

ADHESIVE-BASED AND HEAT-TACKED FIELD SEAMS FOR GEOSYNTHETIC CLAY LINERS

In some projects, a geosynthetic clay liner (GCL) is placed on slopes longer than the standard roll length of Bentomat (150 feet). If the friction between these two surfaces is low (Bentomat placed over a drainage geocomposite, for example), it is possible that the Bentomat could be placed in tension when a normal load is applied. To allow the downslope transfer of this tension, it is necessary either to manufacture extra-long rolls of GCL or to devise a means by which the continuity of the liner system can be preserved.

Manufacturing extra-long GCL rolls (exceeding 200 feet) may not be feasible due to the significant handling problems which could be created as a result of increasing the roll weight. Because Bentomat and other geotextile-based GCLs are not rigid materials, the core bars and spreader bars used for handling and installation must bear nearly the entire weight of the roll. CETCO's past experience with handling Bentomat has clearly indicated that this is not a safe or practical approach to solving this problem. Instead, it is recommended that standard-length GCL panels be bonded together in the field. A successful bond will provide stress transfer yet will not require handling extremely heavy rolls of GCL.

Two approaches to bonding seams are presented in this document, adhesive bonding and heat-tack bonding, each described separately below.

Adhesive Bonding

In order to demonstrate the viability of adhesive bonding, CETCO performed some bench-scale tests with different adhesives. The objective of the experiment was to identify an adhesive with suitable strength properties to bond the end of one panel of Bentomat ST to the beginning of another. One of the glues was a common construction adhesive, Liquid Nails. The second adhesive was simple wood glue.

Small Bentomat panels approximately four inches wide and eight inches long were overlapped and bonded together with each adhesive. The overlap distance was approximately three inches, and each adhesive was placed in a 1/2-inch wide bead within this overlap zone. The panels were pressed together by hand and then were allowed to dry 24 hours without confining pressure.

The glued samples were tested for tensile strength in accordance with ASTM D 4632. The specimens were mounted in the tensile testing device such that the strength of the bond could be measured and compared to the typical tensile strength of the GCL itself. The overlapped specimens were mounted with the end of one panel in one jaw of the tensile tester and the end of the other panel in the opposite jaw. The specimens were then pulled until the breaking load was reached. It was reasoned that, if the bond strength was found to be similar to the strength of Bentomat, then the bond could be judged as adequate for allowing stress transfer from one panel to another.

The results, summarized in Table 1, showed that the overlaps with Liquid Nails had an average bond strength of over 140 lbs. This is greater than the typical tensile strength of Bentomat ST.

Table 1. Summary of Adhesive Bonding Test Results

Overlap Specimen	Tensile Strength*	
	Wood Glue (lbs)	Liquid Nails (lbs)
A	--	149.8
B	49.8	148.5
C	53.7	154.7
D	49.4	134.5
E	72.0	139.2
Average	56.2	145.3

*Tensile testing was performed in accordance with ASTM D 4632 modified for GCLs.

Based on these results, it can be concluded that Liquid Nails may be used to bond overlapping panels of Bentomat as necessary. Specifically, it is recommended that the end-of-panel overlap be performed as shown in Figure 1:

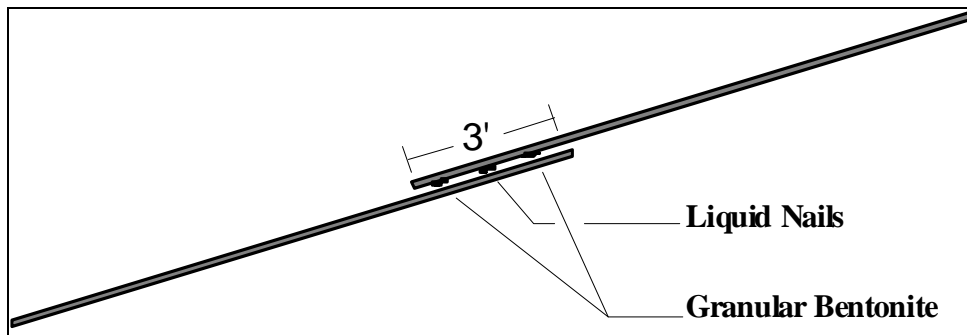


Figure 1

The three-foot overlap zone can be divided into three one-foot sections. Granular bentonite should be applied in the outer two sections to preserve seam integrity and to minimize the potential for exposure of the adhesive to water and/or leachate. It is important to note that the panels should be shingled as shown above to prevent water or leachate from flowing into the overlap. The central portion of the overlap should contain the adhesive, placed in a continuous bead (approximately 1/2 inch) that is sufficiently wide and thick to provide a uniform coating on the surface of the Bentomat panel. This portion of the panel should be clean before the adhesive is applied. Application of the adhesive can be executed simply by use of a caulking gun across the overlap zone. This will allow a controlled application of the adhesive and will minimize variability in the amount applied as the overlap is traversed.

In addition physical strength, the Liquid Nails offers other advantages for bonding overlapping Bentomat panels: (1) It dries rapidly; (2) It is water-resistant and freeze/thaw stable; (3) It is inexpensive; and (4) It is readily available in caulking tubes.

Heat-Tack Bonding

Another approach to bonding end of roll seams is heat-tacking. This is accomplished by overlapping the Bentomat seams by a minimum of 2 feet, applying a propane torch to the seamed area, then dragging a sand bag over the area to press the seam together right after the torch is applied, as shown below.



For the purposes of testing, heat-bonded samples were produced in the field by deploying full-scale Bentomat DN panels, overlapping the ends of the panels by 6 inches, and then heat-bonding the seam using a propane torch. A 2.5' x roll width sample of the bonded seam (spanning the 6-inch seam, as well as 1 foot of material on either side of the seam) was submitted to the laboratory for tensile strength testing.

At the laboratory, 4" x 12" specimens were cut from random locations along the heat-tack bonded seam. The bonded specimens were tested for tensile strength in accordance with ASTM D 6768. The specimens were mounted in the tensile testing device such that the strength of the bond could be measured and compared to the typical tensile strength of the GCL itself. The overlapped specimens were mounted with the end of one panel in one jaw of the tensile tester and the end of the other panel in the opposite jaw. The specimens were then pulled until the breaking load was reached.

The test results, summarized in Table 2, showed that the heat-tacked seam had an average bond strength of over 63 lbs/inch, or 255 lbs. This is greater than the certified tensile strength of Bentomat DN by ASTM D 6768. Based on these results, it can be concluded that heat-tack welding may also be used to bond overlapping panels of Bentomat.

Based on the above information, the use of either adhesive-based or heat-tack bonds is feasible in projects where there may be downslope tension on the GCL. This is typically only relevant for projects where there is a low-friction interface beneath the GCL or where there are very steep slopes (2H:1V or steeper).

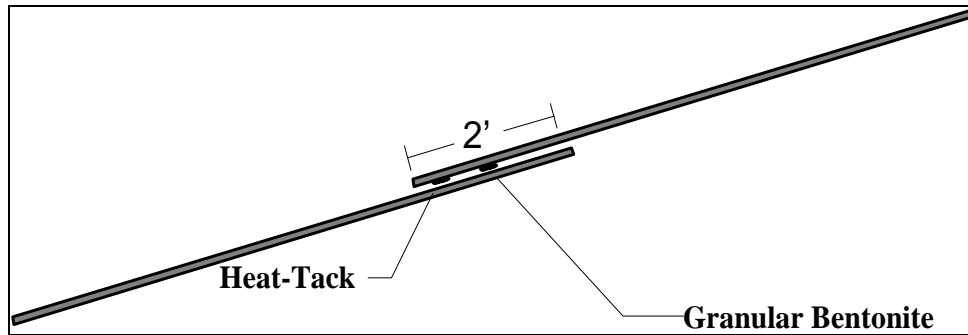


Figure 2

Table 2. Summary of Heat-Tacking Test Results

Overlap Specimen	Tensile Strength*	
	lbs/inch	lbs
A	51.1	204.4
B	68.9	275.7
C	65.3	261.0
D	66.4	265.6
E	67.7	270.6
Average	63.9	255.5

*Tensile testing was performed in accordance with ASTM D 6768.