

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.

**CONDITION 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**

Specify bentonite treated soil liners to comply with all Federal, state, and local laws, rules, and regulations.

Evaluate and avoid or minimize impact to cultural resources, wetlands and Federal and state protected species to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National and Florida policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH) Florida Supplements to Parts 600.1 and 600.6, National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).

Specify bentonite treated soil liners to 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. The National Engineering Handbook (NEH), Part 633, Chapter 26 – Gradation Design of Sand and Gravel Filters, provides criteria on filter compatibility.

Specify the bentonite to be used to be a sodium bentonite with a free swell of at least 22 milliliters as measured by 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, perform the tests using bentonite of the same quality and fineness as that proposed for use.

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

**Liner Construction.** Use methods described in NEH Series, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D for liner construction.

**Liner Protection.** Protect bentonite treated soil liners against damage caused by the effects of water surface fluctuations, desiccation and

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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.

Include in the design 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 the use of perimeter drains to lower the water table, maintaining minimum liquid depth in the impoundment, and using liners thick enough to resist uplift water pressures.

Protect the finished liner from the effects of desiccation during periods when the pond or impoundment is empty. If a protective soil cover is used, specify the soil cover to be of a soil type, thickness, and density that is resistant to erosion and desiccation.

**Side Slopes.** Specify the side slopes of ponds or waste storage impoundments to be 3H: 1V or flatter to facilitate mixing of the bentonite when the bathtub method of construction as described in Appendix 10D, AWMFH, is used. Slopes as steep as 2H: 1V may be considered if the stair-step method of construction as described in Appendix 10D to the AWMFH is used for constructing the liner.

**Criteria Applicable to Ponds**

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

**Application Rate.** For ponds, in the absence of laboratory tests or field performance data on soils similar to those to be treated, follow Table 1 for the minimum application of finely ground bentonite per 1-inch thickness of constructed liner.

Table 1 - Minimum Application Rate of Finely Ground Bentonite per 1-inch Thickness of Constructed Liner

<b>Pervious Soil Description</b>	<b>Application rate (lb/ft<sup>2</sup>)</b>
Silts (ML, CL-ML))	0.375
Silty Sands (SM, SC-SM, SP-SM)	0.500
Clean Sands (SP, SW)	0.625

**Liner Thickness.** In the absence of more detailed testing and analyses, specify liner thickness in accordance with Table 2.

Table 2 - Minimum Liner Thickness for Ponds

<b>Water Depth (feet)</b>	<b>Liner Thickness (inches)</b>
8 or less	6
8.1 - 16	12
16.1 - 24	18
24.1 – 30	24

**Criteria Applicable to Waste Impoundments**

**Design.** Design bentonite treated soil liners for waste impoundments to reduce specific discharge (unit seepage) to rates recommended in the NEH Series, Part 651, AWMFH, Chapter 10, Appendix 10D and/or rates mandated in state regulations if they are more restrictive. Lower specific discharge rates may be used at the discretion of the designer.

**Liner Thickness.** Specify the minimum thickness of the finished compacted treated liner to be the greater of:

1. that required to achieve a specific discharge (unit seepage) design value selected by the designer,
2. that required by state regulations, or
3. that given in Table 3. The water depth to be used in the table is the normal full pool storage depth in the impoundment

Table 3 - Minimum Liner Thickness for Waste Impoundments

<b>Water Depth (feet)</b>	<b>Liner Thickness (inches)</b>
16 or less	12
16.1 - 24	18
24.1 or greater	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.

Consider maintenance requirements when selecting a side slope.

Consider filling pond with water after construction to prevent desiccation.

### **PLANS AND SPECIFICATIONS**

Describe the requirements for applying the practice to achieve its intended purpose in the plans and specifications for bentonite treated soil liners for ponds and waste impoundments. Include in the plans and specifications such drawings, specifications, material requirements, quantities, construction requirements, equipment requirements, and other documents as necessary to describe the work to be done

As a minimum, include the following in the plans and specifications:

- Location map
- Plan view of system layout
- Foundation preparation
- Type and application rate of bentonite to be used
- Method of installation
- Method to protect liner
- Structural details
- Quantity of material

- Temporary erosion control measures during construction
- Vegetative requirements or other measures to stabilize the area
- Location of utilities and notification requirements.

### **OPERATION AND MAINTENANCE**

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage to the bentonite treated soil liner. The O&M plan shall include, but not limited to, the following:

- Excluding animals and equipment from the treated area
- 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, as well as activities involved in removal of solids and sludge
- Prevent damage that might be caused by roots from trees and large shrubs by removing such vegetation at first appearance.
- If the liner is damaged, repair any disturbed or eroded areas to restore the liner to its original thickness and condition.

### **REFERENCES**

- ASTM Standard Test Method D5890  
General Manual  
Title 420-Part 401  
Title 450-Part 401  
Title 190-Parts 410.22 and 410.26
- National Engineering Handbook  
Part 633, Chapter 26  
Part 650, Agricultural Waste Management  
Field Handbook, Chapter 10, Appendix 10D
- National Cultural Resources Procedures Handbook
- National Environmental Compliance Handbook
- National Food Security Act Manual
- National Planning Procedures Handbook  
Florida Supplements to Parts 600.1 and 600.6