

UNITED STATES DEPARTMENT OF AGRICULTURE
NATURAL RESOURCES CONSERVATION SERVICE

CONSERVATION PRACTICE STANDARD

**POND SEALING OR LINING
COMPACTED CLAY TREATMENT**

(No.)

CODE 521D

DEFINITION

A liner for a pond or waste storage impoundment constructed using compacted soil without soil amendments.

PURPOSE

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

CONDITIONS WHERE PRACTICE APPLIES

This practice applies where:

- Soils at the site would exhibit seepage rates in excess of acceptable limits or would allow an unacceptable migration of contaminants from the impoundment.
- An adequate quantity of soil suitable for constructing a clay liner without amendments is available at an economical haul distance.

CRITERIA

Criteria for Limiting Seepage

Compacted 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.

Compacted soil liners for waste storage impoundments shall be designed to reduce specific discharge (unit seepage) to rates suggested 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. Other, lower specific discharge rates may be used for design at the discretion of the Designer.

The AWMFH, Chapter 10, Appendix 10D provides methods for computing unit seepage rates and includes recommended allowable rates of seepage. Other generally accepted methods for computing unit seepage rates may also be used.

Soil properties used in the AWMFH, Chapter 10, Appendix D method(s) for computing unit seepage shall be determined by standard soil laboratory tests on soil samples of the proposed liner material for liners to be installed in ponds used for storing animal waste.

Other Criteria

Compacted 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 guidance on filter compatibility.

Liner Thickness. The minimum thickness of the finished compacted liner shall be the greatest of:

1. that required to achieve a specific discharge (unit seepage) design value selected by the designer,
2. that required by state regulations, or

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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 |

Liner Protection. The soil liner shall be protected against damage caused by the effects of water surface fluctuations, 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, and penetrations through the liner.

Design should include measures to protect against damage to the compacted liner if a seasonal high water table occurs at a level above that of the lowest potential level of liquid in the impoundment. Perimeter drains to lower the water table, maintaining minimum liquid depth in the impoundment, and using liners thick enough to resist uplift water pressures are examples of protective design measures.

The finished liner should be protected against the effects of desiccation during periods when the pond or impoundment is empty. A protective soil cover may be used. For severe conditions, a protective soil cover may not adequately protect the liner from desiccation. Severe conditions include liners constructed with very high plasticity soils that are exposed to long periods of hot, low humidity conditions. Designs including a geomembrane in conjunction with a cover soil may be considered for severe conditions to protect the liner from desiccation adequately.

Side Slopes. The side slopes of ponds or waste storage impoundments should be 3H: 1V or flatter to facilitate compaction of soil on the slopes if the bathtub method of construction as described in Appendix 10D, AWMFH, is used. Slopes as steep as 2H: 1V may be used 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 side slopes.

CONSIDERATIONS

Consider using a flexible geomembrane or geosynthetic clay liner for sites that have water or waste storage depths greater than 30 feet.

Alternatives to compacted clay liners should be considered for poor foundation conditions such as karstic bedrock.

PLANS AND SPECIFICATIONS

Plans and specifications for compacted 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, quality control 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 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 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. If the liner is damaged, any disturbed or eroded areas should be repaired to restore the liner to its original thickness and condition.

CONSTRUCTION SPECIFICATION
NATURAL RESOURCES CONSERVATION SERVICE
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1. Scope

The work shall consist of compacting clay soil to construct a soil liner to control seepage in a pond or waste impoundment.

2. Materials

Unless otherwise specified, the clay soil shall be in-situ materials or clay soil from a designated borrow source. The clay soil shall contain no frozen soil, snow, ice, sod, organic materials such as roots, vegetation, manure, or other perishable materials. Rock particles of a size that would interfere with mixing and compaction shall be removed prior to treatment operations.

3. Equipment

All equipment necessary for the proper construction of the work shall be on the work site prior to the start of the clay liner installation operations. If addition of water is anticipated to achieve the specified moisture content and liner density, a water truck or other suitable methods for applying water shall be available prior to beginning work.

4. Subgrade Preparation

If in-situ soils are to be used for the compacted liner, the subgrade shall be excavated to the elevation of the surface of the lowest compacted layer, (about 6 inches above the planned liner bottom).

If the compacted liner is to be constructed of hauled-in clay, the subgrade shall be excavated to the bottom elevation of the planned liner.

The subgrade surface shall be smoothed to eliminate ridges and depressions in order to facilitate construction of a smooth compacted liner of uniform thickness. If the liner is to be constructed of hauled-in material, the subgrade shall be lightly disked to facilitate bonding of the two materials and lightly moistened if the moisture content of the subgrade is more than 2 percentage points below optimum. Free surface water shall not be present prior to placing the first layer of fill.

5. Placement

If in-situ material is to be used for the liner, the bottom layer shall be thoroughly disked to a depth of 6 inches, resulting in a loose layer thickness of approximately 9 inches. Water shall be applied to the loose soil, if necessary, to bring the soil moisture to the specified content. If the soil moisture is too high to achieve the specified density then it shall be disked and allowed to dry until the moisture content is lowered sufficiently to allow compaction. In no case shall the moisture content be allowed to drop below the specified minimum level at the time of compaction.

If the liner is to be constructed of hauled-in material, the first layer shall be placed and spread to a loose thickness that can be effectively compacted to the specified density by the available equipment. In no case shall the loose layer thickness exceed 9 inches. The moisture content of the loose soil layer shall be adjusted as described in the above paragraph.

6. Compaction

Each compacted lift shall be uniformly dense and relatively free of large depressions or dimples. Where a smooth wheel roller or other type of non-penetrating compaction equipment is used, the surface of each layer shall be lightly disked to achieve bonding with the subsequent overlying layer.

The degree of compaction and the moisture content of the clay liner material at the time of compaction shall not be less than specified below for the selected method.

Method 1 - Each layer of the clay liner shall be compacted to the minimum density and moisture content specified for this job.

Method 2 - Each layer of the clay liner shall be compacted by the specified number of passes of the type and weight of roller or other equipment specified for this job, or by an approved equivalent method. Each pass shall consist of traversal by the wheel or drum over the entire surface of the layer. The moisture content at the time of compaction shall be such that the material, when kneaded by hand, will form a ball that does not readily separate when struck sharply with a pencil and will not extrude from the hand when squeezed tightly.

7. Protective Cover

A protective cover of soil, if required, shall be applied to the surface of the compacted clay liner as soon as practical after the uppermost lift has been compacted. The protective layer shall be installed in one or more layers and have a compacted thickness as specified for this job. Compaction and moisture content of the protective layer shall be as specified for this job. Immediately after compaction of the compacted liner is completed, the surface shall be kept moist until the protective cover is in place. The application of water required to keep the surface moist shall be accomplished in a manner that does not cause erosion to the liner surface or ponding of water on the liner.

Other types of protective cover shall be installed as specified for this job.