ARCADIS

## Appendix D

95% UCL for TCLP Benzene

ARCADIS

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**MEMO**

To:
Jay Reid

Copies:
Craig Derouen, Tim Ratchford

From:
Mark Lupo

Date:
May 28, 2010

ARCADIS Project No.:
OH003000.MS24

Subject:
Benzene TCLP Data Evaluation, Hattiesburg, Mississippi

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The Toxicity Characteristic Leaching Procedure (TCLP) was used to evaluate the leaching potential of benzene in sludge samples collected from the IB Basin at the Hercules Facility location in Hattiesburg, Mississippi. The purpose of this memo is to estimate the true mean of the TCLP results for comparison to United States Environmental Protection Agency (USEPA) Resource Conservation and Recovery Act (RCRA) standards to determine if the material exhibits hazardous characteristics.

**Data Evaluation**

The 16 data points are presented in Table 1 in descending numerical order. Three of the data points had benzene concentrations below the detection limit of 0.02 mg/L. These points were replaced by half of the analytical detection limit. The adjusted data set was evaluated.

The sample mean of the data is 0.2348 mg/L, but the true mean is not known, because to measure this would require sampling the entire volume of the sludge, which is not practical. Statistics can be used to construct an interval that contains the true mean with 95% confidence. The rationale is that the upper limit of this interval, the 95% upper confidence limit (UCL) represents the upper limit of the true mean with 95% confidence.

One necessary precondition for the construction of a confidence limit is that the data be normally distributed. The USEPA recommends the Shapiro-Wilk test for normality. The data were tested with the

Shapiro-Wilk test and found to exhibit non-normal characteristics. These data failed the normality test because of the presence of three high data points. The data set was tested for outliers using the Dixon Test for Outliers, and the three high points were identified as statistically significant outliers. The data were transformed with successive transformations following the ladder of powers. The first transformation to pass the normality test at 5% significance was the logarithmic transformation. Therefore, the data set is lognormally distributed. Attached to this memo is a probability plot generated by the ChemStat statistical package (version 5.2.0.0) of the log-transformed data. The linear trend can be seen for all but the three non-detections.

Table 1 shows the log-transformed data. A natural logarithm was used to transform the data. It should be noted that when the transformed data set was tested with Dixon's Test for Outliers, no statistically significant outliers were identified.

The 95% UCL was computed from the sample mean $\bar{x}$, the sample standard deviation *s*, and the number of data points *n*, using the following formula:

$$UCL = \exp\left(\bar{x} + \frac{s\,t_{(n-1,0.95)}}{\sqrt{n}}\right)$$

The t-statistic $t_{(n-1,\,0.95)}$ was obtained from a table in the groundwater statistical guidance document (USEPA, 1989). The inputs and the result are presented in Table 1. The 95% UCL was computed to be 0.159 mg/L.

**Discussion**

The computed 95% UCL was lower than the arithmetic mean. This was to be expected in a lognormal data set, because the arithmetic mean in such a skewed data set is dominated by the highest data points. In data that are logarithmically distributed, it is the geometric mean, and not the arithmetic mean around which the confidence interval is constructed. The geometric mean of the adjusted, non-transformed data set was 0.082 mg/L (Table 1). To construct an interval around the arithmetic mean in a lognormally distributed data set, Land's procedure is often used. However, this procedure can introduce results that are described as "biased" and "extreme" (USEPA, 2009), particularly when the coefficient of variation is high. This procedure was not used for these data.

The data set is partially censored; there were 3 nondetections out of 16 data points. This is a detection frequency of 81.3%. USEPA guidance recommends that some form of adjustment, such as Cohen's Adjustment, be applied when the detection frequency is between 50% and 85%, and that nonparametric methods be used when the detection frequency is below 50%. Cohen's adjustment was not applied, because it can introduce bias in transformed data sets. It was considered to introduce less bias to omit the adjustment on a data set that was only somewhat more censored than the 85% detection guideline.

Had the normality issue been ignored and a UCL been computed around the untransformed arithmetic mean, the "UCL" would have been estimated as 0.401 mg/L, a value that is still below the 0.5 mg/L criterion.

## Conclusion

The benzene TCLP data were found to be lognormally distributed. The sample geometric mean of the benzene TCLP data set was 0.082 mg/L. One can be 95% confident that the true geometric mean of these data is 0.159 mg/L or less. Therefore, the true mean TCLP concentration is expected to be less than 0.5 mg/L, the TCLP limit for benzene.

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**Table 1. Calculation of the 95% Upper Confidence Limit of Benzene TCLP Results, Ashland Inc., Hattiesburg, Mississippi**

| Location | Original Benzene mg/L | Adjusted Benzene mg/L | Log-transformed Benzene mg/L |
|---|---|---|---|
| IBS-7-LS | 1.3 | 1.3 | 0.2624 |
| IBS-3-LS | 0.96 | 0.96 | -0.0408 |
| IBS-1-US | 0.55 | 0.55 | -0.5978 |
| IBS-1-LS | 0.21 | 0.21 | -1.5606 |
| IBS-6-LS | 0.14 | 0.14 | -1.9661 |
| IBS-2-LS | 0.13 | 0.13 | -2.0402 |
| IBS-3-US | 0.12 | 0.12 | -2.1203 |
| IBS-8-LS | 0.1 | 0.1 | -2.3026 |
| IBS-2-US | 0.058 | 0.058 | -2.8473 |
| IBS-4-LS | 0.052 | 0.052 | -2.9565 |
| IBS-5-LS | 0.043 | 0.043 | -3.1466 |
| IBS-4-US | 0.038 | 0.038 | -3.2702 |
| IBS-5-US | 0.025 | 0.025 | -3.6889 |
| IBS-6-US | <0.02 | 0.01 | -4.6052 |
| IBS-7-US | <0.02 | 0.01 | -4.6052 |
| IBS-8-US | <0.02 | 0.01 | -4.6052 |
| | | | |
| Sample mean | | 0.2348 | -2.5057 |
| Standard deviation | | 0.3784 | 1.5255 |
| number | | 16 | 16 |
| frequency | | 81.3% | 81.3% |
| $t_{(n-1,0.95)}$ | | 1.753 | 1.753 |
| raw UCL | | | -1.837 |
| UCL | | 0.401 | **0.159** |
| | | | |
| median | | 0.079 | |
| Coefficant of variation | | 1.61 | -0.61 |
| geometric mean | | 0.082 | |

Notes:

mg/L: milligrams per liter

Data were adjusted by replacing the non-detections with numerical values equal to half of the detection limit.

A natural logarithm was used for the transformation.

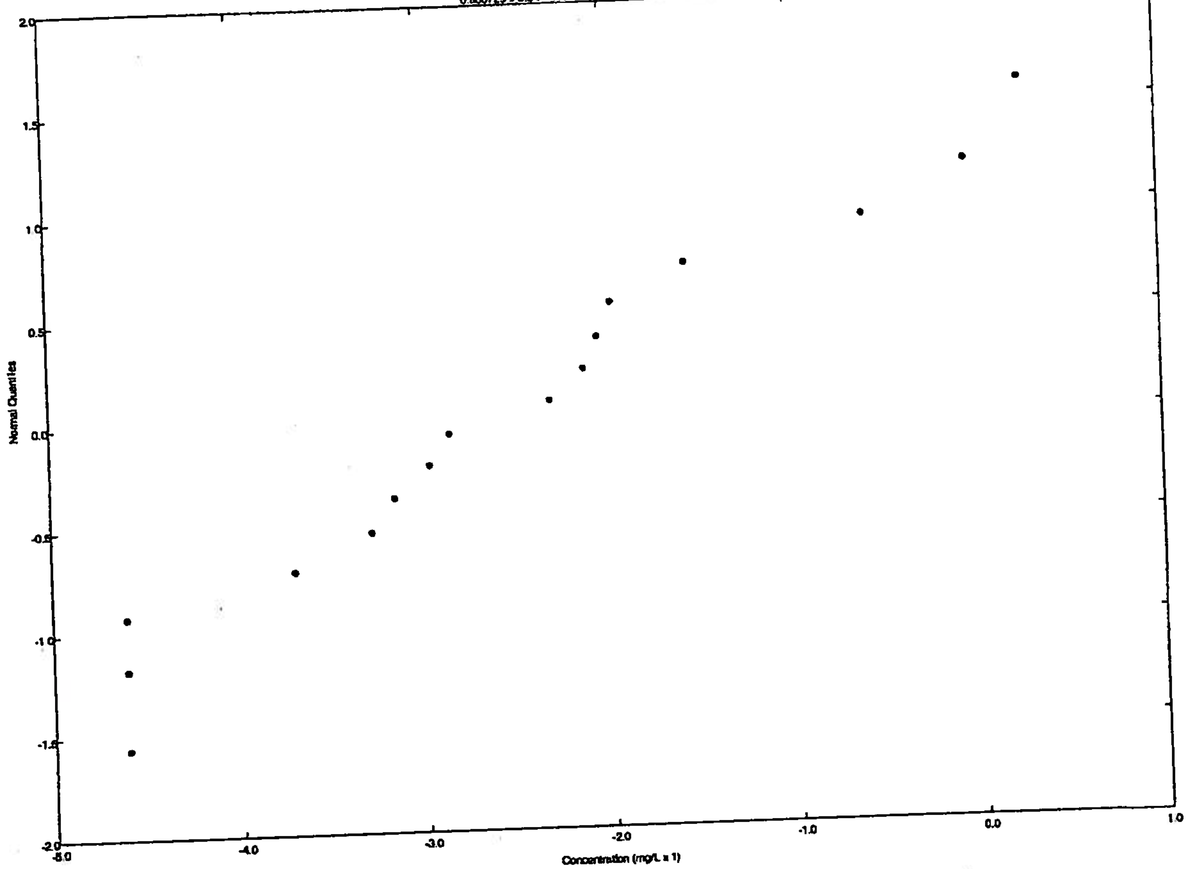
The term "raw UCL" refers to a UCL computed prior to the necessary step of inverse transformation.

## Benzene

### Probability Plot of Measured Values for All Wells

Correlation Coefficient = 0.960723

0.960723 > 0.94 -- Normality test succeeds at 95% level



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# Appendix E

POTW Effluent Discharge Calculations

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Appendix E.

Summary of Potential POTW Effluent Data,
Hercules Incorporated, Hattiesburg, Mississippi.

| POTW Discharge Permit Parameter | Discharge Limitations | | | Sample Results | | | | | | | Maximum Daily Discharge[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity / Loading Average (Monthly Average) | Quantity / Loading Maximum (Daily Maximum) | Units | IBS-4 Centrifuge Centrate (250 ppm Anion Polymer) 6/23/2010 | IBS-4 Centrifuge Centrate (250 ppm Cation Polymer) 6/23/2010 | IBS-4 Centrifuge Centrate (No Polymer) 6/23/2010 | IBS-4 Filter Press Filtrate 6/23/2010 | IBS-4 Gravity Dewatering Liquid 6/23/2010 | IBS-8 Filter Press Filtrate 6/23/2010 | Units | Pounds of Parameter Per Gallon of Water (Pounds) | Maximum Amount of Water that Can be Discharged per Day (Gallons) |
| 1,1,1-Trichloroethane Effluent | 0.064 | 0.175 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,1,2-Trichloroethane Effluent | 0.093 | 0.371 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,1-Dichloroethane Effluent | 0.064 | 0.172 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,1-Dichloroethylene Effluent | 0.064 | 0.175 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,2,4-Trichlorobenzene Effluent | 0.572 | 2.32 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| 1,2-Dichlorobenzene Effluent | 0.572 | 2.32 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| 1,2-Dichloroethane Effluent | 0.525 | 1.68 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,2-Dichloropropane Effluent | 0.572 | 2.32 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,2-Transdichloroethylene Effluent | 0.073 | 0.193 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,3-Dichlorobenzene Effluent | 0.414 | 1.11 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| 1,3-Dichloropropylene, cis Effluent[2] | 0.572 | 2.32 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,3-Dichloropropylene, trans Effluent[2] | 0.572 | 2.32 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| 1,4-Dichlorobenzene Effluent | 0.414 | 1.11 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| 2-Nitrophenol Effluent | 0.19 | 0.674 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| 4,6-Dinitro-o-cresol Effluent | 0.228 | 0.809 | lbs/day | < 0.330 | < 0.330 | < 0.250 | < 0.170 | < 0.050 | < 0.140 | mg/L | NA | NA |
| 4-Nitrophenol Effluent | 0.473 | 1.68 | lbs/day | < 0.330 | < 0.330 | < 0.250 | < 0.170 | < 0.050 | < 0.140 | mg/L | NA | NA |
| Acenaphthene Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Anthracene Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Benzene Effluent | 0.166 | 0.391 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | **0.0013** | mg/L | 1.08108E-07 | 3,616,754 |
| Bis(2-ethylhexyl)phthalate Effluent | 0.277 | 0.753 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Carbon tetrachloride Effluent | 0.414 | 1.11 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Chlorobenzene Effluent | 0.414 | 1.11 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Chloroethane Effluent | 0.321 | 0.861 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Chloroform Effluent | 324 | 0.949 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Diethyl phthalate Effluent | 0.134 | 0.33 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Dimethyl phthalate Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Di-N-Butyl Phthalate Effluent | 0.058 | 0.126 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Ethyl benzene Effluent | 0.414 | 1.11 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Fluoranthene Effluent | 0.064 | 0.158 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Fluorene Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Hexachlorobenzene Effluent | 0.572 | 2.32 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Hexachlorobutadiene Effluent | 0.414 | 1.11 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Hexachloroethane Effluent | 0.572 | 2.32 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Methyl Chloride (Chloromethane) Effluent | 0.321 | 0.861 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Methylene Chloride Effluent | 0.105 | 0.496 | lbs/day | < 0.005 | < 0.005 | < 0.005 | < 2.500 | < 0.005 | < 0.005 | mg/L | NA | NA |
| Naphthalene Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |

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Appendix E. Summary of Potential POTW Effluent Data,
Hercules Incorporated, Hattiesburg, Mississippi.

| POTW Discharge Permit Parameter | Discharge Limitations | | | Sample Results | | | | | | | Maximum Daily Discharge[1] | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Quantity / Loading Average (Monthly Average) | Quantity / Loading Maximum (Daily Maximum) | Units | IBS-4 Centrifuge Centrate (250 ppm Anion Polymer) 6/23/2010 | IBS-4 Centrifuge Centrate (250 ppm Cation Polymer) 6/23/2010 | IBS-4 Centrifuge Centrate (No Polymer) 6/23/2010 | IBS-4 Filter Press Filtrate 6/23/2010 | IBS-4 Gravity Dewatering Liquid 6/23/2010 | IBS-8 Filter Press Filtrate 6/23/2010 | Units | Pounds of Parameter Per Gallon of Water Pounds | Maximum Amount of Water that Can be Discharged per Day Gallons |
| Nitro-Benzene Effluent | 6.53 | 18.7 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Phenanthrene Effluent | 0.055 | 0.137 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Pyrene Effluent | 0.058 | 0.14 | lbs/day | < 0.067 | < 0.067 | < 0.050 | < 0.330 | < 0.010 | < 0.029 | mg/L | NA | NA |
| Tetrachloroethylene Effluent | 0.152 | 0.479 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Toluene Effluent | 0.082 | 0.216 | lbs/day | < 0.001 | **0.00052 J** | < 0.001 | **0.280 J** | < 0.001 | **0.100** | mg/L | 2.32848E-06 | **92,764** |
| Trichloroethylene Effluent | 0.076 | 0.201 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |
| Vinyl chloride Effluent | 0.283 | 0.502 | lbs/day | < 0.001 | < 0.001 | < 0.001 | < 0.500 | < 0.001 | < 0.001 | mg/L | NA | NA |

(1) Maximum gallons per day that can be discharged within the current permit limitations.
The MDEQ POTW Discharge Permit limitations are based on a loading rate. This rate does not take into consideration exceedances of RCRA toxicity characteristic levels. The discharge limitations presented herein area based on the assumption that all parameter concentrations remain below toxicity characteristic levels.

(2) The MDEQ POTW Discharge Permit lists a discharge limit for 1,3-Dichloropropylene. This limit was used for the cis- or trans- isomer listed.

J Estimated concentration.
lbs/day Pounds per day.
MDEQ Mississippi Department of Environmental Quality.
mg/L Milligrams per liter.
NA Not applicable.
POTW Publicly Owned Treatment Works.
RCRA Resource Conservation and Recovery Act.

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## Appendix F

Dewatering Report

ENVIRONMENTAL TMA®

TMA Environmental, Inc.
P.O. Box 150 • Gonzales, LA 70707-0150
Phone: 225.677.8800 • Fax: 225.673.9286

June 21, 2010

Job No. 36810

Mr. Craig Derouen
ARCADIS U.S. Inc.
10352 Plaza America
Baton Rouge, La 70816

Re: Sludge Dewatering Overview

TMA appreciates the opportunity to submit this information on the above referenced project. We are a *"Total Service Company"* assuring our clients the value-added service necessary to meet their Chemical cleaning, Hydroblasting and Vacuum truck services needs in the most cost effective manner.

**Overview:**
TMA Environmental received 4 samples of sludge in 4 separate 5 gallon plastic buckets (with lids) to be studied for dewatering treatability and dewatering simulations performed. The 4 sample buckets were labeled IBS-2, IBS-4, IBS-8 and ETS-2.

We performed bench scale treatability studies and simulations to enable Arcadis to evaluate filter press, centrifuge and gravitational dewatering technologies. We evaluated the insitu sludge samples with a variety of test for physical data. The physical data was used for our evaluation of the different dewatering technologies, volume reductions and additives required for processing.

Before performing the testing and simulations the insitu sludge samples were thoroughly mixed. Each sample was mixed using an electrically powered drill and a five gallon paint mixer for a duration of 5 minutes each. The mixing achieved a homogenous mix ofthe flowable sludge, settled solids and clumped solids. The samples were remixed as needed before each test. No dilution was needed for mixing and no dilution was used for any testing.

As requested, the dewatering test and simulations included Baroid, plate and frame, centrifuge, and stacking (i.e.- gravity drainage or gravitational dewatering). Each technology study used a variety of chemicals, materials and dosages to arrive at the best results. Below or the results of each sample:

***Baroid:***
The Baroid equipment was used in conjunction with various filter media and chemical treatments to obtain an indication for the best result for the recessed chamber filter press simulation. Various dosages of diatomaceous earth, lime, ferric sulfate and combinations were used in the Baroid testing. All samples were also tested using no additives. Decisions were based on cake hardness, estimated % solids of filter cake, estimated minimal filter aid required, time required for dewatering/filtering, cleanliness of filter cloth and cleanliness of filtrate/effluent. Our estimated best results were achieved by adding and mixing 0.5% by weight hydrated lime with the insitu sludge samples. Similar results were achieved on all 4 samples. Filter cake was firm, filter cloth remained clean and filtrate/effluent was good.
Basically all samples showed the ability to be filter pressed using D,E., lime, ferric and most combinations mentioned. Also, all samples showed the ability to be filter pressed without using any filter aid, although the cake was sticky which left filter cloth dirty.

***Plate and Frame / Filter Press:***
Filter press technology achieved the best results when considering volume and mass reduction. Also as expected, filter press technology achieved the best effluent of the dewatering technologies tested.
The filter press simulation samples were achieved using the insitu sludge, no dilution and 0.5% by weight of hydrated lime added. The filter cake definitely would pass paint filter testing. The filter cake was firm which should achieve a good compressive strength and suspended solids percentage. All 4 samples IBS-2, IBS-4, IBS-8 and ETS-2 were very similar in the testing and simulations.

***Centrifuge:***
Centrifuge technology is a very good candidate however the solids content would be lower than that of a filter press. The initial centrifuge simulation was run without chemical addition. The solids phase would definitely pass paint filter test but the centrate/effluent was not as clean as when polymer was not used.
The addition of polymer to enhance the solids/liquids separation process showed positive results in the centrate/effluent. The lab studies show a good two phase separation with very clean water. A minimal amount of light solids particles is noticed in the liquid phase (centrated/effluent).
The samples were jar tested for polymer dosage using cationic and anionic polymers of various charges (low, medium and high charge). The high charge cationic polymer showed the best estimated results based on solids percentage and cleanliness of the centrate/effluent.
Again, all 4 samples IBS-2, IBS-4, IBS-8 and ETS-2 were very similar in the testing and simulations.

***Gravity Drainage (gravity dewatering/stacking)***
Based upon the Arcadis recommended procedure for the "Stacking Simulation", this dewatering process also shows some positive results. The final solids phase from the study will pass the paint filter test without additional solidification. The liquid phase/effluent contained a reasonable amount of suspended solids. An addition of polymer could enhance solids settling and clean up the effluent.
Again, all 4 samples IBS-2, IBS-4, IBS-8 and ETS-2 were very similar in the testing and simulations.

**Conclusion:**
This material (all 4 samples) showed positive signs of dewatering by all the tested technologies.
All 4 samples showed very similar dewatering characteristics.

Once again, thank you for this opportunity to be of service to you. We look forward to your review of this testing study. Should you have any questions or require additional information, please do not hesitate to contact us.

For TMA Environmental

Jody Elisar
Business Development Manager

TMA Environmental, Inc.
P.O. Box 150 • Gonzales, LA 70707-0150
Phone: 225.677.8800 • Fax: 225.673.9286

| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-2 in situ | 47 | % In Situ solids by volume (spin-out) | Bench Test | 2 minutes @ 100% | | |
| | 8.82 | Lbs. per gallon In Situ | Bench Test | | | pass paint filter |
| | 20% by weight | % Solids In Situ | Bench Test (oven) | | effluent not clear after spin-out | |
| | same | In Situ Solids (Including Oil&Grease) | N/A | | | |
| | | | | | | |
| IBS-2 centrifuge with | | | | | | |
| 250 ppm cationic | - | Dilution Factor | N/A | | sample sent to Arcadis | sample sent to Arcadis |
| polymer | 31 | % Solids by weight in Cake | Bench Test (oven) | 2 minutes @ 100% | very light solids | |
| | did not test | % solids in effluent | clarity good, light solids | | | |
| | | | | | | |
| IBS-2 centrifuge with | | | | | | |
| 250 ppm anionic | - | Dilution Factor | N/A | | | |
| polymer | 29 | % Solids in Cake | Bench Test (oven) | 2 minutes @ 100% | light solid particles floating | |
| | did not test | % solids in effluent | clarity good, light solids | | | |
| | | | | | | |
| IBS-2 Baroid with no | | | | | | |
| additives | - | Dilution Factor | N/A | | soft and sticks to cloth | pass paint filter |
| | 40 | % Solids in Cake | Bench Test (oven) | 4.75 minutes @ 80 psi | slight dark color | |
| | did not test | % solids in effluent | effluent has some solids | | | |
| | | | | | | |
| IBS-2 Baroid with 1.0% by | | | | | | |
| wt. diatomacous earth | - | Dilution Factor | N/A | good cake, crumbles | | |
| | 52 | % Solids in Cake | Bench Test (oven) | 3.0 minutes @ 80 psi | clear, no viisible solids | clear, no visible solids |
| | did not test | % solids in effluent | | | | |
| | | | | | | |
| IBS-2 Baroid with 0.5% by | | | | | | |
| wt. diatomacous earth | - | Dilution Factor | N/A | good cake, slightly soft | | |
| | 47 | % Solids in Cake | Bench Test (oven) | 3.5 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | did not test | % solids in effluent | clarity good, light solids | | | |
| | | | | | | |
| IBS-2 Baroid with 1.0% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | good cake, firm | | good cake, very firm |
| | 51 | % Solids in Cake | Bench Test (oven) | 3.0 minutes @ 80 psi | clear, no visible solids | |
| | did not test | % solids in effluent | clarity good, light solids | | | |
| | | | | | | |
| IBS-2 Baroid with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | sample sent to Arcadis | | good cake, firm |
| | 49 | % Solids in Cake | Bench Test (oven) | 3.25 minutes @ 80 psi | sample sent to Arcadis | |
| | did not test | % solids in effluent | clarity good | | | |
| | | | | | | |
| IBS-2 Baroid with 1.0% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | fair cake, soft on top | | |
| & 0.5% ferric sulfate | 51 | % Solids In Cake | Bench Test (oven) | 4.0 minutes @ 80 psi | slight dark color, no visible solids | |
| | did not test | % solids in effluent | clarity good, light solids | | | |

TMA Environmental, Inc.
P.O. Box 150 • Gonzales, LA 70707-0150
Phone: 225.677.8800 • Fax: 225.673.9286

| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-2 Baroid with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| & 0.5% ferric sulfate | 45 | % Solids in Cake | Bench Test (oven) | fair cake, soft on top | | fair cake |
| | did not test | % solids in effluent | clarity good, light solids | 4.0 minutes @ 80 psi | slight color, no visible solids | |
| | | | | | | |
| IBS-2 filter press with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| | 55 | % Solids in Cake | Bench Test (oven) | sample sent to Arcadis | | good cake, firm |
| | did not test | % solids in effluent | clarity good | 5.5 minutes @ 120 psi | sample sent to Arcadis | |
| | | | | | | |
| IBS-2 | | | | | | |
| gravity dewatering | | | | 4.5 days | sample sent to Arcadis | sample sent to Arcadis |

TMA Environmental, Inc.
P.O. Box 150 • Gonzales, LA 70707-0150
Phone: 225.677.8800 • Fax: 225.673.9286

| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-4 in situ | 47 | % In Situ solids by volume (spin-out) | Bench Test | 2 minutes @ 100% | | |
| | 8.82 | Lbs. per gallon In Situ | Bench Test | | | |
| | 18% by weight | % Solids In Situ | Bench Test (oven) | | | pass paint filter |
| | | | | | | |
| IBS-4 centrifuge with | | | | | | |
| 250 ppm cationic | - | Dilution Factor | N/A | | | |
| polymer | 34 | % Solids by weight in Cake | Bench Test (oven) | | sample sent to Arcadis | sample sent to Arcadis |
| | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids on bottom | |
| | | | | | | |
| IBS-4 centrifuge with | | | | | | |
| 250 ppm anionic | - | Dilution Factor | N/A | | | |
| polymer | 33 | % Solids in Cake | Bench Test (oven) | | sample sent to Arcadis | sample sent to Arcadis |
| | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids floating | |
| | | | | | | |
| IBS-4 Baroid with no | | | | | | |
| additives | - | Dilution Factor | N/A | | | |
| | 40 | % Solids in Cake | Bench Test (oven) | | soft and slightly sticky | pass paint filter |
| | did not test | % solids in effluent | effluent has some solids | 4.75 minutes @ 80 psi | slight dark color | |
| | | | | | | |
| IBS-4 Baroid with 1.0% by | | | | | | |
| wt. diatomacous earth | - | Dilution Factor | N/A | | | |
| | 50 | % Solids in Cake | Bench Test (oven) | good cake, crumbles | | |
| | did not test | % solids in effluent | | 3.0 minutes @ 80 psi | clear, no viisible solids | clear, no visible solids |
| | | | | | | |
| IBS-4 Baroid with 0.5% by | | | | | | |
| wt. diatomacous earth | - | Dilution Factor | N/A | | | |
| | 47 | % Solids in Cake | Bench Test (oven) | good cake, slightly soft | | |
| | did not test | % solids in effluent | clarity good, light solids | 3.5 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| IBS-4 Baroid with 1.0% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| | 61 | % Solids in Cake | Bench Test (oven) | good cake, firm | | |
| | did not test | % solids in effluent | clarity good, light solids | 3.0 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| IBS-4 Baroid with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| | 62 | % Solids in Cake | Bench Test (oven) | | good cake, firm | |
| | did not test | % solids in effluent | clarity good | 3.25 minutes @ 80 psi | | clear, no visible solids |
| | | | | | | |
| IBS-4 Baroid with 1.0% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| & 0.5% ferric sulfate | did not test | % Solids in Cake | | fair cake, soft on top | | |
| | did not test | % solids in effluent | clarity good, light solids | 4.5 minutes @ 80 psi | slight dark color, no visible solids | clear, no visible solids |

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| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-4 Baroid with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| & 0.5% ferric sulfate | did not test | % Solids in Cake | | fair cake, soft on top | | clear, no visible solids |
| | did not test | % solids in effluent | clarity good, light solids | 4.5 minutes @ 80 psi | | |
| | | | | | | |
| IBS-4 filter press with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | sample sent to Arcadis | | good cake, firm |
| | 62 | % Solids in Cake | Bench Test (oven) | 5.5 minutes @ 120 psi | sample sent to Arcadis | |
| | did not test | % solids in effluent | clarity good | | | |
| | | | | | | |
| IBS-4 | | | | 4.5 days | sample sent to Arcadis | sample sent to Arcadis |
| gravity dewatering | | | | | | |

TMA Environmental, Inc.
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Phone: 225.677.8800 • Fax: 225.673.9286

| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-8 in situ | 44 | % In Situ solids by volume (spin-out) | Bench Test | 2 minutes @ 100% | | |
| | 8.90 | Lbs. per gallon In Situ | Bench Test | | | |
| | 17% | % Solids In Situ | Bench Test (oven) | | | pass paint filter |
| | same | In Situ Solids (Including Oil&Grease) | N/A | | effluent not clear after spin-out | |
| | | | | | | |
| IBS-8 centrifuge with | - | Dilution Factor | N/A | | | |
| 250 ppm cationic | 28 | % Solids by weight in Cake | Bench Test (oven) | | sample sent to Arcadis | sample sent to Arcadis |
| polymer | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids on bottom | |
| | | | | | | |
| IBS-8 centrifuge with | - | Dilution Factor | N/A | | | |
| 250 ppm anionic | 28 | % Solids in Cake | Bench Test (oven) | | | |
| polymer | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids floating | |
| | | | | | | |
| IBS-8 Baroid with no | - | Dilution Factor | N/A | | | |
| additives | 42 | % Solids in Cake | Bench Test (oven) | | soft and slightly sticky | |
| | did not test | % solids in effluent | effluent has some solids | 6.0 minutes @ 80 psi | slight dark color | |
| | | | | | | |
| IBS-8 Baroid with 1.0% by | - | Dilution Factor | N/A | | | |
| wt. diatomacous earth | 56 | % Solids in Cake | Bench Test (oven) | good cake, crumbles | | |
| | did not test | % solids in effluent | | 4.0 minutes @ 80 psi | clear, no viisible solids | clear, no visible solids |
| | | | | | | |
| IBS-8 Baroid with 0.5% by | - | Dilution Factor | N/A | | | |
| wt. diatomacous earth | 49 | % Solids in Cake | Bench Test (oven) | good cake, slightly soft | | |
| | did not test | % solids in effluent | clarity good, light solids | 4.25 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| IBS-8 Baroid with 1.0% by | - | Dilution Factor | N/A | | | |
| wt. hydrated lime | 60 | % Solids in Cake | Bench Test (oven) | good cake, firm | | |
| | did not test | % solids in effluent | clarity good, light solids | 3.5 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| IBS-8 Baroid with 0.5% by | - | Dilution Factor | N/A | | | |
| wt. hydrated lime | 56 | % Solids in Cake | Bench Test (oven) | sample sent to Arcadis | good cake, firm | |
| | did not test | % solids in effluent | clarity good | 4.0 minutes @ 80 psi | sample sent to Arcadis | clear, no visible solids |
| | | | | | | |
| IBS-8 Baroid with 1.0% by | - | Dilution Factor | N/A | | | |
| wt. hydrated lime | 56 | % Solids in Cake | Bench Test (oven) | fair cake, soft on top | | |
| & 0.5% ferric sulfate | did not test | % solids in effluent | clarity good, light solids | 4.0 minutes @ 80 psi | slight dark color, no visible solids | clear, no visible solids |

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| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| IBS-8 Barold with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| & 0.5% ferric sulfate | 55 | % Solids in Cake | Bench Test (oven) | fair cake, soft on top | | |
| | did not test | % solids in effluent | clarity good, light solids | 4.0 minutes @ 80 psi | | clear, no visible solids |
| | | | | | | |
| IBS-8 filter press with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| | 62 | % Solids in Cake | Bench Test (oven) | sample sent to Arcadis | | good cake, firm |
| | did not test | % solids in effluent | clarity good | 5.5 minutes @ 120 psi | sample sent to Arcadis | |
| | | | | | | |
| IBS-8 | | | | | | |
| gravity dewatering | | | | 4.5 days | sample sent to Arcadis | sample sent to Arcadis |

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| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| **ETS-2 in situ** | 33 | % In Situ solids by volume (spin-out) | Bench Test | 2 minutes @ 100% | | |
| | 8.90 | Lbs. per gallon In Situ | Bench Test | | | |
| | 12% by weight | % Solids In Situ | Bench Test (oven) | | | pass paint filter |
| | same | In Situ Solids (Including Oil&Grease) | N/A | | effluent not clear after spin-out | |
| | | | | | | |
| **ETS-2 centrifuge with** | | | | | | |
| **250 ppm cationic** | - | Dilution Factor | N/A | | | |
| **polymer** | 28 | % Solids by weight in Cake | Bench Test (oven) | | **sample sent to Arcadis** | **sample sent to Arcadis** |
| | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids on bottom | |
| | | | | | | |
| **ETS-2 centrifuge with** | | | | | | |
| **250 ppm anionic** | - | Dilution Factor | N/A | | | |
| **polymer** | 24 | % Solids in Cake | Bench Test (oven) | | | |
| | did not test | % solids in effluent | clarity good, light solids | 2 minutes @ 100% | light solids floating | |
| | | | | | | |
| **ETS-2 Baroid with no** | | | | | | |
| **additives** | - | Dilution Factor | N/A | | | |
| | 39 | % Solids in Cake | Bench Test (oven) | | soft and slightly sticky | |
| | did not test | % solids in effluent | effluent has some solids | 4.75 minutes @ 80 psi | slight dark color | |
| | | | | | | |
| **ETS-2 Baroid with 1.0% by** | | | | | | |
| **wt. diatomacous earth** | - | Dilution Factor | N/A | | | |
| | 55 | % Solids in Cake | Bench Test (oven) | good cake, crumbles | | |
| | did not test | % solids in effluent | | 3.0 minutes @ 80 psi | clear, no viisible solids | clear, no visible solids |
| | | | | | | |
| **ETS-2 Baroid with 0.5% by** | | | | | | |
| **wt. diatomacous earth** | - | Dilution Factor | N/A | | | |
| | 55 | % Solids in Cake | Bench Test (oven) | good cake, slightly soft | | |
| | did not test | % solids in effluent | clarity good, light solids | 3.5 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| **ETS-2 Baroid with 1.0% by** | | | | | | |
| **wt. hydrated lime** | - | Dilution Factor | N/A | | | |
| | 52 | % Solids in Cake | Bench Test (oven) | good cake, firm | | |
| | did not test | % solids in effluent | clarity good, light solids | 3.0 minutes @ 80 psi | clear, no visible solids | clear, no visible solids |
| | | | | | | |
| **ETS-2 Baroid with 0.5% by** | | | | | | |
| **wt. hydrated lime** | - | Dilution Factor | N/A | | | |
| | 46 | % Solids in Cake | Bench Test (oven) | | good cake, firm | **sample sent to Arcadis** |
| | did not test | % solids in effluent | clarity good | 3.25 minutes @ 80 psi | **sample sent to Arcadis** | clear, no visible solids |
| | | | | | | |
| **ETS-2 Baroid with 1.0% by** | | | | | | |
| **wt. hydrated lime** | - | Dilution Factor | N/A | | | |
| **& 0.5% ferric sulfate** | 48 | % Solids in Cake | Bench Test (oven) | fair cake, soft on top | | |
| | did not test | % solids in effluent | clarity good, light solids | 4.0 minutes @ 80 psi | slight dark color, no visible solids | clear, no visible solids |

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| TEST | results | test performed | comments | time for test | effluent phase | solids phase |
|---|---|---|---|---|---|---|
| ETS-2 Baroid with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| & 0.5% ferric sulfate | 45 | % Solids in Cake | Bench Test (oven) | fair cake, soft on top | | |
| | did not test | % solids in effluent | clarity good, light solids | 4.0 minutes @ 80 psi | | clear, no visible solids |
| | | | | | | |
| ETS-2 filter press with 0.5% by | | | | | | |
| wt. hydrated lime | - | Dilution Factor | N/A | | | |
| | 50 | % Solids in Cake | Bench Test (oven) | | good firm cake | sample sent to Arcadis |
| | did not test | % solids in effluent | clarity good | 7.0 minutes @ 120 psi | sample sent to Arcadis | |
| | | | | | | |
| ETS-2 | | | | | | |
| gravity dewatering | | | | 4.5 days | sample sent to Arcadis | sample sent to Arcadis |

ARCADIS

## Appendix G

Solidification Report

FUGRO

FUGRO CONSULTANTS, INC.

4233 Rhoda Drive
Baton Rouge, Louisiana 70816
Tel: 225-292-5084
Fax: 225-292-8084

August 09, 2010

Mr. Craig Derouen
Arcadis
10352 Plaza Americana Drive
Baton Rouge, LA 70816

Re: Sludge Mix Design
Hercules, Inc.
Hattiesburg, MS
Fugro Project Number: 04.55101011

Mr. Derouen:

We have completed the mix study of the onsite sludge of the referenced site. Attached are Tables 1 and 2 of our findings.

If you have any questions regarding this information, please contact me at (225) 292-5084.

It has been a pleasure servicing you and Arcadis on this project.

Sincerely,

George Perkins
CMET Manager

GLP/kkb

Enclosure

## Hercules, Inc. Solidification Study

# Raw Sludge Data
# Table 1

ARCADIS
Hercules, Inc. - Hattiesburg, MS

Date: 7/22/2010

Fugro Project Number: 04.55101011

| Sludge Type | Moisture Content (%)[1] | Specific Gravity | Bulk Density (pcf) | Paint Filter (P/F) | % Solids |
|---|---|---|---|---|---|
| ETS-2 | 87.2 | 1.03 | 62.0 | FAIL | 12.8 |
| IBS-2 | 84.8 | 0.99 | 61.0 | FAIL | 15.2 |
| IBS-4 | 83.8 | 1.03 | 62.5 | FAIL | 16.2 |
| IBS-8 | 90.0 | 1.01 | 63.0 | FAIL | 10.0 |

## Raw Sludge After Dewatering

| Sludge Type | Moisture Content (%)[1] | Type of Dewatering | Bulk Density (pcf) | Paint Filter (P/F) | % Solids |
|---|---|---|---|---|---|
| ETS | 83.9 | Gravity | 54.2 | FAIL | 16.1 |
| ETS | 76.2 | Centrifuge | 53.2 | PASS | 23.8 |
| ETS | 58.0 | Filter Press | 66.1 | PASS | 42.0 |
| IBS-4 | 59.0 | Gravity | - | PASS | 41.0 |
| IBS-2 | 66.5 | Gravity | 56.7 | PASS | 33.5 |
| IBS-2 | 52.0 | Filter Press | 61.7 | PASS | 48.0 |
| IBS-2 | 65.5 | Centrifuge | 62.9 | PASS | 34.5 |

Note: [1] Moisture content based on the total weight of sample

4233 Rhoda Drive
Baton Rouge, LA 70816

Hercules, Inc. Solidification Study

FUGRO

# Sludge Reagent Data
## Table 2

ARCADIS
Hercules, Inc. - Hattiesburg, MS

Date: 7/26/2010

Fugro Project Number: 04.55101011

| Sludge Type | Mix Number | Reagent Type | Reagent (%) | Days Cured | Bulk Density (pcf)[1] | Compressive Strength (psi) | Paint Filter P/F | After 3 day cure P/F |
|---|---|---|---|---|---|---|---|---|
| IBS-2 | 1-A | Portland Cement | 5 | 3 | 58.5 | 0.264 | Fail | Pass |
| | 1-B | Portland Cement | 5 | 7 | 58.5 | 0.64 | Fail | Pass |
| | 2-A | Portland Cement | 10 | 3 | 61.0 | 1.78 | Fail | Pass |
| | 2-B | Portland Cement | 10 | 7 | 61 | 3.36 | Fail | Pass |
| | 3-A | Quick Lime | 5 | 3 | 58.6 | (2) | Fail | Fail |
| | 4-A | Quick Lime | 10 | 3 | 60.4 | (2) | Fail | Pass |
| | 4-B | Quick Lime | 10 | 7 | 60.4 | 0.61 | Fail | Pass |
| | 5-A | Fly Ash | 15 | 3 | 61.3 | (2) | Fail | Fail |
| | 6-A | Fly Ash | 25 | 3 | 68.7 | 0.320 | Fail | Pass |
| | 6-B | Fly Ash | 25 | 7 | 68.7 | 1.02 | Fail | Pass |
| | 7-A | Quick Lime | 25 | 3 | 66.9 | 6.50 | Pass | Pass |
| | 7-B | Quick Lime | 25 | 7 | 66.9 | 13.6 | Pass | Pass |
| | 8-A | Calciment | 10 | 3 | 63.1 | 0.44 | Fail | Fail |
| | 8-B | Calciment | 10 | - | 62.5 | - | Fail | - |
| | 9-A | Calciment | 20 | 3 | 69.1 | 3.54 | Fail | Pass |
| | 9-B | Calciment | 20 | - | 69.7 | - | Fail | - |

Notes:
(1) Bulk density at time of molding
(2) Slumped under own weight
(3) Reagent % is by volume

4233 Rhoda Drive
Baton Rouge, LA 70816

NO CHANGE

**ARCADIS**
*Infrastructure, environment, buildings*

ID#:

# CHAIN OF CUSTODY & LABORATORY ANALYSIS REQUEST FORM

Page 1 of 1

Lab Work Order #

**Send Results to:**

Contact & Company Name: Craig Derouen ARCADIS
Telephone:
Address: 10352 Plaza Americana Dr
Fax:
City: BR State: LA Zip: 70816
E-mail Address: craig.derouen@arcadis-us.com
Project Name/Location (City, State): Hercules / Hattiesburg, MS
Project #: OH003000.A524.0000?
Sampler's Printed Name: Craig A. Derouen
Sampler's Signature: [signature]

| Preservative | — | — | — | — | — | — |
|---|---|---|---|---|---|---|
| Filtered (✓) | — | — | — | — | — | — |
| # of Containers | 1 | 1 | 1 | 1 | 1 | 1 |
| Container Information | | | | | | |

**PARAMETER ANALYSIS & METHOD**

| Sample ID | Collection Date | Collection Time | Type Comp | Type Grab | Matrix | Paint Filter | moisture content | % and suspended solids | specific gravity | bulk density | UCS | | REMARKS |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| ETS-2 (Filter Press) | 6-23-10 | 1320 | | ✓ | SL | 1 | 1 | 1 | 1 | 1 | 1 | | |
| ETS-2 (Centrifuge) | 6-23-10 | 1320 | | ✓ | SL | 1 | 1 | 1 | 1 | 1 | 1 | | |
| ETS-2 (Gravity Dewatering) | 6-23-10 | 1320 | | ✓ | SL | 1 | 1 | 1 | 1 | 1 | 1 | | |

**Keys**

Preservation Key:
A. $H_2SO_4$
B. HCL
C. $HNO_3$
D. NaOH
E. None
F. Other: ______
G. Other: ______
H. Other: ______

Container Information Key:
1. 40 ml Vial
2. 1 L Amber
3. 250 ml Plastic
4. 500 ml Plastic
5. Encore
6. 2 oz. Glass
7. 4 oz. Glass
8. 8 oz. Glass
9. Other: ______
10. Other: ______

Matrix Key:
SO - Soil
W - Water
T - Tissue
SE - Sediment
SL - Sludge
A - Air
NL - NAPL/Oil
SW - Sample Wipe
Other: ______

☐ Special QA/QC Instructions(✓):

Special Instructions/Comments:

**Laboratory Information and Receipt**

Lab Name: Fugro Consultants
☐ Cooler packed with ice (✓)
Specify Turnaround Requirements: std.
Shipping Tracking #:
Cooler Custody Seal (✓) ☐ Intact ☐ Not Intact
Sample Receipt
Condition/Cooler Temp: ______

| Relinquished By | Received By | Relinquished By | Laboratory Received By |
|---|---|---|---|
| Printed Name: Craig Derouen | Printed Name: | Printed Name: | Printed Name: George Perkins |
| Signature: [signature] | Signature: | Signature: | Signature: [signature] |
| Firm: | Firm/Courier: | Firm/Courier: | Firm: |
| Date/Time: 6-23-10 / 1403 | Date/Time: | Date/Time: | Date/Time: 6-23-10 / 1403 |

Distribution: WHITE – Laboratory returns with results YELLOW – Lab copy PINK – Retained by ARCADIS

20730825 CofC AR Form 01.12.2007

ARCADIS

## Appendix H

Feasibility Evaluation Matrix

Appendix H. Feasibility Evaluation Matrix, Sludge Characterization and Bench Scale Treatability Report, Hercules Incorporated, Hattiesburg, Mississippi.

| Technology / Feasibility Criteria | Centrifuge Dewatering with Off-Site Disposal | Filter Press with Off-Site Disposal | Gravity Dewatering with Off-Site Disposal | Solidification with Off-Site Disposal | Solidification with On-Site Capping |
|---|---|---|---|---|---|
| **Effectiveness** | Effective long term. Removes sludge of concern from site. | Effective long term. Removes sludge of concern from site. | Effective long term. Removes sludge of concern from site. | Effective long term. Removes sludge of concern from site. | Not effective. Does not alleviate problem. |
| **Implementability** | Electrical power source and specialty equipment required. Not weather dependent. Shortest duration. Implementable. | Electrical power source and specialty equipment required. Mechanical processing is not weather dependent. Should be faster than non-mechanical technologies. Shortest duration. Implementable. | No electrical power source required. Can be accomplished with standard construction equipment. May require construction of dewatering cell(s). Technology is weather dependent. Longest duration. Implementable. | No electrical power source required Can be accomplished with standard construction equipment. Reagent addition required. Technology is weather dependent. Moderate duration. Implementable. | Not implementable. |

ARCADIS

# Appendix I

IB Decommissioning Work Plan

ARCADIS

Infrastructure, environment, buildings

Imagine the result

HERCULES

# Impoundment Basin Decommissioning Work Plan

Hattiesburg, Mississippi

20 August 2010

ARCADIS

# Impoundment Basin Decommissioning Work Plan

Hattiesburg, Mississippi

Craig A. Derouen, P.E.
Senior Engineer

John Ellis, P.G.
Principal Scientist/Geologist

David R. Escudé, P.E.
Vice President/Principal Engineer

Prepared for:

Hercules Incorporated

Prepared by:

ARCADIS U.S., Inc.
10352 Plaza Americana Drive
Baton Rouge
Louisiana 70816
Tel 225 292 1004
Fax 225 218 9677

Our Ref.:

OH003000.MS24.00002

Date:

20 August 2010

ARCADIS

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**Figures**


1 Site Location Map

2 Potential Dewatering Locations

## 1. Introduction

ARCADIS U.S., Inc. (ARCADIS), submitted the *Sludge Characterization and Bench Scale Treatability Report* (C&T Report) to Hercules Incorporated, (Hercules). Hercules will submit the C&T Report to the Mississippi Department of Environmental Quality (MDEQ). The C&T Report presents the results of a bench scale treatability effort conducted to determine an effective and implementable strategy for decommissioning of the on-site impoundment basin (IB) located at Hercules' 613 West 7$^{th}$ Street facility in Hattiesburg, Mississippi (Figure 1). The C&T Report recommends that the IB sludge be gravity dewatered and disposed off site as a non-hazardous material and the IB backfilled to grade. In the event that another viable option is identified by the implementation contractors as more cost effective, Hercules may implement that option to decommission the IB. This work plan presents the methodology for implementing the decommissioning of the IB using gravity dewatering.

## 2. Decommissioning Method

### 2.1 Pre-Decommissioning Activities

Decommissioning of the IB must be approved by MDEQ. Hercules will work with MDEQ to obtain the necessary approvals.

Throughout the process of removing and dewatering the sludge, water originating from the IB will be discharged to the Publicly Owned Treatment Works (POTW) as needed. Hercules will communicate with the POTW so they are aware of the decommissioning activities.

Prior to implementation of the decommissioning, an approved waste disposal profile will be obtained from the Pine Belt Regional Landfill (landfill) using the current sludge data.

### 2.2 Dewatering Cell Construction

Treatment of the IB sludge will be accomplished through gravity dewatering. Dewatering cells will be constructed on available open space in the vicinity of the IB. Figure 2 shows proposed locations for up to three dewatering cells. It is anticipated that decommissioning can be implemented using two dewatering cells, with the third location identified as a contingency to be used only if required. The subgrade for each dewatering cell will be prepared by using soil from the existing backfill stockpile located west of the IB. This material will be placed and graded at a 2% slope to promote drainage of the water from the sludge back to the IB. This drained water will flow directly to the IB from the West Cell, through a grated drain pipe directly to the IB from the South Cell, or via a concrete-lined ditch from the North Cell. The concrete-lined ditch discharges to the facility's industrial sewer. This sewer is currently covered by Hercules' permit.

A 24-inch soil berm will be built to surround each dewatering cell. The exterior and interior berms of the prepared subgrade will be lined with a 20-mil plastic liner (high density polyethylene [HDPE], or approved equivalent). A geosynthetic drainage composite (GDC) will be placed over the plastic liner. Both the plastic liner and GDC will be placed so that gravity drainage allows water released from the sludge to flow directly into the basin, grated drain piped to the IB, or the concrete-lined ditch, as appropriate. To protect the liner and GDC, 6 inches of rounded stone, or sand, will be placed over the GDC.

### 2.3 Dewatering Methodology

Sludge will be pumped or removed with a bucket excavator onto the upper surface in each dewatering cell until the cell is filled to within 6 inches of the top of the berm. The sludge will be allowed to dewater until it passes the Paint Filter Liquids Test (USEPA Method 9095A). Multiple applications of sludge to each cell will be necessary to dewater the entire volume of sludge in the IB. In the event that the primary decommissioning method cannot be implemented or is not effective at achieving sufficient dewatering to pass the Paint Filter Liquids Test, the partially dewatered IB sludge will be solidified with Portland cement or quick lime and transported off site for disposal. The dewatered sludge will be loaded for off-site transport to Pine Belt Regional Landfill, a municipal solid waste landfill site. Prior to disposal at the facility, an approved profile will be obtained.

Sludge will be removed from the IB until visual evidence indicates that all sludge has been removed and native soil remains on the bottom of the IB. It is anticipated that an additional 6 inches of native soil from the bottom of the IB will be removed, transported to, and disposed of at the landfill as part of this sludge removal process.

During dewatering, air monitoring will be conducted. In the event that nuisance odors are detected, an odor suppressant may be applied to the dewatering cell.

### 2.4 Backfill Activities

Once it has been confirmed that sludge has been removed, the dewatering cells will be removed. All of the material above (stone or sand layer and GDC) and including the plastic liner will be disposed of at the landfill. The soils used to construct the subgrade and berms for the dewatering cells will be excavated and used as backfill material, along with any soil remaining in the stockpile west of the IB. Once these sources have been depleted, additional fill will be imported and placed in the IB. Dewatering of the IB will be conducted concurrently with backfilling, if necessary.

### 2.5 Site Restoration

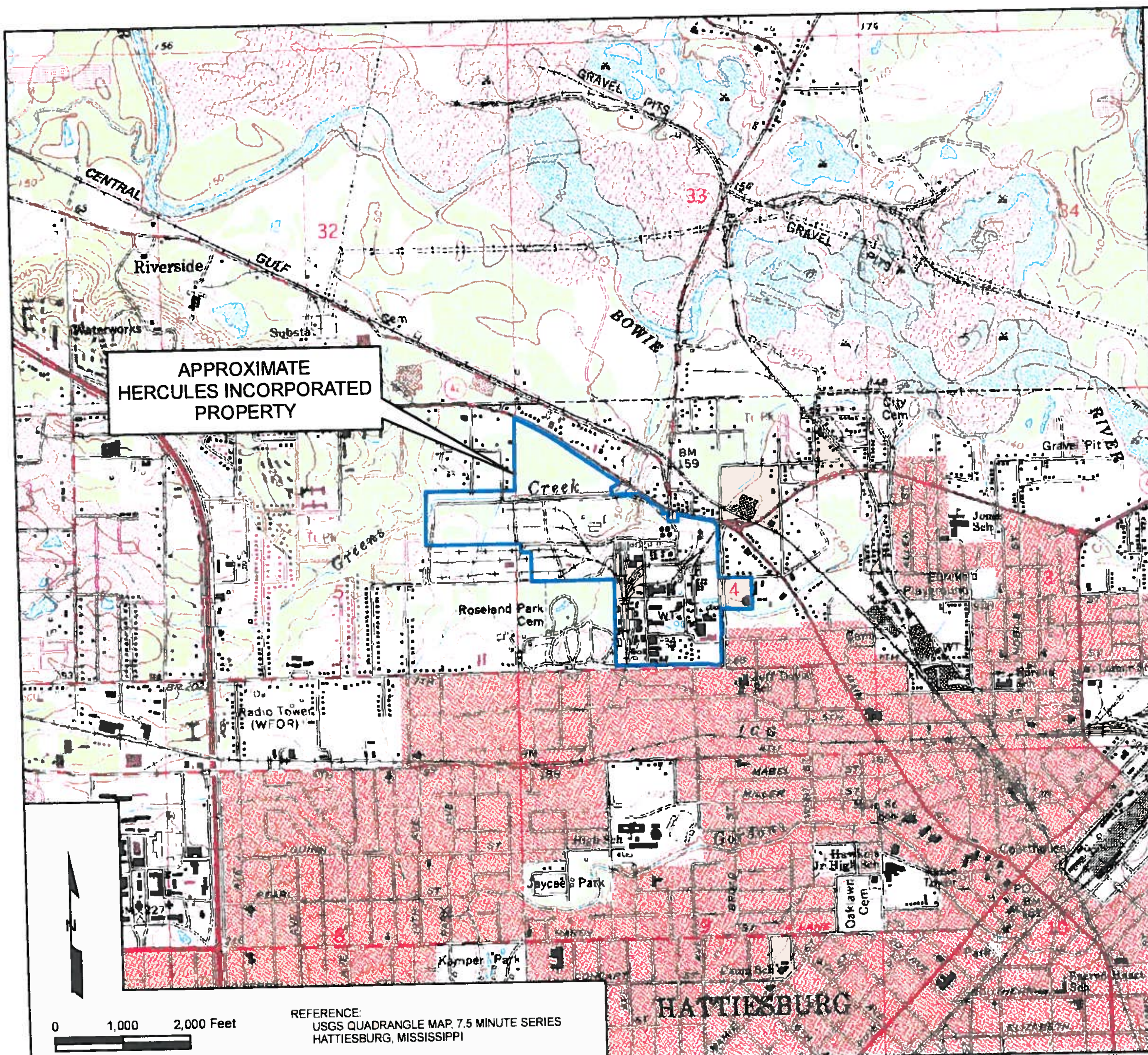
The filled basin and dewatering cells will be graded to promote positive drainage to existing surface water conveyances. Disturbed areas will be seeded with a native grass species and fertilized. After fertilization, all project equipment will be demobilized from the site.

## 3. Reporting

Upon completion of decommissioning activities, a Decommissioning Certification Report will be submitted to MDEQ. The report will document the activities undertaken to decommission the IB and request no further action status for the IB sludge.

## 4. Post-Decommissioning

Post-decommissioning activities related to the IB sludge are not anticipated because of the removal action. The on-site groundwater monitor wells currently surrounding the IB will be left in place to facilitate future groundwater monitoring activities conducted under the Restrictive Use Agreed Order in place for this property.




REFERENCE:
USGS QUADRANGLE MAP, 7.5 MINUTE SERIES
HATTIESBURG, MISSISSIPPI

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## SITE LOCATION MAP

INVESTIGATION AREA
HERCULES INCORPORATED
Hattiesburg, Mississippi


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10352 PLAZA AMERICANA DRIVE
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| PROJECT MANAGER: GHC | CHECKED BY: CD |
| DRAWING FILE: | GIS FILE: |
| DRAWING BY: JEC | DATE: 08/05/2010 |
| PROJECT NUMBER: OH003000.MS24 | FIGURE NUMBER: 1 |

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