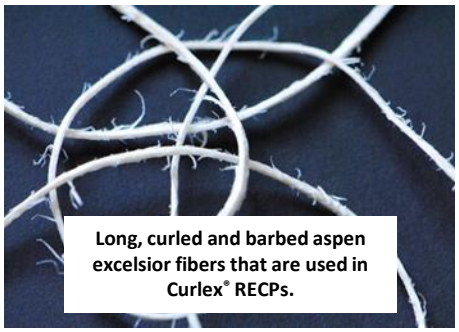
Tech Note

Mechanical vs. Chemical Bonding

Differences Between Rolled Erosion Control Products (RECPs) and Hydraulic Erosion Control Products (HECPs)

Mechanical Bonding of Rolled Erosion Control Products (RECPs)

- RECPs are made from a variety of organic or synthetic fibers.
- RECPs are commonly stitched together and may include one or more nets made from natural or synthetic materials.
- The materials used in RECPs all share a common characteristic – structural integrity and continuity.
- Whether the materials used consist of woven or stitched elements, nearly all RECPs acquire internal structural integrity through mechanical bonding of their components.
- Mechanical bonding extends to the soil through anchors used to secure the RECP to the surface.
- The internal and external mechanical bonding of RECPs is what separates them from other erosion control practices.

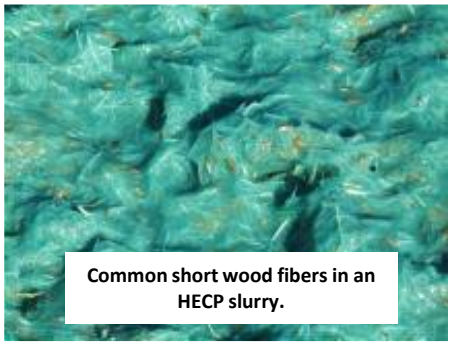


Long, curled and barbed aspen excelsior fibers that are used in Curlex® RECPs.

Chemical Bonding of Hydraulic Erosion Control Products (HECPs)

- Bonded Fiber Matrixes (BFMs) are created by adding a variety of chemicals to HECPs that are, in most cases, made from wood fibers.
- Chemicals are added to improve the durability and adhesive characteristics over standard HECPs and help achieve internal stability (between mulch fibers) and external stability (between the mulch and soil).
- Many of the fibers used in HECPs and BFMs are short, straight and simply lie on each other when applied. They generally have little to no interlocking characteristics. Even the best fibers used in these products have relatively weak interlocking characteristics compared to RECPs because of their inherent properties and dependency on chemical bonds.
- Regardless of fiber type, HECPs and BFMs have no netting, stitching, or anchors in place to mechanically bond them to each other or to the soil.
- Once their chemical bond weakens, these materials become susceptible to failure.

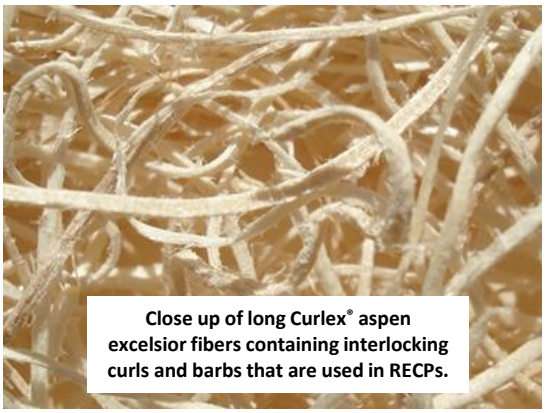
HECP containing toxic malachite green tracer dye being sprayed.



Common short wood fibers in an HECP slurry.

Resistance to Raindrop Impact

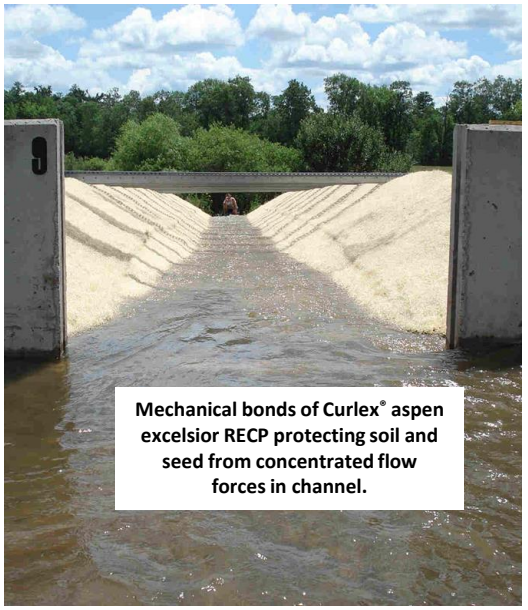
- A correctly installed RECP can dissipate raindrop energy well because the fibers are mechanically bonded together and to the soil.
- A BFM applied at the appropriate rate (lb/acre) that has been allowed to cure, without disruption from rainfall, can dissipate initial raindrop energy until its chemical bonds are weakened or broken by UV, raindrop impact, or hydraulic flow forces.



Close up of long Curlex® aspen excelsior fibers containing interlocking curls and barbs that are used in RECPs.

Resistance to Overland Flow

- The roughness factor (Manning's *n*) of RECPs slows water velocity over the matrix which is locked in place mechanically by stitching, anchors, and netting in most, but not all cases.
- The RECP protects and traps soil particles helping prevent erosion.
- During heavier runoff, when water flows over the surface of an RECP, the RECP forms a boundary layer that helps protect the soil and allows the water to leave the slope or channel without damaging the soil.
- BFMs rely heavily on chemical bonds to resist the loss of structural integrity. These bonds are formed internally between individual mulch fibers in the slurry and externally between the mulch fibers and soil. The direct attachment to, and consolidation of, the underlying soil increases the risk of shallow surface slippages by increasing the weight the surface layer must bear, especially upon saturation.
- HECP surfaces act as a boundary layer to flow-induced shear stress. As shear stress exceeds the shear resistance of the soil and BFM, clumps of mulch and soil break away (erode) and wash downslope, which can result in mass slumping (blow outs) and failure.
    - The dependency on the shear resistance of soil makes BFMs inadequate for protecting soil surfaces exposed to even low shear stresses.
- BFM design encourages water absorption to help minimize runoff.
    - This design can initially offer erosion control, but once fully saturated, the increased weight often causes complete failures (i.e. blowouts, washouts, slumps, etc.).



Mechanical bonds of Curlex® aspen excelsior RECP protecting soil and seed from concentrated flow forces in channel.

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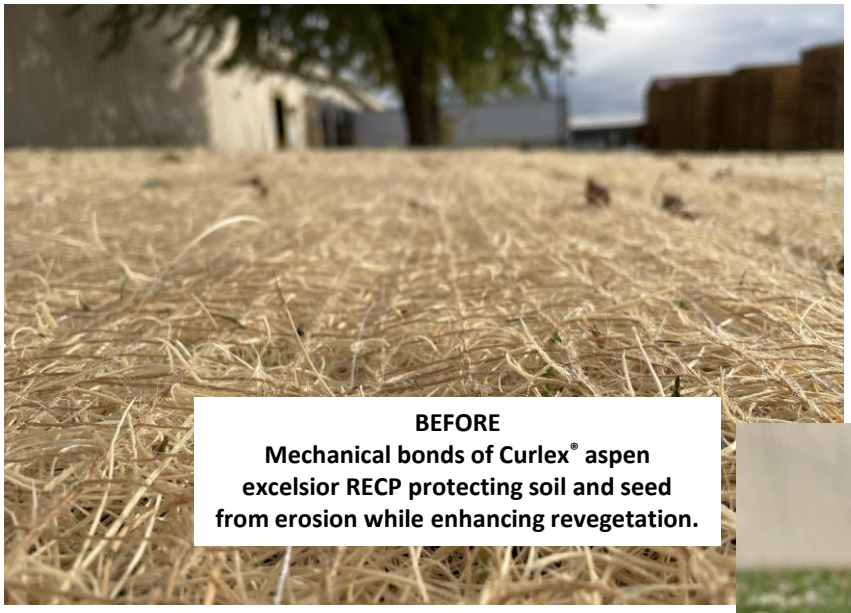
Vegetation Establishment

- Both RECPs and BFMs work to establish vegetation by retaining moisture on the soil surface while moderating temperature fluctuations within the seed bed.
- RECPs provide this function by forming an absorptive shield over the seed bed.
- BFMs are often installed with the seed mixed into the slurry. This type of installation results in some of the seed in contact with the soil and a portion of the seed suspended within the mulch matrix. If the mulch is not kept constantly moist by rainfall or watering, the suspended seed can germinate within the mulch but not root into the underlying soil which can lead to vegetation loss and erosion failure.
- To increase germination when applying BFMs in arid environments, direct seeding to the soil surface prior to mulch application is often recommended so that the seed is guaranteed to be in contact with the soil below the BFM. However, this requires an additional application with the hydroseeder, which adds costs to the project.
- The chemical bonds of a BFM form a rigid crust on the soil surface if there is little moisture. This crust can help protect from initial raindrop impact, but it is also resistant to seedling stem propagation.



BEFORE
Mechanical bonds of Curlex® aspen excelsior RECP protecting soil and seed from erosion while enhancing revegetation.

AFTER
Fully vegetated site after utilizing Curlex® aspen excelsior RECPs that contain strong mechanical bonds and revegetation benefits.

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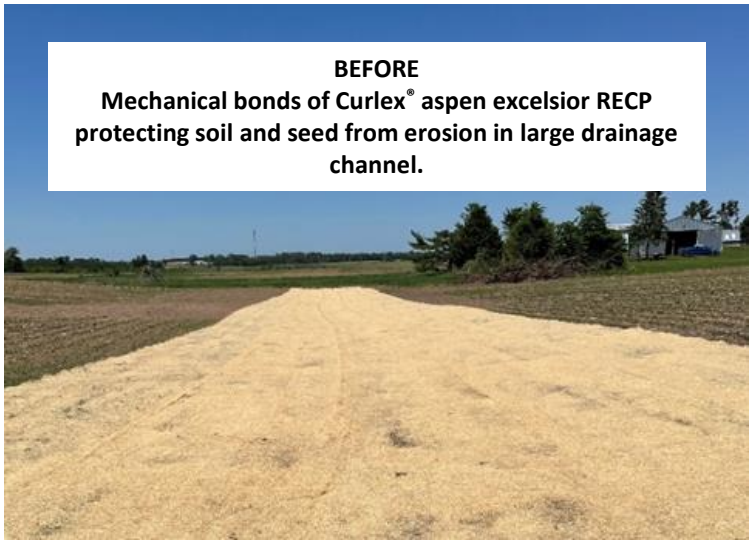
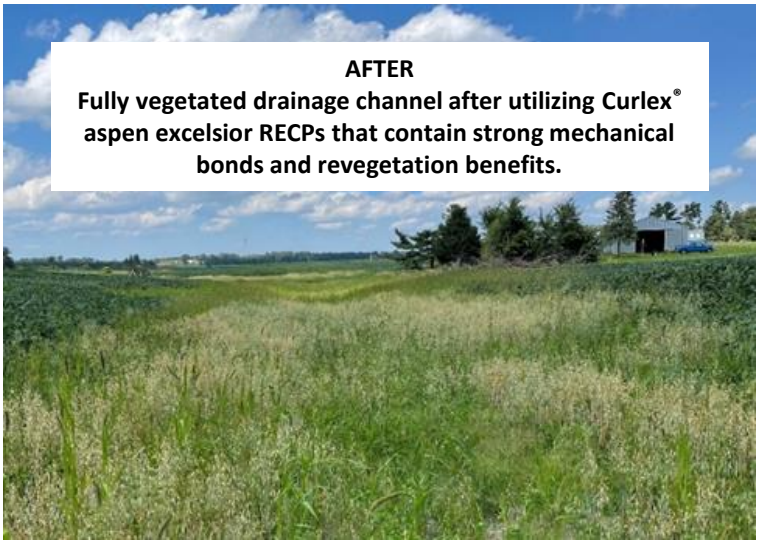
Functional Longevity

- Erosion control materials need to last long enough for vegetation to establish well enough that it can protect the underlying soil on its own.
- RECPs can be customized to meet longevity requirements. The type of netting, fill material and mass determine an RECP's functional longevity. For example, RECPs made with straw and a fast-degrading net are functional for around 3 months while Curlex® (aspen wood excelsior) RECPs can be engineered and designed to be functional ranging from around 3 months to over 3 years depending on netting materials used and how much fiber is contained within the matrix.
- BFMs can be applied at higher rates (lb/acre) to help achieve more complete soil coverage and longer life, but they tend to lose bond strength through successive wetting and drying as well as freeze/thaw cycles. However, slope slumping is more common as more mulch and water weight is added to a slope.
- BFMs are limited in functional longevity. Depending on the amount of exposure to UV and other natural forces, BFMs commonly have not been seen to provide high level functional benefits for more than 4 months in the field depending on several factors.
- RECPs, such as Curlex® QuickGRASS®, use environmentally friendly pigments to color their fibers to provide long lasting aesthetics until vegetation establishes, whereas HECPs use tracer dyes that fade after a few days, and some of the HECPs dyes used incomprehensibly still contain toxic malachite green that is sprayed onto our soils.
- BFMs require a drying period of 24 to 48 hours. If rain falls prior to drying, the binding agents may wash out of the BFM, greatly reducing its immediate and future erosion control capabilities. Thus, careful planning around the weather is necessary to ensure applications take place well before (and after) potential precipitation events, which limits when BFMs can be installed.



BEFORE
Mechanical bonds of Curlex® aspen excelsior RECP protecting soil and seed from erosion in large drainage channel.



AFTER
Fully vegetated drainage channel after utilizing Curlex® aspen excelsior RECPs that contain strong mechanical bonds and revegetation benefits.

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