on a job site. When selecting HECPs the design considerations should be well thought-out. It is important to identify sustainable erosion control objectives and collect site-specific data. It is important to understand the parameters that will affect erosion on the site. Some design considerations are:

- Site accessibility
- Project requirements and expectations
- Other BMPs requirements to achieve overall site goals
- Soil composition
- Slope steepness & length
- Seed and Plant selection or requirements
- Vegetation establishment time based on seed, climate, and plant selection
- Estimated soil loss from the site
- Installation considerations and restrictions for the specific job site
- Water source, quality, available quantity and proximity to job site
- Proper installation equipment requirements

Site reconnaissance and data collection is important to engineer the project appropriately. The designer should use the data collected when developing the project. Examples of site data needed would include a soil test, recording local vegetation (type, species, and density), whether

Figure 2: Embankment and Fill Areas Should be Rolled with a Crimping or Punching Type Roller or Track Walked so that Track / Cleat Marks from the Equipment Form an Indentation on the Slope that is Parallel to the Contour of the Slope (Perpendicular to the Flow of Water Moving Down the Slope).

the site is disturbed or pristine and soil conditions needed to support vegetation. Note the hydrology (flow paths) and the geology. Record the current conditions regarding slope aspect, slope angle and construction type (cut slope/fill slope). Research the site history. Then analyze and design the new topography changes and the effects those changes may have on hydrologic flow paths and other factors.

During the design and BMP selection process use the Revised Universal Soil Loss Equation (RUSLE) to assess the erosion potential of the site. RUSLE is a quantitative procedure for estimating soil loss due to erosion in tons per acre per year. Reviewing large scale slope testing results, such as ASTM D6459, and other conditions identified in the ECTC standard specification will provide guidance to choosing the proper HECP. Designers should compare the estimated soil loss from the site in a bare soil condition and HECP in place as it relates to both the temporary cover and the permanent vegetation. (See the Performance section for more details on cover factors for cover materials.)

HECPs are designed to work for a variety of longevities, slope lengths and gradients. The nature of degradation should be factored into the design consideration. For example, in areas where vegetation may be slow to establish, ECTC type 4 or type 5 should be selected. However, if hydroseeding a finished landscape site with known irrigation, ECTC Type 1, 2 or 3 may be sufficient for the application.

An example calculation for total number of bags of HECP required for the entire project:

Note: slight differences in Imperial and Metric calculations due to rounding.

Total size of project = 60,000 square feet (sf) [5,575 square meters (sm)]
Target HECP application rate = 3,000 lbs/acre [3,363 kg/ha]
Weight of mulch per bag = 50 lbs [22.6 kg]

Convert sf (sm) to acres (ha)

60,000 sf ÷ 43,560 sf / acre = 1.38 acres
5,575 sm ÷ 10,000 sm / ha = 0.5575 hectare

Calculate total weight of HECP at target application rate

3,000 lbs / acre x 1.38 acres = 4,140 lbs of mulch
3,363 kg / ha x 0.5575 ha = 1,875 kgs of mulch

Calculate total number of HECP bags (rounded up to next whole number)

4,140 lbs ÷ 50 lbs / bag = 83 bags
1,875 kgs 22.6 kg / bag = 83 bags

Therefore: a total of 83 bags of HECP would be required.

Figure 3. Calculation to Determine Quantity of HECP Required for the Project.

Installation

Step One: Site and Measurement Preparation. As in any erosion control application, it is necessary to prepare the site and the soil properly. An advantage to hydraulic erosion control products is that they can be applied to rough and uneven surfaces, sometimes even in areas where walking is not possible. Contractors can apply HECPs to surfaces that are not practical for other BMPs. For best results**:**

- Prepare seedbed to be free of rocks, roots, dirt clods, and any other unwanted debris. Measure the total area to be treated using reliable equipment. Record the measurements in square feet or square meters. Increased surface texture will increase surface areas. Designers must ensure proper application rates based upon the manufacturers recommendations. See Figure 1.
- Before application, embankment and fill areas should be rolled with a crimping or punching type roller or track walked. Track walking should be used where other methods are impractical. See Figure 2.

Note that HECPs are designed to provide surface erosion protection and should not be used alone on geotechnically unstable slopes. Hydraulically applied erosion control products shall be applied per the manufacturer's recommendations.

Calculation to determine the number of bags of mulch to place into the tank:

$$\frac{\text{Working capacity of tank (gallons or liters)}}{\text{Water mixing rate per bag (gallons or liters)}} = \textbf{Tank Capacity} \text{ (number of bags per tank)}$$

Assuming use of HECP with water: HECP mix ratio of 100 gallons / 50 lb bag (378.5 liters / 22.6 kg bag

$$\frac{\text{3,000 gallon tank}}{\text{100 gallons / bag}} = \textbf{30 bags} \qquad \frac{\text{11,355 liter tank}}{\text{378.5 liters / bag}} = \textbf{30 bags}$$

Determine the number of tank loads required to treat the total area:

$$\frac{\text{Total number of bags}}{\textbf{Tank capacity} \text{ (number of bags per tank)}} = \textbf{Number of tank loads}$$

$$\frac{\text{83 bags}}{\text{30 bags / tank}} = \textbf{2.77 tank loads}$$

Figure 4. Calculation to Determine Number of Mulch Bags to Put into the Tank.

Step Two: Quantify HECP Needed for Site. Calculate the total amount of HECP needed for the entire project by weight, number of bags and number of tank loads. Use the area measurements from Step One to determine the quantity of HECP required at the target application rate. See Figure 3 for example.

Next, determine the capacity of the hydroseeding tank (i.e. number of bags per tank load) See Figure 4 for equation and an example. If the number of tank loads required is greater than one, proceed to Step 3. If less than or equal to one, plan to mix all HECP bags with proper amount of water in one tank load, proceed to Step 4.

Step Three: Quantify Coverage Area per Tank. Determine the total area one tank load will cover and mark treatment area(s) accordingly with high visibility stakes or flagging. See Figure 5 for example calculation.

Step Four: Select Method for Installation. There are two methods for installation of the HECP, seed and soil amendments. One way is to apply the HECP, seed and soil amendments in one application. The mulch, seed, fertilizer, and other amendments are loaded into the tank of a hydraulic seeding machine, agitated for manufacturer specified time, and applied simultaneously.

Another method is a two-part process where the seed, fertilizer, other amendments, and a small amount of HECP for visual metering are sprayed on the soil first, the remaining HECP is then sprayed over the seed, fertilizer, and soil amendments.

Seed may also be applied by slitting or drilling it into the ground or by broadcasting it onto the surface.

Be sure to follow the manufacturer's application recommendations for the specific HECP used.

Total area per tank load can be determined using the following:

$$\textbf{Tank Capacity}\ (\text{number of bags per tank}) \times \frac{\text{Weight of bag}}{\text{Target HECP application rate}} = \textbf{Total area per tank load}$$

$$\textbf{30 bags} \times \frac{50\ \text{lb / bag}}{3{,}000\ \text{lb / acre}} = 0.5\ \text{acre} \qquad \textbf{30} \times \frac{22.6\ \text{kg / bag}}{3{,}363\ \text{kg / ha}} = 0.2\ \text{ha}$$

Therefore, one tank load will treat 0.5 acre or 0.2 ha. Since total area to be treated is 1.38 acres (0.5575 ha), the area should be staked off in half acre (0.2 ha) parcels, and each full parcel treated with one full tank load. The remaining area (0.38 acres or 0.158 ha, in this example) should be treated with a partial tank load comprised of the remaining HECP (23 bags) mixed at the recommended water/HECP ratio.

Figure 5. HECP Coverage Calculation for Total Area per Tank.

Step Five: Method for Preparing the Slurry. Proper mixing of the hydraulic slurry is crucial to successful installation. The mixing procedure to ensure even distribution of mulch, seed, fertilizer, and soil amendments includes:

Purge pump, tower, and hose to make sure that there are no obstructions.

Close any recirculation valves if equipped.

Fill machine with water to main agitator shaft.

Engage agitator to the HECP manufacturer's recommended speed.

Add mulch material and water at a rate that allows you time to add all bags desired for a load.

Fertilizer, or other amendments should be added when the tank is three-fourths full.

Once all mulch has been added, and the water level is reached, increase agitator speed to full and mix to the desired consistency. For some HECP slurries, it may be necessary to reduce speed of the agitator after it is fully mixed to avoid air entrapment causing potential spraying challenges.

Step Six: Determine the HECP Application Equipment. There are two techniques for applying HECPs: the tower technique and hose technique. Both have their advantages and disadvantages. The tower technique is often used for hard-to-access locations such as very steep slopes. The tower technique will also allow the hydraulic seeding machine to cover an area at a quicker rate thus reducing the installation time as compared to the hose technique and RECP. However, the hose technique allows for greater control when applying the HECP. For example, when the

Figure 6: An Example of the Hose Technique.

Figure 7: An Example of the Tower Technique.

contractor sprays next to curbing or other structures, the hose technique will allow for more precision in the placement of the HECPs also infilling of TRMs and other erosion control products.

HECP manufacturers may provide additional guidance on the best method for applying their product.

Step Seven: How to Spray HECP Slurry. HECPs are recommended to be applied from opposing directions to ensure complete coverage of uneven soil surfaces. If they are not sprayed in opposing directions, a "shadowing" effect may occur. Ideally, the HECP will be applied from the toe of the slope and from the top of the slope. However, this is not practical for all projects due to access feasibility. It is acceptable for when the contractor does not have access to both the top of the slope and bottom of the slope for the contractor to apply the HECP from locations for which they have access. For such scenarios, the contractor can spray forward and then backward as their hydraulic seeding machine proceeds parallel to the slope.

Figure 8: This Site Shows Shadowing on the Hillside.

Figure 9: This Site Has No Shadowing on the Hillside.

Cost Considerations

To an untrained eye, the materials exiting the hydraulic mulching equipment appear nondescript. However, contained within many of these slurries are a growing family of refined fiber matrices, tackifiers, superabsorbents, flocculating agents, fibers, plant bio stimulants, and other performance enhancing additives. All of which contribute to the actual installed costs of an HECP and should be evaluated to the site-specific needs.