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1	1	Cog.Eng. DT Ruff	<i>[Signature]</i>	10/6/94	G3-15	GL Neer	<i>[Signature]</i>	10/12/94	L6-13	1	
1	1	Cog. Mgr. DE Ball	<i>[Signature]</i>	10/11/94	G6-46	KJ Hull	<i>[Signature]</i>	10/6/94	G6-46	1	1
1	1	QA H Spanheimer	<i>[Signature]</i>	10/6/94	G6-46	TL Yount	<i>[Signature]</i>	10/6/94	G6-47	1	1
		Safety				Central Files (Original)			L8-04	3	
		Env.				WRAP/DMC(3)			G6-51	3	
1	1	CA Petersen	<i>[Signature]</i>	10/10/94	G6-47	DA Burbank	<i>[Signature]</i>	10/6/94	G6-47	1	2
1	1	KM Weingardt	<i>[Signature]</i>	10/6/94	G6-47						

18. DT Ruff <i>[Signature]</i> 10/6/94 Signature of EDT Originator	19. <i>[Signature]</i> Authorized Representative Date for Receiving Organization	20. <i>[Signature]</i> 10/11/94 DE Ball Cognizant/Project Engineer's Manager	21. DOE APPROVAL (if required) Ltr. No. ☐ Approved ☐ Approved w/comments ☐ Disapproved w/comments <i>[Signature]</i>
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RELEASE AUTHORIZATION

Document Number: WHC-SD-W100-TP-014, Rev. 0

Document Title: Phase III (Full Scale) Agitated Mixing Test Plan

Release Date: 10/13/94

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**This document was reviewed following the
procedures described in WHC-CM-3-4 and is:**

APPROVED FOR PUBLIC RELEASE

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WHC Information Release Administration Specialist:

Christine Willingham
C. Willingham

10/13/94

(Signature)

(Date)

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5. Key Words WRAP, Mixing, Grout, Immobilization, Waste Encapsulation	6. Author Name: D. T. Ruff <div style="text-align: right; margin-top: 10px;"> Signature </div> <div style="text-align: right; margin-top: 10px;"> 10/6/94 Organization/Charge Code W7FD60/A551A </div>	
7. Abstract <p>This mixing test plan is a continuation of test phases I and II for immobilization of low level radioactive waste in the WRAP-2A plant. Phase III testing is scaled up to full size to refine the full size process for WRAP-2A and to specify the equipment that will be required for WRAP-2A.</p>		
<div style="position: relative;"> <div style="position: absolute; top: 0; left: 0; transform: rotate(-45deg); font-weight: bold; font-size: 1.2em;"> APPROVED FOR PUBLIC RELEASE </div> <div style="position: absolute; top: 0; left: 0; transform: rotate(-45deg); font-weight: bold; font-size: 1.2em;"> CWO 10-13-94 </div> <p>8. PURPOSE AND USE OF DOCUMENT - This document was prepared for use within the U.S. Department of Energy and its contractors. It is to be used only to perform, direct, or integrate work under U.S. Department of Energy contracts. This document is not approved for public release until reviewed.</p> <p>PATENT STATUS - This document copy, since it is transmitted in advance of patent clearance, is made available in confidence solely for use in performance of work under contracts with the U.S. Department of Energy. This document is not to be published nor its contents otherwise disseminated or used for purposes other than specified above before patent approval for such release or use has been secured, upon request, from the Patent Counsel, U.S. Department of Energy Field Office, Richland, WA.</p> <p>DISCLAIMER - This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, nor any of their contractors, subcontractors or their employees, makes any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or any third party's use or the results of such use of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise, does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof or its contractors or subcontractors. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.</p> </div>		10. RELEASE STAMP <div style="border: 2px solid black; padding: 10px; text-align: center; margin: 10px auto; width: fit-content;"> OFFICIAL RELEASE BY WHC DATE OCT 17 1994 <i>Sta #10</i> </div>
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PHASE III (FULL SCALE)
AGITATED MIXING
TEST PLAN

WHC-SD-W100-TP-014, Revision 0

October 1994

D. T. Ruff
Westinghouse Hanford Company

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PHASE III (FULL SCALE) AGITATED MIXING TEST PLAN

1.0 INTRODUCTION

Waste Receiving and Processing Facility Module 2A (WRAP 2A), provided by Project W-100, is the proposed second module of the WRAP facility. This facility will provide the required treatment for Contact Handled (CH) Low Level (LL) Mixed Waste (MW) to allow its permanent disposal. Solidification of a portion of this waste using a cement based grout has been selected in order to reduce the toxicity and mobility of the waste in the disposal site. Mixing of the waste with the cement paste and material handling constraints/requirements associated with the mixed material is, therefore, a key process in the overall treatment strategy.

Batch mixing outside of the waste container has been chosen as the method most suitable for WRAP 2A. In order to determine the proper equipment selection and design parameters, a series of small scale screening tests have been performed and full scale evaluations will be performed. These tests consist of three phases. Phases I and II have addressed the small scale testing to determine preferred mixing regime and paste properties. Phase III, which is covered by this test plan, will attempt to duplicate these results on a full scale. A follow on activity to this work is anticipated to be limited testing to be performed at vendor facilities to demonstrate commercially available equipment. The product of these ventures will be to provide input to the specification for the WRAP 2A grout mixing system.

This test plan addresses Phase III, Full Scale Testing. Phase I and Phase II tests are complete and the results compiled in the test reports referenced in section 12.0. The results of Phase I and II tests have indicated that on a small scale (several liters to several hundred liters) the best mixing results were obtained when mixing in a medium to high shear regime. It was also observed that flat or notched disk disperser blades are quite efficient at creating high shear regimes for a wide range of mixes and that deagglomeration of friable materials is thorough with such a blade. Several blade configurations were investigated and although shape of the blade has some influence on mix quality, it appears that geometric ratios (size) and location in the mix tank are more important.

A wide range of mixes were tested in Phase I and II. Many of the mixes exhibited extremely thick, viscous and sticky properties especially in the high shear regime. Rheologic data and empirical testing indicates that these mixtures are shear thinning (thixotropic) and become increasingly fluid when energy (such as vibration or stirring) is imparted. In general, all mixes flowed easily and mixing vessels emptied and cleaned easily under the influence of external vibration.

2.0 OBJECTIVES

The objectives of these tests are to determine if there are scale-up issues associated with the mixing results obtained in Phase I and II mixing tests, verify the workability of mixtures resulting from previous formulation development efforts (Waste Immobilization Development [WID]), and provide a

baseline for WRAP 2A mixing equipment design. To this end, the following objectives are of particular interest:

- a) Determine geometric influence of mixing blade at full scale (i.e., size, type, and location: height/offset)
- b) Determine if similar results in terms of mixing effectiveness and product quality are achievable at this scale.
- c) Determine if vibration is as effective at this larger scale in fluidizing the mixture and aiding in cleaning the vessel.
- d) Determine if baffles or sweeping blades are needed to aid in mixing at the larger size and for cleaning the vessel.
- e) Determine quality of the poured monolithic product and investigate exotherm and filling influences at this larger size.

3.0 SCOPE

The scope of this testing is to use cement/fly-ash/water/sand mixtures and the full scale silos and mixing equipment in the 305 building to produce full size ($\approx 60 \text{ ft}^3$ (1.7 m^3)) boxes of monolithic products for testing and evaluation of system and waste form parameters. Mixtures should be selected for testing that evaluate the range of mixtures being used in formulation development (WID). The total number of tests should be minimized to utilize only upper and lower boundaries and limited midpoints. Tests should include several different high shear configurations including a dual mixer configuration with a sweeping paddle. Tracer material (Nitrate) will be added to each mix for the eventuality that leach testing becomes part of the scope of this test program.

4.0 TEST DESCRIPTION

4.1 Test Equipment

Table 1. List of Test Equipment

Equipment Name	Description	Detailed Information
Batch Mixing Tank	4' dia. (64 ft^3), 7' depth, conical bottom, 6" outlet controlled by knife gate valve to slurry pump.	Carman ¹ Industries Dwg.#22D-12224-A
Mixer	25 Horse Power, Up to 400 RPM, 460 V 3 Phase motor drive.	Shar Model DSGV250BZ
Two Storage Tanks	5' diameter (100 ft^3), gyrated bin discharge into auger portioner.	Carman Industries Dwg.#210D-12111-B

¹Carman is a trademark of Carman Industries, Inc., of Jeffersonville, Indiana.

Equipment Name	Description	Detailed Information
Auger Portioner	90 RPM max auger speed, .064 ft ³ /rev, 1 HP motor drive, 90 V armature.	Carman Industries Model 66 Dwg.#26D-12110-A
Screw Conveyor	Feeds mix tank from portioner and storage tanks.	Carman Industries Dwg.#26D-12225-A
Digital Scale	Used for monolith weight up to 5,000 pounds.	Fairbanks Inc. Indicator Model H90-5200
Slurry Pump	Positive displacement, hydraulic motor driven. Moves product from mix tank to waste box.	Moyno ² Inc. Type 206-CDQ
Hydraulic Power Supply	Driven by 15 HP G.E. Motor, drives slurry pump and offset mixer.	Vickers ³ Inc.
Mixing Blade	12" dia., High performance blade, stainless steel, Page A-6	Indco, Inc. Design A
Mixing Blade	16" dia., High performance blade, stainless steel, Page A-6	Indco, Inc. Design A
Mixing Blade	30" dia., High performance blade, stainless steel, Page A-6	Indco, Inc. Design A
Mixing Paddle (Wiper)	Blades held by two hubs, counteract vortex, move material away from tank edge, Page A-4	Kaiser Engineers Sketch # ER4730L1A
Baffle	Similar to wiper, but fixed in place to increase agitation.	Same as above
Offset Mixer	Hydraulic motor driven, mixer used in phases I and II, attached to side of mix tank.	No Detailed Info
Fill Conveyor	Flexible screw conveyor, feed dry materials from ground level outside of building to top of storage tanks, 80 cu.ft./hr.	Supplier not known
Data Acquisition	Collect and display temperature data from thermocouples.	HP 3497A Data Acquisition/Control Unit & HP 9000 Model 236 Computer.

²Moyno is a trademark of Robbins & Myers, Inc., of Springfield, Ohio.

³Vickers is a trademark of Vickers, Inc., of Troy, Michigan.

4.2 Test Environment

Phase III testing will occur at the 305 building in the 300 area of the Hanford site. The pilot mixing plant will be installed into the low bay in the southeastern portion of the building. The test set-up is shown in Appendix A in relation to the low bay floor plan. The 305 building is an air conditioned environment and will adequately simulate the environment of WRAP 2A.

4.3 Test Resources

For operation of the equipment, the 305 building will provide the needed floor space for the pilot plant, storage of mixing materials, and space conducive to safe operation and maintenance of the equipment. The test equipment requires 480 V 3-Phase and 120 V single phase power sources. These sources are available at the test site and the equipment will be wired by 305 building electrical technicians. Other test site resources include a water supply and the intermittent use of the bridge cranes in the low bay of the 305 building.

4.4 Data

As a minimum, data requested by the test procedure shall be recorded in a logbook. Additionally, observations regarding the function of the equipment, design, and possible improvements to the system should be recorded in the logbook. Any deviations from this test plan must be recorded and justified in the logbook also. The following is a list of the quantifiable data that will be recorded during testing:

- Raw Material Quantities
- Material Addition Time
- Product Viscosity - Fann Brookfield Viscometers
- Mixing Torque
- Mixing Speed
- Product Density
- Bleed Water - Quantity, general observation
- Monolith Shrinkage
- Compressive Strength Poured Samples - SATEC⁴ Testing Machine
- Compressive Strength Cored Samples - SATEC Testing Machine
- Flow Cone (Various Sizes)
- Colcrete Flowchannel Flow Test
- Clean-up Water Quantity
- Exotherm - Thermocouple temperature measurement

The data sheets in Appendix B of this test plan are only intended to aid in the organization of data collection in the test log. The completed data sheets may be inserted into the logbook.

⁴SATEC is a trademark of SATEC Systems, Inc., of Grove City, Pennsylvania.

5.0 EXPECTED RESULTS

Phase III testing will compare mixing and product characteristics with the smaller scale mixing of test phases I, and II. Full scale mixing will determine if the mixing formulations and configurations scale up from test phases I and II. The comparison between small scale and full scale mixing will be based on quantitative and qualitative data. The following quantities/qualities will aid in this comparison:

- **Maximum Exotherm:** The maximum temperature in the monolith is not expected to exceed 180°F. Higher temperatures are not desirable, but the success or failure of such a mix does not rely solely upon this criteria.
- **Minimum Compressive Strength:** The compressive strength of a sample will be relative to the batch that it was taken from. The strength should be comparable to the corresponding phase I and II batch.
- **Observation of Homogeneity:** The homogeneity of the mixture will be observed and compared with previous observation and experience. This qualitative observation will be supported by core x-rays and the other quantitative measurements.
- **Viscosity:** The viscosity of a batch should match the corresponding values for phases I and II.
- **Flow Cones:** Samples from batches should match flow times through flow cones corresponding to phase I and II values.

Some other characteristics of cement batches produced by high shear mixing should include the following:

- Free standing water after mixing should not be appreciable (gone within 24 hours).
- Relatively easy mixer/pump clean-up/clean-out.
- Less than 15 minutes mix time to homogenize the mixture once all raw materials are in the mix tank.
- Ability to slurry high centipoise materials (sludge) for even distribution within the grout matrix.
- Quick blending of dry materials into the mix (no pooling of dry material on the mix surface).

6.0 TEST PROCEDURE

6.1 System Preparation

All equipment should be checked for proper operation before beginning the test program. The gyrated bin dischargers should be run to verify proper feeding to the portioner screw feeds. The portioner should be calibrated

prior to testing. This calibration will entail the recording of associated feed rates versus auger DC motor voltage for the different materials to be fed through the portioner. The data sheet for this calibration is found in Appendix B. A portion of a batch should be mixed and cleaned up as a trial so that any gained hands-on experience is available for the first actual test.

6.2 Generic Batch Mixing Procedure

This procedure is a general guideline to the sequence of operations during testing. It is not an operating instruction. The test engineers will operate the equipment according to the operating instructions given by the equipment suppliers. The following steps will be universal to all test batches:

1. Blend the correct ratio of fly-ash and cement in the fill bin for loading into the storage silo.
2. Fill (when required) one storage silo with the correct ratio mixture of portland cement and fly-ash.
3. Fill (when required) the second silo with sand.
4. If batching formulation is new, calibrate the portioner to match.
5. Verify correct mixer configuration and operation.
6. Fill mix tank with batch quantity of water.
7. Mix 0.3% Sodium Nitrate by weight into the water.
8. Prepare solid waste box for loading with cement mixture. This includes placement of thermocouples and sealing the lid. (See Page A-7)
9. Attach slurry pump discharge line to the solid waste box.
10. Start mixer, start gyrating bin dischargers on the storage tanks, and start the portioners and screw feed. If sludge waste surrogate is being used, add during cement/fly-ash addition.
11. When the mixture begins pouring into the mix tank, begin to record the feed time.
12. Use the mix tank vibration as needed and record use.
13. Record observations during mixing: vortex generation, average and maximum mixing torque, general mixing action.
14. When the correct amount of cement/fly-ash/sand mixture has been fed into the mix tank, shut off the screw feed, the portioner and gyrating bin dischargers. Record feed time/quantity.
15. Mix for a specified time period. Record observations and mixing torque.

16. When mixing is complete stop the mixer and record the mix time.
17. Turn on the slurry pump (and vibrators as necessary). Open the knife valve on the bottom of the mix tank.
18. When mixture starts filling waste box and flow is homogenous, open the tee on the discharge line and collect enough of the product to fill a compression test sample, take a viscosity measurement, and perform flow tests.
19. When the box is half full, repeat the tests in step 18.
20. When the box is almost filled, repeat the tests in step 18.
21. Turn off the product feed when the box is full or when mix tank has been emptied.
22. Begin data collection from the thermocouples for exotherm measurement. The exothermic heat produced by the curing of the monolith will be measured by thermocouples placed in the locations shown on page A-7.
23. Record general observations.
24. Rinse and clean mixing and slurry pump equipment. Minimize the quantity of water used. Record the water quantity and general observations about the cleanliness of the mixing equipment. Rinse water will be stabilized in a non-test related cement mixture.

6.3 Test A: Large Blades, Centered (One Mix)

Formulation: 1D1-08. Two 30" mixer blades ($2/3$ the diameter of tank) centered in the mix tank at different heights. Mix tank vibrators activated if required to aid in mixing.

6.4 Test B: Medium Blades, Centered, With/Without Baffle (Two Mixes)

Formulation: 1D1-08. Two 16" mixer blades ($\approx 1/3$ the diameter of tank) centered in the mix tank at different heights. Mix tank vibrators activated if required to aid in mixing.

6.5 Test C: Small Blades, Off-Set, With Baffle (One Mix)

Formulation: 1D1-08. Two 12" mixer blades ($\approx 1/4$ the diameter of tank) off-set in the mix tank at different heights. Mix tank vibrators activated if required to aid in mixing.

6.6 Test D: Small Blades, Off-Set, With Wiper Blade (One Mix)

Formulation: 1D1-08. Two 12" mixer blades ($\approx 1/4$ the diameter of tank) off-set in the mix tank at different heights. Mix tank vibrators activated if required to aid in mixing.

6.7 Test E: Preferred Configuration (Up to Five Mixes)

Formulations: 1D1-08 with no waste loading, 1D1-08 with increased waste loading, 1D1-09 with no waste loading, and 1D1-09 with increase waste loading. These formulations will be tested with the preferred configuration of the mixing equipment as found from tests A through D including the use of vibrators (if they were used).

6.8 Test F: Miscellaneous "What If" Tests (Up to Four Mixes)

The following test descriptions are tentative and may be changed as experience is gained during earlier tests:

- Test F1: Using the preferred mixer configuration and the mid point batch formulation, cool the water added to the mixture to less than 4°C before mixing begins. This test will evaluate the effect that the lower temperature add-water has on the monolith exotherm.
- Test F2: Using the preferred mixer configuration, mix a formulation that utilizes waste surrogate from the product of a Komar⁵ mix test (the Komar is a shredder that is being evaluated for use in WRAP 2A).
- Test F3: Determined at test site, and based on experience gained.
- Test F4: Determined at test site, and based on experience gained.

7.0 SAFETY

Industrial safety/hygiene and 305 building management have reviewed and signed the Hanford Job Hazard Analysis Checklist for operation of the mixing equipment in 305 building. The checklist is on page A-8. The control measures instituted by the analysis are listed on the checklist. Close attention must be paid during testing to assure that these measures are met and that all work is done in a safe manner. Safety will not be compromised for the sake of expediency.

8.0 QUALITY ASSURANCE

This phase of testing will be in accordance with this test plan and procedure. The data to be collected per this plan will be recorded in a logbook assigned to the test engineer. Data integrity and sample identification will be maintained by the use of the data sheets in Appendix A. Samples will be identified by the application of permanent markings on each sample to match the ID on the data sheet. All measuring equipment must be in current calibration as maintained by Westinghouse Hanford Company or guaranteed by the manufacturer. The calibration date of the equipment should be recorded in the test log and/or on the data sheets. The data and findings of this test plan will be communicated in a released test report.

⁵Komar is a trademark of Komar Industries, Inc., of Groveport, Ohio.

9.0 ORGANIZATION AND FUNCTION RESPONSIBILITIES

WRAP Solid Waste Projects is responsible for completing the phase III mixing tests. 305 building personnel will provide the facility management and following support toward the completion of this task:

- Control of materials (hazardous and non-hazardous) delivered to and transported from the test site
- Operation of overhead lifting equipment
- Operation of forklifts
- Technician support for test preparation and for changes to equipment configurations

10.0 SCHEDULE

The schedule for this test program is shown on page A-9 of Appendix A.

11.0 REPORTS

The results of this test phase will be reported in a released Detailed Test Report as a supporting document.

12.0 REFERENCES

Weber, Jim R., 1994, *WRAP 2A Phase I Mixing Tests Status Report*, WHC-SD-W100-DTR-002 REV 0, Westinghouse Hanford Company, Richland, Washington.

Weber, Jim R., 1994, *WRAP 2A Phase II Mixing Tests Report*, WHC-SD-W100-DTR-003 REV 0, Westinghouse Hanford Company, Richland, Washington.

APPENDIX A
TEST SET-UP

UNLESS NOTED ALL DIMENSIONS ARE PLUS OR MINUS 1/16"					DRIVEN- 3-10-74 /TA	INDUSTRIES, INC. <small>WESTINGHOUSE ELECTRIC COMPANY DIV.</small>	DEC. NO. 2100-12111-B
REV.	DATE	BY	DESCRIPTION	REFERENCE DWGS.	CHECKED- /		REVISION NO.
2	6-15-74	TA	ADD SCREW CONVEYOR & SURGE TANK		SCALE- 3/4" = 1'-0"	SYSTEM ARRANGEMENT~ VIEW "A" - "A" FOR WESTINGHOUSE HANFORD	
1	4-25-74	TA	DWG NO. WAS 2100-12109-B		FILE NO- SEA-43-10-1562		
					P. S. NO- WFA-WW-30143		
					SERIAL NO- S. G. NO- 12111		

QTY	PN	DESCRIPTION		
1	2	ASSEMBLY, MIXING PADDLE		
1	2	PADDLE, MIXING		DWG ER4730L1B
2	3	WIPER		DWG ER4730L1B
2	4	WIPER		DWG ER4730L1B
2	5	SCREW, SQ HD SET	CONE POINT (90°) 1/2-13 UNC-2A X 1 1/2 LONG	ANSI B18.6.2, STEEL
26	6	SCREW, HEX CAP	NO. 10-24 UNC-2A X 3/4 LONG	ANSI B18.2.1, STEEL
26	7	WASHER, PLAIN	NO. 10 RGLR SERIES, TYPE B	ANSI B18.22.1, STEEL
26	8	WASHER, LOCK	HELICAL SPRING, NO. 10 RGLR	ANSI B18.21.1, STEEL
26	9	NUT, HEX	NO. 10-24 UNC-2B	ANSI B18.2.2, STEEL

1 MIXING PADDLE ASSEMBLY

1
150
150

SKETCH NO.
ER4730L1A

CEMENT MIX FORMULATIONS

FORMULATION 1D1-08:

FEEDSTREAM 1D1 (Waste Surrogate: Sand)

<u>SAMPLE</u>	<u>CEMENT</u>	<u>FLY-ASH</u>	<u>SAND</u>	<u>WATER</u>	<u>SUM</u>	<u>FA/C</u>	<u>W/C</u>
1D1-08	.2	.086	.576	.139	1.0	.43	.69

FORMULATION 1D1-09:

FEEDSTREAM 1D1 (Waste Surrogate: Sand)

<u>SAMPLE</u>	<u>CEMENT</u>	<u>FLY-ASH</u>	<u>SAND</u>	<u>WATER</u>	<u>SUM</u>	<u>FA/C</u>	<u>W/C</u>
1D1-09	.273	0	.604	.123	1.0	0	.45

The above quantities are weight percents. FA/C is the fly-ash to cement weight ratio. W/C is the water to cement weight ratio.

The above formulations are those that produced specimens that passed the compressive strength for the 28 day cure period, thermocycling, and 90 day immersion tests. Each specimen reached an initial set within 48 hours. Initial set is defined as a penetrometer reading of 345 kPa (50 psi) or more.

DISPERSION BLADES

DESIGN A

This design is our performance match for the Cowles blade and is our standard for most mixing and dispersing applications. It is used in manufacturing paint, clay slurries, paper coatings, ink and many other products.

This design has proven its superiority in thousands of applications. Its a very rugged and efficient design that is economical to use. An excellent balance of high shear dispersion and pumping action.

The sizes range from 1 $\frac{5}{8}$ " to 36" in diameter. Manufactured of stainless steel with tungsten carbide coating available for extra abrasive resistance.

A-7

THERMOCOUPLE AND CORE LOCATIONS

T1	1"	1"	1"
T2	13"	13"	10"
T3	25.5"	25.5"	20"
T4	38"	25.5"	20"
T5	50"	25.5"	20"
T6	1"	1"	20"
T7	25.5"	25.5"	1"
T8	25.5"	25.5"	39"
C1	47"	4"	
C2	25.5"	38"	
C3	21.5"	25.5"	

HANFORD JOB HAZARD ANALYSIS CHECKLIST

Page 1 of 1

Prepared By David T. Ruff

Date 09/21/94

Area 300

Bldg. 305

Scope/Description: Evaluate operation of pilot plant mixing equipment for phase III mixing tests.

☒ New☐ Revised

Emergency Contact Person(s):

Primary: Gordon Neer 376-1472 *Ben 10/5/94*

Secondary: Kevin Hull 376-0145

Emergency Radio/Phone Number:

JHA Number (not required):

Specific Work Location(s): Inside the southeastern bay of the 305 building

KNOWN OR POTENTIAL HAZARDS

	Yes	No	✓	•	Reference		Yes	No	✓	•	Reference
1. Radiation Area Work		X	✓	•		10. Respiratory Hazards	X		✓	•	See 6 below
2. Hazardous Waste Operations		X	✓	•		11. Electrical Hazards	X		✓	•	See 24 below
3. Confined Space Entry		X	✓	•		12. Lock and Tag		X	✓	•	
4. Cutting/Welding		X		•		13. Scaffolding	X				See 6 above
5. Roof Work		X				14. Aerial Lifts		X	✓		
6. Fall Hazards (> = 10')	X				WHC Fall Prot	15. Asbestos Removal		X	✓	•	
7. Excavation/Trenching		X		•		16. Other (see JHA Sht. 2):		X			
8. Asbestos Inspection Report		X		•		✓ = Formal training required.					
9. Hazardous Materials	X		✓		See other haz	• = Items than require a permit/form/report.					

Other Hazards	Yes	No	Control Measures
1. Temperature Extremes		X	
2. Noise		X	Ear protection to be worn as needed
3. Poor Lighting		X	
4. Animals/Insects		X	
5. Process Chemicals/Steam	X		Gloves to be worn when handling cement and sodium nitrate
6. Dust	X		Positive ventilation, dust masks, and goggles as needed
7. Flammable/Combustible Materials		X	
8. Ladders	X		Fixed in place on scaffolding
9. Wet/Slippery Floors	X		Spilled water will be cleaned up before operations continue
10. Uneven Terrain		X	
11. Open Excavations/Trenches		X	
12. Adjacent Water Hazard	X		Rinse water will be stabilized in concrete
13. Vehicle Traffic		X	
14. Heavy Equipment	X		Forklift: Operated by trained personnel only
15. Rigging Operation		X	
16. Manual Lifting	X		Personnel amply trained, fill bags positioned horizontally
17. Power Tools	X		Power tools/equipment operated by designated personnel only
18. Pinch Points	X		Guarded
19. Falling Objects	X		Hard hats required as needed, equipment access controlled
20. Sharp Objects	X		Access to equipment area will be controlled
21. Overhead Obstructions	X		See 19 and 20
22. Site Control (Signs/Barricades)	X		Signs: Equipment Operated by Designated Personnel Only
23. Remote Work Area		X	
24. Other (see JHA Sht. 2):	X		Electrical will be properly bonded and grounded

MINIMUM DRESS REQUIREMENTS: N/A

APPROVALS

Does further evaluation of the job steps, associated hazards, or safety measures need to be performed?

☐ Yes☒ No

If Yes, continue job hazard analysis on the following pages.

Supervisor, Person in Charge *K. J. Hull*
(Signature) *10/4/94*Industrial Safety/Hygiene
(Signature)

S.A. Norling

SA Norling 9-30-94

October 5, 1994

WRAP-2A Phase III (Full Scale) Agitated Mixing Test Plan

APPENDIX B
DATA SHEETS

PHASE III MIXING TESTS

TEST: DATE: FORMULATION: BAFFLE WIPER MIXER RPM DIMENSION D DIMENSION H1 DIMENSION H2 DIMENSION M FILL TIME MIX TIME CLEAN-UP WATER OTHER:

SAMPLE ONE

SAMPLE TWO

SAMPLE THREE

DENSITY
(g/ml)SAMPLE NUMBER
(Ø3"x6" and 250 ml Grad.Cyl.)FANN VISCOSITY
(600,300,200,100 RPM)BROOKFIELD VISCOSITY
(10,5,2.5,1 RPM)FLOW CONE RESULT
(1" and 1/2" Discharge)COL-FLOW TEST
(cm)SHRINKAGE
(Ø3"x6") (mm)COMPRESSIVE LOAD
(Ø1.25X2.5, Ø1.25X2.5, Ø3X6) (LBS)CORE SAMPLE NUMBER
(top to bottom)

OTHER

	SAMPLE ONE	SAMPLE TWO	SAMPLE THREE
DENSITY (g/ml)			
SAMPLE NUMBER (Ø3"x6" and 250 ml Grad.Cyl.)	2A - - 1	2A - - 2	2A - - 3
FANN VISCOSITY (600,300,200,100 RPM)			
BROOKFIELD VISCOSITY (10,5,2.5,1 RPM)			
FLOW CONE RESULT (1" and 1/2" Discharge)			
COL-FLOW TEST (cm)			
SHRINKAGE (Ø3"x6") (mm)			
COMPRESSIVE LOAD (Ø1.25X2.5, Ø1.25X2.5, Ø3X6) (LBS)			
CORE SAMPLE NUMBER (top to bottom)	EDGE 2A - - C1	MID 2A - - C2	CENTER 2A - - C3
OTHER			

PHASE III MIXING TESTS

TEST:

B-1

DATE:

10/4/94

FORMULATION:

1D1-08

BAFFLE

Yes

WIPER

None

MIXER RPM

400

DIMENSION D

16"

DIMENSION H1

62"

DIMENSION H2

40"

DIMENSION M

Centered

FILL TIME

600 seconds

MIX TIME

300 seconds

CLEAN-UP WATER

10 gal.

OTHER:

Comments and observations are in
log book WHC-N-730-1 Page 43.

SAMPLE ONE

SAMPLE TWO

SAMPLE THREE

DENSITY
(g/ml)

1.93

1.95

1.98

SAMPLE NUMBER
(Ø3"x6" and 250 ml Grad.Cyl.)

2A - B1 - 1

2A - B1 - 2

2A - B1 - 3

FANN VISCOSITY
(600,300,200,100 RPM)

219, 136, 105, 78

240, 160, 120, 90

250, 170, 135, 95

BROOKFIELD VISCOSITY
(10,5,2.5,1 RPM)
 $\bar{D}$
73M, 282M, 708M,
1.8MM

 $\bar{D}$
82M, 290M, 740M
1.8MM

 $\bar{D}$
85M, 298M, 748M
1.9MM
FLOW CONE RESULT
(1" and 1/2" Discharge)
 $1'' \rightarrow 23 \text{ sec}$
 $1/2'' \rightarrow \text{No flow}$
 $1'' \rightarrow 21 \text{ sec}$
 $1/2'' \rightarrow \text{No flow}$
 $1'' \rightarrow 20 \text{ sec}$
 $1/2'' \rightarrow \text{No flow}$
COL-FLOW TEST
(cm)

35

40

32

SHRINKAGE
(Ø3"x6") (mm)

4

7

10

COMPRESSIVE LOAD
(Ø1.25X2.5, Ø1.25X2.5, Ø3X6) (LBS)

3,800

3,950

3,875

CORE SAMPLE NUMBER
(top to bottom)

	EDGE
2A - B1	- C1

	MID
2A - B1	- C2

	CENTER
2A - B1	- C3

OTHER

PHASE III MIXING TESTS FEED RATE CALIBRATION

DATE

FEED MATERIAL

STORAGE BIN

AUGER ID

DC MOTOR VOLTAGE (V)	TIME (sec)	VOLUME (gallon)	FEED RATE (gal/s)
90			

FEED RATE (GAL/)