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7. Abstract <p>The purpose of this report is to document the Phase II test conditions, observations, and results of this work. This report provides additional mixing performance test data and rheologic data that provide further indications that there are clear and distinct advantages in the preliminary choice of high-shear mixing alone, and high-shear dispersion in combination with, or followed by, a low-speed type mixer/stirrer for WRAP 2A facility design. Another objective was to determine if significant scale-up problems might exist in the various mix and mixer designs. In the later Phase 2 tests the test material quantities were significantly larger than in the Phase 1 tests.</p>		
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Trademarks

Jiffy is a trademark of Jiffy Mixer Company, Inc., Riverside, California.

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Colcrete Flow Channel Test (Colflow test) is a simple test for grout fluidity developed by Colcrete Ltd of the United Kingdom.

WASTE RECEIVING AND PROCESSING MODULE 2A PHASE 2 MIXING TESTS STATUS REPORT

The Phase 2 tests provide additional mixing performance test data, test samples and rheologic data that would provide further indications as to whether there are clear and distinct advantages or disadvantages in the preliminary choice of high-shear mixing alone, and high-shear dispersion in combination with, or followed by, a low-speed type mixer/stirrer for WRAP 2A facility design. A second objective was to determine if significant scale-up problems might exist in the various mix and mixer designs. In the later Phase 2 tests the test material quantities were significantly larger than in the Phase 1 tests.

Another objective of the Phase 2 tests was to fill in data where needed for further evaluation of the observations and results obtained in Phase 1 mixing tests.

This report documents the test conditions, observations, and data obtained in the Phase 2 mixing trials. Further reduction of the data obtained in these tests and the Phase 1 tests, in an effort to more fully understand the observed effects, is continuing.

1.0 PHASE 2 TEST SUMMARY

1.1 TEST PLAN

The Phase 2 tests were considered as an extension of the Phase 1 testing. A Test Plan for this work, defining the objectives, the surrogate wastes and a schedule had been prepared (Weingardt 1993).

1.2 TEST RESULTS AND CONCLUSIONS

Larger volumes of dry materials mixed with the centerline-mounted, high-shear mixer, in general, exhibited similar rheologic properties as the smaller volume, high-shear mix when the same mixer diameter and same relative mixer speeds were used. With the test formulations used in these trials, better mixes, mixability and flowability seem to be obtained with the larger diameter, centerline mounted, high-speed mixers. Mixing and breaking up of lumps, clods, and friable material which might be expected to exist in a feed stream material, in association with other non-friable materials, following only coarse screening (2 in.) of emptied drums, can be accomplished with a high-shear mixer and without damage to the mixer. Externally applied vibration is an effective and simple method for removing the mixed grout and surrogate waste from the mixer tank and the mix tank wall and may be of benefit in speeding up dispersion of light, powdery materials into the mixture.

1.3 GENERAL TESTING OVERVIEW

- A total of 34 high-shear and combined high- and low-speed, mixing tests containing 25 pounds to over 300 pounds of material have been completed in the Phase 2 tests.
- Ordinary, Type I/II, Portland cement, purchased in bags from Ash Grove Cement Company, was used for most of these trials.
- Type III Portland cement, also purchased from Ash Grove Cement Company, was used in several of the larger quantity, cone-bottom mix tank tests.
- Water to solids (W/S) ratios from 22-146% and corresponding water to cement (W/C) ratios from 0.41-0.90 were tested.
- Mixing of heterogeneous waste material containing hard and soft materials as well as agglomerated chunks requiring dispersion into the cement (binder) was performed and results are reported.
- An evaluation of the mixing problems and end effects of water absorbing (water stealing) materials, known to exist in some waste streams, on the resultant mixture was performed and preliminary results are reported.
- The effects of externally applied vibration on material handling, mixing and mixer clean-up were investigated .
- Nothing was observed in the Phase 2 testing to suggest that the Phase 3, 64 cubic foot, Full Scale test plans should be altered, or that the current WRAP 2A plant mixing design plans might be significantly impacted.

2.0 PHASE 2 GENERAL TEST CONDITIONS

2.1 RHEOLOGICAL DATA COLLECTION

Rheological data collected now includes flow-cone studies where applicable (those mixes with particulate materials less than 1/4-in.) and in later tests, Colcrete Flow Channel flow-test data. Flow cones (funnels) are used in these tests in addition to other viscosity measurements, to define and quantify flow ability/workability. In these tests a defined volume or mass of mixed material is timed while flowing out of the prescribed funnel without external assistance. Any interruption of flow before the funnel is completely empty is noted. Two different cones are used, one having a 1/2-in. diameter outlet (per ASTM C939-81) and a larger volume cone with a 1-in. diameter outlet. Mixes have been produced which will not flow out of the smaller opening but will flow through the larger opening. Brookfield viscosity measurements and Fann viscosities where possible, were obtained, i.e., in the case of Fann measurements, those mixes without sand. With the receipt of the Brookfield apparatus, viscosity fill-in data was obtained for some of the early Phase 1 high-shear type mixes. A Colflow tester was fabricated and used

in later tests. This is a test used in the United Kingdom by British Nuclear Fuel, Ltd. (BNFL) in their vibro-grouting development work to measure the fluidity and flowability of in-fill grouts. This may permit a direct comparison of our data with BNFL fluidity data.

2.2 CHEMICAL ADDITIONS

In most cases, sodium nitrate was added to the mix as in the Phase 1 tests for consistency, however, nitrate-leachability testing was not performed in the Phase 2 tests.

2.3 COMPRESSIVE STRENGTH

As in the Phase 1 tests, 3 samples were taken for 28-day testing from each of the mixes, two 3-in. diameter by 6-in. high-cylindrical specimens for compressive testing and shrinkage measurements and one long, 1-1/4-in. diameter cylinder, 250-mL volumetric sample. The 250-mL sample was cast into a modified plastic graduated cylinder from which the pouring spout removed such that a rubber stopper could be inserted to completely seal the sample during the 28 days of curing. The 3x6-in. samples were covered with a plastic wrap to cure. Again, in the Phase 2 tests, all curing occurred at ambient temperature. After 28 days the 250-mL sample was cut with an abrasive saw into appropriate lengths for compressive testing (2 specimens). The extreme top and bottom pieces of the cast are generally discarded. The strength is clearly related to the amount of water used in the mix preparation. All specimens tested including the paper mixture (2A-179) exceeded the required 60 psi limit for land-fill subsidence control.

2.4 MIXER DISCRPTIONS

For most of the high-shear mixes, a flat, 10-in. diameter, 1/8-in. thick steel disc, with 8 radial slots, run at 800 and 1,000 RPM was used. The mixing blades are described in Section 6.0, Figure 2. A more aggressive, 10-in. diameter sawtooth disc was also run at 800 and as high as 1,000 RPM in some of the later tests. A 5-in. diameter sawtooth disc, off-set from the 30-gal mix tank centerline and run at 1300 rpm, was used in several tests. Thirteen hundred rpm, with the 6-in. slotted disc, provides the same tip velocity as the 10-in. disc. These speeds were found to be slightly less than the minimum industry recommended tip speed of 2,500 ft/min for this type of mixing/dispersing. In all of the successful high-shear tests, the mixers were run for only 2 minutes following the last material addition to completely homogenize the mixture as in the Phase 1 high- and medium-shear tests. Visual homogeneity or smoothness of the mixture as it turns over in the mixer has been the criteria used to establish completion of mixing.

2.5 MIXING TANK GEOMETRY

Mixing container diameters of 14- and 18-in. were used in these tests. The 14-in. diameter container has a flat bottom. The 18-in. has a 30 degree conical bottom. The conical bottom mixing tank is fitted with a 2-in. diameter outlet stem. A 2-in. size, full-throat (i.e., 2-in. diameter opening) ball valve is attached to the outlet stem. Tests determined that some problems can occur in emptying mix tank contents. A small air vibrator was attached to a plate welded to the tank outlet stem. Methods to manage this problem were explored and are discussed (See 2.6, 3.5 and 3.6).

2.6 MIXER CLEANING

In the case of the tests with the 14-in. diameter, 15-gal mixer, the mixer assembly was physically moved out of the mixed material at the completion of the mixing cycle and momentarily energized (bumped) to clean the mixer. With the 30-gal mixer the 2-in. ball valve was opened to drain the mix into the inlet hopper of a 2J6 Moyno progressive cavity, open-throat pump. The air vibrator was energized when flow into the Moyno pump ceased or stopped. Test samples were collected at the end of a 15 foot, 1-1/2 in. diameter hose attached to the pump outlet.

3.0 TEST DISCRIPTIONS

3.1 FREE STANDING WATER

Phase 1 tests had indicated that fairly high water to cement rates (without flyash additive) are possible using high-shear mixing. Test data for high-shear mixing with high water to cement (W/C) rates was extended to the point that significant bleed water was present. Free standing or bleed water is indicative of significant settling of the mix, prior to initial setting. These tests were discontinued at a water/cement ratio of 0.9 (2A-181) when 1-7/8-in. of bleed water was observed in the 250-ml sample tube and shrinkage of 1 in. in the 3x6-in. cured specimen was measured.

3.2 MIXING OF HETEROGENEOUS MATERIALS

One test (2A-154) was performed in which an approximate 40-lb quantity of damp, high-carbon content, bottom-ash acquired from the Spokane, Washington municipal waste incinerator, including lumps, clods, and friable materials (glass) was mixed, using the least aggressive, 10-in. high-shear mixer in the 14-in. diameter mix tank. The thrust of this test was to evaluate the mixing and breaking up of lumps, clods, and friable material in association with non-friable, or debris type materials. Prior to mixing, the waste was first coarsely screened to determine the proportions, size distribution and gross physical nature of the waste material. At the completion of the mixing cycle, a sample (approximately 6 Kg.) of the material was re-screened. For this test a 6-in. diameter by 12-in. tall cylinder was cast in addition to the 3x6-in. cylinders. No clumps of undispersed soft- or hand-friable (breakable) material remained after mixing. Approximately, 8 percent of the material was

shredded by the mixing action. There was no damage to the mixer shaft, blade or mix tank. The actual test data are shown in Section 6.0, Table 2. The problems of mixing and the dispersion of lumpy/sticky, aggregated type surrogate waste forms in association with other materials were also addressed by this test and another test (2A-179), in which wetted wads of torn (shredded) paper was added directly to and dispersed in the cement slurry (See 3.4).

3.3 BOTTOM-ASH CORE EVALUATIONS

Significant, but unmeasured and unidentified quantities of gas evolved from the test specimens cast from the Spokane Bottom-ash. This was assumed to be due to a chemical reaction between the cement and the high level of unburned organic material in this particular waste material. No feed stream of this type material has been identified for WRAP 2. This gas evolution, however, caused approximately a 3 percent expansion of the cast specimens. Physical examination of the hardened test specimens with the mold removed showed numerous fissures (voids) about the exterior, but no uncoated or unmixed loose material. An X-ray examination of the 3x6- and 6x12-in. (diameter by height) monolithic cylinders of the bottom ash showed very interesting results (see Section 6.0, Figure 1). A single leaf of a 3-in. butt hinge was suspended in the center in one of the 3x6-in. specimens. A radiator type hose clamp is near the top of the other. Numerous small dense objects (nails, screws, etc.) appeared throughout the casts. Broken glass was identified. The larger fissures at various levels appeared to be connected forming cracks almost completely across the cast. However no settling of any of the dense materials/items, large or small, was observed, by X-ray examination, in either the 3x6-in. or 6x12-in. specimens. The excess material from the mix test was still generating gas bubbles in the waste and rinse container 72 hours later.

3.4 WATER ABSORBING MATERIALS/ADMIXTURES

Five high-shear tests (2A-183a, 2A-183b, 2A-184, 2A-185 and 2A-186) were performed with diatomaceous earth to determine the limits and mixing constraints of high water absorbing (water-stealing) surrogate waste forms. Diatomite was shown to hold approximately two times its weight of water with none free standing. A large excess of water was then used to form a cement/water slurry to which dry diatomite was added. The minimum water/cement ratio that allowed mixing in our current test system was 1.20, a water/total solids ratio of 80 percent with 50 percent of the solids as diatomite. With these high water ratios, the cement paste had no gell strength and significant settling (layering) of the diatomite was observed. It is important to note that only cement powder and diatomite were used in these tests and no feed stream of this type is identified for WRAP 2 (i.e. a quantity of diatomite is reported to have been used as a liquid absorbing admixture in the top and bottom of some waste drums). As noted above, test 2A-179 was conducted using shredded wet paper as the water absorbing waste surrogate. This test stopped at a point when the mixture became too thick to be mixed, the paper was pulped, mixing ceased and the pressure on the hydraulic system was approaching design limits. By weight, only 3.9 percent paper was added, hence some definition of process tolerance and material limits can be drawn for these materials.

3.5 LARGE VERSUS SMALL VOLUME RHEOLOGY

The larger volumes mixed with the high-shear mixer exhibited similar rheologic properties as the smaller high-shear mix volumes when the same mixer and same relative mixer speeds were used in some cases. Note the small volumes were mixed in the flat bottom tank. Low-measured viscosities however, both Fann and Brookfield, did not correlate with flowability (time) of the mixture in flowing out of the test cones (see Section 6.0, Table 1). This table also shows the increase in flowability gained with fly-ash as a mix additive with identical material mass. These tests also determined that some problems can occur in emptying the conical bottom mix tank contents at completion of mixing. Energizing the air vibrator on the outlet stem immediately restored the exit flow from the tank.

3.6 DUAL MIXER TESTING

Tests 2A-190 and 2A-191 were performed to evaluate a dual-mixer concept, in the 30-gal mix tank. Test 2A-190 used an offset, 5-in. high-shear mixing blade to disperse the material. Difficulty was encountered in getting the dry materials dispersed with the off-set mixer in Test 2A-190. Test 2A-191 used a centerline mounted, low-shear U-shaped anchor impeller with wipers, as described in the literature (Harnby et al. 1992), in an attempt to stir and empty the tank of high-shear, centerline mixed grout. These concepts proved difficult to test with our current equipment arrangement. The low-speed blade(s) were not effective, in this configuration, of emptying the tank of mixed material. External vibration was used with success, in these tests, to aid in both dispersion of dry material into the mix slurry with the off-set mixer and to fully empty the tank.

3.7 SEQUENCE OF MIXING

The order of addition of materials for all the Phase 2 tests has been water first, the trace sodium nitrate (for leachate testing only) second, cement and/or flyash, third and waste surrogate material, last. This is the order of addition recommended in the literature for mixing dry materials into cement and mixing grout or mortar, (Akroyd 1962 and Lea 1971). The cement and flyash were not pre-blended as dry materials in these tests. This sequence of mixing also produces the smoothest power curve and lowest power draw on the mixer (Weber 1993). A graded sand mixture consisting of various sizes, types and densities (silica and garnet), and a quantity of aquarium gravel was prepared and pre-mixed in 100-lb quantities and used in some of the mixes.

4.0 CURRENT TEST CONCLUSIONS

4.1 MIX VOLUMES and PERFORMANCE

Larger volumes of dry materials mixed with the centerline-mounted, high-shear mixer, in general, exhibited similar rheologic properties as the smaller volume, high-shear mix when the same mixer diameter and same relative mixer speeds were used. With the test formulations used in these trials, better mixes and mixability, in general, and flowability seem to be obtained with the larger diameter, centerline mounted, high-speed mixers (See Table 1).

4.2 HETEROGENEOUS MIXTURES

Mixing and breaking up of lumps, clods, and friable material which might be expected to exist in a feed stream material in association with other non-friable materials, following only coarse screening (2 in.) of emptied drums, can be accomplished with a high-shear mixer and without damage to the mixer. With the formulation used in this particular test (2A-154), the dispersed mixture had sufficient grout gel strength to prevent settling or layering of contents (See Figure 1).

4.3 EFFECT OF MIXTURE VIBRATION ON MIX TANK CLEANING

Externally applied vibration is an effective and simple method for removing the mixed grout and surrogate waste from the mixer tank, the mix tank wall and the ridge of partially mixed grout that always occurs at the transition of the grout mix and dry tank wall (i.e., at the top of the initial stirring vortex). This finding could have a significant impact on the plant design in lowering the amount of waste water generated in mixer clean-out/clean-up. The impact to the current plant design is minimal.

4.4 EFFECTS OF VIBRATION ON MIXING

The use of external mix tank vibration to assist in dispersion of dry powdery mix materials or waste forms could simplify plant feed and mixing systems and deserves further testing, evaluation and should be part of the Phase 3 test program.

5.0 RECOMMENDATIONS FOR FURTHER PHASE 2 TYPE TESTS

The 30-gal capacity cone bottom mixing system should be used to pre-test mix designs chosen for testing in the full-scale system. Further Phase 2 type tests should be continued for an effort to evaluate, explain and understand what appear to be inconsistencies found in the Phase 1 and Phase 2 rheological data (Weber 1994). What needs to be thoroughly understood is, "what are the physical properties of the grout/waste mixture that are important to final product performance that need to be measured and controlled, and what device(s) should be used to obtain them". The data suggest that there is some mixture property characteristic (perhaps "stickiness") which isn't being

adequately measured with the rheologic tests which we have been using to date. Perhaps tests using the Vicat test apparatus, modified as described in ASTM C 110-92, ASTM C 187-91 or ASTM C 359, in addition to the Fann, Brookfield and flow-cones, might be used to explain the inconsistencies and define this "elusive" property. For economical reasons, these continued tests would be best conducted on quantities of mixed material less than 64 cubic feet.

6.0 CURRENT RECOMMENDATIONS FOR PHASE 3 TESTING (FULL-SCALE TESTS)

None of the test observations or results would suggest that a 64 cubic foot quantity of grouted waste cannot be mixed and processed as defined in the current WRAP 2 design basis. The Phase 3 tests should proceed as scheduled and planned. Due to the scale of the Phase 3 tests, a clear and thorough understanding of the exact parameters to be observed and measured in each of the proposed tests should be carefully reviewed prior to performing the test. In some cases, it may be prudent to perform a pilot run, using the 30 gallon mixer with the identical mix design and materials to be used in the full scale test prior to a 64 cubic foot test. Concurrently, small scale tests should be continued to provide needed data described above.

7.0 FIGURES AND TABLES

Figure 1. Radiograph of 3-in. Diameter Samples of Spokane Bottom Ash

Figure 2. Mixing Blade Description

- BLADE 1 - A WHC-designed 10-in. diameter, 0.125-in. thick disc, with 8 radial slots
- BLADE 2 - A 10-in. diameter sawtooth disperser disc, Design A, purchased from INDCO, Inc., New Albany, IN 47150
- BLADE 3 - A 10-in. diameter high-viscosity high-turbulence disc, Design D, purchased from INDCO, Inc., New Albany, IN 47150
- BLADE 4 - A WHC designed 6-in. diameter, 0.125-in. thick disc, with 8 radial slots
- BLADE 5 - A 5-in. diameter sawtooth disperser disc, Design A, purchased from INDCO, Inc., New Albany, IN 47150

Table 1. Flyash Benefit

5" Sawtooth Mixer, Centerline-Mounted (1320 RPM) All tests same dry material total mass, same volume water			10" Sawtooth Mixer, Centerline-Mounted (speed as noted) Same material mass, as before, same volume water		
	2A-173 0% FA	2A-175 40% FA	2A-159 0% FA (780 RPM)	2A-161 40% FA (780 RPM)	2A-188 40% FA (1,000 RPM)
Fann Reading	too thick	190	213	139	no data
		122	151	92	
		105	124	76	
		75	92	56	
Brkfld Viscosity	14.9M	21.6M	9.5M	4.0M	2.6M
	31.5M	46.6M	21.5M	8.2M	4.7M
	77.9M	98.4M	43.6M	16.3M	8.8M
	197.0M	258.0M	105.0M	38.0M	21.0M
ASTM Flow-cone Time	too thick	12.84 sec	43.9 sec	18.37 sec	14.0 sec

Table 2. Sieve Analysis on Bottom Ash

BATCH I.D.	SIEVE <3/8x1 in.	SIEVE >3/8x1 <1 in.	SIEVE >1 in.	% OF BATCH
171	2494	1607	557.3	53.5,34.5,12
179	2661.3	1415.6	600.3	57,30,13
193	1916.2	1052.9	494.4	55.3,30.4,14.3
187	288.2	0	0	100,0,0
173	2726.6	1297.7	688.5	57.9,27.5,14.6
TOTAL	10086.3	5373.2	2340.5	57, 30, 13

There was 17.8 kg bottom ash in 43.6 kg total mix, or 40% of mix. 23% of mix was bottom ash that went through 3/8x1-in. sieve. Twelve percent of mix was bottom ash that did not go through 3/8x1-in. sieve but did go through 1-in. diameter sieve. Five percent of mix was bottom ash that would not go through 1-in. diameter sieve. After mixing a 5883.3 g sample was taken and screened with the 3/8x1-in. sieve, 551.6 g remained behind on the sieve. The remaining debris represented 9% of mix, down from 17% of mix that was caught by the 3/8x1-in. The debris that remained did not contain any friable material, the debris was mainly rock, glass, and metal.

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APPENDIX: TEST PROTOCOLS

PHASE 2 - HIGH SHEAR (TYPE I/II)

HIGH-SHEAR MIXING BLADES TESTS

(ALL WEIGHTS IN Kg UNLESS OTHERWISE NOTED)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-151 5/3	9.1	0.0	3.73	11.19	0	0	0	0	41	41	41	BLADE 1 320 psi/800 RPM F 219,136,108,78 B 73M, 282M, 768M, 1.87MM 1.96 g/ml 30 sec solids addition Shrinkage 1/16 in. •11000 •5439,7944
2A-152 5/3	9.1	0.0	3.91	11.73	0	0	0	0	43	43	43	BLADE 1 310 psi/800 RPM F 157,100,79,58 B 55M, 138M, 398M, 999M 1.92 g/ml 30 sec solids addition Shrinkage 3/32 in. •13930 •6772,6245

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O / SOL-IDS	W% H ₂ O / CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-172 5/4	9.1	0.0	4.10	12.30	0	0	0	0	45	45	45	BLADE 1 300 psi/800 RPM F 158,110,77,57 B 26M, 57M, 134M, 320M 1.91 g/ml 30 sec solids addition FLOW2 34.28 sec Shrinkage 3/32 in. •8690 •4990,7170
2A-153 5/9	26.7	0.0	12	36.00	0	0	0	0	45	45	45	BLADE 1 470 psi/780 RPM F 201,131,103,75 B 14M, 29M, 54M, 115M 1.90 g/ml FLOW1 11.93 sec FLOW2 47.84 sec Blade 3 in. up from bottom Shrinkage 3/32 in. •12140 •7065

A-3

MHC-SD-M100-DTR-002 REV 0

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) -1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-155 5/12	19.0	7.6	12	36.00	0	0	0	40	45	45	63	BLADE 1 410 psi/800 RPM F30 240,121,111,79 F60 185,115, 94,68 F90 163,124,104,74 F120 152,108, 88,65 B30 48M,140M,430M,1.8MM B60 35M, 83M,130M, 520M B90 21M, 50M, 98M, 230M B120 6.3M,12M, 25M, 56M 1.82 g/ml FLOW1 8.38 sec FLOW2 17.78 sec Shrinkage 3/32 •9990 •4069,7065
2A-156 5/11	17.8	0.0	8	24.00	17.8	0	0	0	22	45	45	BLADE 1 930 psi/930 RPM B 24M, 84M, 96M, 245M 2.21 g/ml FLOW1 7.45 sec FLOW2 45.16 sec Trouble with hyd motor, could not get speed down Shrinkage 1/16 in. •25380 •7421,9717

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-W100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOLIDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-154 6/3	17.8	0.0	8	0	0	0	17.8	0	22	45	45	BLADE 1 910 psi/950 RPM B 66M, 246M, 340M, 1.1MM 1.89 g/ml FLOW1 12.13 sec Excess creating gas in waste drum under water, up to 72 hours later. The samples have grown 2 to 3 %. 9% screened of unfriables. •
2A-158 5/12	12.7	5.1	8	24.00	17.8	0	0	40	22	45	63	BLADE 1 700 psi/800 RPM B 9M, 18M, 41M, 110M 2.14 g/ml FLOW1 8.65 sec. Shrinkage 1/8 in. •21260 •7992, 6252
2A-159 5/9	26.7	0.0	12	36.00	0	0	0	0	45	45	45	BLADE 2 530 psi/780 RPM F 213, 151, 124, 92 B 9.5M, 21.5M, 43.6M, 105M 1.91 g/ml FLOW1 8.45 sec FLOW2 43.9 sec Blade was run backwards Shrinkage 1/8 in. •16240 •6437, 8417

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-161 5/9	19.0	7.6	12	36.00	0	0	0	40	45	45	63	BLADE 2 500 psi/790 RPM F 139,92,76,56 B 4M, 8.2M, 16.3M, 38M 1.82 g/ml FLOW1 8.10 sec FLOW2 18.37 sec Shrinkage 3/16 in. •11270 •8022,5660
2A-162 5/12	17.8	0.0	8	24.00	17.8	0	0	0	22	45	45	BLADE 2 950 psi/740 RPM B 22M, 51M, 125M, 330M 2.23 g/ml FLOW1 12.31 sec 1040 psi max hyd pres. Shrinkage 1/32 in. •29790 •8826,7220
2A-164 5/12	12.7	5.1	8	24.00	17.8	0	0	40	22	45	63	BLADE 2 810 psi/800 RPM B 19M, 34M, 74M, 148M 2.16 g/ml FLOW1 8.93 sec FLOW2 24.41 sec Shrinkage 1/8 in. •15320 •8590,7759

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-165 5/12	26.7	0.0	12	36.00	0	0	0	0	45	45	45	BLADE 3 550 psi/790 RPM F 209,143,113,84 B 14M, 26.4M, 52M, 128M 1.93 g/ml FLOW1 10.38 sec FLOW2 47.90 sec Shrinkage 1/16 in. •7250 •6527,5800
2A-167 5/13	19.0	7.6	12	36.00	0	0	0	40	45	45	63	BLADE 3 510 psi/800 RPM F 132,88,69,50 B 5.9M, 12M, 23M, 56M 1.83 g/ml FLOW1 8.19 sec FLOW2 20.00 sec Shrinkage 3/16 in. •4540(dropped) •5125,4975
2A-168 5/13	17.8	0.0	8	24.00	17.8	0	0	0	22	45	45	BLADE 3 860 psi/800 RPM B 49M, 110M, 190M, 600M 2.22 g/ml FLOW1 13.15 sec Shrinkage 1/16 in. •21180 •7074,7837

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) -1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-170 5/13	12.7	5.1	8	24.00	17.8	0	0	40	22	45	63	BLADE 3 790 psi/800 RPM B 12M, 26M, 54M, 130M 2.15 g/ml FLOW1 8.90 sec FLOW2 27.79 sec Shrinkage 5/32 in. •17270 •7750,8025
2A-173 6/14	26.7	0.0	12	36.00	0	0	0	0	45	45	45	BLADE 5 450 psi/1670 RPM B 14.9M,31.5M,77.9M,197M 1.92 g/ml FLOW1 14.18 sec FLOW2 TOO THICK Shrinkage 1/8 in. • .
2A-174 6/14	12.7	5.1	8	24.00	17.8	0	0	40	22	45	63	BLADE 5 500 psi/1660 RPM B 14.8M,35.2M,88M,242M 2.16 g/ml FLOW1 9.37 sec FLOW2 37 sec Shrinkage 7/32 in. •22260 .

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2.

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-175 5/23	19.0	7.6	12	36.00	0	0	0	40	45	45	63	BLADE 5 300 psi/1320 RPM F30 274,155,131,90 F60 196,120,101,73 F90 175,138,116,81 F120 190,122,105,75 F150 172,115,93,68 F180 154,110,91,67 F240 158,102,84,63 F300 160,98,82,62 F360 140,90,75,56 all Brookfield X 1,000 B30 23.6,70,186,962 B60 39,92.8,217,554 B90 27.2,74.8,157,416 B120 21.6,46.4,98.4,258 B150 15.2,35.2,72.8,162 B180 14.4M,31.2,57.6,162 B240 5.8,12.5,23.2,57.7 B300 4.4,9.4,17.7,41.2 B360 4.1,7.8,14.7,36.8 FLOW1 7.41 sec FLOW2 12.84 sec

MHC-SD-M100-DTR-002 REV 0

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/SOL-IDS	W% H ₂ O/CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-176 6/6	12.0	0.0	9	27.00	0	0	0	0	75	75	75	BLADE 1 320 psi/1030 RPM F 33,20,15,11 B 960,2.1M,4.9M,15.4M 1.63 g/ml FLOW1 5.19 sec FLOW2 10.94 sec 25/32 in. WATER IN SAMPLE TUBE Shrinkage 19/32 in. •3750 (channel cones) •3077,2254
2A-177 6/6	11.3	0.0	9	27.00	0	0	0	0	80	80	80	BLADE 1 290 psi/1030 RPM F 30,17,13,9 B 360,720,1.8M,4.8M, 10M@.5RPM 1.62 g/ml FLOW1 6.5 sec FLOW2 10.75 sec 7/32 in. WATER IN SAMPLE TUBE Shrinkage 7/16 in. •4280 •3062,2485

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

A-10

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/SOL-IDS	W% H ₂ O/CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-179 6/8	26.7	0.0	14.9	0	1.67	0	0	0	53	56	45	<p>BLADE 2</p> <p>NOTE: SHREDDED WETTED PAPER (36.5% PAPER-63.5% WATER) ADDED IN PLACE OF SAND. DRY PAPER WT IN SAND COLUMN, WATER WT INCLUDED WITH MAIN WATER.</p> <p>1650 psi/880 RPM</p> <p>1.74 g/ml</p> <p>Blade 3 in. up from bottom. Mix stopped turning over at 55 sec.</p> <p>3.9% waste loading.</p> <p>Skiff of water in sample tube</p> <p>Shrinkage 0 in.</p> <p>•16440</p> <p>•2769,3166</p>
2A-181 6/6	11.1	0.0	10	30.00	0	0	0	0	90	90	90	<p>BLADE 1</p> <p>310 psi/1030 RPM</p> <p>F 24,13,10,7</p> <p>B 380,720,1.5M,3.6M, (7.2M @ .5RPM)</p> <p>1.57 g/ml</p> <p>FLOW1 6.42 sec</p> <p>FLOW2 10.44 sec</p> <p>1 7/8 in. water in sample tube</p> <p>Shrinkage 1 in.</p> <p>•3560</p> <p>.3992,2766</p>

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) -1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

A-11

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-183a 6/6	4.5	0.0	11.1	0	0	4.5	0	0	123	247	45	BLADE 1 750 psi/960 RPM 1240 psi max F 175,70,45,18 B 1.8M,3.3M,5.7M,15.6M 1.39 g/ml FLOW1 25.6 sec 200% excess water/dia. Dia. settled out easily 5/8 in. water in sample tube Shrinkage 1/2 in. •2300 •332,460
2A-183b 6/7	9.0	0.0	13.1	0	0	4.5	0	0	97	146	45	BLADE 1 670 psi/1030 RPM F 156,77,56,23 B 2.7M,5.9M,11.5M,45.8M 1.49 g/ml FLOW1 7.75 sec FLOW2 28 sec 200% excess water/dia. Dia. settled in mix. 13/16 in. water in sample tube Shrinkage 7/16 in. •5200 •1088, 960

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/SOL-IDS	W% H ₂ O/CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-184 6/7	9.5	0.0	12.6	0	0	4.75	0	0	88	133	45	BLADE 1 850 psi/960 RPM F 212,124,68,32 B 4.9M,11.6M,29.6M,94.4M 1.53 g/ml FLOW1 12.44 sec FLOW2 50.50 sec 175% excess water/dia. Dia. settled in mix. 1/2 in. water in sample tube Shrinkage 15/32 in. •6520 •1316,1286
2A-185 6/7	10.1	0.0	12.1	0	0	5.05	0	0	80	120	45	BLADE 1 1340 psi/980 RPM F -,127,68,34 B 12.2M,25.4M,44M,77M 1.56 g/ml FLOW1 18.47 sec FLOW2 155 sec 150% excess water/dia. AT LIMIT OF BEING MIXABLE, 1920 psi MAX ON PRESSURE, DIA. STILL SETTLES OUT OF MIX. 5/16 in. water in sample tube Shrinkage 3/8 in. •5340 •1650,1812

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) -1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS-1-2

MHC-SD-M100-DTR-002 REV 0

A-13

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/ SOL-IDS	W% H ₂ O/ CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-186 6/8	7.2	2.9	12.1	0	0	5.05	0	40	80	120	45	BLADE 1 1320 psi/960 RPM F -, -, -, - B 10.3M, 19.8M, 32.4M, 49M 1.5 g/ml FLOW1 26.63 sec 150% excess water/dia. At 45 sec mixer shaft slipped and mixing stopped. Dia. still settled out, 1690 psi max on pressure. Shrinkage 7/16 in. •5130 •1301, 1384
2A-187 7/18	88.9	0.0	40	120.0 0	0	0	0	0	45	45	45	BLADE 2 1100 psi/1000 RPM (1220 psi max) B 4.2M, 7.7M, 14.7M, 34.4M 1.93 g/ml FLOW1 8.25 sec FLOW2 14.9 sec CFCT 22.2 cm 5 min material addition 25 min to do tests, end temp. in beaker 28.3C. Vibration to empty worked well. . .

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) -1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/SOL-IDS	W% H ₂ O/CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-188 7/27	63.5	25.4	40	0	0	0	0	40	45	45	63	BLADE 2 970 psi/1000 RPM B 2.6M,4.7M,8.8M,21M 1.84 g/ml FLOW1 6.84 sec FLOW2 14.63 sec CFCT 48.9 cm 350 RPM blade 2 during draining, vibrate after draining and 200 ml more drained, ridge from vortex slumped with vib. • .
2A-189 7/28	77.8	0.0	35	0	66.1 6	0	0	0	24	45	45	BLADE 2 2500 psi/750 RPM B 15M,35M,55M,150M 2.17 g/ml FLOW1 8.88 sec FLOW2 23.59 sec CFCT 41.9 cm Vibration during draining, max power on motor needed, 50 RPM Moyno had settling in hose • .

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O/SOL-IDS	W% H ₂ O/CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-190 8/4	88.9	0.0	40	0	0	0	0	0	45	45	45	<p>BLADE 5 (OFFSET) 520 psi/1280 RPM F 287,193,153,110 B 6.4M,12M,24M,54.4M 1.93 g/ml FLOW1 9.66 sec FLOW2 23.31 sec CFCT 53.7 cm First attempt to mix on 8/3 resulted in unmixed cement floating on top of slurry (4.5 min addition), no movement of dry material was occurring, started vibrator at 1 min, took 1 min for unmixed cement to turn in, shaft then slipped in motor coupling and mixing was stopped. Second attempt still had a small amount floating (13 min add.), vibration turned it in quickly.</p> <p>• .</p>

* Sand consists of 25% garnet sand, 25% grade 70 sand, and 50% grade 30 sand, plus a trace of aquarium gravel.

** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)

*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-W100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O / SOL-IDS	W% H ₂ O / CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-191 8/15	88.9	0.0	40	0	0	0	0	0	45	45	45	BLADE 2 & ANCHOR 1230 psi/1000 RPM (1450 psi max) F 216, 165, 140, 102 B 5.6M, 11M, 20M, 47M 1.94 g/ml FLOW1 7.88 sec FLOW2 15.19 sec CFCT 44 cm Anchor paddle at 400 RPM to empty, used vibration to fully empty. • .
2A-192 7/20	85.4	0.0	42.7	0	0	0	0	0	50	50	50	BLADE 2 1000 RPM (slowed to 550 during last 1/2 bag) B 99M @ 1.5RPM, 204M @ .6 RPM FLOW1 15.62 sec CFCT 21.6 cm (full funnel) Type III cement used. Mix would not turn over when speed fell. Drained with vibration until elevation of mixer blade, flow stopped, restarted mixer, then flowed. • .

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*** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder

FILE: PHASE2HS.1-2

MHC-SD-M100-DTR-002 REV 0

PHASE 2 - HIGH SHEAR (TYPE I/II)

TEST # & DATE	WT TYPE I/II	WT FLY ASH	WT H ₂ O	WT NaNO ₃ grams	WT SAND *	WT DIA-TO-MITE	WT BTM ASH	W% FA / CEM	W% H ₂ O / SOL-IDS	W% H ₂ O / CEM +FA	W% H ₂ O / CEM	Hyd. Pressure, Viscosity (**), Load Tests (***), Comments, Density, Flow
2A-193 8/1	85.4	0.0	42.7	0	0	0	0	0	50	50	50	BLADE 2 1460 psi/1000 RPM (1950 psi max) F -, 285, 245, 185 B 23M, 38M, 76M, 172M 1.82 g/ml FLOW1 14.9 sec CFCT 27.9 cm Type III cement used. 5 1/2 min add. Amb temp 28.5C, mix temp 29.9C at 27 min after mix. . .

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MHC-SD-M100-DTR-002 REV 0

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 ** F = Fann Viscometer (600, 300, 200, & 100 RPM), B = Brookfield Viscometer (10, 5, 2.5, & 1 RPM; M = 1000, MM = 1,000,000)
 *** (•) 3" dia X 6" tall test cylinder, (•) ~1.25" dia X 2.5" tall test cylinder