APPENDIX D

MINERAL PROCESSING SERVICES PHASE IV ADDENDUM 6 SUMMARY REPORT

MINERAL PROCESSING SERVICES, LLC

Onondaga Lake Pre-Design Investigation Geotextile Dewatering Structure Geotube®

Bench Scale Testing Summary Report

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Executive Summary

Mineral Processing Services, LLC conducted application testing of TenCate™ Geotube® dewatering structures and chemical program evaluations to ascertain best dewatering performance combinations of fabric design and polymers for sediments from Onondaga Lake Sediment Management Units (SMUs) 1a, 1b and 6.

The results of the tests indicated that TenCate™ GT 500 filter cloth design combined with a dry polymer program provided by Ashland Chemical and Kemira Chemical offers the best performance for dewaterability. The processing programs are compatible with sediments from SMU 1a, 1b and 6 using a similar range of polymer dosage rates. SMU 6 required post addition of a coagulant to achieve similar filtrate capture rates within the Geotube® dewatering structure as SMU 1a and SMU 1b.

The characteristics of the SMU 1a and 1b sediments, and corresponding dredge slurry, are similar to mining slurry applications, where the filter cloth selection has been used successfully in many applications.

The SMU 6 slurry characteristic is similar to marine sediments with high biological content, in which the fabric selection has extensive applications.

Overall, the testing demonstrated soundness of the processing program and its application on sediment samples provided. Specific recommendations pertaining to the fabric design of the Geotube® containers, and the type and dosage of the polymer, can be incorporated into the Remedial Design.

Geotube® Geotextile Dewatering Structure Bench-Scale Testing Report

1.0 Introduction

The Rapid Dewatering Test (RDT) and the Pressure-Gravity Dewatering Test (P-GDT) were developed by TenCate and Mineral Processing Services LLC, respectively. RDT evaluates proper chemical agents and dosage for sediment conditioning. P-GDT validates full-scale application of the chemical program, sediment dewatering rate, filter cake dryness and filtrate parameters. RDT testing has been TenCate's standard for chemical program evaluation since 2005. P-GDT testing was developed in 2006 to augment RDT results. MPS has used RDT and P-GDT test results to support more than 20 projects, including mining, sediment dredging, water and wastewater treatment sludge. A detailed description of RDT and P-GDT, including descriptions of the process steps, are provided in Appendices B and C.

Application of the RDT and P-GDT testing to Onondaga Lake samples was described in the New York State Department of Environmental Conservation (NYSDEC) approved Onondaga Lake Pre-Design investigation Phase IV–Addendum 6 Workplan (Parsons, 2009). The purpose of this report is to provide results of bench scale evaluation for application of geotextile dewatering structures using a polymer conditioning program. This report details the chemical program selection process, geotextile fabric evaluation process and process mass balance for geotextile dewatering structures design.

2.0 Objectives

The specific objectives for the bench scale testing completed as part of this investigation includes testing and identifying best-performing chemical agents and filtration fabrics associated with a full-scale Geotube® dewatering operation. More specifically, the testing described in this report was designed to accomplish the following:

- Evaluate commercially available polymer programs using RDT (Rapid Dewatering Test) on sediment samples from SMUs 1 and 6.
- Evaluate Geotube® fabric design for compatibility with sediment samples from Onondaga Lake, and with polymer programs identified as best performing.
- Filtration evaluation of polymer programs and filter fabric design for thickened and non-thickened slurry, and screened (removing particle sizes greater than 100 US Mesh) and unscreened (removing particle sizes greater than 20 US Mesh) to allow samples to pass through P-GDT test stand meters.
- Provide estimate of Geotube® filtration area based on test results for project anticipated dredge yd^3 screened and non-screened options.

3.0 Sample Handling

Slurry preparation and bench-scale testing were performed by Mineral Processing Services, LLC (MPS) at its facility in South Portland, ME for RDT chemical program evaluation, and at Honeywell's Ground Water Treatment plant (WTP) on Willis Avenue in Syracuse, NY for bench scale filtration evaluation testing via P-GDT.

RDT Testing Sample Handling

Conducted at MPS Facility Location

Samples were shipped by Parson to MPS's South Portland, ME facility for an evaluation of commercially available polymer programs. SMU sediment samples were received in 5-gallon buckets from SMU 1b (location OL-STA-10118), SMU 1a (location OL-STA-10114); and SMU 6 (locations OL-STA-60098 and 60100). Additionally, water from Onondaga Lake was received to prepare slurries to the estimated dredge percent solids. Lake water was shipped in 55-gallon drums from Lake Onondaga, marked as "background water."

Samples from SMU 1a and 1b were a grayish-white color that exhibited slight hydrocarbon naphthalene odor characterization during mixing. Samples were mixed with blender with a tip speed of 600 rpm for duration of 15 minutes. As footnote on Table 1 indicates, samples averaged 41.5 percent dry solids pre-screening and 36.1 percent dry solids after screening with a 100 US Mesh screen. A 100 US Mesh screen was determined to be the most efficient screen size for this type of slurry. The SMU 1 samples had a wet weight reduction of 28.6 percent after screening at 100 US Mesh and exhibited light grey color with hydrocarbon smell.

The sample from SMU 6 was brown in color and exhibited slight organic septic odor during mixing. Sample was mixed with blender with a tip speed of 600 rpm for duration of 15 minutes. Sample measured 55.1 percent dry solids pre-screening and 35.1 percent dry solids after 100 US Mesh screening. Screening of the SMU 6 sample resulted in a 34 percent reduction in the wet weight.

Table 1 Volume Relationship Screened Particles RDT Test

P-GDT Testing Sample Handling

Conducted at Honeywell Ground Water Treatment Facility

SMU 1 and SMU 6 samples were delivered to Honeywell's Willis Avenue WTP location for P-GDT evaluation. Samples were received in 55-gallon drums and/or 5-gallon pails. Samples were mixed using a twin-prop shear mixer that extended the full length of the drum. Sample drums from SMU 1b required mechanical excavation using steel bar and shovel to create a 6-inch-diamenter hole through the settled solids, under the water cap, allowing installation of mixer shaft.

Sample drum was mixed until settled solids were able to be resuspended after 40 minutes of mix time.

SMU 1a and 1b particles are possible agglomeration of calcium carbonate fines that withstood shear mixing resulting in particle sizes that resembled course gravel and sand. SMU 6 particles are possible natural sediments with high organic content.

Sample odors were evident at the highest concentration of solids being the insitu raw slurry state having a naphthalene characterization during the resuspension process. The threshold of odor was reduced once lake dilution water was introduced to create a dredged slurry characterization.

Foam was evident during the raw insitu mixing state but dissipated quickly after completion of mixing. The foam volume increased and became more stable when mixing at the stage of dilution using lake water to replicate dredged slurry. Assessment of the mineralogy or chemical and physical characteristics of the foam was not completed. For pragmatic reasons, its existence needs to be considered should screening or clarification options be utilized. Foam may result in the carryover of particles in clarifications resulting in higher total suspended solids, and in the fluid mechanics of particle separation using hydrocyclone or screening.

Table 2 Volume Relationship of Screen Particles P-GDT Test

Screening Method of Samples

Samples received in 55-gallon drums for P-GDT testing were mixed for 40 minutes with a twin prop mixer operating at 1,800 rpm. The slurry percent dry solids of the drums for SMU 1b averaged 38-48 percent dry solids after mixing. The slurry preparation for the pressurized test tube pumps and meters used two or three different stages: first stage (applied to all tests), oversized 4-inch diameter to ¼-inch; second stage (applied to all tests), slurry passing 20 US Mesh (tests herein referred to as “unscreened”); and third stage, passing a 100 US Mesh (herein referred to as “screened”). The NYSDEC approved workplan specified that the material for the “screened” P-GDT tests would be completed on fine-grained slurry effluent from the hydrocyclone tests completed as a separate part of the workplan. Due to logistical difficulties and the locations of the various testing, use of this material was not possible. To ensure sufficient representation of the sand removal anticipated from the hydrocyclone, screening was done in a manner intended to replicate the hydrocyclone.

As noted above and in Section 2, all test samples were screened to at least the 20 US mesh size. Although the NYSDEC-approved workplan specified that P-GDT testing would also be completed on unscreened samples, the large-sized particles present in the sediment samples intended for testing was problematic for the meters and components of the P-GDT test stand. For this reason, all samples were screened to the 20 US Mesh level.

A vibratory separator operating at 4,000 Gs provided the best separation rates. The screening operation required wetting the screen prior to slurry addition, then pouring the slurry from a container at a rate of 2.6 gpm per square foot on a 20 US Mesh screen area and 1.8 gpm on a 100 US Mesh per square-foot screen area. Pouring was done by hand; pour rates were determined by best screen performance, time versus volume.

Overflow or coarse product was collected and held in a 55-gallon drum marked “screened material.” The underflow slurry was collected and added to the dilution mix tank marked “dredge slurry.” This tank was the staging mix tank, where lake water was added to create dredge slurry ranging from 8-12 percent dry solids. The screening operation was reliable and results repeatable throughout the test.

Odor was evident at the screening stage but not as strong as the raw slurry mixing stage. Foam was not evident during screening of the raw slurry, which had not received dilution with lake water. Screening of diluted dredge slurry was not tested.

4.0 Sample Testing Matrix

Appendix A provides a testing matrix that shows the interaction of test methods submitted prior to commencement of testing. Tables are provided with the results of each test method listed in the testing matrix.

Testing Goals

The use of geotextile structures requires application testing, which determines limits of structure design, fabric filtration rates "units required", dewatered "solid phase" and filtrate "water phase" characteristics. This data will support the design team in its evaluation of technology performance and its design relationship with dredging, slurry processing, geotextile structures selection and water treatment.

Methods

Testing methods of the activities included in this investigation are designed to analyze the effect of several contributing factors in a geotextile dewatering structure application. In preparation of bench testing, slurry samples are prepared to simulate the slurry feed from dredge operations. Chemical conditioning is required to facilitate water and solids destabilization and flocculation to facilitate dewatering. Chemical program testing examines the flocculation particle best suited for geotextile applications in regard to shear and consolidation.

Geotextile fabric evaluation is based on filtration rate, retention of colloidal solids and geotextile fabric characteristic for tube structure design. Full-scale simulation applies hydraulic shear forces to chemical program, examining colloid stability and solids capture rate evaluated by total suspended solids (TSS) values of the filtrate released through the fabric under full-scale design operating pressure. The results provide data on solids consolidation rates within a known filtration area to determine estimated geotextile dewatering structure consumption per dry ton of solids processed.

Evaluation

The objectives for evaluation will employ the following means:

- Sample preparation for non-thicken dredging will use dilution of sample to 12 percent dry solids with no screening or thickening conducted in P-GDT tests 1 through 6.
- Sample preparation for thickening will utilized vibratory screens removing greater than 100 US Mesh and thickening to 26 percent dry solids with chemical conditioning with in-cone thickener.
- Chemical conditioning program will utilize Rapid Dewatering Test (RDT) methods for evaluation. See Appendix B for method details.
- Geotextile filter cloth application will utilize RDT methods where the chemical conditioning program is a constant and filter cloth selection is a variable.
- Full-scale simulation testing of chemical program and filter cloth selection will utilize Pressure-Gravity Dewatering Test (P-GDT) methods for evaluation.
- Test report will submit raw data with discussions for each test method with a statistical conclusion on technology design parameters.

5.0 RDT Rapid Drainage Test

The Rapid Dewatering Test (RDT), outlined in Appendix B, was developed to evaluate chemical program requirements for water-solids separation. The test allows evaluation of 250 ml samples with various conditioning programs.

The evaluation uses gravity drainage of a known quantity of sediment, over 180 seconds. The drainage rate is evaluated using volume over time, monitored every 3 seconds using RDT software that plots results for comparisons. The drainage graph comparisons provide rates of drainage and total volume of filtrate.

Additional data produced from the RDT test includes filtrate quality (TSS) and turbidity (NTUs). Filter-cake compaction is also measured using a penetrometer recorded as kg/in², referred to as "consolidation" in the P-GDT test log. These tests provide the starting point for chemical program comparisons.

RDT Test Results

The test program utilized slurry created with sediment samples from SMU 1 and SMU 6, screened to 100 US Mesh prior to testing. For this phase of testing, samples from SMU 1a and 2b were mixted together, and tests were conducted on the mixed SMU 1 sample. Several chemical manufactures products were evaluated, usingtest kits that are provided by manufacturers. A list of manufactures and test kits used during testing is provided on Table 39. Several evaluation factors were considered when assessing the results of the various chemical products. Desirable performance characteristics of the chemical program include:

- Production of flocculants described as a "BB" or "small sphere," 6-4 mm in diameter. Flocculants with these characteristics typically result in the best dewatering performance, as it typically provides optimum free-water transport (drainage) with lowest moisture absorption (retention) in the filter cake.
- Resistance to shear resulting from hydraulic transport in piping and valves is evaluated using a mixer station speed setting and duration based on 6-7 velocity feet per second at 15 seconds.
- Ability to maintain drainage and capture rate with exposure to pH range of 8.2 – 10.8.
- Ability to retain sufficient surface charge potential to maintain flocculation characterization in salinity application of 1.7-4.3 ppt (parts per thousand).
- Comparable performance for sediments from SMUs 1 and 6.
- Chemical program dosage range has a "window of dewaterability" if operating 20 percent out of its target dosage rate.

MPS screened the manufacturers' products to evaluate what chemical program best meets the described goals of the RDT test method. Polymer manufactures were invited to participate in the evaluations of their respective products. Several of the vendors came to MPS's facility to participate in the optimization of their products. Tables 4 through 8 detail the results of RDT testing.

The subsections below outline the steps taken during the RDT testing, and key observations from the testing conducted.

Chemical Program Screening

- Sample aliquots of 250 ml slurry using lake water and insitu samples were created to 8-12 percent dry solids, representing the anticipated dredge slurry.
- Anionic and cationic emulsions were made down to 0.5 percent dilutions.

- Anionic and cationic dries were made down to 0.2 percent dilutions.
- Dilutions were aged after preparation for one hour before testing.
- Polymers were selected based on their background for treating carbonate mine slurry applications with high pH, and sediment dewatering for marine applications due to the salinity levels.
- Polymers were jar tested using a Kost and Sons paddle mixer to generate slurry velocity of 6-7 fps to establish desired flocculation structure at 15 seconds on dries and 10 seconds on emulsions.
- Products and dose rates were evaluated first by the ability to create flocculation characterization of a "BB"-size sphere with clear filtrate.
- Products meeting the first criteria were then applied to the RDT for drainage and capture-rate testing.
- Products were then ranked using RDT software that correlated drainage rates.
- One of the two dry-chemical programs selected was then tested on four filter fabric designs manufactured by TenCate™. The test results shown in Table 38 indicate that fabrics 02B and 02F had higher drainage rates than GT 500, with similar capture rates when gravity drainage tested.

Observations

- Cationic and anionic polymers show the slurry could be flocculated prior to RDT testing.
- Emulsion polymers tested showed that the flocculated sphere broke down when exposed to the higher pH and salinity slurry during shear mixing phase of testing.
- An emulsion polymer with a cationic charge provided the best overall results for the cationic emulsion products tested at 2.98 lbs/dry ton.
- Dry polymers with anionic charge provided the best overall results for dry products tested at .99 lbs/dry ton dosage.
- Best performing polymer programs were anionic dries, being low-charge, high-molecular-weight polyacrylamide formulations.
- Shear benchmarked at 6-7 fps for 15 seconds showed anionic dries ranked 1 and 2 as having the highest shear resistance.
- Products with the highest resistance to flocculated sphere deterioration resulting from high pH and salinity was anionic dries ranked 1 and 2, found in Table 3.
- Sample testing of SMU 1and SMU 6 showed similar drainage rate, with capture rates slightly lower for SMU 6 sample, indicating a coagulant program in addition to the flocculent may be required should results from P-GDT testing prove poorer capture rates on SMU 6 sample.
- RDT samples with same percent dry solids showed variability in drainage rates based on the relationship of pH, salinity and conductivity. This was most interesting as with large sediment projects, flow and percent dry solids have the largest upper and lower limits of values. But with the SMU slurries, it is expected that pH, salinity and conductivity will share these large ranges of values.
- RDT drainage rates trends have a benchmark, at X axis 60 seconds and Y axis 100 ml, to assist in evaluation comparisons.

RDT Testing and Screening Summary

The RDT test method is the first step in selection of chemical program and fabric design.

Results showed SMUs 1and 6 are successful applications for Geotube® containment dewatering structures when using the selected anionic dries polymer chemical programs.

The drainage characteristics of sediment from SMU 1 is much like mining ore slurries, having moderate but consistent water release due to the high percentage of particle fines of equal size. The drainage characteristics of sediment from SMU 6 was similar to marine sediment, having organic matter resulting in higher drainage rate than sediment from SMU 1.

The RDT testing program resulted in three out of six chemical manufacturers having products that would advance to the P-GDT testing program. These products are ranked in Table 3, showing anionic dry products as best selected chemical program with a dosage rate of .99 lbs/dry ton with filtrate total suspended solids (TSS) < 20 mg/l and filter cake compaction of .8 kg/in².

Screening requirements for the evaluation was to remove oversized particles down to 20 US Mesh and 100 US Mesh to generate comparable slurries from hydrocyclone operation. Screening preparation of the samples was not intended to be an evaluation of particle classification technologies. The vibratory screen method used in sample preparation was efficient in removing oversized particle with repeatable results. A volumetric mass balance estimate of values retained on 100 US Mesh of the SMU 1 and 6 samples received for testing is shown in Tables 1 and 2.

6.0 Pressure-Gravity Dewatering Test (P-GDT)

The Pressure-Gravity Dewatering Test (P-GDT) outlined in Appendix C was developed to evaluate the following criteria:

- Replicate the largest tube design for the project estimated at 90-foot circumference, having a hydraulic internal fill pressure of 3.67 psi.
- To evaluate chemical program resistance to design pressure and extrusion through fabric tested.
- To create a fill-pipe shear velocity of 6-7 fps for evaluating a chemical program's resistance to shear prior to entering the tube.
- To evaluate chemical program and filter cloth selection for processing the highest amount of solids based on wet and dry mass contained in a test tube having 1 ft³ void filtration area.

The P-GDT test uses three methods (M_1, M_2 and M_3) for mass of sediment processed by the test:

M_1: Total mass recorded by Coriolis meter (WP_1) less the mass of filtrate released (F_1) weighed by filtrate weigh scale.

$$WP_1\ [lb] - F_1\ [lb] = TM_1\ [lb]$$

M_2: Total Processed Volume of slurry ("V_1" -gallons) determined by Coriolis meter multiplied by density determined by Humbolt density meter ("D_2" -lb_{wet}/gal) multiplied by dry solids determined by lab dry solids meter (DS_1 -%). V_1 measured by the Coriolis accounts for instantaneous changes in density during the fill. D_2 (via Humboldt) is representative of the mix tank slurry average density prior to fill. Use of V_1 x D_2 rather than a direct mass flow measurement by the Coriolis eliminates the effects of instantaneous changes in density. This allows the use of one lab test of solids (DS_1) rather than three individual tests.

$$V_1\ [gal] \times D_2\ [lb_{wet}/gal] \times DS_1\ [\%\ solids] \div 100 = DP_{M2}\ (lbdry)$$

M_3: Perform dry-solids analysis of the sediments within the tube after dewatering for 24 hours (DS_2 -% solids). Multiply by the tube's total wet weight (TT_{w2}) to establish pounds of dry solids processed for filter area. TTW_2 already accounts for the tare weight of the empty tube.

$$TT_{w2}\ [lb] \times DS_2\ [\%\ solids] \div 100 = DP_{M3}\ (lbdry)$$

M_1 and M_2 are used for performance evaluations of chemical program and fabric. M_3 is used for estimating void area of tube required to process estimated dry pounds of SMU slurries.

Assumptions

The calculation presented in the P-GDT log for wet and dry mass determination methods:

- Volume of slurry determined by Coriolis Meter V_1
- Density of slurry determined by Coriolis meter D_1
- Density of slurry determined by Humbolt mud balance D_2
- M_1 Wet pounds determination using batch volume method WP_{m1}
- M_2 Dry pounds determination using volume removed from slurry tank method DP_{m2}
- M_3 Dry pounds value calculated based on test tube % dry solids multiplied by 24/hr dewatered wet mass of tube method DP_{m3}
- Wet pounds determination using Coriolis meter WP_1
- Dry solids value using lab meter of aliquot sample of slurry tank DS_1
- Dry solids value using lab meter of aliquot sample of test tube DS_2
- Pounds of filtrate F_1
- Unit weight of water in 1ft³ of test tube Y_wT_v = 62.4 pcf
- Wet mass of test tube completion of test TT_{w1}
- Wet mass of test tube after 24hr dewatering TT_{w2}
- Methods of determining dry and wet mass M_1, M_2 and M_3

P-GDT Log Mass Calculations Methods

M_1, wet bulk density retained / ft³ (by volume): $WP_1 = V_1 * D_1$

M_2, dry solids retained / ft³ (by mass): $DPm2 = V_1 * D_2 * DS_1$

M_3, dry solids retained / ft³ (by mass after 24 hours of dewatering): $DP_{m3} = TT_{w2} * DS_2$

P-GDT Testing

The goal of the P-GDT test is to evaluate dewaterability and consolidation rate from representative samples of a full-scale dredge operation for slurry represented by sediment samples from SMU 1a, 1b and 6.

Sediment samples were screened and/or thickened as described in Section 3, and all slurry dilutions utilized Onondaga Lake background water collected as part of the Pre-Design Investigation. A range of 8-12 percent dry solids for non-thickened testing was used and 20 percent dry solids for thickened clarified application testing was created. A screening mass-balance is provided in Table 1 for RDT testing and Table 2 for P-GDT testing.

A total of 13 P-GDT tests were completed as part of this investigation. All tests except Tests 7 and 8 were conducted on unscreened material. Tests 7 and 8 were conducted on screened material that was also thickened. Tests conducted include:

P-GDT Test 1. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 2. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ O2B

P-GDT Test 3. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ O2F

P-GDT Test 4. SMU 1b Unscreened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 5. SMU 1b Unscreened Nalco 7766 Emulsion Polymer Filtered by TenCate™ GT 500

P-GDT Test 6. SMU 1a Unscreened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 7. SMU 1b Screened Thickened Ashland 2520 Dry Polymer Filtered by Ten Cate™ GT 500

P-GDT Test 8. SMU 1b Screened Thickened Kemira A-100 Dry Polymer Filtered by TenCate™ GT 500

P-GDT Test 9. SMU1b Unscreened Kemira A-100 Dry Polymer Filtered by Ten Cate™ GT 500 (repeat of Test 4)

P-GDT Test 10. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500 (repeat of Test 1)

P-GDT Test 11. SMU 1b Unscreened Ashland 2520 Dry Polymer Filtered by TenCate™ GT 500 (dosage at RDT evaluation .99 / lbs dry ton)

P-GDT Test 12. SMU 6 Unscreened Brown (60098) Ashland 2520 Dry Polymer & Coagulant 492 Filtered by Ten Cate™ GT 500 (2520 @ 1.59 / lbs dry ton; 492 coag @ 5.71/lbs dry ton)

P-GDT Test 13. SMU 6 Unscreened Black (60100) Ashland 2520 Dry Polymer & Coagulant 492 Filtered by TenCate™ GT 500 (2520@ 1.59/lbs dry ton; 492 coag @ 5.71/lbs dry ton)

The subsections below outline key observations and summaries from the testing conducted.

P-GDT Test Results

Chemical program testing in the RDT phase shown in Table 3 provided optimal programs cited as anionic dry polymers with a dosage rate of 0.99 lbs / dry ton for SMU slurries, evaluated under gravity drainage conditions. During the P-GDT, and at the RDT dosage of 0.99 lbs / dry ton, a breaking down of the flocculated spheres was observed during the 20 minute (and greater) duration in the mixing tank, likely due to exposure to high pH and salinity. To counter this effect, the dosage rate was increased. Following iterative testing, a dosage rate of 1.59 lbs / dry ton was found to be successful in retaining floc formation for extended duration. P-GDT dosage rates0 .99 lbs / dry ton compared to 1.59 lbs / dry ton shows much higher losses of solids in filtrate (703 TSS) during Test 11 (Table 31) as compared to (26 TSS) Test 1 (Table 11). The higher solids losses at the lower dose could result in blinding of filter cloth openings, resulting in larger clarifier design.

The filter fabric design evaluation using TenCate™ fabric design drainage rates were: GT 500, 20 gpm / ft^2; O2B, 30 gpm / ft^2; 02F, 70 gpm / ft^2, which demonstrated greater drainage rates during RDT testing and would have beneficial application. But the slightly lower capture rates shown as higher total suspended solids (TSS) would need evaluation under pressure in the P-GDT test program. The P-GDT test fabric selection results showed higher filtration rates with fabric O2B (Table 13) and O2F (Table 15), but experienced greater than a 5:1 increase in solids loss with pressures 1.5 psi and higher during the P-GDT testing compared to GT 500 (Table 11). The results of the filter fabric evaluation showed GT 500 had the highest retention of solids under design pressure of 3.67 psi; coupled with variability of performance due to pH, salinity and conductivity changes, GT 500 would have highest recovery rate of TSS during these change conditions.

Mass-balance evaluations for performance of chemical programs combined with filter cloth selection are shown in P-GDT logs (Tables 11-36) as M1 (Method 1) and M2 (Method 2). The trend of each method individually compared with the various P-GDT tests are used in evaluations. The best performance (BP) of chemical program and filter fabric is based on the highest yield of dry and wet lbs per 1ft³ resulting from evaluations in M1 for wet lbs / 1ft³ and in M2 for dry lbs / 1ft³. The filtration area of a Geotube® containment structure required to process a dry ton of slurry solids is based on 24 hours' dewatering period of the tube after pressure filling and is expressed in dry lbs / 1ft³. The results of test provided in Table 11 shows that 2.11 yd³ of tube volume is required for 1 dry ton of SMU 1a and 1b. Table 35 shows that 2.84 yd³ of tube volume is required for 1 dry ton of SMU 6 Black (OL-STA-60100). Table 33 shows that 2.97 yd³ of tube volume is required for 1 dry ton of SMU 6 Brown (OL-STA-60098).

P-GDT Testing Summary

The P-GDT testing supports that Geotube® containment structures combined with best performing (BP) chemical programs can effectively dewater sediments from SMU 1a and 1b using similar design filter fabric TenCate™ Geotube® GT 500. The process flexibility of chemical programs ranked 1 and 2 in Table 3 (Ashland 2520 and Kemira A-100, respectively) appears to have the ability to tolerate variability in the slurries' pH, salinity, conductivity, percent dry solids and flow, and resulting filter fabric solids retention. Based on testing performed in this investigation, sediments from SMU 6 (Brown & Black) would also effectively dewater with chemical program selected for SMU 1a & 1b. Followed with a coagulant to aid in filtrate solids capture rates of the biological fines, a chemical treatment using a coagulant to restabilize floc fragments was used (as shown in Test 12, SMU 6 Black with coagulant, and Test 13, SMU 6 Brown with coagulant).

There exist multiple combinations of these variables, which the chemical conditioning system will need to monitor and react to in real time. The broad operational window which the best-performing chemical programs have, in combination with the filter-fabric design for solids retention and dewaterability, will provide a successful combination for dewatering methods.

7.0 Polymer Make Up Using Filtrate Testing

Objective

The purpose of this test is to evaluate the use of filtrate water from the Geotube® dewatering process. In most applications, potable water is needed for a chemical program using dry polymer creating an emulsion of 0.2 percent dilution for the dewatering process. Due to the absence of an existing potable water source in the immediate area the anticipated SCA, additional tests were conceived to assess whether filtrate from the dewatering operation (P-GDT filtrate), or effluent from the water treatment plant which will be constructed for the project (WTP effluent), could be utilized in the polymer "make-down" process. This test evaluated the use of filtrate from the Geotube® P-GDT test during on-site testing, and water produced by treatability testing completed by O'Brien & Gere as part of a separate portion of the investigation.

In the following section, Phase 1 refers to testing conducted at Honeywell Ground Water Treatment Plant and Phase 2 refers to testing conducted at MPS Filtration Lab.

Test Method

Phase 1 Performed At On-site Ground Water Facility

- 0.400 g dry polymer was introduced to 200 ml of tap water creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml P-GDT filtrate creating 0.2 percent dilution.

- Polymer was aged for 6 hours, reflecting a hold time duration for temporary shut down as normal process aging is 1-2 hours.
- Polymer was added to 250 ml raw sample of SMU 1b anticipated from a dredging operation at 1.50 lbs / dry ton.
- Samples flocculated were run on the Rapid Dewatering Test (RDT).
- Drainage and capture rates were monitored and recorded as provided in Table 9.

Phase 2 Performed At MPS Facility

- 0.400 g dry polymer was introduced to 200 ml of tap water creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml P-GDT filtrate creating 0.2 percent dilution.
- 0.400 g dry polymer was introduced to 200 ml WTP effluent rate creating 0.2 percent dilution.
- Polymer was aged for 6 hours, reflecting a hold time duration for temporary shut down as normal hold time aging is 1-2 hours.
- Polymer make up water variables were used to flocculate the three samples.
- Sample drainage and capture rates were monitored and recorded on Table 10.

Observations

Phase1, 6 hours aging time

- Test utilizing P-GDT filtrate failed drainage test and had TSS 4 times higher than potable water.
- TSS for tap water was 20 TSS and 86 TSS for P-GDT filtrate.
- Flocculation of slurry using P-GDT filtrate did not result in sphere characterization as did the tap water.
- Filter cake from untreated filtrate did not register compaction.

Phase 2, 6 hours aging time

- Test utilizing P-GDT filtrate had required sphere characterization.
- Test utilizing WTP effluent had required sphere characterization.
- Test utilizing tap water had required sphere characterization.
- Dewatering rates were similar for all three samples tested.
- RDT cake compaction was similar for all three samples tested.

Phase 2, Characterization of Water Used For Polymer Make Down (Table 10)

Filtrate Sample	TSS mg/l	pH	Salinity PPT	Conductivity mS/cm
Tap Water	0	8.8	0	70.45
WTP Effluent	0	7.5	1.7	3.82
P-GDT Filtrate	0	10.2	4.7	9.35

Phase 2. RDT Testing Results Comparisons (Table 10)

Filtrate Sample	Sphere Characterization	Floc Shear Resistance	Drainage Rate ml After 180 Sec	Compaction Rate kg/in^2	Filtrate TSS mg/l
Tap Water	Similar BB	Similar 15 Sec	174	0.8	4
WTP Effluent	Similar BB	Similar 15 Sec	174	0.6	12
P-GDT Filtrate	Similar BB	Similar 15 Sec	181	0.2	21

Summary

Bench scale testing used RDT evaluation of water and P-GDT filtrate for polymer make down and was conducted in two phases. The first phase was an RDT test at the end of the P-GDT trials (Table 9) which resulted in poor drainage and capture rates of filtrate water sample. During this first phase of testing, the pH of the P-GDT filtrate was adjusted using SO^4 to similar pH values of tap water. This pH adjustment was made to simulate anticipated processes associated with the treatment of filtrate in the onsite Water Treatment Plant. The second phase (Table 10) used no chemical pretreatment of water prior to make down with dry polymer. The results showed only minimal difference between tap water, P-GDT filtrate and WTP effluent.

The largest variable in parameters between test phases was filtrate used in Phase 1 was the pH adjustment. This possibly precipitated calcium forming $CaSO^4$ that consumed much of the activity of the polymer. In Phase 2, no pH adjustment was conducted on samples prior to use for polymer make down.

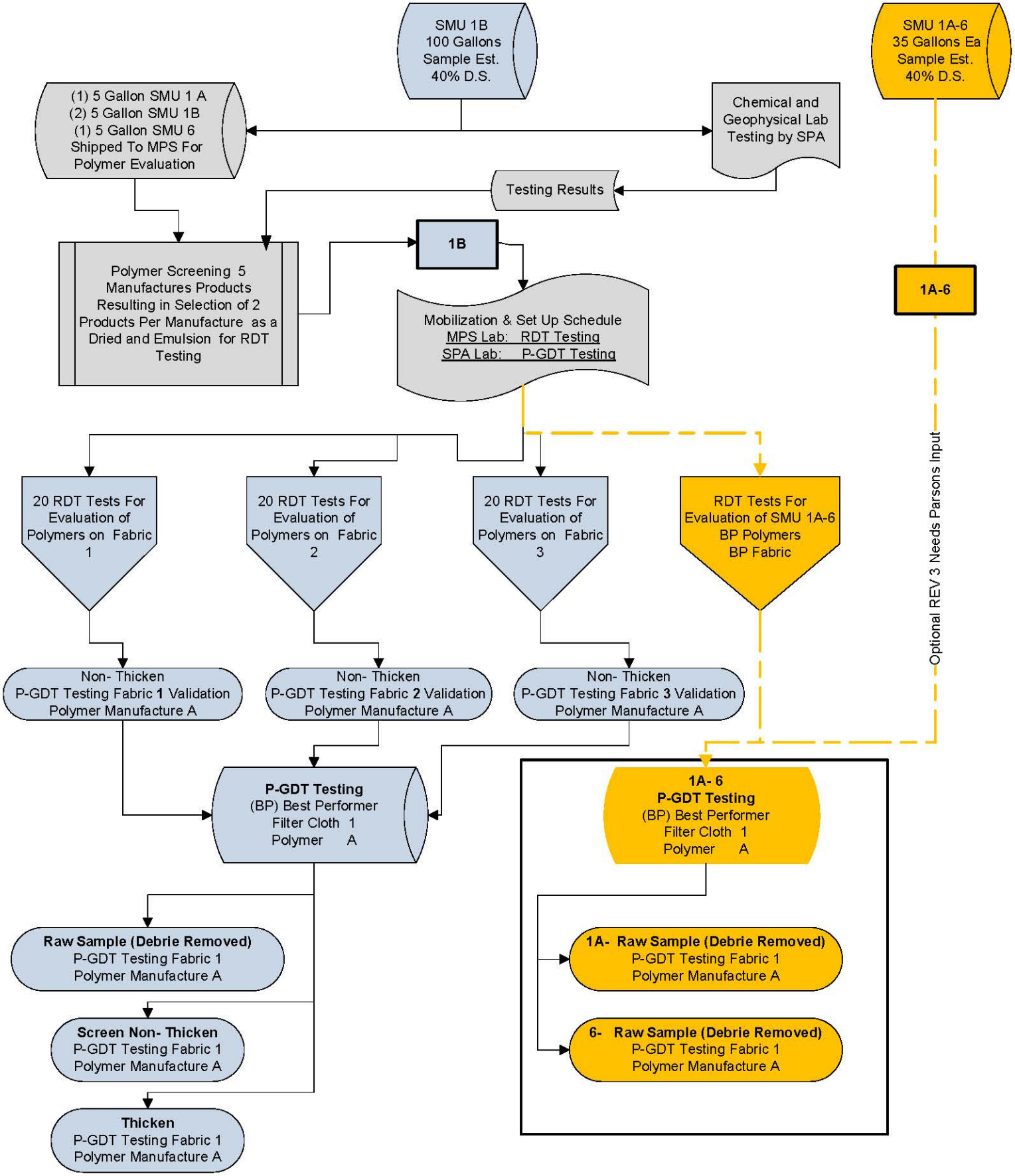
Based on RDT evaluation, the WTP effluent is a candidate for supplementing the use of potable water for polymer make down operations. Although the bench tests described above did not identify major discrepancies between the effectiveness of polymer made up of the different water sources, previous project experience attempts has demonstrated that the use filtrate as polymer makeup water can be challenging. Furthermore, based on this bench testing, further evaluation would be necessary to determine whether pH adjustment completed as part of the water treatment process would have the same impact on the effectiveness of the polymer as was noted during this bench testing. Further evaluation and/or full-scale field validation on the use of filtrate water, or WTP effluent, as polymer makeup water, could be completed during the initial startup phases of the dredging operation. As a contingency, it would likely be necessary to have a potable water feed line rated for 300 gpm @ 60 psi installed to the chemical treatment pad in the event poor dewatering performance results are experienced from untreated filtrate, or the WTP effluent.

Appendix A

Purposed Testing Matrix

Submittal of Geotube® Testing Matrix Per SMU Test Sample

Review 12/11/08 Rev 1
Review 12/21/08 Rev 2
Review 2/12/09 Rev 2 A
Review 2/13/09 Rev 3



Appendix B

RDT Rapid Drainage Test Methods

TENCATE
Geotube

TenCate Geotube RDT Test
A Fast And Easy Way To Measure Dewatering Efficiency and Polymer Selection

Prueba TenCate Geotube RDT
Un medio rápido y fácil de medir la Eficiencia en el desagüe y la selección del polímero

Test de Déshydratation Rapide (TDR) de TenCate Geotube
Une méthode simple et rapide pour choisir le polymère et évaluer l'efficacité de la déshydratation

TenCate Geotube RDT Teste
Uma maneira simples e rápida de medir

Protective & Outdoor Fabrics
Aerospace Composites
Armour Composites
Geosynthetics
Industrial Fabrics
Synthetic Grass

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materials that make a difference


Geotube
DISPOSABLE Latex Gloves

Required Equipment for the Geotube® RDT

1. One five-gallon (20L) plastic bucket
2. Plastic cups
3. Two 500ml clear beakers
4. 100ml graduated cylinder
5. 3.75" (9.5cm) diameter Geotube® GT 500 fabric
6. RDT Test Kit
7. Hand mixer (to make down neat polymer to solution)
8. Syringes
9. Latex gloves
10. Hand sanitizer
11. Stopwatch

Equipo requerido para la prueba Geotube® RDT

1. Una cubeta plástica de 20 litros (5 galones)
2. Tazas plásticas
3. Dos vaso graduados transparentes de 500ml
4. Un cilindro graduado de 100ml
5. Círculos de Geotube® GT 500 de 9.5 cm de diámetro (3.75")
6. El Prueba RDT el kit
7. Mezcladores manuales (para diluir polímero puro a solución)
8. Jeringas
9. Guantes de látex
10. Limpiador para desinfeccion de manos
11. Cronómetro

Matériel requis pour le TDR de TenCate Geotube

1. Un seau en plastique de 20 litres (5 gallons)
2. Récipients en plastique
3. Deux béchers de 500 ml
4. Un cylindre gradué de 100 ml
5. Un morceau de membrane Geotube® GT 500 de 9.5 cm de diamètre (3.75 pouces)
6. Kit de test TDR
7. Un mixer (pour mettre le polymère en solution)
8. Seringues
9. Gants de latex
10. Désinfectant pour les mains
11. Un chronomètre

Equipamentos necessários para a realização do teste Geotube® RDT

1. 1 balde plástico de 20L
2. Recipientes plásticos
3. 2 beckers transparentes de 500ml
4. Cilindro graduado de 100ml
5. Amostra cilíndrica de geotêxtil Geotube® GT 500 com diâmetro de 9.5cm
6. Kit de teste RDT
7. Misturador manual para o preparo da solução de polímero
8. Seringas
9. Luvas de látex
10. Desinfetante para as mãos
11. Cronômetro

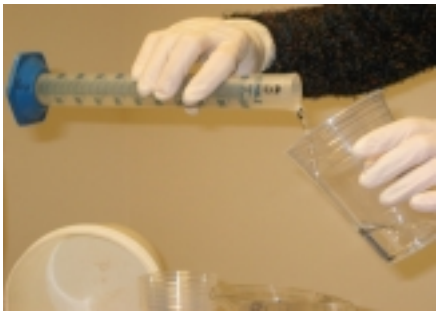
A Fast and Easy Way to Evaluate Sludge Dewatering and Polymer Selection

The Geotube® RDT (Rapid Dewatering Test) is a fast and easy test to determine how well a sludge sample dewaters through the GT 500 textile. The test is designed to:

- Evaluate the efficiency of the candidate polymers
- Measure the volume of effluent filtered from the sludge
- Record the time for filtration
- Analyze the quality of effluent water

Step 1

Measure 100ml of water into cups in which to make down polymer solution. This is usually an ample amount to conduct several 1-liter sludge tests. If sludge sample is high in solids by weight, a higher dose of polymer will be required.

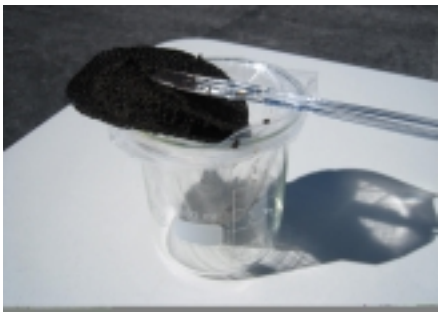


Step 2

Make down neat polymer into 1.0%, 0.5%, 0.3%, or 0.25% solution by adding neat polymer to each cup of 100ml of water. Make down charts are available from TenCate Geotube. Vigorous shaking or mechanical mixing is required to invert the neat polymer into solution. If using an electric hand mixer, mix for about 10-15 seconds only. Allow the polymer solution to age for 15-20 minutes before adding polymer solution to the sludge samples. Repeat this make down procedure with other candidate polymers being tested.

Step 3

Assemble the RDT test kit by inserting a 3.75 in. (9.5 cm) diameter piece of Geotube® GT 500 fabric into the plastic funnel. Assemble funnel and place on top of the collection beaker.



Step 4

Fill a 500ml beaker with the sludge to be tested. Determine a starting point for the polymer dosage in PPM and draw the required amount of polymer into a syringe. Example: Start with 40 PPM. If this dosage creates a good floc, test a lower dosage until the optimum dose is determined. A chart of dosages is available from TenCate Geotube. Add the polymer solution to the 500ml of sludge and begin to pour the sample back and forth between the two beakers until a floc forms.

Step 5

Slowly pour the 500ml of conditioned sludge into the RDT funnel.

Step 6

Using a stopwatch, time the free water flow through the funnel. Record the effluent volume at 30-second intervals up to 5 minutes.

Step 7

Examine the filtrate for clarity and suspended solids. Remove the RDT from the beaker, and unscrew the top of the funnel.

Slowly remove the Geotube® GT 500 fabric from the plastic funnel and collect the dewatered sludge. Examine how the cake releases from the fabric.

Repeat this procedure for all the candidate polymers to determine the most efficient polymer in terms of time to dewater, volume of filtrate, and clarity of filtrate.

Step 8

Collect a sample of dewatered sludge. Conduct a moisture content test to determine percent dewatered solids.

CAUTION!

Do Not Exceed Fill Height Printed On Geotube® Unit.
Always Install Geotube® Containers On A Flat, Level Surface.
If any questions, contact your TenCate Geotube Representative.

¡PRECAUCION!

No exceda la altura de llenado impresa en el Geotube®
Siempre instale el Geotube® en una superficie plana y nivelada
Para cualquier duda o ampliación contacte a su representante de TenCate Geotube.

ATTENTION!

Ne pas dépasser la hauteur limite de remplissage imprimée sur chaque Geotube®.
Toujours installer les containers Geotube® sur une surface plane et au niveau.
Pour toute question, contacter votre représentant TenCate Geotube.

Atenção!

Não exceda a altura máximas de enchimento impressa nas unidades Geotube®.
Sempre instale as unidades Geotube® em superfície plana.
Para quaisquer esclarecimentos, contate seu representante TenCate Geotube.

3680 Mount Olive Road
Commerce, Georgia 30529

706.693.1897
Toll Free 888.795.0808
Fax 706.693.1896
www.geotube.com

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Appendix C

P-GDT Pressure Gravity Drainage Test Methods

P-GDT

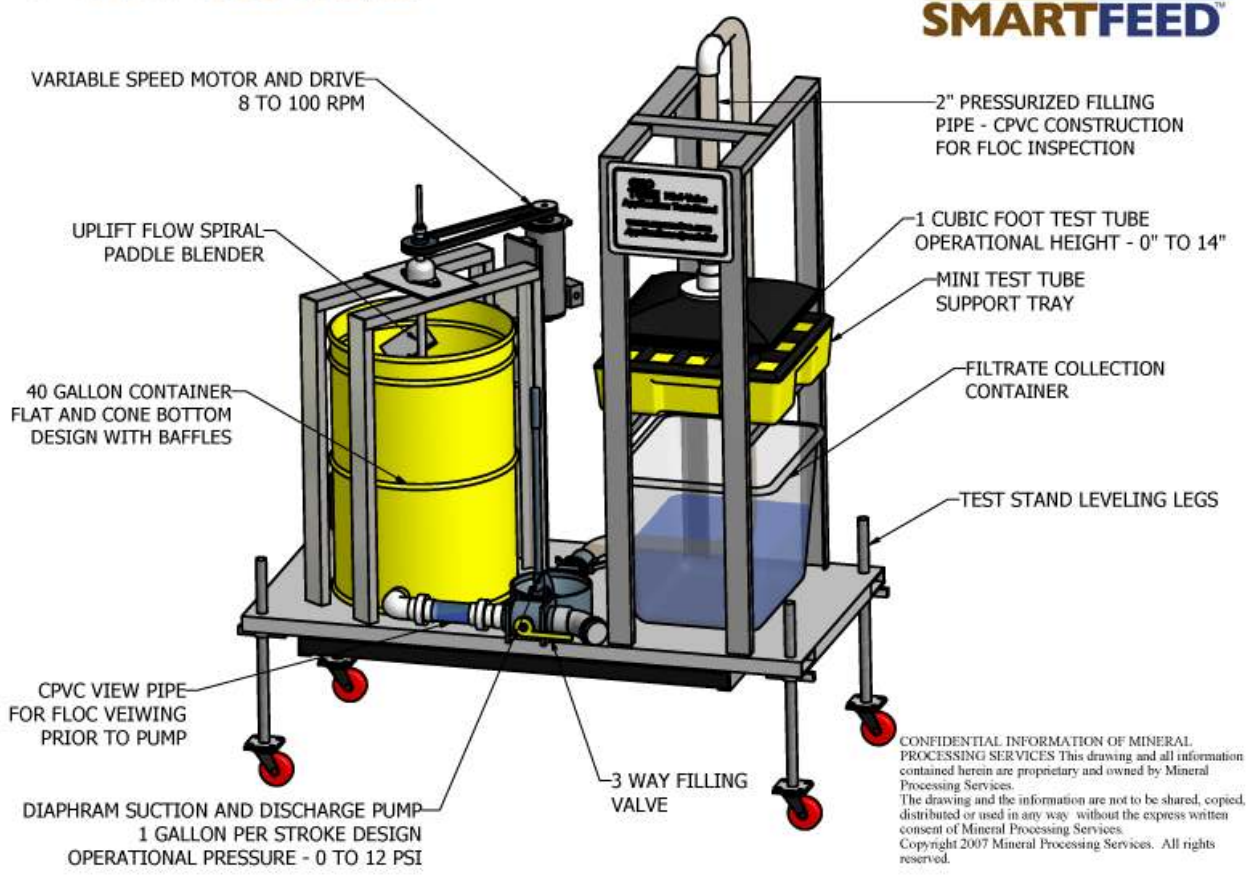
Pressure-Gravity Dewatering Test Procedures

Steps For A Successful Test Of SmartFeed™ Geotube® Dewatering Technology

SF SMARTFEED®

TENCATE Geotube

P-GDT Test Stand



SmartFeed™ P-GDT (Pressure-Gravity De-watering Test) is a demonstration, using a Geotube® MiniTube™, of sludge dewatering under field conditions.

Once complete, the P-GDT will establish baseline measurements for the use of SmartFeed™ technology that can then be carried forward and applied to an entire dewatering project.

The purpose of the test is to:

» Visualize the dewatering process
» Simulate physical force interaction between permeability of filter fabric selection and polymer performance under full-scale application pressure
» Confirm chemical program (polymer) dosage are representative of full-scale application
» Create samples of filtrate and filter cake
» Confirm application mass-balance of Geotube® filtration area required for project

Note: Prior to P-GDT testing, a Geotube® distributor needs to conduct a Rapid Dewatering Test (RDT) for polymer screening of the project.

Note: Protective eyewear and face shields are required for personnel operating the P-GDT test unit.

Step 1

Sample quantity varies depending on slurry type and percent of solids of slurry.

Insert 2" hose supplied with test unit in to sample storage container using test stand pump for transfer slurry to mix tank. *Note: Valve 1 handle in suction position*

Turn on tank mixer remove 300 ml sample from mix tank for dry solids testing

Record gallons measurement on side of mix tank

Install MiniTube™ 1 cubic foot capacity on stand support tray and connect piping

Turn on mixer speed at 50%

Step 2

Add polymer to mix tank at dose rate determined by Rapid Dewatering Test (RDT)

Adjust mixer until floc is evenly distributed in tank

Pump slurry thru piping re-circulate to mix tank *Note: Connect pump discharge hose to mix tank re-circulation fitting*

Once recirculated, discharge slurry has similar floc as mix tank, stop pumping and connect hose to MiniTube™ fill manifold

Confirm gallon measurements on side of mix tank

Step 3

"1st phase fill": Operate fill pump until pressure gauge located on pump discharge achieves discharge pressure of Geotube circumference 30' circ 2.6 psi * 45' circ 3.0 psi * 80' circ 3.5 psi

Maintain test pressure on MiniTube™ for 60 sec then stop pumping

Stop slurry mixer

Allow MiniTube™ to drain for 20 minutes

Step 4

Record level in mix tank and subtract amount from previous volume to attain gallons of slurry processed in 1st phase fill

Record volume in filtrate collection tray after 20 minutes as filtrate from 1st phase fill

Step 5

Start mixer

"2nd phase fill": Operate fill pump until MiniTube™ achieves pressure as in 1st fill phase and hold for 60 seconds

Stop mixer

Record volume in mix tank as volume processed in 2nd fill phase

Allow MiniTube™ to drain for 20 minutes and record volume as 2nd fill phase

Step 6

Start mixer

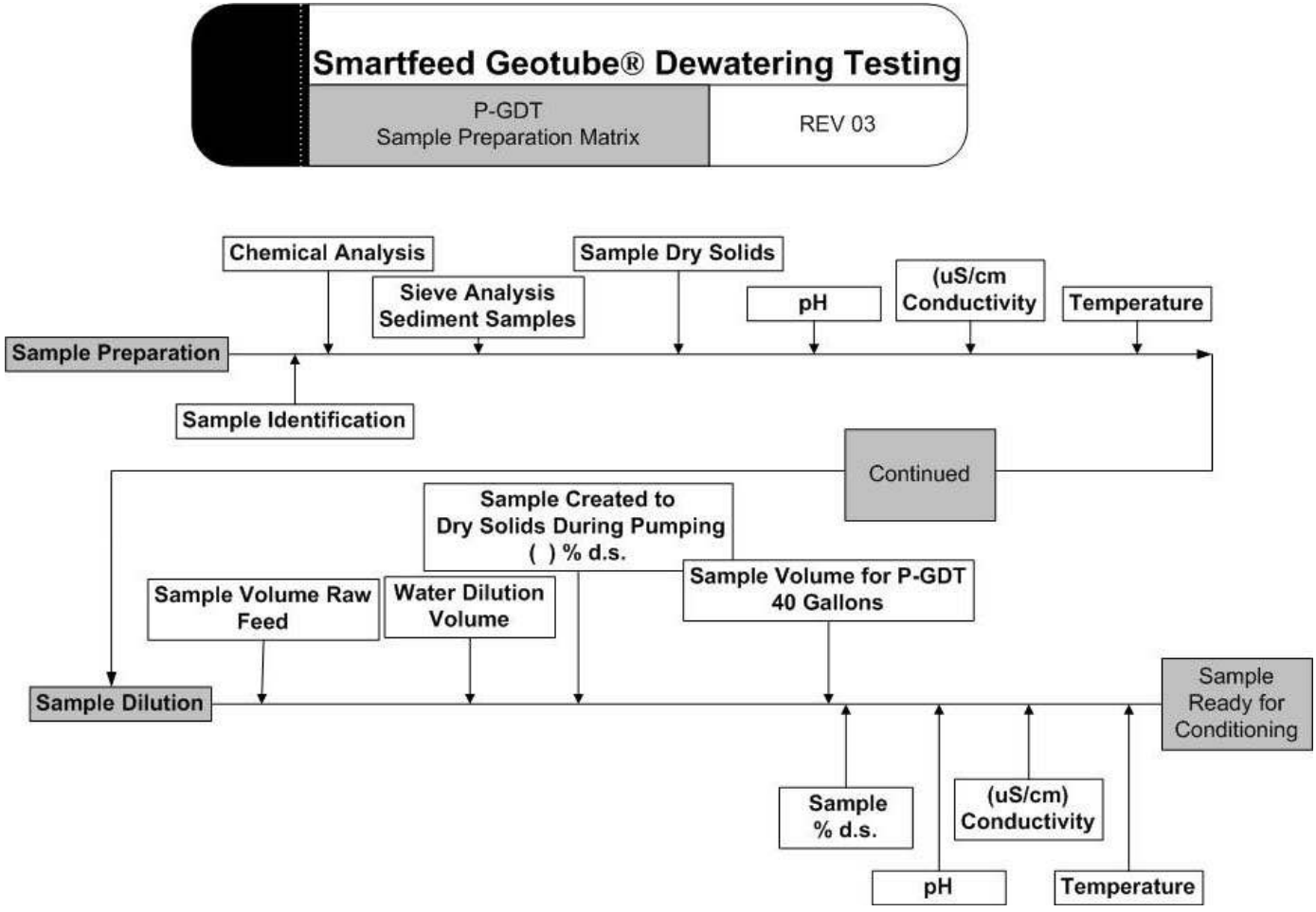
"3rd phase fill": Operate fill pump until MiniTube™ achieves pressure as in 2nd fill phase and hold for 60 seconds

Stop mixer

Record volume in mix tank as volume processed in 3rd fill phase

Allow MiniTube™ to drain for 20 minutes and record volume as 3rd fill phase

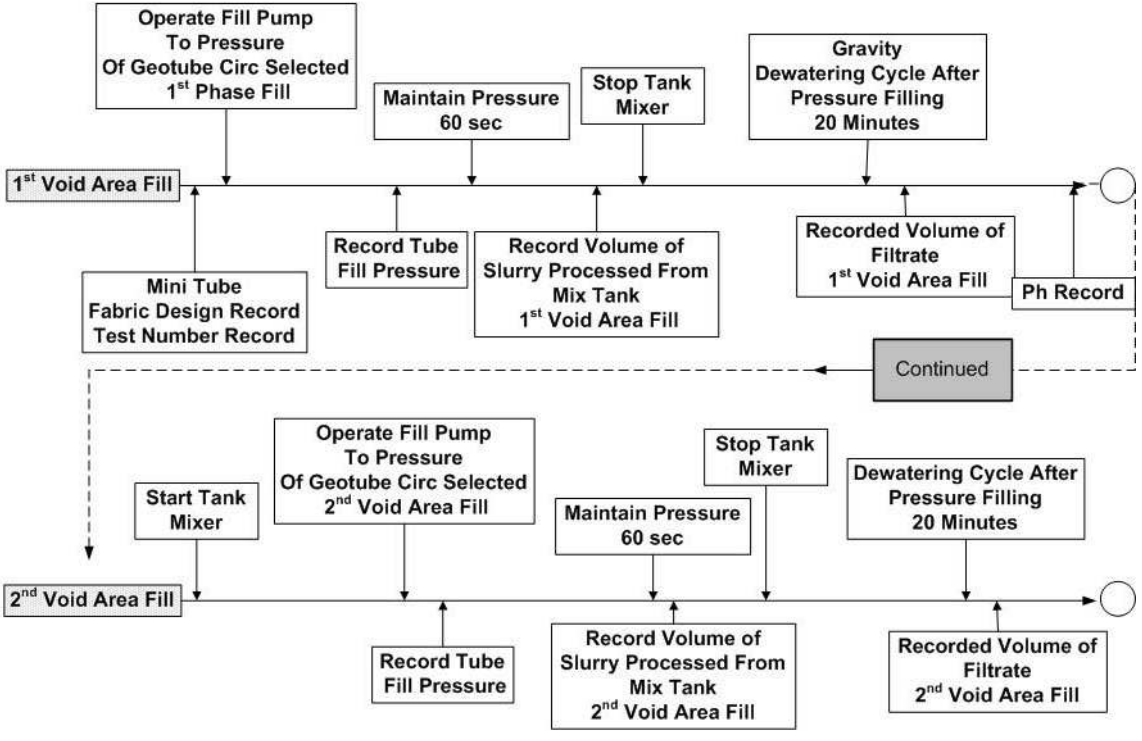
The data collected and samples resulting from P-GDT test will allow Geotube® distributor to estimate filtration area required for project. Samples can be used for further testing in a physical and chemical analysis to support permitting requirements.

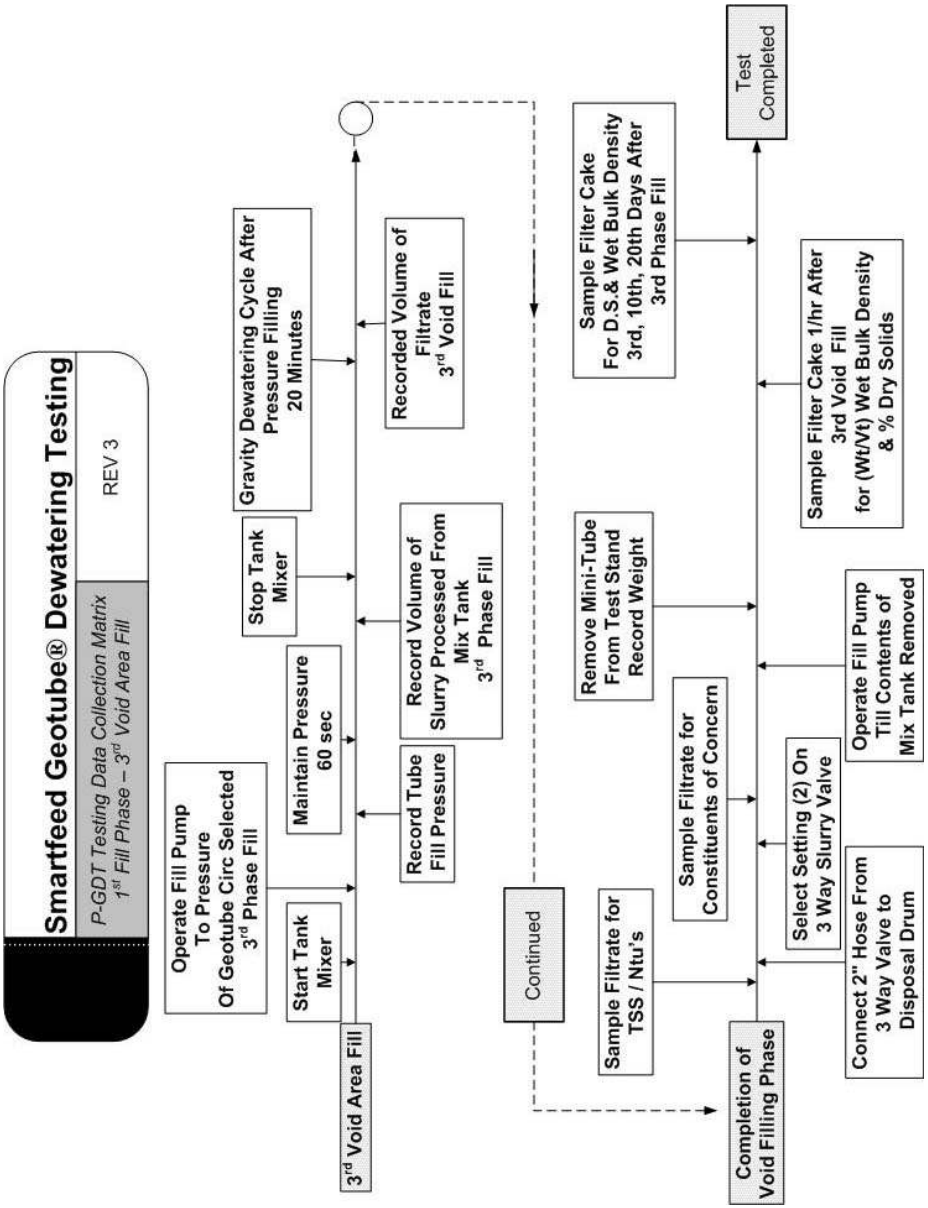

Smartfeed Geotube® Dewatering Testing
P-GDT
Sample Preparation Matrix
REV 03
Chemical Analysis
Sieve Analysis
Sediment Samples
Sample Dry Solids
pH
(uS/cm
Conductivity
Temperature
Sample Preparation
Sample Identification
Continued
Sample Created to
Dry Solids During Pumping
( ) % d.s.
Sample Volume Raw
Feed
Water Dilution
Volume
Sample Volume for P-GDT
40 Gallons
Sample Dilution
Sample
Ready for
Conditioning
Sample
% d.s.
(uS/cm)
Conductivity
pH
Temperature

P-GDT
Smartfeed™ Geotube® Dewatering Testing

P-GDT Testing Data Collection Matrix
Fill 1st Fill Phase

REV 3





Mineral Processing Services LLC

Application Specialists and Manufacturer Of Supporting Technologies For Geotube®
PMB 128 50 Market Street, South Portland, ME 04104
Telephone (207) 741-2955 Fax (207) 799-3782
http://www.smartfeedsystem.com jmmps@maine.rr.com

Appendix D

The Geotube® Simulator

TENCATE Geotube

Geotube® Simulator

Version 7.8 Beta Copy

Tom Stephens Master Copy 01-07-07

Input			Output		
Date:	6/10/09		Maximum Tensile Force (T) =	118.34	lb/in.
Project Name:	ABC Lake Dredgeing		Geotube® Base Contact Width (B) =	32.09	ft
Units:	English		Geotube® Filled Width (W) =	36.21	ft
Water Level:	Emerged		Geotube® Cross Section Area (A) =	257.80	sq ft
Geotube® Height (H) =	8.0	ft	Geotube® Volume Per Unit of Length (V) =	9.55	cu yd/ft
Geotube® Circumference (C) =	80	ft	Pressure at Base (P_{base}) =	4.892	psi
Specific Gravity of Fill Material (SGint) =	1.4	sg	Excess Pressure at Top of Geotube® (P_{top}) =	0.039	psi
Geotube® Fabric Type:	GT500		Factor of Safety =	3.38	FS

Geotube® Simulator
Cross Section

6/10/09	Project:	ABC Lake Dredgeing

Units:	English		Maximum Tensile Force (T) =	118.34	lb/in.
Water Level:	Emerged		Geotube® Base Contact Width (B) =	32.09	ft
Geotube® Height (H) =	8	ft	Geotube® Filled Width (W) =	36.21	ft
Geotube® Circumference (C) =	80	ft	Geotube® Cross Section Area (A) =	257.80	sq ft
Specific Gravity of Fill Material (SGint) =	1.4	sg	Geotube® Volume Per Unit of Length (V) =	9.548	cu yd/ft
Geotube® Fabric Type:	GT500		Factor of Safety =	3.4	FS

Appendix E

The Geotube® Estimator

TENCATE Geotube

Geotube® Estimator

English Units Input - Known Volume

Version 8.0

Licensed to: Mark Gunzenhauser 12/16/08

Project Name:	**ABC Company**
Location:	**Venezuala**
Contact:	**anytown, USA**
Date:	**6/10/2009**
Type of Material:	**PCB Laden Lake Sediments**

Input		Units
Volume	1,000,000	Cubic Yards
Specific Gravity	1.40	
% Solids in Place	35.0%	
% Solids During Pumping	15.0%	
Target dewatered % Solids	55%	
% Coarse grain & sand*	2.0%	

* % Coarse grain & sand is removed from the calculation for volume reduction due to dewatering and added back in at the end in required Geotube® volume.

Output		Units
Total Volume Pumped	501,259,259	Gallons
Wet Volume per day	907,200	Gallons
Wet Volume per day	4,491.1	CY
Total Bone Dry Tons	327,600.0	Tons
Estimated Pumping Days	552.5	Days
Estimated Dewatered Volume	604,040.4	CY
Estimated Dewatered Weight	595,636.4	Tons

Production:

Pumping Rate (GPM)	1,400
Hours per Day	12.0
% Efficiency	90%

Estimated Geotube® Quantity:

CircumferenceX Pumping Height	*Feet*
80' X 8.5'	67,116

For MDS Applications:

Legal Hauling Capacity	15	Tons

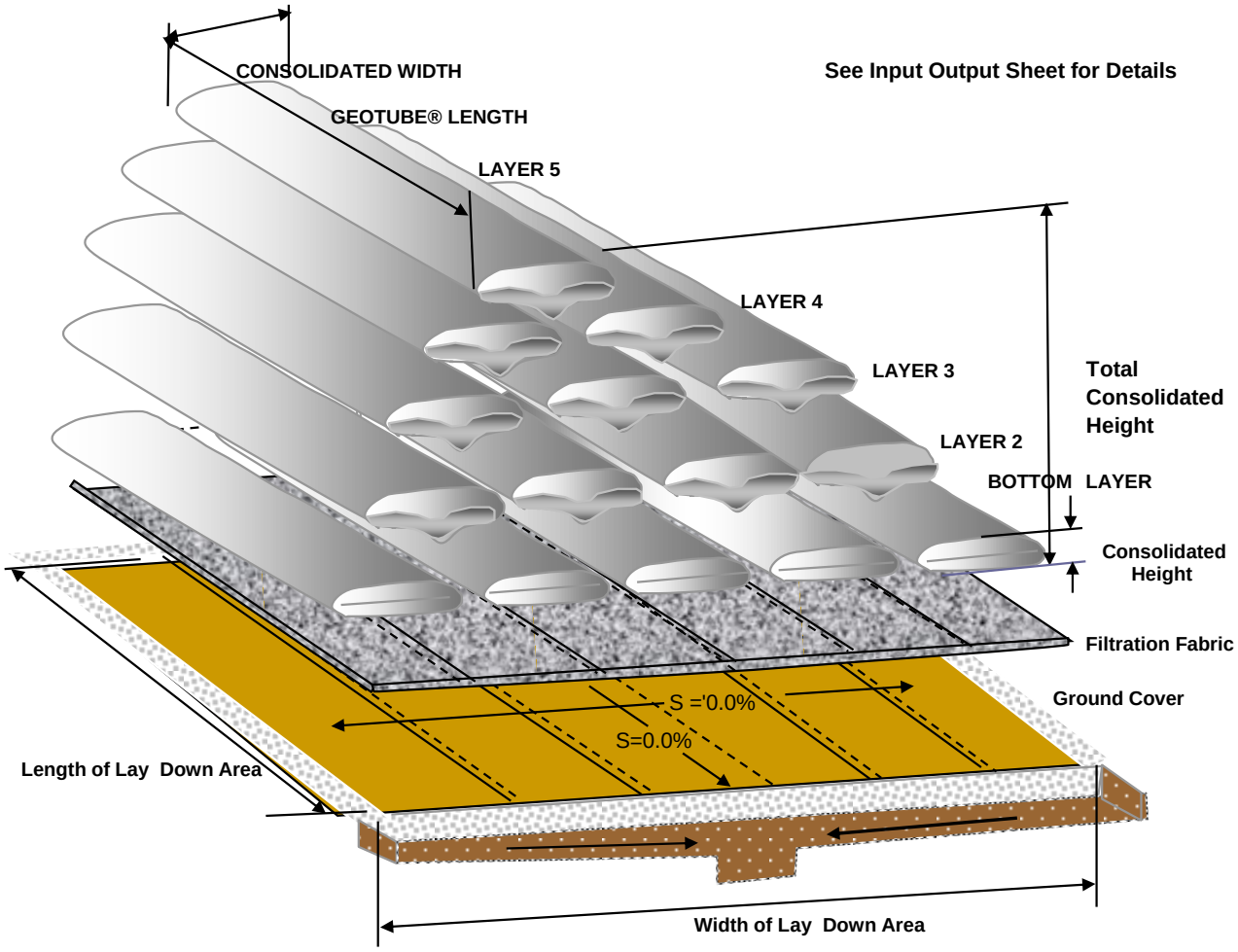
Estimated MDS Geotube® Units:

MDS Dimension	*Each*
22.5' X 22'	39,709.1

Appendix F

The Geotube® Illustrator

TENCATE Geotube



Membrane
Non woven

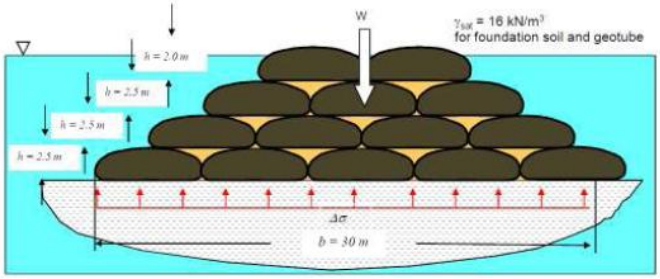
Appendix G

The Geotube® Structure Bearing Capacity and Settlement Analysis Program

TENCATE Geotube

Brazil Terminal Portuario Bearing Capacity and Settlement Analysis

ESTIMATE OF CONTACT STRESS AND BEARING CAPACITY: NORTH BUND
SECTION #4: THREE LAYERS OF GEOTUBES PALCED ON TOP OF FOUNDATION SOIL



CONTACT NORMAL STRESS BETWEEN GEOTUBE AND FOUNDATION SOIL:

$\Delta\sigma = W/b = [12(6 \times 2.5)(16\text{-}9.8) + 2(6 \times 2)16]/30 = 49.9$ kPa
However, due to an estimated settlement of 2.7 m (see page 8), the submerged depth of the 4-layer geotube embankment would be equal to 7.5 + 2.7 = 10.2 m, then
*$\Delta\sigma = W/b = [14 (6 \times 2) (16\text{-}9.8)]/30 = 34.6$ kPa , **USE 43 kPa***

UNDRAINED SHEAR STRENGTH OF FOUNDATION SOIL :

Layer #1 from 0 to 15 m: $S_u = 7.0 + 2.3\,z$ (kPa)
Layer #2 from 15 to 27 m: $S_u = 20.0 + 2.8\,z$ (kPa)
Layer #3 from 27 to 35 m: $S_u = 20.0 + 2.8\,z$ (kPa)
Assume the average S_u of the 1st soft soil layer can be used to estimate bearing capacity of the soft soil to support the single layer geotube bund, then the average undrained shear strength is
$S_u = 7 + 2.3\,z = 7 + 2.3\,(7.5) = 24.3$ (kPa)

BEARING CAPACITY OF FOUNDATION SOIL

$q_{ult} = cN_c$
where N_c = bearing capacity factor, and c = cohesion = undrained shear strength
$q_{ult} = 24.3 \times 6 = 145.8$ kPa

FACTOR OF SAFETY AGAINST BEARING CAPACITY FAILURE:

FS** = $q_{ult}/Ds = 145.8/43.0 =$ **3.4
Considering the effect of settlement, then
FS = qult/Ds = 145.8/34.6 = 4.2

TENCATE Geotube

FIGURE NO.	5
PROJECT NO.	
DOCUMENT NO.	
FILE NO.	

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Appendix H

P-GDT Geotube® Evaluation General Set Up

P-GDT Test Stand Operation With RDT Scales Test Stands

Appendix I

Computer Lab
RDT Drainage Rate Tracking / P-GDT Test Stand Mass Balance Tracking

Appendix J

RDT Cake Samples Awaiting Consolidation Testing

RDT Cake Samples Pentromenter Consolidation Evaluation kg/in²

Appendix K

Chemical Program Flocculation Characterization

RDT Testing Drainage Rate Trending Analysis

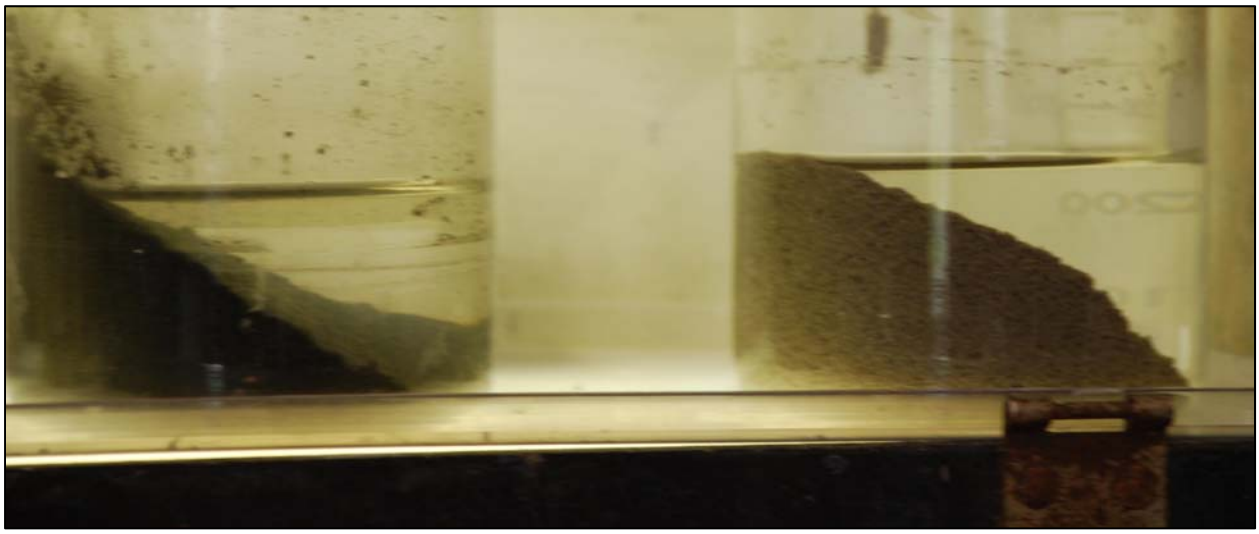
Appendix L

SMU 6 Brown Flocculation Ashland 2520 1.59 lbs/Dry Ton

SMU 6

Black Floc Stability
Ashland 2520 1.59 lbs/D.T.

Brown Floc Stability
Ashland 2520 1.59 lbs/D.T.



Appendix M

SMU 1b. Oversize Screening

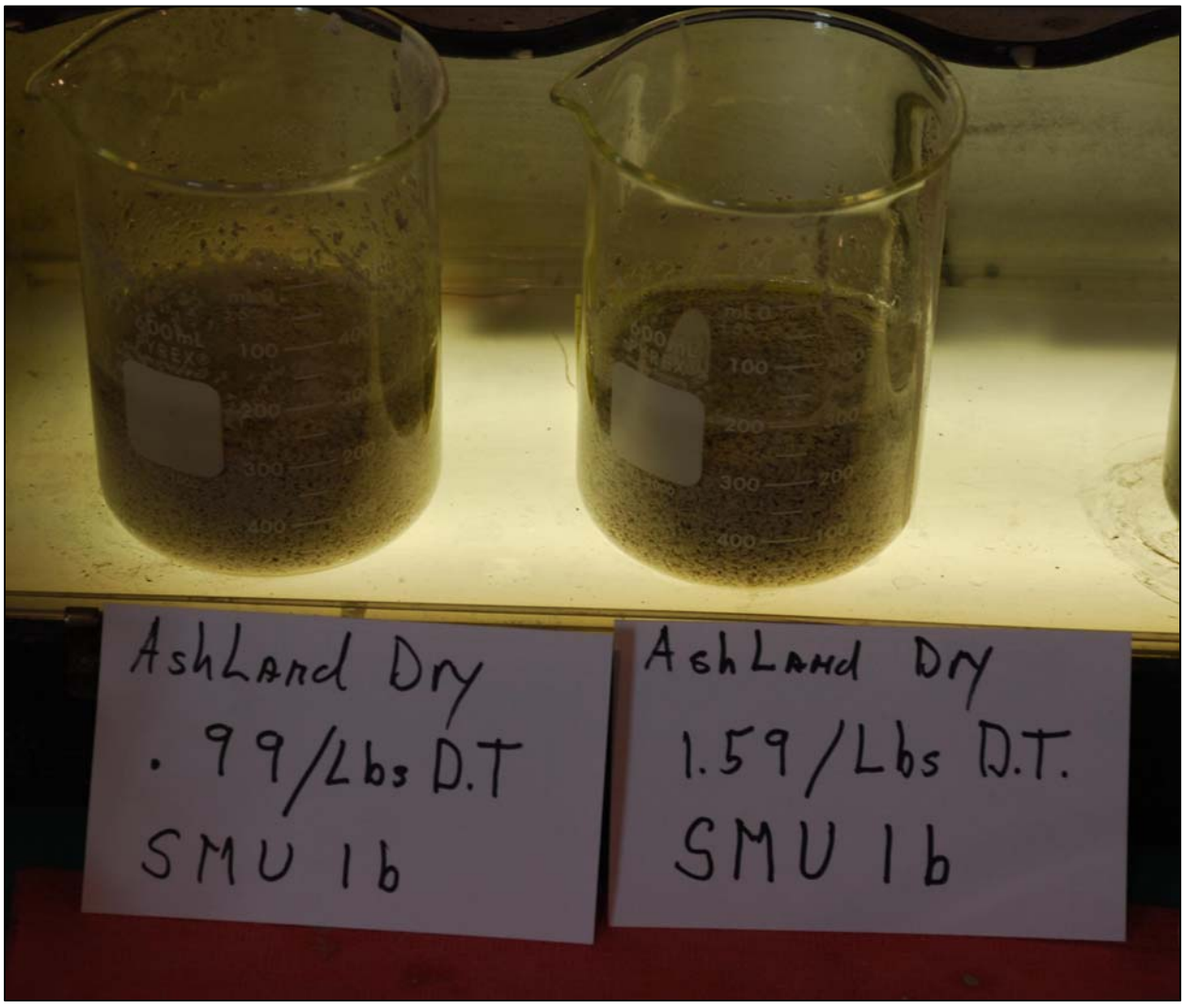
SMU 6 Black Oversize Screening

Appendix N

SMU 1b. Floc Formation Dosage Rate RDT Test vs. P-GDT Test

.99 Lbs / Dry Ton

1.59 Lbs / Dry Ton



Appendix O

P-GDT Testing Tube In 3 PSI Filling Phase

P-GDT Test Tube 24 hours Dewatering Phase

Appendix P

SMU 1b Table 11 P-GDT Test
Tube Exposed After 24 Hours Dewatering 43% Dry Solids

Appendix Q

SMU 1b. Foam Generated During Suspension Stage

Foam Perfusion With Filtrate During Dewatering @ .99/lbs Dry Ton

Tables

TABLE 1: **RDT Testing Sample Sceening Values**

(Conducted At Mineral Processing Services Filtration Laboratory)

Test	Tares	lbs	Lbs/gal	S.G.	
Test 1	Sample Wet Weight	42.56			
101118	4" to 0.5" Diameter	0	0	0	
White	20 Mesh	1.21	10.7	1.29	
	100 Mesh	1.21	9.7	1.16	
	% D.S. Raw	35.8			
	% D.S. Screen	32.1			
	pH	11.2			
	Salinity	2.7 ppt			
	S.G. Screen	1.07 / 9.0lbs			(Specific Gravity of Screened Product)
	Cond	5.26 mS/cm			
Test 2	Sample Wet Weight	56.04			
10118	4" to 0.5" Diameter	12.42	ND	ND	
White	20 Mesh	8.32	ND	ND	
	100 Mesh	6.92	ND	ND	
	% D.S. Raw	38.9			
	% D.S. Screen	38.8			
	pH	11.0			
	Salinity	3.3 ppt			
	S.G. Screen	1.31 / 10.9 lbs			(Specific Gravity of Screened Product)
	Cond	6.26 mS/Cm			
Test 3	Sample Wet Weight	64.86			
60098	4" to 0.5" Diameter	0	0	0	
Brown	20 Mesh	14.58	12.1	1.45	
	100 Mesh	6.86	12.7	1.52	
	% D.S. Raw	55.1			
	% D.S. Screen	35.1			
	pH	8.1			
	Salinity	13.8 ppt			
	S.G. Screen	1.28 / 10.7lbs			(Specific Gravity of Screened Product)
	Cond	23.6 mS/cm			
Test 4	Sample Wet Weight	43.72			
10114	4" to 0.5" Diameter	0			
White	20 Mesh	3.74	12.1	1.45	
	100 Mesh	3.78	ND	ND	
	% D.S. Raw	43.72			
	% D.S. Screen	38.6			
	Salinity	1.55 ppt			
	pH	11.0			
	Cond	5.48 m/S/cm			
	S.G. Screen	1.25/ 10.5lbs			(Specific Gravity of Screened Product)
Test 5	Sample Wet Weight	57.68			
10118	4" to 0.5" Diameter	16.2	ND	ND	
White	20 Mesh	7.34	11.7	1.40	
	100 Mesh	5.78	11.8	1.42	
	%D.S. Raw	?			
	% D.S. Screen	36.1			
	Salinity	2.7 ppt			
	pH	11.4			
	Cond	6.86 mS/cm			
	S.G. / Screen	1.27 /10.6Lbs			(Specific Gravity of Screened Product)
Test 6	Sample Wet Weight	59.84	ND	ND	
10118	4" to 0.5" Diameter	ND	ND	ND	
White	20 Mesh	4.58	ND	ND	
	100 Mesh	7.28	ND	ND	
	% D.S. Raw	ND			
	% D.S. Screen	38.16			
	Salinity	3.4 ppt			
	pH	11.7			
	Cond	6.64 mS/cm			
	S.G. / Screen	1.31 / 11.0lbs			(Specific Gravity of Screened Product)

Dry Soilds Average SMU 1 5 samples 41.5 % D.S.

Dry Soilds SMU 6 1 sample 55.1 % D.S.

(Dry soilds determed on slurry pre-screening 100 US Mesh)

Sample SMU 6 percentage removed by screening to 100 US Mesh 34%

Samples SMU1 Percentage removed by screening to 100 US Mesh 28.6%

(Sample screened percentage based on sample gross wet weight and screened product wet weight)

TABLE 2.					
	P-GDT Testing Screening Sample Drums				
	Sheet 1 of 1				
P-GDT Test Sceening Log					
	SMU 1.b				
Drum # 1 SMU 1b.	Drum Volume	Volume % Over Size	Volume % 20 Mesh	Volume % 100 Mesh	Volume Passing 100 US Mesh
Sample Gallons	42 gallons	1.6 gallons	3.8 Gallons	3.5 Gallons	33.1 Gallons
Percentage of Volume	% of Volume	4%	9%	8%	79%
	SMU 6				
Drum #4 SMU 6	Drum Volume	Volume % Over Size	Volume % 20 Mesh	Volume % 100 Mesh	Volume Passing 100 US Mesh
Sample Gallons	46 gallons	.5 gallons	7.4 gallons	5.1	33 Gallons
	% of Volume	1%	16%	11%	72%
	Notes:				
	Description oversize is 4" diamenter to 6.35 mm				
	Description retained on 20 US Mesh is equal to 0.841 mm				
	Description retained on 100 US Mesh is equal to 0.149 mm				
	Description % of volume uses beginning volume of drum prior screening				
	Screening mass balance was completed on 1 drum from each SMU				

Table 3 (REV 2)
Polymer Program Evaluation
MPS Filtration Laboratory [RDT] Rapid Drainage Test
SMU 1 & 6 Slurry (Screen US Mesh 100)

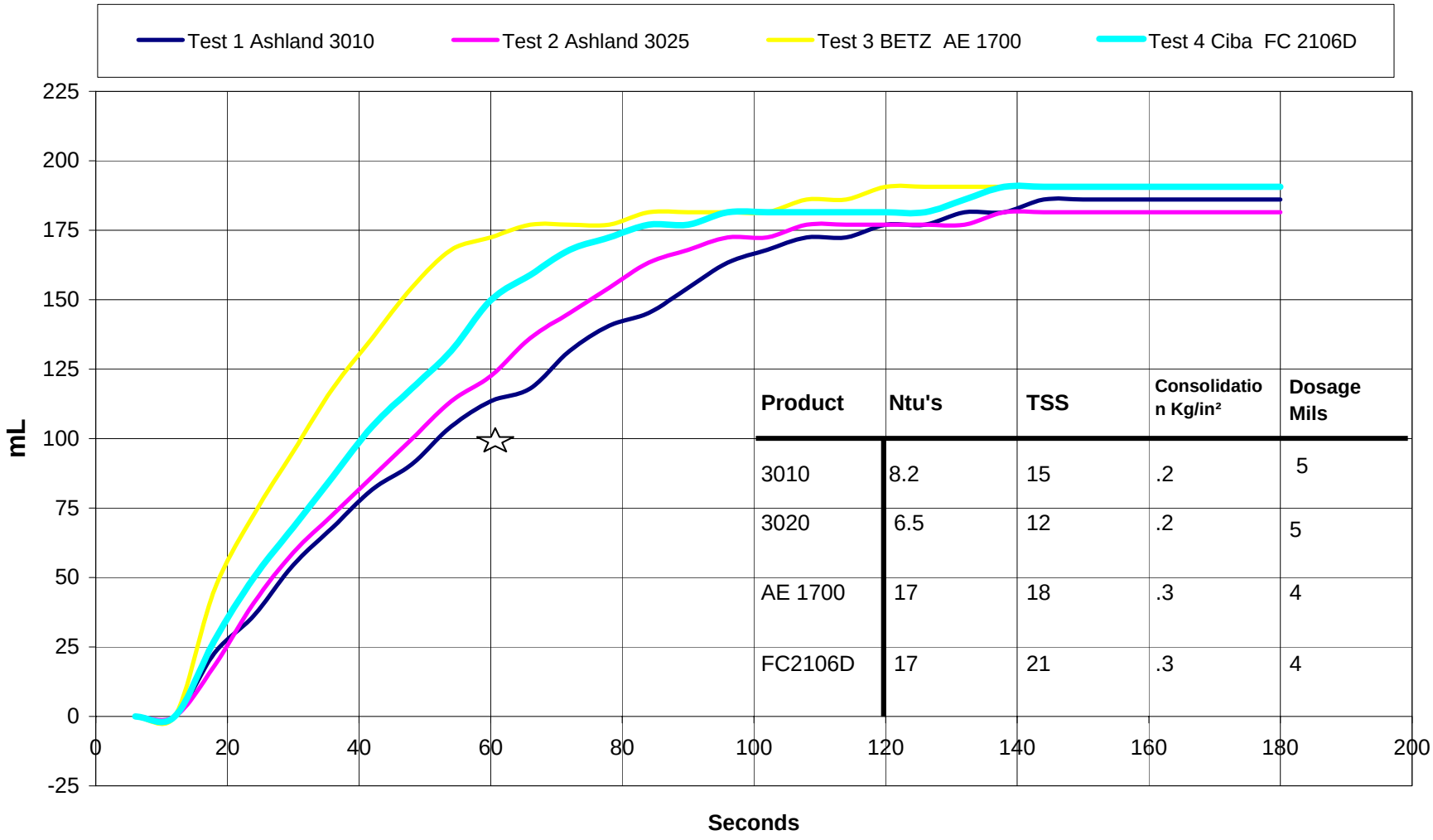
SMU 1 Sample Volume 250 mls / % D.S. 8.89 % / Specific Gravity 1.08 / Salinity 4.29 ppt / mS/Cm 4.25 / pH 10.8
SMU 6 Sample Volume 250 mls / % D.S. 8.00 % / Specific Gravity 1.06 / Salinity 1.70 ppt / mS/Cm 3.57 / pH 8.2

Test	Manufacture	Slurry	Product	Charge	Medium	Dosage	Shear Mix	Cloth	Cake % D.S.	Cake Consolidation	T.S.S.	Ntu's	Poly Dilution	Mils Dose	Filtrate Mils	Performance Ranking
#			#	Cat/Anionic	Emulsion/Dry	lbs/D.T.	10 Sec 100%	#	%	kg/in²	mg/l	#	%	#	#	#
1	Ashland	SMU 1	3010	Anionic	Emulsion	2.48	10	GT500	32.6	0.2	15	8.2	0.5	5	176	4
2	Ashland	SMU 1	3025	Anionic	Emulsion	2.48	10	GT500	30.2	0.2	12	6.5	0.5	5	172	6
3	BETZ	SMU 1	AE 1700	Anionic	Emulsion	1.99	10	GT500	31.6	0.3	18	17	0.5	4	181	3
4	Ciba	SMU 1	FC2106D	Cationic	Emulsion	1.99	10	GT500	32.7	0.3	21	17	0.5	4	176	2
5	Kemira	SMU 1	1849	Anionic	Emulsion	2.98	10	GT500	26.9	0.1	14	22	0.5	6	77	11
6	SNF	SMU 1	240 CT	Cationic	Emulsion	2.98	10	GT500	28.4	0.2	12	6.5	0.5	6	136	8
7	SNF	SMU 1	C-6227	Cationic	Emulsion	2.98	10	GT500	28.1	0.2	18	17	0.5	6	145	9
8	SNF	SMU 1	EM140 CT	Cationic	Emulsion	2.73	10	GT500	27.2	0.2	13	9	0.5	5.5	154	6
9	SNF	SMU 1	EM154CT	Cationic	Emulsion	2.98	10	GtT500	26.8	0.2	16	13	0.5	6	90	10
10	Nalco	SMU 1	7766		Emulsions	2.98	10	GT500	32.7	0.4	12	14	0.5	6	186	1
11	Nalco	SMU 1	2706		Emulsions	2.98	10	Gt500	27.2	0.1	11	11.5	0.5	6	158	7
12	Ashland	SMU 1	2520	Anionic	Dry	0.99	15	GT500	28.6	0.8	16	26	0.2	5	186	1
19	Ashland	SMU 6	2520	Anionic	Dry	1.00	15	GT500	26.2	0.4	10	12	0.2	5	181	1
13	BETZ	SMU 1	AP 1100	Anionic	Dry	0.74	15	GT500	33.6	0.5	8	23	0.5	1.5	181	3
14	Ciba	SMU 1	FC 2044	Cationic	Dry	0.99	15	GT500	30.2	0.3	7	7.5	0.2	5	127	5
15	Kemira	SMU 1	A-100	Anionic	Dry	0.99	15	GT500	34.4	0.6	12	22	0.2	5	181	2
16	SNF	SMU 1	4290 SH	Cationic	Dry	0.99	15	GT500	28.6	0.3	2	4	0.2	5	172	4
17	Nalco	SMU 1	9601	Anionic	Dry	0.99	15	GT500	27.8	0.2	5	7	0.2	5	149	6
18	Nalco	SMU 1	9602	Anionic	Dry	0.99	15	Gt500	26.3	0.1	5	6	0.2	5	117	7

TABLE 4

Vendors Best Product Run Emulsions

SMU 1 (Screened 100 US Mesh)

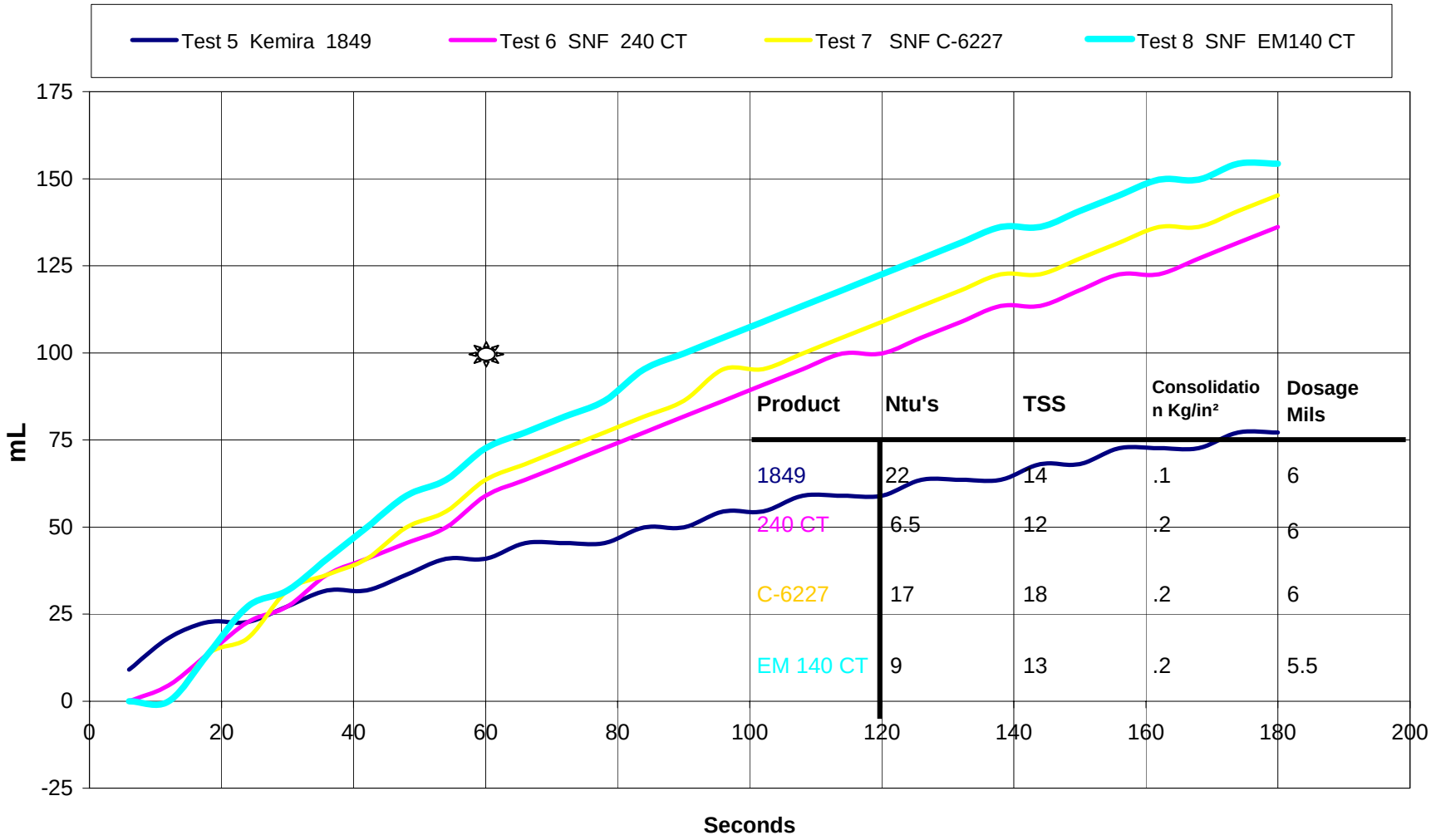


Product	Ntu's	TSS	Consolidation Kg/in²	Dosage Mils
3010	8.2	15	.2	5
3020	6.5	12	.2	5
AE 1700	17	18	.3	4
FC2106D	17	21	.3	4

TABLE 5

Vendors Best Products Run Emulsions

SMU 1 (Screened 100 US Mesh)

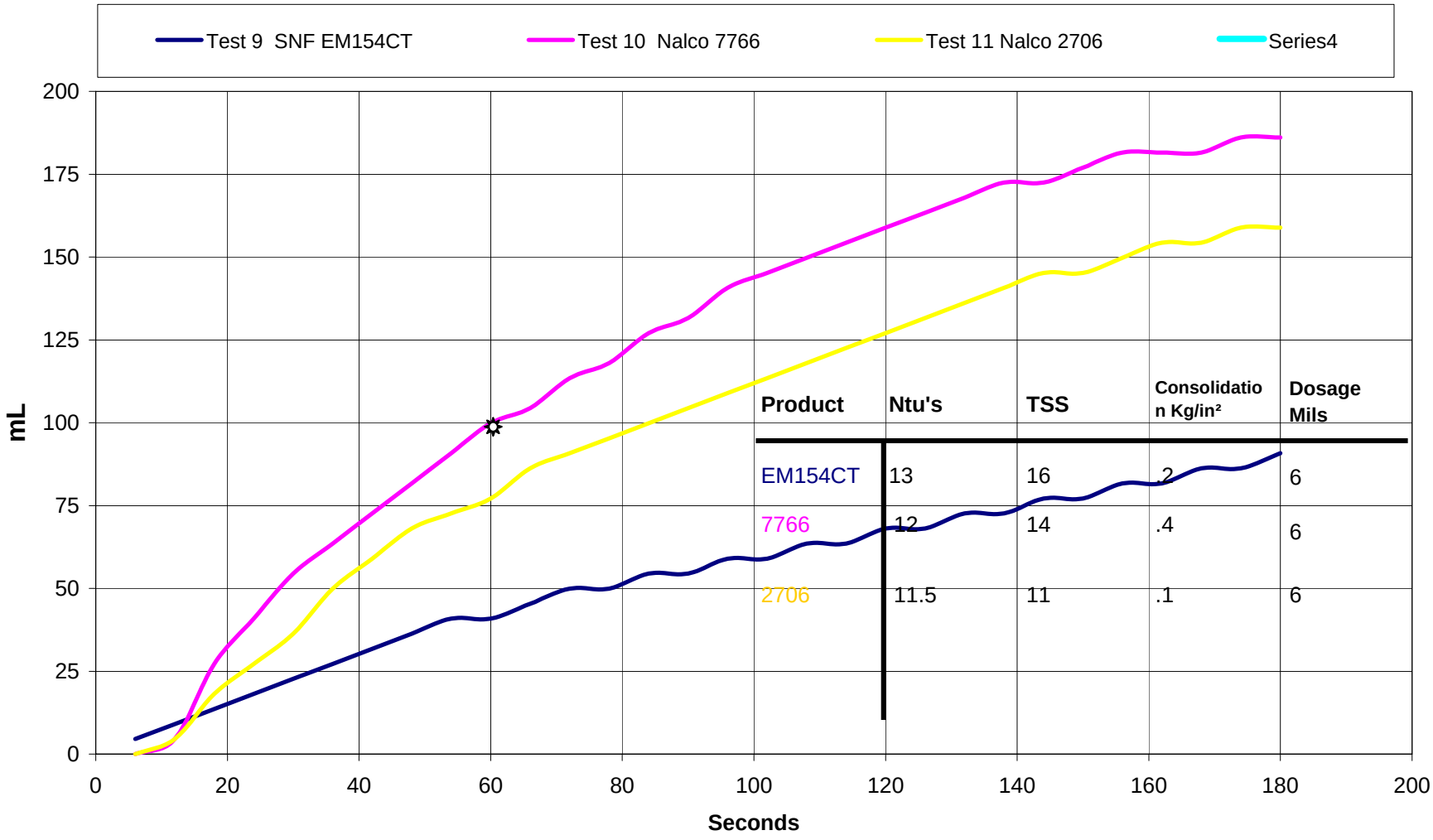


Product	Ntu's	TSS	Consolidation Kg/in²	Dosage Mils
1849	22	14	.1	6
~~240 CT~~	6.5	12	.2	6
C-6227	17	18	.2	6
EM 140 CT	9	13	.2	5.5

TABLE 6

Vendors Best Products Run Emulsions

SMU 1 (Screened 100 US Mesh)

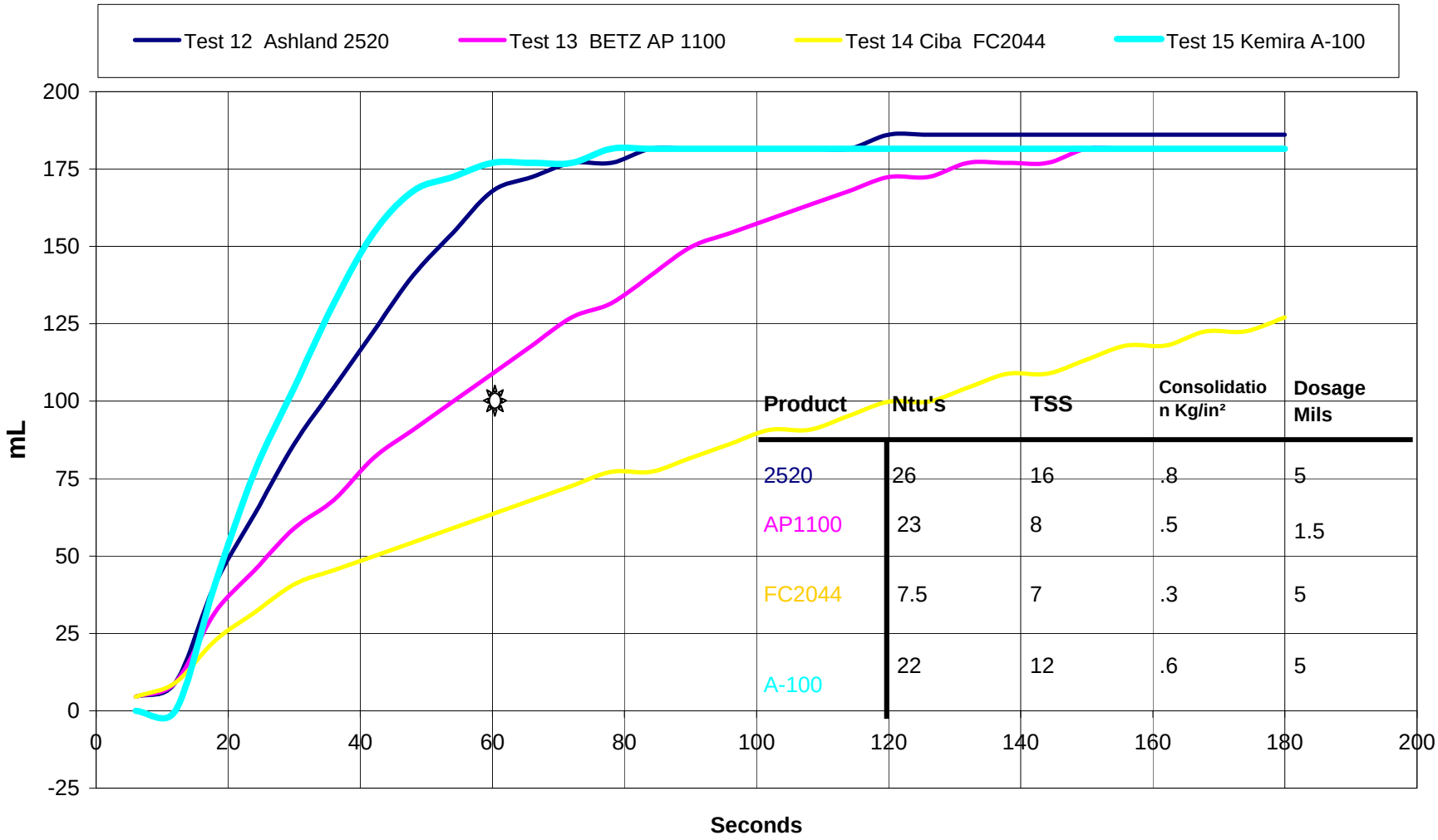


Product	Ntu's	TSS	Consolidation Kg/in²	Dosage Mils
EM154CT	13	16	.2	6
7766	12	14	.4	6
2706	11.5	11	.1	6

Table 7
1 of 2

Vendors Best Products Run Dries

SMU 1 (Screened 100 US Mesh)

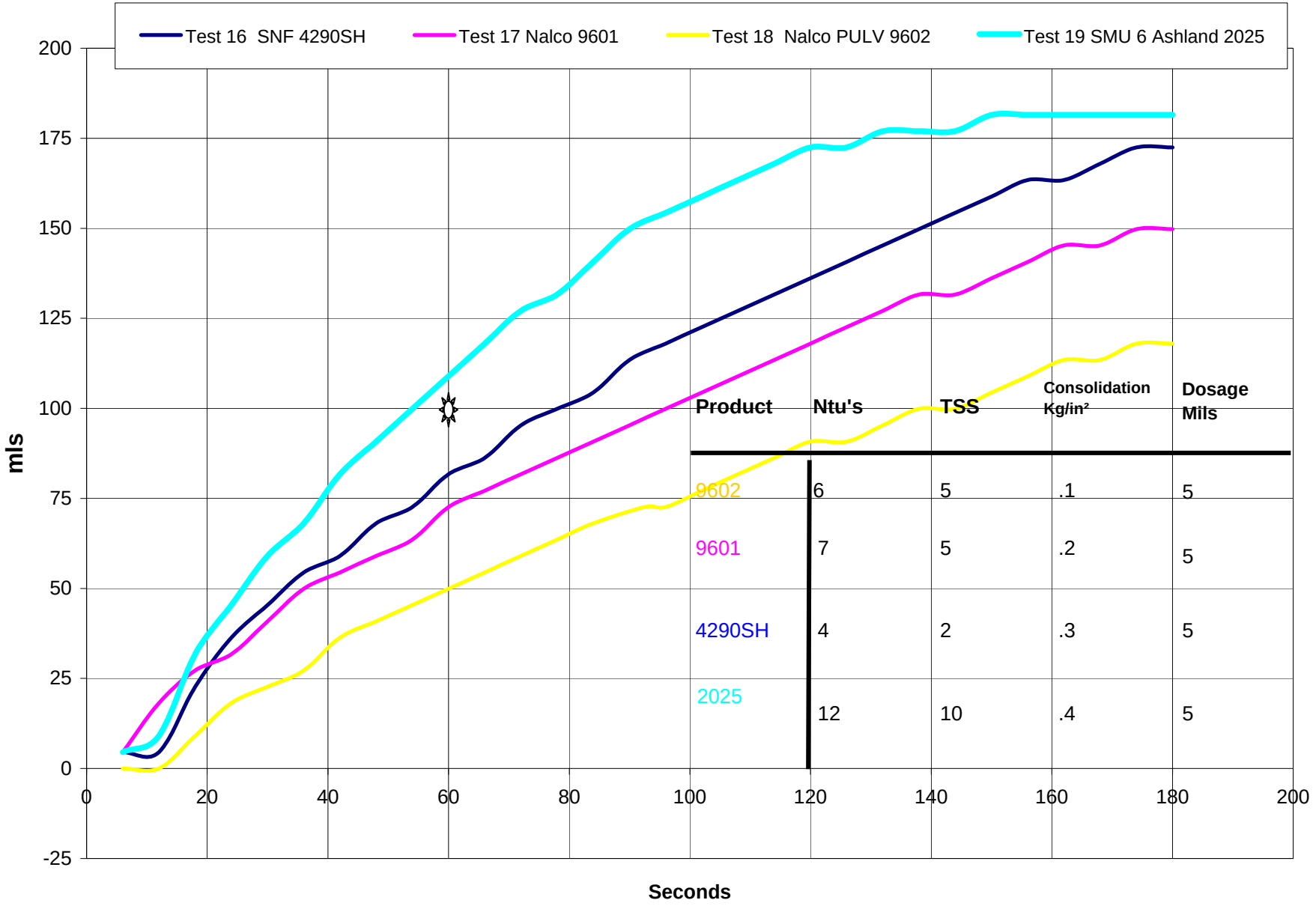


Product	Ntu's	TSS	Consolidation Kg/in²	Dosage Mils
2520	26	16	.8	5
AP1100	23	8	.5	1.5
FC2044	7.5	7	.3	5
A-100	22	12	.6	5

Table 8
2 of 2

Vendors Best Dry Products Run
SMU 1 & 6 (Screened 100 US Mesh)

SMU 1 Sample Volume 250 mls Dry Solids 8.06 % pH 10.8 Salinity 2.23 PPT mS/Cm 4.27 Specific Gravity 1.08
SMU 6 Sample Volume 250 mls Dry Solids 8.00 % pH 8.20 Salinity 1.70 PPT mS/Cm 3.57 Specific Gravity 1.06



Product	Ntu's	TSS	Consolidation Kg/in²	Dosage Mils
9602	6	5	.1	5
9601	7	5	.2	5
4290SH	4	2	.3	5
2025	12	10	.4	5

Table 9

Test Filtrate Untreated
SMU1b Filtrate vs. Tap Water Polymer Make Down Comparison
Evaluation Of Drainage & Filtrate Capture
Slurry 250 mls @ 16.2 % D.S. pH 10.8 / Salinity 2.6 PPT / 5.49 mS/Cm / 1.08 S.G. 9.0 lbs/Gal.

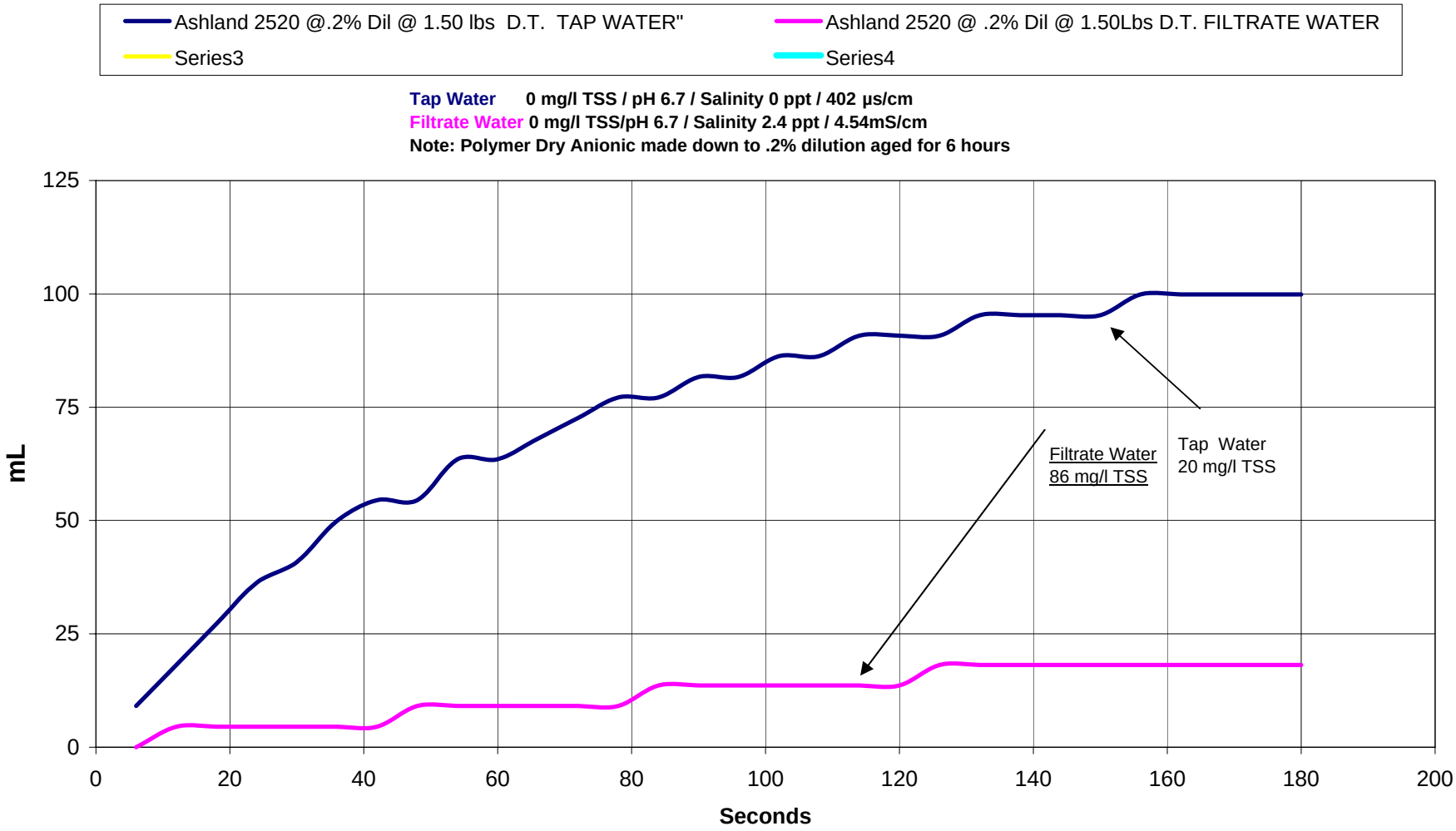
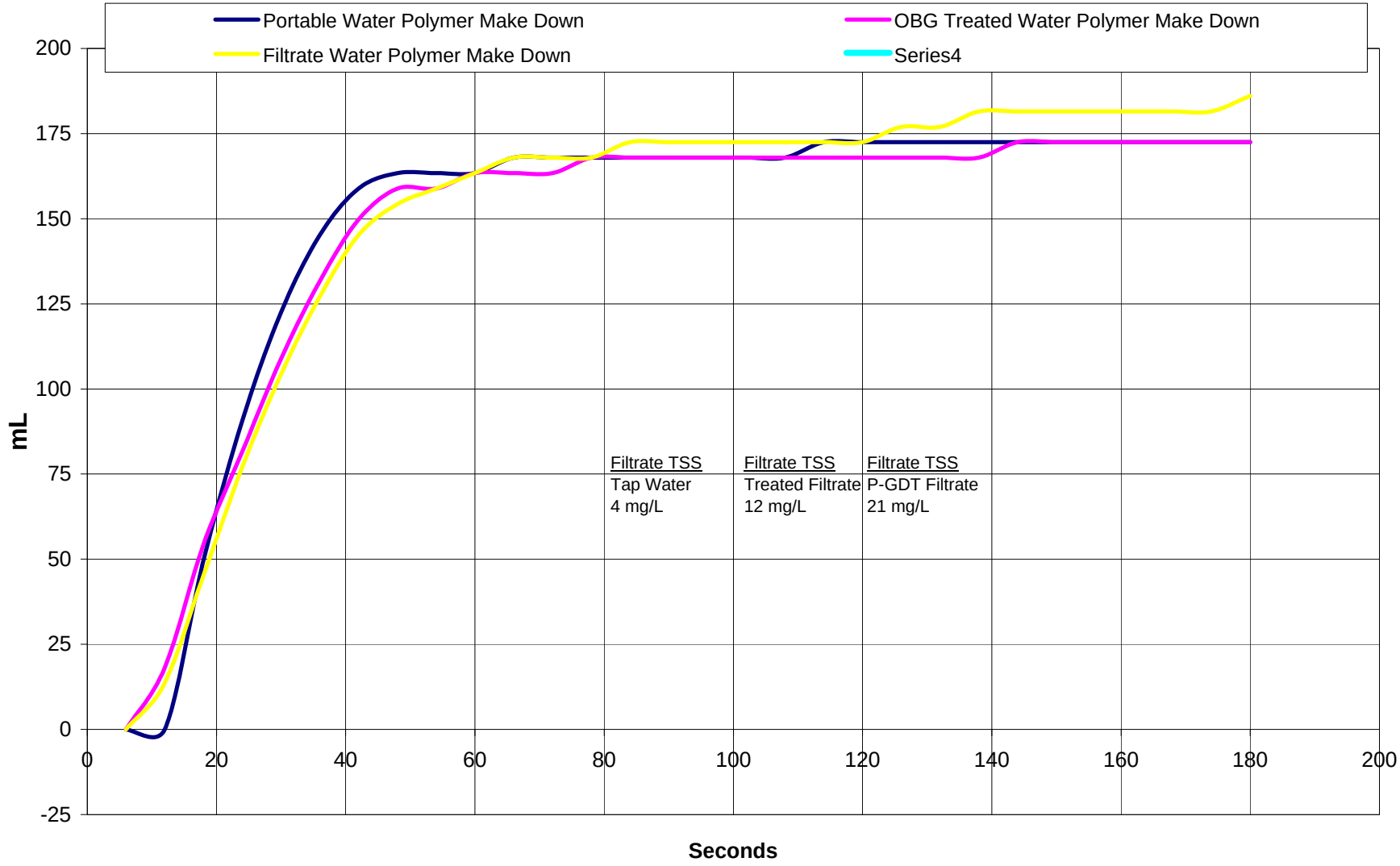


Table 10

SMU1b Portable Water,OBG Treated Water & Geotube Filtrate Polymer Make Down Comparison
Drainage Rate Volume Over Time & Filtrate Total Suspended Solids
Slurry 250 mls @ 12.0% D.S. pH 9.8 / Salinity 1.5 PPT / 3.12 mS/Cm / 1.08 S.G. 9.0 lbs/Gal.

Portable Water	**0 mg/L TSS/ pH 8.8 / Salinity 0.00 ppt / 70.45 µS/cm**
Treated Water	**0 mg/L TSS / pH 7.5 / Salinity 1.7 ppt / 3.82 mS/cm**
Filtrate Water	**0 mg/LTSS / pH 10.2 / Salinity 4.7 / 9.35 mS/cm**



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 11

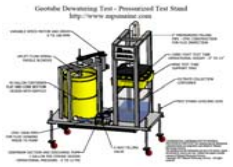
Project :	Parsons Geotube® P-GDT Test 1
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 8th 2009
Test Tracking Code	Line 11

Comments:

TenCate Fabric Testing GT500
Dry Polymer Ashland 2520

						Values Totals	Values Avg
1st Void Fill Phase		**2nd Void Fill Phase**		**3rd Void Fill Phase**		**1st Fill Phase**	
Processed Mass Lbs	109.23	Processed Mass Lbs	14.31	Processed Mass Lbs	10.12	133.66	
Filtrate Lbs	12.00	Filtrate Lbs	8.60	Filtrate Lbs	6.02	26.62	
Tube Mass Retained **M^1**	97.23	Tube Mass Retained **M^1**	5.71	Tube Mass Retained **M^1**	4.10	107.04	
Processed Gallons	10.88	Processed Gallons	1.43	Processed Gallons	0.99	13.30	
Filtrate Gallons	1.44	Filtrate Gallons	1.03	Filtrate Gallons	0.72	3.19	
Tube Gallons Retained	9.44	Tube Gallons Retained	0.40	Tube Gallons Retained	0.27	10.11	
% Dry Solids Raw	12.10	% Dry Solids Raw	12.10	% Dry Solids Raw	12.10		12.10
Dry Solids Retained /1ft³ **M^2**	12.90	Dry Solids Retained /1ft³ **M^2**	1.70	Dry Solids Retained /1ft³ **M^2**	1.17	15.77	
T.S.S.	28.00	T.S.S.	26.00	T.S.S.	24.00		26.00
Ntu's	49.00	Ntu's	48.00	Ntu's	45.00		47.33
pH	11.10	pH	11.00	pH	10.80		10.97
Conductivity mS/cm	4.40	Conductivity mS/cm	5.76	Conductivity mS/cm	5.76		5.31
Salinity ppt	3.10	Salinity ppt	2.70	Salinity ppt	2.70		2.83
Slurry Density lbs/gal *calc*	10.04	Slurry Density lbs/gal *calc*	10.01	Slurry Density lbs/gal *calc*	10.22		10.09
Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

TENCATE Geotube®



SF SMARTFEED®

24/hr Cake Density		10.70
24/hr Cake S.g		1.28
24/hr Cake % Dry Solids		43.60
1ft³ lbs 24hrs Dewatering		80.34
Dry Solids Retained /1ft³ **M^3**		35.03
1ft³ lbs End of Fill		92.00
Penetrometer RDT Kg/in²		3.62
Penetrometer P-GDT Kg/in²		0.90
RDT T.S.S.		43.00
RDT Ntu's		45.70
RDT Cake % Dry Solids		40.40

Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

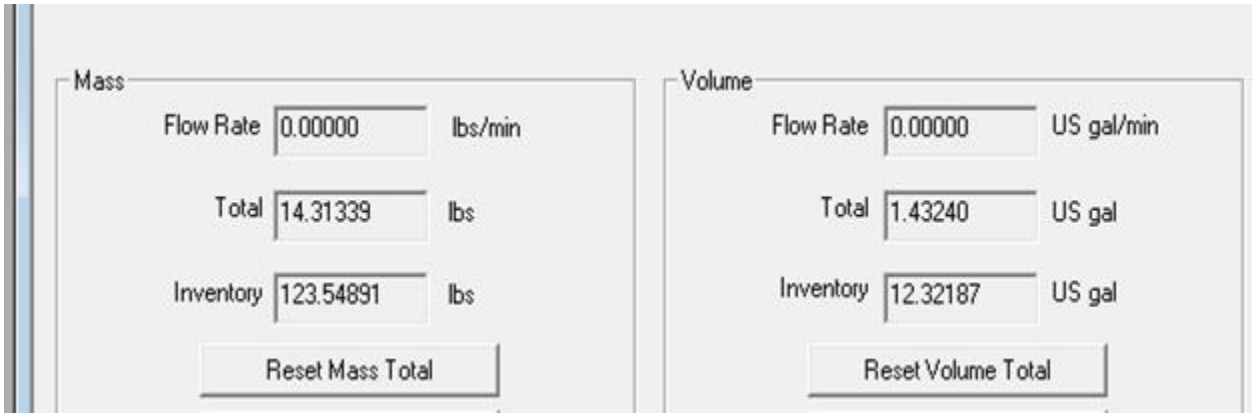
Dry lbs 1ft³ Method 3 M^3

Table 12

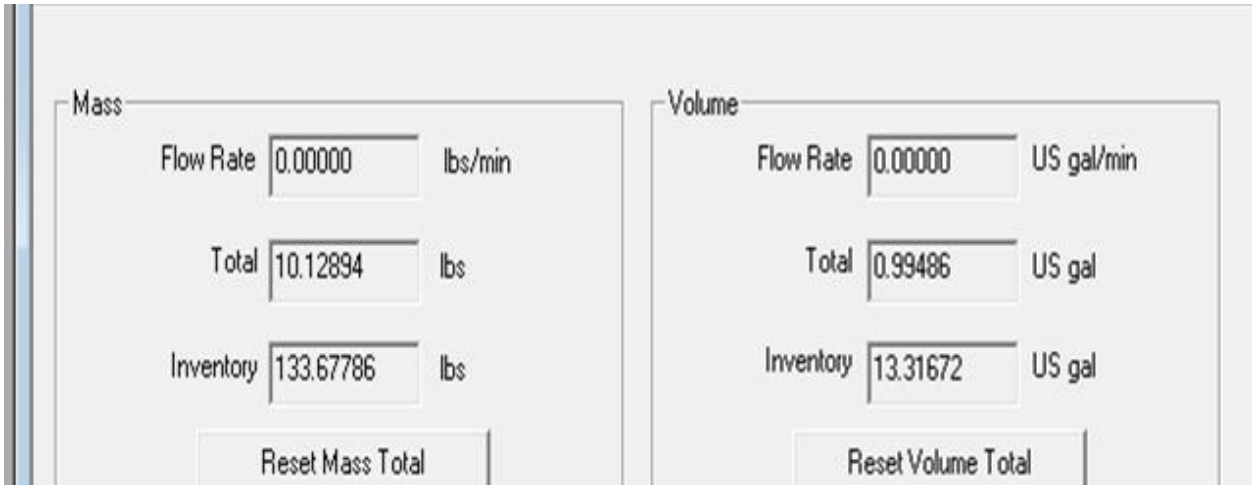
Validation of Fill Phases: Test 1, May 8, 2009
Sample: SMU 1b; Fabric: TenCate GT 500; Polymer: Ashland 2520

First Fill Phase

Second Fill Phase



Third Fill Phase



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 13

Project :	Parsons Geotube® P-GDT Test 2
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 8th 2009
Test Tracking Code	Line 12

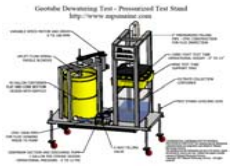
Comments:

TenCate Fabric Testing O2B
Polymer Ashland 2520

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	104.70	Processed Mass Lbs	26.60	Processed Mass Lbs	24.95	156.25	
Filtrate Lbs	39.00	Filtrate Lbs	20.00	Filtrate Lbs	19.50	78.50	
Tube Mass Retained **M^1**	65.70	Tube Mass Retained **M^1**	6.60	Tube Mass Retained **M^1**	5.45	77.75	
Processed Gallons	11.40	Processed Gallons	2.66	Processed Gallons	2.50	16.56	
Filtrate Gallons	4.68	Filtrate Gallons	2.40	Filtrate Gallons	2.34	9.41	
Tube Gallons Retained	6.72	Tube Gallons Retained	0.33	Tube Gallons Retained	0.16	7.22	
% Dry Solids Raw	11.80	% Dry Solids Raw	11.80	% Dry Solids Raw	11.80		11.80
Dry Solids Retained /1ft³ **M^2**	12.64	Dry Solids Retained /1ft³ **M^2**	3.08	Dry Solids Retained /1ft³ **M^2**	0.28	16.00	
T.S.S.	442.00	T.S.S.	26.00	T.S.S.	32.00		166.67
Ntu's	605.00	Ntu's	48.00	Ntu's	52.00		235.00
pH	11.10	pH	11.00	pH	11.00		11.03
Conductivity mS/cm	4.40	Conductivity mS/cm	5.76	Conductivity mS/cm	5.76		5.31
Salinity ppt	2.90	Salinity ppt	2.70	Salinity ppt	2.70		2.77
Slurry Density lbs/gal *calc*	9.18	Slurry Density lbs/gal *calc*	10.00	Slurry Density lbs/gal *calc*	9.98		9.72
Slurry Density lbs/gal *lab scale*	9.40	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	O2B	Fabric Vendor	O2B	Fabric Vendor	O2B		

24/hr Cake Density		10.90
24/hr Cake S.g		1.32
24/hr Cake % Dry Solids		41.50
1ft³ lbs 24hrs Dewatering		78.00
Dry Solids Retained /1ft³ **M^3**		32.37
1ft³ lbs End of Fill		62.00
Penetrometer RDT Kg/in²		3.60
Penetrometer P-GDT Kg/in²		0.50
RDT T.S.S.		37.00
RDT Ntu's		58.00
RDT Cake % Dry Solids		44.24

TENCATE Geotube®



SF SMARTFEED®

Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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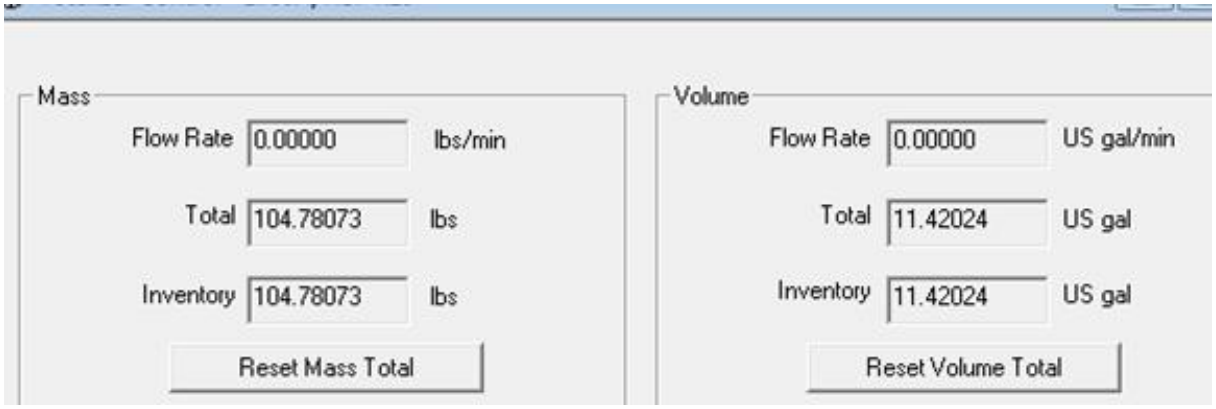
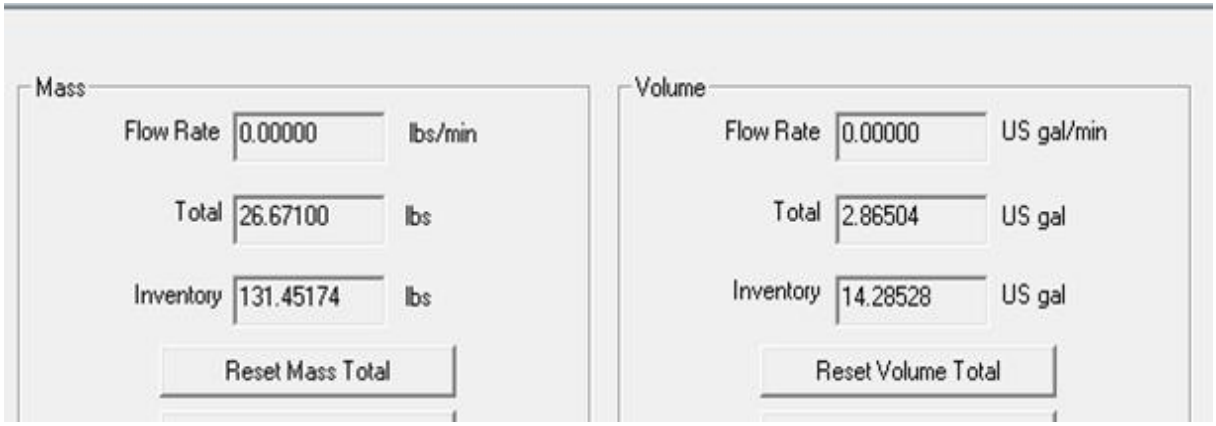
Table 14

Validation of Fill Phases: Test 1, May 8, 2009
Sample: SMU 1b; Fabric: TenCate O2B; Polymer: Ashland 2520

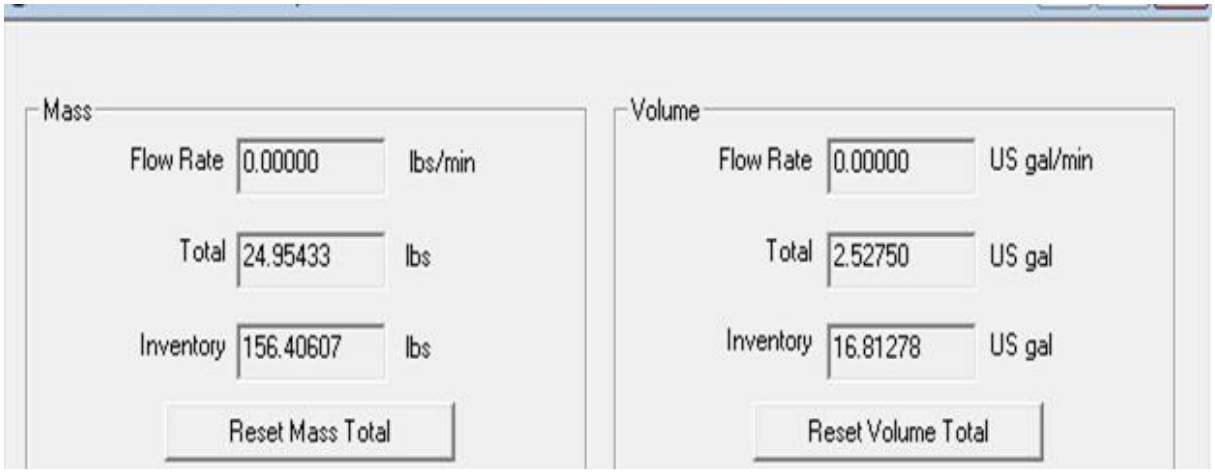
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 15

Project :	Parsons Geotube® P-GDT Test 3
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 9th 2009
Test Tracking Code	Line 13

Comments:

TenCate Fabric Testing O2F
Polymer Ashland 2520

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	108.94	Processed Mass Lbs	23.39	Processed Mass Lbs	13.38	145.71	
Filtrate Lbs	20.60	Filtrate Lbs	12.60	Filtrate Lbs	8.00	41.20	
Tube Mass Retained **M[1]**	88.34	Tube Mass Retained **M[1]**	10.79	Tube Mass Retained **M[1]**	5.38	104.51	
Processed Gallons	11.36	Processed Gallons	2.46	Processed Gallons	1.47	15.29	
Filtrate Gallons	2.47	Filtrate Gallons	1.51	Filtrate Gallons	0.96	4.94	
Tube Gallons Retained	8.89	Tube Gallons Retained	0.95	Tube Gallons Retained	0.51	10.35	
% Dry Solids Raw	12.10	% Dry Solids Raw	12.10	% Dry Solids Raw	12.10		12.10
Dry Solids Retained /1ft³ **M[2]**	13.47	Dry Solids Retained /1ft³ **M[2]**	2.92	Dry Solids Retained /1ft³ **M[2]**	1.74	18.13	
T.S.S.	124.00	T.S.S.	116.00	T.S.S.	70.00		103.33
Ntu's	167.00	Ntu's	155.00	Ntu's	78.00		133.33
pH	11.20	pH	11.00	pH	10.80		11.00
Conductivity mS/cm	4.52	Conductivity mS/cm	4.52	Conductivity mS/cm	4.52		4.52
Salinity ppt	2.30	Salinity ppt	2.30	Salinity ppt	2.30		2.30
Slurry Density lbs/gal *calc*	9.59	Slurry Density lbs/gal *calc*	9.51	Slurry Density lbs/gal *calc*	9.10		9.40
Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	TenCate O2F	Fabric Vendor	TenCate O2F	Fabric Vendor	TenCate O2F		

24/hr Cake Density		10.60
24/hr Cake S.g		1.26
24/hr Cake % Dry Solids		38.10
1ft³ lbs 24hrs Dewatering		64.26
Dry Solids Retained /1ft³ **M[3]**		24.48
1ft³ lbs End of Fill		78.00
Penetrometer RDT Kg/in²		3.40
Penetrometer P-GDT Kg/in²		0.40
RDT T.S.S.		22.00
RDT Ntu's		18.80
RDT Cake % Dry Solids		43.35

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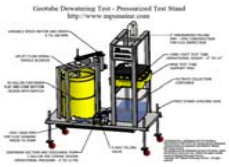

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M[1]

Dry lbs 1ft³ Method 2 M[2]

Dry lbs 1ft³ Method 3 M[3]

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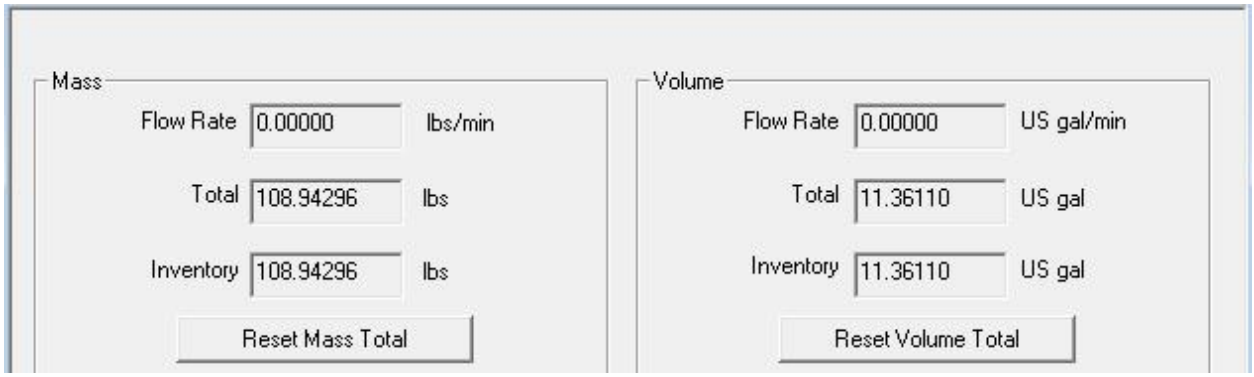
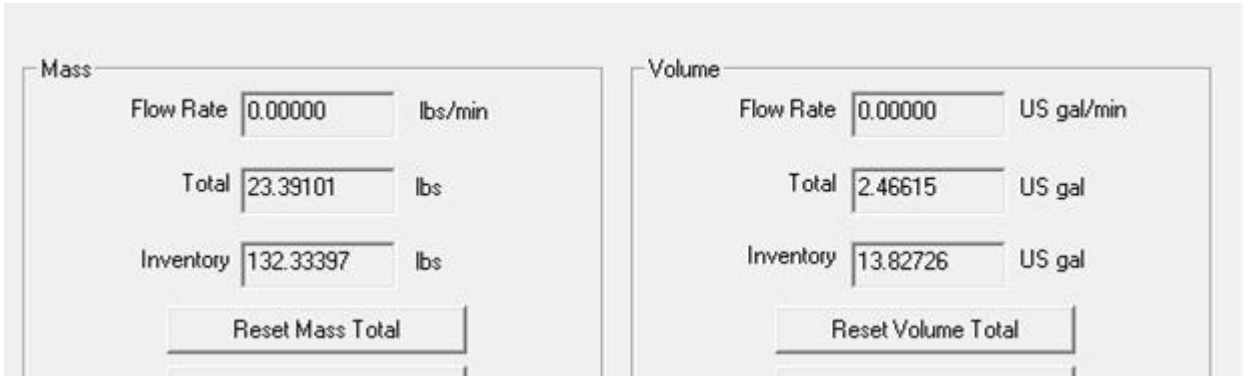
Table 16

Validation of Fill Phases: Test 3, May 9, 2009
Sample: SMU 1b; Fabric: TenCate O2F; Polymer: Ashland 2520

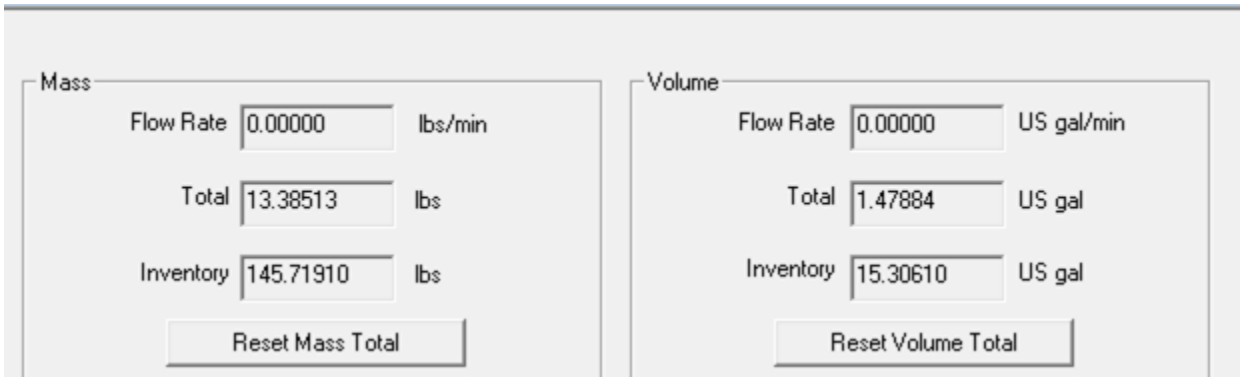
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 17

Project :	Parsons Geotube® P-GDT Test 4
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 11th 2009

Comments:

TenCate Fabric Testing GT500
Polymer Kemira A-100

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	133.01	Processed Mass Lbs	26.45	Processed Mass Lbs	20.37	179.83	
Filtrate Lbs	32.44	Filtrate Lbs	11.44	Filtrate Lbs	12.74	56.62	
Tube Mass Retained **M[1]**	100.57	Tube Mass Retained **M[1]**	15.01	Tube Mass Retained **M[1]**	7.63	123.21	
Processed Gallons	13.88	Processed Gallons	3.06	Processed Gallons	2.40	19.34	
Filtrate Gallons	3.89	Filtrate Gallons	1.37	Filtrate Gallons	1.52	6.78	
Tube Gallons Retained	9.99	Tube Gallons Retained	1.69	Tube Gallons Retained	0.88	12.56	
% Dry Solids Raw	12.50	% Dry Solids Raw	12.50	% Dry Solids Raw	12.50		12.50
Dry Solids Retained /1ft³ **M[2]**	17.35	Dry Solids Retained /1ft³ **M[2]**	3.75	Dry Solids Retained /1ft³ **M[2]**	2.94	24.04	
T.S.S.	30.00	T.S.S.	22.00	T.S.S.	23.00		25.00
Ntu's	31.90	Ntu's	42.00	Ntu's	45.00		39.63
pH	10.70	pH	11.30	pH	11.40		11.13
Conductivity mS/cm	3.07	Conductivity mS/cm	4.47	Conductivity mS/cm	4.82		4.12
Salinity ppt	1.51	Salinity ppt	2.30	Salinity ppt	2.30		2.04
Slurry Density lbs/gal *calc*	9.58	Slurry Density lbs/gal *calc*	8.64	Slurry Density lbs/gal *calc*	8.49		8.90
Slurry Density lbs/gal *metered*	10.00	Slurry Density lbs/gal *metered*	9.80	Slurry Density lbs/gal *metered*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Kemira A-100	Polymer Vendor	Kemira A-100	Polymer Vendor	Kemira K-100		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cakle Density		
24/hr Cakle S.g		
24/hr Cake % Dry Solids		
1ft³ lbs 24hrs Dewatering		
Dry Solids Retained /1ft³ **M[3]**	0.00	
1ft³ lbs End of Fill	81.52	
Penetrometer RDT Kg/in²	0.40	
Penetrometer P-GDT Kg/in²	0.90	
RDT T.S.S.	47.00	
RDT Ntu's	53.00	
RDT Cake % Dry Solids	26.00	

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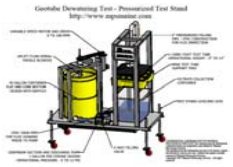

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Color legend:

Wet lbs 1ft³ Method 1	M[1]
Dry lbs 1ft³ Method 2	M[2]
Dry lbs 1ft³ Method 3	M[3]

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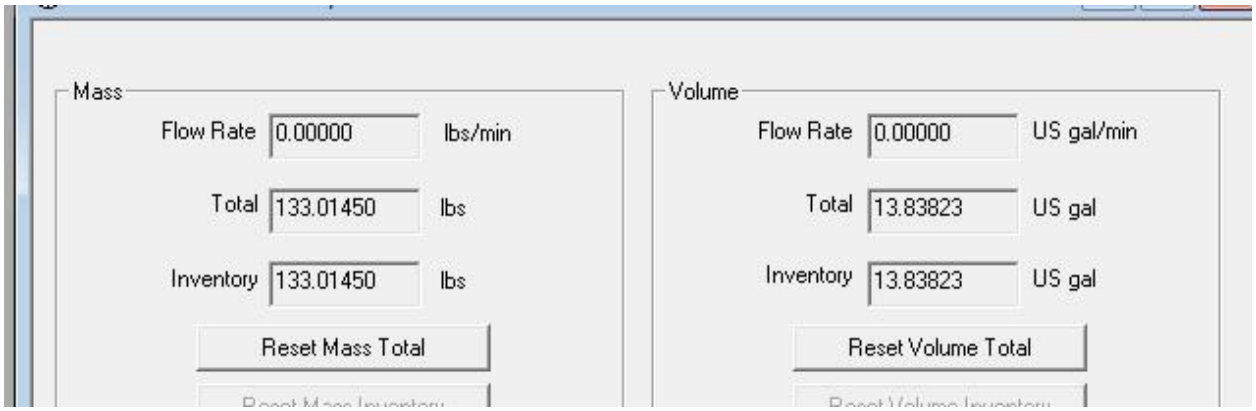
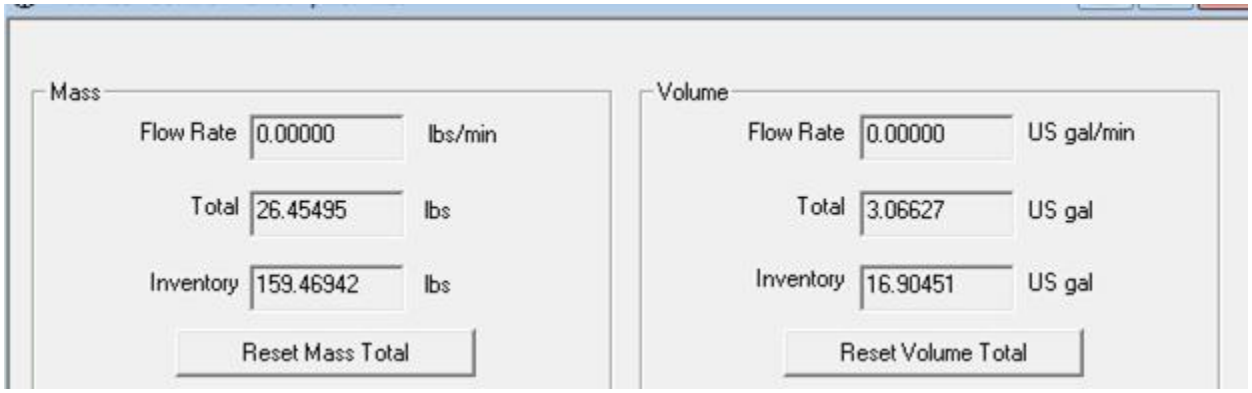
Table 18

Validation of Fill Phases: Test 4, May 11, 2009
Sample: SMU 1b; Fabric: TenCate GT 500; Polymer: Kemira A-100

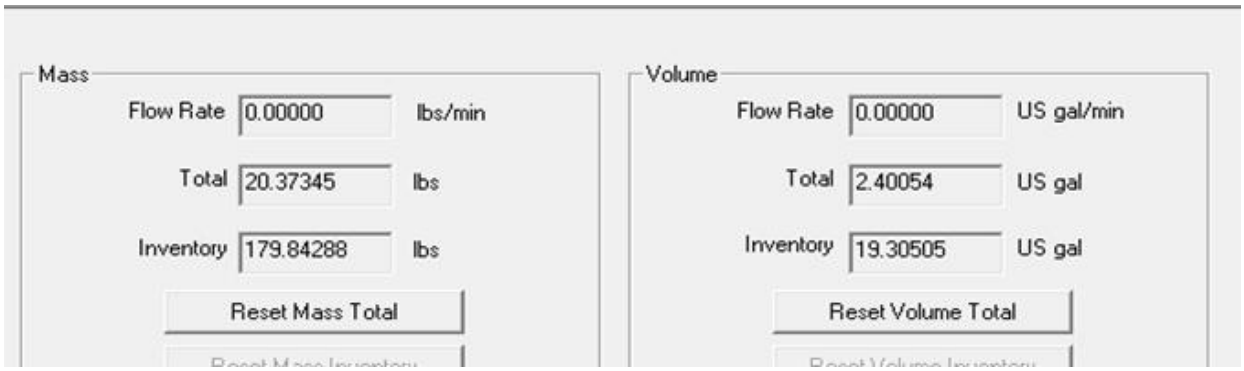
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 19

Project :	Parsons Geotube® P-GDT Test 5
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 12,2009
Test Tracking Code	Line 15

Comments:
TenCate Fabric Testing GT500
Polymer Nalco 7766

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	107.84	Processed Mass Lbs	13.42	Processed Mass Lbs	14.32	135.58	
Filtrate Lbs	21.58	Filtrate Lbs	2.60	Filtrate Lbs	3.60	27.78	
Tube Mass Retained **M[1]**	86.26	Tube Mass Retained **M[1]**	10.82	Tube Mass Retained **M[1]**	10.56	107.64	
Processed Gallons	11.59	Processed Gallons	1.43	Processed Gallons	1.59	14.61	
Filtrate Gallons	2.59	Filtrate Gallons	0.31	Filtrate Gallons	0.43	3.33	
Tube Gallons Retained	9.00	Tube Gallons Retained	1.12	Tube Gallons Retained	1.16	11.28	
% Dry Solids Raw	12.60	% Dry Solids Raw	12.60	% Dry Solids Raw	12.60		12.60
Dry Solids Retained /1ft³ **M[2]**	12.85	Dry Solids Retained /1ft³ **M[2]**	1.59	Dry Solids Retained /1ft³ **M[2]**	1.76	16.20	
T.S.S.	320.00	T.S.S.	312.00	T.S.S.	290.00		307.33
Ntu's	50.70	Ntu's	41.00	Ntu's	38.50		43.40
pH	10.90	pH	10.80	pH	10.70		10.80
Conductivity mS/cm	3.76	Conductivity mS/cm	4.91	Conductivity mS/cm	4.86		4.51
Salinity ppt	1.80	Salinity ppt	2.60	Salinity ppt	2.70		2.37
Slurry Density lbs/gal *calc*	9.30	Slurry Density lbs/gal *calc*	9.38	Slurry Density lbs/gal *calc*	9.01		9.23
Slurry Density lbs/gal *lab scale*	8.80	Slurry Density lbs/gal *lab scale*	8.80	Slurry Density lbs/gal *lab scale*	8.80		
Chemical Dose *Anonic lbs/dt*		Chemical Dose *Anonic lbs/dt*		Chemical Dose *Anonic lbs/dt*			0.00
Chemical Dose *Catoniclbs/dt*	3.81	Chemical Dose *Catonic*	3.81	Chemical Dose *Catonic*	3.81		
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Nalco	Polymer Vendor	Nalco	Polymer Vendor	Nalco		
Fabric Vendor	GT500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density	9.60	
24/hr Cake S.g	1.15	
24/hr Cake % Dry Solids	31.20	
1ft³ lbs 24hrs Dewatering	52.00	
Dry Solids Retained /1ft³ **M[3]**	16.22	
1ft³ lbs End of Fill	72.00	
Penetrometer RDT Kg/in²	1.40	
Penetrometer P-GDT Kg/in²	0.35	
RDT T.S.S.	16.00	
RDT Ntu's	11.50	
RDT Cake % Dry Solids	40.10	

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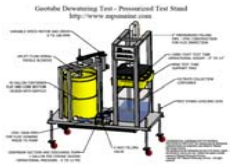

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M[1]

Dry lbs 1ft³ Method 2 M[2]

Dry lbs 1ft³ Method 3 M[3]

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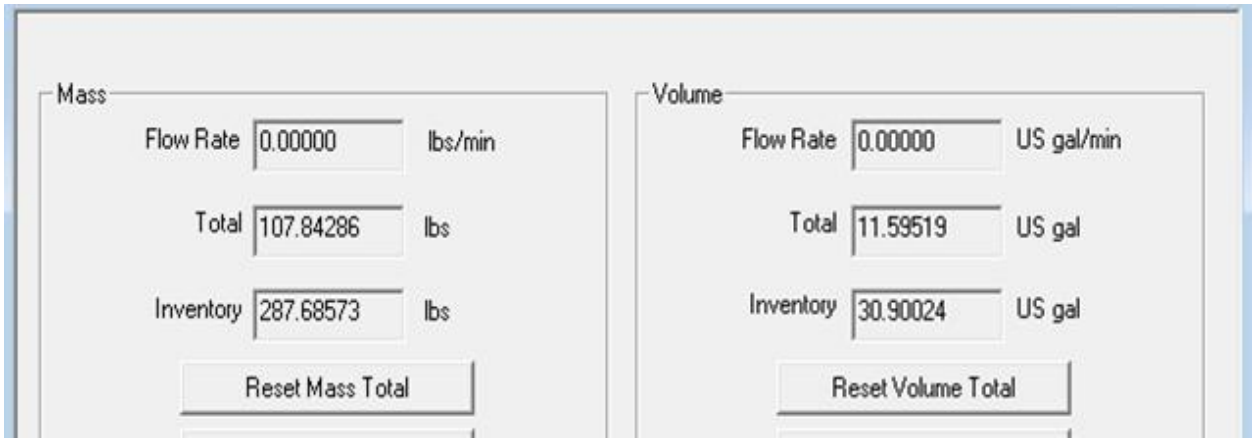
Table 20

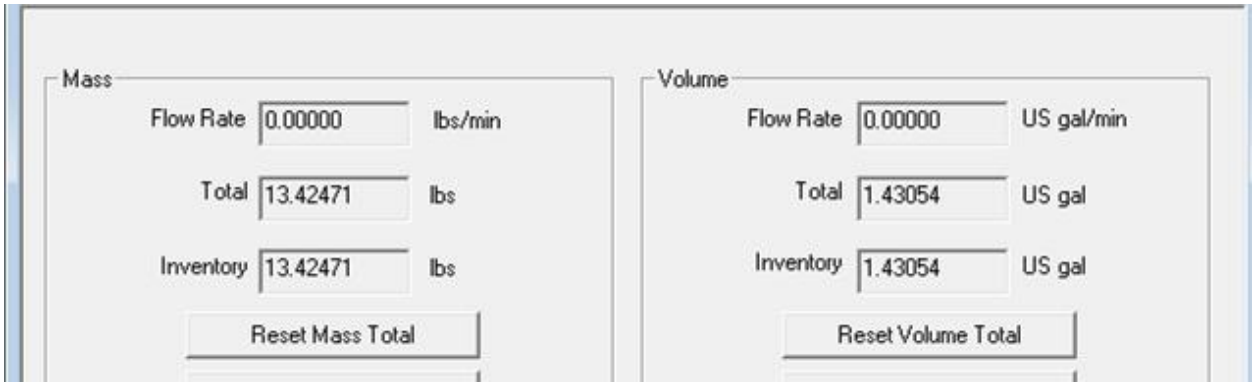
Validation of Fill Phases: Test 5, May 12, 2009
Sample: SMU 1b; Fabric: TenCate GT 500; Polymer: Nalco 7766

Note: Inventory was not cleared on First Void Fill

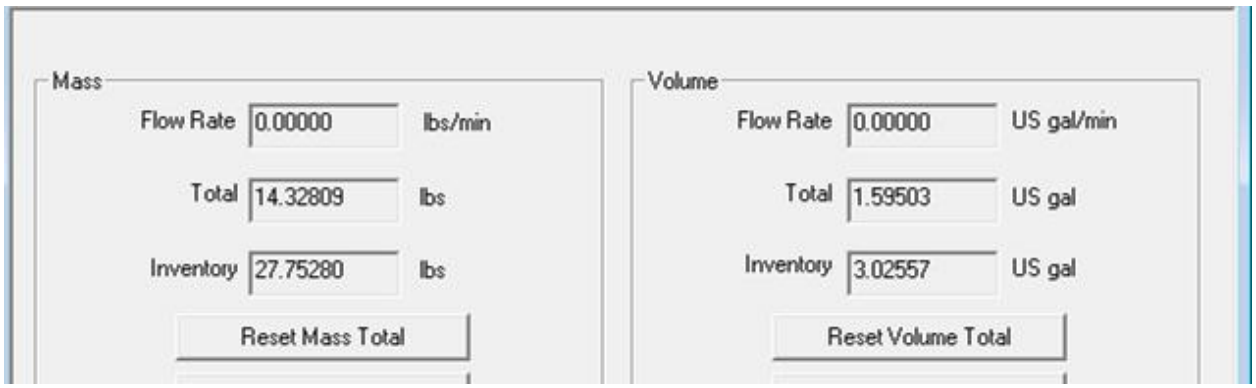
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 21

Project :	Parsons Geotube® P-GDT Test 6
Slurry Type:	SMU 1a
Customer:	Parsons
Date:	May 13th 2009
Test Tracking Code	Line 16

Comments:

TenCate Fabric Testing GT500
Kemira A-100

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	124.68	Processed Mass Lbs	29.82	Processed Mass Lbs	36.80	191.30	
Filtrate Lbs	29.60	Filtrate Lbs	18.00	Filtrate Lbs	28.10	75.70	
Tube Mass Retained **M^1**	95.08	Tube Mass Retained **M^1**	11.82	Tube Mass Retained **M^1**	8.70	115.60	
Processed Gallons	13.32	Processed Gallons	3.52	Processed Gallons	4.22	21.06	
Filtrate Gallons	3.55	Filtrate Gallons	2.16	Filtrate Gallons	3.37	9.08	
Tube Gallons Retained	9.77	Tube Gallons Retained	1.36	Tube Gallons Retained	0.85	11.98	
% Dry Solids Raw	13.90	% Dry Solids Raw	13.90	% Dry Solids Raw	13.90		13.90
Dry Solids Retained /1ft³ **M^2**	17.59	Dry Solids Retained /1ft³ **M^2**	4.65	Dry Solids Retained /1ft³ **M^2**	5.57	27.81	
T.S.S.	49.00	T.S.S.	41.00	T.S.S.	33.00		41.00
Ntu's	57.00	Ntu's	97.00	Ntu's	20.00		58.00
pH	10.00	pH	9.80	pH	10.00		9.93
Conductivity mS/cm	4.38	Conductivity mS/cm	5.38	Conductivity mS/cm	5.76		5.17
Salinity ppt	2.30	Salinity ppt	2.90	Salinity ppt	2.90		2.70
Slurry Density lbs/gal *calc*	9.36	Slurry Density lbs/gal *calc*	8.47	Slurry Density lbs/gal *calc*	8.72		8.85
Slurry Density lbs/gal *lab scale*	9.50	Slurry Density lbs/gal *lab scale*	9.50	Slurry Density lbs/gal *lab scale*	9.50		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Kemira	Polymer Vendor	Kemira	Polymer Vendor	Kemira		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density	10.60	
24/hr Cake S.g	1.26	
24/hr Cake % Dry Solids	39.60	
1ft³ lbs 24hrs Dewatering	62.00	
Dry Solids Retained /1ft³ **M^3**	24.55	
1ft³ lbs End of Fill	67.00	
Penetrometer RDT Kg/in²	1.60	
Penetrometer P-GDT Kg/in²	0.80	
RDT T.S.S.	10.00	
RDT Ntu's	6.60	
RDT Cake % Dry Solids	39.45	

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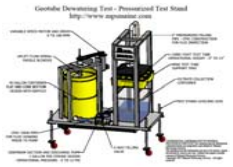

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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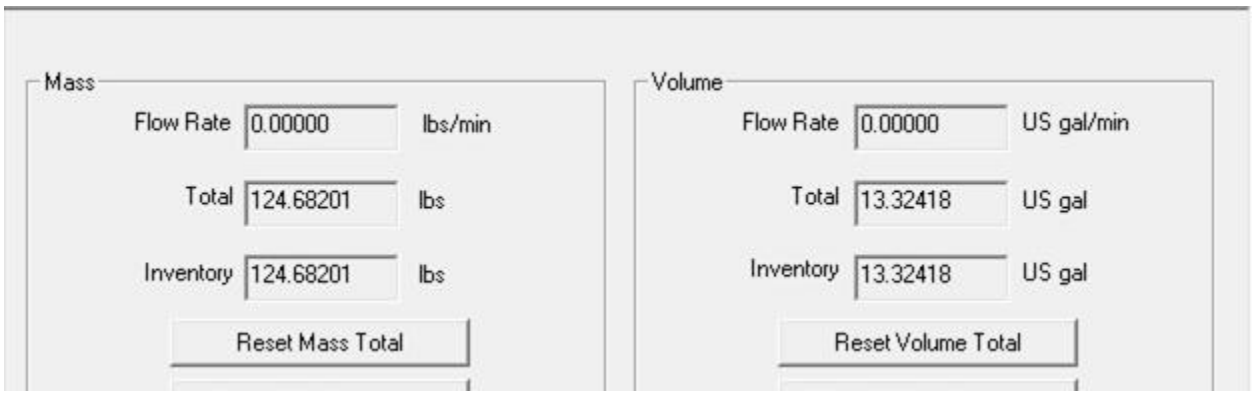
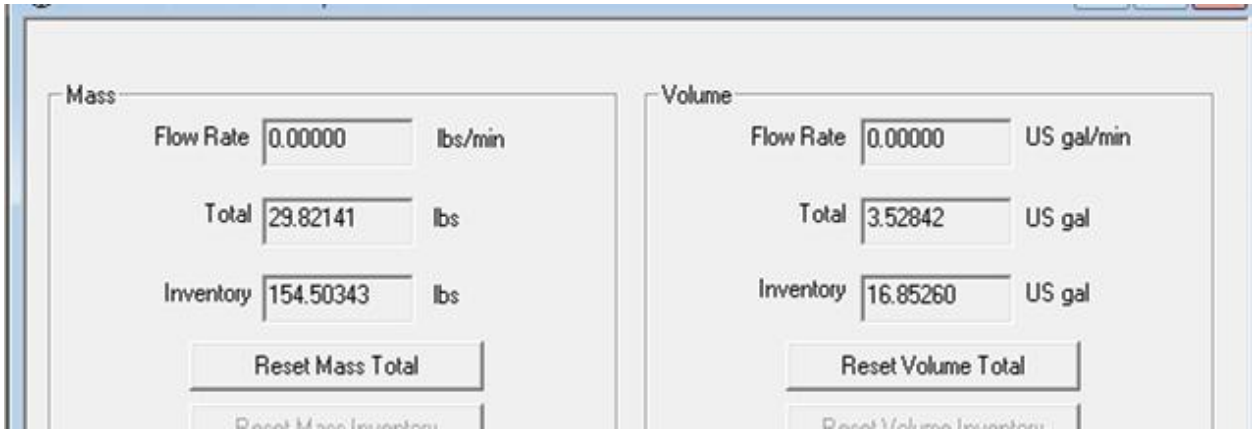
Table 22

Validation of Fill Phases: Test 6, May 13, 2009
Sample: SMU 1a; Fabric: TenCate GT 500; Polymer: Kemira A-100

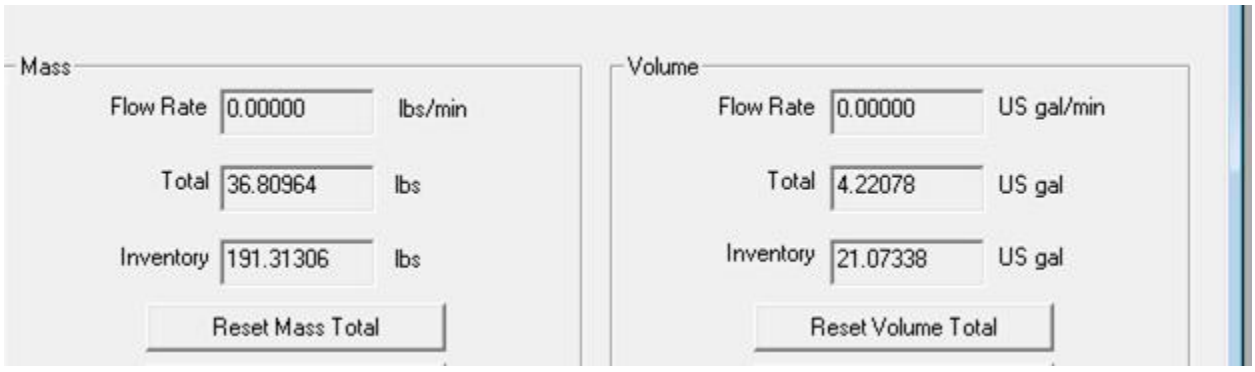
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 23

Project :	Parsons Geotube® P-GDT Test 7
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 13th 2009
Test Tracking Code	Line 16

Comments:

TenCate Fabric Testing GT500
Polymer Ashland 2520
Thicken

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	109.00	Processed Mass Lbs	11.74	Processed Mass Lbs	4.06	124.80	
Filtrate Lbs	12.00	Filtrate Lbs	7.10	Filtrate Lbs	3.10	22.20	
Tube Mass Retained **M^1**	97.00	Tube Mass Retained **M^1**	4.64	Tube Mass Retained **M^1**	0.96	102.60	
Processed Gallons	11.44	Processed Gallons	1.22	Processed Gallons	0.42	13.08	
Filtrate Gallons	1.44	Filtrate Gallons	0.85	Filtrate Gallons	0.37	2.66	
Tube Gallons Retained	10.00	Tube Gallons Retained	0.37	Tube Gallons Retained	0.05	10.42	
% Dry Solids Raw	26.60	% Dry Solids Raw	26.60	% Dry Solids Raw	26.60		26.60
Dry Solids Retained /1ft³ **M^2**	30.43	Dry Solids Retained /1ft³ **M^2**	3.25	Dry Solids Retained /1ft³ **M^2**	1.12	34.79	
T.S.S.	42.80	T.S.S.	65.00	T.S.S.	50.00		52.60
Ntu's	77.60	Ntu's	89.00	Ntu's	76.00		80.87
pH	11.20	pH	11.20	pH	10.80		11.07
Conductivity mS/cm	4.47	Conductivity mS/cm	6.67	Conductivity mS/cm	6.45		5.86
Salinity ppt	2.30	Salinity ppt	3.50	Salinity ppt	3.10		2.97
Slurry Density lbs/gal *calc*	9.53	Slurry Density lbs/gal *calc*	9.62	Slurry Density lbs/gal *calc*	9.67		9.61
Slurry Density lbs/gal *lab scale*	10.00	Slurry Density lbs/gal *lab scale*	10.00	Slurry Density lbs/gal *lab scale*	10.00		
Chemical Dose *Anonic lbs/dt*	1.56	Chemical Dose *Anonic lbs/dt*	1.56	Chemical Dose *Anonic lbs/dt*	1.59		1.57
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density		10.60
24/hr Cake S.g		1.27
24/hr Cake % Dry Solids		40.80
1ft³ lbs 24hrs Dewatering		62.50
Dry Solids Retained /1ft³ **M^3**		25.50
1ft³ lbs End of Fill		80.76
Penetrometer RDT Kg/in²		3.70
Penetrometer P-GDT Kg/in²		0.90
RDT T.S.S.		25.00
RDT Ntu's		18.00
RDT Cake % Dry Solids		46.20

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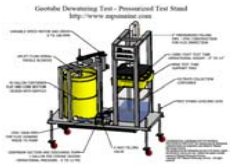

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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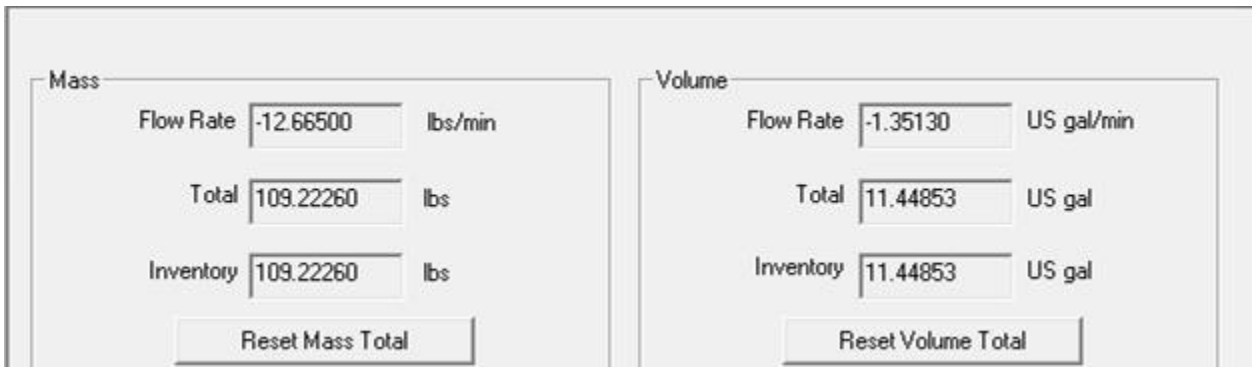
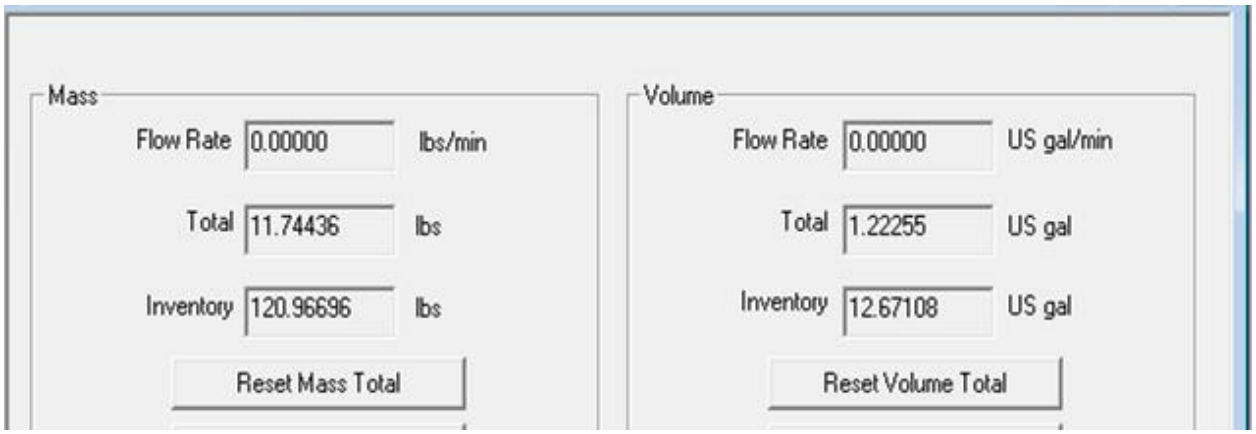
Table 24

Validation of Fill Phases: Test 7, May 13, 2009
Sample: SMU 1b, thickened 26.6% d.s.; Fabric: TenCate GT 500; Polymer: Ashland 2520

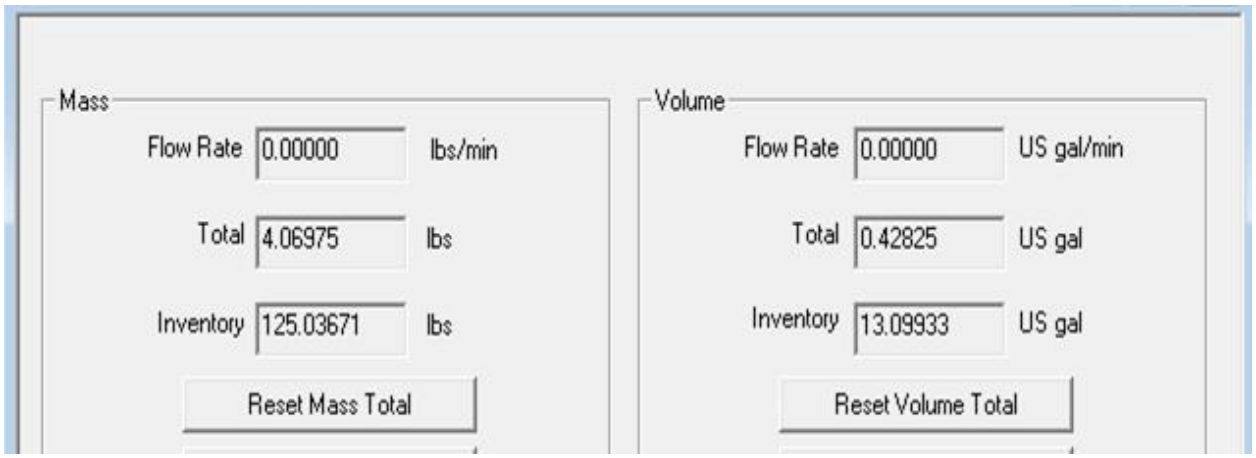
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 25

Project :	Parsons Geotube® P-GDT Test 8
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 13th 2009
Test Tracking Code	Line 18

Comments:

TenCate Fabric Testing GT500
Polymer Kemira A-100
Thicken

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	125.03	Processed Mass Lbs	11.51	Processed Mass Lbs	14.20	150.74	
Filtrate Lbs	13.40	Filtrate Lbs	6.70	Filtrate Lbs	5.98	26.08	
Tube Mass Retained **M[1]**	111.63	Tube Mass Retained **M[1]**	4.81	Tube Mass Retained **M[1]**	8.22	124.66	
Processed Gallons	13.09	Processed Gallons	1.20	Processed Gallons	1.53	15.82	
Filtrate Gallons	1.61	Filtrate Gallons	0.80	Filtrate Gallons	0.72	3.13	
Tube Gallons Retained	11.48	Tube Gallons Retained	0.40	Tube Gallons Retained	0.81	12.69	
% Dry Solids Raw	26.60	% Dry Solids Raw	26.60	% Dry Solids Raw	26.60		26.60
Dry Solids Retained /1ft³ **M[2]**	34.82	Dry Solids Retained /1ft³ **M[2]**	3.13	Dry Solids Retained /1ft³ **M[2]**	3.99	41.94	
T.S.S.	29.00	T.S.S.	34.00	T.S.S.	24.00		29.00
Ntu's	35.00	Ntu's	23.00	Ntu's	45.00		34.33
pH	10.90	pH	10.90	pH	10.80		10.87
Conductivity mS/cm	5.87	Conductivity mS/cm	5.76	Conductivity mS/cm	5.76		5.80
Salinity ppt	3.10	Salinity ppt	3.70	Salinity ppt	2.70		3.17
Slurry Density lbs/gal *calc*	9.55	Slurry Density lbs/gal *calc*	9.59	Slurry Density lbs/gal *calc*	9.28		9.47
Slurry Density lbs/gal *lab scale*	10.00	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Kemira	Polymer Vendor	Kemira	Polymer Vendor	Kemira		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density	10.40	
24/hr Cake S.g	1.25	
24/hr Cake % Dry Solids	41.30	
1ft³ lbs 24hrs Dewatering	67.50	
Dry Solids Retained /1ft³ **M[3]**	27.88	
1ft³ lbs End of Fill	81.80	
Penetrometer RDT Kg/in²	3.70	
Penetrometer P-GDT Kg/in²	0.90	
RDT T.S.S.	24.00	
RDT Ntu's	19.00	
RDT Cake % Dry Solids	44.80	

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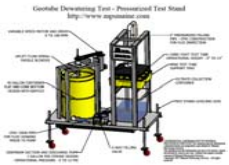

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M[1]

Dry lbs 1ft³ Method 2 M[2]

Dry lbs 1ft³ Method 3 M[3]

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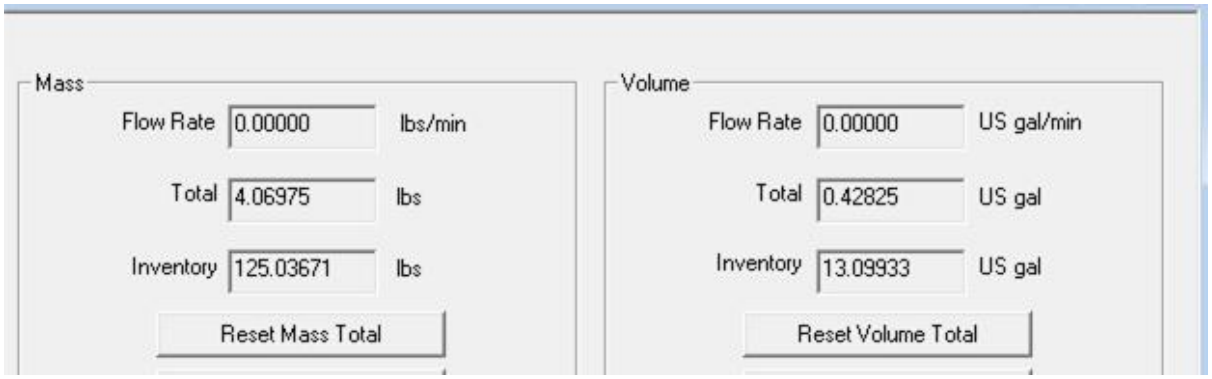
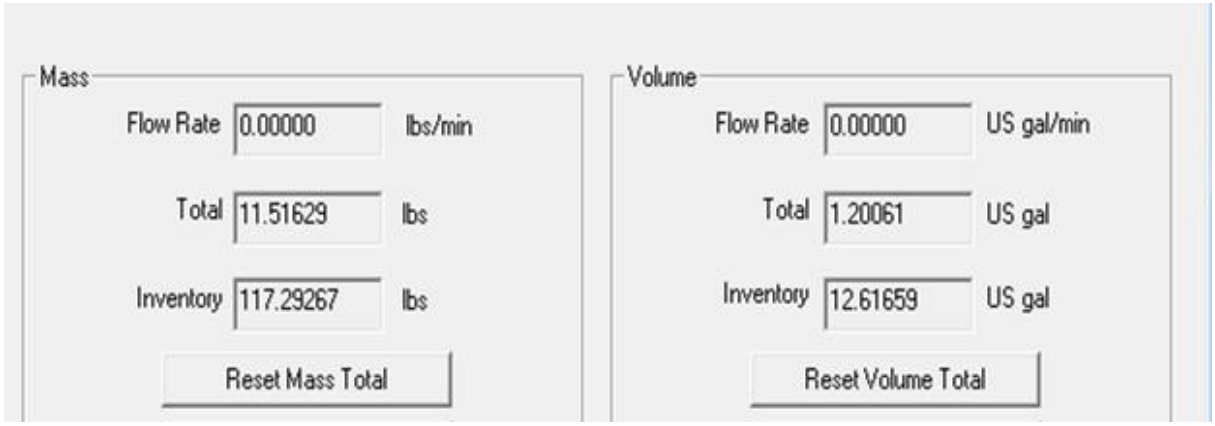
Table 26

Validation of Fill Phases: Test 8, May 13, 2009
Sample: SMU 1b, thickened; Fabric: TenCate GT 500; Polymer: Kemira A-100

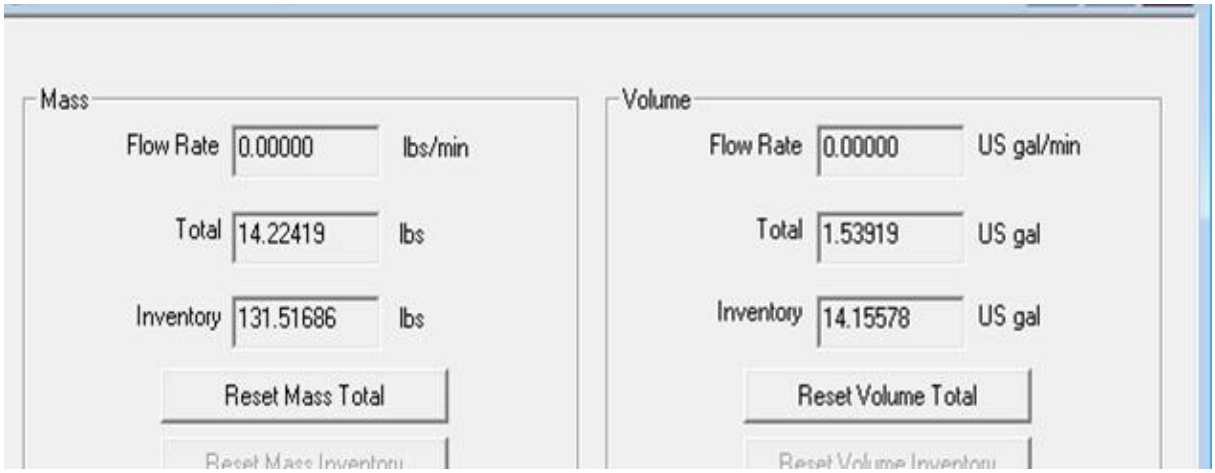
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 27

Project :	Parsons Geotube® P-GDT Test 9
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 14th 2009
Test Tracking Code	Line 00

Comments:

TenCate Fabric Testing GT500
Polymer Kemira A-100

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	110.48	Processed Mass Lbs	30.22	Processed Mass Lbs	32.85	173.55	
Filtrate Lbs	15.96	Filtrate Lbs	13.52	Filtrate Lbs	10.47	39.95	
Tube Mass Retained **M^1**	94.52	Tube Mass Retained **M^1**	16.70	Tube Mass Retained **M^1**	22.38	133.60	
Processed Gallons	11.60	Processed Gallons	3.33	Processed Gallons	3.89	18.82	
Filtrate Gallons	1.91	Filtrate Gallons	1.62	Filtrate Gallons	1.26	4.79	
Tube Gallons Retained	9.69	Tube Gallons Retained	1.71	Tube Gallons Retained	2.63	14.03	
% Dry Solids Raw	12.60	% Dry Solids Raw	12.60	% Dry Solids Raw	12.60		12.60
Dry Solids Retained /1ft³ **M^2**	14.32	Dry Solids Retained /1ft³ **M^2**	4.11	Dry Solids Retained /1ft³ **M^2**	4.80	23.24	
T.S.S.	195.00	T.S.S.	31.00	T.S.S.	23.00		83.00
Ntu's	246.00	Ntu's	22.80	Ntu's	20.30		96.37
pH	10.40	pH	10.90	pH	10.80		10.70
Conductivity mS/cm	3.73	Conductivity mS/cm	4.75	Conductivity mS/cm	5.76		4.75
Salinity ppt	3.10	Salinity ppt	2.40	Salinity ppt	2.60		2.70
Slurry Density lbs/gal *calc*	9.52	Slurry Density lbs/gal *calc*	9.08	Slurry Density lbs/gal *calc*	8.44		9.01
Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Kemira	Polymer Vendor	Kemira	Polymer Vendor	Kemira		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density	0.00	
24/hr Cake S.g	0.00	
24/hr Cake % Dry Solids	37.90	
1ft³ lbs 24hrs Dewatering	53.56	
Dry Solids Retained /1ft³ **M^3**	20.30	
1ft³ lbs End of Fill	72.46	
Penetrometer RDT Kg/in²	ND	
Penetrometer P-GDT Kg/in²	0.50	
RDT T.S.S.	ND	
RDT Ntu's	ND	
RDT Cake % Dry Solids	ND	

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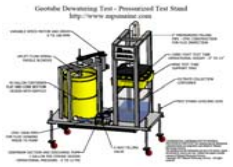

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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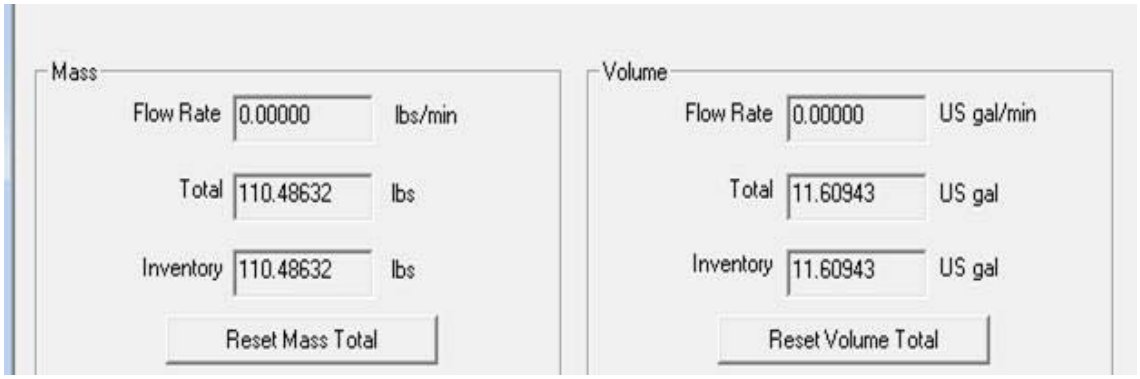
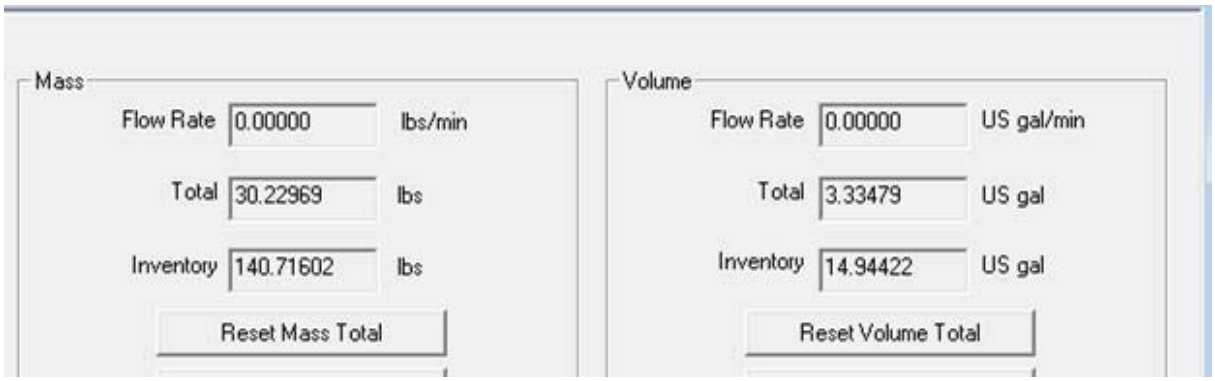
Table 28

Validation of Fill Phases: Test 9 (Redo Test 4), May 14, 2009
Sample: SMU 1b, thickened; Fabric: TenCate GT 500; Polymer: Kemira A-100

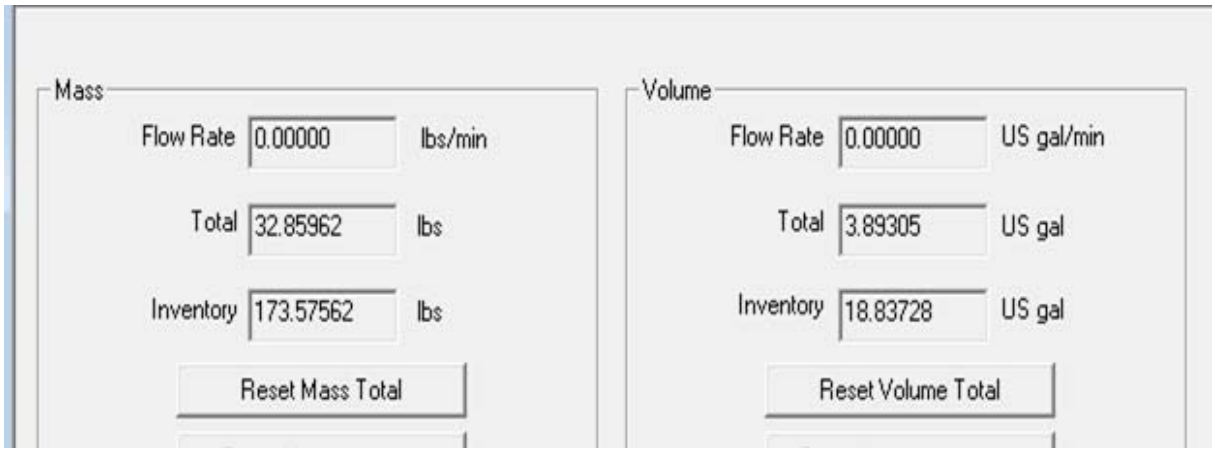
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 29

Project :	Parsons Geotube® P-GDT Test 10	**Comments:**
Slurry Type:	SMU 1b	TenCate Fabric Testing GT500
Customer:	Parsons	Polymer Ashland 25 20
Date:	May 14th 2009	Redo Test 1
Test Tracking Code	0	

1st Void Fill Phase		**2nd Void Fill Phase**		**3rd Void Fill Phase**		Values Totals **1st Fill Phase**	Values Avg
Processed Mass Lbs	117.55	Processed Mass Lbs	23.60	Processed Mass Lbs	22.09	163.24	
Filtrate Lbs	17.00	Filtrate Lbs	11.40	Filtrate Lbs	13.72	42.12	
Tube Mass Retained **M^1**	100.55	Tube Mass Retained **M^1**	12.20	Tube Mass Retained **M^1**	8.37	121.12	
Processed Gallons	12.27	Processed Gallons	2.61	Processed Gallons	2.46	17.34	
Filtrate Gallons	2.04	Filtrate Gallons	1.37	Filtrate Gallons	1.65	5.05	
Tube Gallons Retained	10.23	Tube Gallons Retained	1.24	Tube Gallons Retained	0.81	12.29	
% Dry Solids Raw	12.60	% Dry Solids Raw	12.60	% Dry Solids Raw	12.60		12.60
Dry Solids Retained /1ft³ **M^2**	14.22	Dry Solids Retained /1ft³ **M^2**	3.03	Dry Solids Retained /1ft³ **M^2**	2.85	20.10	
T.S.S.	83.00	T.S.S.	82.00	T.S.S.	71.00		78.67
Ntu's	77.00	Ntu's	67.00	Ntu's	58.00		67.33
pH	10.90	pH	10.80	pH	11.00		10.90
Conductivity mS/cm	4.09	Conductivity mS/cm	5.27	Conductivity mS/cm	5.55		4.97
Salinity ppt	2.10	Salinity ppt	2.60	Salinity ppt	2.90		2.53
Slurry Density lbs/gal *calc*	9.58	Slurry Density lbs/gal *calc*	9.04	Slurry Density lbs/gal *calc*	8.98		9.20
Slurry Density lbs/gal *lab scale*	9.20	Slurry Density lbs/gal *lab scale*	9.20	Slurry Density lbs/gal *lab scale*	9.20		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density		10.80
24/hr Cake S.g		1.29
24/hr Cake % Dry Solids		41.30
1ft³ lbs 24hrs Dewatering		72.90
Dry Solids Retained /1ft³ **M^3**		30.11
1ft³ lbs End of Fill		79.72
Penetrometer RDT Kg/in²		ND
Penetrometer P-GDT Kg/in²		0.40
RDT T.S.S.		ND
RDT Ntu's		ND
RDT Cake % Dry Solids		ND

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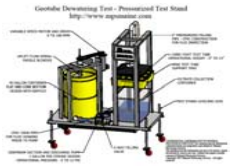

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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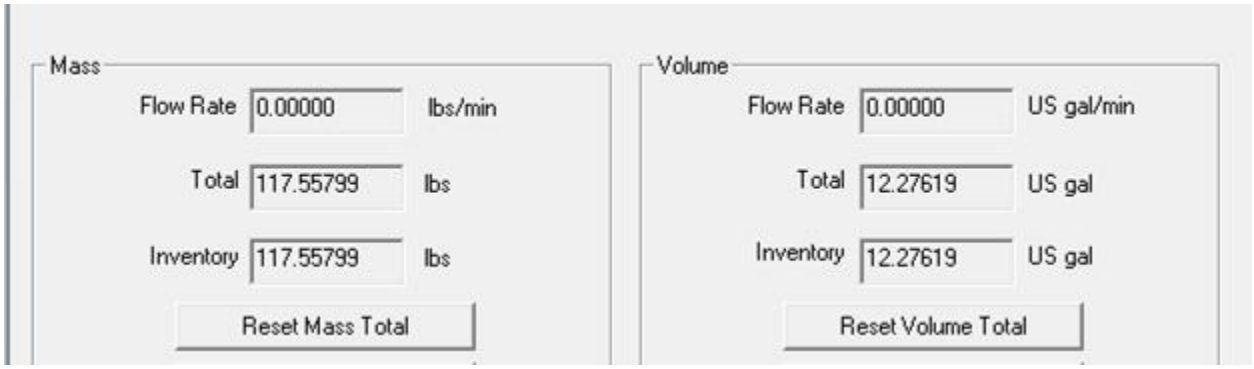
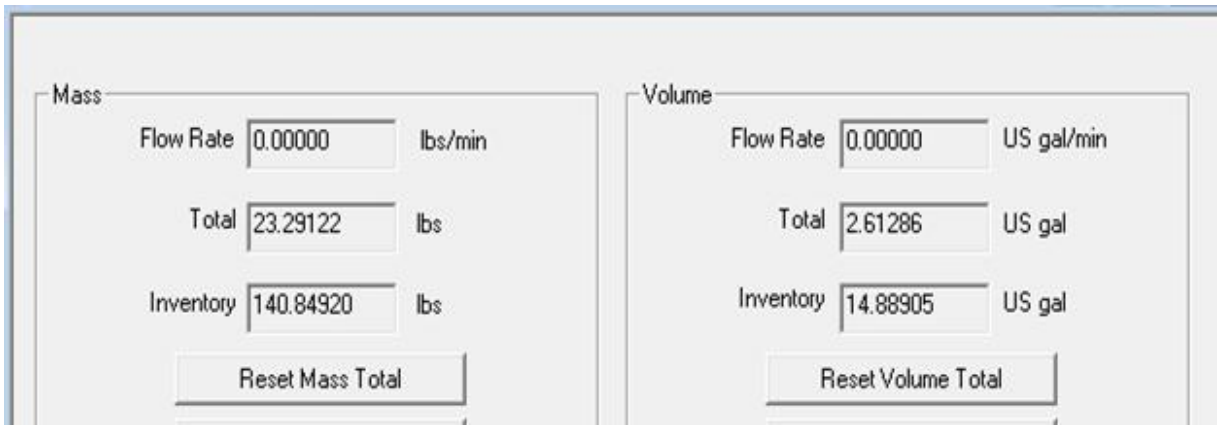
Table 30

Validation of Fill Phases: Test 10, May 14, 2009
Sample: SMU 1b; Fabric: TenCate GT 500; Polymer: Ashland 2520

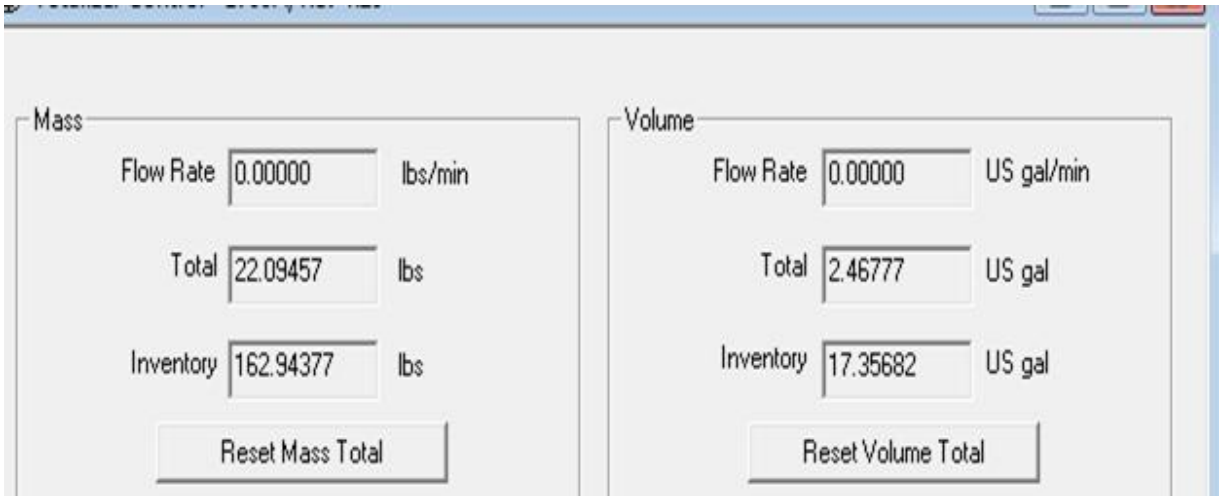
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 31

Project :	Parsons Geotube® P-GDT Test 11
Slurry Type:	SMU 1b
Customer:	Parsons
Date:	May 15th,2009
Test Tracking Code	Line 11

Comments:

TenCate Fabric Testing GT500
Polymer Ashland 2520
Polymer Doage .99lbs/D.T.

1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
Processed Mass Lbs	101.09	Processed Mass Lbs	32.70	Processed Mass Lbs	9.80	143.59	
Filtrate Lbs	17.00	Filtrate Lbs	11.40	Filtrate Lbs	6.02	34.42	
Tube Mass Retained **M^1**	84.09	Tube Mass Retained **M^1**	21.30	Tube Mass Retained **M^1**	3.78	109.17	
Processed Gallons	10.96	Processed Gallons	3.56	Processed Gallons	1.00	15.52	
Filtrate Gallons	2.04	Filtrate Gallons	1.37	Filtrate Gallons	0.72	4.13	
Tube Gallons Retained	8.92	Tube Gallons Retained	2.19	Tube Gallons Retained	0.28	11.39	
% Dry Solids Raw	16.50	% Dry Solids Raw	16.50	% Dry Solids Raw	16.50		16.50
Dry Solids Retained /1ft³ **M^2**	17.72	Dry Solids Retained /1ft³ **M^2**	5.76	Dry Solids Retained /1ft³ **M^2**	1.62	25.10	
T.S.S.	989.00	T.S.S.	620.00	T.S.S.	500.00		703.00
Ntu's	380.00	Ntu's	310.00	Ntu's	355.00		348.33
pH	11.10	pH	10.90	pH	10.60		10.87
Conductivity mS/cm	4.92	Conductivity mS/cm	6.01	Conductivity mS/cm	5.76		5.56
Salinity ppt	2.60	Salinity ppt	3.10	Salinity ppt	3.10		2.93
Slurry Density lbs/gal *calc*	9.22	Slurry Density lbs/gal *calc*	9.19	Slurry Density lbs/gal *calc*	9.80		9.40
Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	0.99	Chemical Dose *Anonic lbs/dt*	0.99	Chemical Dose *Anonic lbs/dt*	0.99		0.99
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Agent*		Chemical Dose *Agent*		Chemical Dose *Agent*			
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density	10.20	
24/hr Cake S.g	1.22	
24/hr Cake % Dry Solids	32.30	
1ft³ lbs 24hrs Dewatering	63.58	
Dry Solids Retained /1ft³ **M^3**	20.54	
1ft³ lbs End of Fill	79.72	
Penetrometer RDT Kg/in²	2.60	
Penetrometer P-GDT Kg/in²	0.30	
RDT T.S.S.	11.00	
RDT Ntu's	12.50	
RDT Cake % Dry Solids	43.13	

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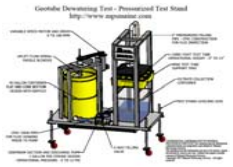

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Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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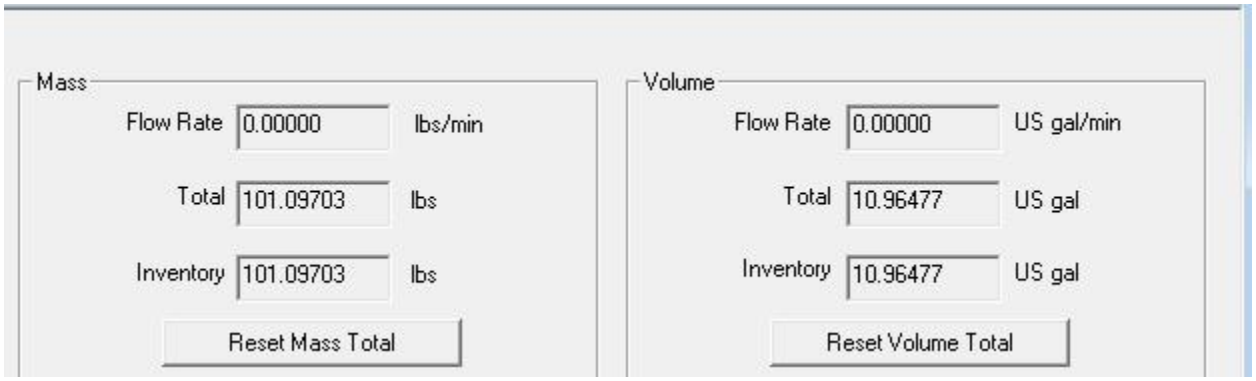
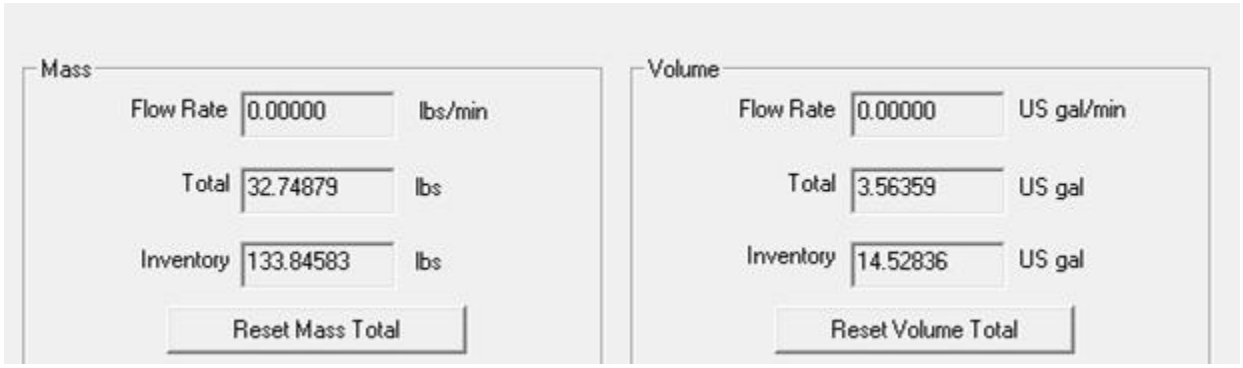
Table 32

Validation of Fill Phases: Test 11, May 15, 2009
Sample: SMU 1b; Fabric: TenCate GT 500; Polymer: Ashland 2520; Polymer Dosage .99lbs/D.T.

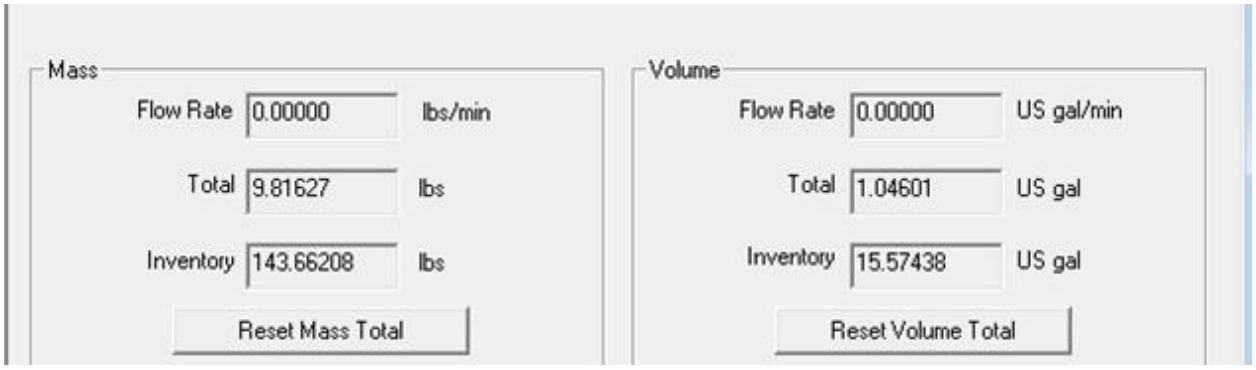
First Void Fill



Second Void Fill



Third Void Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

Table 33

Project :	Parsons Geotube® P-GDT Test 12
Slurry Type:	SMU 6 Brown (60098)
Customer:	Parsons
Date:	Aug-09
Test Tracking Code	Line 00

Comments:

TenCate Fabric Testing GT500
Polymer Ashland 2520 / Coag 492
Data Acquisition Lost Power Re-Test

	1st Void Fill Phase		2nd Void Fill Phase		3rd Void Fill Phase		Values Totals 1st Fill Phase	Values Avg
9	Processed Mass Lbs	125.45	Processed Mass Lbs	37.95	Processed Mass Lbs	67.29	230.69	
10	Filtrate Lbs	38.00	Filtrate Lbs	20.10	Filtrate Lbs	26.50	84.60	
11	Tube Mass Retained **M[1]**	87.45	Tube Mass Retained **M[1]**	17.85	Tube Mass Retained **M[1]**	40.79	146.09	
12	Processed Gallons	12.52	Processed Gallons	4.42	Processed Gallons	7.90	24.84	
13	Filtrate Gallons	4.56	Filtrate Gallons	2.41	Filtrate Gallons	3.18	10.14	
14	Tube Gallons Retained	7.96	Tube Gallons Retained	2.01	Tube Gallons Retained	4.72	14.70	
15	% Dry Solids Raw	10.50	% Dry Solids Raw	10.50	% Dry Solids Raw	10.50		10.50
16	Dry Solids Retained /1ft³ **M[2]**	12.36	Dry Solids Retained /1ft³ **M[2]**	4.36	Dry Solids Retained /1ft³ **M[2]**	7.80	24.52	
17	T.S.S.	20.00	T.S.S.	16.00	T.S.S.	11.00		15.67
18	Ntu's	11.20	Ntu's	9.80	Ntu's	6.70		9.23
19	pH	7.70	pH	7.80	pH	7.70		7.73
20	Conductivity mS/cm	5.84	Conductivity mS/cm	5.84	Conductivity mS/cm	5.84		5.84
21	Salinity ppt	2.90	Salinity ppt	2.90	Salinity ppt	2.90		2.90
22	Slurry Density lbs/gal *calc*	10.02	Slurry Density lbs/gal *calc*	8.59	Slurry Density lbs/gal *calc*	8.39		9.00
23	Slurry Density lbs/gal *lab scale*	9.40	Slurry Density lbs/gal *lab scale*	9.40	Slurry Density lbs/gal *lab scale*	9.40		
24	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
25	Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
26	Chemical Dose *Agent Coag*	5.17	Chemical Dose *Agent Coag*	5.17	Chemical Dose *Agent Coag*	5.17		
27	Odor Level		Odor Level		Odor Level			
28	Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
29	Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		
30					24/hr Cake Density		10.20	
31					24/hr Cake S.g		1.22	
32					24/hr Cake % Dry Solids		33.80	
33					1ft³ lbs 24hrs Dewatering		72.46	
34					Dry Solids Retained /1ft³ **M[3]**		24.49	
35	**Color legend:**				1ft³ lbs End of Fill		79.58	
36	Wet lbs P-GDT test tube 1ft³ Method 1 M[1]				Penetrometer RDT Kg/in²		4.92	
37	Dry lbs 1ft³ Method 2 M[2]				Penetrometer P-GDT Kg/in²		5.90	
38	Dry lbs 1ft³ Method 3 M[3]				RDT T.S.S.		33.00	
39					RDT Ntu's		28.10	
40					RDT Cake % Dry Solids		53.50	
41								
42								

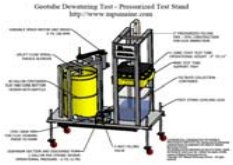


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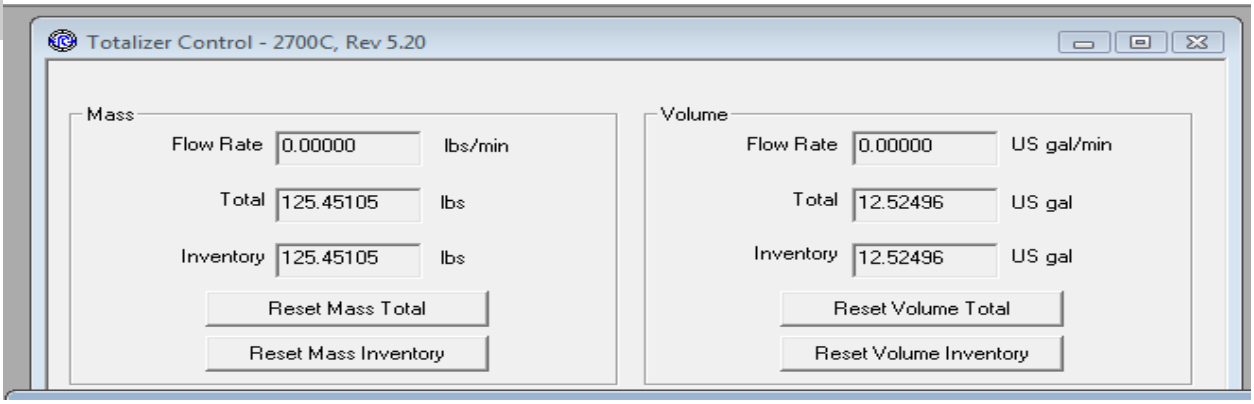
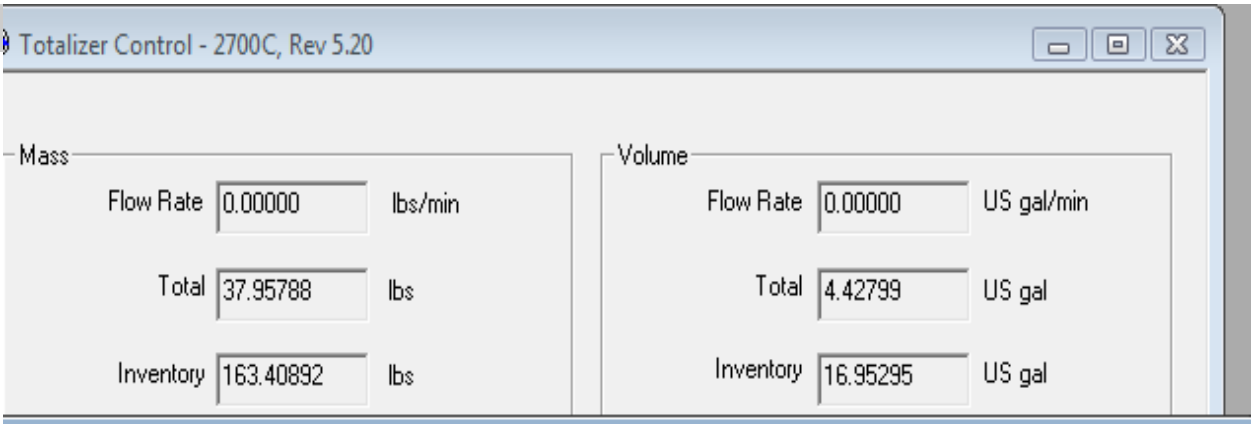
TABLE 34 Rev 1
Test 12
SMU 6 Brown
Polymer Ashland 2520 / 1.59 lbs/DT
Coag Ashland 492 5.17 lbs/DT
Non-screened
GT500 Filter Cloth

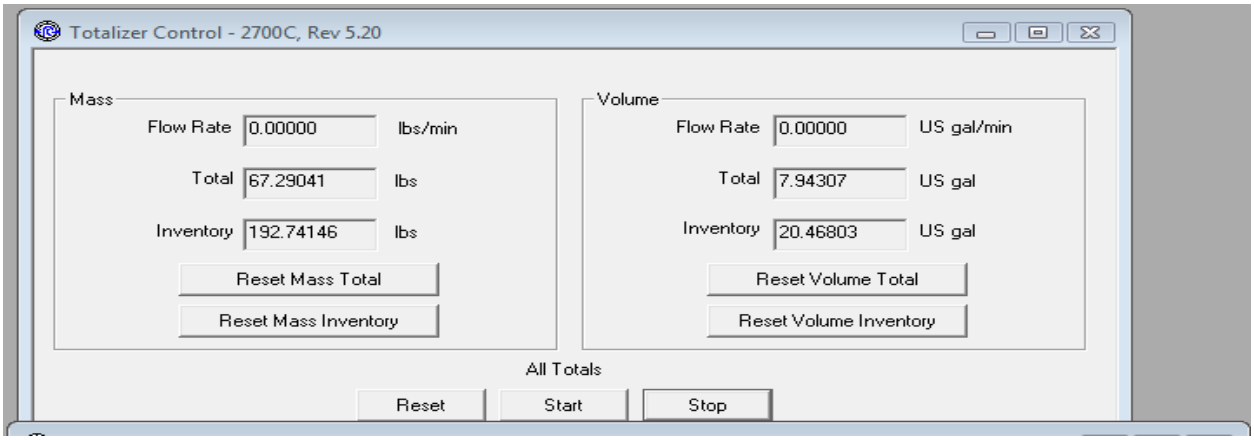
1st Void Fill



2ndVoid Fill



3rdVoid Fill



P-GDT TEST

Pressurized Gravity Dewatering Test

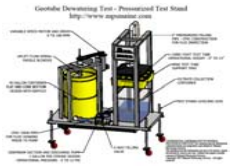
Table 35

Project :	Parsons Geotube® P-GDT Test 13	**Comments:**
Slurry Type:	SMU 6 Black (60100)	TenCate Fabric Testing GT500
Customer:	Parsons	Polymer Ashland 2520
Date:	May 16th 2009	Coag 492
Test Tracking Code	Line 00	

1st Void Fill Phase		**2nd Void Fill Phase**		**3rd Void Fill Phase**		Values Totals **1st Fill Phase**	Values Avg
Processed Mass Lbs	124.39	Processed Mass Lbs	96.57	Processed Mass Lbs	106.00	326.96	
Filtrate Lbs	36.12	Filtrate Lbs	19.76	Filtrate Lbs	19.58	75.46	
Tube Mass Retained **M^1**	88.27	Tube Mass Retained **M^1**	76.81	Tube Mass Retained **M^1**	86.42	251.50	
Processed Gallons	12.18	Processed Gallons	8.23	Processed Gallons	11.30	31.71	
Filtrate Gallons	4.33	Filtrate Gallons	2.37	Filtrate Gallons	2.35	9.05	
Tube Gallons Retained	7.85	Tube Gallons Retained	5.86	Tube Gallons Retained	8.95	22.66	
% Dry Solids Raw	16.20	% Dry Solids Raw	16.20	% Dry Solids Raw	16.20		16.20
Dry Solids Retained /1ft³ **M^2**	19.34	Dry Solids Retained /1ft³ **M^2**	13.07	Dry Solids Retained /1ft³ **M^2**	17.94	50.34	
T.S.S.	100.00	T.S.S.	56.00	T.S.S.	59.00		71.67
Ntu's	86.00	Ntu's	48.00	Ntu's	50.10		61.37
pH	9.40	pH	8.20	pH	7.90		8.50
Conductivity mS/cm	3.57	Conductivity mS/cm	3.85	Conductivity mS/cm	3.27		3.56
Salinity ppt	1.70	Salinity ppt	2.00	Salinity ppt	2.01		1.90
Slurry Density lbs/gal *calc*	10.21	Slurry Density lbs/gal *calc*	11.73	Slurry Density lbs/gal *calc*	9.38		10.44
Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80	Slurry Density lbs/gal *lab scale*	9.80		
Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59	Chemical Dose *Anonic lbs/dt*	1.59		1.59
Chemical Dose *Catonic*		Chemical Dose *Catonic*		Chemical Dose *Catonic*			
Chemical Dose *Coag lbs/dt*	5.71	Chemical Dose Coag lbs/dt	5.71	Chemical Dose Coag lbs/dt	5.71		
Odor Level		Odor Level		Odor Level			
Polymer Vendor	Ashland	Polymer Vendor	Ashland	Polymer Vendor	Ashland		
Fabric Vendor	GT 500	Fabric Vendor	GT500	Fabric Vendor	GT500		

24/hr Cake Density		10.55
24/hr Cake S.g		1.24
24/hr Cake % Dry Solids		42.00
1ft³ lbs 24hrs Dewatering		62.00
Dry Solids Retained /1ft³ **M^3**		26.04
1ft³ lbs End of Fill		89.00
Penetrometer RDT Kg/in²		4.92
Penetrometer P-GDT Kg/in²		0.20
RDT T.S.S.		68.00
RDT Ntu's		45.90
RDT Cake % Dry Solids		62.60

TENCATE Geotube®



SF SMARTFEED®

Color legend:

Wet lbs P-GDT test tube 1ft³ Method 1 M^1

Dry lbs 1ft³ Method 2 M^2

Dry lbs 1ft³ Method 3 M^3

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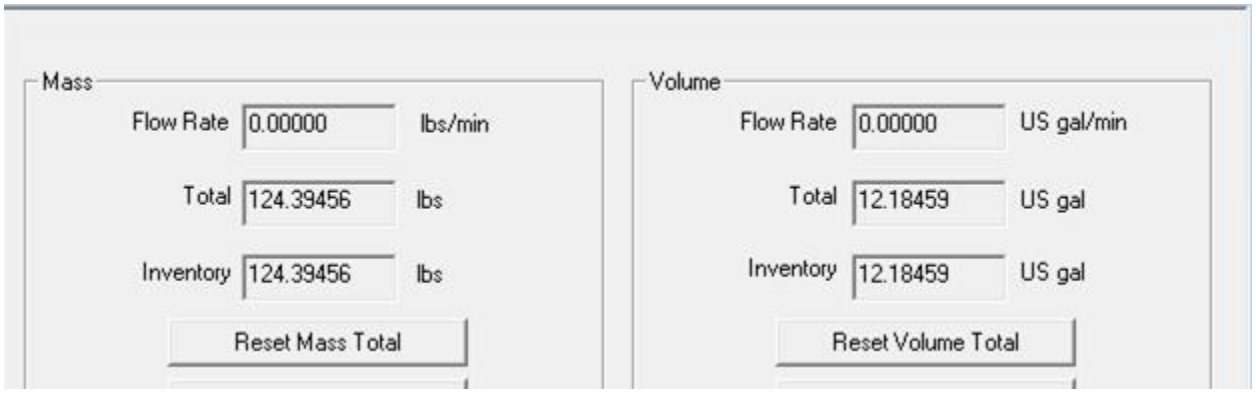
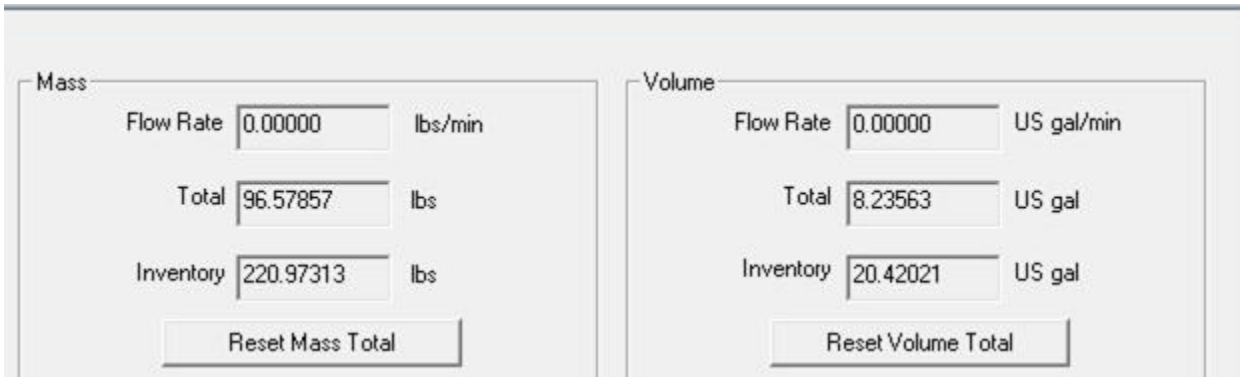
Table 36

Validation of Fill Phases: Test 13, May 16, 2009
Sample: SMU 6 Black; Fabric: TenCate GT 500; Polymer: Ashland 2520 Polymer, Ashland 492 Coag

First Void Fill



Second Void Fill



Third Void Fill

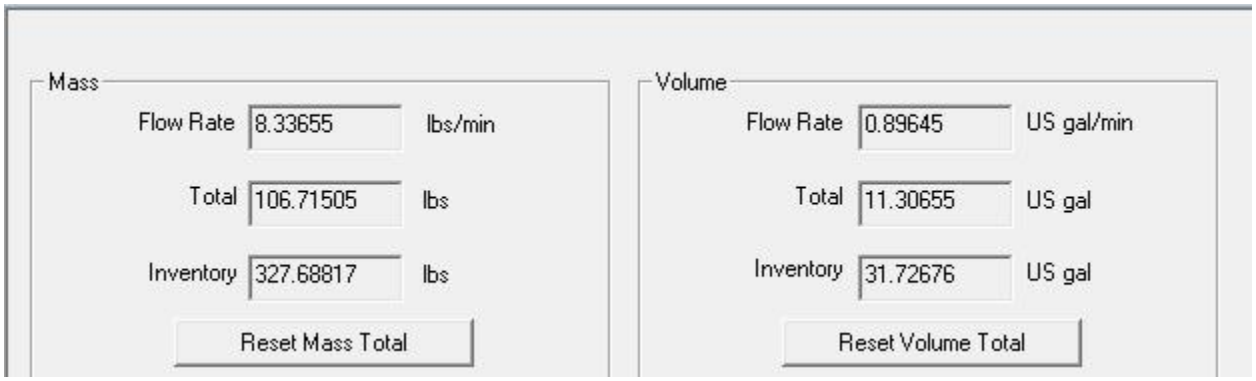


Table 37

TenCate Estimator & Illustrator Design Results Vs. P-GDT Test Results

June 26th 2009 REV 2

Tube Design 80' Circ

Project Design Yard 1,985,000 Yd^3

Project Tube Lengths vs. Screening	**Version 1**	**Version2**	**Version 3**	**Version 4**	**Version 5**	**Version 6**
Specific Gravity 60 Day Dewatering	2.61	2.61	2.61	2.61	2.61	2.61
Specific Gravity 1 Day Dewatering	1.24	1.24	1.24	1.24	1.24	1.24
% Solids In place	55%	55%	55%	55%	55%	55%
% Solids Pumping	8%	8%	8%	8%	8%	8%
Target Dry Solids	43%	43%	43%	43%	43%	43%
% Course Grain @ 100 US Mesh Removed	0%	12%	18%	25%	15%	15%

Design Wet / Dry Mass Specific Gravity	SG 1.4				SG 1.24	SG 2.61
Illustrator Fill Height Non-Stacked or Fillers	Version 1a	Version 2a	Version 3a	Version 4a	Version 5a	Version 6a
% of Design Height 80%	6.8'	6.8'	6.8'	6.8'	6.8'	6.8'
Tube Length 8.36yd^3/lf	316,057	278,129	259,167	237,049	264,858	287,069

Illustrator Fill Height Stacked wo/ Fillers	Version 1b	Version 2b	Version 3b	Version 4b	Version 5b	Version 6b
% of Design Height 75%	6.0'	6.0'	6.0'	6.0'	6.0'	6.0'
Tube Length Field Fill Height Average 7.54^3 l.f.	350,429	308,378	287,352	262,822	293,662	318,288

Illustrator 4 Tier 4000' x 780'	Version 1c	Version 2c	Version 3c	Version 4c	Version 4c	Version 5c
	6.0'	6.0'	6.0'	6.0'	6.0'	6.0'
Laydwon Acres	70.39	70.39	70.39	70.39	70.39	70.39

Illustrator 5 Tier 3400' x 780'	Version 1d	Version 2 d	Version 3d	Version 4d	Version 6d	Version 6d
	6.0'	6.0'	6.0'	6.0'	6.0'	6.0'
Laydown Acres	59.39	59.39	59.39	59.39	59.39	59.39

Note: Laydown area did not change for Version 1c-4c for 4 Tier only # of tubes in last tier

Note: Laydown area did not change for Version 1d-4d for 5 Tier only # of tubes in last tier

Note: Geotube® lay down design area is based on average tube field fill height of 75.23%

Version 1 Based on milling all slurry passing 100 US Mesh

Version 2 Based on 12% of the dredge yards retained on 100 US Mesh and removed (2007 Screening Parson)

Version 3 Based on 18% of the dredge yards retained on 100 US Mesh and removed (RDT Testing Screening)

Version 4 Based on 25% of the dredge yards retained on 100 US Mesh and removed (P-GDT Testing Screening)

Version 5 Based on 15% of the dredge yards retained on 100 US Mesh Filter Cake 1.24 S.G. (TenCate Estimator Projection)

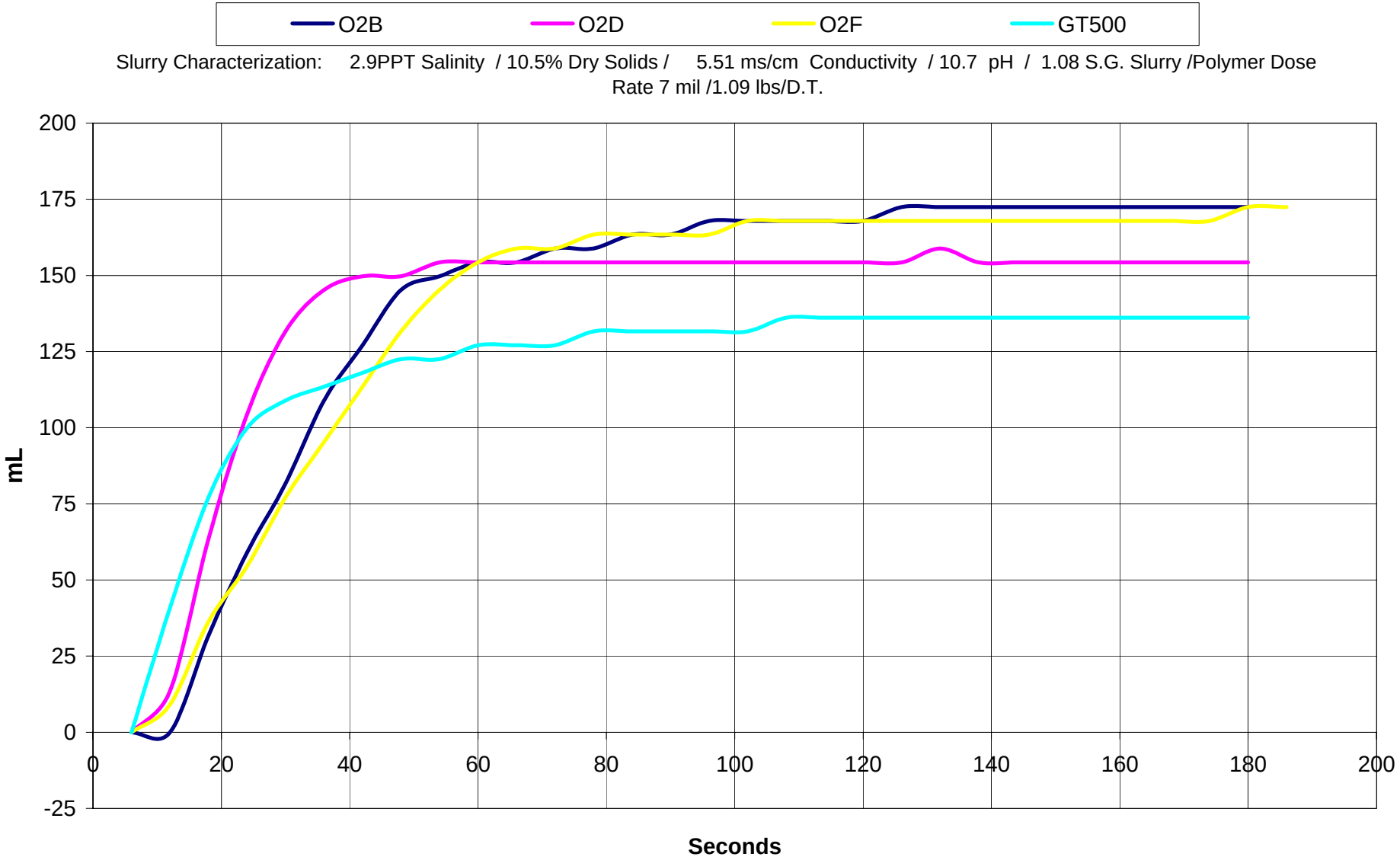
Version 6 Based on 15% of the dredge yards retained on 100 US Mesh Filter Cake 2.61 S.G. (TenCate Estimator Projection)

Note: These estimates are based on 80' circufurance tube design for cost estimates acutual liner foot design will vary with tube stack design

TABLE 38

RDT Testing Filter Cloth Selection Volume vs. Time Polymer / Ashland 2520L .2%

Slurry SMU 1



Slurry Characterization: 2.9PPT Salinity / 10.5% Dry Solids / 5.51 ms/cm Conductivity / 10.7 pH / 1.08 S.G. Slurry /Polymer Dose Rate 7 mil /1.09 lbs/D.T.

	RDT Cake	1hr	24hr	TSS mg/l	% DS 24hr	Load Bearing kg/in²
O2B		95g	69g	18	43.88	5.3
O2D		93g	66g	21	41.75	4.6
O2F		104g	75g	24	41.9	4.6
GT500		94g	66g	12	39.8	3.6

Parson

Table 39

SMU 1A - 1B - SMU 6 Brown

RDT Geotube® Evaluation Polymer Vendor Product Code

Testing Conducted At MPS Filtration Lab

Ashland	BETZ	CIBA	Kemira	SNF	Nalco
2520 DRY A	AP 1100	FC2106D	1154	913SH	7766 PLUS
K105L	AE 1700	FC 2044	3140	4190	7533 PLUS
3010	AP1110	371	3603	913VHM	7539
3025	AS1002	368	7221	4140SH	8158
3010	AP1120	156	7223	4107SH	71307
K1481	MP2402	336	3455	923	7736EZ
K132L	AS1001	10	1146	4800	7194 PLUS
K122L	AP1138	455	1162	4650	71325
K128	AE 1702	338	3135	455D	8172 PULV
K275FLX	AE1700	351	4814RS	4240VHM	8682-SC
N3100LTR	CE2694	7692	7225	4550SSH	7190 PLUS
490	AE1147	919	3620	905	7196 PLUS
12	AE1703	8844FS	7426	4650SH	7769
K136L	AP1142	333	7251	4498SH	8172 PULV
7			3638	945SH	7199
K290Fl			3456	910VHM	71303
K280FL			3155	905VHM	71306
K111L			3196	956SH	71305
485			3192	934VHM	71300
133L			3188	C-6227	71303
K110L			7257	240CT	61733
K144L			3640	EM140CT	7191 PLUS
482			3440	EM154CT	7181
K133L			3644	4290SH	71302
5320			3610	4290 SH	71301
K290FLX			1144	4115SH	7593
36			7222	956	9602
K260FL			3135	912	9601
K279FLX			3630	4190VHM	2706
A3040LA			A-100	934	7766
851BC			1849	A-6321	9602 PULV
K148L			3601	A-6341	1689
K292FLX			1849	EM1540CT	
K274FLX				EM240CT	
K120L				4290SH	
K295FL				EM 532	