NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

POND SEALING OR LINING – COMPACTED SOIL TREATMENT

(ft^2)

CODE 520

DEFINITION

A liner for an impoundment constructed using compacted soil with or without soil amendments.

PURPOSE

This practice is installed to reduce seepage losses from impoundments constructed for water conservation and environmental protection.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where—

- In-place natural soils have excessive seepage rates, and
- An adequate quantity and type of soil suitable for constructing a compacted soil liner without amendments is available, or
- An adequate quantity and type of soil suitable for treatment with a soil dispersant or bentonite amendment is available for an amended soil liner.

CRITERIA

General Criteria Applicable to All Purposes

Use of this standard requires compliance with all applicable federal, state, and local laws and regulations.

Design Seepage Requirements. Design a compacted soil liner for a waste storage impoundment to reduce specific discharge (unit seepage) to rates specified in the National Engineering Handbook (NEH), 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 must be used if required by regulatory authorities, and may be used at the discretion of the designer even if no such lower limit exists.

Laboratory testing of the proposed material for the compacted soil liner for a waste storage impoundment is required to document the capability of the material to be compacted to achieve the required specific discharge and meet the design seepage threshold.

Design a compacted soil liner for a clean water pond to reduce seepage to a rate that will allow the pond to function as intended.

Liner filter compatibility. Design a compacted soil liner that is filter-compatible with the subgrade on to which it is placed to prevent loss of the liner soil into larger openings in the subgrade material. NEH, Part 633, Chapter 26, Gradation Design of Sand and Gravel Filters, provides criteria on filter compatibility.

Liner Thickness. The minimum thickness of the finished compacted liner must be the greater of—

- The liner thickness required to achieve a specific discharge (unit seepage) design value, or
- A liner thickness required by State regulations, or
- The minimum liner thickness as shown

in table 1.

Table 1. Minimum liner thickness by design storage depth.

Design Storage Depth (ft)	Liner Thickness (in)
≤16	12
16.1–24	18
24.1–30	24

Liner Construction. Use methods described in the AWMFH, Appendix 10D, for liner construction. Properly seal all protrusions through the liner, such as pipes or posts.

Liner Protection. Protect the soil liner 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.

A protective soil cover may be used to protect the soil liner from desiccation or erosion. The soil cover will be of a soil type, thickness, and density that is resistant to erosion and desiccation. Under severe conditions, a protective soil cover may not adequately protect the liner from desiccation. For example, during long periods of hot, low-humidity condition, a soil cover constructed with very high plasticity soils may experience damage. Under severe conditions, additional design measures such as installation of a geomembrane in conjunction with the soil cover may be required.

All structures will be fenced for the safety of humans, livestock, wildlife and pets to protect the liner from damage after completion.

Side Slopes. The side slopes of the impoundment should be 3H (horizontal) to 1V (vertical) or flatter to facilitate compaction of soil on the slopes when the “bathtub” method of construction is used, as described in AWMFH, Appendix 10D. Slopes as steep as 2H to 1V can be considered if the “stair-step” method of construction as described in appendix 10D of the AWMFH is used. Steeper side slopes can be designed for isolated areas if the slope is protected.

Foundation. For waste storage impoundment, foundation conditions for compacted soil liners, including the location and proximity of groundwater and bedrock, will be designed according to Indiana (IN) Field Office Technical Guide (FOTG) Standards (313) Waste Storage Facility or (359) Waste Treatment Lagoon.

The liner design will include measures to protect against damage to the 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 and heavy enough to resist uplift water pressures.

Evaluate the foundation for conditions such as karstic bedrock, joints, and other discontinuities of the underlying bedrock to determine the appropriateness for a compacted soil liner.

Additional Criteria for Soil Dispersant Treatment

Dispersant Materials. The dispersant must be tetrasodium pyrophosphate (TSPP), sodium tripolyphosphate (STPP), or soda ash unless laboratory tests using other dispersant types are used in the design.

Application Rate. For waste storage impoundments, conduct laboratory permeability tests using a dispersant of the same quality and fineness as that proposed for use. To meet the liner design threshold, use the application rate and the number and thickness of compacted soil lifts specified in the geotechnical laboratory report.

For clean water ponds, in the absence of laboratory tests or field performance data on soils similar to those to be treated, apply dispersant at a rate equal to or greater to the amount lined in table 2. Install the liner with a maximum 6-inch-lift thickness.

Table 2. Minimum Dispersant Application Rates for Clean Water Ponds.

Dispersant Type	Minimum Application Rate per 6-inch lift thickness (lbs./100 ft^2)
Polyphosphate (TSPP, STPP)	7.5
Soda Ash	15

Safety. During dispersant handling, application and mixing, personnel onsite must wear masks and goggles for protection against dispersant dust.

Additional Criteria for Bentonite Treatment

Bentonite Material. The bentonite must 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.

Application Rate. For waste storage impoundments, conduct laboratory permeability tests using bentonite of the same quality and fineness as that proposed for use. To meet the liner design threshold, use the application rate and number and thickness of compacted soil lifts specified in the geotechnical laboratory report.

For clean water ponds, in the absence of laboratory tests or field performance data on soils similar to those to be treated, apply the bentonite at a rate equal to or greater to the amount listed in table 3. Install the liner with a maximum **of 6-inch-lift thickness.**

Table 3. Minimum Bentonite Application Rates for Clean Water Ponds.

Pervious Soil Description	Minimum Application Rate (lbs./ft^2) per 1-inch Lift thickness
Silts (ML, CL-ML)	0.375
Silty Sands (SM, SC-SM, SP-SM)	0.5
Clean Sand (SP, SW)	0.625

Safety. During bentonite handling, application and mixing, personnel on site must wear masks and goggles for protection against bentonite dust.

CONSIDERATIONS

Consider maintenance access safety and slope stability when selecting inside side slopes for design.

Consider using a composite liner system, including a geomembrane and/or geosynthetic clay liner for sites that have liquid depths greater than 24 feet.

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

Consider installing a 12-inch protective soil cover over the compacted soil liner.

In areas where the liner can potentially be damaged or scoured by agitation, pumping, or other equipment access, consider installing a concrete pad over the liner.

PLANS AND SPECIFICATIONS

Prepare plans and specifications for a compacted soil liner for a pond or a waste storage impoundment that describe the requirements for applying the practice to achieve its intended purpose. As a minimum, include—

For the supporting documentation:

- Soils investigation, including subgrade.
- Laboratory test results for the proposed soil liner materials. Design measures to mitigate effects of seasonal high water table, if applicable.

For the construction plans:

- Soil amendment requirements, as needed.
- Quantities of soil liner material and soil cover material, as needed.
- Quantity and gradation of filter material, as needed.
- Compaction requirements.
- Supplemental practices, such as geomembrane, as needed.
- Construction and material specifications.
- Equipment requirements
- Safety requirements.

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent and/or repair damage to the compacted soil liner. This includes, but is not limited to—

- Excluding animals and equipment from the treated area.
- Repairing damage to the liner; restoring the liner to its original thickness and condition.
- Removing roots from trees and large shrubs at first appearance.
- For waste storage facilities, the removal of waste (agitation, pumping, and/or removal of solids/sludge) while protecting the integrity of the liner.

REFERENCES

USDA Natural Resources Conservation Service. 2012. Agricultural Waste Management Field Handbook (AWMFH). USDA-NRCS, Washington, D.C.

National Engineering Handbook, Part 633, Chapter 26 – Gradation Design of Sand and Gravel Filters.