4.2.6.5 Hydroseeding, Soil Binders, and Tackifiers

Source: TNWRRC

Definition and Purpose

Hydroseeding, soil binders, and tackifiers are hydraulically applied soil and slope stabilization measures, sometimes referred to as chemical stabilizers. On occasion, they are applied as powders.

Hydroseeding is a water-based slurry containing mulch, tackifiers, soil amendments and/or seed that can be applied to exposed soils to aid vegetation growth (TDOT). Hydro applications include hydroseeding, hydromulching, bonded fiber matrix (TDOT HECP Type IV - BFMs) and fiber reinforced matrix (TDOT HECP Type V – FRMs) applications. They provide a method of stabilization to slopes that are often difficult to otherwise vegetate.

Soil binders are a large family of products that include plant-based materials, polymeric emulsion blends, and cementitious-based binders that are employed as short-term surface protection material. Polyacrylamides bind soil particles and fiber mulch together thereby increasing the size of particles and making them more difficult to erode (TDOT). Other polymeric emulsion blends, plant-based materials, and cementitious-based materials bind fiber mulch together to form a blanket.

Though tackifiers are an anchoring mechanism, they are often used synonymously with soil binders. Tackifiers are used as a glue that binds straw, mulch, etc. together, making them more difficult to dislodge while protecting soil from wind, runoff, or raindrop impact (MPCA, 2023). Hereafter, soil binders and tackifiers are used interchangeably.

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Appropriate Applications

Hydraulically applied soil stabilization measures are applicable on any site where bare soil is exposed, such as cut and fill slopes and stockpiles. Exposed soils should be stabilized immediately with any method that is most feasible due to budget, season, and vegetation timelines. Hydraulic applications may be more reasonable than mulch, straw, RECPs, etc. on steep slopes, large areas, or where access is limited.

Hydroseeding is a beneficial measure where temporary protection is needed until vegetation can fully establish. Soil binders are effective for short term protection where grading or earth disturbing activities are temporarily halted (CalTrans, 2017).

Limitations and Maintenance

Inspect soil stabilizers for uniform coverage upon hydraulic application and after storm events. Reapply as necessary. Inspect slopes for rill erosion. Rill erosion may occur from underapplied sections at the top of slope where water can infiltrate and traverse the length of the slope. Hydraulic applications should not be used in areas exposed to vehicle traffic or concentrated flow. On steep slopes, HECP Types IV and V are ideal as typical hydroseeding methods are mostly effective on flat slopes with mild precipitation. Soil binders require frequent reapplication (usually at a lesser application rate than the original application), especially after larger storms. Most soil binders (e.g., excluding polyacrylamides) require a minimum curing time before becoming fully effective; therefore, they cannot be applied prior to precipitation. Further, soil binders may not be effective in soils with a high clay content (again, excluding polyacrylamides), highly compacted soils, in low relative humidity conditions, and when temperatures are below 40°F (CalTrans, 2017). Chemical applications may require approval from TDEC and is the responsibility of the engineer to acquire such approvals. Lastly, though hydromulches are often composed of recycled and biodegradable materials (e.g., recycled paper, straw, woodchips), the mulch is typically dyed green using triphenylmethanes. Triphenylmethanes break down very slowly and inadvertently introduce chemicals into the environment that can pose negative ecological impacts when used in sufficiently high concentrations. It is best to purchase hydromulches premixed with dyes as manufacturers are often weary of such environmental impacts and produce their products well below such thresholds. Further, be weary of chemical leachate from soil binders that may cause environmental concerns (e.g., cementitious-based materials).

Planning and Design Considerations

Hydro applications such as hydroseeding and TDOT HECP Types I through V (categories identified in TDOT's QPL 17.020) generally require surface roughening (furrows along contours) before application (CalTrans, 2017). HECP Types IV and V differ from general hydroseeding in that they are applied at a rate of 2,000 - 4,000 pounds per acre and can be

used on slopes up to 1H:1V, whereas hydroseed fiber is not recommended on slopes greater than 4H:1V, is generally applied at a rate of 2,000 pounds per acre, and should be thoroughly mixed with water per manufacturer specifications. Hydro applications should be applied to the surface within 24 hours of seeding and during dry, non-windy conditions. Hydro applications are often dyed green to visually inspect it is being applied to the surface evenly. To ensure the proper application rate, mark off a small section on the ground, and calibrate the sprayer to apply the correct seeding rate for such area, before applying at a large scale. Under relatively normal precipitation, proper coverage with HECP Types IV and V provide soil stabilization and protection of the seed bed for approximately one growing season, while typical hydroseeding applications may provide protection for a few months.

Like hydro applications, soil binders may require soil surface preparation. The soil should be roughened with a crimping or punching type roller. When this is not feasible, the surface can be roughened by tracking (CalTrans, 2017). Depending on the type of soil binder used, soil surface prewetting may be required. Ensure to check prewetting, curing times, and weather restrictions, such that the soil binders are applied with appropriate moisture in the soil. When provided, application rates should conform to manufacturer specifications and should be heaviest at the edges, crests of ridges, and banks to resist wind. Binders should be applied uniformly to the remaining area. Similar to hydro applications, consider using a test plot to calibrate application rates and eliminate the use of dyes if possible. Further, consider any environmental impacts chemical applications may pose to the surrounding ecosystem. When applying liquid soil binders:

- Crown or slope the area to avoid ponding;
- Uniformly and lightly prewet the area or according to manufacturer specifications;
- Apply solution under pressure. Overlap solution six to 12 inches;
- Allow treated area to cure for the time recommended by the manufacturer which is typically 24 hours or more;
- Apply the second treatment before first treatment becomes ineffective, using an application rate of 50% of the original rate; and
- In low humidities, reactivate chemicals by re-wetting as necessary.

Consider Table 4.2.6.5-A when selecting an appropriate type of soil binder for construction sites. Consider where it will be applied: will the binder need a high resistance to leaching or abrasion, and will it be compatible with the existing vegetation? Furthermore, will the binder be used over a long period of time? Consider what soils the binder is being applied on: are the soils compacted, are they high in clay content, or do they possess other properties that may affect the ability of the soil binder to form a surface crust? Lastly, consider soil surface, subsurface, and weather conditions that may indicate how often the binder will need to be reapplied (CalTrans, 2017).

Table 4.2.6.5-A: Properties of soil binders. Amended from CalTrans (2017) with professional guidance.

Parameter	Plant Based Material (Short Lived)	Plant Based Material (Long Lived)	Polymeric Emulsion Blends	Polyacrylamides	Cementitious-Based Binders
Cost	Low	Low	Low	Low	Low
Resistance to Leaching	High	High	Low to Moderate	Low	Moderate
Resistance to Abrasion	Moderate	Low	Moderate	Low	Moderate to High
Longevity	Short to Medium	Medium	Medium to Long	Medium to Long	Medium
Minimum Curing Time (hrs)	9 - 18	19 - 24	0 - 24	Immediate	4 - 8
Compatibility with Existing Vegetation	Good	Poor	Poor	Good	Poor
Mode of Degradation	Bio	Bio	Photo/Chemically	Photo/Chemically	Photo/Chemically
Labor Intensive	No	No	No	No	No
Specialized Application Equipment	Water Truck, Hydraulic Mulcher	Water Truck, Hydraulic Mulcher	Water Truck, Hydraulic Mulcher	Water Truck, Hydraulic Mulcher	Water Truck, Hydraulic Mulcher
Liquid or Powder	Powder	Liquid	Liquid/Powder	Liquid/Powder	Powder
Surface Crusting	Yes[a]	Yes	Yes[a]	No	Yes
Clean-up	Water	Water	Water	Water	Water
Application Rate (lbs/ac)	Variable[b]	Variable[b]	Variable[b]	Variable[b]	4,015 - 12,500

[a]Dissolves upon rewetting and requires (semi-) frequent reapplication (excluding polyacrylamides).

[b]Dependent on product, soil type, and slope.

Short lived plant-based soil binders last less than six months (MPCA, 2023); typically, two to three months according to Tennessee professionals. Common soil binders in this type include guar, psyllium, and starch. Guar gum is from the *Cyammopsis tetragonolobus* plant and is a non-toxic, biodegradable agent. It is to be mixed with water at a rate of 11 to 15 pounds per 1,000 gallons (MCPA, 2023).Psyllium is composed of the finely ground coating of plantago seeds that is applied as either a dry powder or in a wet slurry to the surface of the soil. It dries to form a firm but rewettable membrane that binds soil particles together but permits germination and growth of seed. Psyllium requires 12 to 18 hours drying time. Application rates vary slightly depending on the amount of water in the solution to allow for a uniform slurry flow. Starch is non-ionic, cold water soluble (pre-gelatinized) granular cornstarch. The material is mixed with water and before application. Approximate drying time is nine to 12 hours (CalTrans, 2017; MCPA, 2023). Application rates of soil binders are provided in Table 4.2.6.5-B.

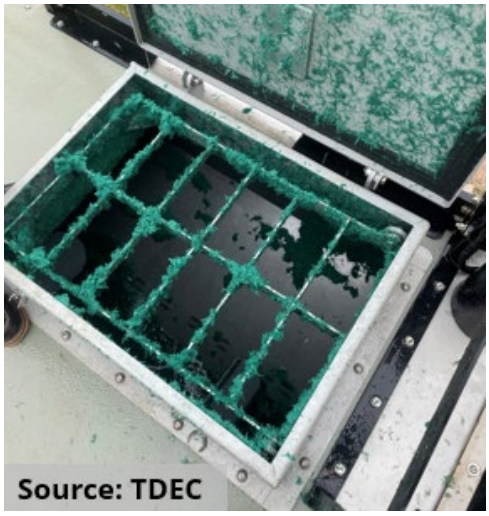
Table 4.2.6.5-B: Application rates for short lived (i.e., less than six months) soil binders. Source: Caltrans (2017) and MCPA (2023).

Soil Binder	Drying Time (hrs)	Application Rate (lbs/ac)
Guar Gum	-	40, 45, 50, 60, or 70 for flat, 4H:1V, 3H:1V, 2H:1V, or 1H:1V slopes
Psyllium	12 - 18	80 - 200
Startch	9 - 12	150

Pitch and rosin emulsion is a plant based soil binder that lasts six to 12 months (MCPA, 2023). Generally, they should have a minimum solids content of 48%. The rosin should be a minimum of 26% of the total solids content. The soil stabilizer should be non-corrosive, water dilutable emulsion that upon application cures to a water insoluble binding and cementing agent. For soil erosion control applications, the emulsion is diluted five parts water to one part emulsion for clayey soils and 10 parts water to one part emulsion for sandy soils (CalTrans, 2017; MCPA, 2023). It should be applied at rates specified by the manufacturer.

Common polymeric emulsion blends include acrylic copolymers and polymers, liquid polymers of methacrylates and acrylates, copolymers of sodium acylates and acrylamides (polyacrylamide), and hydro-colloid polymers. Acrylic copolymers and polymers consist of a liquid or solid polymer or copolymer with an acrylic base, containing at least 55% solids. To prevent foaming during handling and mixing, they may include an anti-foaming agent. The compounds must be readily miscible in water, non-flammable, non-toxic, and should not re-emulsify once cured. Typically, liquid copolymers are diluted at a ratio of 10 parts water to one part polymer and applied at a rate of 1,175 gallons per acre, with air curing taking between 12 to 48 hours. Liquid polymers composed of methacrylates and acrylates act as

tackifiers or sealers, typically containing 40% solids by volume and free from styrene or other potentially harmful compounds. These are diluted according to manufacturer recommendations and applied at around 20 gallons per acre, with a drying time of 12 to 18 hours. Polyacrylamide (PAM) are used for erosion control and are diluted at a rate of 11 pounds per 1,000 gallons of water, with application rates of three to five, five to 10, or 10 to 20 pounds per acre on slopes 5H:1V or flatter, 5H:1V to 3H:1V and 2H:1V or steeper, respectively. Liquid polyacrylamides are used for erosion control and are diluted at a rate of one gallon per 800 gallons of water, with application rates of three, five, and 10 gallons per acre on slopes 5H:1V or flatter, 5H:1V to 3H:1V, and 2H:1V or steeper, respectively. To reduce potential toxicity to aquatic environments, only anionic forms of PAM are permitted: cationic forms have a positive charge that bind to and damage fish gills. Excessive application of PAM can reduce infiltration capacity, have adverse soil binding effects, and may result in a slimy film like deposition (KTC, 2015). Lastly, hydrocolloid polymers, which consist of various dry flowable polymers, are mixed with water and applied at 53 to 62 pounds per acre, drying in about four hours (CalTrans, 2017).


Source: TDEC

Gypsum is a cementitious based soil binder that readily mixes with water and mulch to form a protective crust on the soil surface. Gypsum is ground, calcined and processed to be mixed in a hydraulic seeder and applied at rates 4,000 to 12,000 pounds per acre. Drying time is four to eight hours (CalTrans, 2017). Ensure the use of gypsum allowed per local regulations as it is known to release sulfate (MCPA, 2023).

Example Application

No formal design or quantities are required for this measure and therefore are not presented here.

References

CalTrans. (2017). *Construction Site Best Management Practices (BMP) Manual.*

KTC. (2015). *Best Management Practices (BMPs) for Controlling Erosion, Sediment, and Pollutant Runoff from Construction Sites.*

MPCA. (2023). *Minnesota Stormwater Manual: Erosion prevention practices – tackifiers and soil stabilizers.*

TDOT. *Drainage Manual Ch10*.