

**NATURAL RESOURCES CONSERVATION SERVICE  
CONSERVATION PRACTICE STANDARD**

**POND SEALING OR LINING  
BENTONITE TREATMENT**

(No.)

CODE 521C

**DEFINITION**

A liner for a pond or waste storage impoundment consisting of a compacted soil-bentonite mixture.

**PURPOSE**

To reduce seepage losses from ponds or waste impoundments for water conservation and environmental protection.

**CONDITIONS WHERE PRACTICE APPLIES**

This practice applies where:

- Soils are suitable for treatment with bentonite.
- Ponds or waste storage impoundments require treatment to reduce seepage rates and to impede the migration of contaminants to within acceptable limits.

**CRITERIA**

**General Criteria Applicable to All Purposes**

Bentonite-treated soil liners shall comply with all federal, state, and local laws, rules, and regulations.

Lined structures shall meet all applicable Natural Resources Conservation Service (NRCS) standards.

Bentonite-treated soil liners shall be filter-compatible with the sub-grade on which they are compacted to prevent loss of the liner soil into larger openings in the sub-grade material.

[National Engineering Handbook Part 633 \(NEH 633, Soil Engineering, Chapter 26, "Gradation Design of Sand and Gravel Filters,"](#) provides criteria on filter compatibility.

The bentonite shall be a sodium bentonite with a free swell of at least 22 milliliters as measured by American Society for Testing and Materials (ASTM) Standard Test Method D5890 unless laboratory tests using other bentonite types are used for design.

When laboratory permeability tests are required to determine application rates, the tests shall be performed using bentonite of the same quality and fineness as that proposed for use.

For protection against bentonite dust, personnel on-site during bentonite application and mixing shall wear mask and goggles.

**Liner construction.** Use methods described in [Appendix 10D in National Engineering Handbook Part 651 \(NEH 651\), Agricultural Waste Management Field Handbook](#), for liner construction.

**Liner protection.** Bentonite-treated soil liners shall be protected against damage caused by the effects of water surface fluctuations, desiccation and cracking, wave action, rainfall during periods when the liner is exposed, water falling onto the liner from pipe outlets, agitation equipment, solids and sludge removal activity, animal activity, penetrations through the liner, and any other activity capable of causing physical damage to the liner.

Design should include measures to protect against damage to a bentonite-treated soil liner due to uplift water pressures if a seasonal high water table occurs at a level above that of the

lowest potential level of liquid in the impoundment. Examples of protective design measures are using perimeter drains to lower the water table, maintaining minimum liquid depth in the impoundment, and using liners thick enough to resist uplift water pressures.

Protection of the finished liner from the effects of desiccation during periods when the pond or impoundment is empty is required. The soil cover shall be of a soil type, thickness, and density that is resistant to erosion and desiccation.

A soil cover with a 6-inch minimum thickness shall be placed over the soil-dispersant liner unless the liner will always be covered by water. Topsoil for grass establishment can be used as soil cover for the side slopes

**Side slopes.** The side slopes of ponds or waste storage impoundments should be 3 horizontal to 1 vertical (3:1) or flatter to facilitate mixing of the bentonite when the bathtub method of construction as described in [Appendix 10D in NEH 651](#) is used. Slopes as steep as 2:1 may be considered if the stair-step method of construction as described in [Appendix 10D in NEH 651](#) is used for constructing the liner. Maintenance requirements should also be considered when selecting a side slope.

**Application rate.** In the absence of laboratory tests or field performance data on soils similar to those to be treated, the minimum application of a finely ground bentonite **per 6-inch thickness** of constructed liner shall be as follows:

Pervious Soil Description	Application Rate (lb./ft. <sup>2</sup> )
Silts (ML, CL-ML)	2.25
Silty sands (SM, SC-SM, SP-SM)	3.0
Clean sands (SP, SW)	3.75

#### **Criteria Applicable to Ponds**

**Design.** Design of bentonite-treated soil liners for ponds not storing animal waste shall be designed to reduce seepage to rates that will allow the pond to function suitably as intended.

**Liner thickness.** In the absence of more detailed testing and analyses, liner thickness shall be according to the following table:

Water Depth (feet)	Liner Thickness (inches)
≤ 8	6
8.1 - 16	12
16.1 - 24	18
24.1 - 30	24

#### **Criteria Applicable to Waste Impoundments**

**Design.** Bentonite-treated soil liners for waste storage impoundments shall be designed to reduce specific discharge (unit seepage) to rates recommended in [Appendix 10D in NEH 651](#) or rates mandated in Kansas Department of Health and Environment (KDHE) rules and regulations if they are more restrictive. Lower specific discharge rates may be used at the discretion of the designer.

**Liner thickness.** The minimum thickness of the finished compacted treated liner shall be the greatest of the following:

1. That required to achieve a specific discharge (unit seepage) design value selected by the designer.
2. That required by KDHE rules and regulations.
3. That given in the following table. The water depth to be used in the table is the normal full pool storage depth in the impoundment (freeboard elevation).

Water Depth (feet)	Liner Thickness (inches)
≤ 16	12
16.1 - 24	18
24.1 - 30	24

**CONSIDERATIONS**

Consider using a flexible geomembrane or geosynthetic clay liner for sites that have water depths greater than 24 feet.

Alternatives to bentonite-treated soil liners should be considered for poor foundation conditions such as karstic bedrock, joints, or other discontinuities of the underlying bedrock.

**PLANS AND SPECIFICATIONS**

Plans and specifications for bentonite-treated soil liners for ponds and waste storage impoundments shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall include such drawings, specifications, material requirements, quantities, construction requirements, equipment requirements, and

other documents as are necessary to describe the work to be done.

**OPERATION AND MAINTENANCE**

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage the bentonite-treated soil liner. This includes (but is not limited to) excluding animals and equipment from the treated area and repairing damage to the liner occurring from erosion during initial filling; erosion resulting from wave action after the impoundment fills; and erosion caused by agitation, pumping operations, and activities involved in removal of solids and sludge. Damage that might be caused by roots from trees and large shrubs should be prevented by removing such vegetation at first appearance. If the liner is damaged, any disturbed or eroded areas should be repaired to restore the liner to its original thickness and condition.