

TECHNICAL SPECIFICATIONS SOIL-BENTONITE SLURRY TRENCH CUTOFF WALL

(This technical specification is to be used to guide the writer in the contract requirements for Slurry Trench Cutoff Wall construction for a specific site. Included are_____ to be filled in with project specific data. Also included are [] which denote options to be considered for specific design requirements. Optional subsections are denoted by *. Parenthetical remarks () are included when appropriate to provide the writer with additional, nonessential information. Most [] and * are used to include Slurry Trench Cutoff Wall designs which go beyond the standard design and may include addition of proprietary additives, injection of air for vapor phase extraction of organics. All [], (), and * should be filled in or omitted from the writer's specification.)

SCOPE OF WORK

This section of the specifications includes requirements for the Slurry Trench Cutoff Wall and related work as indicated on the drawings and as hereinafter specified. The work consists of furnishing all plant, labor, equipment and materials and of performing all operations as required to construct the slurry trench cutoff wall.

Reference Standards

Following is a list of standards that will be referenced in this specification. Such referenced standards shall be considered part of these specifications as if fully repeated herein.

<u>REFERENCE</u>	<u>TITLE OR DESCRIPTION</u>
API Spec 13A	API Specification for Oil-Well Drilling-Fluid Materials
API RP 13B	API Recommended Procedure for Field Testing Drilling Fluids
ASTMD 4380	Density
ASTMC 143	Test Method for Slump of Portland Cement Concrete
ASTMD 1140	Materials Finer than No. 200 Sieve in Mineral Aggregate by Washing

ASTMD 422	Particle Size Analysis of Soils
ASTMD 2216	Moisture Content Determination
ASTMD 4318	Liquid Limit, Plastic Limit and Plasticity Index of Soils
EM 100-2-1906 or ASTMD 5084	Permeability Testing

Abbreviations and Definitions

- A. API - American Petroleum Institute
- B. ASTM - American Society for Testing and Materials
- C. EM - Engineering Manual of the Department of the Army, Corps of Engineers
- D. Owner - The Owner as referred to herein is _____.
- E. Owner's Representative - The Owner's Representative is _____ (or individuals) designated by the Owner to act on its behalf in the execution of these specifications.
- F. Slurry Trench - A narrow vertical-walled trench of specified width excavated by the slurry trench method and backfilled with the specified materials to form a cutoff wall of permeability. The terms "Slurry Trench" and "Slurry Wall" will be used interchangeably in these specifications.
- G. Slurry Trench Technique - A method of excavating a narrow vertical-walled trench using a specified slurry mixture to support the trench walls, form a filter cake on and in the trench walls, and prevent movement of groundwater into or through the excavated trench.
- H. Water-Bentonite Slurry - A stable colloidal suspension of powdered bentonite in water. The terms "slurry" and "water-bentonite slurry" will be used interchangeably in these specifications.
- I. Soil-Bentonite Slurry Backfill - A homogeneous mixture of specified soil material, bentonite and water. The terms "soil-bentonite slurry backfill" and "backfill" will be used interchangeably in these specifications.
- J. Slurry Trench Specialist - An individual who has had proven and successful experience in slurry trench construction and is knowledgeable of: (1) the proper mixing methods employed to mix slurry and backfill; (2) the use, testing and control of bentonite as a slurry; (3) construction equipment; (4) excavation and backfill operations; and (5) testing for slurry trench quality control.

- K. Working Platform - The working platform is the surface of compacted fill and/or excavated surface from which the slurry wall is constructed. The work platform is relatively level, stable and well drained with a specified minimum width and specified minimum clearance above the groundwater table.

QUALIFICATION OF CONTRACTOR

The Contractor shall submit evidence that he is experienced and competent to construct a soil-bentonite slurry trench. This evidence will insure that the Contractor will have sufficient competent experienced personnel to carry out the operations specified. In particular, a slurry trench specialist (as approved by the Engineer) shall supervise the construction, slurry preparation and quality control.

SLURRY TRENCH CUTOFF

An impervious slurry trench cutoff wall shall be constructed to the lines, grades and cross sections as indicated on the drawings. The trench shall have essentially vertical walls, a minimum width of _____ inches, and shall extend through the overburden and key a minimum depth of _____ ft into the aquiclude. A generalized description of the overburden through which the slurry trench cutoff is to be excavated is indicated by boring logs included in the drawings.

MATERIALS

Slurry

Slurry shall consist of a stable colloidal suspension of bentonite in water and shall be controlled in accordance with the most current API Standard 13B, "Standard Procedure for Testing Drilling Fluids," and the following requirements:

- A. At the time of introduction of the slurry into the trench, the slurry shall be a mixture of not less than 18 pounds per barrel (42 gallons) of bentonite and water. Additional bentonite may be required depending on the hardness and temperature of the water and the quality of the bentonite. The slurry shall have a minimum apparent viscosity of 15 centipoise or 40 seconds reading through a Marsh Funnel Viscosimeter, and a maximum filtrate loss of 25 cubic centimeters in 30 minutes at 100 psi, and unit weight ≥ 64 pcf.
- B. The slurry mixture in the trench shall have a unit weight not less than 64 pcf (1.03 gm/cc), not greater than 85 pcf (1.36/gm/cc), or as approved by the Engineer.

Bentonite

Bentonite used in preparing slurry shall be pulverized (powder or granular) premium grade sodium cation montmorillonite and shall meet the most current API Standard 13A "API

Specifications for Oil-Well Drilling-Fluid Materials."

Water

Fresh water, free of excessive amounts of deleterious substances that adversely affect the properties of the slurry shall be used to manufacture bentonite slurry. It is the responsibility of the Contractor that the slurry resulting from the water shall always meet the standards of this Specification.

Additives

Admixtures of the type used in the control of oil-field drilling muds such as softening agents, dispersants, retarders or plugging or bridging agents may be added to the water or the slurry to permit efficient use of bentonite and proper workability of the slurry. However, no additives shall be used except as approved by the Engineer.

Backfill

The material for trench backfilling shall be composed of slurry and selected soils obtained from the designated borrow area or trench spoils. The soil shall be friable and free from roots, organic matter or other deleterious materials. The backfill shall be thoroughly mixed and reasonably well graded between the following gradation limits:

Screen Size (U.S. Standard)	Percent Passing <u>By Dry Weight</u>
No. 200	15% - 60%

(NOTE: Backfill design should accommodate, if possible, in-situ soils.)

EQUIPMENT

Trench Excavation

Excavation of the slurry trench cutoff wall shall be accomplished by use of any suitable earth-moving equipment or combination thereof such as a backhoe and/or clamshell so that the required width trench can be carried to its final depth of cut continuously along the trench line. Special chopping, chiseling or other suitable equipment may be used as necessary to satisfactorily accomplish the required excavation. The width of the excavating tool shall be equal to or greater than the specified width of the cutoff wall. Additional equipment such as air lift pumps and slurry desanders shall be used if required to clean the trench bottom and/or slurry in accordance with the requirements of the specification.

Slurry Batching Plant

The slurry batching plant shall include the necessary equipment including a mixer capable of producing a colloidal suspension of bentonite in water, pumps, valves, hoses, supply lines, and all other equipment as required to adequately supply slurry to the trench. Storage ponds may be provided (if needed) to store initially mixed slurry to allow hydration and to serve as a reserve in cases where substantial slurry loss from the trench through underlying previous zones or other reasons may occur. The slurry shall be agitated or recirculated in the storage ponds as required to maintain a homogeneous mix. All slurry for use in the trench shall be prepared using a suitable mixer. No slurry is to be made in the trench. Mixing of water and bentonite shall continue until bentonite particles are fully hydrated and the resulting slurry appears homogeneous.

Backfill Mixing and Placing

Equipment for mixing and placing backfill may consist of a suitable type of earthmoving or grading equipment, such as bulldozers, or blade graders, or blenders such as a pug mill. Equipment will be capable of thoroughly mixing the backfill materials into a homogeneous paste having the required gradation and properties and placing the material in the trench as hereinafter specified.

EXECUTION OF THE WORK

Slurry Trenching

Excavation shall be carried to final depth at the point where excavation is started and then the final depth of cut shall be carried along the line of the trench. Excavation shall proceed continuously from the starting point to the finishing point. Slurry shall be introduced into the trench at the same time trenching is begun and shall be maintained in the trench during excavation and until backfilled. The Contractor shall maintain the stability of the excavated trench at all times for its full depth. The level of the bentonite slurry shall always be maintained at least 2 ft above the local groundwater level and shall not be permitted to drop more than 3 ft below the surface of the slurry trench working platform except as approved by the Engineer. The Contractor shall have personnel, equipment and materials ready to raise the slurry level at any time. To this end, the Contractor shall have personnel on call to raise the slurry level.

Key

Unless otherwise directed, the bottom of the slurry trench will be keyed the minimum specified penetration into the underlying aquiclude beneath the site as indicated by soil borings. In the event that the backhoe or clamshell is unable to achieve the minimum specified penetration into weathered rock without the assistance of ripping teeth, blocks or percussion chisels, the minimum penetration requirements may be modified and the trench will extend to the depth where refusal of the excavating equipment is encountered. The final depth and penetration of the trench shall be measured and checked by the Contractor and approved by the Engineer immediately following excavation.

Cleaning Trench Bottom

The removal of undesirable sediments in the trench will be accomplished by the excavator. At the beginning of each shift (if necessary, i.e., soundings indicate buildup) and after each cut, the trench bottom will be scraped clean by adequate repeated passes of the excavator's bucket, horizontally across the trench.

The accumulation of sediments in the trench will be minimized by proper construction practices. The length of trench supported only by slurry shall be minimized. As much as possible, the toe of the backfill slope will be kept close to the face of the excavation. Soundings will be taken at regular intervals to determine if sediments are present. Any sediments accumulated on the trench bottom or on the backfill slope will be removed by the excavating tool or by flushing with clean slurry. Desanding will be used if other means are not successful in controlling the density of the slurry. Airlift cleaning will be used in extreme cases and then only after due consideration of the effect on the stability of the trench and the associated disposal problems are addressed.

Backfill Mixing

Backfill material shall be mixed and blended in mechanical blenders, by windrowing, disk harrowing, bulldozing, blading, or by other approved methods. Mixing and blending shall be performed in such a manner as to produce the required gradation of backfill. The backfill material shall be thoroughly mixed into a homogeneous mass, free from large lumps or pockets of fines, sand or gravel. Occasional lumps of up to 6 inches in their largest dimensions will be permitted. Just prior to placing, the backfill material shall have a slump of 3 to 6 inches. To this end, the materials shall be sluiced with slurry during blending operations. Sluicing with water will not be permitted.

Backfill Placement

The backfill shall be placed continuously from the beginning of the trench, in the direction of the excavation, to the end of the trench. The toe of the slope of the trench excavation shall precede the toe of the backfill slope so that the toe of the backfill shall not be less than 50 ft following the toe of the excavation, or as required to permit proper cleaning of the trench bottom and to permit inspection and measurement. Placing operations shall proceed in such fashion that the surface of the backfill below the slurry shall follow a reasonably smooth grade and shall not have hollows, which may trap pockets of slurry during subsequent backfilling. Free dropping of backfill material through the slurry will not be permitted. Initial backfill shall be placed by lead-in slope (1h:1v) or by lowering a clamshell bucket or backhoe to the bottom of the trench until the surface of the backfill rises above the surface of the slurry. Additional backfill may then be placed in such manner that the backfill enters the trench by sliding down the forward face of the previously placed backfill. To accomplish this, sufficient backfill shall be piled on the edge of the existing backfill to cause a slump and sliding action on the face of the in-place backfill. The backfill shall not be dropped or deposited in any manner that will cause segregation. An acceptable substitute for the initial placing of backfill by the use of a clamshell bucket, shall be to begin excavation at a point outside of the limits of work which will provide a sufficient distance for the backfill face to form (i.e., lead-in trench)

by pushing the backfill into the trench, before the toe of the backfill reaches the point where the cutoff is required.

TREATMENT FOR TOP OF CUTOFF TRENCH

Upon completion of backfill placement and before drying of the backfill can occur, the cutoff trench shall be capped in accordance with the details shown on the Drawings.

CLEAN-UP

After completion of the backfill and capping, all remaining excavated material and slurry shall be removed and the surface shall be cleaned and leveled as directed by the Engineer. Excess slurry shall be disposed of by spreading in thin layers on adjacent areas designated by the Engineer. No slurry shall be left in ponds, and all ponds shall be pumped dry and backfilled.

QUALITY CONTROL

The Contractor shall maintain his own quality control for the cutoff wall construction under the direction of a qualified Engineer. Testing requirements are summarized in Table 1 and specified herein.

Trench Continuity and Key

The Contractor shall be responsible for demonstrating to the satisfaction of the Engineer that the trench is continuous and keyed the minimum specified depth into the underlying aquiclude. Trench continuity shall be assured by the action of movement of the trench excavation equipment such that the digging tools can be passed vertically from top to bottom of the trench as well as moved horizontally along the axis of the trench without encountering unexcavated material. Penetration of the bottom of the trench into the aquiclude shall be demonstrated by observation of the cuttings removed from the trench and by direct measurement of trench depth to the satisfaction of the Engineer.

Slurry and Backfill

A. Materials

- Bentonite: Certificate of Compliance with the specification shall be obtained from the material manufacturer.

- Backfill Mix: Backfill material shall be tested prior to placement in the trench by conducting tests to determine slump and gradation. Testing frequency will be as directed by the Engineer, and as shown in Table 1.

B. Slurry Introduced in the Trench

A complete series of tests shall be conducted from the mixer or pond containing slurry ready for introduction in the trench at least twice per shift or each time a pond is prepared. The tests shall include:

- Unitweight of the slurry
- Filtrate loss of the slurry
- Viscosity of the slurry
- pH of the slurry

C. Slurry in the Trench

Slurry in the trench shall be tested at least twice per shift. Samples shall be obtained from near the bottom of the trench near the point of trenching and tested for unitweight.

Documentation

Results of all tests performed in accordance with the specification will be recorded on forms acceptable to the Engineer and signed by the Contractor's Project Engineer. These forms will be available to the Engineer at all times for his inspection. Copies of all forms will be submitted daily to the Engineer for his reference.

Work Plan

The Contractor shall submit a detailed operating plan regarding proposed construction procedures and schedules. This shall include, but not be limited to, the Contractor's plan for:

- A. Coordinating the construction, maintenance and removal of working platforms, mixing pads, and haul roads with the Owner
- B. Site set-up
- C. Material and equipment storage
- D. Water-bentonite slurry mixing, transportation and recirculation
- E. Chemical analysis and supply of water
- F. Control of drainage, spills, wastes, etc.
- G. Quality control
- H. Clean-up

Submittals

In addition, the following specific information shall be submitted prior to the start of slurrywall construction:

- A. Soil-bentonite slurry mix design and trial mix reports, including mix proportions, density, moisture content, gradations, and hydraulic conductivity shall be performed.
- B. Specifications of the batch plant and layouts showing locations of equipment, ponds, tanks, pumps, valves, hoses and supply lines.
- C. Source of all imported material, including bentonite. Shipment of materials to the site shall be accompanied by the shipper's written verification of the quality or specification of the material, a copy of which shall be retained by the Contractor.
- D. Certification of bentonite quality, showing compliance with API Standard 13A.
- E. Certification of quality of any admixture.

Upon completion, the Contractor shall submit the results of the quality control testing referenced elsewhere in these specifications.