NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

POND SEALING OR LINING
BENTONITE TREATMENT

(No.)

CODE 521-C

DEFINITION

A liner for a pond or waste 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:

1. Soils are suitable for treatment with bentonite.
2. Ponds or waste impoundments require treatment to reduce seepage rates and to impede the migration of contaminants to within acceptable limits.
3. Seepage losses from a pond or waste impoundment would prevent it from fulfilling its intended purpose or where leakage will damage land and crops or cause waste of water or environmental problems.

CRITERIA

General Criteria Applicable To All Purposes

Ponds and impoundments to be lined shall be constructed to meet all applicable NRCS Conservation Practice Standards, and may include any of the following as appropriate:

- Irrigation Storage Reservoir (Code 436)
- Pond (Code 378)
- Waste Storage Facility (Code 313)
- Waste Treatment Lagoon (Code 359)

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

Lined structures shall meet all applicable NRCS standards.

Bentonite treated soil liners shall be filter compatible with the natural foundation materials on which they are compacted according to Chapter 26, Part 633 of the National Engineering Handbook.

The minimum thickness of the finished compacted liner shall be 6 inches.

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.

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

Compaction. The treated layer shall be compacted to a minimum 90% of the maximum density as determined by the Standard Proctor Test, ASTM D-698.

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

Storage. Stored bentonite must be covered with a plastic sheet or tarpaulin until used. The work must be staged so that the contractor can complete subgrade preparation, scarification, soil moisture adjustment, spreading and mixing the bentonite, compaction of the bentonite treated soil, and covering the treated area with

12 inches of soil cover under dry weather conditions. Wet bentonite is difficult to work with.

Criteria Applicable to Waste Impoundments

Design. Design of the bentonite treated soil liners for waste impoundments shall be in accordance with National Engineering Handbook Series, Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Appendix 10D and or state regulatory requirements.

Liner Protection. The liner shall be protected against desiccation cracking, the effects of water surface fluctuations, wave action, surface erosion, erosion from pipe inlets, agitation equipment, animals, or items installed through the liner. Protective measures shall be designed into the system to protect the liner for these cases. At least 6 inches of compacted soil cover shall be placed over the soil-bentonite liner.

Criteria Applicable to Ponds

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

Pervious Soil Description	Application rate (lb/ft^2)
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 or less	6
8.1 – 16	12
16.1 – 24	18
24.1 - 30	24

A minimum thickness of 12 inches is recommended for all areas in the vertical range of water fluctuation. A minimum 12-inch compacted layer of untreated soil shall be placed over the treated liner where shoreline erosion or wetting and drying from fluctuating water levels exist. Treated structures should be fenced to protect the liner from cattle damage.

CONSIDERATIONS

Flattening the slopes of ponds or waste impoundments to facilitate compactive efforts during construction should be considered. The stair-step method of construction as outlined in Appendix 10D may be considered in lieu of slope flattening.

A protective compacted soil cover should be considered for protecting the soil-bentonite liner for ponds.

Consider using a flexible membrane liner for sites that have water depths greater than 24 feet.

PLANS AND SPECIFICATIONS

Plans and specifications for bentonite treated soil liners for ponds and waste 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.

CONSTRUCTION

1. The area to be treated shall be drained and dried.

2. All vegetation, stumps, trash, stones and other objects of a size sufficient to interfere (usually less than 1/3 of the treated soil depth) with the operation shall be removed from the pool area below maximum water line.

3. Holes or crevices beneath the layer to be treated shall be compacted to a minimum density of 90 percent of Standard Proctor with soil at optimum moisture content. Areas of exposed gravel or fractured rock shall be covered with a minimum of 12 inches of soil with a minimum of 20 percent clay content and compacted to the specified density.

4. Spread finely ground bentonite evenly over the subgrade surface at the specified rate.

The bentonite shall be free flowing, high swelling, granular sodium bentonite. The bentonite shall be American Colloid Company, Volclay SG-40, Wyo-Ben, Envirogel-10, or equivalent.

5. Mix the material thoroughly to the specified depth with rotary tiller or similar equipment using multiple cross-direction passes. A disc is not recommended because of its poor mixing capabilities.

6. Each treated layer shall be compacted to a dry density of 90 percent or more of standard Proctor with soil at optimum moisture content.

7. The interface between a previous day's work and the next day's work consists of re-mixing and compacting a transition zone that is a minimum of 3 feet wide.

8. Special attention must be given to sealing around pipes and structures. Compact 3 parts soil with 1 part bentonite near optimum moisture into a notch in the subgrade and hand compact.

9. Treated areas shall be protected from damage by livestock. Areas near the water line and at points of concentrated surface flow into the pond shall be protected against erosion.

10. Construction shall be carried out in such a way that erosion and air and water pollution will be kept to a minimum.

DESIGN DATA

1. Statement concerning location and type of leaks to be sealed

2. Gradation and classification of soils to be sealed.

3. Description of foundation preparation to be made

4. Rate of application and thickness of the treated blanket

5. Method of mixing of materials

6. Method of compaction and protection

CHECK DATA

1. A statement of conformance to design with all exceptions noted

2. A statement of the degree of effectiveness of the treatment

OPERATION AND MAINTENANCE

Maintenance activities required for this practice consist of those operations necessary to prevent damaging the treated soil liner. This includes, but is not limited to, excluding animals and equipment from the treated area, protection of the liner during initial filling, agitation, or pumping operations, and repair of disturbed or eroded areas.

REFERENCES

National Engineering Handbook Part 650, Engineering Field Handbook, Chapters 4 and 11

National Engineering Handbook, Part 651, Agricultural Waste Management Field Handbook, Chapter 10, Appendix D

NRCS Conservation Practice Standards:

Code 436 - Irrigation Storage Reservoir
Code 378 - Pond
Code 359 - Waste Treatment Lagoon
Code 313 - Waste Storage Facility