

## Pond Sealing or Lining – Bentonite Treatment (No.) 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 be planned, designed, and installed to meet all federal, state, local and tribal laws and regulations.

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. The National Engineering Handbook, Part 633, 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 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.

The minimum thickness of the finished compacted liner shall be 6 inches. The liner material shall be placed in layers not over 9 inches thick before compaction. The final compacted thickness of each layer shall be no greater than 6 inches. Thicker liners shall be constructed in multiple layers with each layer compacted before the next layer is placed. Liner thickness is measured perpendicular to the finished surface.

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

#### 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.

**Application Rate.** For ponds, 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 1-inch thickness of constructed liner shall be:

| Pervious Soil Description      | Application rate (lb/ft <sup>2</sup> ) |
|--------------------------------|--|
| Silts (ML, CL-ML)              | 0.375                                  |
| Silty Sands (SM, SC-SM, SP-SM) | 0.5                                    |
| Clean Sands (SP, SW)           | 0.625                                  |

**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.** Design of the bentonite treated soil liners for waste storage impoundments shall be designed to reduce specific discharge (unit seepage) to rates recommended in the National Engineering Handbook Series, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D or rates mandated in state regulations if they are more restrictive. Lower specific discharge rates may be used at the discretion of the Designer.

The application rate of the bentonite shall produce a permeability of 0.0028 ft/day ( $1 \times 10^{-6}$  cm/sec) or less with a compaction of 90 percent of the maximum density as determined by the Standard Proctor Test, ASTM-698.

**Liner Thickness.** The minimum thickness of the finished compacted treated liner shall 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 the following table. The water depth to be used in the table is the normal full pool storage depth in the impoundment.

| Water Depth (feet) | Liner Thickness (inches) |
|--------------------|--------------------------|
| ≤ 16               | 12                       |
| 16.1 – 24          | 18                       |
| > 24               | 24                       |

**Other Criteria**

**Liner Construction.** Use methods described in Appendix 10D to the AWMFH 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 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.

Protection of the finished liner from the effects of desiccation during periods when the pond or impoundment is empty is advisable. At least 12 inches of compacted soil cover shall be placed over the soil-bentonite liner. The soil cover shall be of a soil type, thickness, and density that is resistant to erosion and desiccation.

**Side Slopes.** The side slopes of ponds or waste storage impoundments should 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. Maintenance requirements should also be considered when selecting a side slope.

**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 shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended use.

Support data documentation requirements are as follows:

- Inventory and evaluation records
  - Assistance notes or special report
- Survey notes, where applicable
  - Design survey
  - Construction layout survey
  - Construction check survey

- Design records
  - Physical data, functional requirements and site constraints, where applicable
  - Soils/subsurface investigation report, where applicable
- Design and quantity calculations
- Construction drawings/specifications with:
  - Location map
  - “Designed by” and “Checked by” names or initials
  - Approval signature
  - Job class designation
  - Initials from preconstruction conference
  - As-built notes
- Construction inspection records
  - Assistance notes or separate inspection records
  - Construction approval signature
- Record of any variances approved, where applicable
- Record of approvals of in-field changes affecting function and/or job class, where applicable

#### **OPERATION AND MAINTENANCE**

An Operation and Maintenance (O&M) plan shall be developed for this practice. The O&M plan shall be consistent with the purposes of the practice, its intended life, safety requirements, and the criteria for the design.

#### **REFERENCES**

USDA-NRCS, National Engineering Handbook Series, Part 651, Agricultural Waste Management Field Handbook (AWMFH), Chapter 10, Appendix 10D