CONSTRUCTION SPECIFICATION

NATURAL RESOURCES CONSERVATION SERVICE

POND SEALING OR LINING - COMPACTED SOIL TREATMENT

1. Scope
The work shall consist of compacting soil (with or without soil amendments) to construct a soil liner to control seepage in a pond or waste impoundment.

Compacted Clay Treatment

2a. 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, and 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.

3a. 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.

4a. 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.

5a. 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.

6a. 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.

7a. 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.

Soil Dispersant Treatment

2b. Materials
Unless otherwise specified, the soil shall be in situ materials that contain no frozen soil, snow, ice, sod, brush, roots, vegetation, or other perishable materials. Rock particles of a size that would interfere with mixing and compaction shall be removed prior to treatment operations.

Unless otherwise specified, dispersant shall be free flowing, tetrasodium pyrophosphate (TSPP), sodium tripolyphosphate (STPP), or soda ash.

3b. Equipment
All equipment necessary for the proper construction of the work shall be on the work site prior to the start of dispersant treatment operations. Unless otherwise approved, mixing equipment shall consist of a high-speed rotary mixer capable of mixing uncompacted lifts of the specified thickness.

All equipment used to store dispersant on the work-site and to convey or transport dispersant to or on the work-site shall be covered or enclosed to protect the dispersant from moisture and to avoid dispersant dust problems.

4b. Safety
All personnel on site shall wear goggles and dust masks when exposed to dispersant dust.

5b. Dispersant Proportioning
The amounts of dispersant applied per unit area and per compacted layer thickness shall be as specified for this job.

6b. Site Preparation
Prior to the start of dispersant treatment, the area to be treated shall be graded to the approximate finished planned line and grade as depicted on the drawings. If multiple layers are required, grading shall be to the approximate grade of the lowest layer required. Excavation and/or earth fill may be required prior to grading. Soil used for earth fill shall be similar to the soil materials tested for the liner.

Where more than one lift is to be treated, the soil in the upper lift(s) shall be removed to facilitate treatment of the lower lift(s). Accurately control the depth of the material that is removed so that when returned to the treatment area it is processed and compacted to the specified lift thickness.

Immediately prior to applying the dispersant, the moisture of the lift shall be adjusted, if necessary, to a content that will not cause the dispersant to clump. Material that is too wet shall either be removed or be dried to the specified moisture content prior to applying dispersant, processing, and compacting each lift.

7b. Placement
Dispersant-treated earth is normally treated in place. Where more than one lift is to be treated, the soil for the upper lift shall not be returned until the completed lower lift is inspected and approved.

Immediately before placement of the upper lift, the lower lift shall be lightly moistened to allow suitable bonding of the two lifts. Free surface water shall not be present during placement operations. The mixing equipment must be capable of being set to mix only the required depth of uncompacted liner thickness to prevent the disturbance of any lower lifts.

The compacted thickness of the lift(s) normal to the surface shall be as specified. In no case shall the lift thickness, prior to compaction, exceed nine inches or be greater than the depth that can be effectively mixed by the equipment. Materials placed by dumping in piles or windrows shall be spread uniformly to a thickness that will result in the specified compacted thickness.

8b. Dispersant Application
Dispersant shall be uniformly applied in dry form on the soil surface at a rate that will attain the specified proportioning. Dispersant shall not be applied during high wind conditions that hinder effective application or cause pollution by drift off site.

Bags - Dispersant may be applied by distributing bags of material in a marked grid pattern that will result in a uniform and properly proportioned distribution. Bags shall be emptied and removed from the treatment area; dispersant shall be uniformly spread over the surface prior to processing.

Drop Type Agricultural Seed/Fertilizer/Lime Spreader or Other Equipment - A drop-type agricultural seed/fertilizer/lime spreader or other equipment that is capable of uniformly distributing the dispersant to the specified proportions may also be used to apply dispersant.

Unless otherwise approved broadcast spreaders shall not be used. Where drop-type agricultural seed/fertilizer/lime spreader or other equipment is used to apply the dispersant, one-half of the dispersant shall be applied in one direction and the other half shall be applied in the direction perpendicular to the first direction of application.

Pre-measured tarpaulin or drop clothes may be spread in various locations and weighed after spreading dispersant over them to determine the application rate. Adjustments to the rate of travel and/or material offloading shall be made so that the rate of application is consistent with the specified proportioning.

9b. Mixing
The soil and dispersant shall be mixed with a high-speed rotary mixer until a uniform mixture is obtained. Care shall be taken to control the depth of the mixing to within plus or minus ½ inch of the depth required to attain the specified lift thickness. If the mixture is too dry, no more than 0.25 in. of water shall be uniformly applied followed by mixing with a high-speed rotary mixer.

The cycle of watering and mixing shall continue until the soil, dispersant, and water mixture has been thoroughly processed to a uniform mixture without lumps of soil and/or dispersant. This mixing process shall continue until the water content of the mix is as specified for compaction.

10b. Compaction
The finished surface of each compacted lift shall be uniformly dense and relatively free of small depressions or dimples. Where a sheep-foot roller or other type of penetrating compaction equipment is used, finishing the compaction with a less penetrating type of compaction equipment such as a smooth wheel roller or a smooth drum roller may be required.

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

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

Method 2 - Each layer of dispersant treated earth 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 at least one passage of the roller 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.

11b. Protective Cover
A protective cover of soil, if required, shall be applied to the surface of the dispersant treated earth 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 dispersant treated earth 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.

Bentonite Treatment

2c. Materials
Unless otherwise specified, the soil shall be in situ materials that contain no frozen soil, snow, ice, sod, brush, roots, vegetation, or other perishable materials. Rock particles of a size that would interfere with mixing and compaction shall be removed prior to treatment operations.

Unless otherwise specified, bentonite shall be free flowing, sodium bentonite, and have a minimum swell index of 22 milliliters per two grams (22mL/2g) when tested according to ASTM D 5890. Fineness shall be as specified for this job.

3c. Equipment
All equipment necessary for the proper construction of the work site shall be on the work site prior to the start of bentonite treatment operations. Unless otherwise approved, mixing equipment shall consist of a high-speed rotary mixer capable of mixing uncompacted lifts of the specified thickness.

All equipment used to store bentonite on the work-site and to convey or transport bentonite to or on the work-site shall be covered or enclosed to protect the bentonite from moisture and to avoid bentonite dust problems.

4c. Safety
All personnel on site shall wear goggles and dust masks when exposed to bentonite dust.

5c. Bentonite Proportioning
The amount of bentonite applied per unit area and per compacted layer thickness shall be as specified for this job.

6c. Site Preparation
Prior to the start of bentonite treatment, the area to be treated shall be graded to the approximate finished planned line and grade as depicted on the drawings. If multiple layers are required, grading shall be to the approximate grade of the lowest layer required. Excavation and/or earth fill may be required prior to grading. Soil used for earth fill shall be similar to the soil materials tested for the liner.

Where more than one lift is to be treated, the soil in the upper lift(s) shall be removed to facilitate treatment of the lower lift(s). Accurately control the depth of the material that is removed so that when returned to the treatment area it is processed and compacted to the specified lift thickness.

Immediately prior to applying the bentonite, the moisture content of the lift shall be adjusted, if necessary, to a content that will not cause the bentonite to clump prior to the mixing operation. Material that is too wet shall either be removed or be dried to the specified moisture content prior to applying bentonite, processing, and compacting each lift.

7c. Placement
Bentonite-treated earth is normally treated in place. Where more than one lift is to be treated, the soil for the upper lift shall not be returned until the completed lower lift is inspected and approved.

Immediately before placement of the upper lift, the lower lift shall be lightly moistened to allow suitable bonding of the two lifts. Free surface water shall not be present during placement operations. The mixing equipment must be capable of being set to mix only the required depth of uncompacted liner thickness to prevent the disturbance of any lower lifts.

The compacted thickness of the lift(s) normal to the surface shall be as specified. In no case shall the lift thickness, prior to compaction, exceed nine inches or be greater than the depth that can be effectively mixed by the equipment. Materials placed by dumping in piles or windrows shall be spread uniformly to a thickness that will result in the specified compacted thickness.

8c. Bentonite Application
Bentonite shall be uniformly applied in dry form on the soil surface at a rate that will attain the specified proportioning. Bentonite shall not be applied during high wind conditions that hinder effective application or cause pollution by drift off site.

Bags - Bentonite may be applied by distributing bags of material in a marked grid pattern that will result in a uniform and properly proportioned distribution. Bags shall be emptied and removed from the treatment area; bentonite shall be uniformly spread over the surface prior to processing.

Drop Type Agricultural Seed/Fertilizer/Lime Spreader or Other Equipment - A drop type agricultural seed/fertilizer/lime spreader or other equipment that is capable of uniformly distributing the bentonite to the specified proportions may also be used to apply bentonite.

Unless otherwise approved broadcast spreaders shall not be used. Where drop type agricultural seed/fertilizer/lime spreader or other equipment is used to apply the bentonite, one-half of the bentonite shall be applied in one direction and the other half shall be applied in the direction perpendicular to the first direction of application.

Pre-measured tarpaulin, or drop clothes, may be spread in various locations and weighed after spreading bentonite over them to determine the application rate. Adjustments to the rate of travel and/or material off-loading shall be made so that the rate of application is consistent with the specified proportioning.

9c. Mixing
The soil and bentonite shall be mixed with a high-speed rotary mixer until a uniform mixture is obtained. Care shall be taken to control the depth of the mixing to within ± ½ in. of the depth required to attain the specified lift thickness. If the mixture is too dry, no more than 0.25 in. of water shall be uniformly applied followed by mixing with a high-speed rotary mixer.

The cycle of watering and mixing shall continue until the soil, bentonite, and water mixture has been thoroughly processed to a uniform mixture without lumps of soil and/or bentonite. This mixing process shall continue until the water content of the mix is as specified for compaction.

10c. Compaction
The finished surface of each compacted lift shall be uniformly dense and relatively free of small depressions or dimples. Where a sheep-foot roller or other type of penetrating compaction equipment is used, finishing the compaction with a less penetrating type of compaction equipment such as a smooth wheel roller or a smooth drum roller may be required.

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

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

Method 2 - Each layer of bentonite treated earth 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 at least one passage of the roller 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.

11c. Protective Cover
A protective cover of soil, if required, shall be applied to the surface of the bentonite treated earth 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 bentonite treated earth 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.