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**BENTONITE-AMENDED SOIL LINER USAGE
IN SOLID WASTE DISPOSAL FACILITIES:**

C 708

no. 29

CASE HISTORIES

Prepared For

EXXON MINERALS COMPANY

CRANDON PROJECT MINE WASTE DISPOSAL FACILITY

Black & Veatch
Engineers-Architects

June 1984



State of Wisconsin

DEPARTMENT OF NATURAL RESOURCES

Carroll D. Besadny
Secretary

BOX 7921
MADISON, WISCONSIN 53707

November 12, 1984

File Ref: 1630
(Exxon)

RE: Exxon Crandon Mine Project EIR/
Additional Documents for Public
Information and Review

Dear Librarian:

Please place the enclosed document along with the rest of the Exxon
environmental impact report (EIR):

"Bentonite/Amended Soil Liner Usage in Solid Waste Disposal
Facilities Case Histories: Black & Veatch, June, 1984.

This document pertains to the EIR. People who have comments or
questions about this item should contact Mr. Robert Ramharter at
(608) 266-3915 or at DNR, Box 7921, Madison, WI, 53707.

Thank you for your assistance.

Sincerely,
Bureau of Environmental Analysis and Review

Carol Nelson

Carol Nelson
Environmental Specialist

Enclosure

BENTONITE-AMENDED SOIL LINER USAGE IN
SOLID WASTE DISPOSAL FACILITIES:
Case Histories

Prepared for:
Exxon Minerals Company

Black & Veatch
Engineers-Architects
Bethesda, Maryland

June 1984

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INTRODUCTION

Sodium bentonite is a colloidal clay that has the potential to swell to over ten times its dry volume. This highly expansive property makes it desirable for use as a liner or sealer for facilities requiring a relatively impermeable barrier to liquid migration. Past liner installation practices have involved the placement of a homogenous, two to four-inch thick pure, sodium bentonite layer, followed by a protective soil blanket. The placement of this soil blanket by machinery, however, repeatedly caused the bentonite layer to rupture or to develop vertical fracture planes, thereby permitting the system to leak. Consequently, the practice of placing separate pure bentonite and soil layers is currently being abandoned in favor of mixing the bentonite with in-situ or select borrow soils.

The two most common methods used to mix and place the liner and/or sealer are by: (1) diskings pure bentonite into pre-placed or in-situ soil, and (2) combining water, soil and pure bentonite in a pug mill and subsequently placing and compacting the mixture on the site. Both practices require careful mixing, achievement of optimum moisture content, fairly precise application rates, uniform distribution and compaction of the bentonite-amended soil liner in order to assure proper installation. Backfill material is usually placed immediately over the liner after compaction to assure that the bentonite-amended soil remains moist and maintains its swelling ability.

This summary has been prepared for the Exxon Minerals Company in support of permit application documents previously submitted to the Wisconsin Department of Natural Resources in conjunction with the Crandon Project Mine Waste Disposal Facility (MWDF). The proposed facility design

features mine waste disposal ponds lined with a bentonite-amended soil liner system. The purpose of this report is to document that liners and sealers of this type have been installed successfully in a wide variety of facilities. In the United States, these facilities have included not only sewage lagoons, water storage ponds, tank farm impoundments, and slurry trenches, but also both sanitary and hazardous waste landfills.

Since the Crandon Project MWDF will result in a sealed, lined landfill, the content of this report will only focus on landfill applications of bentonite-amended soil liners and caps. Twelve case histories discussing a variety of solid and hazardous waste disposal operations throughout the United States and Canada are included. One facility, the Oswego County Sanitary Landfill, utilized a pug mill operation for producing the bentonite-soil mixture. Such an operation is proposed for the Exxon MWDF. Much of the mixing operation and liner installation procedures for the Oswego County Landfill were documented via color slides, which are available as supplementary material to this report.

Pertinent information for each case history is summarized in Table 1. Following Table 1 are summary descriptions of each of the case histories, including information on project contact personnel. These descriptions have been assigned case numbers and appear in the same sequence as presented in Table 1. Detailed documentation has been collected for several of these facilities, as described in the case study summarizations; this information is also available as a supplement to this report.

TABLE 1. SUMMARY OF CASE HISTORIES

Project/ Location (Facility Type)	Facility Size (Acres)	Bentonite Liner Thickness (Inches)	Bentonite Application Rate (lbs/ft ²)	*Admixture Specifications	Mixing Procedure	Designer	Operator	Permitting Agency
(1) Eastern Sanitary Landfill/Baltimore County, MD (Sanitary Landfill)	140 total 35 operative	6	3.9 - 5.0+	1) $k=1.0 \times 10^{-8}$ cm/sec. 3) 90%	In-place tilling	Gannett-Flemming Corddry and Carpenter (Paul Bricker) (717)763-7211	Baltimore County, MD Bureau of Sanitation (Steve G. Lippy) (301)494-2009	MD Dept. of Health and Medical Hygiene (Jim Pittman) (301)383-2772
(2) Westmoreland County Landfill/ Westmoreland County, VA (Sanitary Landfill)	-	6	4.5	1) $k=1.0 \times 10^{-7}$ cm/sec. 3) 90%	Batch mixing via soil- cement mixer	Culpeper Engineering (Wayne Stanton) (703)825-2455	Westmoreland County, VA (Col. Preston Hodges) (804)493-8911	VA State Health Dept. (Barry Wright) (804)225-2667
(3) Oswego County Landfill/ Oswego County, NY (Sanitary Landfill)	90 total 8 operative	4	2.0	1) $k=1.0 \times 10^{-7}$ cm/sec. 2) $\leq 1-1/3''$ 3) 95%	Pugmill	Barton & Loguidice (William R. Jones) (315)457-5200	Oswego County, NY Dept. of Public Works (Arthur Ospelg) (315)349-3442	NY Dept. of Environmental Conservation (Charles Branagh) (315)428-4483
(4) Aloe Hazardous Waste Landfill/ Findlay Town- ship, PA (Hazardous (Chemical) Waste Landfill)		4	2.5					PA Dept. of Environmental Resources (Dave Mashek) (717)787-2657
(5) Orlando Utilities Commission/Orlando, FL (Coal Storage Pile and Runoff Ponds)	-	6	2.5	1) $k=1.0 \times 10^{-7}$ cm/sec.	In-place tilling (Construction scheduled for late 1984)	Black & Veatch (Paul Zaman) (913)967-2476	Orlando Utilities Commission (Lou Stone/ Bill Herrington) (305)423-9018	FL Dept. of Environmental Regulation (Hamilton S. Oven, Jr.) (904)488-0130
(6) CIBA-Geigy Industrial Landfill/Queensbury, NY (Industrial (Heavy Metal Sludge) Landfill)	-	2x6 (double liner)	4.0-4.5	1) $k=1.0 \times 10^{-7}$ cm/sec.	In-place tilling	CIBA-Geigy Chemical Co. (Bazil Burns) (518)761-2000	CIBA-Geigy Chemical Co. (Bazil Burns) (518)761-2000	NY Dept. of Environmental Conservation (Bud Colden) (518)623-3671

TABLE 1. SUMMARY OF CASE HISTORIES (Continued)

Project/ Location (Facility Type)	Facility Size (Acres)	Bentonite Liner Thickness (Inches)	Bentonite Application Rate (lbs/ft ²)	*Admixture Specifications	Mixing Procedure	Designer	Operator	Permitting Agency
(7) Getty Mining Co./ Mercur, Utah (Mill tailings pond)	-	6	4.0	1)k=1.0x10 ⁻⁷ cm/sec. 2)≤ 3/8"	Pre-mixed w/ rotary tiller and stock- piled for application	Davy McKee Corp. (Mian Khalil) (415)838-1166	Getty Mining Co. (Greg Hawkins/ Glenn Yurick) (801)268-4447	UT Division of Environmental Health (Jerry Riding/ Dennis Dalley) (801)533-6121
(8) Montana Power Co./ Colestrip, Montana (Fly ash pond)	50	6	5.0	-	In-place tilling	Bechtel Power Company (John Kunkel) (406)748-2315	Montana Power Co. (Tom Olson) (406)723-5421	MT Dept. of Natural Resources (Earl Griffith) (406)444-6699
(9) Mill Services Landfill/ Bulgar, PA (Industrial (pickle liquor) Landfill)	12	6	5.0	1)k=1.0x10 ⁻⁷ cm/sec. 3)85%	In-place tilling	Mill Services, Inc. (Gary Berman) (412)343-4906	Mill Services, Inc. (Gary Berman) (412)434-4906	PA Dept. of Environmental Resources (Charles Duritsa) (412)665-2900
(10) County of Loudoun Sanitary Landfill/ County of Loudoun, VA (Sanitary Landfill)	30	4	2.7	1)k=5.0x10 ⁻⁸ cm/sec. 3)90%	In-place tilling	Black & Veatch (J. Lawrence Hosmer) (301)986-8980	County of Loudoun (William Wiggins) (703)471-6050	VA State Health Dept. (Barry Wright) (804)225-2667
(11) Broward County Sanitary Landfill/ Broward County, FL (Sanitary Landfill)	-	4	2.5	1)k=1.0x10 ⁻⁶ cm/sec. 3)95%**	In-place tilling	Hazen & Sawyer (John Carlson) (305)987-0066	Broward County Utilities Div. (Edward Goscicki) (305)971-6220	FL Dept. of Environmental Regulation (Greg Parker) (904)488-0300
(12) Brock West Sanitary Landfill/ Toronto, Canada (Sanitary Landfill)	160	6	3.0	1)k=1.0x10 ⁻⁷ cm/sec. 3)95%**	In-place tilling	Hydrology Consultants Limited (J.P. Nunan) (416)279-1611	Metropolitan Toronto Works Dept. (I. McKerracher) (416)947-8285	Ontario Ministry of Environment (Ken Hogg) (416)424-3000

* 1) Coefficient of Permeability (k); 2) Particle Size; 3) Degree of Compaction (% of modified Proctor).

** Standard Proctor

CASE HISTORY NO. 1
EASTERN SANITARY LANDFILL
BALTIMORE COUNTY, MARYLAND

The Eastern Sanitary Landfill, a 140-acre solid waste disposal area which began operation in December of 1982, incorporated bentonite amended soil as a liner material. The bentonite was applied to the prepared, in-situ soil base by a modified lime spreader towed by either a farm tractor or small bulldozer. The bentonite application rate ranged between a minimum of 3.9 pounds per square foot and a maximum in excess of 5.0 pounds per square foot, depending upon the particle-size of the in-situ soil. Quality control of the application rate was maintained by applying bentonite over a metal sign of known area at the beginning of each pass of the spreader and weighing the discharged material. This procedure was repeated each 100-foot interval for the entire liner installation process. The liner thickness, designed to be a total of 6 inches applied in a single lift was varied up to 9 inches to assure that the minimum in-place permeability specification was met. The coefficient of permeability attained for the liner was 1×10^{-8} centimeters per second, determined through a laboratory testing program.

The Eastern Sanitary Landfill is currently about 25 percent in use. There has been no evidence of ground-water contamination or leachate migration problems resulting from the landfill.

Project contacts are as follows:

Operator: Baltimore County Bureau of Sanitation
111 West Chesapeake Avenue
Room 223
Towson, Maryland 21204
Attention: Mr. Steven G. Lippy
(301) 494-2009

Designer: Gannett-Fleming, Corddry and Carpenter, Inc.
Attention: Mr. Paul Bricker
(717) 763-7211

Permitting Agency: Maryland Department of Health and Mental
Hygiene
Office of Environmental Programs
Waste Management Administration
201 West Preston Street
Baltimore, Maryland 21201
Attention: Mr. Jim Pittman
(301) 383-2772

CASE HISTORY NO. 2
WESTMORELAND COUNTY LANDFILL
WESTMORELAND COUNTY, VIRGINIA

The Westmoreland County Landfill, operated between 1981 and 1983, utilized sodium bentonite-amended in-situ soils as a liner material. The sanitary landfill is located in an area of coastal plain marine sediments consisting primarily of fine sands. Bentonite was mixed with the natural Potomac River alluvial deposits underlying the site at a rate of 4.5 pounds per square foot to provide a total liner thickness of 6 inches in one lift. The application procedure consisted of first establishing sections of a size requiring 100 pounds of bentonite at the above application rate. Then, one sack of dry bentonite was incorporated in each section using a soil cement mixing machine. Rain subsequent to application acted to hydrate the bentonite. The bentonite-soil mixture attained a coefficient of permeability of 1×10^{-7} centimeters per second and a minimum degree compaction of 90 percent of maximum dry density.

Site monitoring consists both of ground-water monitoring wells and measurements of accumulated liquid within the cell. Samples from the several monitoring wells located between the downgradient edge of the fill area and several hundred feet down-gradient have not revealed ground-water contamination. The accumulated liquid measurements, which have been stable, further indicate minimal seepage loss.

Project contacts are as follows:

Operator: Westmoreland County Public Works Department
Box 467
Montrose, Virginia 22520
Attention: Colonel Preston Hodges
(804) 493-8911

Designer: Culpeper Engineering
601 South Main Street
Culpeper, Virginia 22201
Attention: Mr. Wayne Stanton
(703) 825-2455

Permitting Agency: Commonwealth of Virginia, Department of Health
Division of Solid & Hazardous Waste
Management
906 Madison Building
109 Governor Street
Richmond, Virginia 23219
Attention: Mr. Berry Wright
Director, Bureau of Solid Waste
Management
(804) 225-2667

CASE HISTORY NO. 3
OSWEGO COUNTY LANDFILL
OSWEGO COUNTY, NEW YORK

The Oswego County Landfill, officially referred to as the Bristol Hill Landfill, is located in Oswego County, New York, near the Town of Fulton. Design of the landfill began in 1978, before the New York Department of Environmental Conservation had formally developed design standards for landfills. The standards that did exist stipulated a maximum in-place coefficient of permeability of 1×10^{-5} centimeters per second. The in-situ soil at the landfill site met this requirement; however, anticipating more stringent standards in the future, the design engineer, Barton & Loguidice of Syracuse, New York, recommended the installation of a 4-inch thick bentonite-amended soil liner system so that a maximum coefficient of permeability of 1×10^{-7} centimeters per second could be achieved.

Bentonite and the in-situ soil, which was screened to a maximum particle-size of 1-1/3 inches, were mixed on site using a pug mill operation. Because the particle-size characteristics and capabilities of the in-situ soils were favorable, a bentonite application rate of 2.0 pounds per square foot was determined to be sufficient to meet the 1×10^{-7} centimeters per second coefficient of permeability objective. Prior to placement of the liner, the entire subgrade was proof-rolled in order to achieve the required density in the bentonite-soil layer. The bentonite-soil mixture was applied to the subgrade via an asphalt paver in one loose 6-inch thick lift, and compacted to a uniform thickness of 4 inches. Compaction of the liner was accomplished using a vibratory roller. Five passes with the

roller were required to yield the required degree of compaction of 95 percent of the maximum dry density. Quality control of the liner was the responsibility of an independent testing laboratory; tests using nuclear density meters were performed at 20 to 30 - foot intervals along each liner strip after compaction to document the compactive effort. To prevent damage to the liner, 18 inches of protective soil was placed over each liner strip subsequent to completion of the quality control tests. To assure proper mending of the seams between the 8-foot wide liner strips layed by the asphalt paver, the outside 8 to 12 inches of each strip were left uncompacted and were overlapped by the leading 8 to 12 inches of the following strip. After overlapping, the two meshed layers were rolled to produce an undetectable seam.

The landfill, owned and operated by the Oswego County Department of Public Works, was permitted by the New York Department of Environmental Conservation. Eight acres of the 90-acre landfill site have been in operation for slightly less than one year. No leachate has been detected at the existing monitoring sites.

Project contacts are as follows:

Operator: Oswego County Department of Public Works
42 East Bridge Street
Oswego, New York 13126
Attention: Mr. Arthur Ospelg
(315) 349-3442

Designer: Barton & Loguidice, P.C.
Box 3107
Syracuse, New York 13220
Attention: Mr. William R. Jones, P.E.
(315) 457-5200

Permitting Agency:

New York Department of Environmental
Conservation
50 Wolf Road
Albany, New York 12233
Attention: Mr. Charles Branagh
(315) 428-4483

CASE HISTORY NO. 4

ALOE HAZARDOUS WASTE LANDFILL

FINDLAY TOWNSHIP, PENNSYLVANIA

The Aloe Sanitary Landfill has been operated since 1978 for the disposal of chemical wastes. Polymer-treated bentonite was applied and incorporated at a rate of 2.5 pounds per square foot into the surficial 4 inches of in-situ soil. (Polymer treatment of sodium bentonite increases the swelling potential of the clay particles through destruction of the macro-structure, and therefore increases exposure of the clay particle surface.)

Construction documentation for the landfill was approved by and is available through both the Allegheny County Health Department and the State regulatory agency. This documentation was not made available at the time of completion for this report.

Project contacts are as follows:

Permitting Agency: Pennsylvania Department of Environmental
 Resources
 Office of Environmental Protection
 Bureau of Solid Waste Management
 Fulton Building, P.O. Box 2063
 Harrisburg, Pennsylvania 17120
 Attention: Mr. Dave Mashek
 (717) 787-2657

CASE HISTORY NO. 5
ORLANDO UTILITIES COMMISSION
ORLANDO, FLORIDA

Bentonite-amended in-situ soils were approved by the Florida Department of Environmental Regulation as a liner material for both the coal storage pile and the associated coal storage runoff ponds at a coal-fired power plant. The construction, scheduled to begin in late 1984, will utilize bentonite-amended soil as a liner system in the coal storage pile application.

The construction specifications required a 6-inch thick, single-lift liner incorporating bentonite applied at a rate adequate to yield an in-place coefficient of permeability of 1×10^{-7} centimeters per second. The bentonite application rate proposed for the coal storage pile liner by the successful contract bidder was 2.5 pounds per square foot.

The bentonite will be spread at one-half of the application rate in a north-south direction using an agricultural seed or lime spreader. Four passes with an adjustable, depth-controlled rotary tiller will be used to incorporate the bentonite into the in-situ, natural soil material. Then, the above procedure will be repeated using the same application rate in an east-west direction. The bentonite application rate will be verified at an average frequency of once for every 2 acres of surface area by weighing material spread over a premeasured tarpaulin. The liner will be compacted to a minimum of 90 percent of the maximum dry density using a wobble-wheeled or steel-wheeled roller, vibratory compactor, or other similar compaction equipment. The liner will be hydrated with fresh water for a minimum of 7 days after placement.

Project contacts are as follows:

Operator:

Orlando Utilities Commission
Post Office Box 3193
500 South Orange Avenue
Orlando, Florida 32802
Attention: Mr. Lew Stone
 Mr. Bill Herrington
(305) 423-9018

Designer:

Black & Veatch, Engineers-Architects
P.O. Box 8405
Kansas City, Missouri 64114
Attention: Mr. Paul R. Zaman
(913) 967-2476

Permitting Agency:

Florida Department of Environmental Regulation
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, Florida 32301
Attention: Mr. Hamilton S. Oven, Jr.
 Administrator, Power Plant Siting
 Section
(904) 488-0130

CASE HISTORY NO. 6
CIBA-GEIGY INDUSTRIAL LANDFILL
QUEENSBURY, NEWYORK

Bentonite-amended soils were used in a double-liner application for the CIBA-Geigy Industrial Landfill in Queensbury, New York. Bentonite was disked into the surficial 6 inches of natural soil at an application rate between 4.0 and 4.5 pounds per square foot. A second, 6-inch thick lift of bentonite-soil mixture was then placed and compacted. The liner achieved the State coefficient of permeability requirement of 1×10^{-7} centimeters per second during a test application in 1974. Based on information received as recently as the fall of 1982, the surficial liner has maintained an overall coefficient of permeability of approximately 3×10^{-8} centimeters per second. During construction, the liner was compacted by a steel wheel-roller to 90 percent of the maximum dry density. The liner was periodically hydrated as necessary in response to measurements of the moisture content. Limited construction documentation may be available from the New York Department of Environmental Conservation (DEC), but has not been obtained at the time of completion of this report.

Background documents entitled "CIBA-Geigy Industrial Landfill, Queensbury, New York" and "Clay Mineralogy and Importance When Utilizing Clay As A Soil Sealant" are available as a supplement to this report.

Project contacts are as follows:

Operator and Designer: CIBA-Geigy Chemical Company
Lower Warren Street
Glens Falls, New York 12801
Attention: Mr. Bazil Burns
(518) 761-2000

Permitting Agency:

New York Department of Environmental
Conservation
Raybrook, New York 12977
Attention: Mr. Bud Colden
(518) 623-3671

CASE HISTORY NO. 7
GETTY MINING COMPANY
MERCUR, UTAH

The Getty Mining Company gold mine operation in Mercur, Utah, includes a pond designed to receive the tailings from the milling operation. The liner for the pond consists of a 6-inch thick layer of bentonite-amended soil. The liner was placed over native shale, where it existed, or over a 6-inch thick layer of crushed shale where the native shale was considered to be an inadequate subbase. Sodium bentonite was combined with soil which had been screened to a maximum particle-size of 3/8 inch. The mixture was blended in a single lift approximately 1-foot in thickness, utilizing a rotary tiller to achieve a homogeneous composition. The mixed material was stockpiled and transported to the pond floor as needed. A bentonite application rate of 4.0 pounds per square foot was used to achieve the required in-place coefficient of permeability of 1×10^{-7} centimeters per second. Fill stakes with elevation markings were placed throughout the working surface of the pond floor to attain quality control of the liner thickness. The bentonite/soil admixture was placed in the working area, distributed and compacted. Further quality control was maintained by an independent geotechnical firm, which monitored the thickness and density of the liner.

Project contacts are as follows.

Operator: Getty Mining Company
 P.O. Box 838
 Tooele, Utah 84074
 Attention: Mr. Greg Hawkins
 Mr. Glenn Yurick
 (801) 268-4447

Designer:

Davy McKee Corporation
P.O. Box 5500
San Ramon, California 94583
Attention: Mr. Mian Khalil
(415) 838-1166

Permitting Agency:

Utah Division of Environmental Health
State Department of Health
150 W. North Temple Street
Salt Lake City, Utah 84110
Attention: Mr. Jerry Riding
 Mr. Dennis Dalley
(801) 533-6121

CASE HISTORY NO. 8
MONTANA POWER COMPANY
COLSTRIP, MONTANA

The Montana Power Company 50-acre fly ash containment pond in Colstrip, Montana, was originally designed with a 2.5 foot thick, slurry wall leachate barrier extending 45 to 80 feet in depth to the bedrock. Upon reviewing the permit application, the Montana Department of Natural Resources and Conservation requested that a bentonite-amended soil liner also be incorporated into the pond design.

Sodium bentonite was disked into the surficial 6 inches of natural, in-situ soil using a rotary tiller at an application rate of approximately 5.0 pounds per square foot. After application, the liner was lightly hydrated and compacted with a rubber-tired vibratory roller.

Limited construction documentation may be available from the State of Montana Department of Natural Resources. Photographs detailing the liner installation are available as a supplement to this report.

Project contacts are as follows:

Operator:	Montana Power Company 40 East Broadway Butte, Montana 59701 Attention: Mr. Tom Olson (406) 723-5421
Designer:	Bechtel Power Company P.O. Box 189 Colstrip, Montana 59323 Attention: Mr. John Kunkel, P.E. (406) 748-2315

Permitting Agency:

Montana Department of Natural Resources and
Conservation
32 South Ewing
Helena, Montana 59620
Attention: Mr. Earl Griffith
(406) 444-6699

CASE HISTORY NO. 9
MILL SERVICES INDUSTRIAL WASTE LANDFILL
BULGAR, PENNSYLVANIA

A bentonite-soil mixture was used as a liner for the 12-acre Mill Services, Inc. industrial waste landfill in Bulgar, Pennsylvania. The landfill contains treated pickle liquor wastes. Sodium bentonite was disked into the surficial 6 inches of in-situ soil with conventional agricultural equipment at an application rate of approximately 5.0 pounds per square foot. Optimum moisture content was achieved by hydrating the in-situ soil 6 to 8 hours before the bentonite was applied to the soil. A vibratory compactor followed behind the disking equipment to ensure immediate compaction of the liner on the bottom of the landfill. A winch was used to hoist the mixing and compacting equipment along the sides of the landfill for slope placement and compaction. The liner coefficient of permeability was specified at 1×10^{-7} centimeters per second. A degree of compaction of 85 percent of the maximum dry density was achieved.

Construction and design documentation is available from the Pennsylvania Department of Environmental Resources; the agency is currently in the process of reviewing the landfill permit application. A diagram of the landfill is included as a supplement to this report.

Project contacts are as follows:

Operator and Designer: Mill Services, Inc.
1815 Washington Road
Pittsburgh, Pennsylvania 15241
Attention: Mr. Gary Berman
(412) 343-4906

Permitting Agency:

Pennsylvania Department of Environmental Resources
121 South Highland Street
Pittsburgh, Pennsylvania 15206
Attention: Mr. Charles Duritsa
(412) 665-2900

CASE HISTORY NO. 10
COUNTY OF LOUDOUN SANITARY LANDFILL
COUNTY OF LOUDOUN, VIRGINIA

Sodium bentonite-amended in-situ soil will be used as a liner and cap material for the 30-acre County of Loudoun, Virginia Sanitary Landfill closure and expansion. The landfill design has been approved in concept by the Commonwealth of Virginia Department of Health and is currently in the process of final permit review.

Bentonite will be disked into the surficial 4 inches of natural in-situ soil, consisting of colluvial deposits of silt, sand and clay particle-size, at an application rate of approximately 2.7 pounds per square foot. The final cap and liner coefficients of permeability are designed to be 5.0×10^{-8} centimeters per second. Compaction, specified to be 90 percent of the maximum dry density, will be accomplished using a vibratory roller. The resident engineer will conduct in-place permeability tests at 25,000-square foot intervals, and density tests at 10,000 square foot intervals immediately after compaction to assure that the above values are achieved. The moisture content will also be verified at scheduled intervals for correlation purposes, and to determine if the bentonite-soil mixture should be rehydrated. Moisture will be controlled at the proper content through the placement of a 6-inch layer of natural soil over the liner and cap when that value is attained. Construction documentation is not yet available for the landfill.

Hydrogeologic characteristics of the facility are described in Chapter III of the "Engineering Analysis and Design Documentation, County of Loudoun Sanitary Landfill, 1983" report, which is a supplement to this report.

Project contacts are as follows:

Operator: County of Loudoun
Department of Technical Services
18 North King Street
Leesburg, Virginia 22075
Attention: Mr. William Wiggins, P.E.
Director of Technical Services
(703) 471-6050

Designer: Black & Veatch, Engineers-Architects
7315 Wisconsin Avenue
Suite 850N
Bethesda, Maryland 20814
Attention: Mr. J. Lawrence Hosmer, P.E.
Project Manager
(301) 986-8980

Permitting Agency: Commonwealth of Virginia, Department of Health
Bureau of Solid & Hazardous Waste
Management
906 Madison Building
109 Governor Street
Richmond, Virginia 23219
Attention: Mr. Barry Wright
Director, Bureau of Solid Waste
Management
(804) 225-2667

CASE HISTORY NO. 11
BROWARD COUNTY LANDFILL
BROWARD COUNTY, FLORIDA

The Broward County Landfill was expanded in early 1984 by the placement of an intermediate cap and leachate collection system. This design, which utilized sodium bentonite-amended soil, will allow an additional cell to be filled above the intermediate cap.

The sodium bentonite was applied in approximately 1,000-foot long passes with an agricultural spreader. Initially, 6 inches of sand was placed and rolled 1 to 2 times. Bentonite was then spread and disked into the surficial 4 inches of sand. The coefficient of permeability attained was 1×10^{-6} centimeters per second. In-place density tests requiring 90 percent of the maximum dry density consistently produced values in excess of 95% maximum dry density.

The bentonite application rate of 2.5 pounds per square foot was determined after analysis of the on-site soil samples by the bentonite supplier. Quality control of the application rate was accomplished by applying bentonite to 4-foot square tarpaulin, placed at the end of each pass, and weighing the discharged material. After the initial passes were made, only small adjustments were necessary to maintain a consistent application rate.

Project contacts are as follows:

Owner/Operator: Broward County Utilities Division
2401 North Powerline Road
Pompano Beach, Florida 33060
Attention: Mr. Edward Goscicki
(305) 971-6220

Designer: Hazen & Sawyer, Consulting Engineers
5950 Washington Street
Hollywood, Florida 33023
Attention: Mr. John Carlson
(305) 987-0066

Permitting Agency: Florida Department of Environmental
Regulation
Twin Towers Office Bldg.
2600 Blair Stone Road
Tallahassee, Florida 32301
Attention: Mr. Greg Parker
(904) 488-0300

CASE HISTORY NO. 12

BROCK WEST SANITARY LANDFILL

TORONTO, CANADA

The Metropolitan Toronto Works Department 160-acre sanitary landfill in Toronto, Canada, utilizes a bentonite-amended soil liner to control leachate migration. Bentonite was disked into the surficial 6 inches of natural, in-situ soil at an application rate of 3.0 pounds per square foot. The liner was lightly hydrated, as necessary, to achieve optimum moisture content and compacted with a sheepsfoot roller. Strict quality control was exercised during the liner installation by the resident engineer who performed scheduled moisture content and compaction tests. A coefficient of permeability of 1×10^{-7} centimeters per second and a degree of compaction of 95 percent of the maximum dry density were achieved. A design report, which includes laboratory test results, is provided as a supplement to this report.

Project contacts are as follows:

Operator: Metropolitan Toronto Works Department
Phoenix House, 10th Floor
439 University Avenue
Toronto, Ontario, Canada M5G1Y8
Attention: Mr. Ian McKerracher, P.E.
(416) 947-8285

Designer: Hydrology Consultants Limited
Suite 13, 1125 Dundas Street East
Mississauga, Ontario, Canada L4Y2C4
Attention: Mr. J.P. Nunan, P.E.
(416) 279-1611

Permitting Agency:

Ontario Ministry of Environment
Central Region
150 Serrand Drive
Don Mills, Ontario, Canada N3C3C3
Attention: Mr. Ken Hogg
(416) 424-3000



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