

TEST SUMMARY REPORT

Rev. 0

TEST/TEST SERIES Waste Form Qualification for Cement Solidification of
Sludge Wash LiquidsDESCRIPTION Development of the Nominal Recipe for Cement Solidification of
Sludge Wash LiquidsTEST REQUEST NO. WVN-TRQ-025 TEST PLAN NO. WVNS-TPL-70-011TEST COMMENCEMENT DATE 5/1/91 TEST COMPLETION DATE 5/17/91

Engineering Release #2157

1.0 OBSERVATIONS/COMMENTS:

The purpose of this test procedure was to determine the nominal recipe for cement solidification of sludge wash liquids using the existing recipe for supernatant solidification as a first approximation. This test procedure verified that the existing supernatant recipe will be the nominal recipe used in future testing with the exception that the waste liquid will be 29 to 33% solids instead of 37 to 41% used for supernatant.

2.0 REFERENCES:

- 1) Letter No. EK:91:0047, "Preliminary Flowsheet: Sludge Wash with Existing 8D-2 Heel", dated March 7, 1991.
- 2) DOE/NE/44139-49, Topical Report on Development of the Recipe for Solidification of Decontaminated Supernatant, McVay, et. al.
- 3) USNRC Branch Technical Position on Waste Form, Rev. 1, dated January 1991.
- 4) Letter No. FH:91:0089, "Test Results on Nominal Recipe Qualification", dated June 21, 1991.

3.0 OBJECTIVES MET:

- 3.1 Determine the acceptable range of percent solids (by weight) in the waste liquid.

STATUS: Complete

OBSERVATION: Increasing the percent solids in the waste liquid above the "nominal" range lowers the compressive strength of the waste form.

DATA: Refer to Table 1

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- 3.2 Determine the acceptable range of calcium nitrate recipe enhancer to be blended with Portland Type I cement.

STATUS: Complete

OBSERVATION: The waste form produced with no calcium nitrate in the cement blend exhibited lower compressive strength as well as slow gel times. Large amounts of calcium nitrate in the cement blend also resulted in lower compressive strength.

DATA: Refer to Table 2

- 3.3 Determine the acceptable range of water-to-cement ratio.

STATUS: Complete

OBSERVATION: The waste form exhibits lower compressive strength at high water-to-cement ratios.

DATA: Refer to Table 3

- 3.4 Determine the acceptable range of antifoam recipe enhancer to be added to the waste.

STATUS: Complete

OBSERVATION: None

DATA: Refer to Table 4

- 3.5 Determine the acceptable range of sodium silicate recipe enhancer to be added to the waste/cement mixture.

STATUS: Complete

OBSERVATION: The waste form produced with no sodium silicate exhibited a slow gel time, and bleed water.

DATA: Refer to Table 5

- 3.6 Determine the maximum practical compressive strength of the waste form.

STATUS: Complete

OBSERVATION: The average compressive strength exhibited by the waste form at the "nominal" recipe was 1403 psi, with a 2 sigma (90% confidence band) of 316 psi.

DATA: Refer to Table 6

- 3.7 Evaluate the effects of the recipe parameters on "gel time" and free liquid in the waste mixture.

STATUS: Complete

OBSERVATION: See section 3.2 and 3.5 above.

DATA: Refer to Table 7

4.0 CONCLUSIONS:

- 4.1 The nominal recipe for supernatant processing will be used for sludge wash waste form qualification testing. This recipe is shown in table 7.

- 4.2 There is a practical upper limit to the water-to-cement ratio, as well as to the percent solids in the waste stream and calcium nitrate cement blend.

These are three variations of the same effect: cement must be hydrated by water, and any parameter which changes the amount of water (solids in the waste liquid) or cement (calcium nitrate in the blend) will affect the hydration reaction.

5.0 ACCEPTABILITY OF RESULTS:

- 5.1 The results of this test are acceptable. It is felt that a reasonable number of test specimens were prepared and that the results clearly demonstrate where an effect is encountered.
- 5.2 The results of tests where no effect is seen are sufficiently close in order of magnitude to establish that no concern is justified.


6.0 ACTIONS OUTSTANDING:

- 6.1 The exact limits for recipe parameters, as well as the possible interaction of all variables will be evaluated during multi-variant testing as described in WVNS-TP-028.
- 6.2 Characterization of the solids in the waste liquid, discussed in WVNS-TRQ-025, was not performed, but the effect of sulfates, nitrates, nitrites, aluminum, ect., will be evaluated during WVNS-TP-028/028A.

APPROVAL(S) 
(Test Requester)

J. C. Cwynar
J. C. Cwynar

ADDITIONAL REVIEWERS: YES NO


J. L. Mahoney

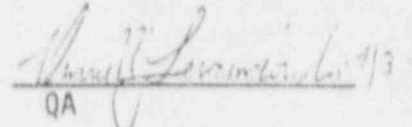

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TABLE 1

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Total Solids Variations					
SWCF4 28.79%	10	>700	<1	2021	1.75
SWCF4 30.14%	10	>700	<1	1817	1.77
SWCF4 32.23%	5	>700	<1	1601	1.76
SWCF4 34.91%	7	>700	<1	1343	1.79
SWCF4 41.46%	58	>700	<1	859	1.81

TABLE 2

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Calcium Nitrate Variations					
SWCF4 NR 0%	7	>700	<1	1054	NA
SWCF4 NR 0%	10	>700	<1	1334	1.80
SWCF4 NR 0%	20	>700	<1	822	1.74
SWCF4 NR 3%	5	>700	<1	1535	1.79
SWCF4 NR 3%	5	>700	<1	1359	1.74
SWCF4 NR 4%	5	>700	<1	1331	1.74
SWCF4 NR 5.7%	5	>700	<1	1581	1.71
SWCF4 NR 9%	5	>700	<1	1518	1.66
SWCF4 NR 11.4%	5	>700	<1	1274	1.67
SWCF4 NR 17.1%	5	>700	<1	481	1.63

TABLE 3

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Water to Cement Ratio					
SWCF4 0.50	5	>700	<1	2174	NA
SWCF4 0.55	5	>700	<1	1731	NA
SWCF4 0.61	5	>700	<1	1434	1.77
SWCF4 0.70	5	>700	<1	1089	NA
SWCF4 0.70	7	>700	<1	1216	1.71
SWCF4 0.80	30	>700	<1	565	NA
SWCF4 0.80	20	>700	<1	788	1.62

TABLE 4

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Antifoam Variation					
SWCF4 0 ml	5	>700	<1	1777	1.69
SWCF4 0.075 ml	5	>700	<1	1695	1.78
SWCF4 0.15 ml	5	>700	<1	947	1.76
SWCF4 0.30 ml	5	>700	<1	1443	1.76
SWCF4 0.375 ml	5	>700	<1	1591	1.75
SWCF4 0.45 ml	5	>700	<1	1418	1.75
SWCF4 0.60 ml	5	>700	<1	1479	1.72

TABLE 5

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Sodium Silicate Variations					
SWCF4 NR 0 g	10	>700	2	1926	1.80
SWCF4 NR 2.75 g	5	>700	<1	1400	NA
SWCF4 NR 5.09 g	0	>700	<1	1367	1/66
SWCF4 NR 8.25 g	5	>700	<1	1500	1/76
SWCF4 NR 10.04 g	5	>700	<1	1489	1.74
SWCF4 NR 13.75 g	5	>700	<1	1321	1.77
SWCF4 NR 15.38 g	7	>700	<1	1308	NA
SWCF4 NR 16.88 g	20	>700	<1	1281	1.71

TABLE 6

<u>SAMPLE ID.</u>	<u>GEL TIME</u> <u>(mins)</u>	<u>PENETRATION</u> <u>(psi)</u>	<u>BLEED WATER</u> <u>(mls)</u>	<u>COMP</u> <u>STRENGTH</u> <u>(psi)</u>	<u>SLURRY DENSITY</u> <u>(g/ml)</u>
Nominal Recipe					
SWCF4 NR	5	>700	<1	1339	1.73
SWCF4 NR	5	>700	<1	1435	1.71
SWCF4 NR	5	>700	<1	1203	1.74
SWCF4 NR	5	>700	<1	1253	1.75
SWCF4 NR	5	>700	<1	1438	1.70
SWCF4 NR	5	>700	<1	1263	1.75
SWCF4 NR	5	>700	<1	1694	NA
SWCF4 NR	5	>700	<1	1296	NA
SWCF4 NR	5	>700	<1	1303	NA
SWCF4 NR	5	>700	<1	1722	1.75
SWCF4 NR	5	>700	<1	1432	1.77
SWCF4 NR	5	>700	<1	1401	1.76
SWCF4 NR	5	>700	<1	1464	1.77

TABLE 7

<u>PARAMETER</u>	<u>"NOMINAL" RECIPE FOR SUPERNATANT PROCESSING</u>	<u>SATISFACTORY RANGE FROM THIS TEST PROCEDURE</u>
% Solids in Waste	37 to 41%	28.79 to 34.91%
Calcium Nitrate	4.7 to 7.4%	3.0 to 11.4%
W/C Ratio	0.54 to 0.70	0.50 to 0.70
Antifoam	0.30 mL	0 mL to 0.60 mL
Sodium Silicate	10.5 to 11.5 grams	2.75 to 15.3 grams
Compressive Strength	>500 PSI	1403 PSI Average
Gel Time	0 to 90 minutes	5 to 10 minutes