

PROCESS CONTROL PROGRAM
FOR
INCONTAINER SOLIDIFICATION OF
10 TO 14 WEIGHT PERCENT BORIC ACID

1.0 Purpose

1.1 The purpose of the Process Control Program (PCP) for in-container solidification of boric acid slurries is to provide a program which will assure a solidified product with no free liquid prior to transportation for disposal.

The program consists of four major steps, which are:

- (a) Procedures for collecting and analyzing samples;
- (b) Procedures for solidifying samples;
- (c) Criteria for process parameters for acceptance or rejection as solidified waste.
- (d) Calculation of minimum and recommended quantities of cement and anhydrous sodium metasilicate to be used in full scale liner solidifications.

1.2 This document shall be considered complete only when used in concert with the HNDC procedures for field solidification. This document describes the methodology for determining the range of acceptable ratios of waste, cement and additive that will result in an acceptable product for transportation and burial. The Solidification Data Sheet then converts these ratios into minimum and recommended quantities of cement and additive that must be mixed with the waste. Assurance that quantities of cement and additive between these ranges are actually mixed with the waste is covered in the Field Services Weekly Report.

2.0 System Description

See attachment 1

3.0 Collection and Analysis of Samples

3.1 General Requirements

3.1.1 As required by the Radiological Effluent Technical Specifications for PWR's and BRW's the PCP shall be used to verify the solidification of at least one representative test specimen from every tenth batch of each type of wet radioactive waste.

3.3 Analysis of Samples

This document only defines the parameters to be analyzed and not the methodology. This is left to the plant staff.

<u>Parameter</u>	<u>Acceptable Range</u>
pH	7.4 - 9.2 or > 11.5
Boric Acid or Boron	10 - 14 wgt % 17,400 to 24,500 ppm
Detergents	No appreciable foaming
Oil	<1%

4.0 Test Solidification and Acceptance Criteria

4.1 Waste Conditioning

- 4.1.1 Prior to the test sample solidification the pH of the sample shall be adjusted to a range of 7.4 to 9.2 or greater than 11.5.
- 4.1.2 It is recommended that 50 weight percent sodium hydroxide solution be used to adjust the pH. The amount of sodium hydroxide necessary for the pH adjustment shall be recorded.
- 4.1.3 If large quantities of detergents are present, the sample should be treated with an anti-foaming agent. The quantity of anti-foaming agent required shall be recorded.
- 4.1.4 If oil is present in quantities greater than 1% by volume, the oil shall be reduced to less than 1% by skimming. Emulsification agents should be used to break up the remaining oil. The quantity of any substance added to the sample for this purpose shall be recorded.

4.2 Test Solidification

- 4.2.1 Any Sample to be solidified shall be pretreated as specified in Section 4.1.
- 4.2.2 Test Solidifications should be conducted using a 1000 ml. disposal beaker or similar size container. Mixing should be accomplished by stirring with a rigid stirrer until a homogeneous mixture is obtained, but in no case for less than two minutes.

- 4.2.3 For the test solidification of the borated wastes, measure into two mixing vessels 400ml of waste each.
- 4.2.4 Measure out the required quantities of cement and anhydrous sodium metasilicate as shown below.

<u>Waste</u>	<u>Grams Cement</u>		<u>Grams Anhydrous Sodium Metasilicate</u>	
	<u>Sample A</u>	<u>Sample B</u>	<u>Sample A</u>	<u>Sample B</u>
10-14 wgt. % Boric Acid	440	505	63	84.2

4.2.5 Mix the cement and additive together and slowly add this mixture to the test sample while it is being stirred.

4.2.6 After mixing for approximately two minutes once all cement and additive are added and a homogeneous mixture is obtained, allow the waste to stand for a minimum of 4 hours.

4.3 Solidification Acceptability

The following criteria define an acceptable solidification process and process parameters.

- 4.3.1 The sample solidifications are considered acceptable if there is no free standing water.
- 4.3.2 The sample solidifications are considered acceptable if upon visual inspection the waste appears that it would hold its shape if removed from the beaker and it resists penetration.
- 4.3.3 The sample solidifications establish a range for the ratios of cement and additive to waste that will result in an acceptable product.

4.4 Solidification Unacceptability

- 4.4.1 If the waste fails any of the criteria set forth in Section 4.3, the solidification will be termed unacceptable and a new set of solidification parameters will need to be established under the procedures in Section 4.5.
- 4.4.2 If the test solidification is unacceptable then the same test procedures must be followed on each subsequent batch of the same type of waste until three consecutive test samples are solidified.

Liner No.: _____
Sample No.: _____
Date: _____

WASTE SOLIDIFICATION DATA SHEET
for
10-14 Weight Percent Boric Acid

Sample Volume, ml: Sample A _____ Sample B _____

Sample pH: _____ Volume NaOH solution used to adjust pH, ml: _____

Quantity of Oil %: _____

Quantity of Emulsifier (20% of vol. of oil), ml¹: _____

Quantity of Anti-foaming Agent, ml: _____

Temperature at Solidification, °F: _____

Quantity of Cement Added: Cement Ratio² (#/ft³ Waste)

Sample A _____ gms Sample A _____

Sample B _____ gms Sample B _____

Quantity of Additive Added: Additive Ratio³ (#/ft³ Waste)

Sample A _____ gms Sample A _____

Sample B _____ gms Sample B _____

Packaging Efficiency: $\frac{\text{Waste Volume}}{\text{Solidified Waste Volume}}$

Sample A _____

Sample B _____

Product Acceptable: Sample A Yes _____ No _____ (If no, refer to Section 4.5 and proceed as directed)
Sample B Yes _____ No _____

Additional batches solidified based on this sample solidification:

Liner No.	Waste Vol.	Date	Liner No.	Waste Vol.	Date	Liner No.	Waste Vol.	Date
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PCP Performed by _____ Date _____

4.5 Alternate Solidification Parameters

4.5.1 If a test sample fails to provide acceptable solidification of the waste, the following procedures should be followed.

- (1) Mix equal volumes of dry cement and water to ensure that the problem is not a bad batch of cement.
- (2) Add additional caustic solution to raise the pH according to section 4.1.1.
- (3) If the waste is only partially solidified, use lower waste to cement and additive ratios. Using the recommended quantities of cement and anhydrous sodium metasilicate, reduce the waste sample volume to 375ml and continue reducing the sample volume by 25ml until the acceptability criteria of Section 4.3 are met.

SOLIDIFICATION DATA TABLES

I. For the Minimum Amount of Cement and Additive.

	<u>Series 1</u>	<u>HN-100 Series 2</u>	<u>Series 3</u>	<u>HN-100S</u>
Usable Liner Volume, (cu. ft.)	143	143	143	143
Max. Waste Vol. (cu. ft.)	84.8	82.7	104.5	101.9
Max. Solidified Waste Vol. (cu. ft.)	116	113.1	143	139.4
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Cement Added at Max. Waste Vol.				
Weight (lbs.)	5,814.8	5,673.5	7,171.0	6,991.8
Volume (bags)	61.9	60.4	76.3	74.4
Anhydrous Sodium Metasilicate Added at Max. Waste Vol.				
Weight (lbs.)	830.7	810.5	1,024.4	998.8
Volume (bags)	8.3	8.1	10.2	10.0
Max. Radiation Level R/hr Contact	12	12	12	3

PROCESS CONTROL PROGRAM
FOR INCONTAINER SOLIDIFICATION OF BEAD RESIN

1.0 Purpose

- 1.1 The purpose of the Process Control Program (PCP) for in-container solidification of bead resin is to provide a program which will assure a solidified product with no free liquid prior to transportation for disposal.

The program consists of four major steps, which are:

- (a) Procedures for collecting and analyzing samples;
- (b) Procedures for solidifying samples;
- (c) Criteria for process parameters for acceptance or rejection as solidified waste;
- (d) Calculation of minimum and recommended quantities of cement and anhydrous sodium metasilicate to be used in full scale liner solidification.

- 1.2 This document shall be considered complete only when used in concert with the HNDC procedures for field solidification. This document describes the methodology for determining the range of acceptable ratios of waste, additional water cement and additive that will result in an acceptable product for transportation and burial. The Solidification Data Sheet then converts these ratios into minimum and recommended quantity of cement and additive that must be mixed with the waste. Assurance that quantities of cement and additive between these ranges are actually mixed with the waste is covered in the Field Services Weekly Report.

2.0 System Description

See attachment 1

3.0 Collection and Analysis of Samples

3.1 General Requirements

- 3.1.1 As required by the Radiological Effluent Technical Specifications for PWR's and BRW's the PCP shall be used to verify the solidification of at least one representative test specimen from every tenth batch of each type of wet radioactive waste.