WTP-RPT-198 Rev 0
PNNL-18291

U.S. DEPARTMENT OF ENERGY

Prepared for the U.S. Department of Energy
under Contract DE-AC05-76RL01830

Results of Aging Tests of Vendor-Produced Blended Feed Simulant

RL Russell
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KJ Cantrell
RA Peterson
DE Rinehart

April 2009

Pacific Northwest
NATIONAL LABORATORY

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Test specification: 24590-WTP-TSP-RT-07-004, Rev 0
Test plan: TP-RPP-WTP-509, Rev. 0.5
Test exceptions: 24590-WTP-TEF-RT-08-00013
R&T focus area: Pretreatment
Test Scoping Statement: None

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under Contract DE-AC05-76RL01830

Pacific Northwest National Laboratory
Richland, Washington 99352

Completeness of Testing

This report describes the results of work and testing specified by Test Specification, 24590-WTP-TSP-RT-07-004, Rev 0, Test Plan TP-RPP-WTP-509, Rev 0, and Test Exception 24590-WTP-TEF-RT-08-00013 Rev 0. The work followed the quality assurance requirements outlined in the Test Specification and Test Plan. The descriptions provided in this report are an accurate account of both the conduct of the work and the data collected. Test plan results are reported. Also reported are any unusual or anomalous occurrences that are different from expected results. The test results and this report has been reviewed and verified.

Approved:

Gordon H. Beeman (signature) — 5/1/09

Gordon H. Beeman, Manager
WTP R&T Support Project

Date

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Abbreviations and Acronyms

BNI	Bechtel National, Inc.
DIW	De-Ionized Water
DOE	U.S. Department of Energy
IC	Ion Chromatography
ICP-AES	Inductively Coupled Plasma-Atomic Emission Spectroscopy
PEP	Pretreatment Engineering Platform
PNNL	Pacific Northwest National Laboratory
PSD	Particle-Size Distribution
QAM	Quality Assurance Manual
QAP	Quality Assurance Program
QARD	Quality Assurance Requirements and Description (document)
RPP	River Protection Project
R&T	Research and Technology
SBMS	Standards-Based Management System
SWRI	Southwest Research Institute
WTP	Hanford Tank Waste Treatment and Immobilization Plant

Testing Summary

This report includes the results of the simulant aging tests performed in accordance with the test plan TP-RPP-WTP-509, Rev 0[1] (WTP Doc. No. 24590-101-TSA-W000-0004-72-00019 Rev 00A) prepared and approved in response to the Test Specification 24590-WTP-TSP-RT-07-004, Rev 0 (Sundar 2007), and the Test Exception 24590-WTP-TEF-RT-08-00013 Rev 0 (Sundar 2008).

Objective

The test objectives for the work addressed in TP-RPP-WTP-509, Rev 0 (Daniel and Shimskey 2007) are summarized in Table S.1 along with a discussion of how the objectives were met. The overall objective of the work from the test plan described in this report was to determine the effect of aging on the physical characteristics of the filtration simulant.

Table S.1. Test Objectives from TP-RPP-WTP-509, Rev. 0

Test Objective	Objective Met? (Y/N)	Discussion
1) Determine the effect of initial aluminate ion concentration on the rate of boehmite leaching in caustic solutions and in the presence of soluble anions in a waste. The anions to be considered are those that are typically present in the Hanford Tank Farm wastes in significant amounts. This includes carbonate, free-hydroxide, nitrate, nitrite, oxalate, phosphate, and sulfate.	NA	This objective was addressed in report WTP-RPT-184, Rev. 0.
2) Determine the sensitivity of the rate of dissolution of boehmite to soluble anions through a limited number of laboratory tests. The anions to be considered are those that are typically present in the Hanford Tank Farm wastes in significant amounts. This includes carbonate, free-hydroxide, nitrate, nitrite, oxalate, phosphate, and sulfate.	NA	As of March 20, 2008, Pacific Northwest National Laboratory (PNNL) has been released from this objective by Test Exception, 24590-WTP-TEF-RT-07-00016.
3) Determine the effect of scaling the length of the ultrafilter element from 2 ft to 8 ft on the filtrate flux over the expected operating range of the ultrafilter using the crossflow ultrafiltration unit.	NA	This objective was addressed in report WTP-RPT-168, Rev. 0.

Table S.1 (Contd)

Test Objective	Objective Met? (Y/N)	Discussion
4) Use an 8-ft-long filter element in the crossflow ultrafiltration unit to determine the effect of temperature on the filtration of a waste simulant over the range of temperature conditions for the leaching processes.	NA	This objective was addressed in report WTP-RPT-168, Rev. 0.
5) Use a 2-ft-long filter element in the crossflow ultrafiltration unit to evaluate the effect of the fine-particle fraction in the ultrafiltration simulant on fouling of the filter element over the range of concentrations of operating solids. The fine-particle fraction is defined as those particles with diameters smaller than the 10th percentile (i.e., the dp10) of the particle-size number distribution.	NA	This objective was addressed in report WTP-RPT-183, Rev. 0.
6) Perform various simulant aging tests to understand the changes that may occur to the simulant in storage and to confirm the adequacy of the simulant for use in the Pretreatment Engineering Platform (PEP).	Y	Aging tests were performed under various circumstances, including temperature cycling, stirring, storing in the laboratory, and storing outside in a tote. It was found that there was no significant aging effect on the filtration simulant under these conditions in the time frame tested.
7) Perform Cr-simulant leaching tests to establish that the Cr-simulant from the larger batch exhibits similar or better leaching behavior than the initial trial batch during caustic and oxidative leaching operations.	NA	These results will be presented in a report that is yet to be released.
8) Perform leaching tests to determine the mass loss and aluminum and chromium dissolution rates during caustic leaching under varying temperature-processing conditions without aeration in both UFP-1A/B and UFP-2A/B vessels as well as to measure the effect of aeration on chromium leaching in UFP-2A/B.	NA	These results will be presented in a report that is yet to be released.
9) Perform leaching tests to develop an accurate model for the dissolution of boehmite.	NA	These results will be presented in a report that is yet to be released.

Table S.1 (Contd)

Test Objective	Objective Met? (Y/N)	Discussion
10) Perform leaching tests to verify the effect of aluminate ions on the performance of the boehmite component B3 during caustic leach at temperatures lower than 100°C and to determine the effect of temperature on the dissolution rate of boehmite component B7.	NA	These results will be presented in a report that is yet to be released.
11) Perform leaching tests to determine the extent of boehmite conversion one would expect under leaching conditions during the planned testing in PEP.	NA	These results will be presented in a report that is yet to be released.

Success Criteria

This work meets the sixth success criterion described in TP-RPP-WTP-509, Rev. 0 (Daniel and Shimskey 2007), which is listed in Table S.2.

Table S.2. Results and Performance against Success Criteria of TP-RPP-WTP-509, Rev. 0

List Success Criteria	Explain How the Tests Did or Did Not Meet the Success Criteria
1) Development of empirical information that allows the effect of initial aluminate ion concentration on the kinetics of boehmite leaching in a waste simulant to be determined.	This criterion is addressed in report WTP-RPT-184, Rev. 0.
2) Determination of the sensitivity of boehmite leaching to carbonate, free-hydroxide, nitrate, nitrite, oxalate, phosphate, and sulfate anions in a waste-simulant solution.	As of March 20, 2008, PNNL has been released from this objective by Test Exception, 24590-WTP-TEF-RT-07-00016.
3) Determination of the effect of scaling the length of the ultrafilter element from 2 ft to 8 ft on the performance of the filter over the expected process operating range in transmembrane pressure, axial velocity, and ultrafiltration temperature.	This criterion is addressed in report WTP-RPT-168, Rev. 0.
4) Determination of the effect of temperature on the filtration flux for the waste simulant over the range of solid concentrations and temperature conditions for the leaching processes.	This criterion is addressed in report WTP-RPT-168, Rev. 0.
5) Determination of the effect of fine-particle concentration on the propensity of the waste simulant to foul the ultrafilter element over the range of concentrations of operating solids in the waste simulant.	This criterion is addressed in report WTP-RPT-183, Rev. 0.
6) Determine the effect of longer term outdoor and indoor storage, prolonged mixing under ambient conditions, and the effect of temperature cycling on the characteristics of the vendor produced PEP	The results of these tests discussed in Section 2 showed that there was no significant effect of storage on the physical characteristics of the PEP simulant after the aging period under outdoor storage, indoor storage at

Table S.2 (Contd)

simulant (Test Exception 24590-WTP-TEF-RT-08-00013 Rev 0).	ambient conditions, prolonged mixing under ambient conditions, and temperature cycling from 70°F to 113°F. Rheology at 5 wt% UDS was measured; however, rheology was not measured at 20 wt% UDS due to the results obtained at 5 wt% UDS and the lack of resources which was a deviation from the Test Exception,
7) Verification of Cr-simulant produced both in the small batch (15 kg of Cr) and the production batch (57 kg of Cr) exhibit similar or better leaching behavior than the initial trial batch from 2007 (Test Exception 24590-WTP-TEF-RT-08-00013 Rev 0).	These results will be presented in a report that is yet to be released.
8) Determination of the mass loss and aluminum and chromium dissolution rates during caustic leaching under varying temperature-processing conditions without aeration in both UFP-1A/B and UFP-2A/B vessels as well as to measure the effect of aeration on chromium leaching in UFP-2A/B (Test Exception 24590-WTP-TEF-RT-08-00014 Rev 0).	These results will be presented in a report that is yet to be released.
9) Development of a rate equation for the discussion of boehmite in concentrated caustic solutions containing aluminate ions approaching or exceeding the saturation solubility for boehmite (Test Exception 24590-WTP-TEF-RT-08-00015 Rev 0).	These results will be presented in a report that is yet to be released.
10) Verification of the effect of aluminate ion on the rate and the extent of dissolution of boehmite component B3 during caustic leach temperatures lower than 100°C (Test Exception 24590-WTP-TEF-RT-08-00015 Rev 0).	These results will be presented in a report that is yet to be released.
11) Determine the effect of temperature on the dissolution rate of boehmite component B7 (Test Exception 24590-WTP-TEF-RT-08-00015 Rev 0).	These results will be presented in a report that is yet to be released.
12) Determination of the extent of boehmite conversion one could expect under leaching conditions during the planned testing in PEP (Test Exception 24590-WTP-TEF-RT-08-00015 Rev 0).	These results will be presented in a report that is yet to be released.

Test Exceptions

Four test exceptions were issued for Test Plan TP-RPP-WTP-509. These test exceptions are summarized in Table S.3 along with a brief description of how each exception impacted existing objectives and test plan scope.

Table S.3. Test Exceptions to Test Plan TP-RPP-WTP-509

Test Exception Number	Description of Test Exception
24590-WTP-TEF-RT-07-00016, Rev. 0	This test exception released PNNL from test objective 2 (see Table S.2).
24590-WTP-TEF-RT-08-00013, Rev. 0	This test exception did not affect any existing test plan objectives. It added test objectives concerned with 1) aging of the PEP simulants during storage and 2) leaching of the chromium simulant. These are objectives 6 and 7 in Table S.2. The results of objective 6 are reported here, and the results of objective 7 will be released at a later date.
24590-WTP-TEF-RT-08-00014, Rev. 0	This test exception both affected existing test objectives and added new test objectives. Tests associated with objective 4 were modified slightly in response to this test exception with the temperatures examined being changed slightly. The results of this testing are reported in WTP-RPT-168. In addition, a new objective concerned with the influence of temperature and aeration on caustic leaching processes was added. This is objective 8 in Table S.2, and the results will be released at a later date.
24590-WTP-TEF-RT-08-00015, Rev. 0	This test exception did not affect any existing objectives in the test plan. It added three new test objectives concerned with 1) in-depth assessment of the leaching kinetics with respect to dissolved aluminate concentration and 2) the extent of leaching under planned PEP operating conditions. The added objectives are 9, 10, and 11 in Table S.2, and the results will be released at a later date.

Quality Requirements

Pacific Northwest National Laboratory (PNNL) is operated for the U.S. Department of Energy (DOE) by Battelle under Contract DE-AC05-76RL01830. PNNL implements a Quality Assurance Program that is based upon the requirements as defined in DOE Order 414.1C, “Quality Assurance,” and 10 CFR 830, “Energy/Nuclear Safety Management,” Subpart A—“Quality Assurance Requirements.” PNNL has chosen to implement the requirements of DOE Order 414.1C and 10 CFR 830, Subpart A by integrating them into the laboratory’s management systems and daily operating processes. The procedures necessary to implement the requirements are documented through the laboratory’s Standards-Based Management System (SBMS).

PNNL implemented the RPP-WTP quality requirements by performing work in accordance with the River Protection Project – Waste Treatment Plant Support Program (RPP-WTP) Quality Assurance Plan (RPP-WTP-QA-001, QAP). Work was performed to the quality requirements of NQA-1-1989 Part I, *Basic and Supplementary Requirements*, NQA-2a-1990, Part 2.7, and DOE/RW-0333P, Rev 13, *Quality Assurance Requirements and Descriptions (QARD)*. These quality requirements were implemented through the River Protection Project–Waste Treatment Plant Support Program (RPP-WTP) Quality Assurance Manual (RPP-WTP-QA-003, QAM). All analytical services were provided by Southwest Research Institute (SWRI). The requirements of DOE/RW-0333P, Rev 13, *Quality Assurance Requirements and Descriptions (QARD),* were not required for this work.

A matrix that cross-references the NQA-1 and NQA-2a requirements with RPP-WTP's procedures for this work is given in TP-RPP-WTP-509. It includes justification for those requirements not implemented. Experiments that were not method-specific were performed in accordance with RPP-WTP's procedures QA-RPP-WTP-1101 "Scientific Investigations" and QA-RPP-WTP-1201 "Calibration and Control of Measuring and Testing Equipment" so that sufficient data were taken with properly calibrated measuring and test equipment to obtain quality results.

RPP-WTP addressed internal verification and validation activities by conducting an independent technical review of the final data report in accordance with PNNL's procedure QA-RPP-WTP-604. This review verifies that the reported results were traceable, inferences and conclusions were soundly based, and the reported work satisfied the Test Plan objectives. This review procedure is part of PNNL's RPP-WTP QAM.

R&T Test Conditions

The research and technology (R&T) test conditions, as defined in the Bechtel National Inc. (BNI) Test Specification 24590-WTP-TSP-RT-07-004, Rev. 0[(a)] associated with the test plan TP-RPP-WTP-509, Rev. 0 are summarized in Table S.4.

Table S.4. R&T Test Conditions from 24590-WTP-TSP-RT-07-004, Rev. 0

List R&T Test Conditions	Were Test Conditions Followed?
1) Boehmite Dissolution Tests—examine the impact of aluminate, hydroxide, and other principal anions on boehmite dissolution kinetics. (Section 5.1 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. Results discussed in WTP-RPT-184.
2) Boehmite Dissolution Tests—verify the effect of temperature on the dissolution of boehmite component B7 and verify the effect of aluminate ion on the performance of the boehmite component B3 during caustic leach at temperatures lower than 100°C. (Section 5.5 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. It will be addressed in a future report.
3) Boehmite Dissolution Tests—provide greater discrimination on anion impact by performing tests under a greater range of anion concentrations. (Section 5.1 of TP-RPP-WTP-509, Rev. 0)	Not applicable to current testing. PNNL was released from this requirement by Test Exception 24590-WTP-TEF-RT-07-00016.
4) Filtration Tests—test a base simulant under identical process conditions with 2-ft and 8-ft filter elements. (Section 5.2 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. Results discussed in WTP-RPT-168.

(a) PS Sundar. April 2007. *Simulant Testing in Support of Phase I Demonstration of the Ultrafiltration and Leaching Processes in the Integrated Test Facilty*. 24590-WTP-TSP-RT-07-004, Rev. 0.

Table S.4 (Contd)

List R&T Test Conditions	Were Test Conditions Followed?
5) Filtration Tests—increase the fines loading in filtration test base simulant to evaluate the impact of fouling on filtration performance. (Section 5.2 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. Results discussed in WTP-RPT-183.
6) Filtration Tests—use an 8-ft filter element to measure the filtration rate as a function of temperature up to 45°C for the base filtration simulant. (Section 5.2 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. Results discussed in WTP-RPT-168.
7) Aging Tests—will be performed in the 250-gal tote and a 1-gal container in the laboratory, a container in a heat-cycled oven, and a baffled 1-gal container that is mixed in the laboratory. Samples will be taken throughout the tests and characterized by particle-size distribution, settling, rheology, and centrifuged solids content to evaluate the effect of aging on the behavior of the simulant. (Section 5.3 of TP-RPP-WTP-509, Rev. 0)	Aging tests were performed in the 250-gal tote by storing it outside and in 1-gallon containers in the laboratory. One container was temperature cycled in an oven, one container was stored on the counter, and another was put into a baffled container and stirred continuously. Samples were taken throughout the tests and characterized by PSD, rheology at 5 wt% UDS (rheology was not measured at 20 wt% UDS due to the results obtained at 5 wt% UDS and the lack of resources), settling, and centrifuging of solids. It was found that there was no significant effect of aging on the physical characteristics of the simulant under the conditions tested in this time frame.
8) Chromium Simulant Leaching Tests—will be performed with both a caustic leach and an oxidative leach to evaluate the leaching performance of the various vendor batches of Cr-simulant. (Section 5.4 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. It will be addressed in a future report.
9) PEP Leaching Support Tests—are to be carried out with the vendor-produced 250-gal batch of the PEP simulant and the vendor-produced CrOOH Test Batch 1 simulant slurry. The tests are directed to determine the mass loss and aluminum and chromium dissolution rates during caustic leaching under varying temperature processing conditions without aeration in both UFP-1A/B and UFP-2A/B vessels as well as to measure the effect of aeration on chromium leaching in UFP-2A/B. (Section 5.5 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. It will be addressed in a future report.
10) PEP Leaching Support Tests—will be performed using a vendor-produced 250-gal batch of the PEP simulant. The tests are directed to measure the extent of boehmite conversion expected under leaching conditions during the planned testing in the PEP. (Section 5.5 of TP-RPP-WTP-509, Rev. 0)	Not applicable to this report. It will be addressed in a future report.

Simulant Use

The simulant used for the aging tests described in this report was produced by simulant vendor Noah Technologies based on a recipe provided to them that was developed by PNNL. The recipe was based on specifications for the demonstration of the ultrafiltration and leaching processes in the PEP. The simulant does not mimic any actual tank waste or even any composite waste.

Discrepancies and Follow-on Tests

None.

1.0 Introduction

The Hanford Tank Waste Treatment and Immobilization Plant (WTP) is procuring 3,500-gallon batches of waste simulant for Phase 1 testing in the Pretreatment Engineering Platform (PEP) through Pacific Northwest National Laboratory (PNNL). To make sure that the quality of the simulant is acceptable, the production method was scaled up starting from a laboratory-prepared 25-liter batch of simulant through 15-gallon vendor prepared simulant and 250-gallon vendor prepared simulant before embarking on the production of the 3500-gallon simulant batch by the vendor.

The 3,500-gallon PEP simulant batches were produced and packaged in 250-gallon high-molecular-weight polyethylene totes at NOAH Technologies. The simulant was stored at NOAH Technologies within their warehouse at about 70 to 75°F before blending or shipping. For the 15-gallon, the 250-gallon, and the 3,500-gallon Batch 0, the simulant was shipped in ambient temperature trucks with shipments requiring nominally 3 days. The 3,500-gallon Batch 1 traveled in a 70 to 75°F temperature-controlled truck. Typically, the simulant was uploaded into a PEP receiving tank within 24 hours of receipt. The first uploading required longer with the simulant stored outside from receipt until the transfer.

The stability of the physical and chemical characteristics of the simulant both in transit and in storage before its use in the PEP was paramount to accomplishing the process demonstration objectives in the PEP. Therefore, aging tests were conducted on the 250-gallon batch of the vendor-produced PEP blended feed simulant to identify and determine any changes to the physical characteristics of the simulant when in storage. The supernate was also chemically characterized. Four aging scenarios for the vendor-produced blended simulant were studied: 1) stored outside in a 250-gallon tote, 2) stored inside in a 1-gallon plastic bottle, 3) stored inside in a well mixed 5-L tank, and 4) subject to extended temperature cycling under summer temperature conditions in a 1-gallon plastic bottle. In particular, the following series of aging tests were conducted to accomplish these objectives.

1. The simulant was stored in the 250-gallon tote outside in a shaded area for 45 days. The maximum temperature was 108°F, and the minimum temperature was 43°F with an average of 72°F. The average high temperature was 88°F, and the average low temperature was 57°F. The supernatant composition was analyzed chemically every 7 days. The capability to re-suspend the solids in the simulant at the end of 45 days was also tested. Note that the tote was left undisturbed during the test duration, allowing extensive settling to occur. The tote was mixed using the method prescribed for PEP operational procedures using an air sparge and pumping out of the top of the tote and into the bottom of the same tote. This was performed at the beginning of the testing (0 days) and at the end of the 45 days with a homogenous slurry sample withdrawn for characterization.

2. About 1 gallon of simulant was stored in a plastic bottle in the laboratory (without continuous mixing) for 60 days at ambient temperature (64°F to 70°F). The simulant was allowed to settle between sampling. The simulant was well shaken to suspend the settled solids before sampling, and then an aliquot of the slurry was taken and physically characterized at 15, 30, and 60 days.

3. About 1 gallon of simulant was well mixed under turbulent conditions in a plastic, baffled container using a marine impeller-type stirrer in the laboratory for 30 days at ambient temperature (64°F to 70°F). It was physically characterized at 15 and 30 days.

4. Temperature cycling was performed on approximately 1 gallon of simulant in a 1-gallon plastic bottle in an oven. It was heated and held at 45°C (113°F) during the day (8 to 10 hours) and then allowed to cool and stand at ambient temperature overnight and on weekends and holidays. The sample was cycled for 45 calendar days (29 temperature cycles) and physically characterized at 7, 15, 30, and 45 days.

The sample characterizations performed for the above tests were:

- Particle size distribution (PSD)
- Solids-settling tests over a period of 72 hours to determine settled solids volume as a function of time
- Rheology determination—flow curves at 5 wt% (as received)
- Measurement of centrifuged solids content as a gel-point indicator. The slurry was centrifuged for 30 minutes at 4500 G.
- Measurement of supernatant composition of the 250-gallon tote every 7 days.

Based on the results obtained from the rheology measurements at 5 wt% undissolved solids and the lack of resources, it was decided not to perform the rheology curves at 20 wt% undissolved solids as stated in the Test Exception. It was also determined from previous work that centrifuging at 1,000 G does not separate the simulant efficiently or show the true gel point. Therefore, it was decided to centrifuge the samples at 4,500 G to obtain an efficient separation and accurate gel point of the simulants.

2.0 Aging Results

The various aging slurry samples were characterized in several ways as described below.

2.1 Particle-Size Distribution

PSD measurements were conducted on 11 samples collected during the aging experiments. The samples were analyzed with a S3000 Microtrac Analyzer according to procedure TPR-RPP-WTP-222, Rev. 3. Nominally 0.2 grams of each sample (run in duplicate) were placed into approximately 10 grams of de-ionized water (DIW), and 2 to 3 drops of Darvan® 821A Dispersing Agent were added. A transfer pipette was used to mix the slurry and transfer the required amount to the analyzer. The amount of the slurried sample aliquot required for analysis varied with the actual mass of the sample and the actual volume of DIW in the sample. Neither the amount of sample nor the amount of water was critical to the analytical process since the internal system software visually indicated to the analyst the amount needed for analysis. No sonication was performed with these samples. The 2 micron standard used in verifying the calibration of the instrument gave an error range of ± 0.5 microns. The 11 samples collected and analyzed are shown in Table 2.1.

Table 2.1. PSD Samples Collected During the Aging Experiment

Aging Scenario	Sampling Time
Stored Outside	0 days and 45 days
Well Stirred (Inside)	15 days and 30 days
Stored Inside	15 days, 30 days, and 60 days
Temperature Cycled	7 days, 15 days, 30 days, and 45 days

The PSD results are shown in Table 2.2 in terms of volume percent distribution and in Table 2.3 in terms of number percent distribution.

Table 2.2. Aging Test PSD Volume Percent Distribution (without sonication)

Sample ID	5% (microns)	50% (microns)	90% (microns)
Initial Feed	1.64	9.50	26.22
Stored Outside 45 days	1.62	9.43	25.63
Temp. Cycling 7 days	1.61	9.20	24.38
Temp. Cycling 15 days	1.22	8.67	23.00
Temp. Cycling 30 days	1.69	8.82	21.08
Temp. Cycling 45 days	1.67	8.98	22.77
Stored Inside 15 days	1.52	9.31	25.21
Stored Inside 30 days	1.61	8.78	20.57
Stored Inside 60 days	1.59	9.08	24.70
Well-Stirred 15 days	1.51	8.70	22.77
Well-Stirred 30 days	1.67	8.99	22.80

Table 2.3. Aging Test PSD Number Percent Distribution (without sonication)

Sample ID	5% (microns)	50% (microns)	90% (microns)
Initial Feed	0.73	1.06	2.38
Stored Outside 45 days	0.73	1.06	2.35
Temp. Cycling 7 days	0.73	1.07	2.38
Temp. Cycling 15 days	0.62	0.90	1.74
Temp. Cycling 30 days	0.73	1.09	2.52
Temp. Cycling 45 days	0.73	1.07	2.47
Stored Inside 15 days	0.73	1.05	2.24
Stored Inside 30 days	0.73	1.08	2.43
Stored Inside 60 days	0.73	1.08	2.39
Well-Stirred 15 days	0.73	1.08	2.32
Well-Stirred 30 days	0.73	1.08	2.49

The PSD result for the sample that was stored outside for 45 days is compared to the initial simulant sample (0 days in Table 2.1) in Figure 2.1 as volume percent and in Figure 2.2 as number percent. These results indicate that there was no discernable change in the average particle size during the 45 days of storage outside. There may have been some slight precipitate ripening based on the number distribution results but it is not definitive based on these results and therefore, it appears that storing the simulant in the tote outside undisturbed did not cause a definitive change in the average particle size over 45 days.

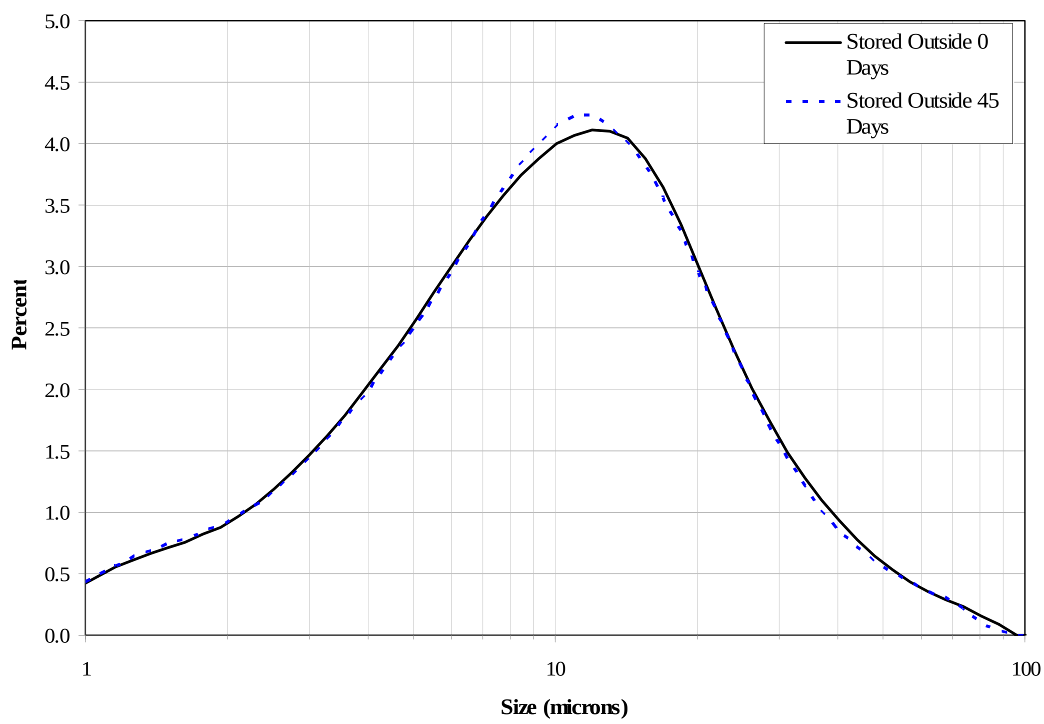


Figure 2.1. PSD (Volume Percent) for the Stored-Outside Samples

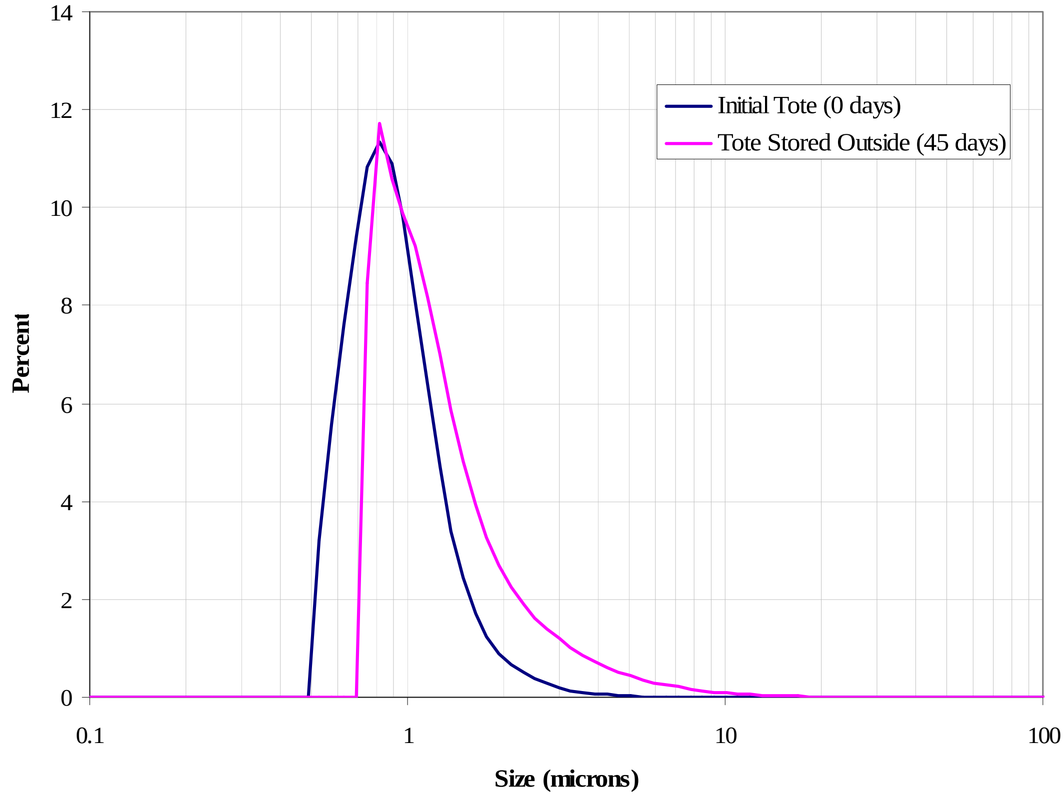


Figure 2.2. PSD (Number Percent) for the Stored-Outside Samples

The PSD of the two well-stirred samples and the initial simulant sample (0 days in Table 2.1) are compared in Figure 2.3 as volume percent distribution and in Figure 2.4 as number size distribution. These results do not show any definitive differences in the average particle size, indicating that stirring the simulant over 30 days did not change the particle size. There may have been some slight precipitate ripening based on the number distribution results but it is not definitive based on these results and no definitive conclusion can be drawn.

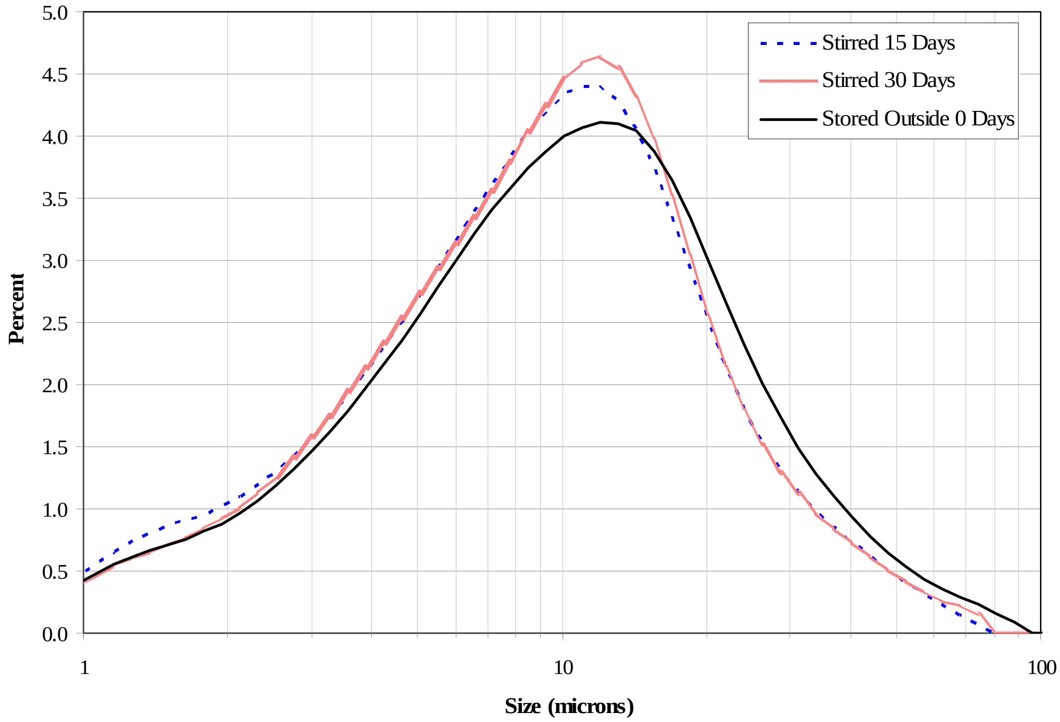


Figure 2.3. PSD (Volume Percent) for the Two Well Stirred Samples

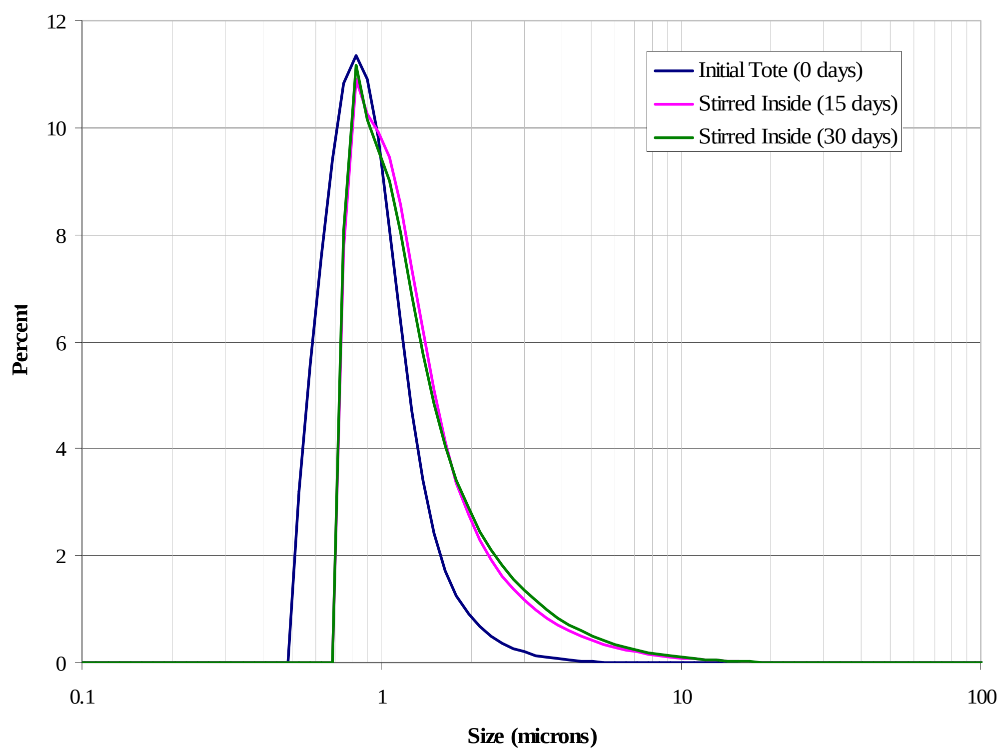


Figure 2.4. PSD (Number Percent) for the Two Well Stirred Samples

The PSD results for the samples stored inside are compared with the initial simulant sample (0 days in Table 2.1) in Figure 2.5 as volume percent distribution and Figure 2.6 as number percent distribution. The 15-day and 60-day volume distribution samples are nearly identical to the initial sample, indicating that storage at ambient conditions does not affect the average particle size of the simulant. There may have been some slight precipitate ripening based on the number distribution results but it is not definitive based on these results and no definitive conclusion can be drawn. The sample collected after 30 days of storage exhibits a difference in the volume percent distribution from the other samples. This result is not consistent with the other results, and the reason for this disparity has not yet been identified.

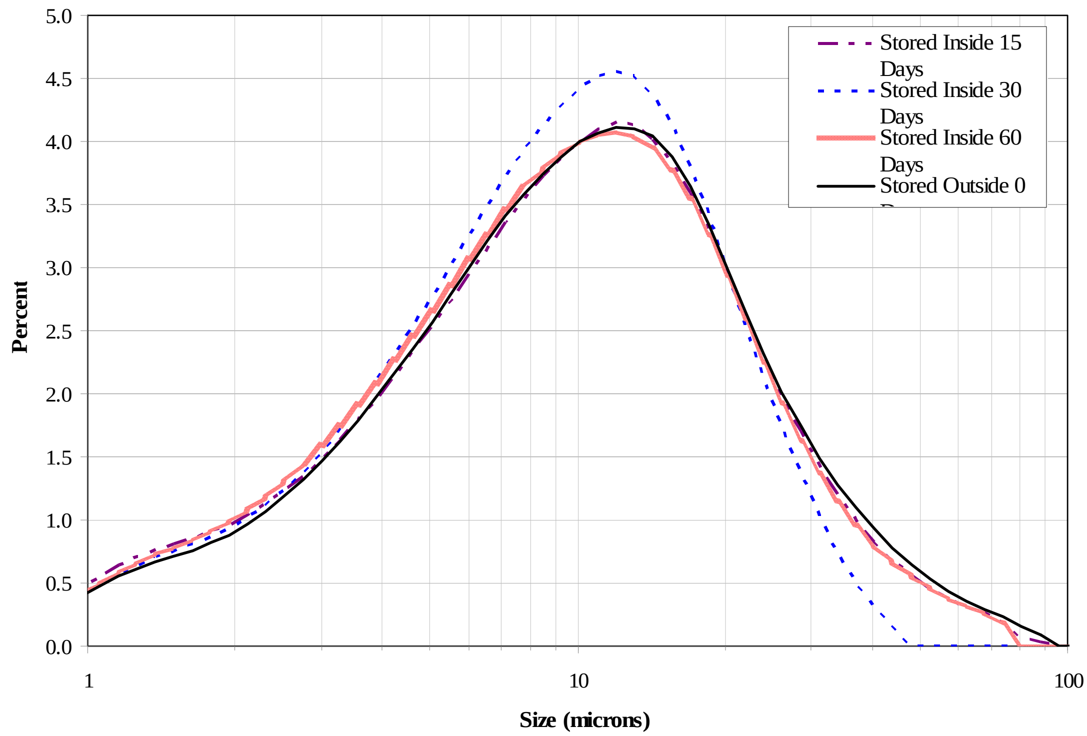


Figure 2.5. PSD (Volume Percent) for the Stored Inside Samples

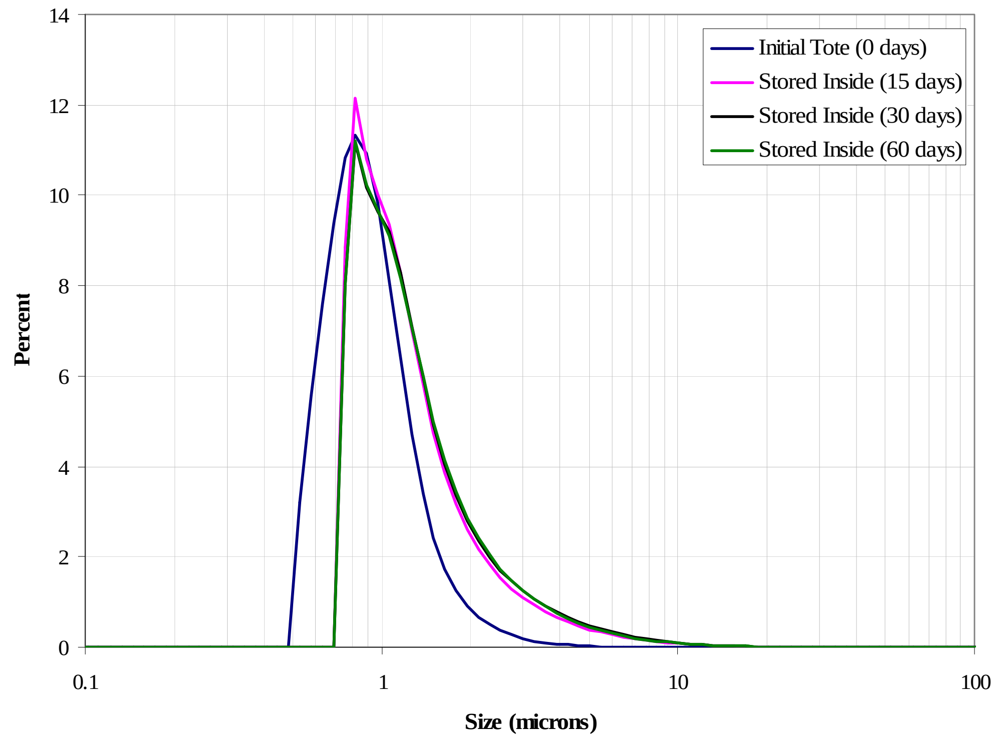


Figure 2.6. PSD (Number Percent) for the Stored Inside Samples

Results of the PSD analysis for the temperature-cycled samples are compared with the initial simulant sample (0 days in Table 2.1) in Figure 2.7 for the volume percent distribution and Figure 2.8 for the number percent distribution. All of the temperature-cycled samples except the 15-day sample are nearly identical to the initial volume distribution sample, indicating that temperature cycling did not significantly affect the average particle size. The 15-day temperature-cycled sample has an anomalous fractional increase of particles in the size range of 1 µm to 2 µm, and the reason for this is not known at this time. There may have been some slight precipitate ripening based on the number distribution results but it is not definitive based on these results and no definitive conclusion can be drawn.

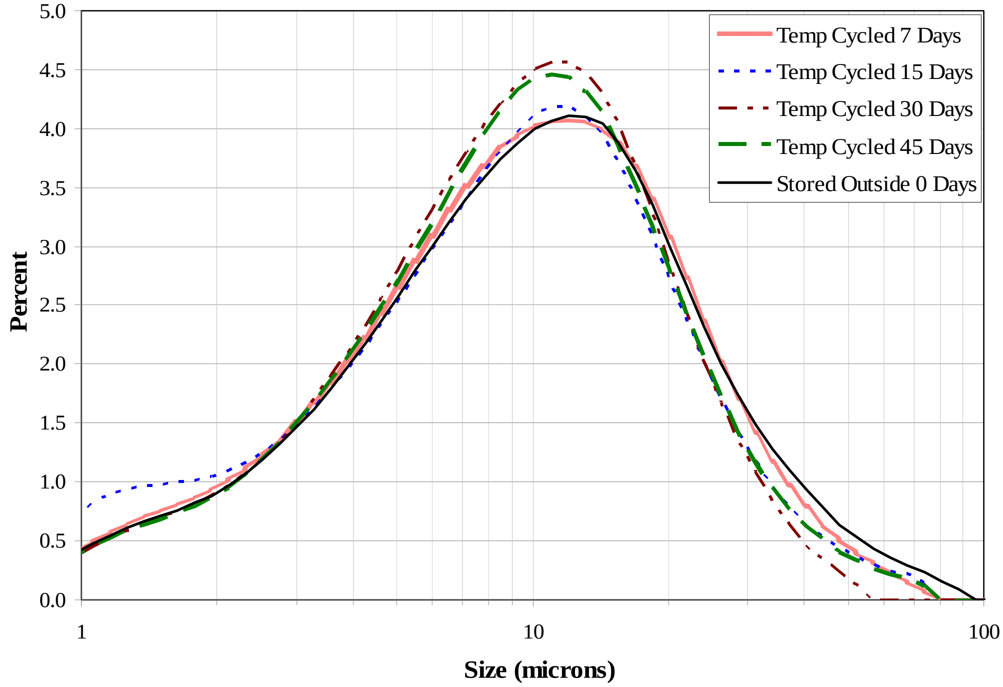


Figure 2.7. PSD (Volume Percent) for the Temperature Cycled Samples

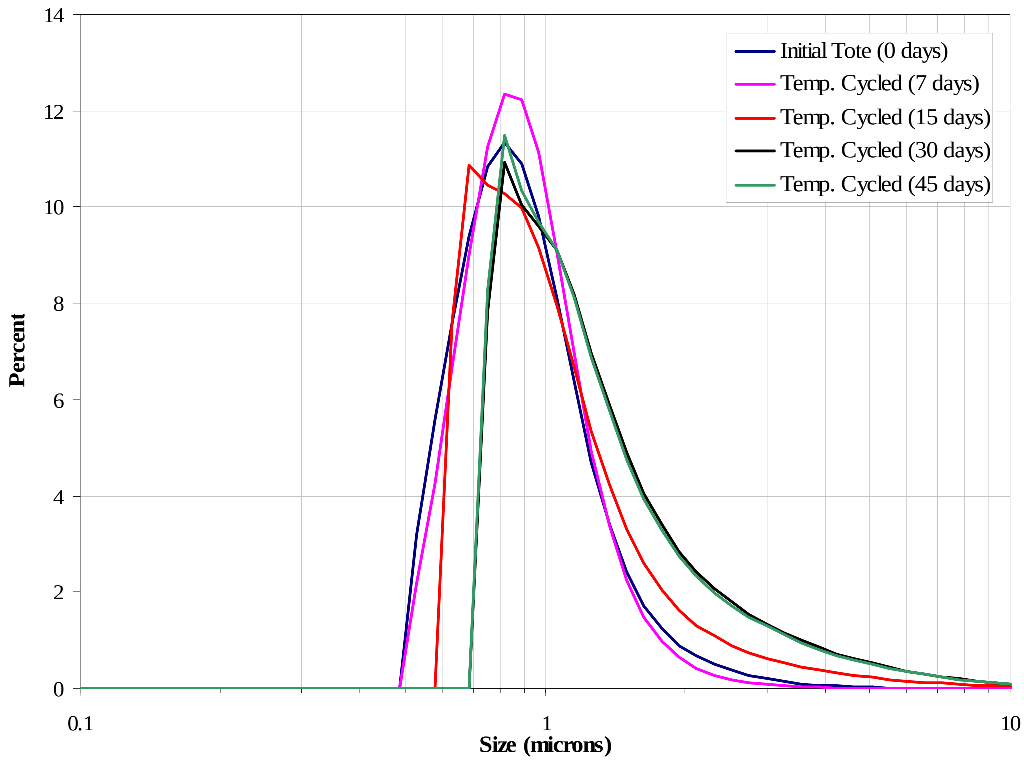


Figure 2.8. PSD (Number Percent) for the Temperature Cycled Samples

The PSD analysis results for the longest time period for each aging scenario are compared with that of the initial simulant sample (0 days in Table 2.1) in Figure 2.9 as volume distribution and Figure 2.10 as number distribution. All of the curves showed the same pattern with no significant differences indicating that aging method appears to have little effect on the steady state ~~PSD .~~PSD. This indicates that storing, stirring, or temperature cycling the simulant should not affect the average particle size of the simulant.

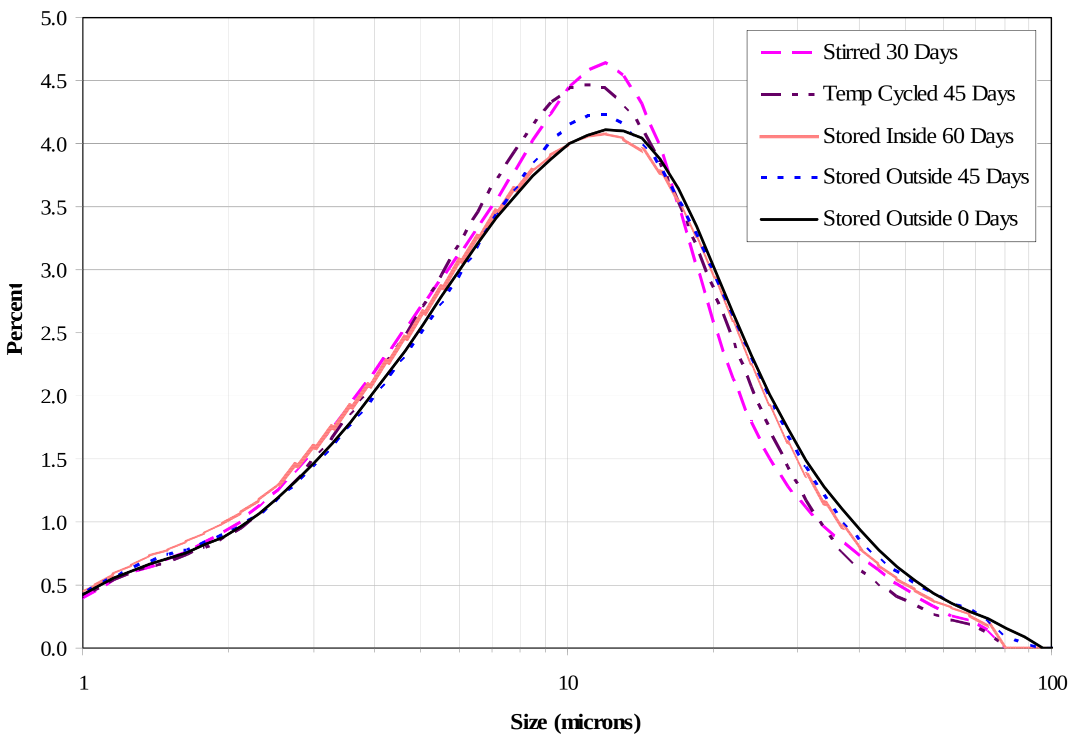


Figure 2.9. PSD (Volume Percent) for the Last Sample Collected for Each Aging Scenario

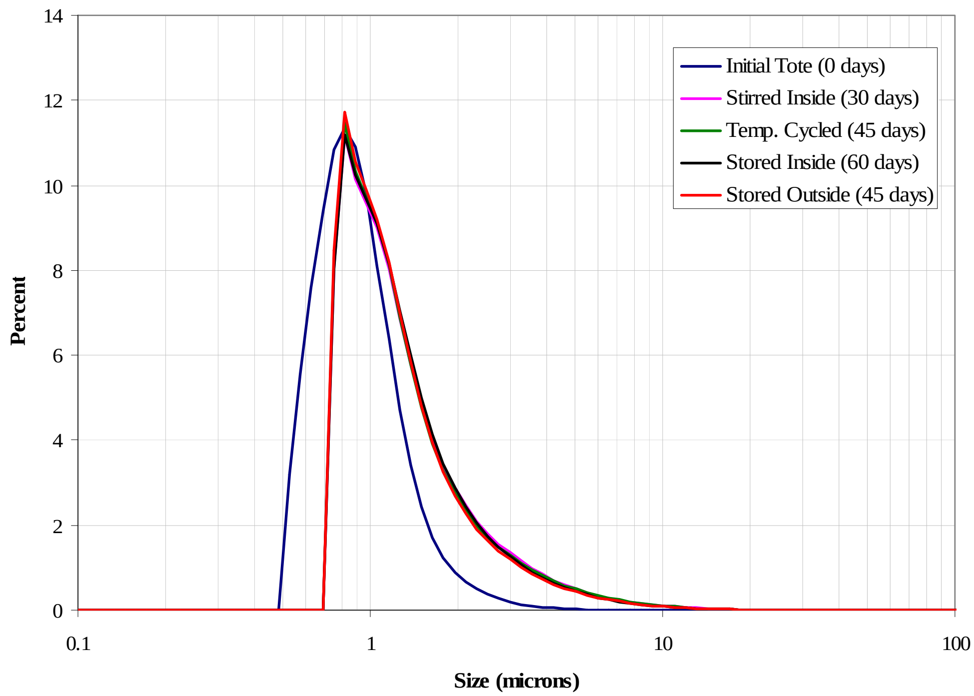


Figure 2.10. PSD (Number Percent) for the Last Sample Collected for Each Aging Scenario

2.2 Settling Tests

These tests were performed by placing a homogenous sample of the slurry in a 50-mL centrifuge tube and then measuring the height of the solids in the tube in terms of inches over time. Results of these settling tests are shown in Figure 2.11. The volume percent of solids is plotted as a function of time. The highest degree of settling occurred in the stirred simulant sample. The temperature-cycled sample and the two samples that were stored inside and outside were nearly identical in their settling. The stirred sample was essentially finished settling after 8 hours, and the stored samples did not finish settling until ~24 hours whereas the temperature-cycled sample was still settling at the end of the 72-hour test. They all settled to between 20 vol% and 30 vol% solids after 72 hours. However, the continuously stirred sample resulted in the most significant simulant change settling to a solids volume of ~21% in 8 hours while the others took 24 hours or longer to settle to a solids volume of ~26%. These were not compared to the settling rate of the initial slurry because its settling rate was not measured.

The 250-gallon tote contents were mixed by air sparging and diaphragm pumping for approximately 30 minutes, and then a 2-liter sample was taken mid-stream during recirculation. The density of the slurry was then measured to make sure that homogenization was complete. After settling for 45 days in the tote outside, the slurry was mixed again with the air sparger and diaphragm pump in the exact same way as initially to determine how well the solids were re-suspended. The solids were easily mixed and re-suspended with no difference from the initial mixing. The initial density was measured as 1.262 g/mL, and the final density was measured as 1.257 g/mL, indicating the same degree of homogenization.

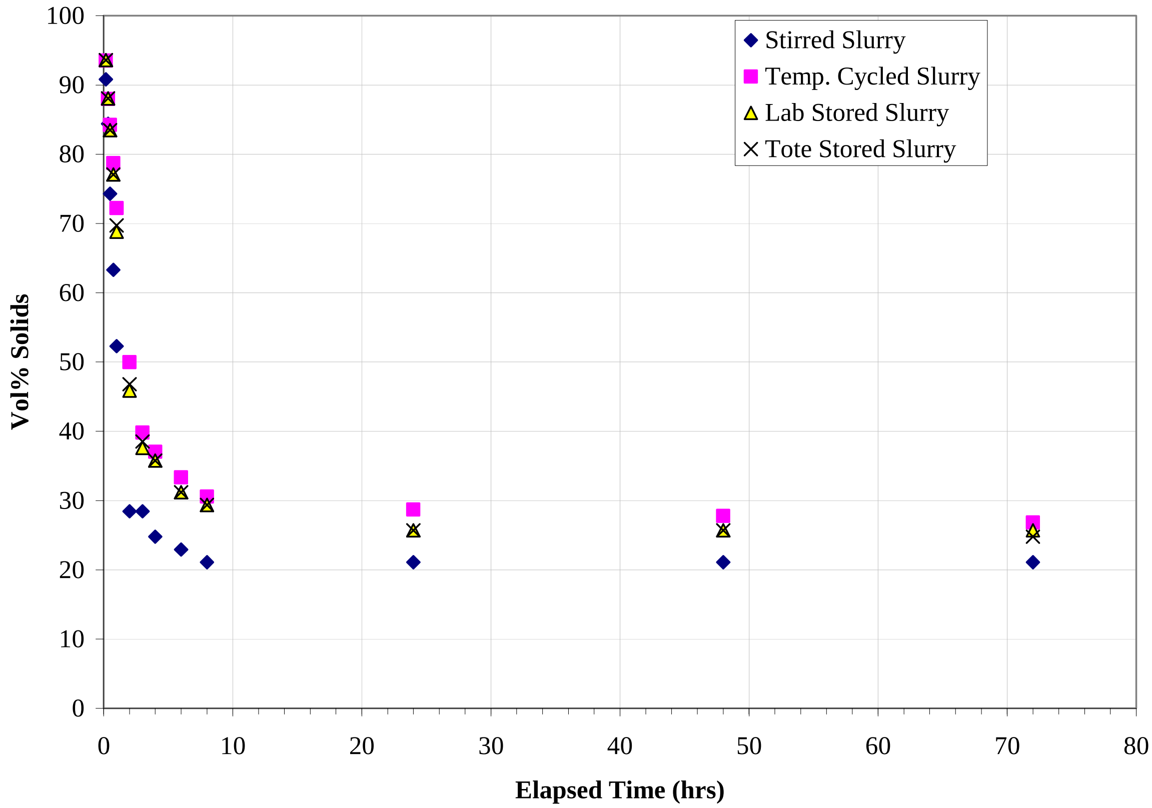


Figure 2.11. Volume-Percent Solids as a Function of Time

2.3 Rheology

Rheology data were obtained on an Anton Paar Physica MCR 301 rheometer (Anton Paar Ostfildern Germany) with a Peltier-controlled cylinder measuring system where both speed and torque are measured at the rotating shaft. The rheometer was operated in the controlled-rate mode. This geometry required approximately 37 mL of sample and had a gap of 3.46 mm. The samples were shaken before being measured to produce a fully suspended material. Shear stress was measured as a function of shear rate over a range of 0 to 1000 s^{-1}. Measurements were made with both increasing and decreasing shear rate. Rheometer control and data acquisition were accomplished with a computer connection using the RheoPlus Software, Version 3.21.

The results of the rheology tests are presented in Table 2.4 and Figure 2.12. The flow curves are shown in Appendix B. All the aging study samples exhibited Newtonian flow behavior. The overall average simulant viscosity was 3.43 cP with a standard deviation of 0.37 cP. All of the measurements were within this range except for the initial slurry, which indicates that the slurry may have become slightly less viscous by <1cP over this time frame. This indicates that aging did not have a significant effect on the rheology of the PEP simulant under these various conditions, and its flow behavior remained essentially the same.

Table 2.4. Rheology Results for the Aging Test Samples

Days	Stored Outside	Stored Inside	Temperature Cycled	Well-Stirred
	Viscosity cP			
0	4.50	No sample [(a)]	No sample [(a)]	3.41
7	No sample	No sample	3.24	No sample
15	No sample	3.49	3.30	3.21
30	No sample	3.38	3.19	3.15
45	3.64	No sample	3.24	No sample
60	No sample	3.45	No sample	No sample

(a) The initial value may be assumed to be 4.50 cP since this was a well mixed sample withdrawn from the tote at the beginning of the testing.

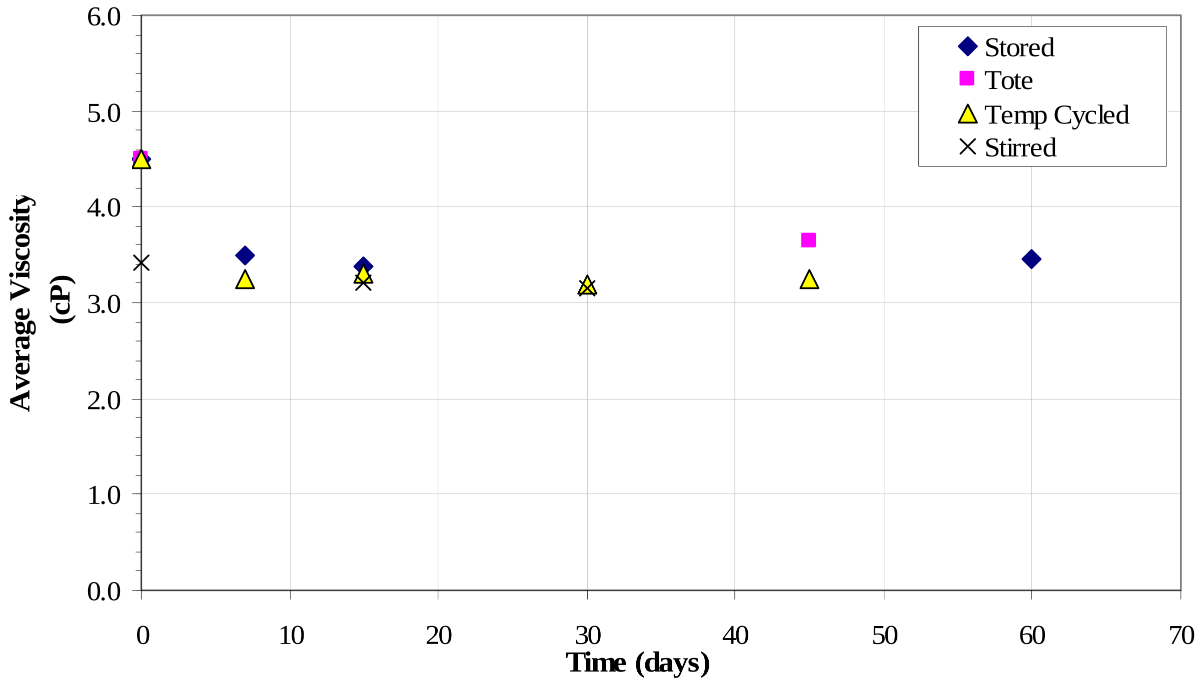


Figure 2.12. Average Viscosity as a Function of Time

2.4 Solids Content

The solids content for the 45-day temperature-cycled sample and the 45-day stored-outside sample are shown in Table 2.5. The total solids content and the dissolved solids content are essentially the same for both samples with a difference of approximately 1.02 wt% and 0.58 wt%, respectively, which is well within analytical uncertainty of ±15% variance. The undissolved solids content shows a difference of 0.44 wt%.

The samples were also centrifuged at 4500 G for 30 minutes to determine the solids content at this point. This point represents the gel point of the slurry in which the column height is self-supporting at whatever G force is applied. The results of the tests for centrifuged solids content are shown in Table 2.6. The initial slurry was not centrifuged and measured. The temperature-cycled slurry had slightly higher vol% solids than the other samples. The other samples were all about the same, indicating that they all centrifuge to essentially the same amount, and different aging scenarios do not alter the final results significantly.

Table 2.5. Percent Total, Dissolved, and Undissolved Solids Content

Sample	% Total Solids	% Dissolved Solids	% Undissolved Solids
Stored Outside 45 days	31.3	27.0	4.3
Temperature Cycled 45 days	30.3	26.4	3.9

Table 2.6. Centrifuged Solids Content

Aging Scenario	Approximate Percent Centrifuged Solids
Stored Outside	10.0
Well Stirred (Inside)	10.0
Stored Inside	11.3
Temperature Cycled	12.5

2.5 Supernatant Composition

Supernatant samples were collected at 14, 21, 28, 35, 42, and 45 days from the tote that was stored outside. The samples were analyzed for metals by inductively coupled plasma-atomic emission spectroscopy (ICP-AES) and anions by ion chromatography (IC). Supernatant samples were also collected at 15, 22, and 30 days from the well-stirred aging test. These samples were analyzed for Al, Cr, Fe, and Na by ICP-AES.

Analytical results for the supernatant samples collected from the stored-outside aging-scenario test for components that had concentrations above their respective detection limits are compiled in Table 2.7, and the entire analytical results are shown in Appendix C. The composition is essentially the same with all results well within the range of experimental error (±15%) with no significant trends occurring for any component between days 14 and 45. Analytical results for the supernatant samples collected from the well-stirred aging-scenario test for Al, Cr, Fe, and Na are compiled in Table 2.8. The results for these components are very similar to those of the outside aging scenario with no aging trends apparent and all results well within the range of experimental error (±15%). Both of these sets of results indicate that the supernatant reached equilibrium by the time the first sample was collected, and aging did not affect it.

Table 2.7. Supernatant Composition Results for Stored-Outside Aging Scenario (mg/kg solution)

Component	Sample ID					
	TST-14	TST-21	TST-28	TST-35	TST-42	TST-45
Al	2,820	2,930	3,030	2,960	2,900	2,820
B	4.96	5.15	5.24	5.18	5.17	4.98
Cr	0.979	1.03	1.09	1.03	1.11	1.02
Fe	<1.04	<0.860	1.09	<0.865	2.40	<1.11
P	1,640	1,740	1,790	1,760	1,730	1,680
K	643	693	695	693	675	651
Si	1.69	1.51	1.76	1.57	2.01	1.59
Na	85,100	81,200	87,000	88,400	89,400	85,600
S	4,360	4,570	4,700	4,560	4,570	4,410
Zr	0.786	0.811	0.882	0.804	0.932	0.813
Nitrate-N	19,400	19,600	19,800	19,900	18,900	19,200
Nitrite-N	5,690	5,750	5,790	5,830	5,590	5,660
Oxalate	701	764	751	733	727	725
Phosphate-P	1,860	1,890	1,880	1,880	1,810	1,830
Sulfate	15,600	15,700	15,800	15,900	15,400	15,600

Table 2.8. Supernatant Composition Results for Stirred Aging Scenario (mg/kg solution)

Component	Sample ID		
	SAT-15	SAT-22	SAT-30
Al	2,780	2,910	2,930
Cr	0.965	1.03	1.24
Fe	<5.40	<10.5	<8.03
Na	83,300	85,600	85,000

3.0 Conclusions

These tests indicate that there are only minor changes in the characteristics of the simulant with aging under the time and conditions tested as shown in Table 3.1.

These results indicate that storing, stirring, or temperature cycling the simulant should not affect the behavior of the simulant over the time frame tested.

The stirred sample was essentially finished settling after 8 hours, and the stored samples finished settling at ~24 hours whereas the temperature-cycled sample continued to settle throughout the test until 72 hours. They all settled to between 20 vol% and 30 vol% solids after 72 hours. However, the continuously stirred sample resulted in the most significant simulant change, settling to a solids volume of ~21% in 8 hours while the others took 24 hours or longer to settle to a solids volume of ~26%. After settling for 45 days in the tote outside, the solids were easily mixed and re-suspended with no difference in the effort required to re-suspend the solids in the tote at the beginning of the test.

All the aging study samples exhibited Newtonian flow behavior. The overall average simulant viscosity was 3.43 cP with a standard deviation of 0.37 cP. All of the measurements were within this range except for the initial slurry, which indicates that the slurry may have become slightly less viscous by <1cP over this time frame. This indicates that aging did not have a significant effect on the rheology of the PEP simulant under these various conditions, and its flow behavior remained essentially the same.

Measurement of solids content of the simulants did not allow one to discern the effect of the aging conditions on the initial simulant slurry. This is not considered a sufficiently accurate metric for determining aging effects.

The supernatant composition is essentially the same with no significant trends occurring for any component between days 14 and 45. These results indicate that the supernatant reached equilibrium by the time the first sample was collected, and aging did not affect it for both the stored-outside and the stirred aging scenarios.

Table 3.1. Summary Table of Aging Effects

Aging Test	Volume Dist. PSD Change at 50%	Number Dist. PSD Change at 50%	Rheological Change	Chemical Change
Stored Outside	-0.07 microns	0.00 microns	-0.86 cP	Al-0 mg/kg Cr-0.041 mg/kg Na-500 mg/kg
Stirred 30 Days (Inside)	-0.51 microns	+0.02 microns	-0.26 cP	Al-150 mg/kg Cr-0.275 mg/kg Na-1,700 mg/kg
Stored Inside 60 Days	-0.42 microns	+0.02 microns	-1.05 cP	Not Measured
Temperature Cycled 29 Times Over 45 Days	-0.52 microns	+0.01 microns	-1.26 cP	Not Measured

4.0 References

Daniel RC, and RW Shimskey. 2007. "Test Plan for Simulant Testing in Support of Phase I Demonstration of the Ultrafiltration and Leaching Processes in the Integrated Test Facility." TP-RPP-WTP-509, Rev. 0. Pacific Northwest National Laboratory, Richland, Washington.

Sundar PS. 2007. *Simulant Testing in Support of Phase I Demonstration of the Ultrafiltration and Leaching Processes in the Integrated Test Facility*. 24590-WTP-TSP-RT-07-004, Rev. 0, Bechtel National, Inc., Richland, Washington.

Sundar PS. 2008. *Test Exception to 24590-101-TSA-0004-72-00019 Rev 00A: Test Plan for Simulant Testing in Support of Phase I Demonstration of the Ultrafiltration and Leaching Processes in the Integrated Test Facility*. 24590-WTP-TEF-RT-08-00013, Rev. 0, Bechtel National, Inc., Richland, Washington.

Appendix A

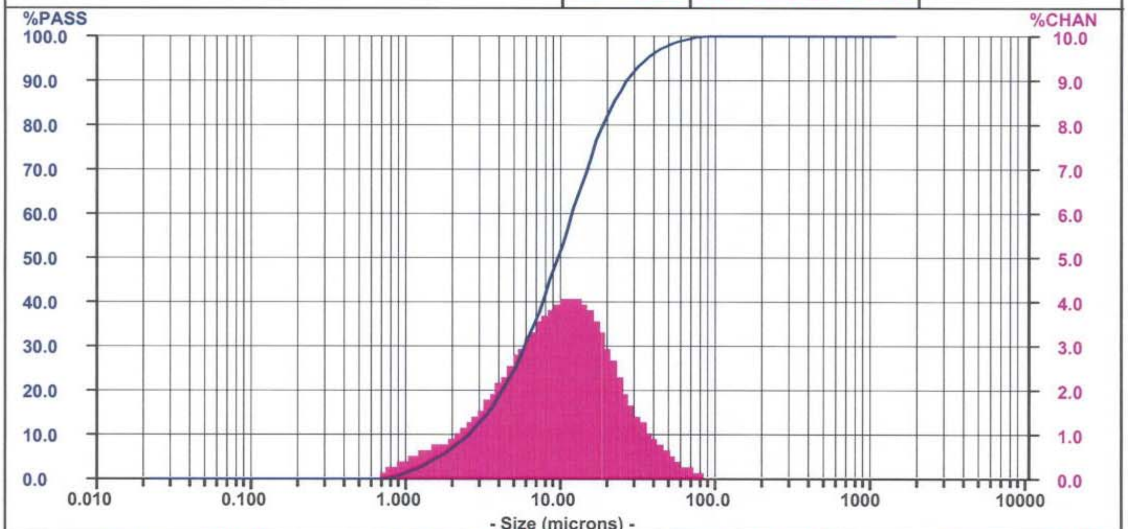
PSD Plots

Appendix A: PSD Plots

Serial Number: S3177 Range: 0.021 -1408 um	MICROTRAC - S3000	V:9.1.15 DB : Original
M12 HLW Simulant	PEP 250 gallon D37455	Date: 10/08/08 Meas #: 926 Time: 14:21 Pres #: 1

Sample:PEP Feed 250 gallon Batch 7/28/08 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Run: 2
Fe2O3 RI setup

Summary	Percentiles		Dia	Vol%	Width
mv = 12.67	5% = 1.644	60% = 11.76	9.503	100%	17.30
mn = 1.427	20% = 4.204	70% = 14.56			
ma = 5.686	30% = 5.840	80% = 18.52			
cs = 1.055	40% = 7.569	90% = 26.22			
sd = 8.650	50% = 9.503	95% = 35.34			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	99.75	0.23	3.889	18.06	1.98	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.52	0.29	3.566	16.08	1.79	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.23	0.36	3.270	14.29	1.62	0.172	0.00	0.00
1086	100.00	0.00	57.06	98.87	0.43	2.999	12.67	1.47	0.158	0.00	0.00
995.6	100.00	0.00	52.33	98.44	0.53	2.750	11.20	1.32	0.145	0.00	0.00
913.0	100.00	0.00	47.98	97.91	0.64	2.522	9.88	1.19	0.133	0.00	0.00
837.2	100.00	0.00	44.00	97.27	0.78	2.312	8.69	1.07	0.122	0.00	0.00
767.7	100.00	0.00	40.35	96.49	0.93	2.121	7.62	0.97	0.111	0.00	0.00
704.0	100.00	0.00	37.00	95.56	1.10	1.945	6.65	0.88	0.102	0.00	0.00
645.6	100.00	0.00	33.93	94.46	1.28	1.783	5.77	0.82	0.094	0.00	0.00
592.0	100.00	0.00	31.11	93.18	1.49	1.635	4.95	0.76	0.086	0.00	0.00
542.9	100.00	0.00	28.53	91.69	1.74	1.499	4.19	0.71	0.079	0.00	0.00
497.8	100.00	0.00	26.16	89.95	2.01	1.375	3.48	0.67	0.072	0.00	0.00
456.5	100.00	0.00	23.99	87.94	2.32	1.261	2.81	0.61	0.066	0.00	0.00
418.6	100.00	0.00	22.00	85.62	2.66	1.156	2.20	0.55	0.061	0.00	0.00
383.9	100.00	0.00	20.17	82.96	3.00	1.060	1.65	0.48	0.056	0.00	0.00
352.0	100.00	0.00	18.50	79.96	3.35	0.972	1.17	0.40	0.051	0.00	0.00
322.8	100.00	0.00	16.96	76.61	3.64	0.892	0.77	0.33	0.047	0.00	0.00
296.0	100.00	0.00	15.56	72.97	3.88	0.818	0.44	0.27	0.043	0.00	0.00
271.4	100.00	0.00	14.27	69.09	4.04	0.750	0.17	0.17	0.039	0.00	0.00
248.9	100.00	0.00	13.08	65.05	4.10	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	60.95	4.11	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	56.84	4.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	52.77	4.00	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	48.77	3.88	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	44.89	3.74	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	41.15	3.58	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	37.57	3.41	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	34.16	3.21	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	30.95	3.00	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	27.95	2.79	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	25.16	2.57	0.265	0.00	0.00			
88.00	100.00	0.09	4.625	22.59	2.36	0.243	0.00	0.00			
80.70	99.91	0.16	4.241	20.23	2.17	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

Filter: On

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Database Path: C:\MTW9115\SIC.DB

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0474
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

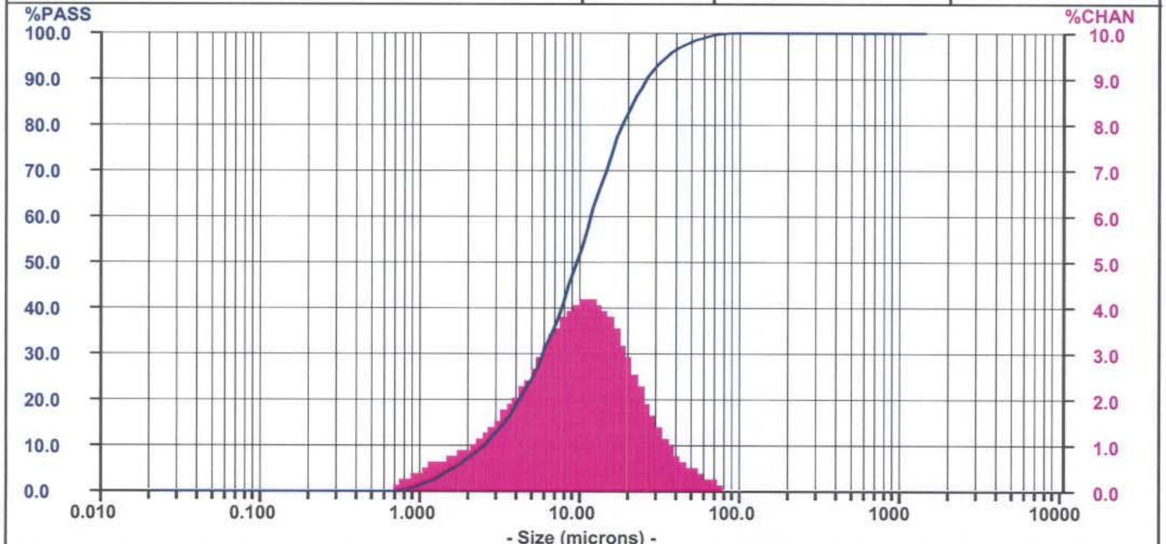
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1102
Time: 13:37 Pres #: 1

Sample:250 GAL Tote 45 Day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 12.46	5% = 1.616	60% = 11.59	9.432	100%	16.97
mn = 1.422	20% = 4.186	70% = 14.31			
ma = 5.635	30% = 5.845	80% = 18.23			
cs = 1.065	40% = 7.564	90% = 25.63			
sd = 8.484	50% = 9.432	95% = 34.42			



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1291	100.00	0.00	67.86	99.65	0.31	3.566	16.25	1.78	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.34	0.36	3.270	14.47	1.61	0.172	0.00	0.00
1086	100.00	0.00	57.06	98.98	0.43	2.999	12.86	1.46	0.158	0.00	0.00
995.6	100.00	0.00	52.33	98.55	0.51	2.750	11.40	1.31	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.04	0.61	2.522	10.09	1.19	0.133	0.00	0.00
837.2	100.00	0.00	44.00	97.43	0.72	2.312	8.90	1.07	0.122	0.00	0.00
767.7	100.00	0.00	40.35	96.71	0.86	2.121	7.83	0.98	0.111	0.00	0.00
704.0	100.00	0.00	37.00	95.85	1.02	1.945	6.85	0.90	0.102	0.00	0.00
645.6	100.00	0.00	33.93	94.83	1.22	1.783	5.95	0.84	0.094	0.00	0.00
592.0	100.00	0.00	31.11	93.61	1.45	1.635	5.11	0.78	0.086	0.00	0.00
542.9	100.00	0.00	28.53	92.16	1.70	1.499	4.33	0.74	0.079	0.00	0.00
497.8	100.00	0.00	26.16	90.46	2.00	1.375	3.59	0.69	0.072	0.00	0.00
456.5	100.00	0.00	23.99	88.46	2.31	1.261	2.90	0.64	0.066	0.00	0.00
418.6	100.00	0.00	22.00	86.15	2.64	1.156	2.26	0.57	0.061	0.00	0.00
383.9	100.00	0.00	20.17	83.51	2.96	1.060	1.69	0.50	0.056	0.00	0.00
352.0	100.00	0.00	18.50	80.55	3.29	0.972	1.19	0.41	0.051	0.00	0.00
322.8	100.00	0.00	16.96	77.26	3.57	0.892	0.78	0.34	0.047	0.00	0.00
296.0	100.00	0.00	15.56	73.69	3.83	0.818	0.44	0.27	0.043	0.00	0.00
271.4	100.00	0.00	14.27	69.86	4.02	0.750	0.17	0.17	0.039	0.00	0.00
248.9	100.00	0.00	13.08	65.84	4.16	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	61.68	4.23	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	57.45	4.22	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	53.23	4.15	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	49.08	4.02	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	45.06	3.86	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	41.20	3.65	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	37.55	3.44	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	34.11	3.20	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	30.91	2.97	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	27.94	2.75	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	25.19	2.53	0.265	0.00	0.00			
88.00	100.00	0.03	4.625	22.66	2.33	0.243	0.00	0.00			
80.70	99.97	0.10	4.241	20.33	2.13	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0392
Transmission: 0.88
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

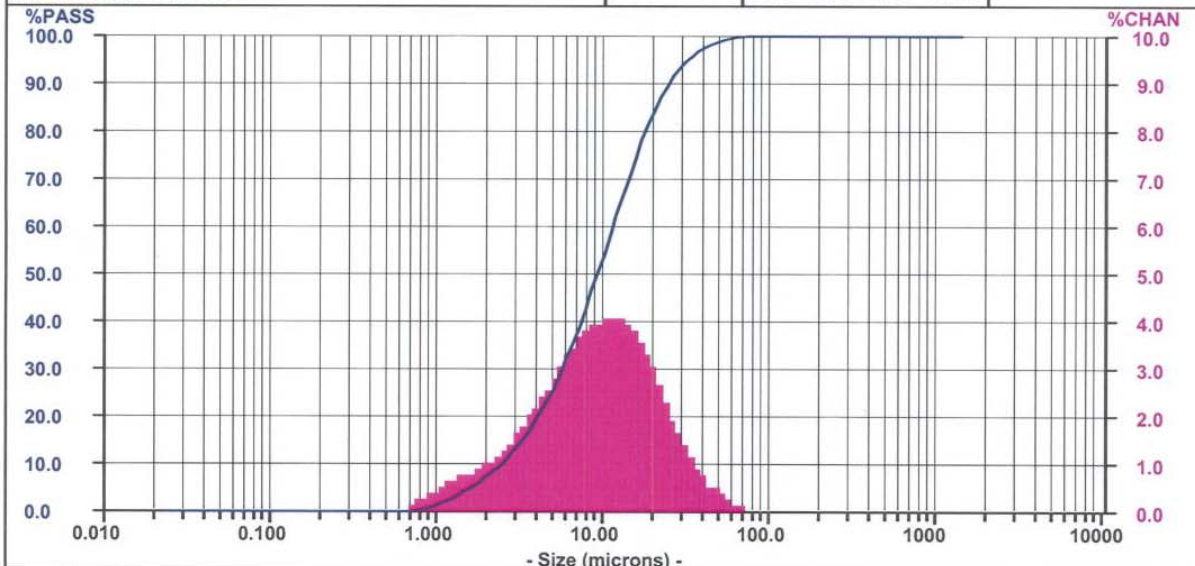
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 08/06/08 Meas #: 928
Time: 19:56 Pres #: 1

Sample:PEP Feed Temperature Cycling 080508 7 day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Fe2O3 RI setup
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.89	5% = 1.605	60% = 11.39	9.197	100%	16.42
mn = 1.434	20% = 4.089	70% = 14.11			
ma = 5.539	30% = 5.675	80% = 17.82			
cs = 1.083	40% = 7.337	90% = 24.38			
sd = 8.210	50% = 9.197	95% = 31.69			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.08	3.889	18.74	2.03	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.92	0.16	3.566	16.71	1.84	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.76	0.23	3.270	14.87	1.67	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.53	0.32	2.999	13.20	1.50	0.158	0.00	0.00
995.6	100.00	0.00	52.33	99.21	0.40	2.750	11.70	1.36	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.81	0.51	2.522	10.34	1.23	0.133	0.00	0.00
837.2	100.00	0.00	44.00	98.30	0.63	2.312	9.11	1.11	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.67	0.79	2.121	8.00	1.02	0.111	0.00	0.00
704.0	100.00	0.00	37.00	96.88	0.97	1.945	6.98	0.93	0.102	0.00	0.00
645.6	100.00	0.00	33.93	95.91	1.17	1.783	6.05	0.87	0.094	0.00	0.00
592.0	100.00	0.00	31.11	94.74	1.41	1.635	5.18	0.81	0.086	0.00	0.00
542.9	100.00	0.00	28.53	93.33	1.70	1.499	4.37	0.76	0.079	0.00	0.00
497.8	100.00	0.00	26.16	91.63	2.02	1.375	3.61	0.71	0.072	0.00	0.00
456.5	100.00	0.00	23.99	89.61	2.36	1.261	2.90	0.65	0.066	0.00	0.00
418.6	100.00	0.00	22.00	87.25	2.73	1.156	2.25	0.58	0.061	0.00	0.00
383.9	100.00	0.00	20.17	84.52	3.07	1.060	1.67	0.50	0.056	0.00	0.00
352.0	100.00	0.00	18.50	81.45	3.40	0.972	1.17	0.41	0.051	0.00	0.00
322.8	100.00	0.00	16.96	78.05	3.67	0.892	0.76	0.33	0.047	0.00	0.00
296.0	100.00	0.00	15.56	74.38	3.87	0.818	0.43	0.27	0.043	0.00	0.00
271.4	100.00	0.00	14.27	70.51	4.00	0.750	0.16	0.16	0.039	0.00	0.00
248.9	100.00	0.00	13.08	66.51	4.06	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	62.45	4.08	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	58.37	4.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	54.30	4.03	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	50.27	3.94	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	46.33	3.83	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	42.50	3.68	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	38.82	3.51	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	35.31	3.31	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	32.00	3.09	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	28.91	2.87	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.04	2.65	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	23.39	2.43	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	20.96	2.22	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0384
Transmission: 0.88
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\SIC.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

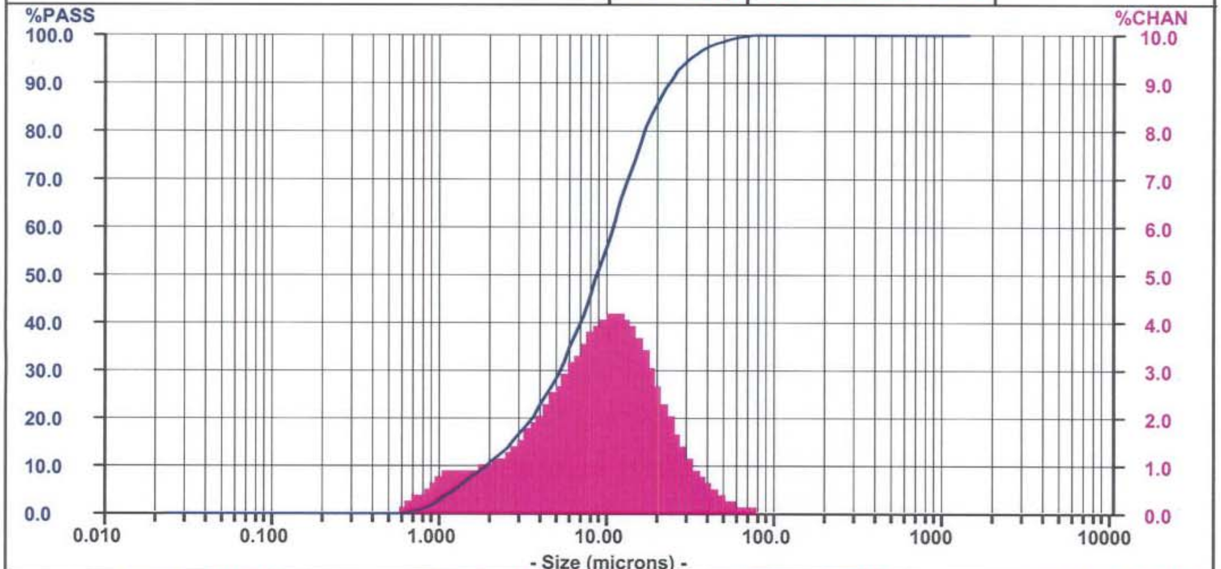
M12 HLW Simulant

PEP Temp Cycl 15 d
D37455

Date: 08/13/08 Meas #: 1044
Time: 23:45 Pres #: 1

Sample: PEP 250 Gallon Feed Batch Temp Cycl 15 day Test
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.21	5% = 1.221	60% = 10.70	8.669	100%	15.73
mn = 1.144	20% = 3.533	70% = 13.19			
ma = 4.688	30% = 5.173	80% = 16.64			
cs = 1.280	40% = 6.860	90% = 23.00			
sd = 7.863	50% = 8.669	95% = 30.41			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.15	3.889	22.17	1.97	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.85	0.22	3.566	20.20	1.80	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.63	0.25	3.270	18.40	1.64	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.38	0.30	2.999	16.76	1.50	0.158	0.00	0.00
995.6	100.00	0.00	52.33	99.08	0.37	2.750	15.26	1.37	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.71	0.44	2.522	13.89	1.26	0.133	0.00	0.00
837.2	100.00	0.00	44.00	98.27	0.54	2.312	12.63	1.17	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.73	0.65	2.121	11.46	1.10	0.111	0.00	0.00
704.0	100.00	0.00	37.00	97.08	0.80	1.945	10.36	1.05	0.102	0.00	0.00
645.6	100.00	0.00	33.93	96.28	0.98	1.783	9.31	1.01	0.094	0.00	0.00
592.0	100.00	0.00	31.11	95.30	1.19	1.635	8.30	1.00	0.086	0.00	0.00
542.9	100.00	0.00	28.53	94.11	1.44	1.499	7.30	0.98	0.079	0.00	0.00
497.8	100.00	0.00	26.16	92.67	1.72	1.375	6.32	0.97	0.072	0.00	0.00
456.5	100.00	0.00	23.99	90.95	2.03	1.261	5.35	0.94	0.066	0.00	0.00
418.6	100.00	0.00	22.00	88.92	2.37	1.156	4.41	0.90	0.061	0.00	0.00
383.9	100.00	0.00	20.17	86.55	2.72	1.060	3.51	0.83	0.056	0.00	0.00
352.0	100.00	0.00	18.50	83.83	3.09	0.972	2.68	0.73	0.051	0.00	0.00
322.8	100.00	0.00	16.96	80.74	3.42	0.892	1.95	0.62	0.047	0.00	0.00
296.0	100.00	0.00	15.56	77.32	3.73	0.818	1.33	0.49	0.043	0.00	0.00
271.4	100.00	0.00	14.27	73.59	3.96	0.750	0.84	0.38	0.039	0.00	0.00
248.9	100.00	0.00	13.08	69.63	4.11	0.688	0.46	0.29	0.036	0.00	0.00
228.2	100.00	0.00	12.00	65.52	4.19	0.630	0.17	0.17	0.033	0.00	0.00
209.3	100.00	0.00	11.00	61.33	4.19	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	57.14	4.13	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	53.01	3.99	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	49.02	3.83	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	45.19	3.63	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	41.56	3.41	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	38.15	3.19	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	34.96	2.98	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	31.98	2.76	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	29.22	2.55	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	26.67	2.35	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	24.32	2.15	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0433
Transmission: 0.85
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

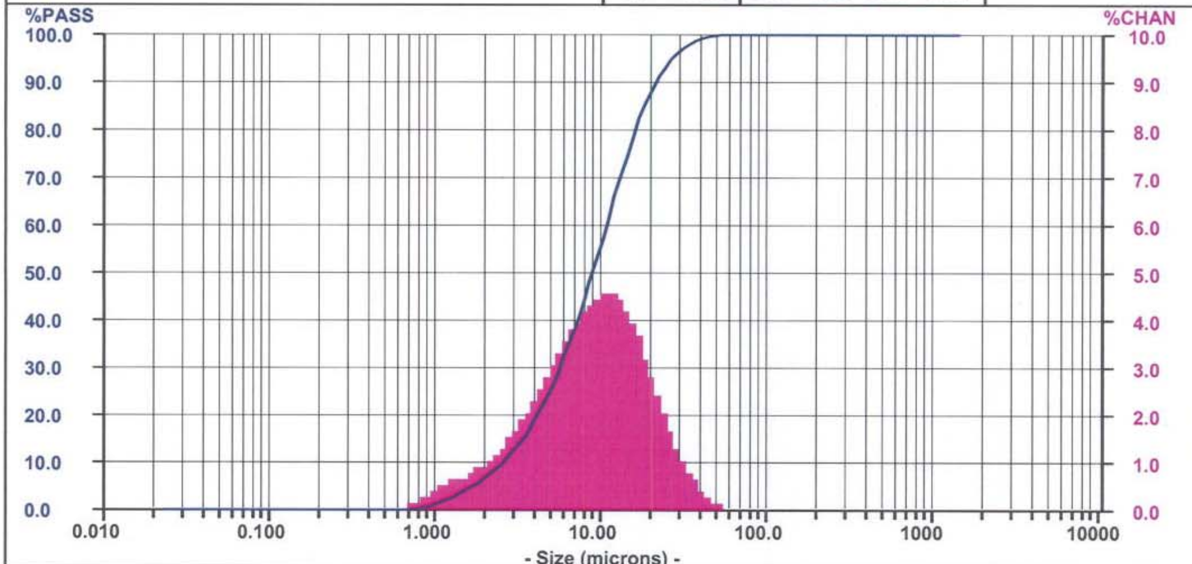
Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177 Range: 0.021 -1408 um	**MICROTRAC - S3000**		V:9.1.15 DB : Original
M12 HLW Simulant	PEP 250 gallon D37455		Date: 10/08/08 Meas #: 1100 Time: 13:37 Pres #: 1

Sample: PEP 250 gal Batch 30 day temperature cycled
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 10.68	5% = 1.685	60% = 10.69	8.820	100%	14.06
mn = 1.482	20% = 4.144	70% = 12.94			
ma = 5.531	30% = 5.636	80% = 15.96			
cs = 1.085	40% = 7.166	90% = 21.08			
sd = 7.030	50% = 8.820	95% = 26.37			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	18.31	2.11	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	16.20	1.91	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	14.29	1.71	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	12.58	1.52	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.13	2.750	11.06	1.36	0.145	0.00	0.00
913.0	100.00	0.00	47.98	99.87	0.24	2.522	9.70	1.21	0.133	0.00	0.00
837.2	100.00	0.00	44.00	99.63	0.34	2.312	8.49	1.08	0.122	0.00	0.00
767.7	100.00	0.00	40.35	99.29	0.47	2.121	7.41	0.98	0.111	0.00	0.00
704.0	100.00	0.00	37.00	98.82	0.65	1.945	6.43	0.89	0.102	0.00	0.00
645.6	100.00	0.00	33.93	98.17	0.85	1.783	5.54	0.81	0.094	0.00	0.00
592.0	100.00	0.00	31.11	97.32	1.09	1.635	4.73	0.75	0.086	0.00	0.00
542.9	100.00	0.00	28.53	96.23	1.36	1.499	3.98	0.70	0.079	0.00	0.00
497.8	100.00	0.00	26.16	94.87	1.68	1.375	3.28	0.65	0.072	0.00	0.00
456.5	100.00	0.00	23.99	93.19	2.03	1.261	2.63	0.59	0.066	0.00	0.00
418.6	100.00	0.00	22.00	91.16	2.44	1.156	2.04	0.53	0.061	0.00	0.00
383.9	100.00	0.00	20.17	88.72	2.85	1.060	1.51	0.46	0.056	0.00	0.00
352.0	100.00	0.00	18.50	85.87	3.29	0.972	1.05	0.37	0.051	0.00	0.00
322.8	100.00	0.00	16.96	82.58	3.68	0.892	0.68	0.30	0.047	0.00	0.00
296.0	100.00	0.00	15.56	78.90	4.04	0.818	0.38	0.24	0.043	0.00	0.00
271.4	100.00	0.00	14.27	74.86	4.30	0.750	0.14	0.14	0.039	0.00	0.00
248.9	100.00	0.00	13.08	70.56	4.48	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	66.08	4.57	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	61.51	4.57	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	56.94	4.51	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	52.43	4.39	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	48.04	4.22	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	43.82	4.03	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	39.79	3.81	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	35.98	3.57	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	32.41	3.32	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	29.09	3.07	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.02	2.81	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	23.21	2.57	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	20.64	2.33	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0360
Transmission: 0.89
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0084
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

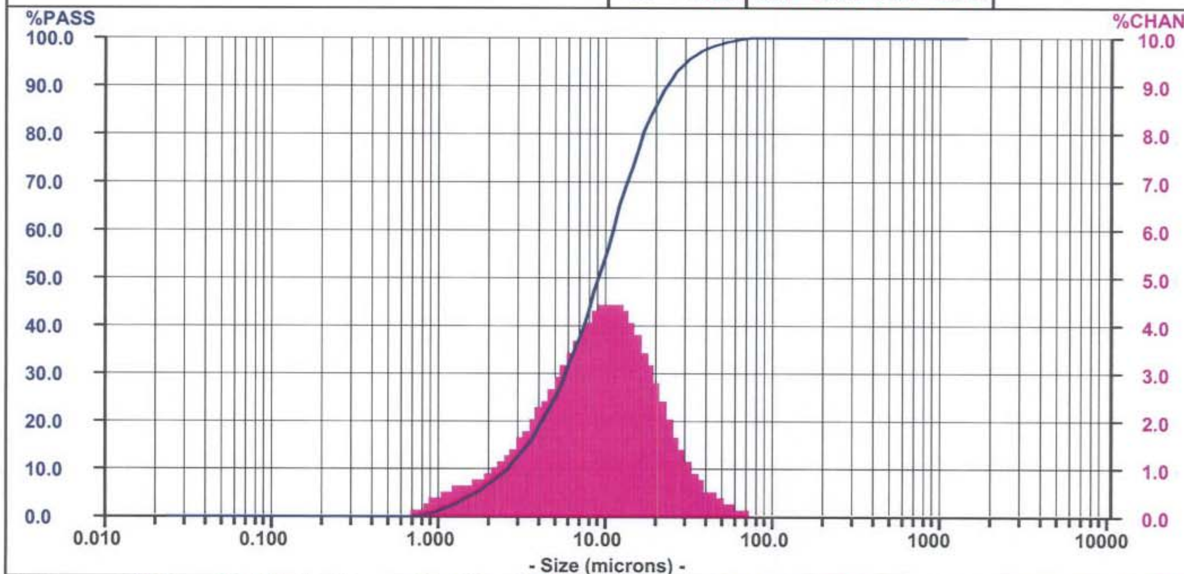
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1105
Time: 13:38 Pres #: 1

Sample:250 GAL Temp Cycl 45 Day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 3
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.43	5% = 1.670	60% = 10.92	8.982	100%	15.02
mn = 1.458	20% = 4.169	70% = 13.31			
ma = 5.578	30% = 5.709	80% = 16.68			
cs = 1.076	40% = 7.287	90% = 22.77			
sd = 7.510	50% = 8.982	95% = 29.73			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.12	3.889	18.19	2.07	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.88	0.19	3.566	16.12	1.87	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.69	0.22	3.270	14.25	1.68	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.47	0.27	2.999	12.57	1.51	0.158	0.00	0.00
995.6	100.00	0.00	52.33	99.20	0.34	2.750	11.06	1.34	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.86	0.41	2.522	9.72	1.20	0.133	0.00	0.00
837.2	100.00	0.00	44.00	98.45	0.51	2.312	8.52	1.07	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.94	0.62	2.121	7.45	0.96	0.111	0.00	0.00
704.0	100.00	0.00	37.00	97.32	0.77	1.945	6.49	0.88	0.102	0.00	0.00
645.6	100.00	0.00	33.93	96.55	0.96	1.783	5.61	0.80	0.094	0.00	0.00
592.0	100.00	0.00	31.11	95.59	1.18	1.635	4.81	0.75	0.086	0.00	0.00
542.9	100.00	0.00	28.53	94.41	1.44	1.499	4.06	0.69	0.079	0.00	0.00
497.8	100.00	0.00	26.16	92.97	1.75	1.375	3.37	0.65	0.072	0.00	0.00
456.5	100.00	0.00	23.99	91.22	2.08	1.261	2.72	0.60	0.066	0.00	0.00
418.6	100.00	0.00	22.00	89.14	2.44	1.156	2.12	0.54	0.061	0.00	0.00
383.9	100.00	0.00	20.17	86.70	2.82	1.060	1.58	0.47	0.056	0.00	0.00
352.0	100.00	0.00	18.50	83.88	3.19	0.972	1.11	0.39	0.051	0.00	0.00
322.8	100.00	0.00	16.96	80.69	3.54	0.892	0.72	0.31	0.047	0.00	0.00
296.0	100.00	0.00	15.56	77.15	3.86	0.818	0.41	0.25	0.043	0.00	0.00
271.4	100.00	0.00	14.27	73.29	4.13	0.750	0.16	0.16	0.039	0.00	0.00
248.9	100.00	0.00	13.08	69.16	4.32	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	64.84	4.44	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	60.40	4.47	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	55.93	4.44	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	51.49	4.33	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	47.16	4.16	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	43.00	3.95	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	39.05	3.72	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	35.33	3.47	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	31.86	3.21	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	28.65	2.97	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	25.68	2.72	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	22.96	2.49	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	20.47	2.28	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0447
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

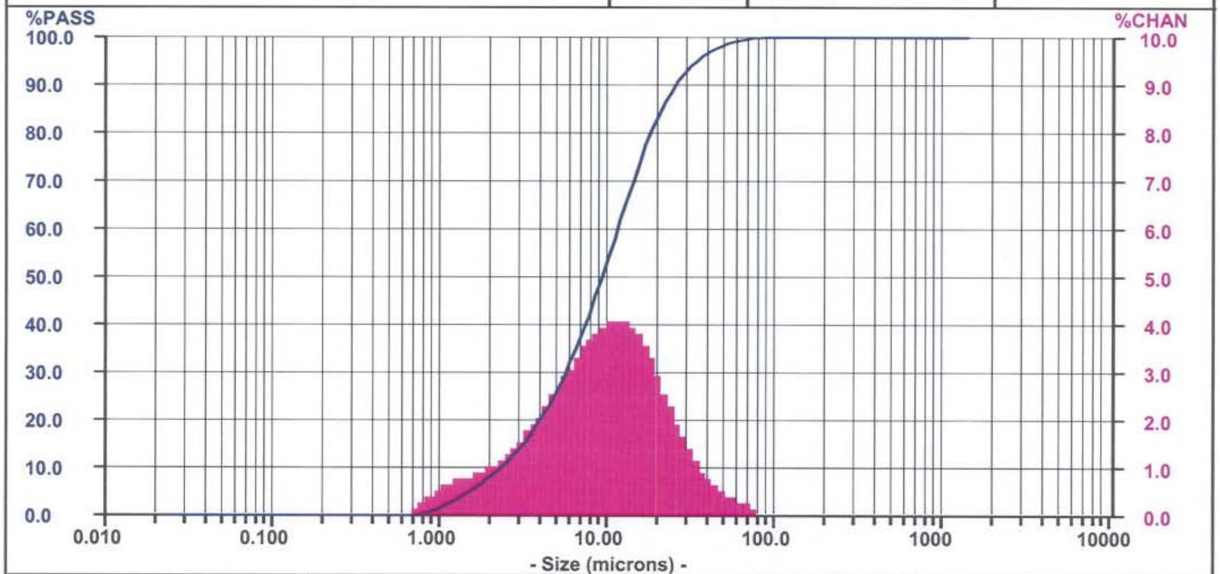
Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177 Range: 0.021 -1408 um	**MICROTRAC - S3000**	V:9.1.15 DB : Original

M12 HLW Simulant	PEP Temp Cycl 15 d D37455	Date: 08/13/08 Meas #: 1047 Time: 23:59 Pres #: 1

Sample: PEP 250 Gallon Feed Batch Stored 15 day Test
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 12.22	5% = 1.521	60% = 11.51	9.306	100%	16.90
mn = 1.385	20% = 4.005	70% = 14.23			
ma = 5.427	30% = 5.655	80% = 18.07			
cs = 1.106	40% = 7.391	90% = 25.21			
sd = 8.452	50% = 9.306	95% = 33.48			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	99.89	0.19	3.889	19.29	1.97	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.70	0.27	3.566	17.32	1.80	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.43	0.31	3.270	15.52	1.64	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.12	0.38	2.999	13.88	1.50	0.158	0.00	0.00
995.6	100.00	0.00	52.33	98.74	0.46	2.750	12.38	1.36	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.28	0.57	2.522	11.02	1.24	0.133	0.00	0.00
837.2	100.00	0.00	44.00	97.71	0.69	2.312	9.78	1.13	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.02	0.83	2.121	8.65	1.05	0.111	0.00	0.00
704.0	100.00	0.00	37.00	96.19	1.01	1.945	7.60	0.97	0.102	0.00	0.00
645.6	100.00	0.00	33.93	95.18	1.21	1.783	6.63	0.91	0.094	0.00	0.00
592.0	100.00	0.00	31.11	93.97	1.44	1.635	5.72	0.86	0.086	0.00	0.00
542.9	100.00	0.00	28.53	92.53	1.71	1.499	4.86	0.81	0.079	0.00	0.00
497.8	100.00	0.00	26.16	90.82	1.99	1.375	4.05	0.77	0.072	0.00	0.00
456.5	100.00	0.00	23.99	88.83	2.31	1.261	3.28	0.71	0.066	0.00	0.00
418.6	100.00	0.00	22.00	86.52	2.65	1.156	2.57	0.65	0.061	0.00	0.00
383.9	100.00	0.00	20.17	83.87	2.98	1.060	1.92	0.56	0.056	0.00	0.00
352.0	100.00	0.00	18.50	80.89	3.32	0.972	1.36	0.47	0.051	0.00	0.00
322.8	100.00	0.00	16.96	77.57	3.60	0.892	0.89	0.38	0.047	0.00	0.00
296.0	100.00	0.00	15.56	73.97	3.84	0.818	0.51	0.31	0.043	0.00	0.00
271.4	100.00	0.00	14.27	70.13	4.02	0.750	0.20	0.20	0.039	0.00	0.00
248.9	100.00	0.00	13.08	66.11	4.13	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	61.98	4.15	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	57.83	4.10	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	53.73	4.00	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	49.73	3.88	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	45.85	3.73	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	42.12	3.55	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	38.57	3.37	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	35.20	3.16	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	32.04	2.96	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	29.08	2.75	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.33	2.54	0.265	0.00	0.00			
88.00	100.00	0.03	4.625	23.79	2.35	0.243	0.00	0.00			
80.70	99.97	0.08	4.241	21.44	2.15	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0609
Transmission: 0.82
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

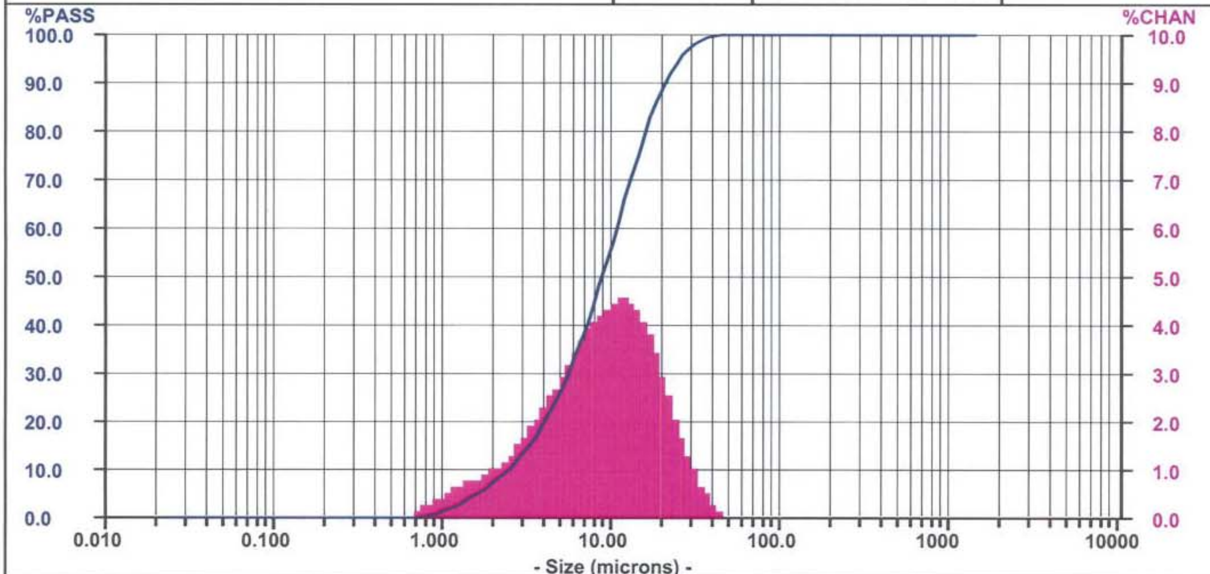
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1099
Time: 13:37 Pres #: 1

Sample: PEP 250 gal Batch 30 day stored
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 10.40	5% = 1.608	60% = 10.67	8.778	100%	13.98
mn = 1.453	20% = 4.030	70% = 12.92			
ma = 5.394	30% = 5.540	80% = 15.85			
cs = 1.112	40% = 7.094	90% = 20.57			
sd = 6.989	50% = 8.778	95% = 25.03			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	19.07	2.11	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	16.96	1.92	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	15.04	1.73	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	13.31	1.55	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	11.76	1.39	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	10.37	1.25	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.17	2.312	9.12	1.13	0.122	0.00	0.00
767.7	100.00	0.00	40.35	99.83	0.32	2.121	7.99	1.02	0.111	0.00	0.00
704.0	100.00	0.00	37.00	99.51	0.51	1.945	6.97	0.94	0.102	0.00	0.00
645.6	100.00	0.00	33.93	99.00	0.74	1.783	6.03	0.87	0.094	0.00	0.00
592.0	100.00	0.00	31.11	98.26	1.04	1.635	5.16	0.81	0.086	0.00	0.00
542.9	100.00	0.00	28.53	97.22	1.38	1.499	4.35	0.76	0.079	0.00	0.00
497.8	100.00	0.00	26.16	95.84	1.74	1.375	3.59	0.71	0.072	0.00	0.00
456.5	100.00	0.00	23.99	94.10	2.14	1.261	2.88	0.65	0.066	0.00	0.00
418.6	100.00	0.00	22.00	91.96	2.56	1.156	2.23	0.58	0.061	0.00	0.00
383.9	100.00	0.00	20.17	89.40	2.99	1.060	1.65	0.50	0.056	0.00	0.00
352.0	100.00	0.00	18.50	86.41	3.43	0.972	1.15	0.41	0.051	0.00	0.00
322.8	100.00	0.00	16.96	82.98	3.81	0.892	0.74	0.32	0.047	0.00	0.00
296.0	100.00	0.00	15.56	79.17	4.14	0.818	0.42	0.26	0.043	0.00	0.00
271.4	100.00	0.00	14.27	75.03	4.38	0.750	0.16	0.16	0.039	0.00	0.00
248.9	100.00	0.00	13.08	70.65	4.52	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	66.13	4.56	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	61.57	4.52	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	57.05	4.43	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	52.62	4.30	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	48.32	4.13	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	44.19	3.95	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	40.24	3.73	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	36.51	3.50	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	33.01	3.27	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	29.74	3.02	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.72	2.78	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	23.94	2.55	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	21.39	2.32	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0146
Transmission: 0.95
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0084
Analysis Gain: 2

Filter: On

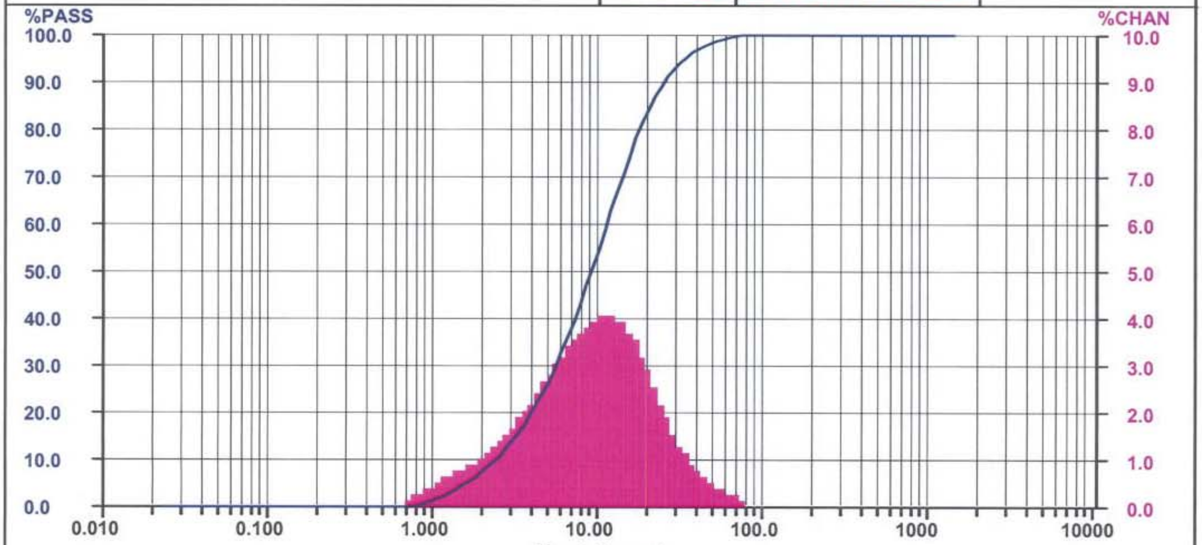
Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177 Range: 0.021 -1408 um	MICROTRAC - S3000	V:9.1.15 DB : Original

M12 HLW Simulant	PEP 250 gallon D37455	Date: 10/08/08 Meas #: 1108 Time: 13:39 Pres #: 1

Sample:PEP 60 day stored
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.98	5% = 1.589	60% = 11.26	9.077	100%	16.53
mn = 1.439	20% = 3.965	70% = 13.96			
ma = 5.454	30% = 5.539	80% = 17.73			
cs = 1.100	40% = 7.212	90% = 24.70			
sd = 8.263	50% = 9.077	95% = 32.91			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.18	3.889	19.51	2.08	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.82	0.27	3.566	17.43	1.91	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.55	0.32	3.270	15.52	1.74	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.23	0.38	2.999	13.78	1.59	0.158	0.00	0.00
995.6	100.00	0.00	52.33	98.85	0.47	2.750	12.19	1.44	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.38	0.56	2.522	10.75	1.30	0.133	0.00	0.00
837.2	100.00	0.00	44.00	97.82	0.67	2.312	9.45	1.18	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.15	0.80	2.121	8.27	1.08	0.111	0.00	0.00
704.0	100.00	0.00	37.00	96.35	0.96	1.945	7.19	0.99	0.102	0.00	0.00
645.6	100.00	0.00	33.93	95.39	1.15	1.783	6.20	0.91	0.094	0.00	0.00
592.0	100.00	0.00	31.11	94.24	1.37	1.635	5.29	0.85	0.086	0.00	0.00
542.9	100.00	0.00	28.53	92.87	1.62	1.499	4.44	0.78	0.079	0.00	0.00
497.8	100.00	0.00	26.16	91.25	1.92	1.375	3.66	0.73	0.072	0.00	0.00
456.5	100.00	0.00	23.99	89.33	2.24	1.261	2.93	0.66	0.066	0.00	0.00
418.6	100.00	0.00	22.00	87.09	2.59	1.156	2.27	0.59	0.061	0.00	0.00
383.9	100.00	0.00	20.17	84.50	2.93	1.060	1.68	0.50	0.056	0.00	0.00
352.0	100.00	0.00	18.50	81.57	3.26	0.972	1.18	0.42	0.051	0.00	0.00
322.8	100.00	0.00	16.96	78.31	3.55	0.892	0.76	0.33	0.047	0.00	0.00
296.0	100.00	0.00	15.56	74.76	3.77	0.818	0.43	0.27	0.043	0.00	0.00
271.4	100.00	0.00	14.27	70.99	3.94	0.750	0.16	0.16	0.039	0.00	0.00
248.9	100.00	0.00	13.08	67.05	4.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	63.01	4.08	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	58.93	4.06	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	54.87	4.00	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	50.87	3.91	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	46.96	3.78	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	43.18	3.63	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	39.55	3.46	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	36.09	3.26	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	32.83	3.07	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	29.76	2.86	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.90	2.66	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	24.24	2.46	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	21.78	2.27	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0453
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

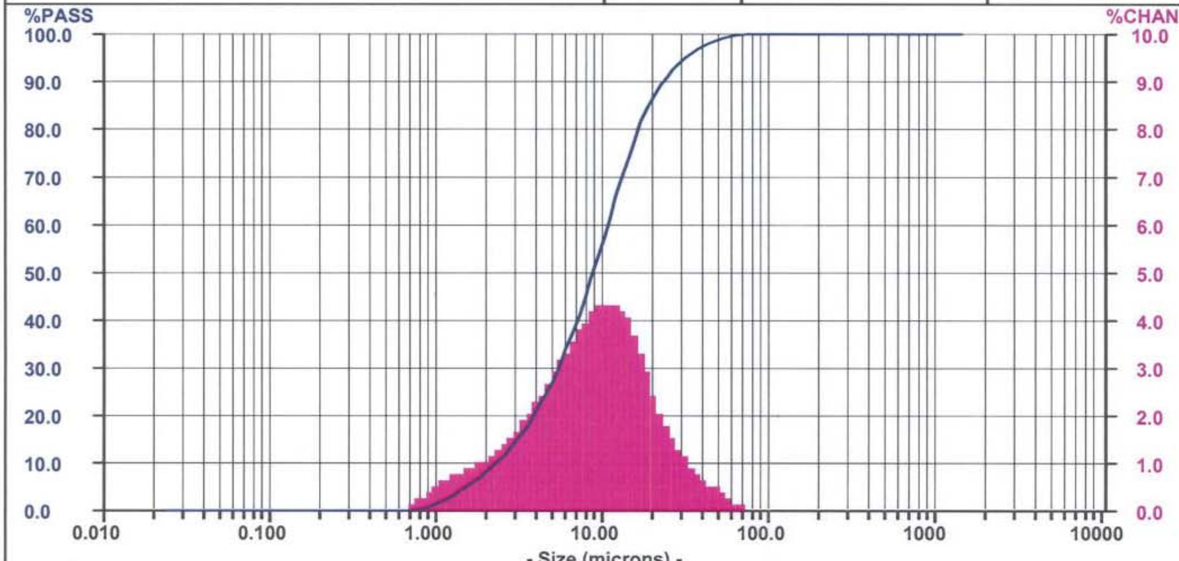
Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177 Range: 0.021 -1408 um	**MICROTRAC - S3000**	V:9.1.15 DB : Original
M12 HLW Simulant	PEP SAT 15 D37455	Date: 10/24/08 Meas #: 1114 Time: 20:39 Pres #: 1

Sample:PEP SAT 15 102308 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.22	5% = 1.510	60% = 10.63	8.696	100%	14.94
mn = 1.422	20% = 3.849	70% = 12.96			
ma = 5.239	30% = 5.382	80% = 16.24			
cs = 1.145	40% = 6.977	90% = 22.77			
sd = 7.470	50% = 8.696	95% = 30.90			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.07	3.889	20.26	2.11	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.93	0.14	3.566	18.15	1.93	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.79	0.23	3.270	16.22	1.75	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.56	0.32	2.999	14.47	1.59	0.158	0.00	0.00
995.6	100.00	0.00	52.33	99.24	0.41	2.750	12.88	1.44	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.83	0.51	2.522	11.44	1.31	0.133	0.00	0.00
837.2	100.00	0.00	44.00	98.32	0.63	2.312	10.13	1.20	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.69	0.74	2.121	8.93	1.10	0.111	0.00	0.00
704.0	100.00	0.00	37.00	96.95	0.86	1.945	7.83	1.03	0.102	0.00	0.00
645.6	100.00	0.00	33.93	96.09	1.00	1.783	6.80	0.96	0.094	0.00	0.00
592.0	100.00	0.00	31.11	95.09	1.15	1.635	5.84	0.91	0.086	0.00	0.00
542.9	100.00	0.00	28.53	93.94	1.33	1.499	4.93	0.87	0.079	0.00	0.00
497.8	100.00	0.00	26.16	92.61	1.55	1.375	4.06	0.81	0.072	0.00	0.00
456.5	100.00	0.00	23.99	91.06	1.81	1.261	3.25	0.75	0.066	0.00	0.00
418.6	100.00	0.00	22.00	89.25	2.14	1.156	2.50	0.66	0.061	0.00	0.00
383.9	100.00	0.00	20.17	87.11	2.52	1.060	1.84	0.57	0.056	0.00	0.00
352.0	100.00	0.00	18.50	84.59	2.94	0.972	1.27	0.46	0.051	0.00	0.00
322.8	100.00	0.00	16.96	81.65	3.36	0.892	0.81	0.36	0.047	0.00	0.00
296.0	100.00	0.00	15.56	78.29	3.76	0.818	0.45	0.28	0.043	0.00	0.00
271.4	100.00	0.00	14.27	74.53	4.07	0.750	0.17	0.17	0.039	0.00	0.00
248.9	100.00	0.00	13.08	70.46	4.29	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	66.17	4.41	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	61.76	4.40	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	57.36	4.34	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	53.02	4.20	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	48.82	4.04	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	44.78	3.83	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	40.95	3.62	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	37.33	3.40	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	33.93	3.17	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	30.76	2.95	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	27.81	2.73	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	25.08	2.51	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	22.57	2.31	0.223	0.00	0.00			

Distribution: Volume	RunTime: 30 seconds	Fluid: Water	Analysis Mode: S3000
Progression: Geometric Root8	Run Number Avg of 3 runs	Fluid Refractive Index: 1.33	Sample Cell Id: 0735
Upper Edge: 1408	Particle: Fe2O3	Loading Factor: 0.0380	Analysis Gain: 2
Lower Edge: 0.021	Particle Transparency: Trans	Transmission: 0.88	
Residuals: Disabled	Particle Refractive Index: 2.98	Above Residual: 0.00	
Number Of Channels: 128	Particle Shape: Irregular	Below Residual: 0.00	
Filter: On	Database Path: C:\MTW9115\WCBTEST.DB		

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Original

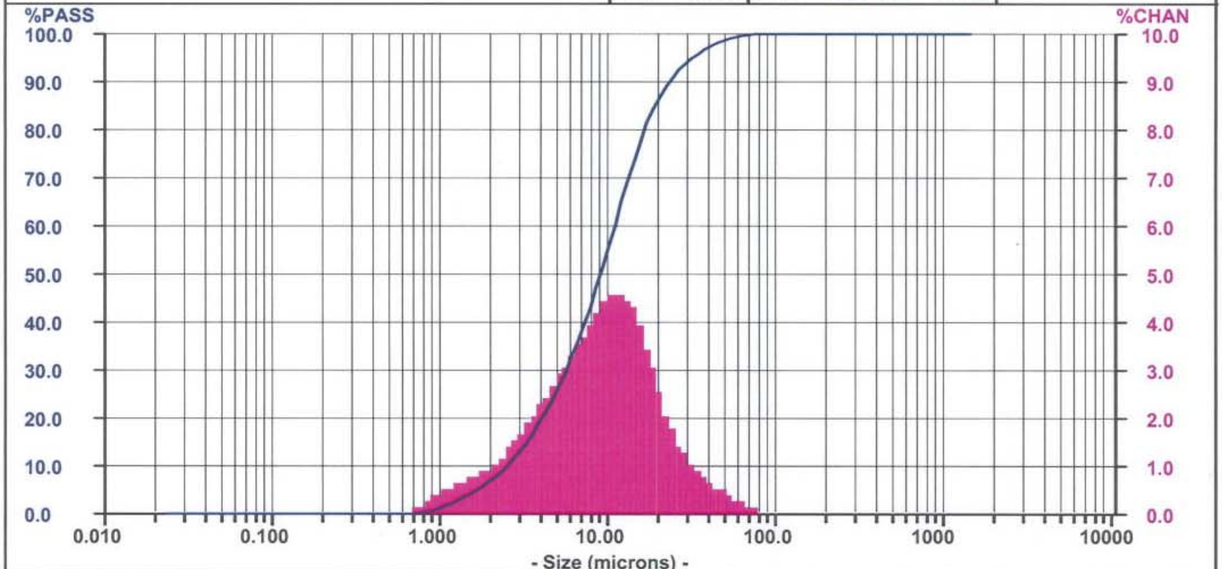
M12 HLW Simulant

PEP SAT 30
D37455

Date: 11/11/08 Meas #: 1117
Time: 21:47 Pres #: 1

Sample:PEP SAT 30 110608 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Vol%	Width
mv = 11.48	5% = 1.667	60% = 10.90	8.992	100%	14.76
mn = 1.469	20% = 4.072	70% = 13.17			
ma = 5.530	30% = 5.609	80% = 16.34			
cs = 1.085	40% = 7.243	90% = 22.80			
sd = 7.378	50% = 8.992	95% = 31.25			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.14	3.889	18.79	2.13	0.204	0.00	0.00
1291	100.00	0.00	67.86	99.86	0.22	3.566	16.66	1.94	0.187	0.00	0.00
1184	100.00	0.00	62.23	99.64	0.26	3.270	14.72	1.75	0.172	0.00	0.00
1086	100.00	0.00	57.06	99.38	0.33	2.999	12.97	1.58	0.158	0.00	0.00
995.6	100.00	0.00	52.33	99.05	0.42	2.750	11.39	1.41	0.145	0.00	0.00
913.0	100.00	0.00	47.98	98.63	0.51	2.522	9.98	1.26	0.133	0.00	0.00
837.2	100.00	0.00	44.00	98.12	0.62	2.312	8.72	1.13	0.122	0.00	0.00
767.7	100.00	0.00	40.35	97.50	0.73	2.121	7.59	1.01	0.111	0.00	0.00
704.0	100.00	0.00	37.00	96.77	0.85	1.945	6.58	0.92	0.102	0.00	0.00
645.6	100.00	0.00	33.93	95.92	0.97	1.783	5.66	0.84	0.094	0.00	0.00
592.0	100.00	0.00	31.11	94.95	1.12	1.635	4.82	0.77	0.086	0.00	0.00
542.9	100.00	0.00	28.53	93.83	1.29	1.499	4.05	0.71	0.079	0.00	0.00
497.8	100.00	0.00	26.16	92.54	1.51	1.375	3.34	0.65	0.072	0.00	0.00
456.5	100.00	0.00	23.99	91.03	1.80	1.261	2.69	0.60	0.066	0.00	0.00
418.6	100.00	0.00	22.00	89.23	2.15	1.156	2.09	0.54	0.061	0.00	0.00
383.9	100.00	0.00	20.17	87.08	2.56	1.060	1.55	0.46	0.056	0.00	0.00
352.0	100.00	0.00	18.50	84.52	3.04	0.972	1.09	0.38	0.051	0.00	0.00
322.8	100.00	0.00	16.96	81.48	3.52	0.892	0.71	0.31	0.047	0.00	0.00
296.0	100.00	0.00	15.56	77.96	3.98	0.818	0.40	0.25	0.043	0.00	0.00
271.4	100.00	0.00	14.27	73.98	4.32	0.750	0.15	0.15	0.039	0.00	0.00
248.9	100.00	0.00	13.08	69.66	4.55	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	65.11	4.64	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	60.47	4.59	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	55.88	4.46	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	51.42	4.25	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	47.17	4.03	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	43.14	3.79	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	39.35	3.56	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	35.79	3.35	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	32.44	3.13	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	29.31	2.93	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	26.38	2.73	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	23.65	2.53	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	21.12	2.33	0.223	0.00	0.00			

Distribution: Volume
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0487
Transmission: 0.85
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

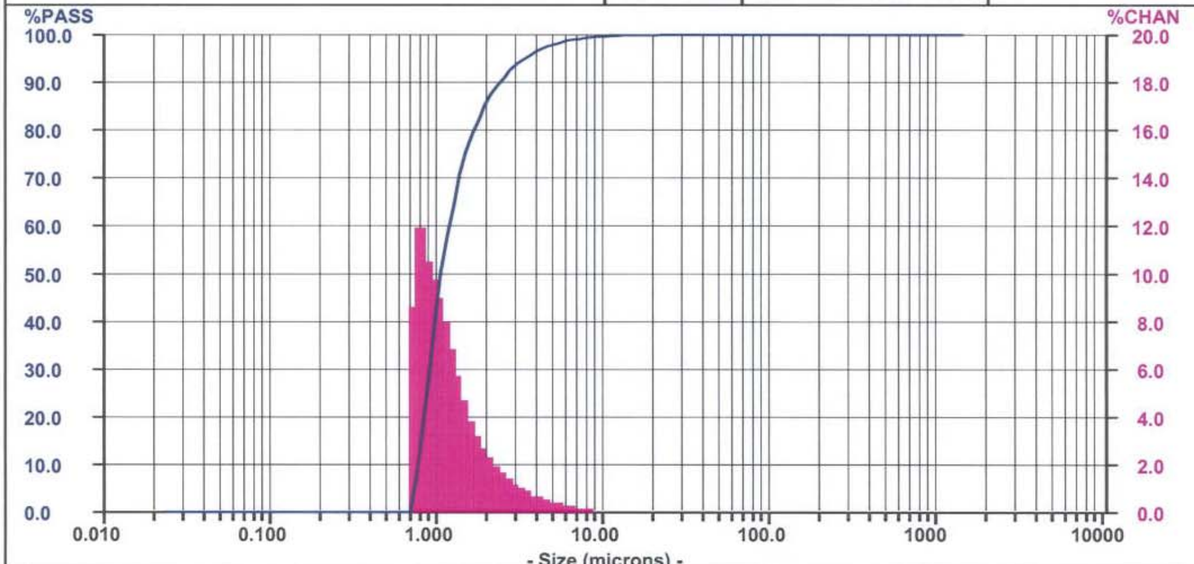
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 926
Time: 14:25 Pres #: 1

Sample:PEP Feed 250 gallon Batch 7/28/08 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Run: 2
Fe2O3 RI setup

Summary	Percentiles		Dia	Num%	Width
mv = 12.67	5% = 0.727	60% = 1.184	1.060	100%	1.075
mn = 1.427	20% = 0.814	70% = 1.361			
ma = 5.686	30% = 0.883	80% = 1.666			
cs = 1.055	40% = 0.964	90% = 2.378			
sd = 0.538	50% = 1.060	95% = 3.331			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.44	0.75	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.69	0.89	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.80	1.04	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.76	1.22	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.54	1.43	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	91.11	1.67	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.44	1.94	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	87.50	2.28	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	85.22	2.70	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	82.52	3.23	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	79.29	3.89	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	75.40	4.73	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	70.67	5.76	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	64.91	6.86	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	58.05	8.03	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	50.02	9.06	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	40.96	9.77	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	31.19	10.56	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	20.63	11.94	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.69	8.69	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.81	0.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.74	0.09	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.65	0.11	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.54	0.14	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.40	0.17	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.23	0.21	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.02	0.26	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.76	0.31	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.45	0.38	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.07	0.45	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.62	0.54	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.08	0.64	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0474
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\SIC.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

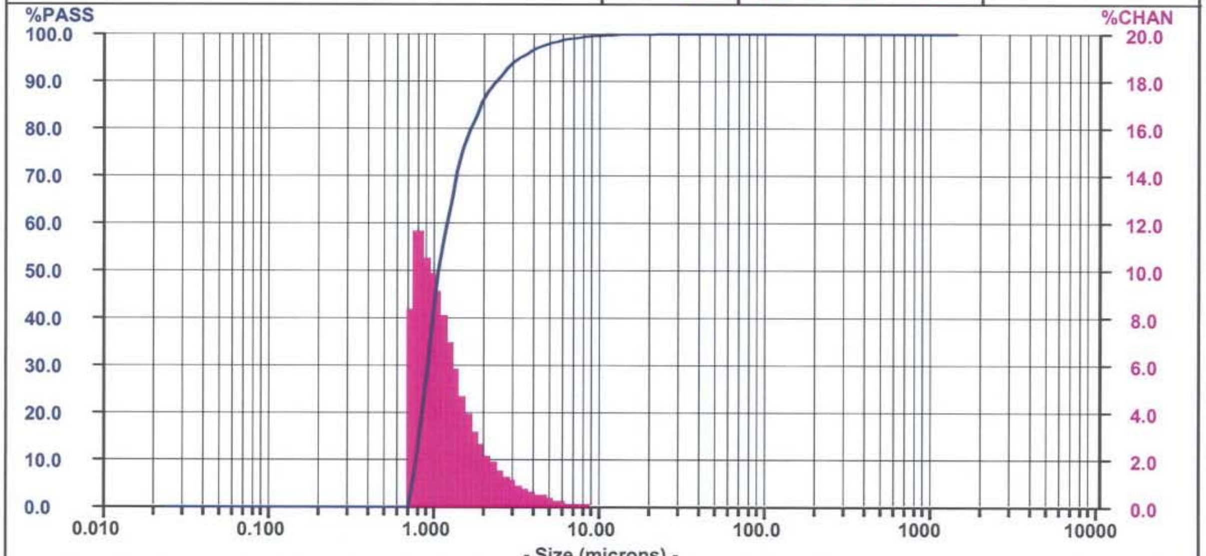
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1102
Time: 14:48 Pres #: 1

Sample:250 GAL Tote 45 Day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 12.46	5% = 0.728	60% = 1.183	1.062	100%	1.053
mn = 1.422	20% = 0.817	70% = 1.357			
ma = 5.635	30% = 0.886	80% = 1.651			
cs = 1.065	40% = 0.967	90% = 2.346			
sd = 0.527	50% = 1.062	95% = 3.289			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.55	0.73	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.82	0.86	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.96	1.01	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.95	1.19	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.76	1.39	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	91.37	1.63	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.74	1.90	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	87.84	2.26	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	85.58	2.69	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	82.89	3.25	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	79.64	3.94	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	75.70	4.80	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	70.90	5.86	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	65.04	6.99	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	58.05	8.18	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	49.87	9.21	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	40.66	9.89	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	30.77	10.57	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	20.20	11.73	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.47	8.47	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.81	0.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.74	0.09	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.65	0.11	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.54	0.14	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.40	0.17	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.23	0.21	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.02	0.25	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.77	0.30	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.47	0.36	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.11	0.43	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.68	0.52	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.16	0.61	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

Filter: On

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Database Path: C:\MTW9115\WCBTEST.DB

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0392
Transmission: 0.88
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

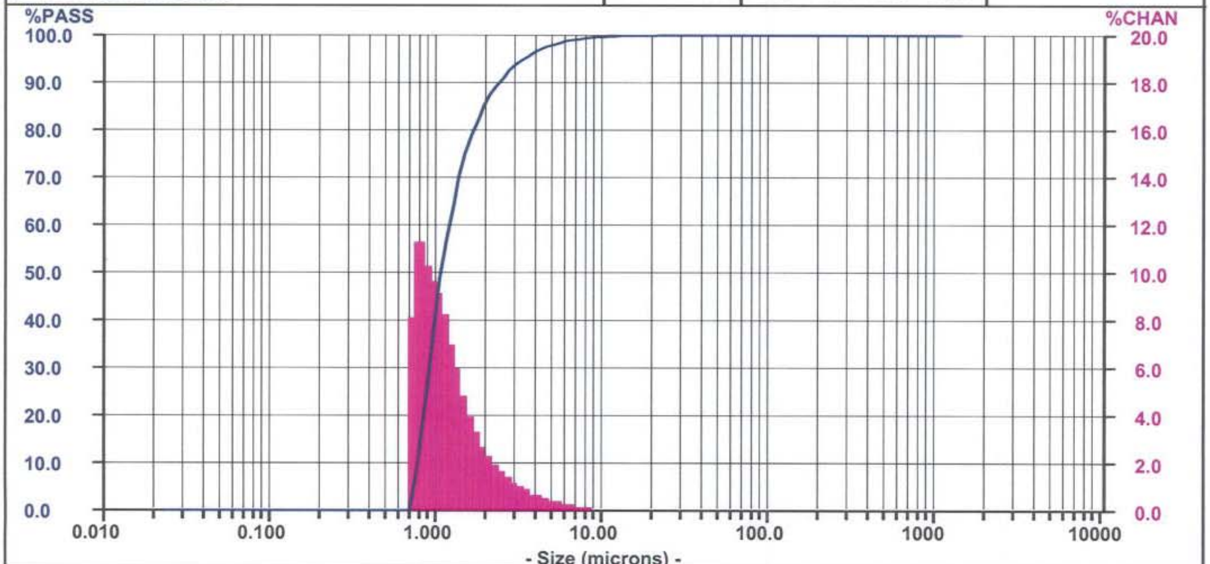
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 928
Time: 14:27 Pres #: 1

Sample:PEP Feed Temperature Cycling 080508 7 day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Fe2O3 RI setup
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.89	5% = 0.729	60% = 1.197	1.073	100%	1.076
mn = 1.434	20% = 0.821	70% = 1.373			
ma = 5.539	30% = 0.893	80% = 1.674			
cs = 1.083	40% = 0.975	90% = 2.376			
sd = 0.538	50% = 1.073	95% = 3.327			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.44	0.75	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.69	0.89	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.80	1.04	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.76	1.22	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.54	1.43	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	91.11	1.67	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.44	1.97	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	87.47	2.33	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	85.14	2.77	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	82.37	3.34	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	79.03	4.04	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	74.99	4.92	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	70.07	5.96	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	64.11	7.07	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	57.04	8.24	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	48.80	9.19	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	39.61	9.73	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	29.88	10.31	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	19.57	11.36	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.21	8.21	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.81	0.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.74	0.09	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.65	0.11	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.54	0.14	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.40	0.17	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.23	0.21	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.02	0.26	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.76	0.31	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.45	0.38	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.07	0.45	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.62	0.54	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.08	0.64	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

Filter: On

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Database Path: C:\MTW9115\SIC.DB

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0384
Transmission: 0.88
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Serial Number: S3177 Range: 0.021 -1408 um	MICROTRAC - S3000	V:9.1.15 DB : Recalc

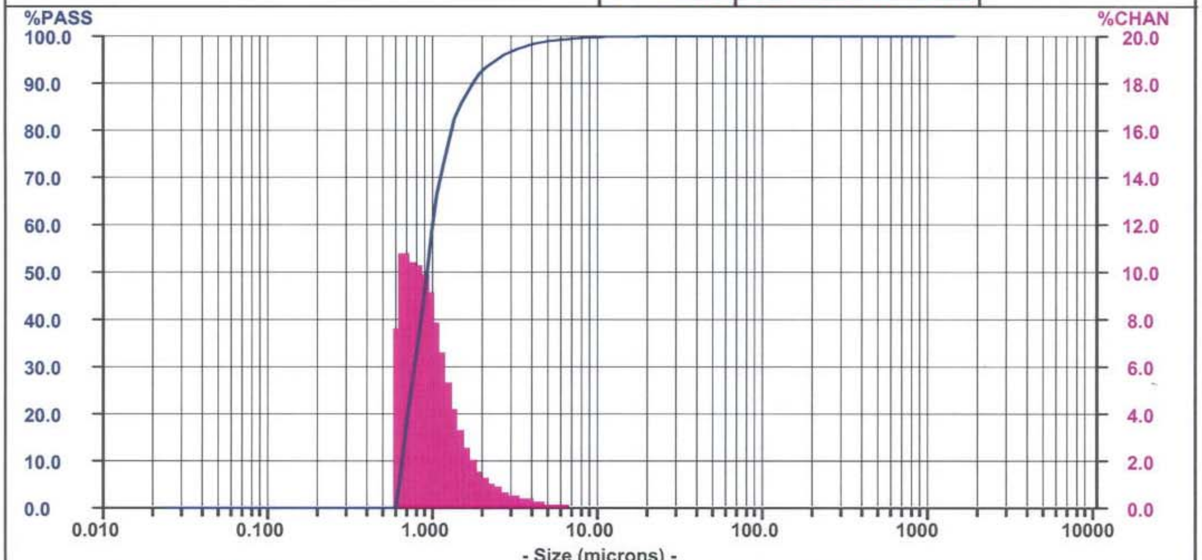
M12 HLW Simulant

PEP Temp Cycl 15 d
D37455

Date: 08/14/08 Meas #: 1044
Time: 15:55 Pres #: 1

Sample: PEP 250 Gallon Feed Batch Temp Cycl 15 day Test
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.21	5% = 0.615	60% = 0.989	0.898	100%	0.750
mn = 1.144	20% = 0.697	70% = 1.110			
ma = 4.688	30% = 0.757	80% = 1.302			
cs = 1.280	40% = 0.823	90% = 1.742			
sd = 0.375	50% = 0.898	95% = 2.413			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	98.18	0.38	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	97.80	0.45	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	97.35	0.54	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	96.81	0.63	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	96.18	0.75	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	95.43	0.90	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	94.53	1.08	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	93.45	1.31	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	92.14	1.62	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	90.52	2.04	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	88.48	2.59	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	85.89	3.32	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	82.57	4.23	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	78.34	5.35	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.00	1.156	72.99	6.67	0.061	0.00	0.00
383.9	100.00	0.00	20.17	100.00	0.00	1.060	66.32	7.94	0.056	0.00	0.00
352.0	100.00	0.00	18.50	100.00	0.01	0.972	58.38	9.15	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.99	0.01	0.892	49.23	9.98	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.98	0.01	0.818	39.25	10.29	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.97	0.02	0.750	28.96	10.45	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.95	0.02	0.688	18.51	10.88	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.93	0.03	0.630	7.63	7.63	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.90	0.04	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.86	0.05	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.81	0.06	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.75	0.07	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.68	0.09	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.59	0.11	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.48	0.13	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	99.35	0.16	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	99.19	0.19	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	99.00	0.23	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	98.77	0.27	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	98.50	0.32	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0433
Transmission: 0.85
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

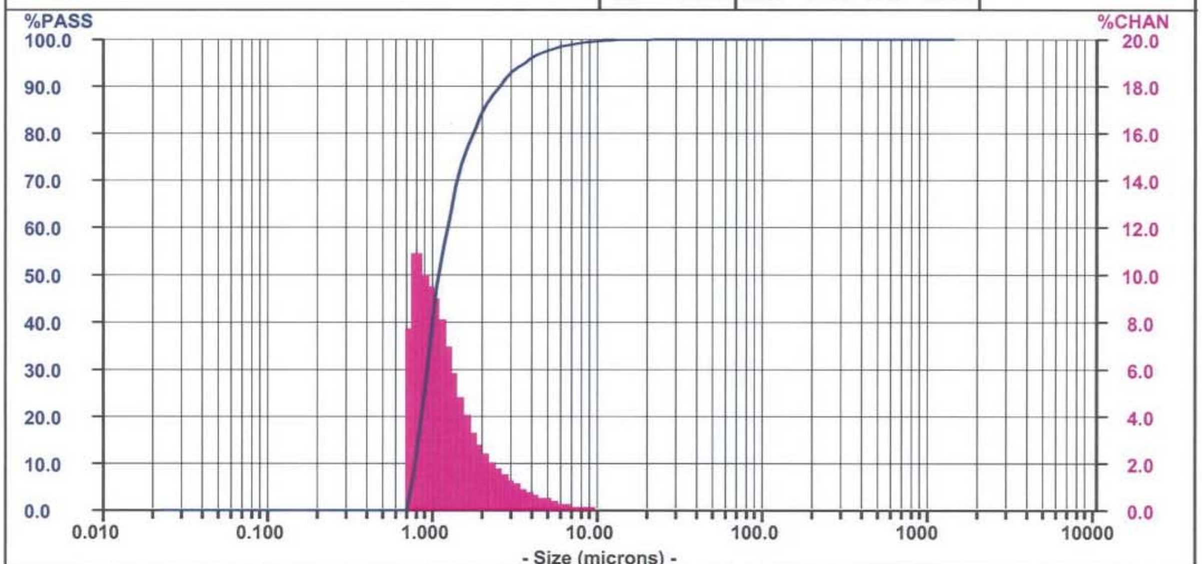
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1100
Time: 14:46 Pres #: 1

Sample: PEP 250 gal Batch 30 day temperature cycled
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 10.68	5% = 0.730	60% = 1.218	1.088	100%	1.162
mn = 1.482	20% = 0.827	70% = 1.410			
ma = 5.531	30% = 0.902	80% = 1.742			
cs = 1.085	40% = 0.987	90% = 2.520			
sd = 0.581	50% = 1.088	95% = 3.551			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	95.91	0.85	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.06	0.99	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.07	1.15	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	92.92	1.34	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	91.58	1.55	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	90.03	1.79	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	88.24	2.07	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	86.17	2.42	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	83.75	2.85	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	80.90	3.39	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	77.51	4.06	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	73.45	4.89	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	68.56	5.88	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	62.68	6.98	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	55.70	8.19	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	47.51	9.11	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	38.40	9.59	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	28.81	10.05	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.03	0.818	18.76	10.94	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.92	0.03	0.750	7.82	7.82	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.89	0.05	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.84	0.06	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.78	0.08	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.70	0.10	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.60	0.13	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.47	0.16	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.31	0.20	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.11	0.25	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	98.86	0.30	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.56	0.36	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.20	0.44	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	97.76	0.52	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.24	0.61	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	96.63	0.72	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0360
Transmission: 0.89
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0084
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

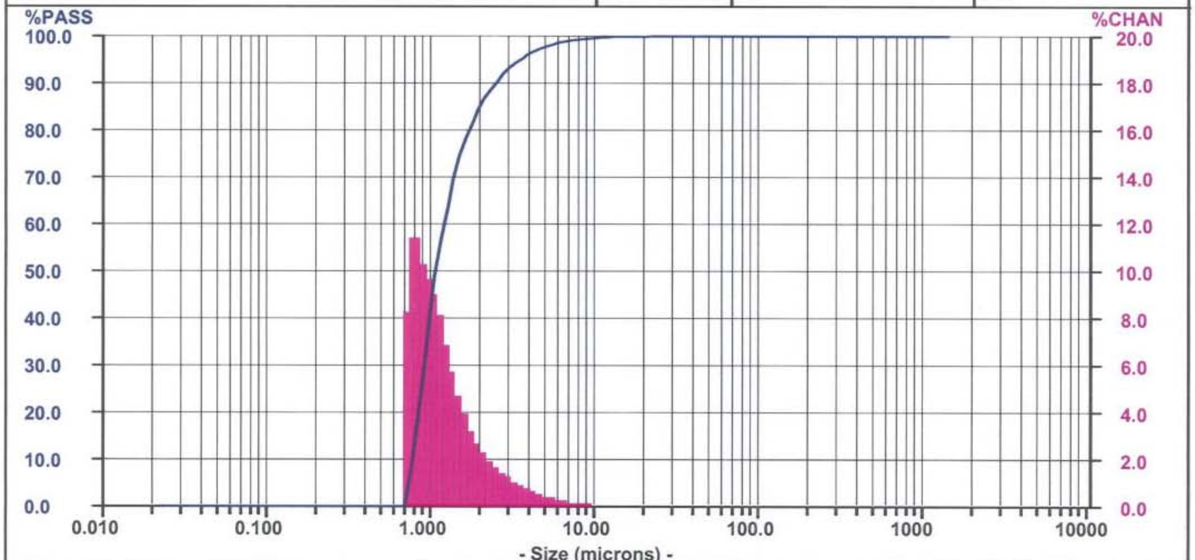
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1105
Time: 14:51 Pres #: 1

Sample:250 GAL Temp Cycl 45 Day
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 3
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.43	5% = 0.728	60% = 1.198	1.072	100%	1.125
mn = 1.458	20% = 0.820	70% = 1.383			
ma = 5.578	30% = 0.891	80% = 1.704			
cs = 1.076	40% = 0.974	90% = 2.465			
sd = 0.562	50% = 1.072	95% = 3.471			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.10	0.81	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.29	0.95	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.34	1.11	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.23	1.29	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	91.94	1.49	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	90.45	1.72	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	88.73	1.99	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	86.74	2.33	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	84.41	2.75	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	81.66	3.28	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	78.38	3.93	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	74.45	4.76	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	69.69	5.77	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	63.92	6.89	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	57.03	8.12	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	48.91	9.11	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	39.80	9.70	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	30.10	10.34	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	19.76	11.48	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.28	8.28	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.06	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.80	0.08	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.72	0.10	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.62	0.13	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.49	0.16	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.33	0.19	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.14	0.24	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	98.90	0.29	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.61	0.34	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.27	0.41	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	97.86	0.49	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.37	0.58	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	96.79	0.69	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0447
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

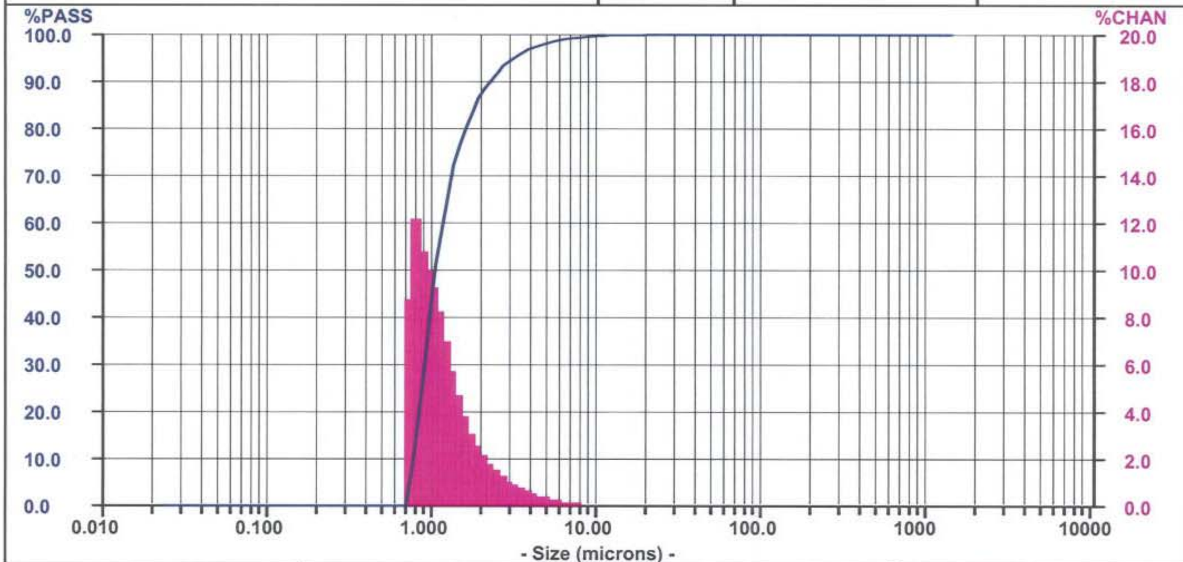
M12 HLW Simulant

PEP Temp Cycl 15 d
D37455

Date: 08/14/08 Meas #: 1047
Time: 15:59 Pres #: 1

Sample: PEP 250 Gallon Feed Batch Stored 15 day Test
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 12.22	5% = 0.726	60% = 1.164	1.048	100%	0.991
mn = 1.385	20% = 0.812	70% = 1.327			
ma = 5.427	30% = 0.879	80% = 1.601			
cs = 1.106	40% = 0.957	90% = 2.241			
sd = 0.495	50% = 1.048	95% = 3.127			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.90	0.66	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	96.24	0.78	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	95.46	0.93	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	94.53	1.09	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	93.44	1.29	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	92.15	1.53	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	90.62	1.81	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	88.81	2.16	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	86.65	2.60	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	84.05	3.16	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	80.89	3.86	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	77.03	4.75	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	72.28	5.82	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	66.46	7.00	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.00	1.156	59.46	8.29	0.061	0.00	0.00
383.9	100.00	0.00	20.17	100.00	0.01	1.060	51.17	9.36	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.99	0.01	0.972	41.81	10.02	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.98	0.01	0.892	31.79	10.79	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.97	0.02	0.818	21.00	12.16	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.95	0.03	0.750	8.84	8.84	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.92	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.88	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.83	0.06	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.77	0.08	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.69	0.10	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.59	0.12	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.47	0.15	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.32	0.18	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.14	0.22	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.92	0.27	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.65	0.33	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.32	0.39	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.93	0.47	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.46	0.56	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0609
Transmission: 0.82
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

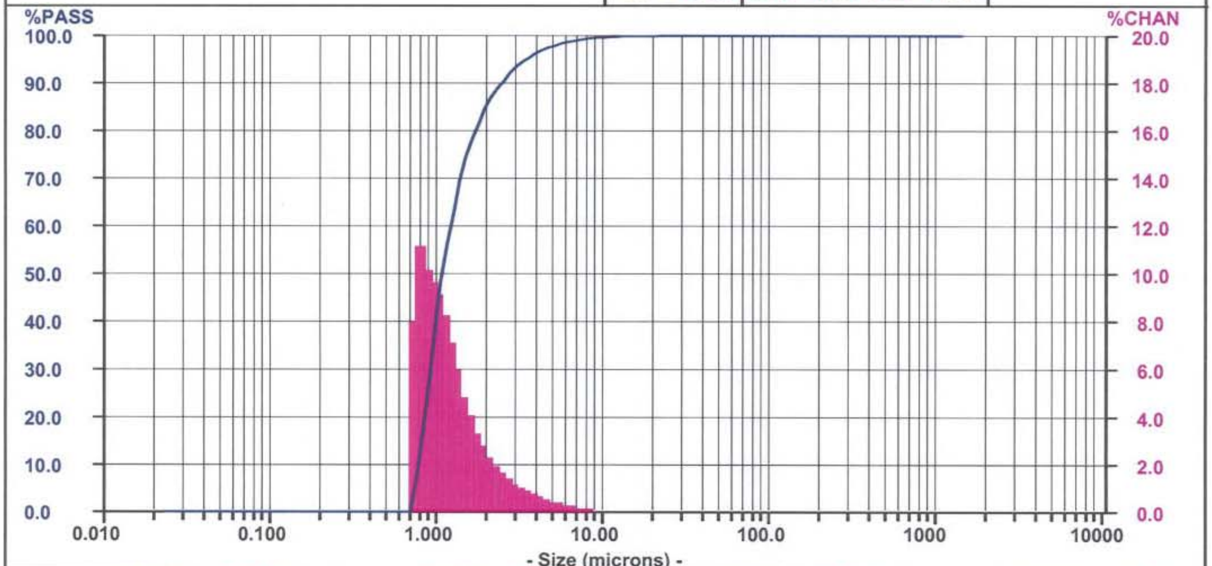
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1099
Time: 14:45 Pres #: 1

Sample: PEP 250 gal Batch 30 day stored
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 10.40	5% = 0.729	60% = 1.205	1.080	100%	1.105
mn = 1.453	20% = 0.824	70% = 1.386			
ma = 5.394	30% = 0.897	80% = 1.696			
cs = 1.112	40% = 0.981	90% = 2.428			
sd = 0.552	50% = 1.080	95% = 3.411			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.27	0.79	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.48	0.92	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.56	1.08	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.48	1.26	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.22	1.47	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	90.75	1.71	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.04	1.99	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	87.05	2.35	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	84.70	2.79	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	81.91	3.36	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	78.55	4.06	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	74.49	4.93	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	69.56	5.97	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	63.59	7.09	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	56.50	8.28	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	48.22	9.19	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	39.03	9.65	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	29.38	10.16	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	19.22	11.19	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.03	8.03	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.06	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.80	0.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.73	0.09	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.64	0.12	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.52	0.15	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.37	0.18	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.19	0.22	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	98.97	0.27	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.70	0.33	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.37	0.40	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	97.97	0.47	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.50	0.56	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	96.94	0.67	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0146
Transmission: 0.95
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0084
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

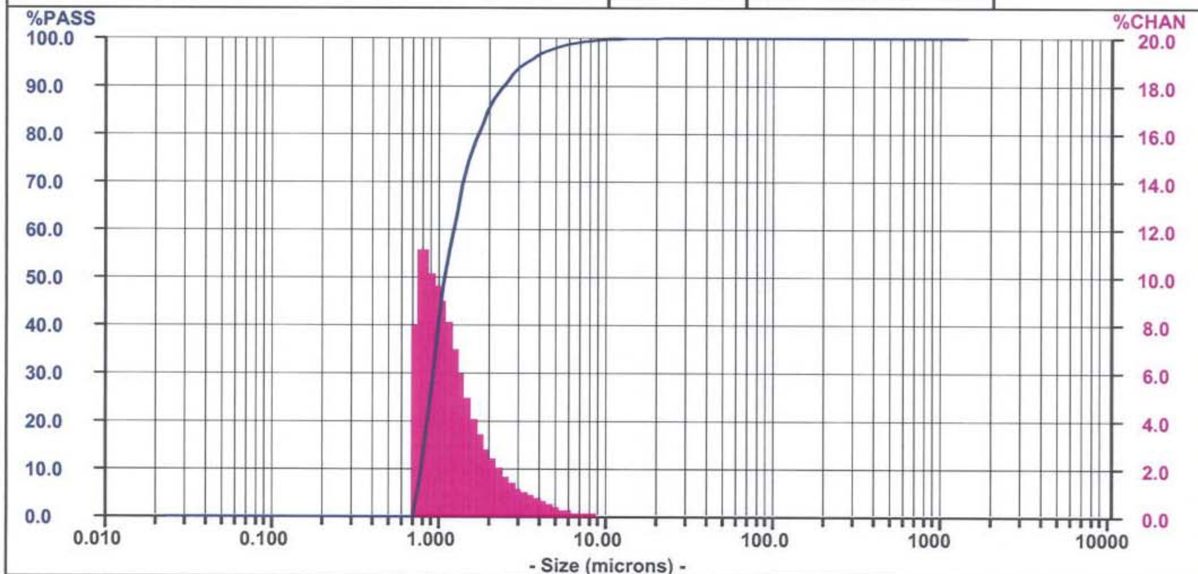
M12 HLW Simulant

PEP 250 gallon
D37455

Date: 10/08/08 Meas #: 1108
Time: 14:54 Pres #: 1

Sample:PEP 60 day stored
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.98	5% = 0.729	60% = 1.207	1.080	100%	1.095
mn = 1.439	20% = 0.824	70% = 1.388			
ma = 5.454	30% = 0.896	80% = 1.694			
cs = 1.100	40% = 0.980	90% = 2.389			
sd = 0.547	50% = 1.080	95% = 3.310			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.54	0.76	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.78	0.90	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.88	1.07	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.81	1.26	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.55	1.48	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	91.07	1.74	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.33	2.04	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	87.29	2.42	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	84.87	2.87	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	82.00	3.44	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	78.56	4.13	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	74.43	4.98	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	69.45	6.00	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	63.45	7.06	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.01	1.156	56.39	8.16	0.061	0.00	0.00
383.9	100.00	0.00	20.17	99.99	0.01	1.060	48.23	9.09	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.98	0.01	0.972	39.14	9.68	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.97	0.02	0.892	29.46	10.23	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.95	0.02	0.818	19.23	11.20	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.93	0.03	0.750	8.03	8.03	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.90	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.81	0.06	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.75	0.08	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.67	0.11	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.56	0.13	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.43	0.16	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.27	0.20	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.07	0.25	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.82	0.30	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.52	0.37	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.15	0.44	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.71	0.53	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.18	0.64	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0453
Transmission: 0.86
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

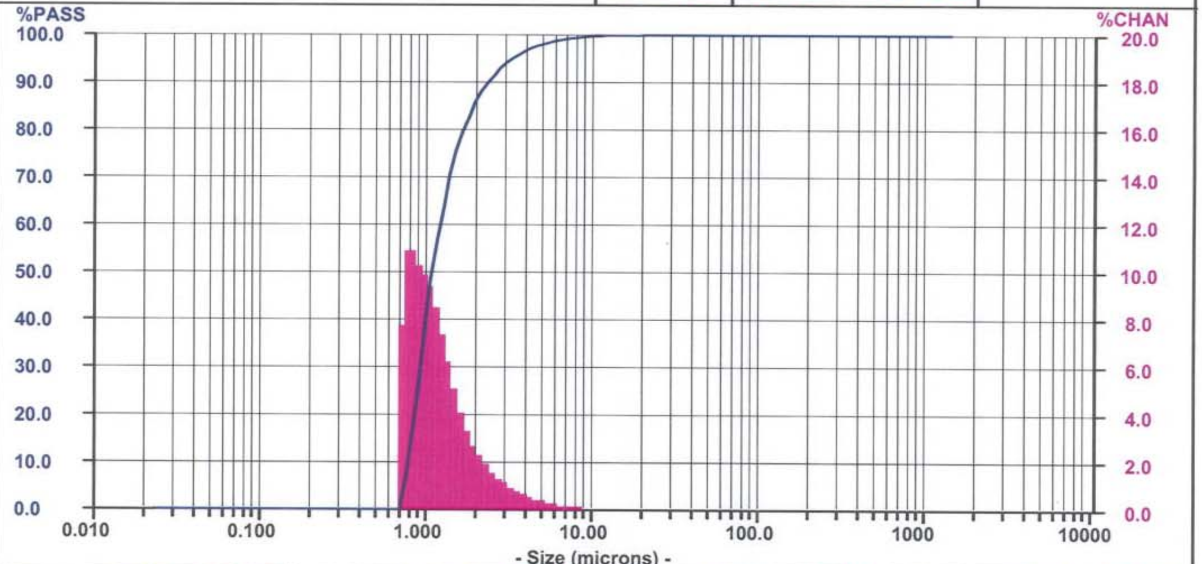
M12 HLW Simulant

PEP SAT 15
D37455

Date: 10/28/08 Meas #: 1114
Time: 10:48 Pres #: 1

Sample:PEP SAT 15 102308 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.22	5% = 0.731	60% = 1.198	1.079	100%	1.036
mn = 1.422	20% = 0.828	70% = 1.367			
ma = 5.239	30% = 0.901	80% = 1.650			
cs = 1.145	40% = 0.983	90% = 2.316			
sd = 0.518	50% = 1.079	95% = 3.235			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.68	0.71	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.97	0.84	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	95.13	0.99	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	94.14	1.17	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	92.97	1.37	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	91.60	1.62	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	89.98	1.92	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	88.06	2.29	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	85.77	2.76	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	83.01	3.37	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	79.64	4.14	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	75.50	5.09	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	70.41	6.21	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	64.20	7.37	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.00	1.156	56.83	8.57	0.061	0.00	0.00
383.9	100.00	0.00	20.17	100.00	0.01	1.060	48.26	9.46	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.99	0.01	0.972	38.80	9.91	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.98	0.01	0.892	28.89	10.26	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.97	0.02	0.818	18.63	10.90	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.95	0.03	0.750	7.73	7.73	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.92	0.04	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.88	0.05	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.83	0.07	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.76	0.08	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.68	0.11	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.57	0.13	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.44	0.16	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.28	0.20	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	99.08	0.24	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.84	0.29	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.55	0.35	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	98.20	0.42	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.78	0.50	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	97.28	0.60	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe2O3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0380
Transmission: 0.88
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

Serial Number: S3177
Range: 0.021 -1408 um

MICROTRAC - S3000

V:9.1.15
DB : Recalc

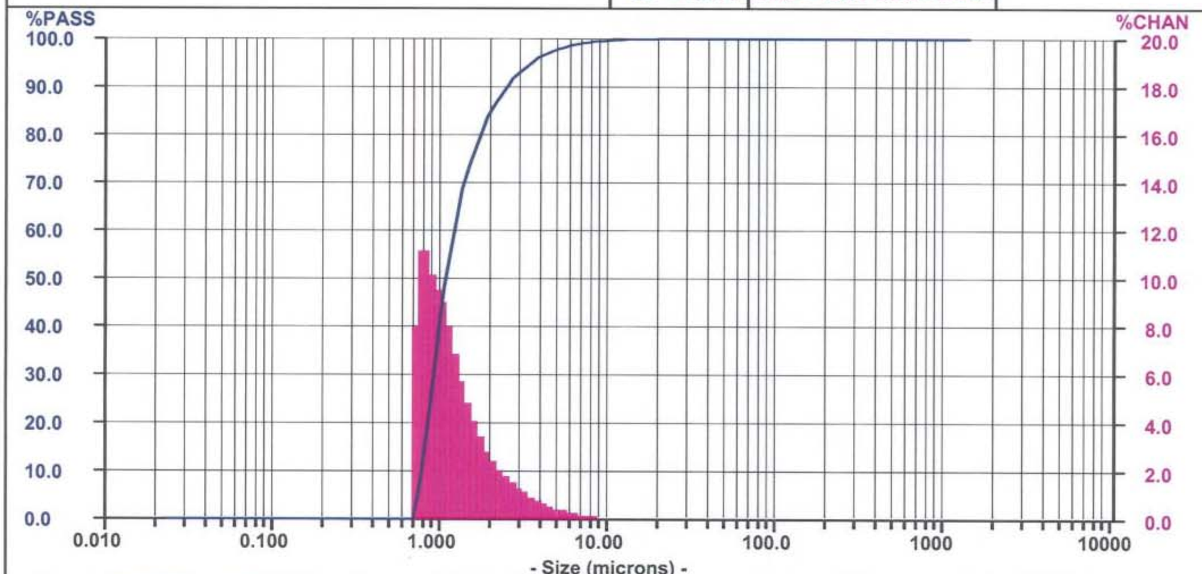
M12 HLW Simulant

PEP SAT 30
D37455

Date: 11/11/08 Meas #: 1117
Time: 21:21 Pres #: 1

Sample:PEP SAT 30 110608 DER
No Sonication
VSR Speed 45
Subsample: 1, Aliquot: 1, Meas: 1
Microtrac S3000 N830506

Summary	Percentiles		Dia	Num%	Width
mv = 11.48	5% = 0.729	60% = 1.214	1.083	100%	1.156
mn = 1.469	20% = 0.823	70% = 1.407			
ma = 5.530	30% = 0.897	80% = 1.738			
cs = 1.085	40% = 0.982	90% = 2.493			
sd = 0.578	50% = 1.083	95% = 3.474			



SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN	SIZE	%PASS	%CHAN
1408	100.00	0.00	74.00	100.00	0.00	3.889	96.13	0.84	0.204	0.00	0.00
1291	100.00	0.00	67.86	100.00	0.00	3.566	95.29	0.99	0.187	0.00	0.00
1184	100.00	0.00	62.23	100.00	0.00	3.270	94.30	1.16	0.172	0.00	0.00
1086	100.00	0.00	57.06	100.00	0.00	2.999	93.14	1.35	0.158	0.00	0.00
995.6	100.00	0.00	52.33	100.00	0.00	2.750	91.79	1.56	0.145	0.00	0.00
913.0	100.00	0.00	47.98	100.00	0.00	2.522	90.23	1.81	0.133	0.00	0.00
837.2	100.00	0.00	44.00	100.00	0.00	2.312	88.42	2.10	0.122	0.00	0.00
767.7	100.00	0.00	40.35	100.00	0.00	2.121	86.32	2.45	0.111	0.00	0.00
704.0	100.00	0.00	37.00	100.00	0.00	1.945	83.87	2.88	0.102	0.00	0.00
645.6	100.00	0.00	33.93	100.00	0.00	1.783	80.99	3.42	0.094	0.00	0.00
592.0	100.00	0.00	31.11	100.00	0.00	1.635	77.57	4.06	0.086	0.00	0.00
542.9	100.00	0.00	28.53	100.00	0.00	1.499	73.51	4.85	0.079	0.00	0.00
497.8	100.00	0.00	26.16	100.00	0.00	1.375	68.66	5.79	0.072	0.00	0.00
456.5	100.00	0.00	23.99	100.00	0.00	1.261	62.87	6.86	0.066	0.00	0.00
418.6	100.00	0.00	22.00	100.00	0.00	1.156	56.01	8.04	0.061	0.00	0.00
383.9	100.00	0.00	20.17	100.00	0.01	1.060	47.97	9.00	0.056	0.00	0.00
352.0	100.00	0.00	18.50	99.99	0.01	0.972	38.97	9.57	0.051	0.00	0.00
322.8	100.00	0.00	16.96	99.98	0.02	0.892	29.40	10.16	0.047	0.00	0.00
296.0	100.00	0.00	15.56	99.96	0.02	0.818	19.24	11.18	0.043	0.00	0.00
271.4	100.00	0.00	14.27	99.94	0.03	0.750	8.06	8.06	0.039	0.00	0.00
248.9	100.00	0.00	13.08	99.91	0.05	0.688	0.00	0.00	0.036	0.00	0.00
228.2	100.00	0.00	12.00	99.86	0.06	0.630	0.00	0.00	0.033	0.00	0.00
209.3	100.00	0.00	11.00	99.80	0.08	0.578	0.00	0.00	0.030	0.00	0.00
191.9	100.00	0.00	10.09	99.72	0.10	0.530	0.00	0.00	0.028	0.00	0.00
176.0	100.00	0.00	9.250	99.62	0.12	0.486	0.00	0.00	0.026	0.00	0.00
161.4	100.00	0.00	8.482	99.50	0.15	0.446	0.00	0.00	0.023	0.00	0.00
148.0	100.00	0.00	7.778	99.35	0.19	0.409	0.00	0.00			
135.7	100.00	0.00	7.133	99.16	0.23	0.375	0.00	0.00			
124.5	100.00	0.00	6.541	98.93	0.28	0.344	0.00	0.00			
114.1	100.00	0.00	5.998	98.65	0.33	0.315	0.00	0.00			
104.7	100.00	0.00	5.500	98.32	0.41	0.289	0.00	0.00			
95.96	100.00	0.00	5.044	97.91	0.49	0.265	0.00	0.00			
88.00	100.00	0.00	4.625	97.42	0.59	0.243	0.00	0.00			
80.70	100.00	0.00	4.241	96.83	0.70	0.223	0.00	0.00			

Distribution: Number
Progression: Geometric Root8
Upper Edge: 1408
Lower Edge: 0.021
Residuals: Disabled
Number Of Channels: 128

RunTime: 30 seconds
Run Number Avg of 3 runs
Particle: Fe_2O_3
Particle Transparency: Trans
Particle Refractive Index: 2.98
Particle Shape: Irregular

Fluid: Water
Fluid Refractive Index: 1.33
Loading Factor: 0.0487
Transmission: 0.85
Above Residual: 0.00
Below Residual: 0.00

Analysis Mode: S3000
Sample Cell Id: 0735
Analysis Gain: 2

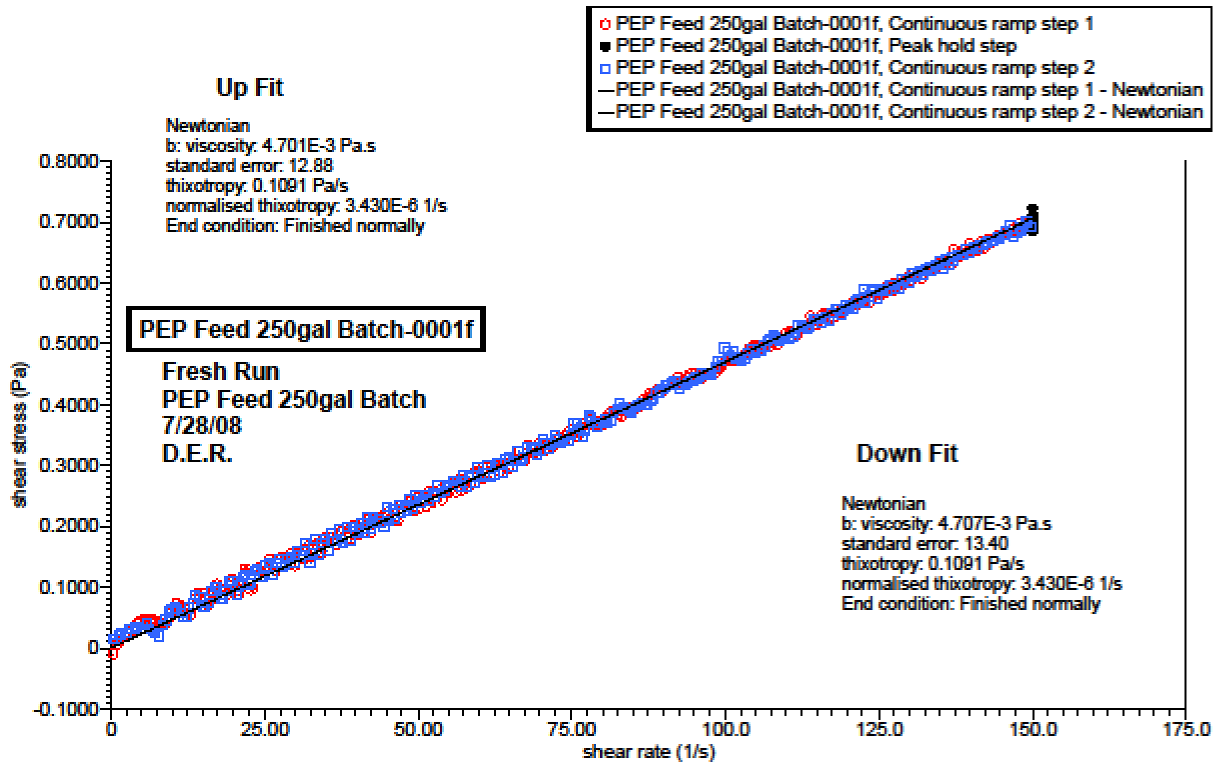
Filter: On

Database Path: C:\MTW9115\WCBTEST.DB

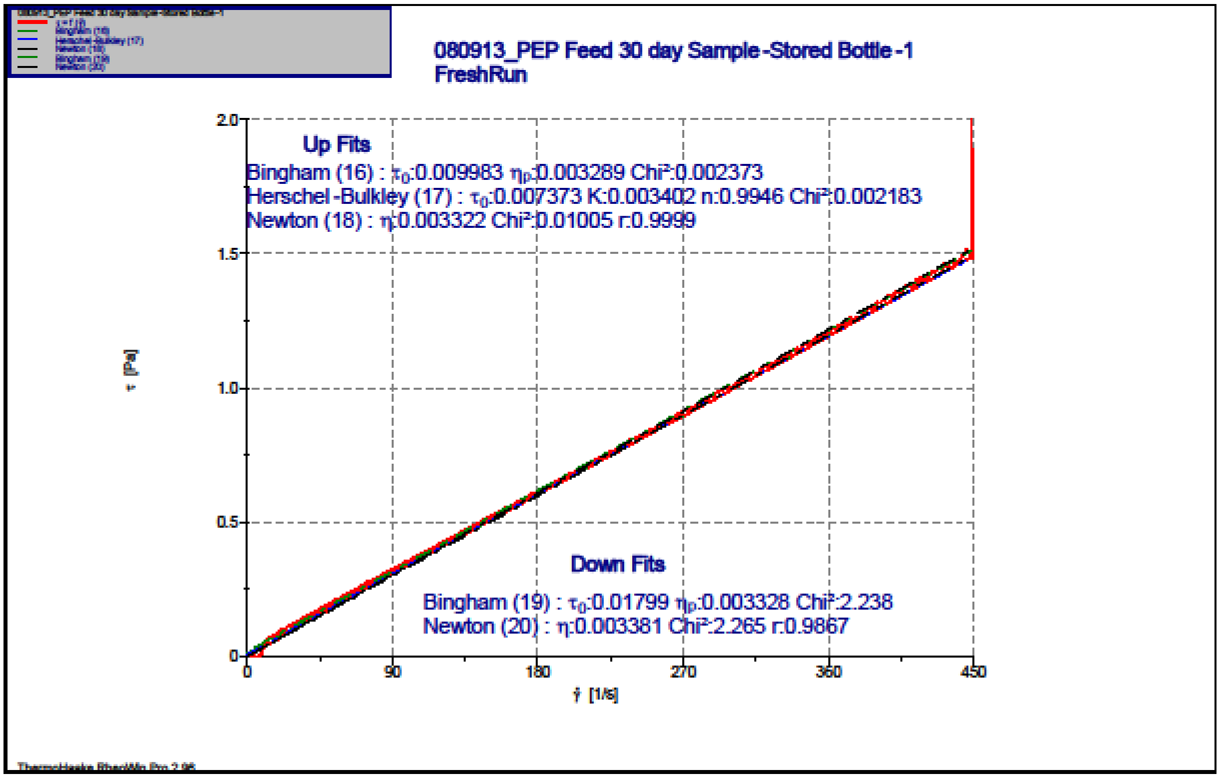
Appendix B

Rheology Flow Curves

Appendix B: Rheology Flow Curves

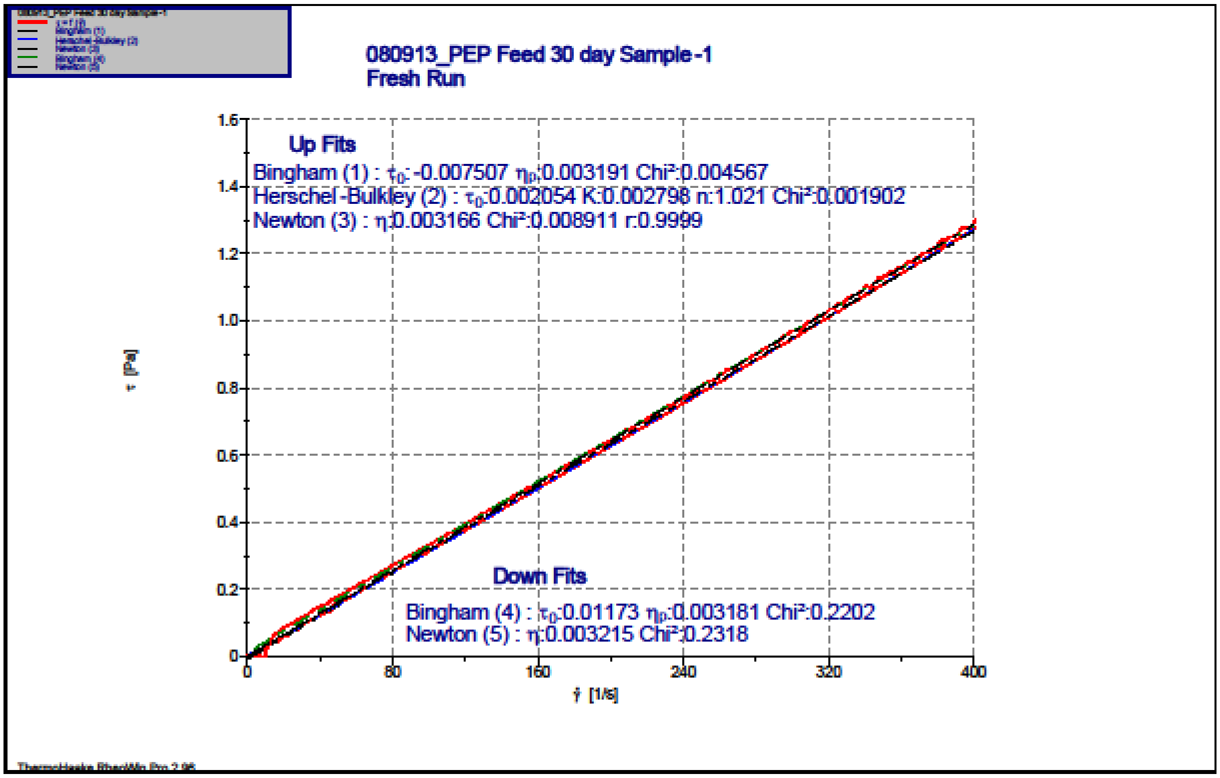


ThermoHaake RheoWin 9/13/2008 / 9:40 AM

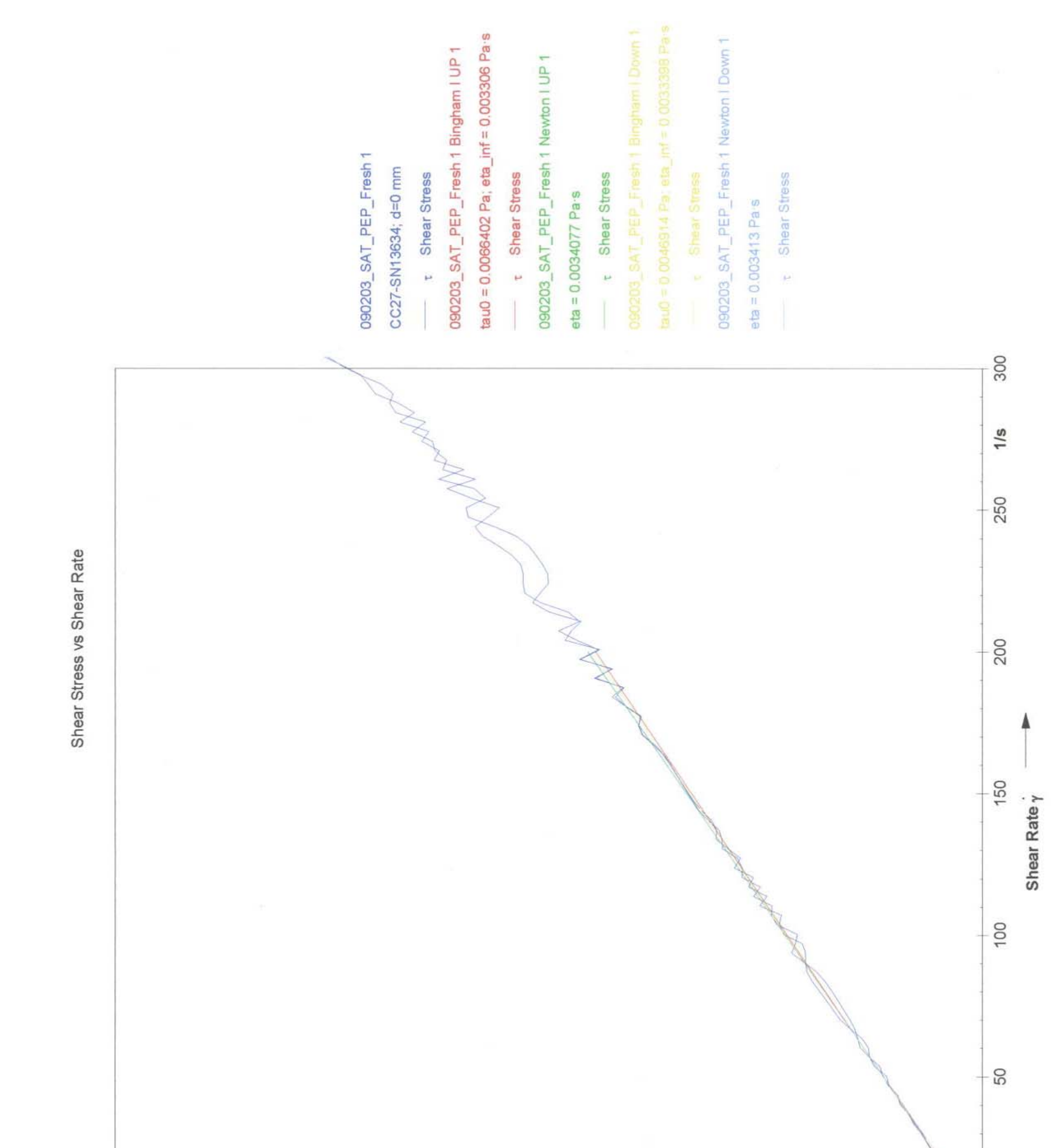


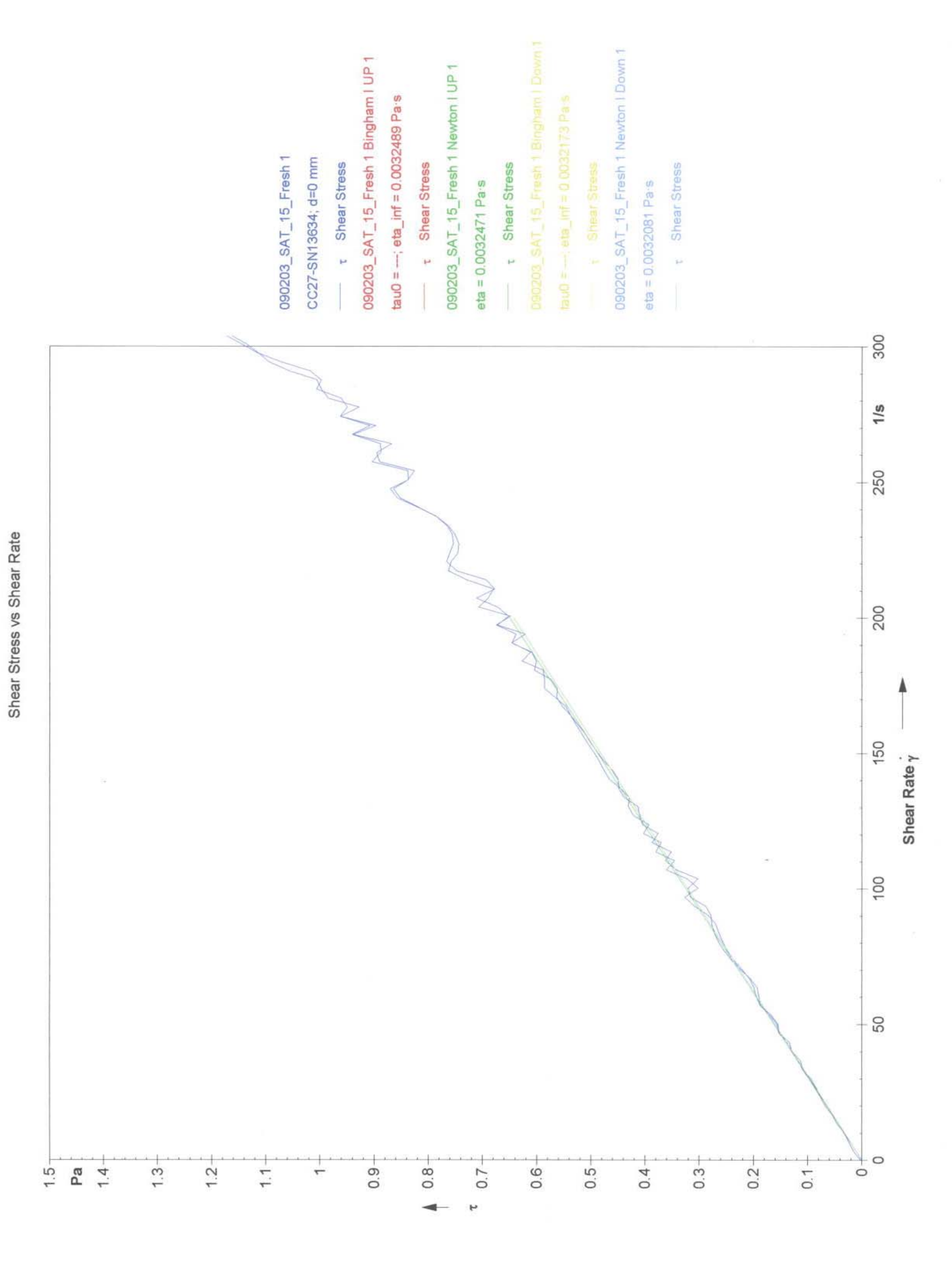
1: C:\Rheology Results\53019-M12\080913\080913_PEP Feed 30 day Sample-Stored Bottle-1.rwd
Company / Operator: PNNL / Xiao-Ying Yu
Date / Time / Version: 13.09.2008 / 9:25:48 AM / RheoWin Pro 296
Substance / Sample no: PEP Feed 30 day Sample-Stored Bottle / 080913_PEP Feed 30 day Sample-Stored Bott
Bingham (16) : τ_0:0.009983 η_p:0.003289 Chi²:0.002373 r:1 □□ $x = \dot{\gamma}$ [1/s] , $y = \tau$ [Pa]
Herschel-Bulkley (17) : τ_0:0.007373 K:0.003402 n:0.9946 Chi²:0.002183 r:1 □□ $x = \dot{\gamma}$ [1/s] , $y = \tau$ [Pa]
Newton (18) : η:0.003322 Chi²:0.01005 r:0.9999 □□ $x = \dot{\gamma}$ [1/s] , $y = \tau$ [Pa]
Bingham (19) : τ_0:0.01799 η_p:0.003328 Chi²:2.238 r:0.9869 □□ $x = \dot{\gamma}$ [1/s] , $y = \tau$ [Pa]
Newton (20) : η:0.003381 Chi²:2.265 r:0.9867 □□ $x = \dot{\gamma}$ [1/s] , $y = \tau$ [Pa]

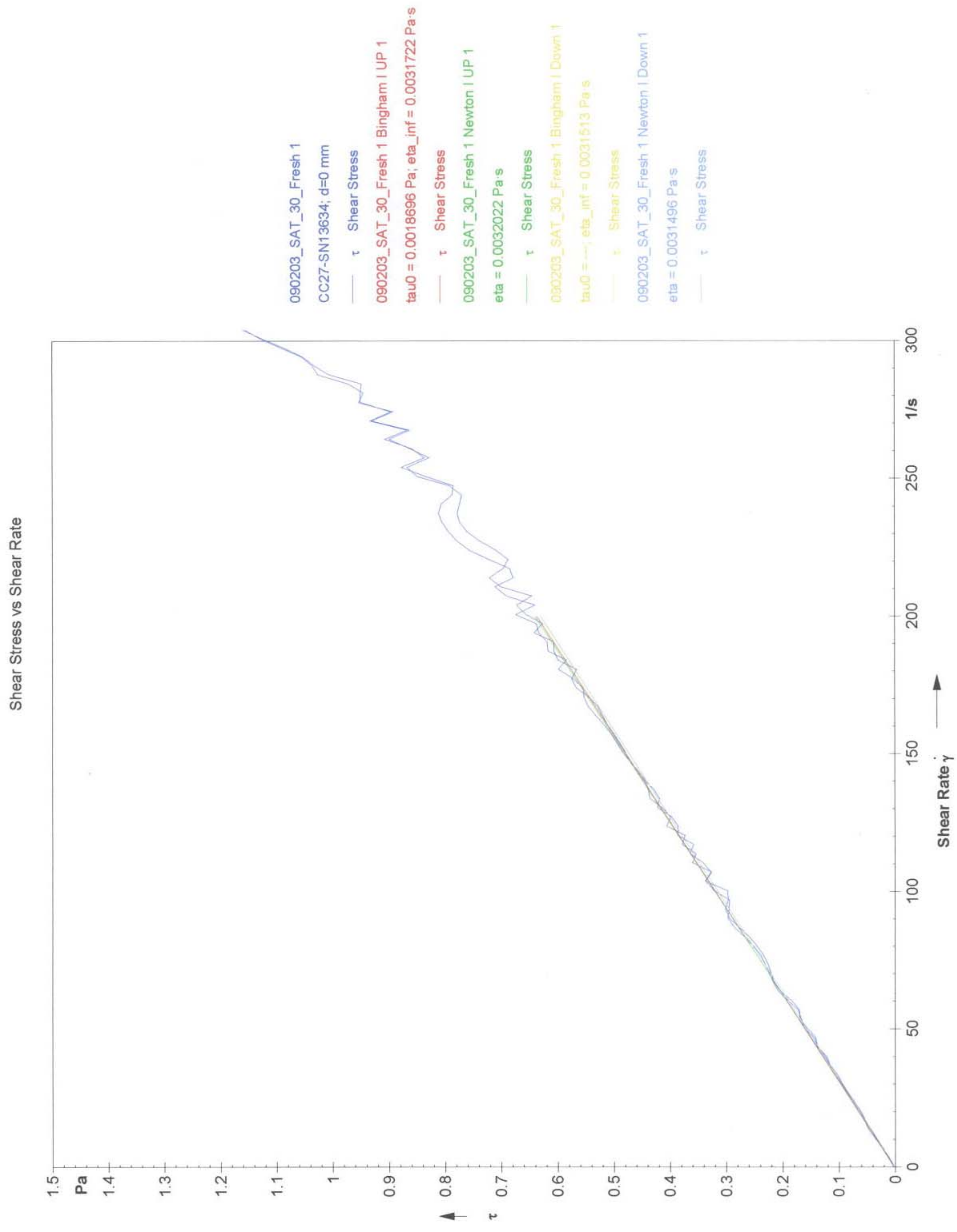
ThermoHaake RheoWin 9/13/2008 / 9:09 AM



1: C:\Rheology Results\53019-M12\080913\080913_PEP Feed 30 day Sample-1.rwd
Company / Operator: PNNL / Xiao-Ying Yu
Date / Time / Version: 13.09.2008 / 8:51:41 AM / RheoWin Pro 296
Substance / Sample no: PEP Feed 30 day Sample / 080913 PEP Feed 30 day Sample-1
Bingham (1) : τ_0: -0.007507 η_p:0.003191 Chi²:0.004567 r:1 □□ x = $\dot{\gamma}$ [1/s] , y = τ [Pa]
Herschel-Bulkley (2) : τ_0:0.002054 K:0.002798 n:1.021 Chi²:0.001902 r:1 □□ x = $\dot{\gamma}$ [1/s] , y = τ [Pa]
Newton (3) : η:0.003166 Chi²:0.008911 r:0.9999 □□ x = $\dot{\gamma}$ [1/s] , y = τ [Pa]
Bingham (4) : τ_0:0.01173 η_p:0.003181 Chi²:0.2202 r:0.9986 □□ x = $\dot{\gamma}$ [1/s] , y = τ [Pa]
Newton (5) : η:0.003215 Chi²:0.2318 r:0.9985 □□ x = $\dot{\gamma}$ [1/s] , y = τ [Pa]


Shear Stress vs Shear Rate
τ
Pa
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
50
100
150
200
250
300
1/s
Shear Rate γ̇
090203_SAT_PEP_Fresh 1
CC27-SN13634; d=0 mm
τ Shear Stress
090203_SAT_PEP_Fresh 1 Bingham I UP 1
tau0 = 0.0066402 Pa; eta_inf = 0.003306 Pa·s
τ Shear Stress
090203_SAT_PEP_Fresh 1 Newton I UP 1
eta = 0.0034077 Pa·s
τ Shear Stress
090203_SAT_PEP_Fresh 1 Bingham I Down 1
tau0 = 0.0046914 Pa; eta_inf = 0.0033398 Pa·s
τ Shear Stress
090203_SAT_PEP_Fresh 1 Newton I Down 1
eta = 0.003413 Pa·s
τ Shear Stress


Shear Stress vs Shear Rate
090203_SAT_15_Fresh 1
CC27-SN13634; d=0 mm
τ Shear Stress
090203_SAT_15_Fresh 1 Bingham I UP 1
tau0 = ---; eta_inf = 0.0032489 Pa·s
τ Shear Stress
090203_SAT_15_Fresh 1 Newton I UP 1
eta = 0.0032471 Pa·s
τ Shear Stress
090203_SAT_15_Fresh 1 Bingham I Down 1
tau0 = ---; eta_inf = 0.0032173 Pa·s
τ Shear Stress
090203_SAT_15_Fresh 1 Newton I Down 1
eta = 0.0032081 Pa·s
τ Shear Stress
τ
Pa
1.5
1.4
1.3
1.2
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
50
100
150
200
250
300
1/s
Shear Rate γ̇


Shear Stress vs Shear Rate
τ
Pa
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1
1.1
1.2
1.3
1.4
1.5
0
50
100
150
200
250
300
1/s
Shear Rate γ̇
090203_SAT_30_Fresh 1
CC27-SN13634; d=0 mm
τ Shear Stress
090203_SAT_30_Fresh 1 Bingham I UP 1
tau0 = 0.0018696 Pa; eta_inf = 0.0031722 Pa·s
τ Shear Stress
090203_SAT_30_Fresh 1 Newton I UP 1
eta = 0.0032022 Pa·s
τ Shear Stress
090203_SAT_30_Fresh 1 Bingham I Down 1
tau0 = ---; eta_inf = 0.0031513 Pa·s
τ Shear Stress
090203_SAT_30_Fresh 1 Newton I Down 1
eta = 0.0031496 Pa·s
τ Shear Stress

Appendix C

Chemical Analysis

Appendix C: Chemical Analysis

Table C.1. ICP-AES Analysis of 250-Gallon Tote Stored Supernate (mg/kg)

Element	TST-14	TST-21	TST-28	TST-35	TST-42	TST-45
Al	2,820	2,930	3,030	2,960	2,900	2,820
Sb	<0.417	<0.344	<0.359	<0.346	<0.497	<0.445
As	0.321	0.396	0.275	0.359	0.180	0.121
Ba	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Be	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Bi	<0.417	<0.344	<0.359	<0.346	<0.497	<0.445
B	4.96	5.15	5.24	5.18	5.17	4.98
Cd	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Ca	<5.21	<4.30	<4.49	<4.33	<6.21	<5.56
Cr	0.979	1.03	1.09	1.03	1.11	1.02
Co	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Cu	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Fe	<1.04	<0.860	1.09	<0.865	2.40	<1.11
La	<0.104	<0.0860	<0.0899	<0.0865	0.131	<0.111
Pb	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Li	<0.209	<0.172	<0.180	<0.173	<0.248	<0.223
Mg	<1.04	<0.860	<0.899	<0.865	<1.24	<1.11
Mn	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Mo	<0.104	<0.0860	<0.0899	<0.0865	0.136	<0.111
Ni	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Pd	<0.209	<0.172	<0.180	<0.173	<0.248	<0.223
P	1,640	1,740	1,790	1,760	1,730	1,680
K	643	693	695	693	675	651
Se	<0.209	<0.172	<0.180	<0.173	<0.248	<0.223
Si	1.69	1.51	1.76	1.57	2.01	1.59
Ag	<0.104	<0.0860	<0.0899	<0.0865	0.132	<0.111
Na	85,100	81,200	87,000	88,400	89,400	85,600
Sr	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
S	4,360	4,570	4,700	4,560	4,570	4,410
Tl	<0.417	<0.344	<0.359	<0.346	<0.497	<0.445
Th	<0.417	<0.344	<0.359	<0.346	<0.497	<0.445
Sn	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Ti	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
W	<0.209	<0.172	<0.180	<0.173	<0.248	<0.223
U	<5.21	<4.30	<4.49	<4.33	<6.21	<5.56
V	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Y	<0.104	<0.0860	<0.0899	<0.0865	<0.124	<0.111
Zn	<0.104	<0.0860	<0.0899	<0.0865	0.221	<0.111
Zr	0.786	0.811	0.882	0.804	0.932	0.813

Table C.2. IC Analysis of 250-Gallon Tote Stored Supernate (mg/kg)

Element	TST-14	TST-21	TST-28	TST-35	TST-42	TST-45
Nitrate-N	19,400	19,600	19,800	19,900	18,900	19,200
Nitrite-N	5,690	5,750	5,790	5,830	5,590	5,660
Oxalate	701	764	751	733	727	725
Phosphate-P	1,860	1,890	1,880	1,880	1,810	1,830
Sulfate	15,600	15,700	15,800	15,900	15,400	15,600

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