Dewatering & Containment Technologies, Inc.

State of Michigan
Department of Environmental Quality
CPC Site, Monroe, Michigan

Lagoon and Ditch Sediment Dewatering Utilizing Geotubes®
Preliminary Pilot Demonstration - Summary Report, May 30, 2003

Section 1.0 Introduction

1.1 Project Background

Geotubes® have proven to be a practical and economical way of dewatering a number of domestic and industrial sludges, and sediments, such as river and lake sediments and contaminates, wastewater lagoon sludge, water treatment plant sludge, packinghouse sludges and wood products sludges. The Michigan Department of Environmental Quality (MDEQ) is interested in evaluating Geotubes® as a method of dewatering material from the lagoons and the ditches at the CPC site located in Monroe, Michigan, as an alternative to the conventional mechanical methods of dewatering material.

Dewatering & Containment Technologies, Inc. (DCT) along with Infrastructure Alternatives, Inc., (IAI) in Michigan, established the objectives of a pilot test, developed a sampling and analytical program and the general work program for the test. These items were completed with input from the MDEQ and Weston Consulting. IAI performed the test and DCT functioned as the primary author of this summary report.

1.2 Pilot Test Objectives

The following objectives for the pilot test were developed by the parties and were incorporated into the project.

Objective 1: Evaluate solids capture. Solids retention or losses was determined by collecting filtrate samples from the hanging bag tube. Samples were collected from below the tube. It was possible to isolate the filtrate and collect discrete samples on a timed basis.

Objective 2: Determine the chemical composition of filtrate. Samples of the filtrate were analyzed for parameters to determine impact on removal of solids and fate of PCB's known to be present in the West ditch material from the Monroe site.

Objective 3: Evaluate solids dewatering factors. Cake samples of the thickened, dewatered solids were taken at day 10 of the test and compared to the solids concentration of the feed sludge to determine shrinkage factors. Dewatering rate was recorded as well. Filtrate was collected and the volume was measured over time to determine how rapidly the material casts off water. This information is then used to determine capacity values in full-scale applications.

1.3 Description of the Test

The test apparatus included a metal framework made of common painters scaffolding and wood support blocks, a hanging Geotube® test bag, (thus termed the "Hanging Bag Test"), a common gas powered trash pump with flexible discharge hose, 50 gallon plastic drum for feed sludge, a hand held electric drill equipped with a 24-inch paint mixer attachment, 30 gallon plastic filtrate catch containers and a suitable polymer dewatering aid.

The test apparatus was located in the enclosed storage area of IAI's headquarters in Comstock Park.

Material for the test was collected from the CPC Monroe, Michigan, site by drawing the material from various randomly chosen locations by pumping with a four-inch gas powered trash pump. Material was sampled from three locations the West Ditch, East Ditch and Lagoon number two. The West Ditch sediments are known to have the highest level of PCB contamination.

Four test bags were filled on Tuesday, April 21, 2003; and the test continued 10 days through Tuesday, May 2, 2003. The hanging bag test was set up in a manner shown below:

Figure 1 – Hanging Bag Pilot Test

Each test utilized approximately thirty-five (35) gallons of sludge mixed with a cationic polymer for approximately five-ten minutes until a discernable solids floc formed. Polymer doses ranged from 50 ppm to 100 ppm. Agitation was provided via the electric drill and mixer attachment and floc formation was confirmed visually. The mixture was then pumped into the top opening of the hanging bag via utilizing the trash pump. Pumping duration varied from brief, about 1-2 minutes to transfer the mixture into the hanging bag once the pumping started. Note: Samples from the various locations varied in consistency and character. Lagoon Number 2 had the lowest "viscosity" and pumped easily. The East Ditch was thicker and did not pump as well. The sample from the West Ditch was very thick and pumped with difficulty as it was difficult to get the trash pump to establish a" prime". All samples had varying amounts of sand, small stones, sticks, grass, and reeds. The West Ditch sample had the most debris and sand of the three samples, which included a two-inch diameter rock that clogged the trash pump.

Filtrate was sampled into discrete sample containers at one (1) minute, ten (10) minute, and sixty (60) minute periods. Except for an initial "blush" of solids, filtrate appeared very clear throughout the test. There was a slight orange cast to the filtrate to the Lagoon sludge, which suggests a high concentration of iron. The filtrate from the East and West remained clear. Odors during mixing and transfer were mild and odors were practically non-existent during the balance of the 10-day test period. The test area was enclosed during the test and kept at room temperature (about 68 degrees F.) There was normal air movement and turn over in the room provided by the building's heating and ventilation system.

Cake samples were taken on day 10 by slicing through the bag material with a razor knife forming a small trap door just above the cake level. The cake layer scooped from the bag for sampling. The cake appeared very solid in nature, drier on the top and sides and somewhat moist towards the center of the cake wad. No free water was observed while the cake was being sampled.

Infrastructure Alternatives performed analytical testing for solids at the Cedar Springs WWTP lab utilizing accepted analytical practices and methods. PCBs and other chemical analysis were performed by Trace Analytical Laboratories.

Section 2.0 Analytical Results

2.1 Solids Capture

Table 1 - Total Solids

Hanging Bag Test April 21, 2003 Total Solid	Logoon #2	Removal	East Ditch	Removal	West Ditch	Removal	West Ditch No Polymer	Removal
Influent total solids	6.50%		14.70%		12.10%		12.10%	
1 min filtrate suspended solids	12.5 mg/L	99.80%	178 mg/L	98.80%	2752 mg/l	77.20%	174 mg/L*	99.56%
10 min filtrate suspended solids	14.0 mg/L	99.78%	18 mg/L	99.87%	36 mg/L	99.70%	0.9 mg/l	99.99%
1 hour filtrate suspended solids	5.0 mg/L	99.92%	4.4 mg/l	99.97%	11mg/l	99.91%		
Total Solids (after 10 days)	24.20%		35.30%		50.40%		52.80%	

* Bag dewatered very slow because of fine particles. Needed nearly 40 min to collect enough sample for the 1 minute test.

The data in the Table 1 above indicates that the solids capture was exceptional at 99.8 percent for Lagoon Number two, 99.9 percent for the East Ditch and 99.7 percent for the West Ditch. Solids concentration in the filtrate was negligible in samples taken at the 10 minute and one hour intervals. The bag material and polymer dosage used in the test can be said to be near optimal.

A fourth "mini test" was run on 10 gallons of the West Ditch sample that utilized no polymer. The initial solids blush was very high at 2,752 mg/l TSS in the one-minute filtrate sample. The solids content of the filtrate improved drastically at 10 minutes to 0.9mg/L but filter rate was extremely slow (took 45 minutes to collect enough of a sample). Indicating that the filter fabric "blinded" without the use of polymer.

2.2 Chemical Composition of West Ditch Filtrate

Filtrate from the West Ditch hanging bag that was not treated with polymer was analyzed for detailed chemical composition by Trace Analytical Laboratories. The results are summarized in Table 2 – Summary of Chemical Composition of Filtrate (following page).

Table 2 – Summary of Chemical Composition of Filtrate
Analysis performed by Richard R. Rediske Ph.D.

Constituent	Concentration Range of Sludge	Geotube® Effluent
PAH compounds	1,500 – 49,000 ug/kg	Not Detected (1-5 ug/l)
PCB's (total)	100,000 – 140,000 ug/kg	0.14 ug/l
PCBs (total) (with polymer)	100,000 – 140,000 ug/kg	Not Detected (0.10 ug/l)
Cadmium	2.6 – 7.9 mg/kg	Not Detected (0.5 ug/l)
Lead	512 – 495 mg/kg	9.4 ug/l
Copper	326 – 343 mg/kg	Not Detected (10 ug/l)
Arsenic	7.3 – 7.7 mg/kg	5.5 ug/l
Mercury	3.8 – 18.4 mg/kg	0.14 ug/l
Zinc	3,700 - 3,700 mg/kg	13 ug/l

The data in Table 2 illustrates that the Geotubes® were very efficient in retaining the waste constituents during dewatering and produced an effluent that contained non-detectable concentrations of PAH compounds. A very small amount of PCBs (.14 ug/l) was present in the effluent from the West Ditch material, however the addition of polymer eliminated this material from the effluent. Small amounts of mercury, arsenic lead, and zinc were present in the effluent from the West Ditch material where polymer was not added. A majority of the mercury and lead was not present in the dissolved phase. Both lead and mercury are similar to PCBs with respect to their low solubility and high affinity for particulate matter. This suggests that the addition of agents that promote coagulation (i.e., polymer) may eliminate the discharge of these elements. The addition of polymer to the sludge therefore may eliminate the discharge of lead and mercury. Arsenic and zinc were present in the dissolved phase and may not be removed by polymer addition. These elements however were present at levels that were not hazardous to the environment.

2.2 Dewatering Factors

As mentioned earlier, except for an initial "blush" of solids, filtrate appeared very clear throughout the test. There was a slight orange cast to the filtrate to Lagoon #2 sludge, which suggests a high degree of iron, however the filtrate from the East and West Ditch remained very clear. Table 3 – "Filtrate Cast-off" illustrates the level of filtrate and how long it took each Geotube® to dewater (following page).

Table 3 – Filtrate Cast-off

Dewatering time	Lagoon No. 2 Water Level	East Ditch Water Level	West Ditch Water Level	West Ditch (no polymer) Water Level
10 minute	6 3/8”	2 ½”	1 ½”	¾”
1 hour	8”	3”	2”	1”

Laboratory results indicate that by day 10 the solids within the hanging bags had reached concentrations shown in Table 4 below. As mentioned earlier in this summary, the characteristics of the solids were very firm, crumbling at the outer edges, and moist near the center with no free water observed.

Table 4 - Total Solids after 10 days

Lagoon No. 2	East Ditch	West Ditch	West Ditch (no polymer)
24.2%	35.3%	50.4%	52.8%

3.0 Conclusions and Recommendations

In summary, the test results demonstrate that the Geotubes® are a highly effective technology for dewatering material at the CPC Monroe site. With the addition of polymer, there was no detectable migration of PCBs and PAH compounds from the material into the dewatering fluids. The Geotubes® also retained most of the heavy metals. Traces of lead and mercury were detected in the filtrate, however these elements were present in the particulate phase. It is very likely that the addition of polymer would eliminate detectable levels of lead and mercury from being discharged. The dewatering fluids also consisted of calcium and magnesium slats and contained low levels of BOD and TOC.

Table 5 illustrates the type of the material being dredged and dewatered based on our experience and the actual samples taken from the CPC Monroe Site. Based on the information in the table, Infrastructure Alternatives, Inc. estimates that the project will need approximately 4,000 lineal feet 60’ circumference tubes.

Table 5 - Information of Material being Dredged

Materials Information	Input
Type of Material to be Dewatered	East & West Ditch
Volume of sludge to be Dewatered (cy)	45,000
Specific Gravity of Solids within Sludge	1.2
Solids of the Insitu Sludge	12%
Solids during Dredging Operation*	10%
Target percent of solids after Dewatering with Geotubes	30-40%
Course Grain solids in the Insitu Sludge	10 - 15%

*Based on experience with similar projects, a 15% slurry is a typical target while dredging this type of material. It should be noted however that the slurry could range from approximately 5% to 20%