This document was prepared in conjunction with work accomplished under Contract No. DE-AC09-96SR18500 with the U. S. Department of Energy.

DISCLAIMER

Keywords: Waste processing, solvent extraction, liquid waste, cesium, MCU

Retention: Permanent

WASTE AND SOLVENT COMPOSITION LIMITS FOR MODULAR CAUSTIC-SIDE SOLVENT EXTRACTION UNIT (MCU)

Kofi Adu-Wusu
D. Douglas Walker
Thomas B. Edwards

MAY 26, 2005

Westinghouse Savannah River Company
Savannah River Site
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-96SR18500

DISCLAIMER

Printed in the United States of America

Prepared For
U.S. Department of Energy

REVIEWS AND APPROVALS

Authors:

6/28/05

K. Adu-Wusu, SRNL Waste Processing Technology — Date

6/28/05

D. D. Walker, SRNL Waste Processing Technology — Date

6/28/05

T. B. Edwards, SRNL Statistical Consulting — Date

Technical Reviewer:

6/28/05

C. A. Nash, SRNL Waste Processing Technology — Date

SRNL Management:

7/5/2005

S. D. Fink, Manager, SRNL Liquid Waste Processing Group — Date

6/28/05

J. C. Griffin, Manager, SRNL Waste Processing Technology Section — Date

Customers:

6/30/05

E. A. Brass, CBU Modular CSSX Unit Design Authority Manager — Date

7/1/05

A. P. Giordano, CBU Modular CSSX Unit Project Manager — Date

7/1/05

B. A. Gifford, CBU Modular CSSX Unit Project Owner — Date

SUMMARY

This study examined waste feed and solvent limits for the Modular Caustic-Side Solvent Extraction Unit (MCU) currently being designed and built at the Savannah River Site (SRS) to remove cesium from highly alkaline radioactive waste. The study involved proposing ranges for 12 waste feed components (i.e., Na^+, K^+, Cs^+, OH^-, NO_3^-, NO_2^-, Cl^-, F^-, SO_4^{2-}, PO_4^{3-}, and CO_3^{2-}, and AlO_2^-) through a compilation of SRS waste data. Statistical design methods were used to generate numerous wastes with varying compositions from the proposed ranges.

An Oak Ridge National Laboratory (ORNL) model called SXFIT was used to predict the cesium extraction distribution coefficients (D-values) between the organic (solvent) phase and the aqueous waste phase using the waste component concentrations as inputs. The D-values from the SXFIT model were used as input along with MCU base case process parameters to a SASSE (Spreadsheet Algorithm for Stagewise Solvent Extraction) model to calculate final cesium concentrations for the MCU. The SASSE model was developed at Argonne National Laboratory (ANL).

The SXFIT D-value and the waste component concentration data were used to develop a handier alternative model (neural network model) to the SXFIT model that predicts D-values within 15% of the SXFIT D-values. Both the SXFIT and the neural network model revealed the following. The solvent extractant concentration ratios are approximately equal to the corresponding D-value ratios; a useful feature that could be used to predict extraction D-values when the extractant concentration in the solvent changes in the MCU operation. Also, potassium is the only waste component out of the 12 that shows a distinct relationship with the cesium extraction D-values; an indication of potassium's competition with cesium in the Caustic-Side Solvent Extraction (CSSX) process.

A waste feed acceptance model suitable for assessing wastes within relatively wide ranges of D-values (0.6 – 40) and initial cesium-137 concentrations (0.2 – 12.8 Ci/gal) has been developed from the SASSE outputs. The waste feed acceptance model is an equation involving initial cesium-137 concentration and D-value that results in a final cesium-137 concentration of 0.1 Ci/gal, the target concentration for the MCU. For example, the waste feed acceptance model shows the minimum acceptable extraction D-value based on MCU base conditions is 5.73. The waste feed acceptance model is defined by a simple linear relationship for extraction D-values $\geq$ 7. This facilitates quicker calculations.

For a given extraction D-value, final cesium-137 concentration (C_f) and initial cesium-137 concentration (C_0) are linearly related; while for a given C_0, log (C_f) and log (extraction D-value) are linear with a slope of -1.43. These two relationships allow one to quickly calculate C_f at other MCU conditions without resorting to the SASSE model.

The SASSE runs indicate that broad changes in the MCU process parameters for the extraction, scrub and strip stages (i.e., flow rate, temperature, fraction of interstage carryover, total liquid volume per contactor stage, and efficiency per contactor stage) will not result in C_f exceeding target, at least for the MCU base conditions. The process parameters ranges are given below.

- Flow rate ranges within which $C_f < 0.1$ Ci/gal

	Nominal flow rate, gal/min	Flow rate range
Solvent flow rate	2.833	0.6 to 1.7 times nominal value
Aqueous waste flow rate	8.5	< 1.45 times nominal value
Aqueous Scrub flow rate	0.567	< 5.5 times nominal value
Aqueous Strip flow rate	0.567	> 0.75 times nominal value

- Temperature ranges within which $C_f < 0.1$ Ci/gal

Process step	Nominal temperature range, ^oC	Temperature limit, ^oC
Extraction	20 - 26	< 28.3
Scrub	20 – 26 (assumed)	< 43.7
Strip	30 - 36	> 30.5

- Fraction of interstage carryover ranges within which $C_f < 0.1$ Ci/gal

Process step	Organic carryover	Aqueous carryover
Extraction	0.000001 - 0.25	0.00001 - 0.75
Scrub	0.000001 - 0.95	0.00001 - 0.90
Strip	0.000001 - 0.90	0.00001 - 0.24
Scrub/Strip	0.000001 - 0.90	0.00001 - 0.90
Extraction/Scrub/Strip	0.000001 - 0.23	0.00001 - 0.90

- Total liquid volume per contactor stage ranges within which C_f = constant

Process step	Organic volume	Aqueous volume
Extraction	1/4 - 4 times nominal value	1/4 - 4 times nominal value
Scrub/Strip	1/4 - 4 times nominal value	1/4 - 4 times nominal value
Extraction/Scrub/Strip	1/4 - 4 times nominal value	1/4 - 4 times nominal value

- Minimum efficiency per contactor stage required for $C_f \leq 0.1$ Ci/gal is 65%.

Based on information in the literature and the current study, the following ranges are considered acceptable for the MCU operation.

Solvent
Extractant: 0.005 – 0.008 M.
Modifier: 0.65 – 0.85 M.
TOA: 0.002 – 0.005 M.

Aqueous Scrub Solution
Preparation: Weighed quantities should be within 1%.
Process: 0.0425 – 0.0575 M HNO_3.

Aqueous Strip Solution
Preparation: Weighed quantities should be within 1%.
Process: 0.00075 – 0.002 M HNO_3.

Wash Solution
Preparation: 0.007 - 0.015 M NaOH.
Process: > 0.003 M for NaOH or < 100 – 200 ppm for total carbon impurities.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

LIST OF ACRONYMS

ANL	Argonne National Laboratory
ARP	Actinide Removal Process
BOBCalixC6	Calix[4]arene-bis(*tert*-octylbenzo-crown-6), also known as extractant
CBU	Closure Business Unit
C_f	final cesium concentration
C_0	initial cesium concentration
Ci/gal	curie/gallon
Cs	cesium
CSSX	Caustic-Side Solvent Extraction
Cs-7SB	(1-(2,2,3,3-tetrafluoropropoxy)-3-(4-*sec*-butylphenoxy)-2-propanol, also known as modifier, CAS # 308362-88-1
DF	decontamination factor
DOA	dioctylamine
DBP	dibutyl phosphate
D-value	cesium extraction distribution coefficient or ratio between the organic (solvent) phase and the aqueous phase, also referred to as D
ESS	extraction, scrub, and strip
FAI	fraction of organic phase carryover in aqueous phase exiting each stage
FOI	fraction of aqueous phase carryover in organic phase exiting each stage
gal/min	gallons per minute
Isopar® L	hydrotreated heavy naphtha which is a blend of C_{10} to C_{12} branched alkanes, CAS # 7133465-00
LCS	low curie salt
L/min	liters/minute
MCU	Modular Caustic-Side Solvent Extraction Unit
ORNL	Oak Ridge National Laboratory
SASSE	Spreadsheet Algorithm for Stagewise Solvent Extraction
SBP	*sec*-butylphenol
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
TOA	trioctylamine, CAS # 1116-76-3
XRD	x-ray diffraction

1.0 INTRODUCTION

The Department of Energy identified the Caustic-Side Solvent Extraction (CSSX) process as the preferred technology to remove cesium from high-level radioactive waste solutions at the Savannah River Site (SRS). [1-2] As a result, Closure Business Unit (CBU) is designing and building a Modular CSSX Unit (MCU) in the Savannah River Site (SRS) tank farm to process soluble high level waste. Figure 1-1 shows a schematic representation of the MCU process.

The MCU will process a variety of waste compositions. Also, the MCU solvent composition may vary due to evaporation, decomposition, or other mechanisms that cause loss of individual components. These changes in salt solution and solvent composition will impact the process performance by changing the decontamination factor for cesium. To ensure adequate process performance, limits must be placed on the composition of the feed solution and solvent. This study provides the basis for feed acceptance criteria and solvent composition limits necessary to meet the required decontamination factor for cesium in the product stream.

The objectives were to:

1. Define acceptable waste composition ranges for the MCU process.

    - Develop a tool to predict cesium extraction D-values from the waste compositions.
    - Develop a tool that predicts acceptable MCU process performance based on D-values and cesium concentration.

2. Verify selected D-values in batch extraction, scrub, and strip experiments.

3. Evaluate MCU process performance.

4. Define acceptable ranges for the following process parameters.

    - Solvent composition (extractant, modifier, and trioctylamine (TOA)).
    - Temperatures in the extraction, scrub, and strip stages.
    - Scrub, strip, and wash solution composition.
    - Organic and aqueous flow rates.

To achieve these objectives, researchers reviewed available process information and used the SXFIT and the SASSE models to evaluate process performance. The SXFIT model[3,4] is a multivariate thermodynamic model that predicts the cesium distribution in the organic and aqueous phases (D-value) for the CSSX process from the waste compositions. It was developed by Oak Ridge National Laboratory (ORNL) researchers. The SASSE model[5] predicts final cesium concentrations given process flow rates, initial cesium concentrations, and D-value. It was developed at Argonne National Laboratory (ANL).

The work proceeded according to the "Task Technical and Quality Assurance Plan for Waste and Solvent Composition Limitations Program".[6] The Task Technical and Quality Assurance Plan

derived from "Technical Task Request for Waste and Solvent Composition Limitations".[7]

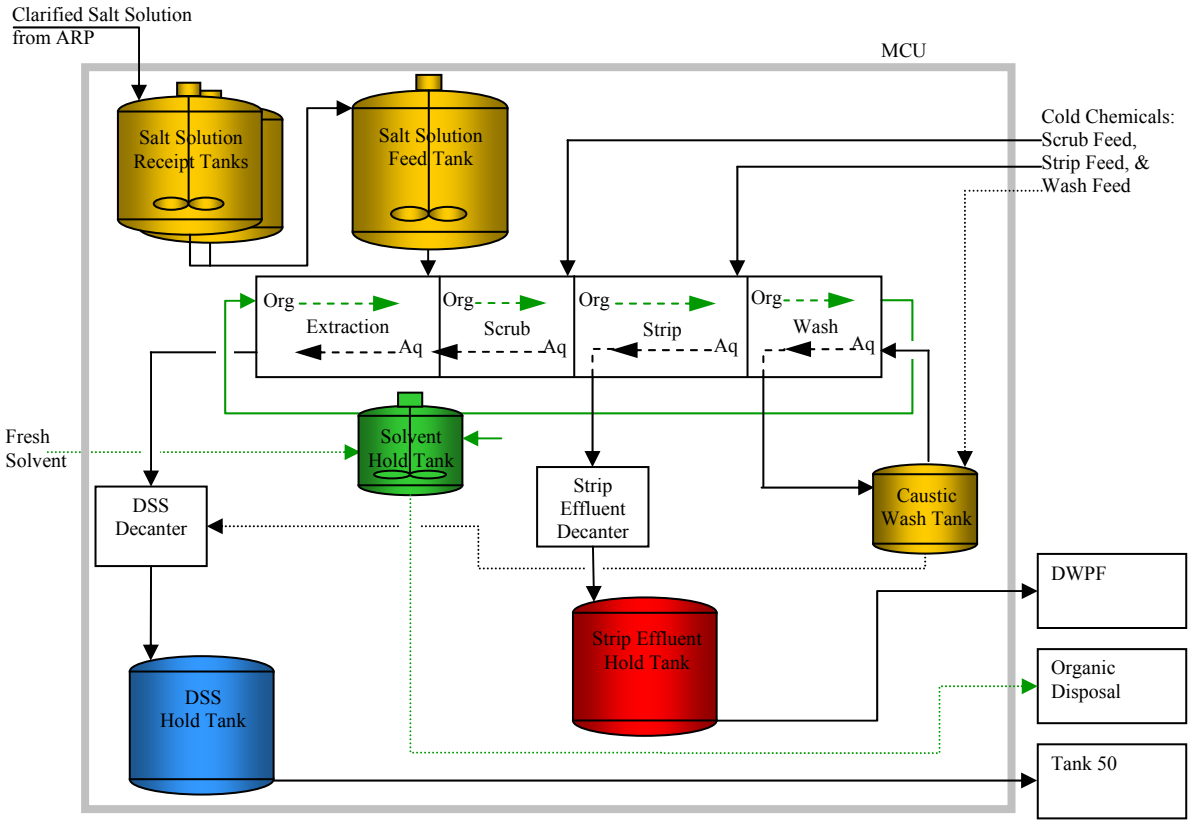

Figure 1-1 Schematic Diagram of the MCU

2.0 APPROACH

2.1 DETERMINATION OF CONCENTRATION RANGES OF SRS WASTE

Researchers compiled available SRS waste composition data to determine the potential ranges of concentration of individual components from reports documenting analytical results of waste samples and from reports predicting batch compositions expected during waste removal. Table 2-1 lists the ranges found. Table 2-1 also lists the maximum component concentrations in the database used to develop the SXFIT model.

Appendix A contains the complete lists and references. Based on the observed and predicted ranges and the SXFIT model basis, proposed limits or ranges were developed for all the various waste components as shown in Table 2-1. Note that the waste constituents comprise 12 ions (i.e., 3 cations and 9 anions).

2.2 DETERMINATION OF MCU PROCESS PARAMETERS

The MCU process parameters were defined through discussions with MCU Design Authority personnel. Table 2-2 gives the process parameters. Note that the parameters in the table represent the base case or nominal conditions for the MCU operation. An exception is the stage efficiency, where values in excess of 90% are possible. The process parameters in Table 2-2 were used in the SASSE model to predict MCU process performance.

Table 2-1. Ranges (Composition Space) of Components in SRS Waste

Components	Na^+, M	K^+, M	Cs^+, mM	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M
Minimum	1.5	0.001	0.007	0.10	0.001	0.01	0.03	0.001	0.001	0.001	0.01	0.01
Maximum	7.0	0.400	0.500	7.00	0.300	7.00	7.00	0.300	0.400	0.800	2.00	2.00
Maximum Conc. Used to Develop SXFIT Model	7	0.06	2	7	7	7	7	1		2	2	2
Ranged Used to Generate the First[a] Test Matrix	1.5 – 7.0	0.001 – 0.400	0.007 – 0.500	0.10 – 7.00	0.001 – 0.300	0.01 – 7.00	0.03 – 7.00	0.001 – 0.300	0.001 – 0.400	0.001 – 0.800	0.01 – 2.00	0.01 – 2.00
Ranged Used to Generate the Second[a] Test Matrix	3.5 – 7.0	0.001 – 0.110	0.007 – 0.500	0.15 – 4.00	0.004 – 0.300	0.06 – 2.10	0.06 – 3.13	0.002 – 0.286	0.001 – 0.350	0.0017 – 0.542	0.01 – 0.92	0.01 – 1.84

[a] The first and second test matrices are discussed in section 3.1 on page 9.

Table 2-2. MCU Base Case (Nominal) Process Parameters

Number of Contactor Stages	
Extraction	7
Scrub	2
Strip	7
Organic Phase/Aqueous Phase Ratios	
Extraction (feed)	0.3333
Extraction[a]	0.3125
Scrub	5
Strip	5
Feed flow rate, gal/min (L/min)	
Aqueous Waste	8.5 (32.176)
Solvent	2.833 (10.725)
Scrub	0.567 (2.145)
Strip	0.567 (2.145)
Efficiency per Contactor Stage	
Extraction	80%
Scrub	80%
Strip	80%
Fraction of Interstage Carryover	
Extraction (organic in aqueous)	0.0002
Scrub (organic in aqueous)	0.003
Strip (organic in aqueous)	0.003
Extraction (aqueous in organic)	0.001
Scrub (aqueous in organic)	0.001
Strip (aqueous in organic)	0.001
Total Liquid Volume per Contactor Stage, gal (L)	
Extraction	5 (18.9)
Scrub	1.5 (5.7)
Strip	1.5 (5.7)
D-values	
Extraction	≥ 8
Scrub	≥ 0.6
Strip	≤ 0.16
Temperature, ^{o}C	
Extraction	23 ± 3
Scrub[b]	23 ± 3
Strip	33 ± 3
Cesium-137 Concentration, Ci/gal	
Initial	1.1
Final	0.1

[a] Aqueous scrub phase is included

[b] The scrub temperature will not be controlled in the MCU operation. A value of 23 ^{o}C is assumed since the solvent from the last extraction stage goes directly to the scrub stages and the flow rate of the scrub solution is one-fifth that of the solvent.

2.3 DEVELOPMENT OF TEST MATRIX FOR THE WASTE COMPOSITION SPACE

A statistical design of experiments method was used to generate waste compositions within the proposed composition space.[8,9] A constraint was imposed that each waste in the test matrix have charge neutrality. In other words, the sum of the charges of cations and anions of each waste should be zero. This portion of the work was done in collaboration with SRNL's Statistical Consulting Section.

2.4 EXTRACTION D-VALUE PREDICTION AND EVALUATION OF PROCESS PERFORMANCE

The SXFIT model mentioned earlier was used to calculate the cesium extraction D-values of the various waste compositions generated from the statistical design work. The cesium extraction D-values were, in turn, used as input in the SASSE model to determine MCU process performance or more specifically, the final cesium concentration of the waste exiting the MCU to ascertain whether it meets the MCU target final cesium concentration of 0.1 Ci/gal (0.0022 mMole/L). The effect of the MCU process parameter variations was also evaluated. All process parameters listed in Table 2-2 were examined except the number of contactor stages.

The SXFIT and SASSE models were verified using previous outputs of the models in the literature as follows:[3,5,10] beginning of the modeling activity, midway through the modeling activity, and end of the modeling activity.

2.5 EXPERIMENTAL VERIFICATION OF SELECTED EXTRACTION D-VALUES

2.5.1 Simulant Preparation

Table 2-3 lists the targeted and analyzed compositions of the simulated waste solutions. The analyzed concentrations of the critical (K^+ and Cs^+) and major (Na^+, OH^+, NO_3^-, NO_2^-, and SO_4^{2}) constituents matched the target compositions within ±15%. Personnel prepared the solutions from reagent grade chemicals. Due to the low nitrate concentrations required for Simulant 1 and Simulant 2, sodium aluminate was used in place of aluminum nitrate. In all three solutions using the sodium aluminate, the final aluminum concentration fell short of the target by approximately 20%, suggesting the sodium aluminate contained absorbed water. However, the new unopened sodium aluminate was initially verified to contain virtually no absorbed water by two methods (i.e., vacuum oven drying and thermal gravimetric analysis). It seems water absorption may have occurred after the analyses. Preparation of the Simple Simulant and Simulant 3 yielded clear solutions with no visible solids. Simulants 1 and 2 contained solids following water addition. Personnel removed the solids by filtration. X-ray diffraction (XRD) analysis identified the solids in Simulant 2 as natrophosphate, $Na_7F(PO_4)_2(H_2O)_{19}$. This is consistent with the low values for phosphate and fluoride found in Simulant 2 compared to the target concentrations. Although not analyzed by XRD, the solids in Simulant 1 are likely the same compound.

Carrier-free Cs-137 tracer (Isotope Products Laboratory (Source # 649-290)) was added to each simulant batch to obtain an activity level of ~$1x10^6$ dpm/mL.

Table 2-3. Simulant Compositions

	Concentration, M							
Component	**Simple Simulant**		**Simulant 1**		**Simulant 2**		**Simulant 3**	
	Target	Found	Target	Found	Target	Found	Target	Found
Na^+	5.0	4.8	3.1	3.0	4.5	4.2	4.6	4.4
K^+	0	0.00025	0.24	0.22	0.059	0.058	0.0078	0.0077
Cs^+ (mM)	0.5	0.53	0.020	0.018	0.25	0.24	0.49	0.48
OH^-	2.0	1.92	0.88	0.84	0.98	1.07	1.96	1.80
NO_3^-	3.0	2.92	0.57	0.54	1.28	1.43	1.59	1.62
NO_2^-	0	0	0.87	0.90	0.35	0.35	0.62	0.62
AlO_2^-	0	0	0.59	0.47	1.07	0.87	0.126	0.096
SO_4^{2-}	0	0	0.017	0.016	0.055	0.051	0.089	0.084
PO_4^{3-}	0	0	0.056	0.039	0.092	0.040	0.24	0.021
Cl^-	0	0	0.0016	<0.004	0.0072	0.0102	0.043	0.038
F^-	0	0	0.089	0.046	0.049	<0.001	0.0029	<0.001
CO_3^{2-}	0	0	0.069	nm	0.193	nm	0.022	nm
Density (g/mL)		1.226		1.138		1.235		1.204

nm = not measured

2.5.2 Solvent, Scrub, and Strip Solutions

Table 2-4 lists the nominal composition of the CSSX optimized solvent system along with those of the scrub and strip solutions. ORNL researchers provided the optimized solvent (Lot # PVB B000894-87W). SRNL researchers prepared the scrub and strip solutions by gravimetric dilution of a standard 0.100 M nitric acid (Fisher, Lot # 041463-25) and verified the compositions were correct by standard titration before use.

Table 2-4. Nominal Compositions of the Solvent, Scrub and Strip Solutions

Solvent	Mole/L	mg/L
Extractant: BOBCalixC6[a]	0.007	8,050
Modifier: Cs-7SB[b]	0.75	253,500
Suppressor: Trioctylamine (TOA)	0.003	1062
Diluent: Isopar® L[c]	Balance	Balance
Scrub solution: HNO_3	0.05	3,150
Strip solution: HNO_3	0.001	63

[a] Calix[4]arene-bis(*tert*-octylbenzo-crown-6)
[b] 1-(2,2,3,3-tetrafluoropropoxy)-3-(4-*sec*-butylphenoxy)-2-propanol
[c] Blend of C_{10} to C_{12} branched alkanes

2.5.3 Batch Extraction, Scrub, and Strip (ESS) Tests

The protocol for the cesium batch ESS tests included a single extraction step, two scrub steps, and three strip steps (i.e., a sequence known as the ESS protocol). Researchers performed the tests in duplicate following a Waste Processing Technology Section procedure.[11] The extraction step used an organic to aqueous volume ratio of 1:3, and the scrub and strip steps used a ratio of 5:1. Theses ratios match the process values. The two phases were shaken by hand in Teflon™ separatory funnels and allowed to gravity separate overnight (20 hours). The laboratory air temperature near the separatory funnels was recorded at the time of separation.

2.5.4 Analytical Methods

The SRNL Analytical Development Section provided the following analyses by routine methods: Al and Na by Inductively Coupled Plasma - Emission Spectroscopy (ICP-ES), common anions (nitrate, nitrite, sulfate, chloride, fluoride, and phosphate) by Ion Chromatography, K and Cs by Atomic Absorption or emission methods, and free hydroxide by titration with standard acid. Cs-137 was measured by Gamma Spectroscopy using a Canberra Model 35 Plus Multichannel Analyzer and an EG&G Ortec Model Gem-10175 intrinsic germanium detector. Researchers counted 3.0 mL portions of the organic and aqueous phases from each step in the ESS protocol for 10 minutes. When gamma counter limitations required reduction of the sample activity or when sample conservation prevented removal of 3 mL portions for analysis, aliquots were diluted 10-fold. Waste, scrub, and strip samples were diluted with water, scrub, or strip solution, respectively. Solvent samples were diluted with CSSX solvent (old formulation containing 0.5 molar modifier and 0.010 molar extractant) to preclude phase separation.

2.5.5 D-value Calculations

Equilibration and separation of phases occurred at ambient temperature. Researchers corrected the ambient temperature D-values to the desired process temperatures (extraction, 23 °C; scrub, 23°C; and strip, 33 °C) using the following equation.[12]

$$D_2 = D_1 \exp\left[\frac{\Delta H}{R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)\right] \quad [1]$$

where T_1 and T_2 are temperatures (°K); D_1 and D_2 are cesium distribution coefficients or D-values at temperature T_1 and T_2 respectively; R is the gas constant (0.00831 kJ/mol/K); and ΔH is the apparent enthalpy change of the process (kJ/mol) as defined in reference 12. The apparent enthalpy change of the various ESS sequential steps is given in Table 2-5.[12]

Table 2-5. Apparent Enthalpy Change for Each ESS Sequential Steps

Process Step	**ΔH, kJ/mol**
Extraction	-47.95
Scrub #1	-86.82
Scrub #2	-74.24
Strip #1	-79.36
Strip #2	-82.94
Strip #3	-82.49

3.0 RESULTS AND DISCUSSION

The model output data and the experimental data in this section are documented in laboratory notebooks.[13,14]

3.1 WASTE TEST MATRIX AND PREDICTED EXTRACTION D-VALUES

An initial waste composition matrix (Appendix B) was developed based on two statistical approaches (i.e., a custom design and an orthogonal Latin hypercube). The details of the statistical data generation are in reference 8. Table B-1 in Appendix B gives the compositions of the180 wastes (first test matrix) statistically generated from the composition space (see Table 2-1) along with the cesium extraction D-values at 23 ^{o}C predicted using the SXFIT model for solvent extractant concentrations of 0.0042, 0.0056, 0.007 (nominal value), and 0.0084 M. The same cesium extraction D-value data are given Table B-2 arranged in descending order. The maximum, minimum, and median D-values are at the end of the table.

Note that the SXFIT model predicts extraction D-values at only 25 ^{o}C. Equation [1] given in subsection 2.5.5 was used to convert the SXFIT model output D-values to 23 ^{o}C, the MCU extraction step temperature. As expected, extraction D-value decreases with decreasing extractant concentration in the solvent. The extractant concentrations of 0.0042 and 0.0084 M are 1.2 and 0.6, respectively, of the nominal extractant concentration of 0.007 M. This range (0.0042 – 0.0084 M) probably more than represents the widest range of extractant concentration swings that may occur in the MCU. The upper end of the range is in the solubility limit region of the extractant. The solubility of the extractant in the solvent is not known explicitly but it is believed to be in the range of 0.00755 to 0.01095 M at 25 ^{o}C.[12,15]

Several D-value ratios at two given solvent extractant concentrations are depicted in Figure 3-1. The dashed line through each set of data points is the extractant concentration ratio. It is interesting to note that the extractant concentration ratios are approximately equal to the corresponding D-value ratios. This implies that at least within the extractant concentration range of 0.0042 – 0.0084 M, a percent increase or decrease in extraction concentration results in about the same percent increase or decrease in extraction D-values. All the other combinations of concentration ratios (not shown) gave similar results. It is also noteworthy to note that the relative standard deviation of all the extractant concentration ratio sets is below 5%. Other researchers have previously reported this relationship.[12,15,16] However, it was stated differently: log (D-value) versus log (extractant concentration) is linear with a slope of approximately one. This feature could be used to estimate extraction D-values when the extractant concentration in the solvent changes in the MCU operation. It will be used to specify solvent extractant concentration limit via D-values later.

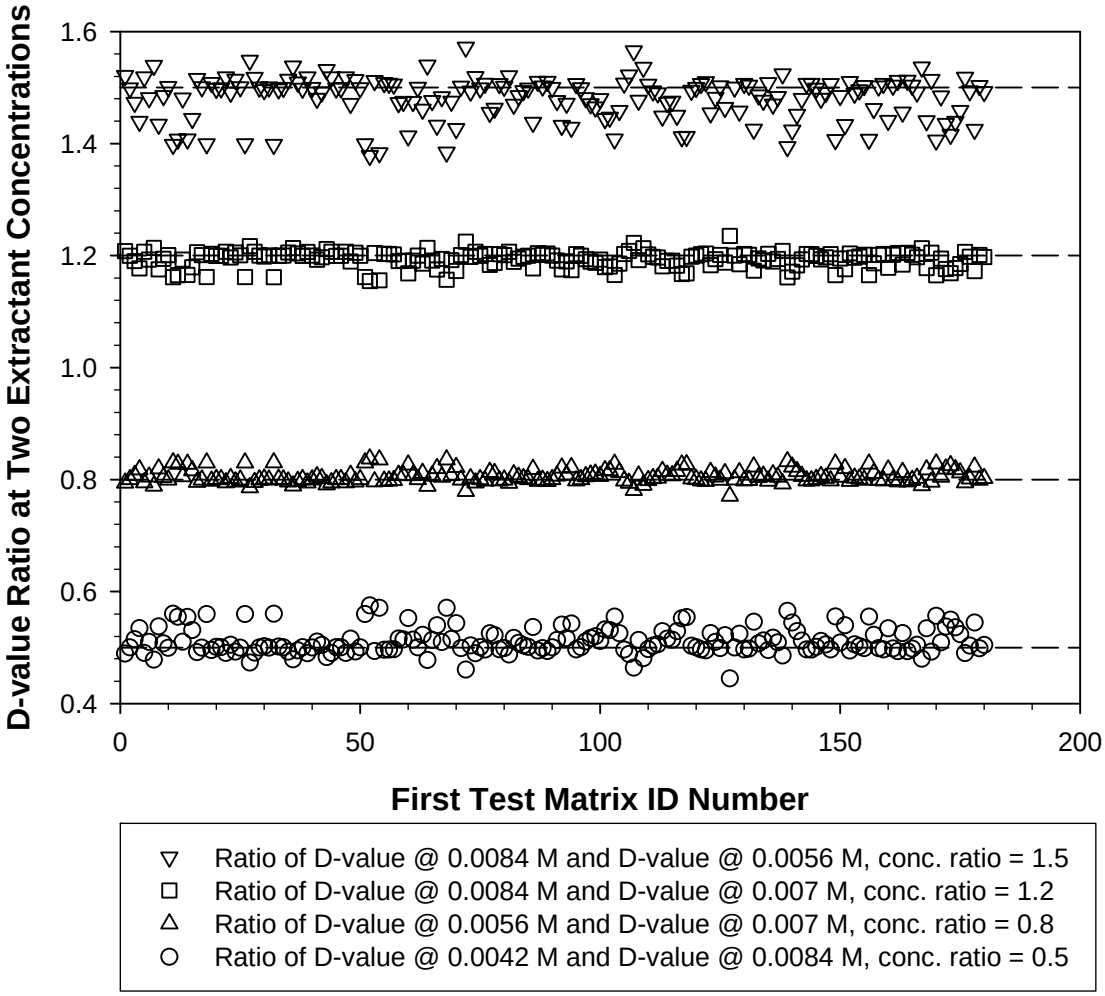

Figure 3-1. Effect of Solvent Extractant Concentration on Extraction D-values

The minimum extraction D-value (base case) for MCU is 8. A look at the D-values in Table B-2 indicates that at the extractant concentration of 0.007 M only 14 out of the 180 individual wastes are greater or equal to 8. Hence, a second test matrix (Appendix C) was developed statistically using a cutoff D-value of 6 for the extractant concentration of 0.007 M. In other words, the new ranges for the various ions or waste constituents for the second test matrix fell within the ion concentrations of test ID MCU081 and MCU036 (i.e., the top or highest 25 test IDs for extractant concentration of 0.007 M in Table B-2). The range or the composition space upon which the second test matrix was based is shown in Table 2-1. The details of the statistical data generation are in reference 9. The cutoff D-value of 6 was used because the minimum extraction D-value required to achieve a final cesium concentration of 0.1 Ci/gal based on the MCU base conditions (Table 2-2) is 5.73. This will be shown later in section 3.3.

Table C-1 gives the compositions of the 251 wastes (second test matrix) statistically generated from the second composition space (see Table 2-1) along with the cesium extraction D-values at 23 ^{o}C predicted using the SXFIT model for solvent extractant concentrations of 0.005, 0.0056, 0.007 (nominal value), and 0.0084 M. The same cesium extraction D-value data are given Table C-2 arranged in descending order. The maximum, minimum, and median D-values are at the end of the table. Again, the SXFIT model output D-values at 25 ^{o}C were converted to D-values at 23 ^{o}C using equation [1].

The deductions made earlier regarding the first test matrix hold including the fact that the extractant concentration ratios are approximately equal to the corresponding D-value ratios. The extractant concentrations of 0.005 and 0.0084 M are 1.2 and 0.71, respectively, of the nominal extractant concentration of 0.007 M. The extractant concentration of 0.005 M was included this time because the minimum extraction D-value based on the MCU base conditions (Table 2-2) is 5.73 and that the ratio of 5.7 and 8 (MCU base case extraction D-value) is equal to the extractant concentration ratio of 0.005 and 0.007 M.

For the second test matrix, 98 and 182 of the individual wastes out of the total of 215 have extraction D-values greater than ~8 and 5.7, respectively. Obviously, these numbers will be higher or lower for extractant concentrations correspondingly higher or lower than the nominal extractant concentration of 0.007 M.

3.1.1 Neural Network Modeling

A neural network modeling method was used to develop a model of D-value as a function of waste component concentrations.[17] A neural net model may be thought of as a nonlinear regression model. The details of the neural network modeling are given in reference 17. The model consists of the following five equations.

$$\ln(\text{D-value}) = [-2.79054642231298 + -2.84144100567294 * H_1 + -6.3214704394414 * H_2 + 5.92896363811888 * H_3 + 8.53571120499823 * H_4] * 0.711175767470704 + 1.639688473143 \quad [2]$$

where $H_t = 1/(1+\exp(-r_t))$ for t=1,2,3, and 4

and

$$r_t = a_t + b_t*(\text{Na-center}_{Na})/\text{scale}_{Na} + c_t * (\text{Cs-center}_{Cs})/\text{scale}_{Cs} + d_t * (\text{K-center}_{K})/\text{scale}_{K} + e_t * (\text{OH-center}_{OH})/\text{scale}_{OH} + f_t * (\text{NO3-center}_{NO3})/\text{scale}_{NO3} + g_t * (\text{NO2-center}_{NO2})/\text{scale}_{NO2} + h_t * (\text{AlO2-center}_{AlO2})/\text{scale}_{AlO2} + i_t * (\text{CO3-center}_{CO3})/\text{scale}_{CO3} + j_t * (\text{SO4-center}_{SO4})/\text{scale}_{SO4} + k_t * (\text{PO4-center}_{PO4})/\text{scale}_{PO4} + l_t * (\text{Cl-center}_{Cl})/\text{scale}_{Cl} + m_t * (\text{F-center}_{F})/\text{scale}_{F}$$

for t = 1, 2, 3, and 4. The factors necessary to center and scale the waste component concentrations and the estimated coefficients (a's through m's) are provided in Table 3-1. This information allows for the computation of the natural log of the D-value that would be

anticipated for a set of waste component concentrations that fall within the intervals outlined in Table 3-1.

Table 3-1. Neural Net Estimates Needed to Compute the Natural Log of the D-value

				r_1	r_2	r_3	r_4
Component	Center Factor	Scale Factor	a's	-1.2750877	-6.754690384	0.167075769	-3.932462036
Na^+	5.1643598	1.417520326	b's	-0.191666886	-1.522893644	-0.063827475	0.119900547
K^+	0.136300114	0.128381776	c's	-0.063559711	-0.600309135	-0.333391619	-1.996287438
Cs^+	0.000273512	0.000159761	d's	0.41214885	-0.042034149	0.203002313	-0.051985725
OH^-	1.105931654	1.105890043	e's	0.445144331	-1.588289942	0.094577736	0.417944324
NO_3^-	1.260500963	1.187054221	f's	-0.773890986	-1.310614994	-0.110217116	-0.361861771
NO_2^-	0.905290885	1.062862186	e's	0.030387274	0.184916279	-0.077384707	-0.103942783
AlO_2^-	0.508434861	0.474046471	g's	0.035179288	0.395269336	0.004790313	-0.011824805
CO_3^{2-}	0.332139591	0.337176126	h's	0.139244589	0.663163083	-0.034723437	-0.01025595
SO_4^{2-}	0.178674308	0.170379926	i's	0.018701789	0.411916852	9.48052E-05	-0.000923302
PO_4^{3-}	0.10477491	0.099624436	j's	-0.026114817	0.307419204	-0.012816843	-0.001671019
Cl^-	0.096055311	0.084280056	k's	0.039997584	0.046492179	-0.008475658	0.028609763
F^-	0.088767223	0.08490684	m's	0.020861794	0.107793124	0.010627018	0.028461846

A Microsoft Excel spreadsheet has been prepared to make the D-value calculations from the above complicated model equation easier. One enters the individual waste component concentrations and the D-value is automatically computed. It is a handy and fast alternative to the SXFIT model.

The neural network model predicts D-values within 15% (with 95% of the data falling within 10%) of the SXFIT D-values for a set of validation data. Note that the data used to develop the neural network model are Test Matrices 1 and 2 data at solvent extractant concentration of 0.007 M and temperature of 23 ^oC.

3.1.2 General Concentration Limits of Waste Components

Since D-value is related to the concentration of the waste components in a complicated manner, it is not straightforward to put limits on the individual waste compositions. However, plots of D-value versus concentration of the individual waste components shed some light on the general trends and concentration limits for at least some of the components.

Figure 3-2 on the following pages provides plots of D-values versus the concentration of the individual waste components for the nominal solvent extractant concentration of 0.007 M for data from both Test Matrices 1 and 2. The trends are the same for all the other extractant concentrations.

Examination of the 12 individual plots in Figure 3-2 reveals that potassium concentration, unlike the other components has a clear relationship with cesium extraction D-values. This is because potassium is the most competitive species to cesium in the extraction process. Hence, low

potassium concentrations lead to generally high cesium extraction D-values. Table 3-2 is a summary of the general remarks or trends of the extraction D-value/waste component concentration relationships and component concentration limits using 5 as the minimum acceptable extraction D-value. The above implies that extraction D-value is the best criterion that can be used to accept or reject waste for the MCU operation. Note that even though Table 3-2 indicates a potassium concentration upper limit of 0.17 M, previous studies indicate the potential for third phase formation is high for potassium concentrations > 0.05 M.[12,15,21]

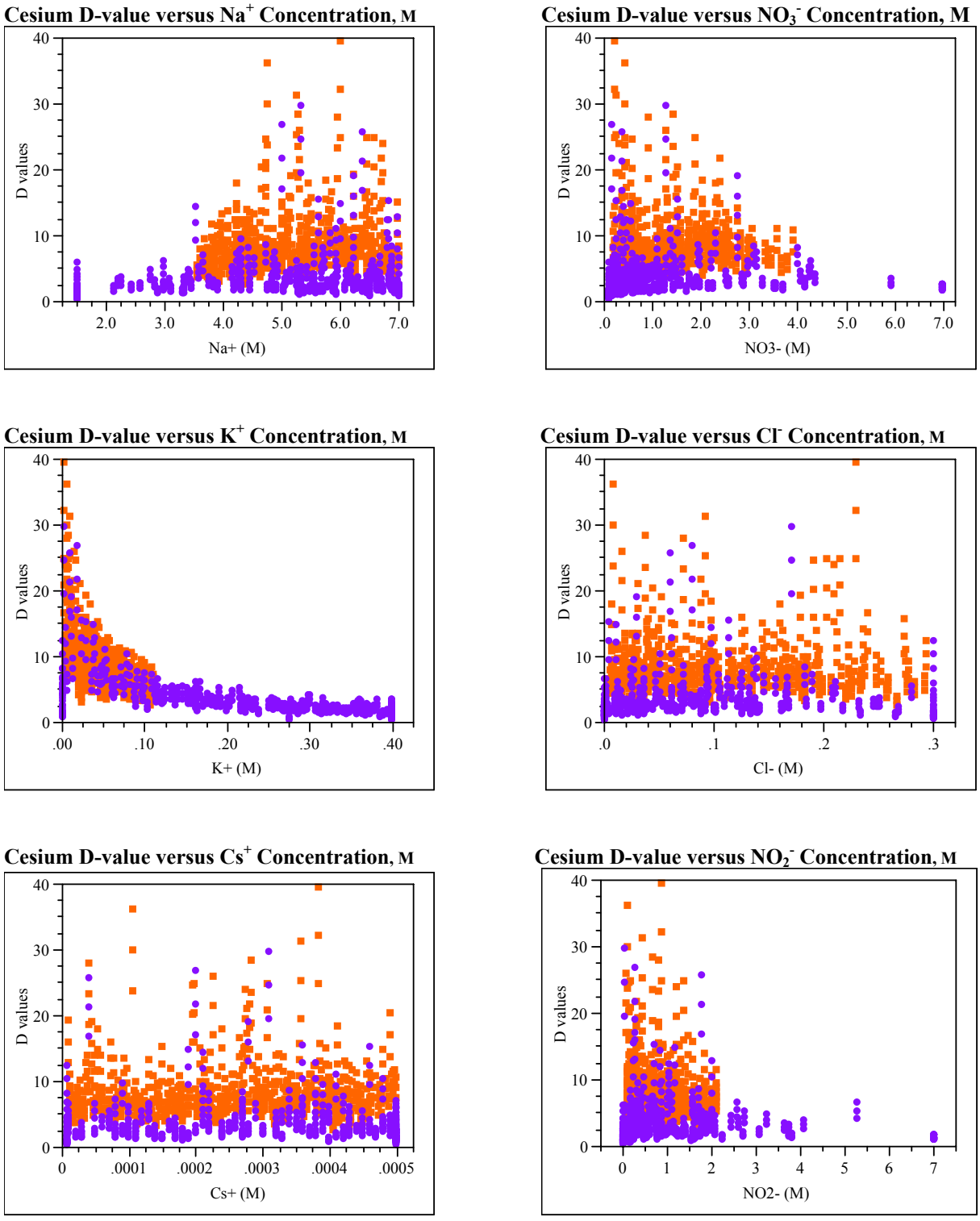

Figure 3-2. Plots of D-values Versus the Concentration of the Individual Waste Components for Nominal Extractant Concentration of 0.007 M. ●: 1st Test Matrix, ■: 2nd Test Matrix

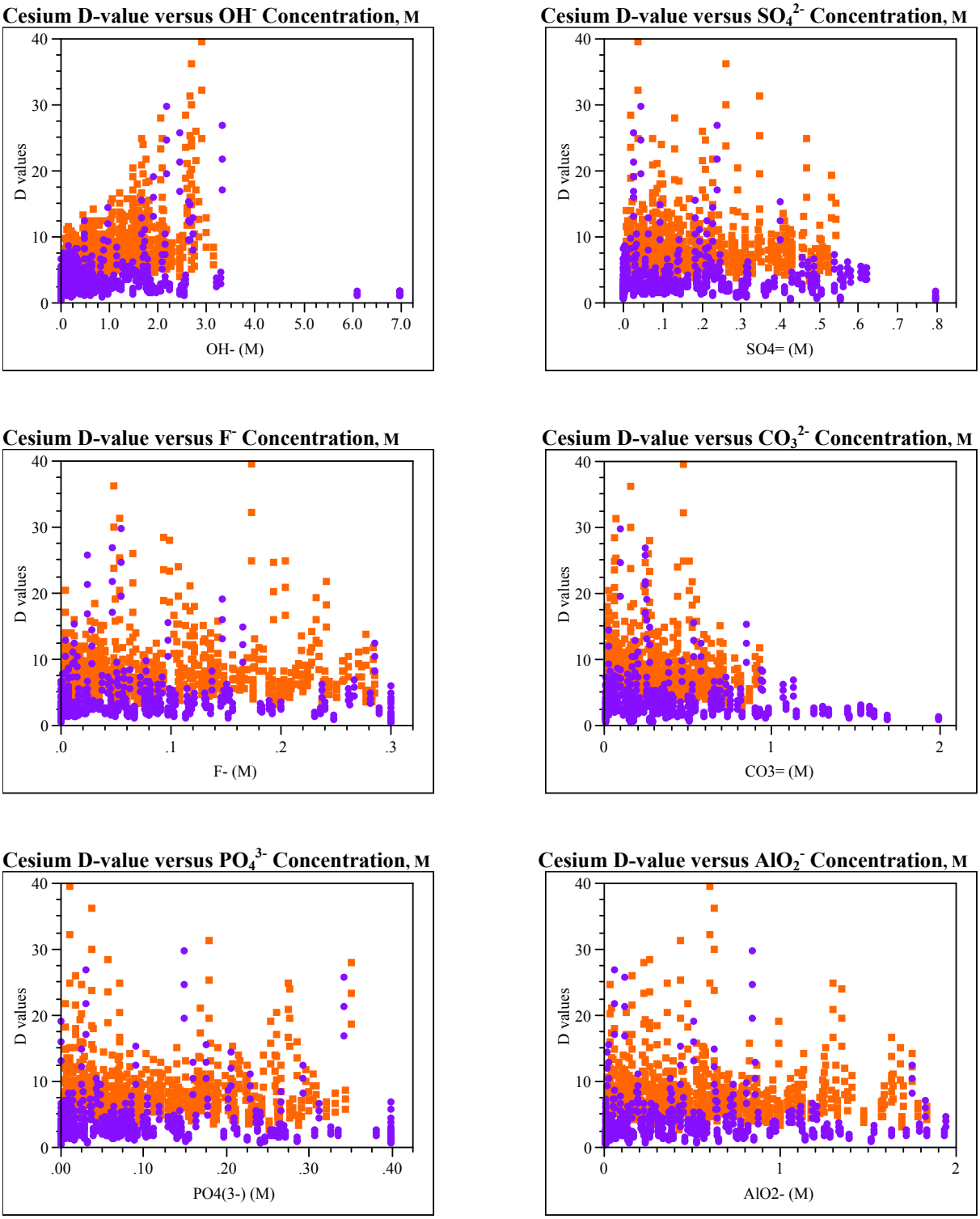

Figure 3-2 Cont'd. Plots of D-values Versus the Concentration of the Individual Waste Components for Nominal Extractant Concentration of 0.007 M. ●: 1st Test Matrix, ■: 2nd Test Matrix

Table 3-2. Generally Favorable Waste Component Concentration Ranges

Component	Remarks and Favorable Concentration Ranges[a], M
Na^+	3.6 - 7
K^+	0.001 - 0.17
Cs^+	Entire range: 0.000007 – 0.0005
NO_3^-	0.06 - 4.3
Cl^-	Entire range: 0.001 - 0.3
NO_2^-	0.01 - 5.3
OH^-	0.03 - 3.4
F^-	Entire range: 0.001 - 0.3
PO_4^{3-}	Entire range: 0.001 - 0.4
SO_4^{2-}	0.001 - 0.6
CO_3^{2-}	0.01 - 1.2
AlO_2^-	0.01 - 1.9

[a] Based on extraction D-value $\geq$ 5

3.2 EXPERIMENTAL VERIFICATION OF THE D-VALUES OF SELECTED WASTE COMPOSTIONS

Three simulant compositions were selected to test the accuracy of the SXFIT and neural network (statistical) models in predicting extraction D-values. Table 3-3 lists the results of the ESS tests and Table 3-4 compares the extraction results to predicted values. The predicted D values are based on the corrected compositions listed in Table 3-5. Since the majority of the component concentrations agreed within 15% of the targets, Table 3-5 generally reflects the target values. When incomplete dissolution occurred (as in Simulants 1 and 2), the sodium, fluoride, and phosphate concentrations were reduced based on the analysis results and assuming the solids had the stoichiometry of natrophosphate.

The MCU process requirements include limits on the scrub and strip D-values. The scrub D-value must equal or exceed 0.6 and the strip D-value must be less than 0.16 (see Table 2-2). [12,18] As shown in Table 3-3, all scrub and strip D-values met these requirements. Strip D-values were quite good, all being less than 0.1.

The measured extraction D-values were consistently smaller than either of the model predictions. The discrepancy varied from 16 to 35% lower than the SXFIT prediction, and 16 to 39% lower than the statistical model prediction. A 25% decrease in D-value corresponds to a significant decrease in the allowable cesium concentration. The effect is not linear with the D-value. For example, if the SXFIT D-value prediction is 8 and the bias is 25% (i.e., the D-value is actually 6), then the allowable cesium concentration (using Figure 3-3) in the waste stream drops from 1.7 to 1.3 (-23%, similar to the decrease in the D-value). However, if the predicted D-value equals 4 and the bias is 25% (i.e., the actual D-value is 3), then the allowable cesium concentration drops from 0.75 Ci/gal to 0.45 Ci/gal (a decrease of -40%, larger than the decrease

in D-value). An appropriate factor (25 to 40%) could be applied to the model predictions to ensure the MCU process can adequately remove the cesium from the salt solution and meet the downstream waste acceptance criteria.

Table 3-3. ESS Test Results

	Measured D-values[a]			
Process Step	**Simple Simulant**	**Simulant 1**	**Simulant 2**	**Simulant 3**
Extraction	12.2 ± 0.2	2.33 ± 0.10	5.4 ± 1.1	10.6 ± 0.1
Scrub 1	0.73 ± 0.30	1.24 ± 0.16	0.92 ± 0.30	1.40 ± 0.15
Scrub 2	0.98 ± 0.37	1.48 ± 0.20	0.77 ± 0.17	1.30 ± 0.23
Strip 1	0.054 ± 0.015	0.059 ± 0.010	0.098 ± 0.002	0.077 ± 0.106
Strip 2	0.074 ± 0.026	0.064 ± 0.030	0.090 ± 0.006	0.076 ± 0.009
Strip 3	0.091 ± 0.055	0.038 ± 0.018	0.038 ± 0.013	0.048 ± 0.008

[a] Corrected to process temperatures (Extraction and Scrub, 23 °C; Strip, 33 °C). Errors represent standard deviation of duplicate measurements.

Table 3-4. Comparison of Measured Extraction D-values to SXFIT and Neural Network Model Predictions

	Simple Simulant	**Simulant 1**	**Simulant 2**	**Simulant 3**
SXFIT	21.7	2.91	8.23	19.2
Neural Network	19.4	3.10	8.20	16.5
Measured	12.2 ± 0.2	2.33 ± 0.10	5.4 ± 1.1	10.6 ± 0.1

Table 3-5. Corrected Compositions of Simulants

	Concentration, M			
Component	**Simple Simulant**	**Simulant 1**	**Simulant 2**	**Simulant 3**
Na^+	5.0	2.8755	4.19115	4.6359
K^+	0.00025	0.24	0.059	0.0078
Cs^+ (mM)	0.50	0.020	0.25	0.49
OH^-	2	0.88	0.98	1.96
NO_3^-	3.00050	0.57	1.28	1.59
NO_2^-	0	0.87	0.35	0.62
AlO_2^-	0	0.59	1.07	0.126
SO_4^{2-}	0	0.017	0.055	0.089
PO_4^{3-}	0	0.004	0.016	0.024
Cl^-	0	0.0016	0.0072	0.043
F^-	0	0.020	0.011	0.0029
CO_3^{2-}	0	0.069	0.193	0.0022

3.3 EVALUATION OF PROCESS PERFORMANCE USING THE SASSE MODEL

A look at the extraction D-value data for both the 1st and 2nd Test Matrices (Appendices B and C) for all the solvent extractant concentrations indicates the extraction D-values range from 0.4 to 40. The SASSE model was therefore calculated at the MCU base conditions given in Table 2-3 except the extraction D-value and the initial cesium-137 concentration (C_0) were varied from 0.6 to 40 and from 0.2 to 12.8 Ci/gal, respectively. These values basically cover broader ranges than the MCU operation. Note that the SASSE model was calculated with its recycle feature activated to make the simulations closer to actual MCU operations. Recycle means the solvent leaving the last strip stage is looped back to the first extraction stage. As a reminder, the target final cesium-137 concentration (C_f) for the MCU is 0.1 Ci/gal.

Table 3-6 is a summary of the results from the SASSE model. For a given D-value, the cesium-137 C_0 was varied until the C_f was equal to the target value of 0.1 Ci/gal. Note that the relative standard deviation (RSD) of all the C_f data is less than 1%. The data in Table 3-6 is plotted in Figure 3-3. The dashed line shows the target final cesium-137 concentration of 0.1 Ci/gal. Since $C_f = 0.1$ Ci/gal for all the data points, $C_f > 0.1$ Ci/gal for the region above the data points and $C_f < 0.1$ Ci/gal for the region below the data points.

Figure 3-3 is very important because it allows one to infer with a relatively high degree of accuracy whether the target C_f of 0.1 Ci/gal for the MCU will be met knowing the D-value and the C_0 of the waste feed. This check will be the standard for waste acceptance criteria.

A linear regression or least-square fit to the data in Table 3-6 gives the equation below.

$$C_0 = 0.3125*D - 0.3820 \quad [3]$$

where C_0 and D are initial cesium-137 concentration and cesium extraction D-value respectively. Even though the coefficient of determination ($r^2 = 0.9982$) is fairly high, the C_0 predictions at low D-values (< 7) are poor. Hence, a more advanced approach (smoothing cubic spline method) was used to model the C_0/D-value relationship.[19]

Table 3-6. SASSE Model Output Data Summary

Extraction D-value	Initial ^{137}Cs Conc. (C_0), Ci/gal	Final ^{137}Cs Conc. (C_f), Ci/gal
40	12	0.0994
35	10.5	0.0994
32	9.6	0.0995
28	8.5	0.1009
25	7.5	0.1000
24	7.2	0.1001
20	6	0.1008
16	4.7	0.1003
14	4	0.0991
12	3.4	0.1008
10	2.7	0.1008
8	1.95	0.1000
6	1.2	0.1000
4	0.55	0.1006
2	0.2	0.0996
1	0.137	0.0998
0.6	0.123	0.1004

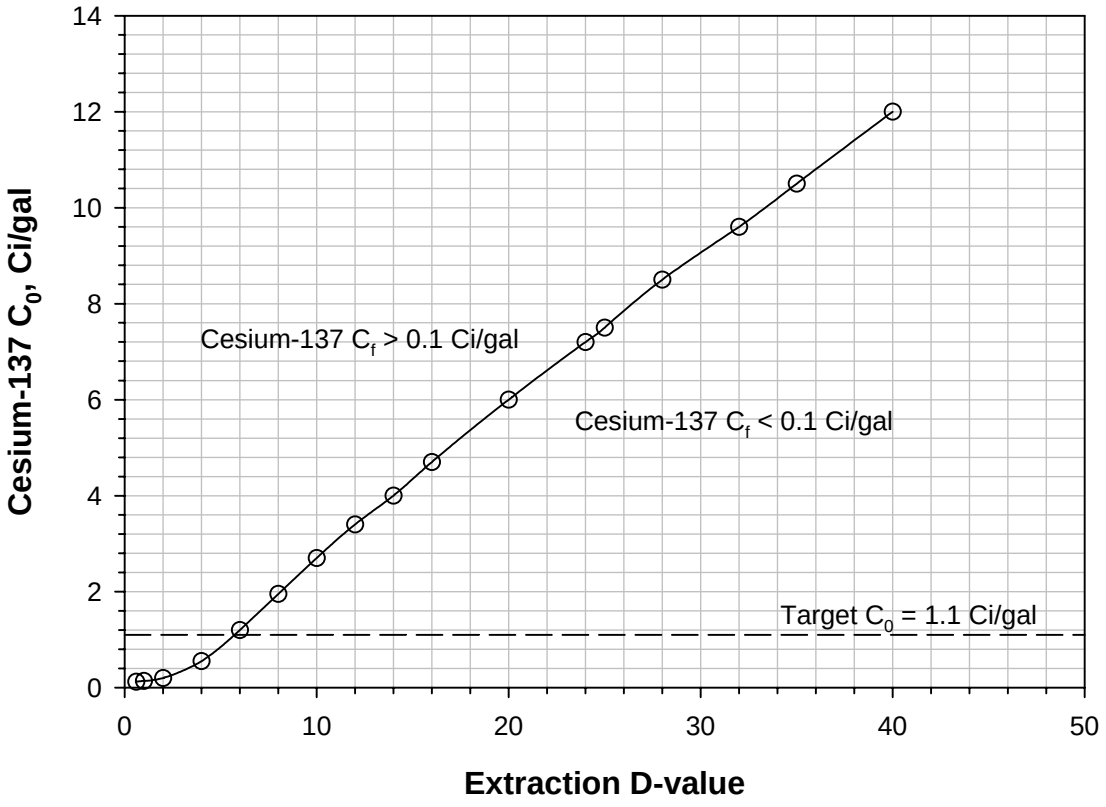

Figure 3-3. A Smoothing Cubic Spline Fit of C_0 to D-value

The coefficients of the cubic equations and the D-value points for calculating C_0 are provided in Table 3-7. Equation [4] provides an example of how one uses the information in Table 3-7 to determine the C_0 corresponding to a given D-value. First determine the interval of D-value points which bound the D-value, then center the D-value, and evaluate the corresponding cubic equation. For D-values from 0.6 to 1, the C_0 is determined by the cubic equation as given in Equation [4]. Note that the D-value (represented by D in the Equation [4]) is centered at the lower D-value point (0.6 in this example) and that the coefficients of the cubic equation correspond to the values in the row for the lower D-value point. Details of the smoothing cubic spline method are given in reference 19.

The smoothing cubic spline model equation for $0.6 \leq D \leq 1$ is given below.

$$C_0 = 0.1 * \left[\begin{array}{l} 1^{st}\text{ row Intercept} + (D-0.6) * 1^{st}\text{ row Linear Term} + (D-0.6)^2 * 1^{st}\text{ row Quadratic Term} + \\ (D-0.6)^3 * 1^{st}\text{ row Cubic Term} \end{array} \right] \quad [4]$$

or more specifically,

$$C_0 = 0.1 * \left[1.22174520 + (D - 0.6) * 0.36213183 + (D - 0.6)^2 * 0 + (D - 0.6)^3 * 0.11837642\right]$$

Again, a Microsoft Excel spreadsheet has been setup to make the C_0 calculations from the above complicated equation easier. One enters the D-value of the waste and the C_0 that corresponds to C_f of 0.1 Ci/gal is automatically computed. The Excel worksheet of this model and that of the neural network model mentioned earlier have been linked such that once the waste component concentrations are entered in the worksheet of the neural network model the D-value and the C_0 are automatically computed. The two worksheets can also be used independently.

Table 3-7. Coefficients for the Cubic Spline Model

D-value	Intercept	Linear Term	Quadratic Term	Cubic Term
0.6	1.22174520	0.36213183	0	0.11837642
1	1.37417402	0.41895251	0.14205171	0.07447470
2	2.00965294	0.92648002	0.36547580	0.01802832
4	5.46874275	2.60472306	0.47364572	-0.07226127
6	11.99468157	3.63217068	0.04007809	-0.00423056
8	19.38549080	3.74171631	0.01469472	-0.01710775
10	26.79084031	3.59520219	-0.08795178	0.01136789
12	33.72038065	3.37980969	-0.01974447	-0.00168016
14	40.38758089	3.28066990	-0.02982543	0.00302797
16	46.85384271	3.19770378	-0.01165763	0.00058389
20	59.49550475	3.13246949	-0.00465094	-0.00029630
24	71.93200453	3.08103964	-0.00820652	0.00275604
25	75.00759369	3.07289473	0.00006161	-0.00034208
28	84.21759624	3.06402828	-0.00301709	0.00039405
32	96.45065532	3.05880612	0.00171155	-0.00087367
35	105.61888840	3.04548620	-0.00615152	0.00041010
40	120.74379400	0	0	0

The accuracy of the smoothing cubic spline model is fairly high. For example, Figure 3-3 or the smoothing cubic spline model shows that for C_0 of 0.8, 1.1 (MCU nominal), and 1.4 Ci/gal, the minimum D-values required are 4.86, 5.73, and 6.55, respectively. SASSE model also predicts minimum D-values of 4.86, 5.73, and 6.54 for the same C_0's. This is also the expected minimum D-value range for a C_0 variation of $\pm$ 0.3 Ci/gal from the nominal of 1.1 Ci/gal.

3.4 EFFECT OF VARIATION IN MCU PROCESS PARAMETERS ON FINAL CESIUM CONCENTRATION (C_F)

All the SASSE model results in this section used the MCU base conditions in Table 2-2 except the parameters being varied. For Figures 3-4 to 3-8 and 3-11 to 3-13 below, the following equations should be used to calculate the relative C_f (i.e., C_f/target C_f).

For a given extraction D-value,

$$\frac{C_{f2}}{\text{Target } C_f} = \frac{C_{f1}}{\text{Target } C_f}\left(\frac{C_{02}}{C_{01}}\right) \quad [5]$$

For a given C_0,

$$\frac{C_{f2}}{\text{Target } C_f} = \frac{C_{f1}}{\text{Target } C_f}\left(\frac{D_2}{D_1}\right)^{-1.43} \quad [6]$$

where
C_{f2} = final cesium-137 concentration at process condition 2
C_{f1} = final cesium-137 concentration at process condition 1
C_{02} = initial cesium-137 concentration at process condition 2
C_{01} = initial cesium-137 concentration at process condition 1
D_2 = extraction D-value at process condition 2
D_1 = extraction D-value at process condition 1
Target C_f = 0.1 Ci/gal

For Figure 3-8, convert the temperatures to extraction D-values using equation [1] before using equation [6]. For Figures 3-9 and 3-10, convert the temperatures to scrub and strip D-values, respectively, using equation [1] and run SASSE for each of the scrub or strip D-values using the parameters of the new condition to generate the plots.

3.4.1 Flow Rate

Flow rate changes where the various organic/aqueous ratios are maintained have no effect on C_f. In other words, simultaneous changes in all flow rates at the same percent level have no effect on the C_f obtained from the SASSE model. The simultaneous variations in flow rate of the aqueous waste feed, solvent, aqueous scrub feed and aqueous strip feed from half to thrice the nominal values resulted in the same C_f. The contactor residence time, however, is affected by the above flow rate variations.

The other flow rate variation studied with the SASSE model is the case when only one flow rate is changed at a time while all the other flow rates and the other MCU process parameters are held

constant at the nominal values in Table 2-2. This is a scenario that may result from pump malfunction, human error, or similar causes.

3.4.1.1 Organic or Solvent Flow Rate

Figure 3-4 is a plot of relative final cesium-137 concentration (C_f/target C_f) versus relative solvent flow rate. The relative final cesium-137 concentrations (C_f/target C_f) are C_f outputs from SASSE model runs normalized by the target C_f of 0.1 Ci/gal. The abscissa is the solvent flow rate given in multiples of the nominal value. For example, solvent flow rate of 1 equals the nominal solvent flow rate of 2.833 gal/min. Hence, the vertical dotted line is the nominal or target solvent flow rate. The dashed horizontal line is the MCU target relative C_f. The plot shows that the solvent flow rate can vary between 0.6 to 1.7 times the nominal if the target C_f is not to be exceeded. This range is a fairly large to accommodate any process upsets.

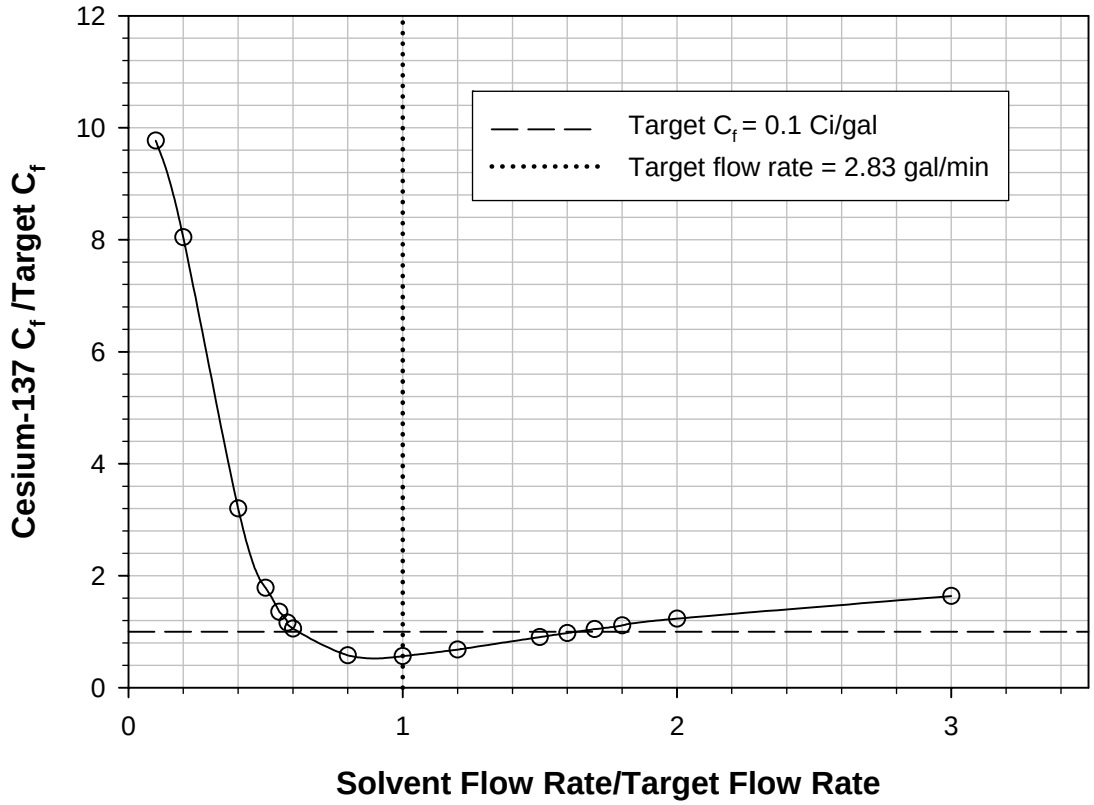

Figure 3-4. Effect of Changes in Solvent Flow Rate on C_f

3.4.1.2 Aqueous Waste Flow Rate

Figure 3-5 is the aqueous waste flow counterpart of Figure 3-5. The plot shows the aqueous waste flow rate cannot be higher than 1.45 times the nominal if the target C_f is not to be exceeded. This is fairly high to accommodate any process upsets.

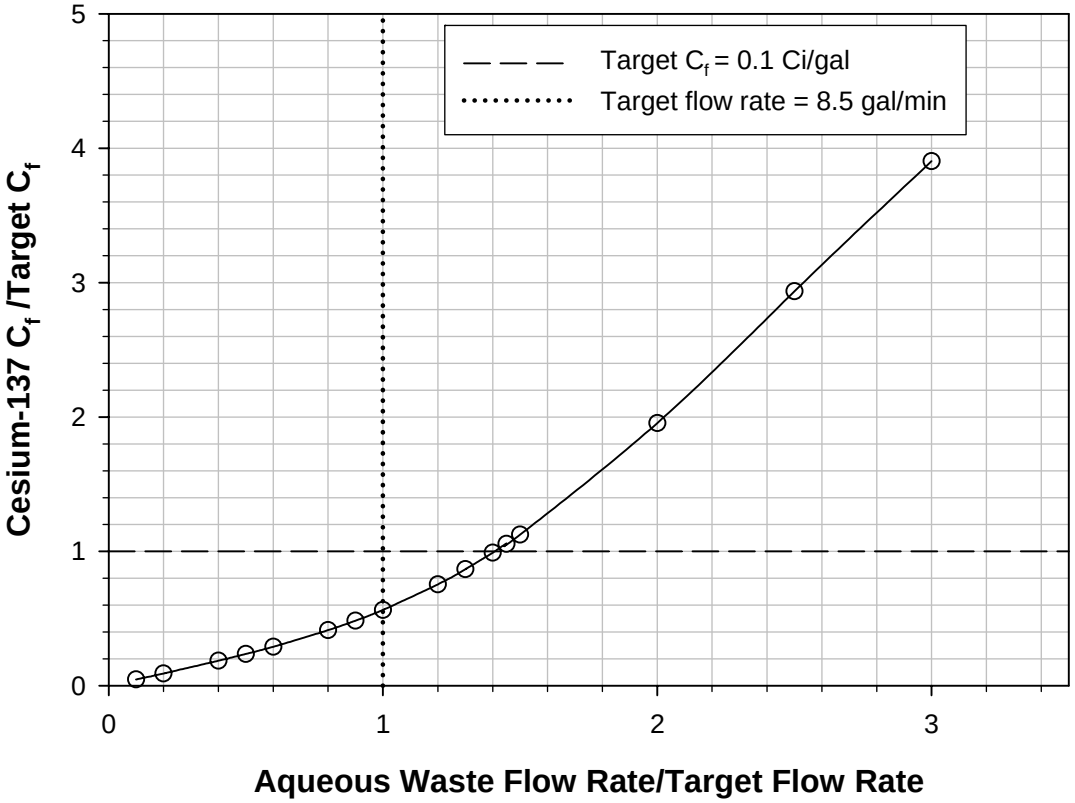

Figure 3-5. Effect of Changes in Aqueous Waste Flow Rate on C_f

3.4.1.3 Aqueous Scrub Flow Rate

Figure 3-6 is the aqueous scrub counterpart of Figure 3-4. The plot shows the aqueous scrub flow rate cannot be higher than 5.5 times the nominal if the target C_f is not to be exceeded. This is fairly high to accommodate any process upsets.

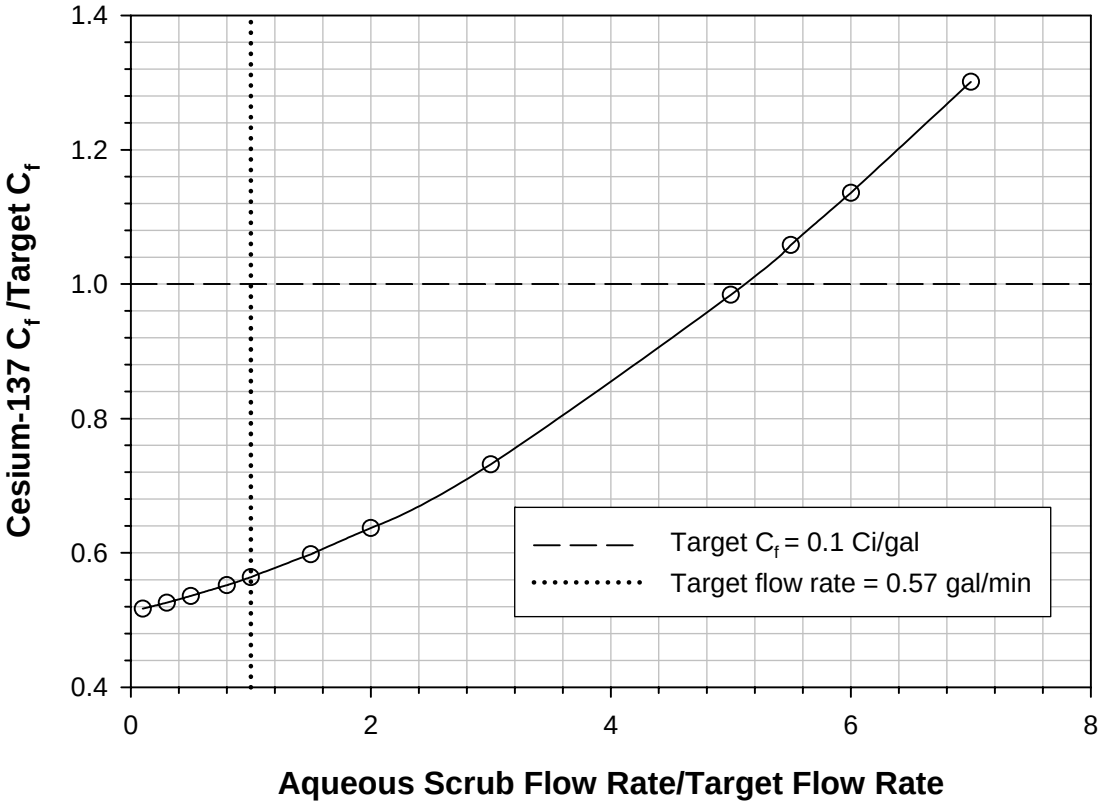

Figure 3-6. Effect of Changes in Aqueous Scrub Flow Rate on C_f

3.4.1.4 Aqueous Strip Flow Rate

Figure 3-7 is the aqueous strip counterpart of Figure 3.4. The plot shows the aqueous strip flow rate cannot be lower than 0.75 times the nominal if the target C_f is not to be exceeded. This is fairly low to accommodate any process upsets.

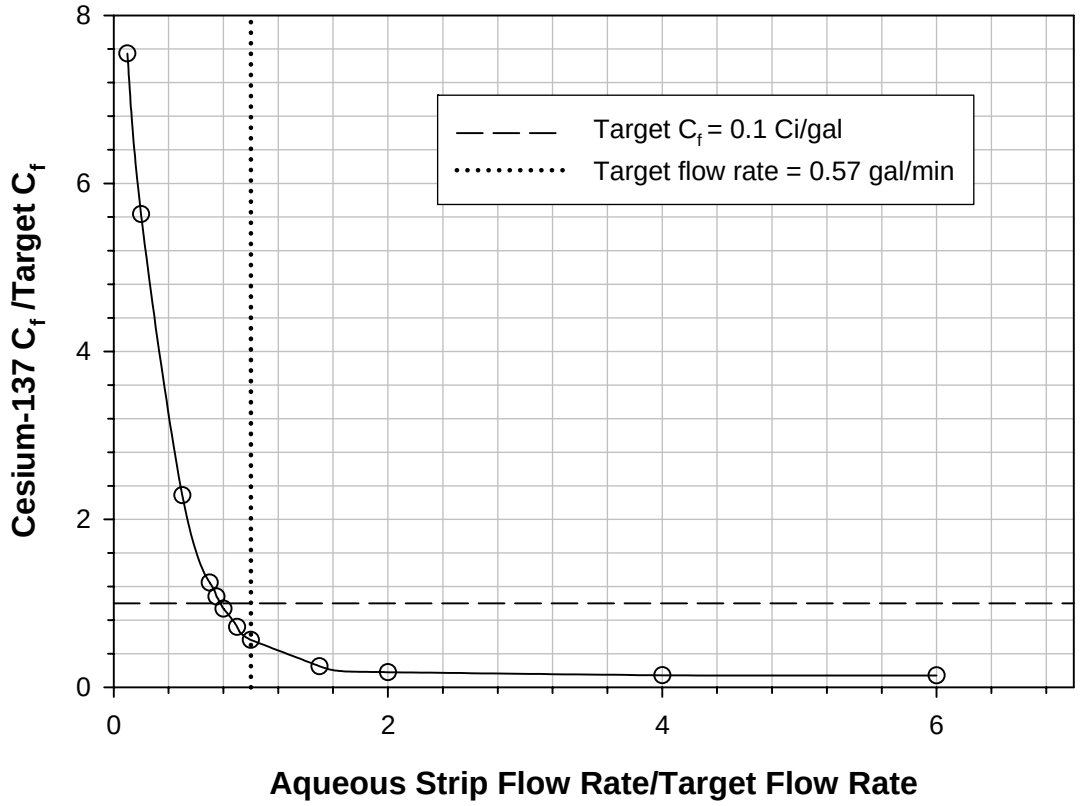

Figure 3-7. Effect of Changes in Aqueous Strip Flow Rate on C_f

3.4.2 Temperature

The extraction, scrub and strip process steps or stages are temperature dependent. As given in Table 2-3, the base case temperatures for extraction, scrub and strip are 23 $\pm$ 3 ^{o}C, 23 $\pm$ 3 ^{o}C (assumed), 33 $\pm$ 3 ^{o}C respectively. This subsection will use the SASSE model to assess the effect of temperature variation on C_f.

Temperature affects the D-value for extraction, scrub and strip as shown by equation [1]. Equation [1] was used to calculate D-values for various temperatures using the base case D-values and temperatures. For conservatism, since the scrub and strip steps have more than one enthalpy change value (see Table 2-5), the value that gave a less favorable D-value was used to calculate the D-values. The extraction, scrub and strip D-values were then used as input into the SASSE model to calculate C_f. Again, all the MCU process parameters were held constant at the base conditions except the particular process step (extraction or scrub or strip) being evaluated.

3.4.2.1 Extraction

A plot of relative C_f versus temperature is shown in Figure 3-8. The horizontal dashed line is the same as described before. The vertical lines are the target minimum and maximum extraction temperatures for the MCU. Low temperatures favor cesium extraction. Figure 3-8 indicates C_f will still be below target if the extraction temperature drops lower than the target minimum temperature. The only major concern is the potential for third phase formation because the solubility of the extractant decreases with decreasing temperature. Hence, the temperature should not go below 18 ^oC. However, the extraction temperature cannot exceed 28.3 ^oC because target C_f will be exceeded. This temperature corresponds to an extraction D-value of 5.73. As mentioned earlier, the minimum extraction D-value for the base case condition at 23 ^oC required to attain target C_f is also 5.73. This can also be obtained from Figure 3-3.

For other conditions, use equation [1] to calculate D-values at other temperatures from the known D-value. The calculated D-values and the C_0 of the waste are then plugged into equation [4] or located on Figure 3-3 to see if the target C_f will be exceeded for the D-value at that temperature.

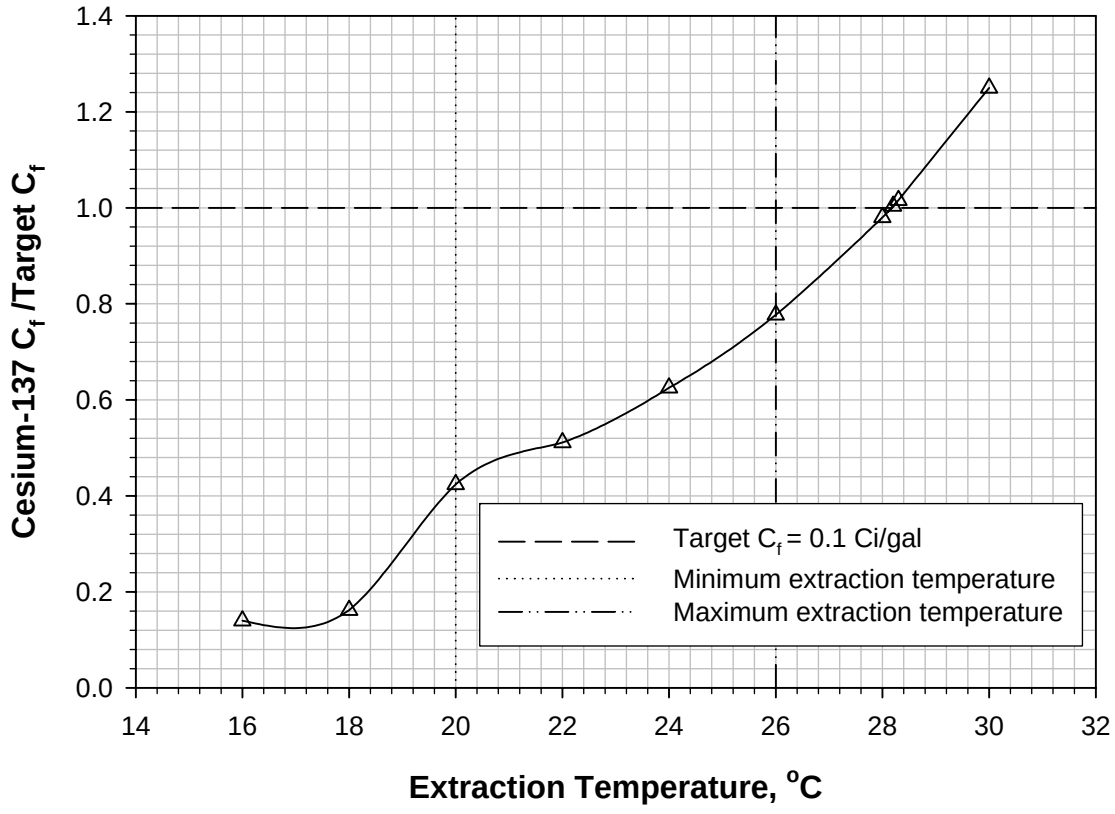

Figure 3-8. Effect of Changes in Extraction Temperature on C_f

3.4.2.2 Scrub

Figure 3-9 is the scrub counterpart of Figure 3-8. Low temperatures favor the scrub process because they lead to high scrub D-values. Figure 3-9 indicates scrub temperatures cannot go beyond 43.7 ^{o}C if target C_f is not to be exceeded. Note that this temperature is higher than the assumed scrub target maximum temperature (see footnote for Table 2-2).

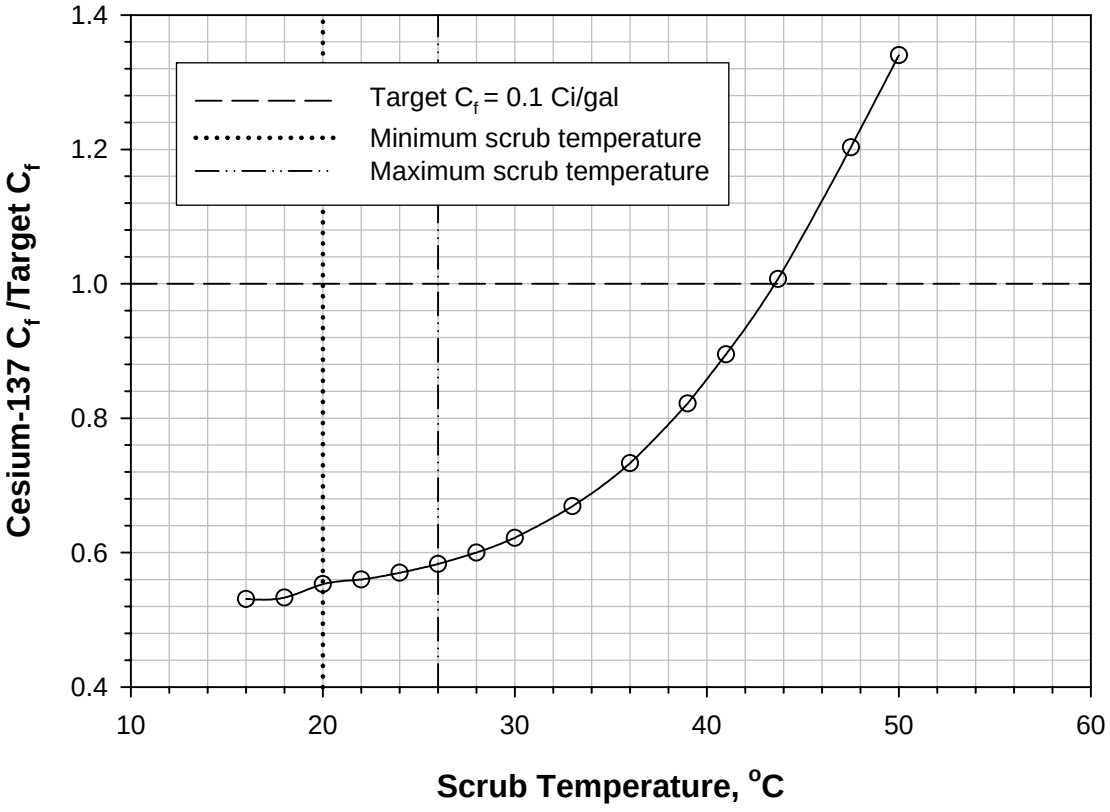

Figure 3-9. Effect of Changes in Scrub Temperature on C_f

3.4.2.3 Strip

Figure 3-10 is the strip counterpart of Figure 3-8. High temperatures favor the strip process because they lead to low strip D-values. Figure 3-10 indicates strip temperatures cannot be lower than 30.5 ^{o}C if target C_f is not to be exceeded. Note that this temperature is slightly higher than the strip target minimum temperature.

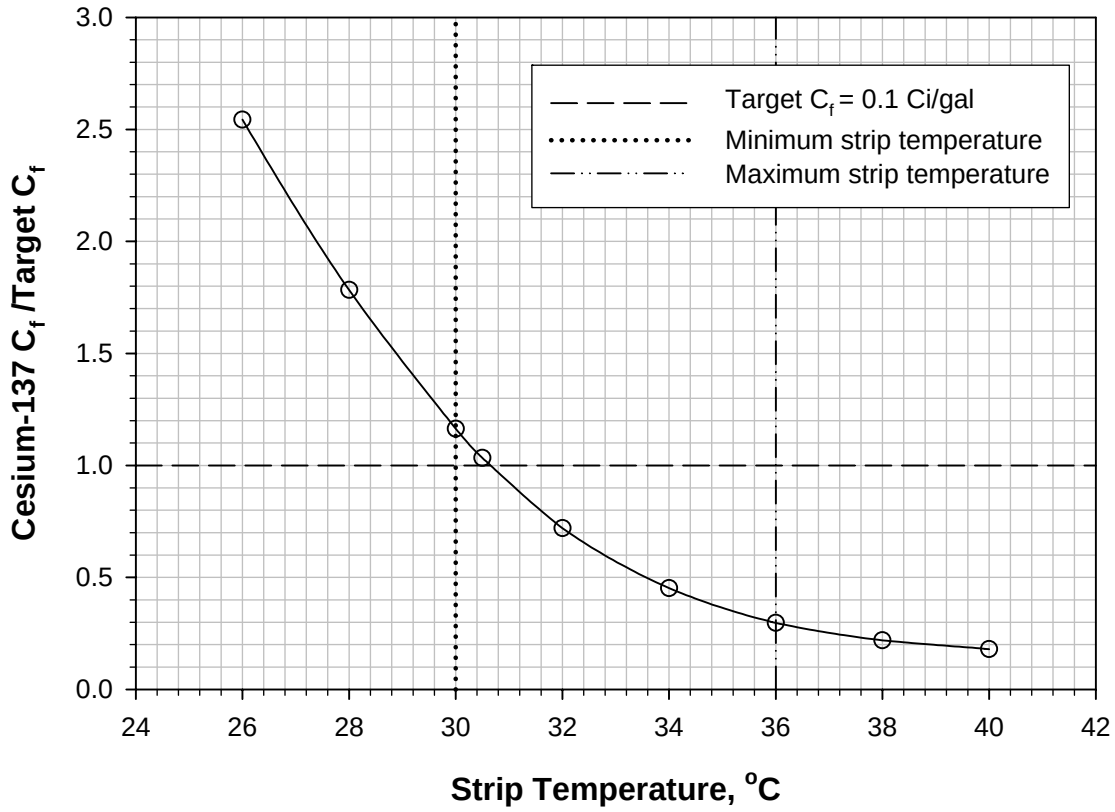

Figure 3-10. Effect of Changes in Strip Temperature on C_f

3.4.3 Interstage Carryover

3.4.3.1 Organic Phase Interstage Carryover in Aqueous Phase

Figure 3-11 are plots of relative final cesium-137 concentration (C_f/target C_f) versus fraction of organic phase carryover in aqueous phase exiting each stage (FAI) for the following steps respectively: extraction; scrub; strip; scrub and strip combined; and extraction, scrub and strip combined.

Each plot is for a scenario where all the MCU base case process parameters given in Table 2-2 are held constant except the FAI for the stages mentioned in the legend.

The dashed horizontal line in Figure 3-11 is the MCU target relative C_f. The left dotted vertical line is the nominal FAI value for the extraction stages, while the right dashed-dotted vertical line is the nominal FAI value for the scrub and strip stages which implies the nominal FAI value for the scrub and strip stages are equal (see Table 2-2).

All the plots indicate C_f is basically insensitive to changes in FAI. An increase or decrease in FAI of between 1 to 3 orders of magnitude depending on the process step or steps results in no change in C_f.

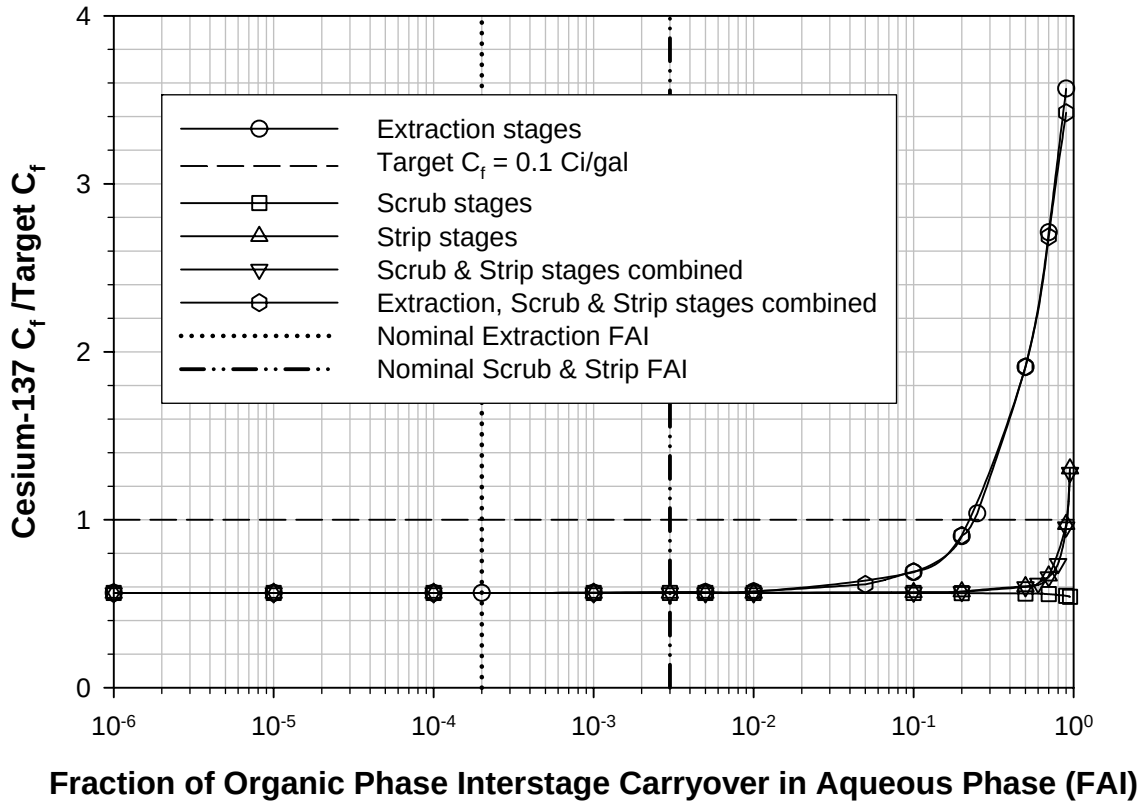

Figure 3-11. Effect of Changes in Extraction, Scrub and Strip Stages Organic Phase Carryover on C_f

3.4.3.2 Aqueous Phase Interstage Carryover in Organic Phase

The plots in Figure 3-12 are similar to those in Figure 3-11 except they are for the fraction of aqueous phase carryover in organic phase exiting each stage (FOI).

Again, the plots indicate C_f is basically insensitive to changes in FOI. An increase or decrease in FOI of between 1 to 2 orders of magnitude depending on the process step or steps results in no change in C_f.

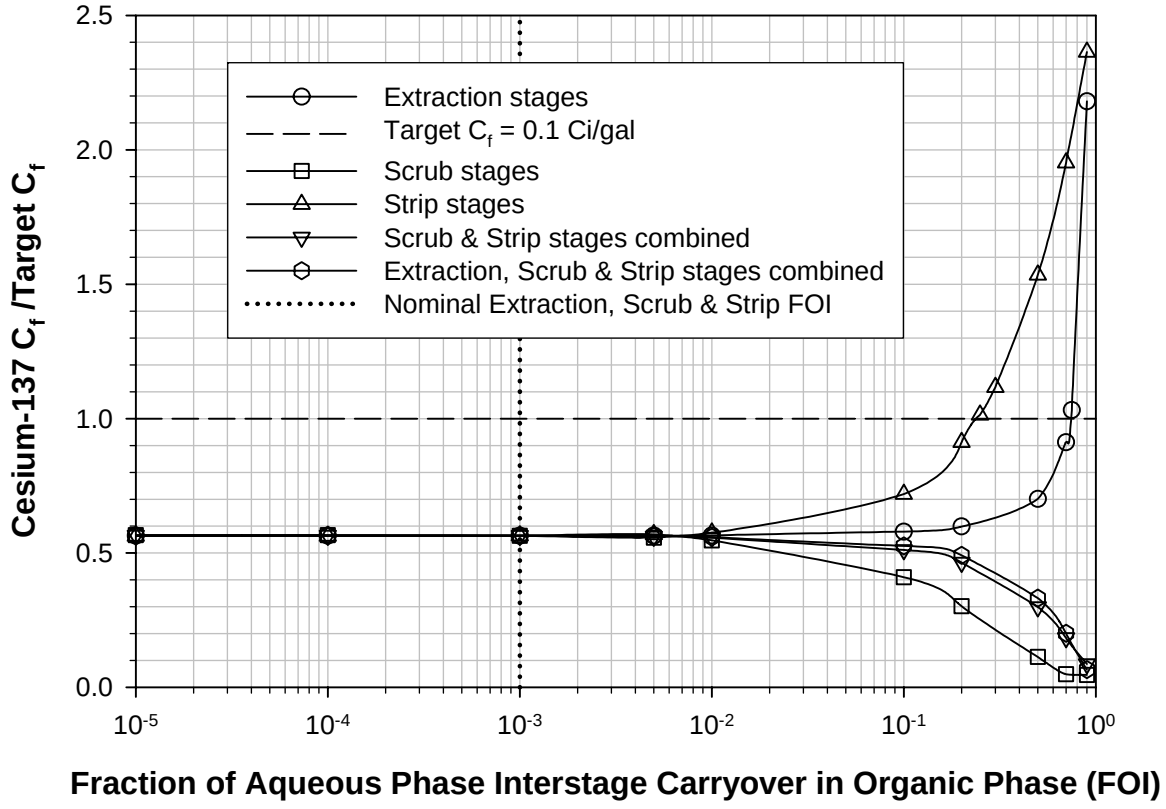

Figure 3-12. Effect of Changes in Extraction, Scrub and Strip Stages Aqueous Phase Carryover on C_f

3.4.4 Stage Efficiency

A plot of relative C_f versus efficiency is shown in Figure 3-13. The horizontal dashed line is the same as described before. The dotted vertical line is the base case or nominal efficiency for the MCU. Increasing efficiencies lead to low C_f. Fig 3-13 indicates the minimum efficiency required for C_f to be below target is 65% for the base case conditions. Since plant-scale contactors typically have higher efficiencies (90 – 99%), this is not a problem at all.[5,15]

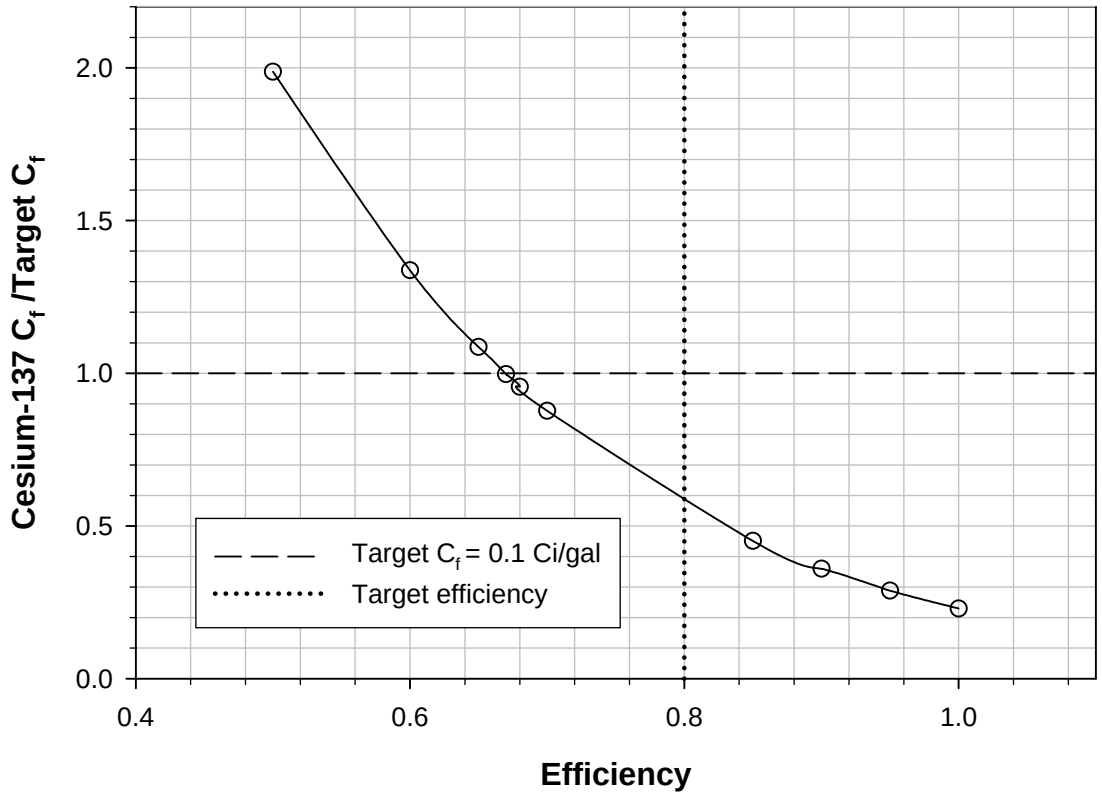

Figure 3-13. Effect of Changes in Stage Efficiency on C_f

3.4.5 Total Liquid Volume per Contactor Stage

Volume variations of aqueous (VAI) and organic (VOI) phases per contactor stage have no effect on C_f. The above variations for extraction; scrub and strip combined; and extraction, scrub and strip combined from a quarter to four times nominal resulted in no change in C_f and other mass transfer related parameters because SASSE does not include these volumes in the mass transfer calculations. The volume variations only affect contactor residence time.

3.5 ACCEPTABLE VARIABILITIES IN MCU FEEDS AND SOLVENT

3.5.1 Aqueous Waste Limits

There is no one set limit for the MCU waste feed. Waste acceptance should be based on the cubic spline model (equation [4]) or the waste acceptance graph (Figure 3-3) using the steps outlined below.

1. Obtain waste component concentrations (including both total cesium C_0 and cesium-137 C_0) of the MCU waste feed.

2. Calculate cesium extraction D-value of the MCU waste feed using either the SXFIT or neural network model with parameters in step 1 as inputs. Note that the total cesium concentration should be used.

3. Compute cesium-137 C_0 using the cubic spline model with cesium extraction D-value (from step 2) of the MCU waste feed as input. The MCU waste feed is acceptable if the computed cesium-137 $C_0 \geq$ the MCU waste feed cesium-137 C_0 in step 1. Note that the computed C_0 is the maximum waste feed cesium-137 concentration that can be treated without exceeding the target final cesium-137 concentration of 0.1 Ci/gal for the given MCU waste feed D-value.

   OR

   Alternatively, locate the coordinate point on the waste acceptance graph (Figure 3-3) using the MCU waste feed cesium-137 C_0 (from step 1) and extraction D-value (from step 2). The MCU waste feed is acceptable if the point is either on or below the curve.

Using the base case (Table 2-2) as an example, substituting a cesium extraction D-value of 8 into the cubic spline model (equation [4] and Table 3-7) gives C_0 of 1.94 Ci/gal. Since this C_0 is greater than the waste feed C_0 of 1.1 Ci/gal, the waste is acceptable. Alternatively, the coordinate point of waste feed cesium extraction D-value of 8 and C_0 of 1.1 Ci/gal lies below the curve on Figure 3.3, indicating the waste is acceptable. Put in a different way, the minimum acceptable cesium extraction D-value for the MCU base case condition is 5.73. This D-value is located at the point where the line C_0=1.1 Ci/gal meets the curve on Figure 3-3.

Again, as mentioned in subsection 3.1.2, potassium concentrations > 0.05 M have a potential for third phase formation.[12,15,21] Information in the literature indicates the optimized solvent may be able to tolerate some level of potassium above 0.05 M. However, there is not sufficient data to determine just how much above 0.05 M is acceptable.

3.5.2 Solvent Limits

Acceptable variability in the solvent component concentrations specified for the optimized solvent from past studies is as follows:[11,15,16] Extractant: 0.006 – 0.008 M, Modifier: 0.65 – 0.85 M, and TOA: < 0.010 M. The extraction, scrub, and strip D-values from batch ESS tests were all

better than the stipulated values (i.e., extraction: $\geq$ 8, scrub: $\geq$ 0.6, and strip: $\leq$ 0.16). Based on the above, the recommended solvent component limits are:

Extractant - low value: 0.005 M. This will depend on the waste feed D-value and C_0. The value given here is based on the base case D-value of 8 and C_0 of 1.1 Ci/gal. This is because a waste with extraction D-value of 8 based on a nominal solvent extractant concentration of 0.007 M is equivalent to an extraction D-value of 5.73 based on a solvent extractant concentration of 0.005 M.

Extractant - high value: 0.008 M. Values greater than 0.008 M have a higher probability of forming a third phase at 15 ^{o}C. Also, this is at the low end of the solubility limit region (0.00755 - 0.01095 M) of extractant in the solvent.

Modifier - low value: 0.65 M. Solubility of extractant in solvent is low below this value (e.g., solubility of extractant in solvent is about 0.0045 M at a modifier concentration of 0.5 M).[15]

Modifier - high value: 0.85 M. Above this value, scrub and strip D-values tend to exceed the stipulated ranges (scrub: $\geq$ 0.6, and strip: $\leq$ 0.16) which implies scrub and strip will be negatively affected.[16]

TOA - low value: 0.002 M. This will ensure enough TOA will be available to make the CSSX process more resistant to anionic impurities. This is because of all the solvent components, it is the most susceptible to thermal and radiolytic degradation.[15]

TOA - high value: 0.005 M. This will ensure it is much lower than the 0.010 M limit above which stripping is adversely affected.[15]

3.5.3 Aqueous Scrub and Strip Solution Limits

Note that the only information in the literature on the effect of HNO_3 concentration on the scrub and strip steps was based on the prior formulation of the solvent.[20] This lack of data was taken into consideration in setting the limits below.

Scrub Solution - low value: 0.0425 M. Low concentrations of HNO_3 may fail to neutralize the aqueous waste carryover in the solvent entering the scrub section. In addition, they will lead to high disproportionate distribution of the extracted cesium to the aqueous phase. This value is expected to yield a scrub D-value > the 0.6 stipulated while the concentration is 15% lower than the nominal of 0.05 M.

Scrub Solution - high value: 0.0575 M. High concentrations of HNO_3 will cause nitration of the extractant to occur at a fast rate. It may further result in reducing the alkalinity of the waste feed because the scrub solution exits to the extraction section of the CSSX process. Low waste alkalinity may lead to the precipitation of aluminum hydroxide. This value is expected to yield a

scrub D-value of about twice the stipulated value while the concentration is 15% higher than the nominal of 0.05 M.

Strip Solution - low value: 0.00075 M. Low concentrations of HNO_3 improve stripping performance. However, they affect phase disengagement and are also difficult to control.

Strip Solution - high value: 0.002 M. High concentrations of HNO_3 negatively impacts stripping performance. However, they improve phase disengagement and are also easier to control. This value is expected to yield a strip D-value of about two-and-half times the value for 0.001 M while still below the target of 0.16.

For both scrub and strip solutions, the key to attaining the target concentrations is that the mass of concentrated HNO_3 solution to be used to prepare the 0.05 and 0.001 M HNO_3 solutions should be within 1%.

3.5.4 Wash Solution Limits

The CSSX process includes solvent washing using 0.010 M NaOH solution. The effects of variations in the sodium hydroxide concentration fall into two categories, removal efficiency for organic impurities and phase separation. Determining the optimum NaOH concentration and appropriate limits depends on balancing these two factors. In addition, accumulation of impurities and the ability to prepare and verify the concentration may be of practical importance.

The known organic impurities of interest include dibutyl phosphate (DBP), carboxylic acids with long carbon chains, anionic surfactants, *sec*-butylphenol (SBP), and dioctylamine (DOA). DBP is a potential component of SRS waste and forms from the decomposition of tributyl phosphate used in actinide separation processes. Carboxylic acids are also potential waste components formed from the radiolytic degradation of paraffin solvents used in separation processes. Anionic surfactants are potential waste components arising from cleaning operations at SRS. SBP and DOA are decomposition products of CSSX solvent components. ORNL researchers studied solvent washing in batch tests with individual impurity compounds.[21] Surfactant removal occurs most efficiently at 0.01 to 0.001 M NaOH and worsens if the concentration is higher or lower. SBP removal improves as hydroxide ion concentration decreases from 0.3 to 0.003 M. The partitioning coefficient (P = concentration in organic/concentration in aqueous) for SBP changes from favored in the organic at 0.03 M (P = 1.3) to favored in the aqueous at 0.01 M (P = 0.47). DBP is highly favored in the aqueous over the range 1 M to 0.01 M NaOH, but its P value increases slightly at hydroxide concentrations below 0.1 M. Carboxylic acid removal is optimum at 0.003 M NaOH. The process baseline choice of 0.010 M NaOH balances the effectiveness for all chemical categories mentioned above.

High alkalinity and high ionic strength benefit phase disengagement, but the presence of certain organic impurities (particularly DOA) may produce adverse affects. Concentrations of 0.03 and 0.001 M NaOH have shown acceptable phase separation in batch tests and 5-cm contactor tests with optimized solvent.[22] However, previous batch tests with the original solvent composition

generated emulsions with 0.010 M NaOH.[21] Researchers suspect that organic impurities contributed to formation of the emulsions.

Given that the optimum NaOH concentration equals 0.010 M and that SBP removal is adversely affected if hydroxide increases to 0.030 M, the recommended upper limit during preparation of wash solution is 0.015 M. On the low side, DBP removal decreases below 0.1 M, so to limit this effect, a low value of 0.007 M is recommended. This range should not present problems in preparation or verification. However, since these limits are somewhat arbitrary, they should be evaluated after some experience has been obtained during process operations.

The decision to dispose of wash solution may depend not only on the hydroxide concentration, but also on the concentration of organic compounds. The ability to remove impurities decreases as they accumulate in the wash solution. Disposal (or regeneration) of wash solution should likely occur when hydroxide drops below 0.003 molar or when the impurities increase to millimolar concentrations. The organic impurity levels can be monitored by total carbon analysis. Millimolar concentrations of impurities containing 12 carbon atoms correspond to a total carbon concentration of 100 to 200 mg/L. The actual point at which impurities in the wash water will interfere is somewhat speculative and the limit may best be determined during processing. It is recommended that the NaOH concentration and total carbon be monitored on a periodic basis.

4.0 CONCLUSIONS

Waste feed acceptance for the MCU should be determined using the developed waste acceptance model or graph. As an example, the developed waste feed acceptance model indicates the minimum acceptable extraction D-value of the waste feed is 5.73 based on MCU base case conditions.

The caution is to limit waste feed potassium concentrations below 0.05 M because of the potential for third phase formation.[12,15,21] Information in the literature indicates the optimized solvent may be able to tolerate some level of potassium above 0.05 M. However, there is not sufficient data to determine just how much above 0.05 M is acceptable. Additional study to determine the limit beyond 0.05 M for the optimized solvent is recommended.

The waste feed acceptance model, which is essentially C_0/extraction D-value equation that results in a C_f of 0.1 Ci/gal is linear for D-values $\geq$ 7. This allows a quick use of the model because this region is represented by a simpler equation.

An alternative model to the SXFIT model which is handier predicts D-values within 15% of the SXFIT values.

Of all the waste components, only potassium concentration exhibits a strong relationship with the cesium extraction D-values which stems from its competitiveness with cesium in the process.

Solvent extractant concentration ratios are approximately equal to the corresponding D-value ratios. This characteristic could be used to predict extraction D-values when the extractant concentration in the solvent changes in the MCU operation.

The SASSE runs indicate that broad changes in the MCU process parameters for the extraction, scrub and strip stages (i.e., flow rate, temperature, fraction of interstage carryover, total liquid volume per contactor stage, and efficiency per contactor stage) will not result in C_f exceeding target, at least for the MCU base conditions. The process parameters ranges are given below.

- Flow rate ranges within which $C_f < 0.1$ Ci/gal

	Nominal flow rate, gal/min	Flow rate range
Solvent flow rate	2.833	0.6 to 1.7 times nominal value
Aqueous waste flow rate	8.5	< 1.45 times nominal value
Aqueous Scrub flow rate	0.567	< 5.5 times nominal value
Aqueous Strip flow rate	0.567	> 0.75 times nominal value

- Temperature ranges within which $C_f < 0.1$ Ci/gal

Process step	Nominal temperature range, ^oC	Temperature limit, ^oC
Extraction	20 - 26	< 28.3
Scrub	20 – 26 (assumed)	< 43.7
Strip	30 - 36	> 30.5

- Fraction of interstage carryover ranges within which $C_f < 0.1$ Ci/gal

Process step	Organic carryover	Aqueous carryover
Extraction	0.000001 - 0.25	0.00001 - 0.75
Scrub	0.000001 - 0.95	0.00001 - 0.90
Strip	0.000001 - 0.90	0.00001 - 0.24
Scrub/Strip	0.000001 - 0.90	0.00001 - 0.90
Extraction/Scrub/Strip	0.000001 - 0.23	0.00001 - 0.90

- Total liquid volume per contactor stage ranges within which C_f = constant

Process step	Organic volume	Aqueous volume
Extraction	1/4 - 4 times nominal value	1/4 - 4 times nominal value
Scrub/Strip	1/4 - 4 times nominal value	1/4 - 4 times nominal value
Extraction/Scrub/Strip	1/4 - 4 times nominal value	1/4 - 4 times nominal value

- Minimum efficiency per contactor stage required for $C_f \leq 0.1$ Ci/gal is 65%.

For a given extraction D-value, C_f and C_0 are linearly related. Also, for a given C_0, log (C_f) and log (extraction D-value) are linear with a slope of -1.43. These two relationships allow the quick calculation of C_f at other MCU conditions without using the SASSE model.

The recommended solvent and chemical solutions limits are as follows.

Solvent
Extractant: 0.005 – 0.008 M.
Modifier: 0.65 – 0.85 M.
TOA: 0.002 – 0.005 M.

Aqueous Scrub Solution
Preparation: Weighed quantities should be within 1%.
Process: 0.0425 – 0.0575 M HNO_3.

Aqueous Strip Solution
Preparation: Weighed quantities should be within 1%.
Process: 0.00075 – 0.002 M HNO_3.

Wash Solution
Preparation: 0.007 - 0.015 M NaOH.
Process: > 0.003 M for NaOH or < 100 – 200 ppm for total carbon impurities.

5.0 REFERENCES

1. C. L. Huntoon to G. P. Rudy, memorandum titled "Preferred Alternative for the Savannah River Salt Processing Project", June 25, 2001.

2. R. A. Dimenna et al., "Bases, Assumptions, and Results of the Flowsheet Calculations for the Decision Phase Salt Disposition Alternatives", WSRC-RP-99-00006, Rev. 3, May 24, 2001.

3. L. H. Delmau, D. A. Bostick, T. J. Haverlock, and B. A. Moyer, "Caustic-Side Solvent Extraction: Extended Equilibrium Modeling of Cesium and Potassium Distribution Behavior", ORNL/TM-2002/116, May 2002.

4. L. H. Delmau, T. J. Haverlock, T. G. Levitskaia, F. V. Sloop, Jr., and B. A. Moyer, "Caustic-Side Solvent Extraction Chemical and Physical Properties: Equilibrium Modeling of Distribution Behavior", ORNL/TM-2001/267, December 2001.

5. R. A. Leonard and M. C. Regalbuto, "A Spreadsheet Algorithm for Stagewise Solvent Extraction," *Solvent Extraction and Ion Exchange*, 12 (5), 909-930 (1994).

6. D. D. Walker, "Task Technical And Quality Assurance Plan For Waste And Solvent Composition Limitations Program," WSRC-RP-2004-00569, Rev. 0, September 28, 2004.

7. C. I. Aponte, "Waste and Solvent Composition Limitations", SP-TTR-2004-00014, Rev. 0, July 21, 2004.

8. T. B. Edwards, "A Statistically Designed Experiment for Computer Experimentation of MCU Decontamination Factors," SRNL-SCS-2005-00007, January 31, 2005.

9. T. B. Edwards, "A Second Statistically Designed Experiment for Computer Experimentation of Cesium Distribution Ratios," SRNL-SCS-2005-00015, March 24, 2005.

10. Seth G. Campbell, "Engineering Study to Determine the Number of Contactors Used in the Modular CSSX Unit," X-ESR-H-00021, Rev. 0, October 11, 2004.

11. D. D. Walker, "Extraction, Scrub, and Strip Testing of Solvent Extraction Systems", Manual L12.1, Procedure IWT-OP-143, Rev. 0, August 20, 2003.

12. L. H. Delmau, J. F. Birdwell, Jr., P. V. Bonnesen, L. J. Foote, T. J. Haverlock, L. N.Klatt, D. D. Lee, R. A. Leonard, T. G. Levitskaia, M. P. Maskarinec, B. A. Moyer, F. V.Sloop, Jr, and B. A. Tomkins, "Caustic-Side Solvent Extraction: Chemical and Physical Properties of the Optimized Solvent", ORNL/TM-2002/190, October 2002.

13. Laboratory Notebook. WSRC-NB-2005-00027, February 24, 2005.

14. Laboratory Notebook. WSRC-NB-2005-00028, February 24, 2005.

15. L. N. Klatt, J. F. Birdwell, Jr., P. V. Bonnesen, L. H. Delmau, L. J. Foote, D. D. Lee, R. A. Leonard, T. G. Levitskaia, M. P. Maskarinec, and B. A. Moyer, "Caustic-Side Solvent Extraction Solvent-Composition Recommendation," ORNL/TM-2001/258, January, 2001.

16. D. D.Lee, , J. F. Birdwell, Jr., P. V. Bonnesen, and B. A. Tomskins, " Density Changes in the Optimized CSSX Solvent System," ORNL/TM-2002/204, November, 2002.

17. T. B. Edwards, "Modeling Cs D-values as a Function of Waste Composition in the MCU Feed," SRNL-SCS-2005-00026, May 20, 2005.

18. L. N. Klatt, L. H. Delmau, D. A. Bostick, T. J. Haverlock, and B. A. Moyer, "Criteria for optimum Composition of the Caustic-Side Solvent Extraction (CSSX) Solvent ", CERS/SR/SX/025, Rev. 0, ORNL, August 2001.

19. T. B. Edwards, "Relating the MCU Feed D-values to Cs DF Values," SRNL-SCS-2005-00027, May 23, 2005.

20. P. V. Bonnesen, L. H. Delmau, and B. A. Moyer, "A Robust Alkaline-Side CSEX Solvent Suitable for Removing Cesium from Savannah River High Level Waste", *Solvent Extraction and Ion Exchange*, 18 (6), 1079-1107 (2000).

21. B. A. Moyer, S. P. Aleandratos, P. V. Bonnesen, G. M. Brown, J. E. Canton, Jr., L. H. Delmau, C. R. Duchemin, T. J. Haverlock, T. G. Levitskaia, M. P. Maskarinec, F. V. Sloop, Jr., and C. L. Stine, "Caustic-Side Solvent Extractin Chemical and Physical Properties Progress in FY 2000 and FY2001," ORNL/TM-2001/285, February 2002.

22. J. F. Birdwell, K.K. Anderson, and D. E. Hobson, "Investigation of Emulsion Formation in Solvent Washing in the Caustic-Side Solvent Extraction (CSSX) Process," ORNL/TM-2002/126, June 2002.

APPENDIX A

Table A-1. Documentation of SRS Waste Composition Data

	Proposed Limits		Observed Limits		Model	Solubility	Saltstone	WCS	Average	High OH^-	High NO_3^-
Component	**High**	**Low**	**High**	**Low**	**Basis**	**Limits**	**WAC**	**(49 tanks)**			
Total Na^+, M	7.0	1.50	19.10	1.50	7	20	7.00	0.4 to 17.7	5.60	5.60	5.60
Total Cs^+, mM	0.5	0.007	0.37	0.0006	2 M	20			0.14	0.37	0.14
Cs-137, Ci/gal			44.3	0.013				0.00014 to 21			
K^+, M	0.4	0.001	0.35	0.0013	0.06	20	0.94	0.0013 to 0.2	0.015	0.03	0.0041
OH^- (free), M	7.0	0.03	15.2	0.03	7	20	11.20	0.1 to 13.1	1.91	3.05	1.17
NO_3^-, M	7.0	0.1	7.3	0.12	7	10	8.53	0.12 to 4.3	2.14	1.1	2.84
NO_2^-, M	7.0	0.01	5.4	0.01	7	20	5.63	0.18 to 5.4	0.52	0.74	0.37
CO_3^{2-}, M	2.0	0.01	4.6	0.01	2	8	2.41	0.02 to 1.1	0.16	0.17	0.16
AlO_2^-, M	2.0	0.01	1.6	0.006	2		5.20	0.01 to 1.1	0.31	0.27	0.32
SO_4^{2-}, M	0.8	0.001	1.2	0.001	2	5	0.72	0.002 to 0.35	0.15	0.03	0.22
PO_4^{3-}, M	0.4	0.001	0.08	0.0004		4	0.38	0.0005 to 0.06	0.01	0.008	0.01
Cl^-, M	0.3	0.001	0.11	0.0016	7	10	0.27	0.003 to 0.03	0.025	0.01	0.04
F^-, M	0.3	0.001	0.1	0.0005	1	20	0.26	0.0005 to 0.1	0.032	0.01	0.05
Reference									2	2	2
	Tk 46F	**Tk 37H/44F**	**Tk 37H**	**Tk 37H**	**Tk 33F**	**Tk 41H**	**Tk 3F**	**Tk 30H**	**Tk 32H**	**Tk 32H**	**Tk 33F**
Component				**(diluted)**					**(2/9)**	**(4/17)**	
Total Na^+, M	5.90	5.61	7.30	6.22	9.05	6.00	6.44	5.50	5.70	4.40	3.40
Total Cs^+, mM	0.016	0.17	0	0.34		0.02	0.061	0.36	0.31	0.24	0.051
Cs-137, Ci/gal	1.2	2.7	0	5.5	0.56	0.2	0.61				
K^+, M	0.075	0.037	0	0.039		0.0065	0.02	0.028	0.013	0.013	0.0034
OH^- (free), M	3.2	3.9	0	3.7	1.51	1.8	1.52	2.57	1.69	1.86	1.51
NO_3^-, M	1.28	0.65	2	0.73	1.122	2.48	3.26	1.49	2.04	1.42	1.31
NO_2^-, M	0.21	0.51	2.4	0.88	0.48	0.7	0.32	0.57	0.76	0.57	0.2
CO_3^{2-}, M	0.25	0.072	0	0		0.13	0.2	0.29	0.29	0.05	0.33
AlO_2^-, M	0.2	0.17	1.5	0.54	0.4	0.34	0.29	0.36	0.48	0.36	0.024
SO_4^{2-}, M	0.042	0.002	0	0		0.16	0.27	0	0.028	0	0.035
PO_4^{3-}, M	0.004	0.003	0	0.02		0.015	0.0059	0.0049	0.0023	0.0032	0.0018
Cl^-, M	0.047	0.012	0	0.009		0.032	0.037	0	0	0	0
F^-, M	0	0	0	0		0.03	0.06	0	0	0	0
Reference	3	4	5	6	7	8	8	9	9	9	9

Table A-1 Cont'd. Documentation of SRS Waste Composition Data

Component	Tk 38H	Tk 46F	Tk 37H/44F	Tk 37H	Tk 37H (diluted)	Tk 33F	Tk 41H	Tk 3F	Tk 30H	Tk 32H (2/9)	Tk 32H (4/17)
Total Na^+, M	5.60	5.90	5.61	7.30	6.22	9.05	6.00	6.44	5.50	5.70	4.40
Total Cs^+, mM	0.0015	0.016	0.17	0	0.34		0.02	0.061	0.36	0.31	0.24
Cs-137, Ci/gal	0.034	1.2	2.7	0	5.5	0.56	0.2	0.61			
K^+, M	0.0022	0.075	0.037	0	0.039		0.0065	0.02	0.028	0.013	0.013
OH^- (free), M	0.59	3.2	3.9	0	3.7	1.51	1.8	1.52	2.57	1.69	1.86
NO_3^-, M	0.12	1.28	0.65	2	0.73	1.122	2.48	3.26	1.49	2.04	1.42
NO_2^-, M	0.06	0.21	0.51	2.4	0.88	0.48	0.7	0.32	0.57	0.76	0.57
CO_3^{2-}, M	1.59	0.25	0.072	0	0		0.13	0.2	0.29	0.29	0.05
AlO_2^-, M	0.011	0.2	0.17	1.5	0.54	0.4	0.34	0.29	0.36	0.48	0.36
SO_4^{2-}, M	0.35	0.042	0.002	0	0		0.16	0.27	0	0.028	0
PO_4^{3-}, M	0.002	0.004	0.003	0	0.02		0.015	0.0059	0.0049	0.0023	0.0032
Cl^-, M	0.083	0.047	0.012	0	0.009		0.032	0.037	0	0	0
F^-, M	0	0	0	0	0		0.03	0.06	0	0	0
Reference	3	4	5	6	7	8	8	9	9	9	9
Component	**Tk 33F**	**Tk 34F**	**Tk35H**	**Tk 44F**	**Tk 48H 1983**	**Tk 48H 1995**	**Tk 25**	**Tk 26F**	**Tk 27F**	**Tk 28F**	**Tk 48H 1983**
Total Na^+, M	3.40	5.80	5.50	5.40	5.50	5.04	13.80	16.70	12.10	13.20	5.50
Total Cs^+, mM	0.051	0.13	0.17	0.35							
Cs-137, Ci/gal				1.7	0.49	0.86	4.3	5.5	3.8	4.4	0.49
K^+, M	0.0034	0.029	0.012	0.051	0.0072		0.17	0.18	0.14	0.13	0.0072
OH^- (free), M	1.51	3.36	2.34	4.3	1.2	2.74	10.6	15.2	9.9	8.5	1.2
NO_3^-, M	1.31	1.14	1.49	0.37	3.1	0.6	1.34	1	1.36	1.37	3.1
NO_2^-, M	0.2	0.2	0.31	0.35	0.27	0.69	1.3	1.3	1.2	1.32	0.27
CO_3^{2-}, M	0.33	0.22	0.36	0.1	0.35	0.19					0.35
AlO_2^-, M	0.024	0.2	0.31	0.126	0.38	0.17	0.55	0.59	0.42	0.64	0.38
SO_4^{2-}, M	0.035	0.01	0.016	0.001	0.18	0.01	0.0053	0.0083	0.0085	0.0066	0.18
PO_4^{3-}, M	0.0018	0.0044	0.0043	0.004		0.006	0.014	0.011	0.013	0.014	
Cl^-, M	0	0	0	0.009		0.014	0.022	0.034	0.021	0.026	
F^-, M	0	0	0	0		0.008	0.0006	0.0008	0	0.0005	
Reference	9	9	9	10/11	13	14	12	12	12	12	13

Table A-1 Cont'd. Documentation of SRS Waste Composition Data

Component	Tk 48H	Tk 25	Tk 26F	Tk 27F	Tk 28F	Tk 29H	Tk 30H	Tk 32H	Tk 38H	Tk 43H	Tk 1F
	1995										
Total Na^+, M	5.04	13.80	16.70	12.10	13.20	14.00	9.10	5.30	19.10	14.40	10.10
Total Cs^+, mM											
Cs-137, Ci/gal	0.86	4.3	5.5	3.8	4.4	11.1	8.2	3.8	3.8	2.6	23.9
K^+, M		0.17	0.18	0.14	0.13	0.086	0.039	0.019	0.083	0.085	
OH^- (free), M	2.74	10.6	15.2	9.9	8.5	6.5	3.9	2.1	9.6	10.4	
NO_3^-, M	0.6	1.34	1	1.36	1.37	0.166	2.19	2.9	1.08	1.73	1.6
NO_2^-, M	0.69	1.3	1.3	1.2	1.32	2.38	0.67	0.95	1.55	1.88	2.4
CO_3^{2-}, M	0.19										
AlO_2^-, M	0.17	0.55	0.59	0.42	0.64	0.93	0.48	0.45	0.53	0.46	0.8
SO_4^{2-}, M	0.01	0.0053	0.0083	0.0085	0.0066	0.012	0.046	0.061	0.0052	0.0064	0.02
PO_4^{3-}, M	0.006	0.014	0.011	0.013	0.014	0	0	0	0.032	0.029	0.08
Cl^-, M	0.014	0.022	0.034	0.021	0.026	0.017	0.0045	0.0019	0.02	0.019	0.06
F^-, M	0.008	0.0006	0.0008	0	0.0005	0	0.001	0.001	0.0014	0.0009	0.001
Reference	14	12	12	12	12	12	12	12	12	12	15
Component	**Tk 2F**	**Tk 4F**	**Tk 5F**	**Tk 6F**	**Tk 8F**	**Tk 18F**	**Tk 9H**	**Tk 10H**	**Tk 11H**	**Tk 12H**	**Tk 13H**
Total Na^+, M	9.30		9.40	5.00	4.00	12.50	12.50	9.10			5.70
Total Cs^+, mM											
Cs-137, Ci/gal	13.6	18.8	39.2	6.8	44.3	18.8	0.15	1			0.34
K^+, M											
OH^- (free), M							3.8	1.9	0.8	1	1.1
NO_3^-, M	2.4	2.4	2.4	1.6	1.7	2.5	1.9	4.5	3.7	3.3	3.6
NO_2^-, M	2.9	3.1	3.1	1.1	0.5	2.6	3.2	1.8	0.6	1.1	0.5
CO_3^{2-}, M		0.2		0.1		0.3	0.1		0.1	0.2	0.1
AlO_2^-, M	0.7	0.5	0.7	0.4	0.4	0.7	1.6	1	0.9	0.7	0.4
SO_4^{2-}, M	0.02	0.03	0.02	0.14	0.18	0.02	0.02	0.08	0.03	0.03	0.08
PO_4^{3-}, M	0.04	0.04	0.04	0.02	0.02	0.03	0.05	0.02	0.009	0.009	0.002
Cl^-, M	0.06	0.03	0.06	0.04	0.03	0.11	0.029	0.02	0.005	0.005	0.018
F^-, M	0.002		0.002	0.003	0.004		0.002	0.003			0.001
Reference	15	15	15	15	15	15	15	15	15	15	15

Table A-1 Cont'd. Documentation of SRS Waste Composition Data

Component	TK14H	Tk 15H	Tk 21H	Tk 24H	Tk 7	Tk 10	Tk 41	Tk 43	Tk 44	Tk 30	Tk 29
Total Na^+, M	8.90	6.20		9.40	5.70	9.20	5.00	5.80	10.60	13.30	10.90
Total Cs^+, mM											
Cs-137, Ci/gal	0.34	1.7			1.4	1.1	0.97	0.97	3.1	12.8	12.8
K^+, M					0.033	0.013	0.041	0.018	0.071	0.078	0.078
OH^- (free), M	2.5	1	2.6	4.3	1.77	0.23	2.63	2.38	4.47	5.7	6.2
NO_3^-, M	2.8	3.6	5.3	2.6	0.4	6.58	1.1	2.3	1.68	1.95	1.3
NO_2^-, M	2	1.1	1.5	1.7	0.26	0.31	0.3	0.28	0.94	2.8	1.3
CO_3^{2-}, M		0.1	0.3		0.082	0.47	0.096	0.25	0.12	0	0.23
AlO_2^-, M	1.1	1	1	0.9	0.2	0.88	0.42	0.38	0.56	1.5	0.7
SO_4^{2-}, M	0.04	0.05	0.05	0.02	0.04	0.22	0	0.06	0	0.07	0
PO_4^{3-}, M	0.01		0.009		0	0	0	0	0	0	0
Cl^-, M	0.019	0.016	0.02	0.04	0.05	0.02	0	0	0.007	0	0
F^-, M	0.004	0.001		0.003	0	0	0	0	0	0	0
Reference	15	15	15	15	16	16	16	16	16	16	16
			Dissolved Salt Cake Data								
Component	**Tk 41**	**Tank 10H**	Tank 17 salt removal (1983)					Tank 29H batch contacts			
	hi/lo of 13 batches	hi/lo of predicted	Batch 1	Batch 2	Batch 3	Batch 4	Batch 5	Batch 1	Batch 2	Batch 3	
Total Na^+, M	14.6 - 5.4	6.00	6.7	6.4	6.9	7.5	6.1	11.5	5.99	2.09	
Total Cs^+, mM		0.016 - 0.0006									
Cs-137, Ci/gal	0.11 - 0.09	0.21 - 0.09	0.08	0.07	0.06	0.04	0.04	9	0.165	0.042	
K^+, M		< 0.007			0.05			< 0.17	< 0.16	< 0.21	
OH^- (free), M	2.2 - .1	0.7 - 0.03	2	1.8	1.7	1.7	1.2	3.17	0.423	0.978	
NO_3^-, M	7.3 - 2.2	5.5 - 1.9	3.6	3.7	3.8	4.7	4.1	1.15	0.028	0.092	
NO_2^-, M	0.41 - 0.01	0.11 - 0.03	0.4		0.35	0.14	0.1	1.6	0.015	0.056	
CO_3^{2-}, M	4.6 - 0	0.99 - 0.13						0.082	0.22	0.74	
AlO_2^-, M	0	0.051 - 0.023	0.5	0.56	0.65	0.74	0.44	1.01	0.75	0.35	
SO_4^{2-}, M	0.24 - 0	1.2 - 0.12	0.11	0.16	0.24	0.15	0.15	0.014	0.053	0.17	
PO_4^{3-}, M	0.016 - 0	< 0.01						0.024	0.0005	< 0.001	
Cl^-, M	0.015 - 0	<0 .015						0.0041	< 0.0003	< 0.0003	
F^-, M	0	< 0.03						<0.005	< 0.0005	< 0.0005	
Reference	21	24	16	16	16	16	16	20	20	20	

Table A-1 Cont'd. Documentation of SRS Waste Composition Data

	Dissolved Salt Cake Data										
	Tank 31 salt cake (batch contacts)				Tank 38H salt cake		Tank 2F		Tank 3F		
Component	Batch 1	Batch 3	Batch 6	Batch 8	Undrained	50% Drain	Undrained	50% drain	#1 Undrain	#4 Undrain	
Total Na^+, M					6.0	6.0	6.0	6.0	6.0	6.0	
Total Cs^+, mM					0.0069	0.0038	0.017	0.0053	0.043	0.084	
Cs-137, Ci/gal	4.9	1.4	0.19	0.013	0.09	0.04	0.2	0.06	0.4	1	
K^+, M					< 0.07	< 0.07	0.0068	0.0013	0.0025	0.0022	
OH^- (free), M	3	1.5	1.4	0.65	0.7	0.38	0.64	0.43	0.33	1.15	
NO_3^-, M	3.4	4.3	4.6	0.4	4.06	4.45	4.19	4.35	5.26	3.93	
NO_2^-, M	0.92	0.31	0.051	0.014	0.24	0.14	0.15	0.095	0.16	0.41	
CO_3^{2-}, M	0.22	0.89 (1.2)	0.54	1.3	0.35	0.37	0.13	0.13	0.68	0.09	
AlO_2^-, M	2.3	1.2	0.15	0.006	0.031	0.024	0.29	0.28	0.035	0.089	
SO_4^{2-}, M	0.058	0.16	0.31	0.33	0.13	0.14	0.032	0.033	0.043	0.12	
PO_4^{3-}, M	< 0.2	< 0.06	< 0.03	<.01	0.0012	0.0004	0.0023	0.0011	0.022	0.044	
Cl^-, M	< 0.1	< 0.04	< 0.02	<.01	< 0.002	< 0.0013	0.0026	0.0023			
F^-, M	< 0.2	< 0.06	< 0.03	<.01	0.011	0.012	< 0.003				
Reference	19	19	19	19	22	22	23	23	23	23	
	Spaceman Predictions for LCS processing										
Component	**Batch 4/5**	**Batch 6**	**Batch 8**	**Hi Ci Salt**	**RE.Low Rad**	**Tk 38H**					
	nominal	**nominal**	**nominal**	**(33 tanks)**	**(21 tanks)**						
Total Na^+, M	7.00	6.44	6.54	1.5 to 15	1.5 to 15	5.60					
Total Cs^+, mM	0.0245	0.0777	0.0396	0.01 to 0.21		0.0015					
Cs-137, Ci/gal	0.37	1.00	0.64	0.21 to 10.6	0.1 to 21	0.034					
K^+, M	0.0119	0.0302	0.0165	0.013 to 0.20	0.013 to .35	0.0022					
OH^- (free), M	0.76	1.74	3.63	0.35 to 5.6	0.83 to 13.1	0.59					
NO_3^-, M	5.01	3.6	1.56	0.12 to 3.8	0.36 to 3.8	0.12					
NO_2^-, M	0.28	0.37	1.01	0.05 to 3.3	0.05 to 3.2	0.06					
CO_3^{2-}, M	0.31	0.192	0.13	0.014 to 1.6	0.01 to .53	1.59					
AlO_2^-, M	0.143	0.167	0.0386	0.01 to 1.6	0.1 to 1.6	0.011					
SO_4^{2-}, M	0.113	0.0687	0.0191	0.004 to 0.3	0.004 to 0.052	0.35					
PO_4^{3-}, M	0.0203	0.0157	0.0072	0.005 to 0.06	0.005 to 0.06	0.002					
Cl^-, M	0.00166	0.00377	0.00326	0.003 to 0.03	0.0028 to 0.029	0.083					
F^-, M	0.0173	0.0137	0.0028	0.002 to 0.015	0.002 to .015	0					
Reference	1	1	1	17	18	3					

Tk = Tank
LCS = Low curie salt

References

1. D. J. McCabe, L. L. Hamm, S. E. Aleman, D. K. Peeler, C. C. Herman, and T. B. Edwards, “High Level Waste System Impacts from Small Column Ion Exchange Implementation,” WSRC-TR-2005-00034, Rev. 0, June 28, 2005.

2. D. D. Walker, “Preparation of Simulated Waste Solutions,” WSRC-TR-99-00116, Rev. 0, April 15, 1999.

3. D. D. Walker, M. H. Beasley, A. D. Coleman, B. H. Croy, C. C. Diprete, and D. P. Diprete, "Solvent Extraction Batch Distribution Coefficients with SRS Dissolved Salt Cake," WSRC-TR-2001-00533, Rev. 1, March 26, 2002.

4. S. G. Campbell, M. W. Geeting, C. W. Kenell, M. A. Norato, R. A. Pierce, D. D. Walker, and W. R. Wilmarth , "Demonstration of CSSX with SRS High Level Waste," WSRC-TR-2001-00223, Rev. 0, April 19, 2001.

5. D. D. Walker, "Composition of Tank 37H Solution," SRT-LWP-2002-00025, July 23, 2002.

6. M. A. Norato, S. D. Fink, F. F. G. F. Kessinger, Fondeur, R. A. Pierce and D. D. Walker, "Demonstration of CSSX with Optimized Solvent in the 2-cm Centrifugal Contactor Apparatus using Dissolved Salt Cake from Tank 37H," WSRC-TR-2002-00307, Rev. 1, September 3, 2002.

7. W. R. Wilmarth, "Tank 33F Sample Analysis," SRT-LWP-2002-00129, November 20, 2002.

8. L. L. Hamm and D. D. Walker, "VERSE-LC® Modeling of Ion Exchange Column Performance for Low Curie Salt," WSRC-TR-2003-00243, Rev. 0, July 16, 2003.

9. M. H. Beasley, A. D. Coleman, B. H. Croy, S. D. Fink, R. A. Jacobs, and D. D. Walker, "IONSIV® IE-911 Performance in SRS Radioactive Waste," WSRC-TR-2000-00526, Rev. 0, April 10 , 2001.

10. D. D. Walker, D. J. Adamson, T. D. Allen, R. W. Blessing, W. T. Boyce, B. H. Croy, R. A. Dewberry, D. P. Diprete, S. D. Fink, T. Hang, J. C. Hart, M. C. Lee, J. J. Olson, and M. J. Whitaker et al., "Cesium Removal from SRS Radioactive Waste using CST (IONSIV® IE-911)," WSRC-TR-99-00308, Rev. 0, September 18, 1999.

11. D. D. Walker, Cesium Sorption/Desorption Experiments with IONSIV® IE-911 in Radioactive Waste," WSRC-TR-2000-00362, Rev. 0, December 13, 2000.

12. D. D. Walker and R. A. Dewberry, "Composition of Tank Farm Supernate Samples," WSRC-RP-93-1009, July 16, 1993.

13. D. D. Walker and B. A. Hamm, "Sample Analyses from the Full Scale In-tank Demonstration of the Precipitation Process," DPST-83-695, July 21, 1983.

14. C. J. Coleman, "Statistical Analysis of Sample Data from Tank 48H," WSRC-TR-95-0325, September 29, 1995.

15. R. S. Ondrejcin, "Chemical Composition of Supernates Stored in SRP High Level Waste Tanks," DP-1347, August 1974.

16. D. D. Walker, Unpublished Results.

17. S. G. Subosits, "Feed Basis for Processing High Curie Salt," WSRC-TR-2001-00557, Rev. 3, November 19, 2002.

18. M. D. Drumm and M. D. Hopkins "Feed Basis for Processing Relatively Low Radioactivity Waste Tanks," WSRC-TR-2001-00559, Rev. 3, June 11, 2003.

19. C. J. Martino and M. R. Poirier, "Tank 31H Saltcake Dissolution Tests," WSRC-TR-2002-388, Rev.0, February 27, 2003.

20. C. J. Martino, D. J. McCabe and R. L. Nichols, "Tank 29H Saltcake Core and Supernate Sample Analysis," WSRC-TR-2004-130, Rev.0, WSRC-TR-2004-00130, March 16, 2004.

21. Q. L. Nguyen and J. A Pike, "Tank 41 LCS 1s Salt Dissolution Batch Analysis," WSRC-TR-2003-0191, June 3, 2003.

22. C. J. Martino, R. L. Nichols, D. J. McCabe and E. K. Hansen, "Tk 38H Saltcake Core and Supernate Sample Analysis," WSRC-TR-2004-129, April 8, 2004.

23. C. J. Martino, R. L. Nichols, D. J. McCabe, M. R. Millings and M. E. Denham, "Tanks 3F and 2F Saltcake Core and Supernate Sample Analysis," WSRC-TR-2004-00131, April 13, 2004.

24. C. J. Martino, R. L. Nichols, D. J. McCabe and M. R. Millings, "Tank 10H Saltcake Core Sample Analysis," WSRC-TR-2004-00164, April 19, 2004.

APPENDIX B

Table B-1. Waste Compositions of the First Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.0042, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU001	6.2410937	0.1996316	0.0005000	0.2611234	0.1624153	0.3185164	2.0827702	0.1016109	0.0564316	0.0547269	1.5868346	0.0623716	1.45E+00	1.96E+00	2.46E+00	2.97E+00
MCU002	1.5000000	0.4000000	0.0000070	0.1000000	0.3000000	0.0100000	0.0300000	0.0010000	0.4000000	0.0010000	0.0100000	0.2370070	5.64E-01	7.51E-01	9.39E-01	1.13E+00
MCU003	4.8697190	0.4000000	0.0005000	0.5877812	0.1424723	0.5839580	0.8213167	0.0887988	0.0044258	0.5393534	0.0100000	1.9339077	1.38E+00	1.82E+00	2.26E+00	2.69E+00
MCU004	1.5000000	0.4000000	0.0005000	0.4308094	0.0010000	0.2056906	0.0300000	0.0010000	0.4000000	0.0010000	0.0100000	0.0100000	1.49E+00	1.93E+00	2.36E+00	2.78E+00
MCU005	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	0.2635000	7.0000000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.26E-01	1.24E+00	1.56E+00	1.89E+00
MCU006	1.5000000	0.0010000	0.0005000	0.1000000	0.0010000	0.0100000	0.0300000	0.3000000	0.1513806	0.2881790	0.0100000	0.0100000	8.04E-01	1.06E+00	1.32E+00	1.58E+00
MCU007	1.5000000	0.0010000	0.0005000	0.1000000	0.3000000	0.4211606	0.3453394	0.3000000	0.0010000	0.0010000	0.0100000	0.0100000	2.88E+00	3.91E+00	4.96E+00	6.02E+00
MCU008	6.4599167	0.3639491	0.0005000	1.1786579	0.0010000	0.1560494	0.6185561	0.0678694	0.0010000	0.0010000	1.5393799	1.7184732	1.47E+00	1.91E+00	2.33E+00	2.74E+00
MCU009	1.5000000	0.4000000	0.0005000	0.1000000	0.0010000	0.0100000	0.0300000	0.3000000	0.0010000	0.5571982	0.1660518	0.0100000	5.02E-01	6.66E-01	8.29E-01	9.90E-01
MCU010	5.5537410	0.2167786	0.0000070	0.4697400	0.3000000	0.2944772	0.2406172	0.2370036	0.3814519	0.3606012	0.9871709	0.3887886	1.36E+00	1.81E+00	2.27E+00	2.72E+00
MCU011	7.0000000	0.4000000	0.0005000	7.0000000	0.0010000	0.0100000	0.3535000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	1.61E+00	2.06E+00	2.48E+00	2.88E+00
MCU012	5.3498674	0.4000000	0.0005000	1.9721698	0.0010000	0.1461945	0.4822592	0.0010000	0.0010000	0.0010000	1.5331865	0.0763709	1.79E+00	2.30E+00	2.77E+00	3.23E+00
MCU013	1.5000000	0.0010000	0.0005000	0.1000000	0.0010000	0.0100000	0.0300000	0.3000000	0.2464003	0.0010000	0.1546495	0.0100000	8.28E-01	1.10E+00	1.36E+00	1.62E+00
MCU014	2.2135047	0.4000000	0.0005000	0.7503707	0.0010000	0.0100000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	1.7966340	2.07E+00	2.65E+00	3.20E+00	3.73E+00
MCU015	1.5000000	0.4000000	0.0005000	0.3206646	0.0010000	0.0100000	0.0300000	0.0010000	0.4000000	0.1346536	0.0292642	0.0100000	1.24E+00	1.62E+00	1.98E+00	2.34E+00
MCU016	7.0000000	0.4000000	0.0005000	0.1486934	0.2341219	0.4820496	2.5417103	0.1521394	0.4000000	0.8000000	0.5022487	0.0372878	9.66E-01	1.30E+00	1.63E+00	1.96E+00
MCU017	6.6782317	0.1927149	0.0000070	1.9119527	0.2516670	0.4530202	0.9127862	0.1163283	0.4000000	0.5613319	0.3199782	0.2625790	1.93E+00	2.57E+00	3.22E+00	3.86E+00
MCU018	7.0000000	0.4000000	0.0005000	7.0000000	0.0010000	0.3335000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	1.56E+00	1.99E+00	2.40E+00	2.79E+00
MCU019	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	1.5418836	0.2278454	0.0010000	0.0010000	0.0010000	2.0000000	1.5237711	6.72E-01	8.99E-01	1.13E+00	1.36E+00
MCU020	1.5000000	0.4000000	0.0000070	0.1000000	0.0010000	0.0100000	0.0300000	0.3000000	0.0010000	0.4269461	0.2960574	0.0100000	4.32E-01	5.75E-01	7.19E-01	8.62E-01
MCU021	1.5000000	0.4000000	0.0000070	0.1722834	0.0010000	0.0911751	0.0300000	0.3000000	0.0010000	0.3156710	0.0100000	0.6512065	6.88E-01	9.17E-01	1.15E+00	1.37E+00
MCU022	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	0.2635000	7.0000000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.26E-01	1.24E+00	1.56E+00	1.89E+00
MCU023	1.5000000	0.0010000	0.0005000	0.1000000	0.3000000	0.0100000	0.0300000	0.3000000	0.0010000	0.0010000	0.3732500	0.0100000	9.47E-01	1.26E+00	1.57E+00	1.88E+00
MCU024	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	7.0000000	0.2635000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.16E-01	1.23E+00	1.54E+00	1.86E+00
MCU025	1.5000000	0.3881704	0.0000070	0.1228059	0.3000000	0.7826060	0.0300000	0.3000000	0.0887274	0.0282917	0.0100000	0.0100000	9.37E-01	1.25E+00	1.56E+00	1.88E+00
MCU026	7.0000000	0.4000000	0.0005000	7.0000000	0.0010000	0.3335000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	1.56E+00	1.99E+00	2.40E+00	2.79E+00
MCU027	7.0000000	0.0010000	0.0005000	0.2939685	0.0010000	5.2712030	0.0300000	0.0010000	0.0010000	0.0010000	0.6946642	0.0100000	3.20E+00	4.36E+00	5.55E+00	6.76E+00
MCU028	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	0.0100000	6.1167415	0.0010000	0.0010000	0.0010000	0.0100000	1.1467585	9.17E-01	1.23E+00	1.55E+00	1.87E+00
MCU029	6.6763055	0.0010000	0.0000070	0.2936744	0.1670100	0.7512393	0.1747777	0.2668169	0.4000000	0.4581542	1.1310637	0.6453584	3.49E+00	4.65E+00	5.82E+00	6.98E+00
MCU030	5.9459257	0.3882860	0.0005000	0.3665167	0.0169574	1.6298472	0.1498082	0.0673472	0.2252007	0.2295337	1.4644269	0.0407119	8.81E-01	1.17E+00	1.46E+00	1.76E+00
MCU031	6.8138692	0.0010000	0.0000070	0.4631959	0.3000000	1.0338462	0.5104239	0.2857624	0.2921999	0.2134486	0.5828008	1.7525492	6.31E+00	8.42E+00	1.05E+01	1.26E+01
MCU032	7.0000000	0.4000000	0.0005000	7.0000000	0.0010000	0.0100000	0.3535000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	1.61E+00	2.06E+00	2.48E+00	2.88E+00
MCU033	6.5076994	0.1149297	0.0000070	2.5284117	0.1664161	0.1901691	0.3150263	0.2638338	0.0844592	0.0735104	0.4041950	1.9499906	2.42E+00	3.22E+00	4.02E+00	4.82E+00
MCU034	1.5000000	0.4000000	0.0000070	0.1000000	0.3000000	0.1356293	0.0300000	0.3000000	0.0010000	0.0010000	0.5096889	0.0100000	5.91E-01	7.87E-01	9.84E-01	1.18E+00
MCU035	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	7.0000000	0.2635000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.16E-01	1.23E+00	1.54E+00	1.86E+00
MCU036	3.6685352	0.0426446	0.0005000	0.2395499	0.1456558	0.5755135	0.6348056	0.0521430	0.0047709	0.0068664	0.1017838	1.8323988	3.50E+00	4.76E+00	6.03E+00	7.32E+00
MCU037	7.0000000	0.4000000	0.0005000	0.3335000	0.0010000	7.0000000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.01E-01	1.21E+00	1.51E+00	1.82E+00
MCU038	1.5000000	0.2749930	0.0000070	0.1000000	0.0010000	0.0100000	0.0300000	0.0010000	0.0010000	0.8000000	0.0100000	0.0100000	4.73E-01	6.30E-01	7.87E-01	9.44E-01
MCU039	1.5000000	0.0010000	0.0005000	0.1000000	0.3000000	0.0100000	0.2911422	0.3000000	0.0010000	0.0010000	0.0100000	0.4753578	2.07E+00	2.78E+00	3.50E+00	4.22E+00
MCU040	6.6548584	0.1643117	0.0005000	0.2795901	0.1337578	0.9747682	0.0476909	0.0982158	0.0010000	0.2672911	1.4571462	1.8337728	1.40E+00	1.87E+00	2.33E+00	2.80E+00

Table B-1 Cont'd. Waste Compositions of the First Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.0042, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU041	1.5000000	0.0010000	0.0005000	0.1000000	0.0010000	0.0100000	0.0300000	0.0010000	0.4000000	0.0010000	0.0100000	0.1375000	8.44E-01	1.12E+00	1.39E+00	1.65E+00
MCU042	1.5000000	0.4000000	0.0005000	0.1000000	0.3000000	0.0100000	0.0300000	0.0010000	0.0334045	0.4962192	0.1784240	0.0100000	5.60E-01	7.44E-01	9.28E-01	1.11E+00
MCU043	6.4727823	0.1366203	0.0005000	0.2096473	0.1253016	4.0714757	0.1442698	0.0595396	0.0685578	0.4974841	0.0100000	0.7790267	1.99E+00	2.69E+00	3.41E+00	4.13E+00
MCU044	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	0.2635000	7.0000000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.26E-01	1.24E+00	1.56E+00	1.89E+00
MCU045	1.5000000	0.4000000	0.0000070	0.5860425	0.0010000	0.1914714	0.0300000	0.3000000	0.0010000	0.0010000	0.0100000	0.7664931	1.08E+00	1.44E+00	1.80E+00	2.16E+00
MCU046	1.5000000	0.4000000	0.0000070	0.1179251	0.3000000	0.0315744	0.0300000	0.0010000	0.2418616	0.0010000	0.2744892	0.1429443	5.72E-01	7.62E-01	9.52E-01	1.14E+00
MCU047	7.0000000	0.4000000	0.0005000	0.1000000	0.0010000	0.2635000	7.0000000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.26E-01	1.24E+00	1.56E+00	1.89E+00
MCU048	1.5000000	0.0010000	0.0005000	0.1616752	0.0010000	0.0758248	0.0300000	0.0010000	0.4000000	0.0010000	0.0100000	0.0100000	1.43E+00	1.88E+00	2.33E+00	2.77E+00
MCU049	7.0000000	0.4000000	0.0005000	0.1532999	0.0010000	7.0000000	0.2102001	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.12E-01	1.22E+00	1.53E+00	1.85E+00
MCU050	1.5000000	0.4000000	0.0000070	0.1000000	0.0010000	0.1875062	0.0300000	0.3000000	0.2422751	0.0010000	0.0100000	0.5326756	6.31E-01	8.42E-01	1.05E+00	1.26E+00
MCU051	7.0000000	0.4000000	0.0005000	7.0000000	0.0010000	0.3335000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	1.56E+00	1.99E+00	2.40E+00	2.79E+00
MCU052	6.8792087	0.1612253	0.0005000	4.2837983	0.2113179	0.2633653	0.0748798	0.0010000	0.0135422	0.5725097	0.3617650	0.2973968	3.64E+00	4.60E+00	5.49E+00	6.34E+00
MCU053	7.0000000	0.4000000	0.0005000	0.2351321	0.0010000	7.0000000	0.1283679	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.06E-01	1.21E+00	1.52E+00	1.84E+00
MCU054	6.8779098	0.4000000	0.0005000	5.9427510	0.0010000	0.0100000	0.0300000	0.0010000	0.0010000	0.0010000	0.0100000	1.2686587	2.05E+00	2.59E+00	3.10E+00	3.59E+00
MCU055	1.5000000	0.4000000	0.0005000	0.1000000	0.3000000	0.2382516	0.5022411	0.0010000	0.0010000	0.3630037	0.0100000	0.0100000	9.10E-01	1.22E+00	1.53E+00	1.84E+00
MCU056	1.5000000	0.4000000	0.0005000	0.1000000	0.3000000	0.0100000	0.6116860	0.0010000	0.0010000	0.0010000	0.0100000	0.8528140	8.75E-01	1.17E+00	1.47E+00	1.76E+00
MCU057	7.0000000	0.4000000	0.0005000	0.3535000	0.0010000	0.0100000	7.0000000	0.0010000	0.0010000	0.0010000	0.0100000	0.0100000	9.83E-01	1.31E+00	1.65E+00	1.98E+00
MCU058	6.1873525	0.0633400	0.0001200	1.0703125	0.2813125	0.7745313	0.0300000	0.2614570	0.2363477	0.6064922	0.7562500	0.3986719	2.94E+00	3.87E+00	4.79E+00	5.70E+00
MCU059	5.0696101	0.2581700	0.0001700	1.2472377	0.0815721	1.9574178	1.0509762	0.0360550	0.0527580	0.1651714	0.0780416	0.3099911	1.89E+00	2.49E+00	3.08E+00	3.67E+00
MCU060	4.2914523	0.0914000	0.0004200	1.9740242	0.0934471	1.1239723	0.1828375	0.0024199	0.0867220	0.1836515	0.1417871	0.0955280	4.41E+00	5.64E+00	6.83E+00	7.98E+00
MCU061	2.5874164	0.2659600	0.0003200	0.4359857	0.0024781	0.5151830	0.2351505	0.0151923	0.1459657	0.1077610	0.2374771	0.5213335	1.54E+00	2.02E+00	2.51E+00	2.99E+00
MCU062	4.3064890	0.0960700	0.0000100	1.6278623	0.1567981	0.4318231	0.8388587	0.0248283	0.0118194	0.4883477	0.0400259	0.2301930	3.36E+00	4.48E+00	5.60E+00	6.72E+00
MCU063	3.8392366	0.2909000	0.0000900	1.8554431	0.0359723	0.4294004	0.7805610	0.0891407	0.0789323	0.0157391	0.0657218	0.5399904	1.85E+00	2.42E+00	2.98E+00	3.54E+00
MCU064	4.4381275	0.0010000	0.0003800	0.2079449	0.0363290	1.5796320	0.3449620	0.1383308	0.0093921	0.0017759	0.9509638	0.1986532	3.95E+00	5.38E+00	6.82E+00	8.28E+00
MCU065	2.4325063	0.3345400	0.0003700	0.4766009	0.0711748	0.0169377	0.9758419	0.0156709	0.3068028	0.1111979	0.0149812	0.0384233	1.47E+00	1.95E+00	2.41E+00	2.87E+00
MCU066	2.2660158	0.3158400	0.0002400	1.2266339	0.1375416	0.1964801	0.3940259	0.0762691	0.0011488	0.0263011	0.1354979	0.2241009	2.04E+00	2.64E+00	3.22E+00	3.78E+00
MCU067	2.7734488	0.1366000	0.0004900	0.4320618	0.0147090	0.3103238	0.6335972	0.2814406	0.1378450	0.1074158	0.1497558	0.3105281	2.54E+00	3.36E+00	4.18E+00	4.99E+00
MCU068	5.9727448	0.2145300	0.0004000	4.2563083	0.1057423	0.2091202	0.1636297	0.0055292	0.0099683	0.2401795	0.2824594	0.3721624	3.09E+00	3.90E+00	4.67E+00	5.41E+00
MCU069	5.7439649	0.1085400	0.0000800	2.2058448	0.0467566	0.1848968	2.1106499	0.0726270	0.0357007	0.5419836	0.0125545	0.0156313	3.89E+00	5.12E+00	6.34E+00	7.55E+00
MCU070	5.9481826	0.3002500	0.0004800	1.7769028	0.0878246	0.5456275	2.5835442	0.0777207	0.0286822	0.4453879	0.0829617	0.0345467	2.30E+00	2.97E+00	3.62E+00	4.24E+00
MCU071	5.3146006	0.3672700	0.0001800	0.2889906	0.0307062	2.2500038	0.0486692	0.1135577	0.0170689	0.2993721	0.9655541	0.3690639	9.85E-01	1.31E+00	1.64E+00	1.97E+00
MCU072	6.9799794	0.0399600	0.0003800	0.3446135	0.0620046	2.0331261	2.7351444	0.0045816	0.1599431	0.0649317	0.1844607	0.8622353	5.94E+00	8.21E+00	1.05E+01	1.29E+01
MCU073	2.8320658	0.2612900	0.0004600	0.3883446	0.0361794	0.5378503	1.0678773	0.1562344	0.0242002	0.0832035	0.0844228	0.4994765	1.70E+00	2.26E+00	2.82E+00	3.37E+00
MCU074	6.6461921	0.1553000	0.0002200	0.2875052	0.0510661	2.0722139	1.6643559	0.1052369	0.1008807	0.4313217	0.3780817	0.6998850	2.33E+00	3.13E+00	3.94E+00	4.76E+00
MCU075	3.1017028	0.3329800	0.0000200	0.7114751	0.0111533	0.1416160	0.9353885	0.0159260	0.2725178	0.0862816	0.1850140	0.2589996	1.30E+00	1.73E+00	2.16E+00	2.59E+00
MCU076	5.5728189	0.1568600	0.0000700	0.3038586	0.0799692	2.6304955	0.6829990	0.0580696	0.1046777	0.1648169	0.4181867	0.4943168	2.17E+00	2.90E+00	3.63E+00	4.37E+00
MCU077	6.7038412	0.3703900	0.0004700	1.4353235	0.0641897	2.0713628	1.8763626	0.0613535	0.0926871	0.2050824	0.3262014	0.2254804	1.46E+00	1.92E+00	2.36E+00	2.79E+00
MCU078	6.1110819	0.1194500	0.0000600	4.0736645	0.0726061	0.4733272	0.4034393	0.0248588	0.1298795	0.2092438	0.1793886	0.0157929	2.48E+00	3.25E+00	4.00E+00	4.75E+00
MCU079	4.2711023	0.1584200	0.0000100	0.1220175	0.0625537	0.4408761	1.7850418	0.1307730	0.1646288	0.1925101	0.2868569	0.4356500	2.44E+00	3.26E+00	4.09E+00	4.92E+00
MCU080	2.8896398	0.2379100	0.0001100	0.1103853	0.0223910	0.5445308	0.0866650	0.0069281	0.0110472	0.0740893	0.3907985	1.3938425	1.03E+00	1.37E+00	1.72E+00	2.06E+00

Table B-1 Cont'd. Waste Compositions of the First Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.0042, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU081	5.3456125	0.0025600	0.0003100	1.2981783	0.1710787	0.0633291	2.1805504	0.0549763	0.1500703	0.0445980	0.0963730	0.8482168	1.45E+01	1.96E+01	2.47E+01	2.98E+01
MCU082	6.5227010	0.3189500	0.0003000	1.1441404	0.0098954	1.7785235	1.2502954	0.0169749	0.0264967	0.4597295	0.1490167	1.3451390	1.59E+00	2.09E+00	2.58E+00	3.07E+00
MCU083	4.9052064	0.3283000	0.0001400	0.8423289	0.0025851	1.2103695	0.8825956	0.0142529	0.0572132	0.0334594	0.2047040	1.6335479	1.41E+00	1.87E+00	2.32E+00	2.78E+00
MCU084	6.8549927	0.1256900	0.0002700	0.9864536	0.1672741	2.0207566	1.7222196	0.0220073	0.0728852	0.0085031	0.3557032	1.1151732	2.77E+00	3.68E+00	4.59E+00	5.49E+00
MCU085	5.0315742	0.3205100	0.0000800	0.6081945	0.2680101	0.2269789	1.8771527	0.0984049	0.0012287	0.1976563	0.2915901	1.2912443	1.33E+00	1.78E+00	2.22E+00	2.66E+00
MCU086	5.3251194	0.1911500	0.0003900	1.4506517	0.0624844	0.6701249	1.3376975	0.1540908	0.2419459	0.0110459	0.0213471	1.0509863	2.97E+00	3.85E+00	4.70E+00	5.54E+00
MCU087	6.0764547	0.2675200	0.0001800	0.2106077	0.1009042	0.0257474	2.4895349	0.0020408	0.2549478	0.2635651	0.5174835	1.1883792	1.42E+00	1.90E+00	2.38E+00	2.86E+00
MCU088	3.0915354	0.2347900	0.0000100	0.5661503	0.0015976	0.8671678	0.8765416	0.0891450	0.0556862	0.0165453	0.0691851	0.5872140	1.77E+00	2.37E+00	2.96E+00	3.56E+00
MCU089	4.2492473	0.0056800	0.0002700	0.4209249	0.1894743	1.5797180	0.1496097	0.0925309	0.0089904	0.1379311	0.7313134	0.0574793	3.72E+00	4.99E+00	6.27E+00	7.54E+00
MCU090	5.5253802	0.1927100	0.0000300	0.8478740	0.1098500	0.3624711	0.9285772	0.0076846	0.0425244	0.4874320	0.6894795	0.9802671	1.89E+00	2.52E+00	3.15E+00	3.78E+00
MCU091	4.3001094	0.2877800	0.0003800	0.6058465	0.0023411	0.9388775	0.4213224	0.1177276	0.1065072	0.1273019	0.9094741	0.1090805	1.44E+00	1.90E+00	2.35E+00	2.80E+00
MCU092	4.7430585	0.0493200	0.0003400	1.9625510	0.0732747	1.7306055	0.1718009	0.0078048	0.2030643	0.0039312	0.0833199	0.0629863	4.72E+00	6.10E+00	7.43E+00	8.73E+00
MCU093	6.2750798	0.2971300	0.0000900	2.1531796	0.0453074	1.0015931	2.2571275	0.0863341	0.0504848	0.0985059	0.0676651	0.5449618	1.60E+00	2.11E+00	2.61E+00	3.10E+00
MCU094	5.8439439	0.0789300	0.0004800	2.3136625	0.0508702	0.4704668	2.1476306	0.0155847	0.0435243	0.0342524	0.1734068	0.3792478	5.74E+00	7.40E+00	9.01E+00	1.06E+01
MCU095	4.3040832	0.1708900	0.0000800	0.1698723	0.1849608	0.5758309	0.6889816	0.1163003	0.2645055	0.1600054	0.4574221	0.7107357	1.85E+00	2.47E+00	3.10E+00	3.72E+00
MCU096	6.9278246	0.2862200	0.0001900	0.6339865	0.0049994	0.4669563	2.4877031	0.0135992	0.0061304	0.1465422	1.6128338	0.0698470	1.14E+00	1.52E+00	1.89E+00	2.27E+00
MCU097	4.3157384	0.0617900	0.0002900	0.6673319	0.1253102	0.2128915	0.5730550	0.0463588	0.3127502	0.1116456	0.6583215	0.2746864	3.45E+00	4.56E+00	5.66E+00	6.75E+00
MCU098	3.3253291	0.2534900	0.0003600	0.6570837	0.0125188	0.7486775	0.6538967	0.0039376	0.0610680	0.4796477	0.0459454	0.2686747	1.98E+00	2.60E+00	3.22E+00	3.83E+00
MCU099	3.9026405	0.3548000	0.0001800	1.2424438	0.0034611	0.3387478	1.8080452	0.0668434	0.0251121	0.0376876	0.3118205	0.0237265	1.52E+00	2.00E+00	2.46E+00	2.92E+00
MCU100	4.1641985	0.1521800	0.0004300	0.7805652	0.1333141	0.8856293	1.3565760	0.1020675	0.0603196	0.0813256	0.3062621	0.1025222	2.79E+00	3.68E+00	4.57E+00	5.45E+00
MCU101	6.9769560	0.2566100	0.0004400	1.5725078	0.0220507	0.1538353	2.5381419	0.0141564	0.0293303	0.3040789	1.0933296	0.0505060	1.89E+00	2.46E+00	3.01E+00	3.55E+00
MCU102	4.8409366	0.2192000	0.0001600	1.7679881	0.0835299	0.2208902	0.6781184	0.0896109	0.0866556	0.0385923	0.7015773	0.4798532	2.18E+00	2.83E+00	3.47E+00	4.10E+00
MCU103	6.6983485	0.2768700	0.0002800	4.1502598	0.2502098	0.0434187	0.9373090	0.0352460	0.0039246	0.0916660	0.6446511	0.0746473	2.08E+00	2.66E+00	3.22E+00	3.75E+00
MCU104	6.2369107	0.0119100	0.0002800	2.7649894	0.0306183	0.2949192	1.9266096	0.1468404	0.0010969	0.0261998	0.2568278	0.5157779	1.01E+01	1.31E+01	1.61E+01	1.91E+01
MCU105	3.3480458	0.3142800	0.0004200	0.2347221	0.0113573	0.0635231	1.4948740	0.0497508	0.0641096	0.0554177	0.7422305	0.0208936	1.16E+00	1.55E+00	1.95E+00	2.34E+00
MCU106	5.7904845	0.1615400	0.0004500	0.2532223	0.2323608	3.7650964	0.1707798	0.0522787	0.0896054	0.0119577	0.5391653	0.1076741	1.72E+00	2.32E+00	2.92E+00	3.53E+00
MCU107	5.0134607	0.0181400	0.0002000	0.1543283	0.0809053	0.2800471	3.3357296	0.0467169	0.0316118	0.2388964	0.2488048	0.0638355	1.25E+01	1.72E+01	2.20E+01	2.69E+01
MCU108	5.9073472	0.2332300	0.0001100	1.5167262	0.0202123	0.3322013	1.8728912	0.1191434	0.2668853	0.1305508	0.5444336	0.1288882	1.87E+00	2.47E+00	3.06E+00	3.65E+00
MCU109	6.8635865	0.1537400	0.0004800	0.3514099	0.0348135	2.4335204	3.2960167	0.0041574	0.0540166	0.0450959	0.2542181	0.1372108	2.26E+00	3.06E+00	3.87E+00	4.70E+00
MCU110	6.4535070	0.3641500	0.0001500	0.2353806	0.1262579	3.8258940	0.4225603	0.0039530	0.1553104	0.1044454	0.5952366	0.3384662	1.03E+00	1.37E+00	1.72E+00	2.06E+00
MCU111	3.7543558	0.0898400	0.0004800	0.2889400	0.0025565	0.2118867	0.2977884	0.0304983	0.0066876	0.2118472	0.8031111	0.9630266	1.94E+00	2.58E+00	3.22E+00	3.85E+00
MCU112	5.0914828	0.1755600	0.0002600	0.7445529	0.0116040	0.3820204	1.7620419	0.0170710	0.2103377	0.1884583	0.5008089	0.3404650	2.32E+00	3.08E+00	3.83E+00	4.58E+00
MCU113	6.7397445	0.3657100	0.0002700	1.6930821	0.0308723	0.8915370	0.7102731	0.0062777	0.0193252	0.1144189	1.3422168	0.8024353	1.30E+00	1.69E+00	2.08E+00	2.45E+00
MCU114	5.9353665	0.0602300	0.0001000	1.0889124	0.0120659	0.0327013	0.3026632	0.1516949	0.0644776	0.4737824	1.0726636	1.1213339	3.29E+00	4.33E+00	5.36E+00	6.38E+00
MCU115	6.5084192	0.2550500	0.0000500	3.5352740	0.1632143	1.1699932	0.7996223	0.0143523	0.0212803	0.2505514	0.2117554	0.0926089	1.52E+00	2.00E+00	2.48E+00	2.95E+00
MCU116	2.9984925	0.0758100	0.0004300	0.6719932	0.0262049	0.0381781	0.3882507	0.2373436	0.0367119	0.0577190	0.5292095	0.4287692	3.34E+00	4.35E+00	5.34E+00	6.31E+00
MCU117	5.8465294	0.3625900	0.0003200	2.5423965	0.2484312	0.1691390	0.7890422	0.0270855	0.0793950	0.1478007	0.5380116	0.8235355	1.94E+00	2.48E+00	3.00E+00	3.51E+00
MCU118	5.7160911	0.0477600	0.0002200	3.9999758	0.0250653	0.4120852	0.3301445	0.0583434	0.0157281	0.2110496	0.0411070	0.3869593	4.64E+00	5.93E+00	7.16E+00	8.37E+00
MCU119	5.8915553	0.3485700	0.0001000	0.7806906	0.0060603	2.7012055	0.2384175	0.0805618	0.1039581	0.0529384	0.4099497	1.1956389	1.18E+00	1.57E+00	1.96E+00	2.34E+00
MCU120	5.2641498	0.2005000	0.0002500	0.5714896	0.1218029	2.0332571	0.7253843	0.0466464	0.1467987	0.3869626	0.1840409	0.3839163	1.99E+00	2.66E+00	3.32E+00	3.99E+00

Table B-1 Cont'd. Waste Compositions of the First Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.0042, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU121	3.3232346	0.3937700	0.0003300	0.1862843	0.0026069	0.7701468	0.9719002	0.0121971	0.0295645	0.2007909	0.4444913	0.3949414	1.02E+00	1.36E+00	1.70E+00	2.05E+00
MCU122	6.3100078	0.1864700	0.0001100	0.2634367	0.0162353	0.7797873	1.6221864	0.1901158	0.0867024	0.2550814	0.7583906	1.3377752	1.92E+00	2.56E+00	3.22E+00	3.87E+00
MCU123	6.9014598	0.2924600	0.0004300	1.0541623	0.1013637	0.9692574	0.3629918	0.0410658	0.3355543	0.0984747	1.2590541	0.9437886	1.49E+00	1.95E+00	2.40E+00	2.84E+00
MCU124	5.3951582	0.3438900	0.0001400	0.9487267	0.0885076	1.6471973	0.1056341	0.0621451	0.1410098	0.0492046	1.1522167	0.0611052	1.14E+00	1.50E+00	1.87E+00	2.23E+00
MCU125	6.2291734	0.2285500	0.0002000	0.4324784	0.1303594	0.0993780	1.2075869	0.1813932	0.2701733	0.4819078	0.5466251	1.5391416	1.69E+00	2.25E+00	2.81E+00	3.38E+00
MCU126	6.2498929	0.0134700	0.0000900	2.7696006	0.1390760	0.8741732	0.4915171	0.0774739	0.0442721	0.0199901	0.4648544	0.8091069	5.11E+00	6.69E+00	8.25E+00	9.79E+00
MCU127	6.8424353	0.0290500	0.0004600	0.2497109	0.0045006	0.7293409	2.6544143	0.0122324	0.0913431	0.4017741	0.8553548	0.4334590	6.86E+00	9.63E+00	1.25E+01	1.54E+01
MCU128	2.9934164	0.2815500	0.0004500	0.3133467	0.0608223	1.4293650	0.4228632	0.1929163	0.1118560	0.0342843	0.1758548	0.1002568	1.46E+00	1.95E+00	2.44E+00	2.92E+00
MCU129	3.5779458	0.1319200	0.0003500	0.7587202	0.0331960	0.3433646	0.4815669	0.0079820	0.0736150	0.2342293	0.2577456	0.8805911	2.87E+00	3.75E+00	4.62E+00	5.47E+00
MCU130	5.5962137	0.3563600	0.0001500	0.1766234	0.1345024	0.4933927	2.4493534	0.1035824	0.0815614	0.0587058	0.8298796	0.5734147	1.04E+00	1.39E+00	1.74E+00	2.09E+00
MCU131	3.4366973	0.1210100	0.0001700	0.3415967	0.0738724	1.9356765	0.0312790	0.0569353	0.0511555	0.3193077	0.1405700	0.0452957	2.23E+00	2.98E+00	3.74E+00	4.49E+00
MCU132	5.5545339	0.0820500	0.0002100	3.0942757	0.1835552	0.1972200	1.1743799	0.0069446	0.0271842	0.0307918	0.0991734	0.6389353	4.62E+00	5.93E+00	7.21E+00	8.46E+00
MCU133	5.7067300	0.2753100	0.0002400	0.6564156	0.0656922	1.6275780	0.2218806	0.0457665	0.1975131	0.0774829	0.9323175	0.7528072	1.34E+00	1.78E+00	2.21E+00	2.64E+00
MCU134	4.7717397	0.3080400	0.0002700	0.7147832	0.1003644	1.5878016	0.1362862	0.0236520	0.1444803	0.0631825	0.6552830	0.6467903	1.38E+00	1.82E+00	2.25E+00	2.68E+00
MCU135	2.1463448	0.2223200	0.0004700	0.1414282	0.0367498	0.4703658	0.3405975	0.0081811	0.2647227	0.0925216	0.1144339	0.1637331	1.31E+00	1.75E+00	2.20E+00	2.64E+00
MCU136	4.9447722	0.1334800	0.0003300	1.0173636	0.0026372	1.7209324	0.6181847	0.0998640	0.0175814	0.2460948	0.3486729	0.3773207	2.91E+00	3.82E+00	4.73E+00	5.62E+00
MCU137	4.1926800	0.2160900	0.0004900	0.4554639	0.0931265	0.3140862	0.5535564	0.0776554	0.0404576	0.0724543	1.3068333	0.0354238	1.51E+00	2.00E+00	2.48E+00	2.97E+00
MCU138	3.5277394	0.0041200	0.0002100	0.3940690	0.0975404	0.8537194	0.9898954	0.0288671	0.2056792	0.2311647	0.0338757	0.0208596	7.05E+00	9.52E+00	1.20E+01	1.45E+01
MCU139	4.8950534	0.0991900	0.0003600	3.1672571	0.1260039	0.6798903	0.0699657	0.0384568	0.1054345	0.0078859	0.0630317	0.4548911	4.34E+00	5.50E+00	6.61E+00	7.67E+00
MCU140	6.8878691	0.3781800	0.0002400	3.7140396	0.0298354	0.6033266	0.6175762	0.0223156	0.0738822	0.0935785	0.9097504	0.0508916	1.48E+00	1.91E+00	2.32E+00	2.72E+00
MCU141	6.5615111	0.1132200	0.0001300	2.9739858	0.0958349	0.7140666	1.2789149	0.0888841	0.1191650	0.3186515	0.1952560	0.1378645	3.36E+00	4.37E+00	5.36E+00	6.34E+00
MCU142	6.8795162	0.0711400	0.0002700	1.4356133	0.0933441	0.3316650	1.7161185	0.0629767	0.2667968	0.2179345	0.9442591	0.1864313	4.33E+00	5.71E+00	7.09E+00	8.46E+00
MCU143	6.5240806	0.3844100	0.0004000	0.1808594	0.2661289	0.0373047	0.8740234	0.2486094	0.2862227	0.2943828	1.6968359	0.4608594	7.94E-01	1.06E+00	1.33E+00	1.60E+00
MCU144	2.9800038	0.1038700	0.0004200	0.1584400	0.0389936	0.5278092	0.1420298	0.0101201	0.1011673	0.3721757	0.2939906	0.5710665	1.56E+00	2.09E+00	2.62E+00	3.15E+00
MCU145	5.5805097	0.3220700	0.0000300	0.8372851	0.1403968	1.3391320	0.3285777	0.0602681	0.0693098	0.4856005	0.9360102	0.1457993	1.17E+00	1.56E+00	1.94E+00	2.33E+00
MCU146	4.5284555	0.0649000	0.0001300	1.2970516	0.1128819	2.5825840	0.1694625	0.0012698	0.0245274	0.0306754	0.0645353	0.1662323	3.52E+00	4.64E+00	5.76E+00	6.87E+00
MCU147	6.5933156	0.1147800	0.0003200	0.9338948	0.1167705	2.7474852	0.5934117	0.0772214	0.0295093	0.5574683	0.2617848	0.5125977	2.79E+00	3.71E+00	4.62E+00	5.53E+00
MCU148	6.8439074	0.1818000	0.0003500	0.6290481	0.0264492	1.8083199	2.1708377	0.1330547	0.1359731	0.0699566	0.3714931	0.9675291	2.08E+00	2.78E+00	3.48E+00	4.18E+00
MCU149	6.8562237	0.3579200	0.0003000	4.1451318	0.0341159	0.0849410	1.7636578	0.0073822	0.0269232	0.1892800	0.0940116	0.5318622	1.91E+00	2.44E+00	2.95E+00	3.43E+00
MCU150	5.6345836	0.0243800	0.0003600	1.5216821	0.1135120	0.2414824	1.6731901	0.0982445	0.1760374	0.1859327	0.5423689	0.0264971	7.96E+00	1.05E+01	1.31E+01	1.56E+01
MCU151	5.2647219	0.1677700	0.0004000	1.4979698	0.0367685	0.2342874	1.4821600	0.0825299	0.0376395	0.2264792	0.1586518	1.2159956	3.36E+00	4.35E+00	5.30E+00	6.23E+00
MCU152	4.4557121	0.2706400	0.0004700	0.2832007	0.0579961	1.3980540	0.8342905	0.1365994	0.0609202	0.0841055	0.2074684	1.2507730	1.47E+00	1.97E+00	2.47E+00	2.98E+00
MCU153	4.2600427	0.0368500	0.0003600	0.5972904	0.1043556	1.0077468	0.2742532	0.0433254	0.1781759	0.2497152	0.2563591	0.7236050	3.77E+00	5.01E+00	6.24E+00	7.46E+00
MCU154	5.2927872	0.3735000	0.0001700	0.4411877	0.0370247	0.4939106	0.6338292	0.2317452	0.0621768	0.5069983	0.9144707	0.7992913	1.06E+00	1.41E+00	1.76E+00	2.11E+00
MCU155	4.8715378	0.1163400	0.0000500	0.8090418	0.0016107	0.6801991	1.7871772	0.0807924	0.0784012	0.0578719	0.0461904	1.1857786	3.34E+00	4.46E+00	5.58E+00	6.70E+00
MCU156	6.7144467	0.3813000	0.0003900	2.8761719	0.2462734	1.0748828	0.4928516	0.2007227	0.2379063	0.1632969	0.0177734	1.1293750	2.00E+00	2.56E+00	3.09E+00	3.60E+00
MCU157	4.3223290	0.0539900	0.0003900	1.0986203	0.0268848	0.3448207	0.8953474	0.0512116	0.0493427	0.1434900	0.3937235	0.7373691	5.06E+00	6.63E+00	8.17E+00	9.69E+00
MCU158	5.6565003	0.3111600	0.0000300	0.4263720	0.0276867	1.7653709	0.4909880	0.0809596	0.2627913	0.4113766	0.6523967	0.2603927	1.24E+00	1.66E+00	2.07E+00	2.49E+00
MCU159	6.5302203	0.0882800	0.0000700	0.5042969	0.0944375	2.0032422	0.6562109	0.0161836	0.0025586	0.3162305	0.8184375	1.0671875	2.87E+00	3.83E+00	4.80E+00	5.77E+00
MCU160	6.6971119	0.2036200	0.0002800	2.5692186	0.0113137	3.6459145	0.0370689	0.0122810	0.0177002	0.0347602	0.2186002	0.0653938	1.95E+00	2.53E+00	3.10E+00	3.65E+00

Table B-1 Cont'd. Waste Compositions of the First Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.0042, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU161	5.8914106	0.2254400	0.0002500	0.5810230	0.0147448	1.1481678	3.2206098	0.0847865	0.0652502	0.2132244	0.1819077	0.0817540	1.92E+00	2.56E+00	3.20E+00	3.84E+00
MCU162	3.4622237	0.2316700	0.0003700	0.1987702	0.0319981	1.4114456	0.4695363	0.0466789	0.3259494	0.0605374	0.1743442	0.0882232	1.54E+00	2.06E+00	2.59E+00	3.12E+00
MCU163	5.4435781	0.1412700	0.0003400	1.1531726	0.2088918	1.7994117	0.2133575	0.1493329	0.0042227	0.6241197	0.1256049	0.5489044	2.88E+00	3.77E+00	4.63E+00	5.48E+00
MCU164	6.3829828	0.3407700	0.0004100	0.3183913	0.1023002	3.7458757	1.9810741	0.0166215	0.0145620	0.0041148	0.1668705	0.1742432	1.19E+00	1.59E+00	2.00E+00	2.41E+00
MCU165	4.4558439	0.1459500	0.0004500	0.5982472	0.0699026	1.6056651	1.4110308	0.1148109	0.1434950	0.1214065	0.0176668	0.0939556	2.79E+00	3.72E+00	4.66E+00	5.60E+00
MCU166	5.4780401	0.3251900	0.0000800	1.1341312	0.1398422	1.2581185	1.8206371	0.0101890	0.0112109	0.2073983	0.4695265	0.0529097	1.34E+00	1.77E+00	2.21E+00	2.65E+00
MCU167	6.0174927	0.0384100	0.0001900	0.5716708	0.0108135	1.1979447	2.6784283	0.1655213	0.0255779	0.0928159	0.2721661	0.6250163	7.16E+00	9.71E+00	1.23E+01	1.49E+01
MCU168	6.3913615	0.3532400	0.0002800	2.2619684	0.1979902	1.8742186	0.7926329	0.0678405	0.2128719	0.2699094	0.1731973	0.0254017	1.65E+00	2.14E+00	2.62E+00	3.08E+00
MCU169	5.1735198	0.1225700	0.0002600	0.3217781	0.0153105	1.8952202	0.4458042	0.0560731	0.0801455	0.5819469	0.2966081	0.5646170	2.44E+00	3.27E+00	4.11E+00	4.95E+00
MCU170	6.1743960	0.2986900	0.0004600	2.8556128	0.0470942	1.3731325	1.0893073	0.1455256	0.0128516	0.1877393	0.2668698	0.0151006	2.42E+00	3.09E+00	3.73E+00	4.34E+00
MCU171	5.9469075	0.0524300	0.0004100	1.3762545	0.1362298	1.0599028	1.7263061	0.0113535	0.2299165	0.1937978	0.2063685	0.1996185	5.69E+00	7.53E+00	9.36E+00	1.12E+01
MCU172	5.9219176	0.3688300	0.0001300	3.5333484	0.0305870	0.4535157	0.3011564	0.1830744	0.0580175	0.1938286	0.3540894	0.5193074	1.57E+00	2.04E+00	2.49E+00	2.93E+00
MCU173	5.5746764	0.3594800	0.0002200	3.2835052	0.0541642	0.7702500	0.4266800	0.2400340	0.1375559	0.0750332	0.0328332	0.5313425	1.97E+00	2.53E+00	3.06E+00	3.58E+00
MCU174	5.5410968	0.1599800	0.0001000	4.3544445	0.0100797	0.1919695	0.0753259	0.0019025	0.1363573	0.0061114	0.2150223	0.2161153	2.29E+00	2.96E+00	3.62E+00	4.27E+00
MCU175	3.4242529	0.2067300	0.0004900	0.8574053	0.0884315	0.4450485	1.5698254	0.1218091	0.0857790	0.1176940	0.0144697	0.0272888	2.65E+00	3.46E+00	4.26E+00	5.05E+00
MCU176	6.3844950	0.0103500	0.0000400	0.3661018	0.0604165	1.7689894	2.4710315	0.0247209	0.3419463	0.0266191	0.2530705	0.1184071	1.27E+01	1.70E+01	2.14E+01	2.59E+01
MCU177	6.6396056	0.2893400	0.0003200	0.6390625	0.2182422	3.0681250	0.1661328	0.2894883	0.2581680	0.2694141	0.4608594	0.3131641	1.34E+00	1.79E+00	2.23E+00	2.67E+00
MCU178	5.6853841	0.1646500	0.0003800	1.3667969	0.0722461	0.6107031	0.1933594	0.0815898	0.0633438	0.6189766	0.6785156	0.7407031	2.91E+00	3.75E+00	4.55E+00	5.34E+00
MCU179	4.2809817	0.2503800	0.0001400	0.3917391	0.1687285	1.1080523	1.0326305	0.0909399	0.0563385	0.3105040	0.1926539	0.5640800	1.67E+00	2.23E+00	2.79E+00	3.36E+00
MCU180	6.1662669	0.0976300	0.0002100	0.9303486	0.0016296	3.2631728	0.2325702	0.0069751	0.0643225	0.0423049	0.6452148	0.2614036	2.53E+00	3.36E+00	4.19E+00	5.01E+00

Table B- 2. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order

Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU081	2.98E+01		MCU081	2.47E+01		MCU081	1.96E+01		MCU081	1.45E+01
MCU107	2.69E+01		MCU107	2.20E+01		MCU107	1.72E+01		MCU176	1.27E+01
MCU176	2.59E+01		MCU176	2.14E+01		MCU176	1.70E+01		MCU107	1.25E+01
MCU104	1.91E+01		MCU104	1.61E+01		MCU104	1.31E+01		MCU104	1.01E+01
MCU150	1.56E+01		MCU150	1.31E+01		MCU150	1.05E+01		MCU150	7.96E+00
MCU127	1.54E+01		MCU127	1.25E+01		MCU167	9.71E+00		MCU167	7.16E+00
MCU167	1.49E+01		MCU167	1.23E+01		MCU127	9.63E+00		MCU138	7.05E+00
MCU138	1.45E+01		MCU138	1.20E+01		MCU138	9.52E+00		MCU127	6.86E+00
MCU072	1.29E+01		MCU072	1.05E+01		MCU031	8.42E+00		MCU031	6.31E+00
MCU031	1.26E+01		MCU031	1.05E+01		MCU072	8.21E+00		MCU072	5.94E+00
MCU171	1.12E+01		MCU171	9.36E+00		MCU171	7.53E+00		MCU094	5.74E+00
MCU094	1.06E+01		MCU094	9.01E+00		MCU094	7.40E+00		MCU171	5.69E+00
MCU126	9.79E+00		MCU126	8.25E+00		MCU126	6.69E+00		MCU126	5.11E+00
MCU157	9.69E+00		MCU157	8.17E+00		MCU157	6.63E+00		MCU157	5.06E+00
MCU092	8.73E+00		MCU092	7.43E+00		MCU092	6.10E+00		MCU092	4.72E+00
MCU132	8.46E+00		MCU132	7.21E+00		MCU132	5.93E+00		MCU118	4.64E+00
MCU142	8.46E+00		MCU118	7.16E+00		MCU118	5.93E+00		MCU132	4.62E+00
MCU118	8.37E+00		MCU142	7.09E+00		MCU142	5.71E+00		MCU060	4.41E+00
MCU064	8.28E+00		MCU060	6.83E+00		MCU060	5.64E+00		MCU139	4.34E+00
MCU060	7.98E+00		MCU064	6.82E+00		MCU139	5.50E+00		MCU142	4.33E+00
MCU139	7.67E+00		MCU139	6.61E+00		MCU064	5.38E+00		MCU064	3.95E+00
MCU069	7.55E+00		MCU069	6.34E+00		MCU069	5.12E+00		MCU069	3.89E+00
MCU089	7.54E+00		MCU089	6.27E+00		MCU153	5.01E+00		MCU153	3.77E+00
MCU153	7.46E+00		MCU153	6.24E+00		MCU089	4.99E+00		MCU089	3.72E+00
MCU036	7.32E+00		MCU036	6.03E+00		MCU036	4.76E+00		MCU052	3.64E+00
MCU029	6.98E+00		MCU029	5.82E+00		MCU029	4.65E+00		MCU146	3.52E+00
MCU146	6.87E+00		MCU146	5.76E+00		MCU146	4.64E+00		MCU036	3.50E+00
MCU027	6.76E+00		MCU097	5.66E+00		MCU052	4.60E+00		MCU029	3.49E+00
MCU097	6.75E+00		MCU062	5.60E+00		MCU097	4.56E+00		MCU097	3.45E+00
MCU062	6.72E+00		MCU155	5.58E+00		MCU062	4.48E+00		MCU151	3.36E+00

Table B-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU155	6.70E+00		MCU027	5.55E+00		MCU155	4.46E+00		MCU062	3.36E+00
MCU114	6.38E+00		MCU052	5.49E+00		MCU141	4.37E+00		MCU141	3.36E+00
MCU141	6.34E+00		MCU141	5.36E+00		MCU027	4.36E+00		MCU155	3.34E+00
MCU052	6.34E+00		MCU114	5.36E+00		MCU116	4.35E+00		MCU116	3.34E+00
MCU116	6.31E+00		MCU116	5.34E+00		MCU151	4.35E+00		MCU114	3.29E+00
MCU151	6.23E+00		MCU151	5.30E+00		MCU114	4.33E+00		MCU027	3.20E+00
MCU007	6.02E+00		MCU007	4.96E+00		MCU007	3.91E+00		MCU068	3.09E+00
MCU159	5.77E+00		MCU159	4.80E+00		MCU068	3.90E+00		MCU086	2.97E+00
MCU058	5.70E+00		MCU058	4.79E+00		MCU058	3.87E+00		MCU058	2.94E+00
MCU136	5.62E+00		MCU136	4.73E+00		MCU086	3.85E+00		MCU136	2.91E+00
MCU165	5.60E+00		MCU086	4.70E+00		MCU159	3.83E+00		MCU178	2.91E+00
MCU086	5.54E+00		MCU068	4.67E+00		MCU136	3.82E+00		MCU163	2.88E+00
MCU147	5.53E+00		MCU165	4.66E+00		MCU163	3.77E+00		MCU007	2.88E+00
MCU084	5.49E+00		MCU163	4.63E+00		MCU129	3.75E+00		MCU129	2.87E+00
MCU163	5.48E+00		MCU129	4.62E+00		MCU178	3.75E+00		MCU159	2.87E+00
MCU129	5.47E+00		MCU147	4.62E+00		MCU165	3.72E+00		MCU147	2.79E+00
MCU100	5.45E+00		MCU084	4.59E+00		MCU147	3.71E+00		MCU165	2.79E+00
MCU068	5.41E+00		MCU100	4.57E+00		MCU100	3.68E+00		MCU100	2.79E+00
MCU178	5.34E+00		MCU178	4.55E+00		MCU084	3.68E+00		MCU084	2.77E+00
MCU175	5.05E+00		MCU175	4.26E+00		MCU175	3.46E+00		MCU175	2.65E+00
MCU180	5.01E+00		MCU180	4.19E+00		MCU067	3.36E+00		MCU067	2.54E+00
MCU067	4.99E+00		MCU067	4.18E+00		MCU180	3.36E+00		MCU180	2.53E+00
MCU169	4.95E+00		MCU169	4.11E+00		MCU169	3.27E+00		MCU078	2.48E+00
MCU079	4.92E+00		MCU079	4.09E+00		MCU079	3.26E+00		MCU079	2.44E+00
MCU033	4.82E+00		MCU033	4.02E+00		MCU078	3.25E+00		MCU169	2.44E+00
MCU074	4.76E+00		MCU078	4.00E+00		MCU033	3.22E+00		MCU033	2.42E+00
MCU078	4.75E+00		MCU074	3.94E+00		MCU074	3.13E+00		MCU170	2.42E+00
MCU109	4.70E+00		MCU109	3.87E+00		MCU170	3.09E+00		MCU074	2.33E+00
MCU112	4.58E+00		MCU112	3.83E+00		MCU112	3.08E+00		MCU112	2.32E+00
MCU131	4.49E+00		MCU131	3.74E+00		MCU109	3.06E+00		MCU070	2.30E+00
MCU076	4.37E+00		MCU170	3.73E+00		MCU131	2.98E+00		MCU174	2.29E+00
MCU170	4.34E+00		MCU076	3.63E+00		MCU070	2.97E+00		MCU109	2.26E+00

Table B-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order							
Extractant Conc. = 0.0084 M		Extractant Conc. = 0.007 M		Extractant Conc. = 0.0056 M		Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value
MCU174	4.27E+00	MCU174	3.62E+00	MCU174	2.96E+00	MCU131	2.23E+00
MCU070	4.24E+00	MCU070	3.62E+00	MCU076	2.90E+00	MCU102	2.18E+00
MCU039	4.22E+00	MCU039	3.50E+00	MCU102	2.83E+00	MCU076	2.17E+00
MCU148	4.18E+00	MCU148	3.48E+00	MCU039	2.78E+00	MCU103	2.08E+00
MCU043	4.13E+00	MCU102	3.47E+00	MCU148	2.78E+00	MCU148	2.08E+00
MCU102	4.10E+00	MCU043	3.41E+00	MCU043	2.69E+00	MCU014	2.07E+00
MCU120	3.99E+00	MCU120	3.32E+00	MCU103	2.66E+00	MCU039	2.07E+00
MCU122	3.87E+00	MCU098	3.22E+00	MCU120	2.66E+00	MCU054	2.05E+00
MCU017	3.86E+00	MCU066	3.22E+00	MCU014	2.65E+00	MCU066	2.04E+00
MCU111	3.85E+00	MCU111	3.22E+00	MCU066	2.64E+00	MCU156	2.00E+00
MCU161	3.84E+00	MCU122	3.22E+00	MCU098	2.60E+00	MCU120	1.99E+00
MCU098	3.83E+00	MCU103	3.22E+00	MCU054	2.59E+00	MCU043	1.99E+00
MCU090	3.78E+00	MCU017	3.22E+00	MCU111	2.58E+00	MCU098	1.98E+00
MCU066	3.78E+00	MCU014	3.20E+00	MCU017	2.57E+00	MCU173	1.97E+00
MCU103	3.75E+00	MCU161	3.20E+00	MCU122	2.56E+00	MCU160	1.95E+00
MCU014	3.73E+00	MCU090	3.15E+00	MCU156	2.56E+00	MCU111	1.94E+00
MCU095	3.72E+00	MCU054	3.10E+00	MCU161	2.56E+00	MCU117	1.94E+00
MCU059	3.67E+00	MCU160	3.10E+00	MCU160	2.53E+00	MCU017	1.93E+00
MCU160	3.65E+00	MCU095	3.10E+00	MCU173	2.53E+00	MCU122	1.92E+00
MCU108	3.65E+00	MCU156	3.09E+00	MCU090	2.52E+00	MCU161	1.92E+00
MCU156	3.60E+00	MCU059	3.08E+00	MCU059	2.49E+00	MCU149	1.91E+00
MCU054	3.59E+00	MCU108	3.06E+00	MCU117	2.48E+00	MCU090	1.89E+00
MCU173	3.58E+00	MCU173	3.06E+00	MCU108	2.47E+00	MCU101	1.89E+00
MCU088	3.56E+00	MCU101	3.01E+00	MCU095	2.47E+00	MCU059	1.89E+00
MCU101	3.55E+00	MCU117	3.00E+00	MCU101	2.46E+00	MCU108	1.87E+00
MCU063	3.54E+00	MCU063	2.98E+00	MCU149	2.44E+00	MCU063	1.85E+00
MCU106	3.53E+00	MCU088	2.96E+00	MCU063	2.42E+00	MCU095	1.85E+00
MCU117	3.51E+00	MCU149	2.95E+00	MCU088	2.37E+00	MCU012	1.79E+00
MCU149	3.43E+00	MCU106	2.92E+00	MCU106	2.32E+00	MCU088	1.77E+00
MCU125	3.38E+00	MCU073	2.82E+00	MCU012	2.30E+00	MCU106	1.72E+00
MCU073	3.37E+00	MCU125	2.81E+00	MCU073	2.26E+00	MCU073	1.70E+00
MCU179	3.36E+00	MCU179	2.79E+00	MCU125	2.25E+00	MCU125	1.69E+00

Table B-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order							
Extractant Conc. = 0.0084 M		Extractant Conc. = 0.007 M		Extractant Conc. = 0.0056 M		Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value
MCU012	3.23E+00	MCU012	2.77E+00	MCU179	2.23E+00	MCU179	1.67E+00
MCU144	3.15E+00	MCU144	2.62E+00	MCU168	2.14E+00	MCU168	1.65E+00
MCU162	3.12E+00	MCU168	2.62E+00	MCU093	2.11E+00	MCU032	1.61E+00
MCU093	3.10E+00	MCU093	2.61E+00	MCU144	2.09E+00	MCU011	1.61E+00
MCU168	3.08E+00	MCU162	2.59E+00	MCU082	2.09E+00	MCU093	1.60E+00
MCU082	3.07E+00	MCU082	2.58E+00	MCU162	2.06E+00	MCU082	1.59E+00
MCU061	2.99E+00	MCU061	2.51E+00	MCU011	2.06E+00	MCU172	1.57E+00
MCU152	2.98E+00	MCU172	2.49E+00	MCU032	2.06E+00	MCU144	1.56E+00
MCU001	2.97E+00	MCU137	2.48E+00	MCU172	2.04E+00	MCU051	1.56E+00
MCU137	2.97E+00	MCU115	2.48E+00	MCU061	2.02E+00	MCU026	1.56E+00
MCU115	2.95E+00	MCU011	2.48E+00	MCU115	2.00E+00	MCU018	1.56E+00
MCU172	2.93E+00	MCU032	2.48E+00	MCU137	2.00E+00	MCU162	1.54E+00
MCU128	2.92E+00	MCU152	2.47E+00	MCU099	2.00E+00	MCU061	1.54E+00
MCU099	2.92E+00	MCU001	2.46E+00	MCU018	1.99E+00	MCU099	1.52E+00
MCU011	2.88E+00	MCU099	2.46E+00	MCU026	1.99E+00	MCU115	1.52E+00
MCU032	2.88E+00	MCU128	2.44E+00	MCU051	1.99E+00	MCU137	1.51E+00
MCU065	2.87E+00	MCU065	2.41E+00	MCU152	1.97E+00	MCU123	1.49E+00
MCU087	2.86E+00	MCU123	2.40E+00	MCU001	1.96E+00	MCU004	1.49E+00
MCU123	2.84E+00	MCU018	2.40E+00	MCU123	1.95E+00	MCU140	1.48E+00
MCU091	2.80E+00	MCU026	2.40E+00	MCU128	1.95E+00	MCU065	1.47E+00
MCU040	2.80E+00	MCU051	2.40E+00	MCU065	1.95E+00	MCU008	1.47E+00
MCU018	2.79E+00	MCU087	2.38E+00	MCU004	1.93E+00	MCU152	1.47E+00
MCU026	2.79E+00	MCU004	2.36E+00	MCU077	1.92E+00	MCU077	1.46E+00
MCU051	2.79E+00	MCU077	2.36E+00	MCU140	1.91E+00	MCU128	1.46E+00
MCU077	2.79E+00	MCU091	2.35E+00	MCU008	1.91E+00	MCU001	1.45E+00
MCU004	2.78E+00	MCU040	2.33E+00	MCU091	1.90E+00	MCU091	1.44E+00
MCU083	2.78E+00	MCU048	2.33E+00	MCU087	1.90E+00	MCU048	1.43E+00
MCU048	2.77E+00	MCU008	2.33E+00	MCU048	1.88E+00	MCU087	1.42E+00
MCU008	2.74E+00	MCU083	2.32E+00	MCU083	1.87E+00	MCU083	1.41E+00
MCU010	2.72E+00	MCU140	2.32E+00	MCU040	1.87E+00	MCU040	1.40E+00
MCU140	2.72E+00	MCU010	2.27E+00	MCU003	1.82E+00	MCU003	1.38E+00
MCU003	2.69E+00	MCU003	2.26E+00	MCU134	1.82E+00	MCU134	1.38E+00

Table B-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order							
Extractant Conc. = 0.0084 M		Extractant Conc. = 0.007 M		Extractant Conc. = 0.0056 M		Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value
MCU134	2.68E+00	MCU134	2.25E+00	MCU010	1.81E+00	MCU010	1.36E+00
MCU177	2.67E+00	MCU177	2.23E+00	MCU177	1.79E+00	MCU177	1.34E+00
MCU085	2.66E+00	MCU085	2.22E+00	MCU133	1.78E+00	MCU133	1.34E+00
MCU166	2.65E+00	MCU166	2.21E+00	MCU085	1.78E+00	MCU166	1.34E+00
MCU135	2.64E+00	MCU133	2.21E+00	MCU166	1.77E+00	MCU085	1.33E+00
MCU133	2.64E+00	MCU135	2.20E+00	MCU135	1.75E+00	MCU135	1.31E+00
MCU075	2.59E+00	MCU075	2.16E+00	MCU075	1.73E+00	MCU113	1.30E+00
MCU158	2.49E+00	MCU113	2.08E+00	MCU113	1.69E+00	MCU075	1.30E+00
MCU113	2.45E+00	MCU158	2.07E+00	MCU158	1.66E+00	MCU015	1.24E+00
MCU164	2.41E+00	MCU164	2.00E+00	MCU015	1.62E+00	MCU158	1.24E+00
MCU105	2.34E+00	MCU015	1.98E+00	MCU164	1.59E+00	MCU164	1.19E+00
MCU119	2.34E+00	MCU119	1.96E+00	MCU119	1.57E+00	MCU119	1.18E+00
MCU015	2.34E+00	MCU105	1.95E+00	MCU145	1.56E+00	MCU145	1.17E+00
MCU145	2.33E+00	MCU145	1.94E+00	MCU105	1.55E+00	MCU105	1.16E+00
MCU096	2.27E+00	MCU096	1.89E+00	MCU096	1.52E+00	MCU096	1.14E+00
MCU124	2.23E+00	MCU124	1.87E+00	MCU124	1.50E+00	MCU124	1.14E+00
MCU045	2.16E+00	MCU045	1.80E+00	MCU045	1.44E+00	MCU045	1.08E+00
MCU154	2.11E+00	MCU154	1.76E+00	MCU154	1.41E+00	MCU154	1.06E+00
MCU130	2.09E+00	MCU130	1.74E+00	MCU130	1.39E+00	MCU130	1.04E+00
MCU110	2.06E+00	MCU110	1.72E+00	MCU080	1.37E+00	MCU080	1.03E+00
MCU080	2.06E+00	MCU080	1.72E+00	MCU110	1.37E+00	MCU110	1.03E+00
MCU121	2.05E+00	MCU121	1.70E+00	MCU121	1.36E+00	MCU121	1.02E+00
MCU057	1.98E+00	MCU057	1.65E+00	MCU071	1.31E+00	MCU071	9.85E-01
MCU071	1.97E+00	MCU071	1.64E+00	MCU057	1.31E+00	MCU057	9.83E-01
MCU016	1.96E+00	MCU016	1.63E+00	MCU016	1.30E+00	MCU016	9.66E-01
MCU005	1.89E+00	MCU023	1.57E+00	MCU023	1.26E+00	MCU023	9.47E-01
MCU022	1.89E+00	MCU005	1.56E+00	MCU025	1.25E+00	MCU025	9.37E-01
MCU044	1.89E+00	MCU022	1.56E+00	MCU005	1.24E+00	MCU047	9.26E-01
MCU047	1.89E+00	MCU044	1.56E+00	MCU022	1.24E+00	MCU044	9.26E-01
MCU023	1.88E+00	MCU047	1.56E+00	MCU044	1.24E+00	MCU022	9.26E-01
MCU025	1.88E+00	MCU025	1.56E+00	MCU047	1.24E+00	MCU005	9.26E-01
MCU028	1.87E+00	MCU028	1.55E+00	MCU028	1.23E+00	MCU028	9.17E-01

Table B-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the First Test Matrix Sorted in Descending Order							
Extractant Conc. = 0.0084 M		Extractant Conc. = 0.007 M		Extractant Conc. = 0.0056 M		Extractant Conc. = 0.0042 M	
Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value
MCU024	1.86E+00	MCU024	1.54E+00	MCU024	1.23E+00	MCU035	9.16E-01
MCU035	1.86E+00	MCU035	1.54E+00	MCU035	1.23E+00	MCU024	9.16E-01
MCU049	1.85E+00	MCU049	1.53E+00	MCU049	1.22E+00	MCU049	9.12E-01
MCU055	1.84E+00	MCU055	1.53E+00	MCU055	1.22E+00	MCU055	9.10E-01
MCU053	1.84E+00	MCU053	1.52E+00	MCU053	1.21E+00	MCU053	9.06E-01
MCU037	1.82E+00	MCU037	1.51E+00	MCU037	1.21E+00	MCU037	9.01E-01
MCU056	1.76E+00	MCU056	1.47E+00	MCU030	1.17E+00	MCU030	8.81E-01
MCU030	1.76E+00	MCU030	1.46E+00	MCU056	1.17E+00	MCU056	8.75E-01
MCU041	1.65E+00	MCU041	1.39E+00	MCU041	1.12E+00	MCU041	8.44E-01
MCU013	1.62E+00	MCU013	1.36E+00	MCU013	1.10E+00	MCU013	8.28E-01
MCU143	1.60E+00	MCU143	1.33E+00	MCU006	1.06E+00	MCU006	8.04E-01
MCU006	1.58E+00	MCU006	1.32E+00	MCU143	1.06E+00	MCU143	7.94E-01
MCU021	1.37E+00	MCU021	1.15E+00	MCU021	9.17E-01	MCU021	6.88E-01
MCU019	1.36E+00	MCU019	1.13E+00	MCU019	8.99E-01	MCU019	6.72E-01
MCU050	1.26E+00	MCU050	1.05E+00	MCU050	8.42E-01	MCU050	6.31E-01
MCU034	1.18E+00	MCU034	9.84E-01	MCU034	7.87E-01	MCU034	5.91E-01
MCU046	1.14E+00	MCU046	9.52E-01	MCU046	7.62E-01	MCU046	5.72E-01
MCU002	1.13E+00	MCU002	9.39E-01	MCU002	7.51E-01	MCU002	5.64E-01
MCU042	1.11E+00	MCU042	9.28E-01	MCU042	7.44E-01	MCU042	5.60E-01
MCU009	9.90E-01	MCU009	8.29E-01	MCU009	6.66E-01	MCU009	5.02E-01
MCU038	9.44E-01	MCU038	7.87E-01	MCU038	6.30E-01	MCU038	4.73E-01
MCU020	8.62E-01	MCU020	7.19E-01	MCU020	5.75E-01	MCU020	4.32E-01
Maximum	2.98E+01	Maximum	2.47E+01	Maximum	1.96E+01	Maximum	1.45E+01
Minimum	8.62E-01	Minimum	7.19E-01	Minimum	5.75E-01	Minimum	4.32E-01
Median	3.47E+00	Median	2.93E+00	Median	2.34E+00	Median	1.78E+00

APPENDIX C

Table C-1. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU181	3.5480771	0.0729570	0.0000147	0.8497362	0.1134981	0.7037833	0.1512358	0.0088780	0.0927284	0.1346394	0.3328519	0.5807497	3.26E+00	3.65E+00	4.56E+00	5.47E+00
MCU182	3.5881189	0.0273984	0.0002092	0.6462891	0.0040000	1.0162500	0.2687500	0.0419375	0.0800703	0.0855313	0.3476953	0.5318359	4.70E+00	5.25E+00	6.53E+00	7.81E+00
MCU183	3.6658880	0.0044063	0.0000898	1.1214279	0.1003809	0.2756828	0.3119608	0.0606026	0.0522799	0.0338295	0.5210892	0.5336521	5.77E+00	6.43E+00	7.96E+00	9.49E+00
MCU184	3.6718794	0.0784922	0.0004557	0.8229617	0.0050106	1.1816607	0.1207671	0.0657683	0.0048192	0.0194183	0.5899257	0.3215131	3.81E+00	4.24E+00	5.21E+00	6.17E+00
MCU185	3.6734282	0.1044648	0.0002265	0.9502341	0.0733039	0.3301490	0.3879241	0.0280797	0.2106380	0.0792330	0.6014663	0.0151160	3.49E+00	3.88E+00	4.77E+00	5.65E+00
MCU186	3.6754236	0.0248438	0.0000725	0.3755859	0.0965000	0.6417188	0.3600781	0.0164219	0.0023633	0.2144414	0.3959375	0.9821875	4.17E+00	4.67E+00	5.84E+00	7.01E+00
MCU187	3.6831077	0.0457070	0.0003806	0.8568359	0.0745313	0.2353125	0.1382813	0.0785469	0.0555313	0.4194297	0.3291406	0.6819531	4.49E+00	4.97E+00	6.07E+00	7.15E+00
MCU188	3.6844548	0.1014844	0.0001322	0.1849122	0.1345857	0.1030510	1.6627749	0.1334931	0.0240731	0.1060141	0.2299737	0.8230597	3.87E+00	4.34E+00	5.47E+00	6.59E+00
MCU189	3.7011244	0.0491133	0.0004422	0.7283329	0.0054693	0.2662229	0.6428734	0.0537071	0.1101895	0.0252798	0.4972072	0.6785318	4.99E+00	5.56E+00	6.88E+00	8.19E+00
MCU190	3.7175519	0.1031875	0.0000186	1.1848878	0.1043516	1.0650152	0.4680620	0.0487091	0.0571912	0.0017245	0.3364145	0.1018805	3.36E+00	3.76E+00	4.70E+00	5.64E+00
MCU191	3.7260755	0.0797695	0.0003151	0.4507813	0.2190625	0.9525000	0.1252344	0.2760156	0.2259414	0.1827422	0.2252344	0.2887891	3.17E+00	3.54E+00	4.41E+00	5.27E+00
MCU192	3.7433745	0.0537969	0.0000166	0.2681558	0.0386134	1.2258879	0.6413197	0.0428481	0.0219469	0.3687659	0.0889427	0.5991053	4.66E+00	5.22E+00	6.54E+00	7.86E+00
MCU193	3.7945684	0.0461328	0.0004961	0.3979777	0.0119208	0.0729447	2.0222518	0.0170054	0.0182710	0.4980314	0.0792501	0.1097207	6.64E+00	7.52E+00	9.61E+00	1.17E+01
MCU194	3.8083982	0.0831758	0.0001457	1.1716518	0.0492607	1.1600766	0.2961232	0.1294657	0.1290079	0.0269780	0.2146587	0.2148446	4.10E+00	4.57E+00	5.64E+00	6.71E+00
MCU195	3.8131352	0.0503906	0.0003479	1.2328398	0.0098658	1.1039251	0.3725973	0.0836599	0.0301794	0.2728830	0.0135370	0.3976076	5.79E+00	6.42E+00	7.87E+00	9.30E+00
MCU196	3.8294319	0.0482617	0.0000571	0.2925269	0.1005522	1.6993731	0.6680664	0.0488887	0.0261418	0.0393117	0.1797757	0.5517434	4.96E+00	5.56E+00	6.98E+00	8.39E+00
MCU197	3.8361525	0.0516680	0.0001110	0.1637083	0.0284619	0.3192960	0.4466497	0.2822197	0.1834260	0.1866905	0.6489944	0.4259479	3.04E+00	3.41E+00	4.28E+00	5.15E+00
MCU198	3.8806495	0.0380430	0.0004923	2.0709331	0.0581938	0.2028104	0.1292640	0.1829187	0.1642559	0.0358598	0.1790114	0.3525548	7.42E+00	8.16E+00	9.81E+00	1.14E+01
MCU199	3.9059725	0.0214375	0.0004268	0.2883496	0.0951932	0.1739420	0.1270076	0.1935888	0.0990110	0.0229185	0.5104768	1.6859322	2.70E+00	3.02E+00	3.75E+00	4.47E+00
MCU200	3.9162710	0.0631641	0.0001977	1.7590896	0.1320464	0.0830674	0.4774529	0.1470523	0.1757018	0.2559686	0.1618992	0.0180832	5.56E+00	6.15E+00	7.51E+00	8.84E+00
MCU201	3.9277555	0.0218633	0.0003036	2.4208990	0.0944993	0.1899342	0.4554748	0.0138033	0.0046587	0.0149799	0.3175741	0.0962277	7.55E+00	8.32E+00	1.01E+01	1.18E+01
MCU202	3.9655750	0.0018516	0.0002111	2.1062091	0.1533872	0.3429144	0.4286702	0.0296482	0.1099065	0.2229903	0.0430741	0.0449603	8.29E+00	9.17E+00	1.12E+01	1.32E+01
MCU203	3.9717459	0.0997813	0.0003209	0.6596407	0.1818988	0.2707886	0.8703524	0.0023281	0.0248476	0.2105773	0.3780150	0.8351120	3.77E+00	4.21E+00	5.24E+00	6.25E+00
MCU204	4.0214624	0.0793438	0.0003787	0.6598810	0.0079704	0.1497476	1.5065705	0.0842183	0.1641069	0.0729214	0.0498288	0.9549757	5.13E+00	5.74E+00	7.17E+00	8.60E+00
MCU205	4.0284914	0.0712539	0.0001726	1.1125000	0.1473750	0.6735938	0.6079688	0.0741094	0.0977930	0.2038750	0.2400781	0.3030859	4.67E+00	5.20E+00	6.43E+00	7.65E+00
MCU206	4.0583396	0.0099414	0.0003286	0.5704058	0.1473994	0.6283252	1.0301092	0.0217078	0.1656805	0.1084155	0.2584020	0.4399857	8.00E+00	9.01E+00	1.14E+01	1.37E+01
MCU207	4.0602168	0.0661445	0.0000590	0.1887314	0.0356610	0.8409432	1.4801067	0.2181946	0.0124239	0.1960363	0.3132927	0.3068537	5.28E+00	5.93E+00	7.45E+00	8.98E+00
MCU208	4.0625435	0.0640156	0.0003710	1.4160313	0.0688320	0.3478015	1.5454957	0.0283949	0.1214424	0.0401920	0.1200916	0.0354803	6.74E+00	7.48E+00	9.20E+00	1.09E+01
MCU209	4.0897133	0.0180313	0.0001187	0.6914063	0.2815000	0.2831250	0.0600000	0.2493906	0.2068555	0.4109766	0.3662500	0.3674219	3.75E+00	4.19E+00	5.19E+00	6.18E+00
MCU210	4.1097399	0.0810469	0.0004114	0.4992747	0.0346983	0.4569690	0.1536516	0.1078980	0.2616084	0.2874018	0.0535307	1.4720164	3.33E+00	3.71E+00	4.58E+00	5.44E+00
MCU211	4.1294383	0.0435781	0.0000686	0.8697905	0.0821848	1.8102504	0.4756593	0.0250160	0.1615398	0.0115155	0.0365669	0.3293997	5.16E+00	5.78E+00	7.22E+00	8.66E+00
MCU212	4.1307197	0.0912656	0.0001129	0.3624402	0.0159604	0.6553551	1.6618557	0.0108719	0.0455219	0.0076089	0.5303427	0.3031460	4.11E+00	4.62E+00	5.80E+00	6.99E+00
MCU213	4.1457037	0.0286758	0.0000455	0.3995623	0.2330745	0.1355456	0.4473469	0.0340582	0.2053286	0.1591854	0.3359157	1.3186495	4.19E+00	4.70E+00	5.87E+00	7.05E+00
MCU214	4.1887896	0.0227148	0.0004287	0.5851332	0.0281395	0.7517060	1.2787227	0.1346856	0.0352977	0.0179100	0.6358931	0.0200471	7.15E+00	8.06E+00	1.02E+01	1.24E+01
MCU215	4.2043785	0.0388945	0.0000474	0.8538060	0.0486953	0.1775283	2.0942188	0.0672406	0.0605563	0.0140691	0.2882276	0.2155691	8.15E+00	9.14E+00	1.15E+01	1.38E+01
MCU216	4.2120247	0.0325078	0.0000513	0.5239239	0.0062763	0.2702012	2.6780500	0.1206545	0.0376087	0.0897912	0.1493248	0.0544198	1.04E+01	1.17E+01	1.47E+01	1.78E+01
MCU217	4.2429745	0.0635898	0.0004249	2.1677154	0.0177348	0.2449399	0.2784890	0.0756159	0.0518660	0.0599653	0.1468980	0.9531696	6.57E+00	7.22E+00	8.69E+00	1.01E+01
MCU218	4.2683180	0.0959492	0.0000975	1.0206318	0.0070300	0.7258698	1.2245677	0.0853487	0.0641241	0.0371921	0.3812373	0.2716860	4.19E+00	4.68E+00	5.83E+00	6.98E+00
MCU219	4.2777162	0.0678477	0.0002882	2.4562475	0.0185043	0.1041141	0.1039391	0.1110004	0.1166177	0.0473436	0.3773073	0.3528919	5.57E+00	6.12E+00	7.37E+00	8.59E+00
MCU220	4.2878990	0.0844531	0.0004519	0.6048852	0.0302862	0.2256029	0.7338039	0.1352568	0.0410887	0.1055727	0.3697188	1.5691200	4.12E+00	4.59E+00	5.70E+00	6.81E+00

Table C-1 Cont'd. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU221	4.2880064	0.0486875	0.0002574	0.5118588	0.0931063	0.4924514	1.2202304	0.1419890	0.1673399	0.1279016	0.4698604	0.1797716	5.53E+00	6.21E+00	7.81E+00	9.42E+00
MCU222	4.2907603	0.0048320	0.0003768	0.5655974	0.0183707	0.1245053	0.7264879	0.1343480	0.0702370	0.4109522	0.1891473	1.3157498	7.27E+00	8.15E+00	1.02E+01	1.23E+01
MCU223	4.3303134	0.0363398	0.0000397	0.6229373	0.0975773	1.1878939	0.7874025	0.0472849	0.1600618	0.3905102	0.0662969	0.2297975	5.99E+00	6.71E+00	8.40E+00	1.01E+01
MCU224	4.3309439	0.1057422	0.0004037	0.1951172	0.2664688	0.0679688	0.4644531	0.2371875	0.2504805	0.1996484	0.8152734	0.4246094	2.24E+00	2.51E+00	3.16E+00	3.80E+00
MCU225	4.3315544	0.0755117	0.0003267	0.4930812	0.0072510	0.2357041	1.0318228	0.1195570	0.0537797	0.2397181	0.6351340	0.6089334	4.12E+00	4.62E+00	5.79E+00	6.96E+00
MCU226	4.3388918	0.0448555	0.0004480	0.3304688	0.2572188	1.1835938	0.2035156	0.0596875	0.2300313	0.1806289	0.5369531	0.2244531	3.35E+00	3.77E+00	4.74E+00	5.71E+00
MCU227	4.3482047	0.0529453	0.0003864	2.1837450	0.0388340	0.2438982	0.7676914	0.0554640	0.0681153	0.1201231	0.0169046	0.6335025	7.42E+00	8.18E+00	9.90E+00	1.16E+01
MCU228	4.3542145	0.0985039	0.0003016	2.2099719	0.0302364	0.1195238	1.2902567	0.0356789	0.0199130	0.1822756	0.0424377	0.2581869	5.80E+00	6.40E+00	7.76E+00	9.09E+00
MCU229	4.3606055	0.0823242	0.0004615	2.1763671	0.0647089	0.4676002	1.3083666	0.0737976	0.0057934	0.1149438	0.0472929	0.0106972	6.73E+00	7.42E+00	9.00E+00	1.05E+01
MCU230	4.3750901	0.0887109	0.0000263	1.5409911	0.0534597	0.2637567	0.6575956	0.2035686	0.0810356	0.2167232	0.5239533	0.0199956	3.83E+00	4.28E+00	5.34E+00	6.39E+00
MCU231	4.3924206	0.0329336	0.0000359	0.3493775	0.1268499	0.2576077	1.7833829	0.0029303	0.2584908	0.0055709	0.2759440	0.5667398	8.18E+00	9.19E+00	1.15E+01	1.39E+01
MCU232	4.3994331	0.0465586	0.0003979	2.5635550	0.0981515	0.2907775	0.9696793	0.0038360	0.0371385	0.0095718	0.0424550	0.3049213	7.86E+00	8.66E+00	1.05E+01	1.23E+01
MCU233	4.4089018	0.0733828	0.0003248	0.2853516	0.0097813	0.7293750	0.9732813	0.0241875	0.1318750	0.3919570	0.3996484	0.4817969	4.01E+00	4.51E+00	5.70E+00	6.89E+00
MCU234	4.4202951	0.0567773	0.0003498	0.8465927	0.0490655	0.2229049	0.8058994	0.0119110	0.0067596	0.3768773	0.0917039	1.5836076	5.64E+00	6.28E+00	7.78E+00	9.26E+00
MCU235	4.4261430	0.0244180	0.0000917	0.7796131	0.0177634	0.9960894	1.2162936	0.2181898	0.0057921	0.1212438	0.3075712	0.3476970	7.98E+00	8.94E+00	1.12E+01	1.35E+01
MCU236	4.4279658	0.0563516	0.0002843	1.7126726	0.0271092	0.2253126	2.0597697	0.0032484	0.0224273	0.0189539	0.0991196	0.1530602	7.62E+00	8.46E+00	1.04E+01	1.23E+01
MCU237	4.4371259	0.1078711	0.0002458	1.7962834	0.0429456	0.1082763	1.9661186	0.0440408	0.0186060	0.0851463	0.1482680	0.0649315	5.16E+00	5.72E+00	7.00E+00	8.26E+00
MCU238	4.4638276	0.0589063	0.0000494	1.2849877	0.0072093	0.3483726	0.9807914	0.0492661	0.0921757	0.0547672	0.1934922	1.0791099	5.37E+00	6.00E+00	7.48E+00	8.95E+00
MCU239	4.4915019	0.0993555	0.0001225	1.1183360	0.0121260	0.5789943	0.6533993	0.2068343	0.1385338	0.0399642	0.6758105	0.1741391	3.69E+00	4.12E+00	5.10E+00	6.09E+00
MCU240	4.5075729	0.0316563	0.0001283	2.0029942	0.0247571	0.1840140	1.2482484	0.0644054	0.0682141	0.2396464	0.0529014	0.2252005	8.06E+00	8.97E+00	1.11E+01	1.32E+01
MCU241	4.5134159	0.0346367	0.0002304	0.5237666	0.0054388	1.1699598	1.0180237	0.0330151	0.0613463	0.2106282	0.2079552	0.7768733	6.35E+00	7.14E+00	8.98E+00	1.08E+01
MCU242	4.5256074	0.0120703	0.0002862	0.6112237	0.0527836	0.7156825	0.7023453	0.0088066	0.0878425	0.0604437	0.8928232	0.2770611	6.10E+00	6.85E+00	8.58E+00	1.03E+01
MCU243	4.5432940	0.0708281	0.0004442	1.3642981	0.0113464	0.2965758	0.8658315	0.0097438	0.3073567	0.1711373	0.3639305	0.0745650	5.76E+00	6.38E+00	7.80E+00	9.20E+00
MCU244	4.5541518	0.0818984	0.0000860	2.8995704	0.1979122	0.4679788	0.2405567	0.0182867	0.0944013	0.0261014	0.0932342	0.2899563	4.05E+00	4.49E+00	5.51E+00	6.52E+00
MCU245	4.5980707	0.1048906	0.0003902	1.6990234	0.2468125	0.3707813	0.2817969	0.1917031	0.2082188	0.1108906	0.0137109	1.0393750	5.16E+00	5.69E+00	6.87E+00	8.02E+00
MCU246	4.6149117	0.0806211	0.0004307	0.5611737	0.1792133	0.8108076	0.4019609	0.0689442	0.0028482	0.0065142	0.8653723	0.9215465	3.33E+00	3.72E+00	4.63E+00	5.54E+00
MCU247	4.6227416	0.0299531	0.0000956	0.4046453	0.0611802	1.3740661	1.2554015	0.0211381	0.0140665	0.1759713	0.5561793	0.0298585	6.91E+00	7.77E+00	9.77E+00	1.18E+01
MCU248	4.6385950	0.0078125	0.0004884	1.4920571	0.0437402	0.1241437	1.4584639	0.0029146	0.2594056	0.2889569	0.0224183	0.1246092	1.23E+01	1.37E+01	1.71E+01	2.04E+01
MCU249	4.6483663	0.1065938	0.0004172	0.4585823	0.0559499	1.4539032	1.4976050	0.0277446	0.2749627	0.0963737	0.1047725	0.0344115	3.83E+00	4.31E+00	5.43E+00	6.56E+00
MCU250	4.7003649	0.0580547	0.0001206	1.3450924	0.1447241	1.0761760	0.8421998	0.0155489	0.0659480	0.1382960	0.4080732	0.0442165	5.09E+00	5.68E+00	7.06E+00	8.43E+00
MCU251	4.7051399	0.0716797	0.0001630	0.4220259	0.0545396	0.1639441	1.8367223	0.0754442	0.0447164	0.0046894	0.4952621	1.0902542	5.01E+00	5.63E+00	7.09E+00	8.56E+00
MCU252	4.7125298	0.0201602	0.0002747	0.4322319	0.0301570	0.4003045	2.5875519	0.1162079	0.1677321	0.0844325	0.2305192	0.0334119	1.19E+01	1.35E+01	1.73E+01	2.11E+01
MCU253	4.7127518	0.0159023	0.0001938	0.5470730	0.1894838	0.1307202	2.6785816	0.1920953	0.0237376	0.2053551	0.2396719	0.0296274	1.40E+01	1.58E+01	2.01E+01	2.45E+01
MCU254	4.7203950	0.0576289	0.0004730	2.5336803	0.0181872	0.9515952	0.0954474	0.0773894	0.0329221	0.1363881	0.1985655	0.3335237	6.21E+00	6.82E+00	8.21E+00	9.55E+00
MCU255	4.7420751	0.1027617	0.0001668	0.3839084	0.2241319	0.0674315	2.6728249	0.2193145	0.0858748	0.1514382	0.0517438	0.6134039	4.49E+00	5.04E+00	6.35E+00	7.66E+00
MCU256	4.7422246	0.0555000	0.0002535	1.4799820	0.0306146	0.0946304	1.5195045	0.1211774	0.1647767	0.0457493	0.4208724	0.1244958	6.69E+00	7.44E+00	9.18E+00	1.09E+01
MCU257	4.7464509	0.0052578	0.0001033	0.4032158	0.0067197	0.0849688	2.6592882	0.0477725	0.0362382	0.2581077	0.1533444	0.6182279	2.10E+01	2.36E+01	2.99E+01	3.61E+01
MCU258	4.7587949	0.0584805	0.0003459	1.8163945	0.0449101	1.1522700	0.1048542	0.0585905	0.1858967	0.1506646	0.3382024	0.1051780	5.22E+00	5.76E+00	7.00E+00	8.21E+00
MCU259	4.7942914	0.0895625	0.0000802	1.6878474	0.1026035	1.0359668	1.0153780	0.0142901	0.0021581	0.4175804	0.0866490	0.0129149	4.51E+00	5.03E+00	6.24E+00	7.45E+00
MCU260	4.8140821	0.0695508	0.0002516	0.3122252	0.0162498	1.5821103	1.6102926	0.0473043	0.0693910	0.1285373	0.0609666	0.7285216	5.21E+00	5.87E+00	7.43E+00	9.00E+00

Table C-1 Cont'd. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU261	4.8186946	0.0704023	0.0000532	1.1032504	0.1259284	0.5562844	1.1705045	0.0521477	0.0802492	0.0732270	0.3997156	0.6944022	4.83E+00	5.41E+00	6.76E+00	8.10E+00
MCU262	4.8378065	0.0572031	0.0004904	0.5410156	0.1947813	0.5939063	2.1475000	0.2260938	0.0964297	0.0897578	0.0100000	0.7033984	6.31E+00	7.13E+00	9.06E+00	1.10E+01
MCU263	4.8422414	0.0337852	0.0001688	0.4658203	0.0814688	0.7851563	0.2948438	0.1273594	0.1536875	0.2672734	0.5146875	1.0965625	4.12E+00	4.62E+00	5.77E+00	6.93E+00
MCU264	4.8682003	0.0763633	0.0002766	2.1250119	0.1808283	0.7718092	0.4097540	0.0273209	0.0138160	0.1526003	0.3716137	0.3402398	5.03E+00	5.55E+00	6.75E+00	7.92E+00
MCU265	4.8720911	0.0550742	0.0001899	2.3262293	0.0798741	0.6227629	0.2074397	0.2132496	0.1383784	0.3871644	0.0890326	0.1102705	5.48E+00	6.06E+00	7.37E+00	8.66E+00
MCU266	4.8843246	0.0963750	0.0001996	1.6843495	0.0639867	0.5423988	0.2318412	0.2385264	0.0492419	0.1319003	0.5503235	0.7076235	4.16E+00	4.60E+00	5.62E+00	6.61E+00
MCU267	4.8936272	0.0657188	0.0001071	1.4734375	0.0999688	0.3867188	0.9471875	0.0319531	0.0173594	0.1214570	0.2178125	1.2895703	5.26E+00	5.87E+00	7.27E+00	8.66E+00
MCU268	4.8996374	0.0874336	0.0002939	0.2983200	0.0101637	0.7765763	1.7021451	0.1885870	0.0631700	0.2981112	0.4780095	0.2698212	4.27E+00	4.81E+00	6.08E+00	7.36E+00
MCU269	4.9110966	0.0836016	0.0002978	0.9937037	0.2341282	0.2162254	0.9347520	0.2088037	0.0058982	0.3945511	0.3555688	0.8894486	4.80E+00	5.34E+00	6.60E+00	7.85E+00
MCU270	4.9562762	0.0235664	0.0002131	2.4980027	0.1803524	0.9020515	0.2642144	0.0855544	0.0923593	0.0315390	0.1939606	0.3218033	6.28E+00	6.94E+00	8.46E+00	9.94E+00
MCU271	4.9844264	0.1040391	0.0002439	2.1480683	0.0674125	0.3455619	1.2291531	0.1313827	0.0569734	0.0102803	0.4795934	0.0164634	4.78E+00	5.29E+00	6.45E+00	7.59E+00
MCU272	4.9871145	0.0397461	0.0003344	1.2817736	0.0525841	0.8320213	0.6481095	0.1349634	0.0295434	0.3099073	0.5875383	0.1942215	6.03E+00	6.70E+00	8.26E+00	9.80E+00
MCU273	4.9887721	0.0124961	0.0002054	1.0658418	0.0796175	0.3893855	1.2005099	0.0374776	0.0098228	0.1350537	0.6848517	0.5593620	8.92E+00	9.99E+00	1.25E+01	1.50E+01
MCU274	4.9958203	0.0699766	0.0003594	0.8117188	0.0398438	0.3309375	0.4383594	0.0053281	0.0691641	0.5208672	0.7150781	0.7605859	4.11E+00	4.57E+00	5.64E+00	6.70E+00
MCU275	4.9976916	0.0933945	0.0002169	0.4272664	0.0947670	1.0967195	1.6277070	0.0035733	0.0486686	0.1945206	0.0413436	1.2235358	4.40E+00	4.94E+00	6.22E+00	7.51E+00
MCU276	4.9982747	0.0431523	0.0002188	0.1884722	0.0486739	1.1323238	2.5807361	0.0354513	0.0498189	0.1495785	0.0187749	0.5698251	8.15E+00	9.22E+00	1.17E+01	1.43E+01
MCU277	5.0002240	0.0423008	0.0004326	2.1219688	0.2225318	0.5670100	0.6627211	0.1792598	0.1280443	0.0788447	0.1504476	0.4467484	7.38E+00	8.15E+00	9.89E+00	1.16E+01
MCU278	5.0394605	0.0418750	0.0003633	1.5512755	0.0166951	0.5316262	0.5792229	0.0178294	0.0944407	0.0324061	0.7034724	0.6299705	6.10E+00	6.76E+00	8.26E+00	9.74E+00
MCU279	5.0806395	0.0256953	0.0004230	1.1876953	0.2930625	0.6656250	0.8558594	0.2338594	0.2654766	0.2228945	0.2734766	0.0814844	7.49E+00	8.35E+00	1.03E+01	1.23E+01
MCU280	5.0895490	0.0303789	0.0000763	2.4857146	0.0240015	0.1354496	1.4385410	0.1210434	0.0104174	0.4041002	0.0209053	0.0339912	8.13E+00	9.06E+00	1.12E+01	1.34E+01
MCU281	5.0980772	0.0082383	0.0003402	2.1726644	0.0126538	1.1633975	0.0926644	0.0264507	0.1799871	0.0716855	0.1841674	0.5871575	6.93E+00	7.65E+00	9.29E+00	1.09E+01
MCU282	5.1062550	0.0210117	0.0000706	1.8366242	0.1245033	0.3586349	1.6269992	0.0117385	0.2841011	0.0704800	0.0175575	0.1404589	9.58E+00	1.07E+01	1.34E+01	1.60E+01
MCU283	5.1360933	0.0090898	0.0000417	0.3549297	0.0509870	0.3470103	1.4591991	0.0480174	0.2516046	0.0233553	0.5499559	0.9836451	1.11E+01	1.25E+01	1.57E+01	1.89E+01
MCU284	5.1409489	0.0950977	0.0003132	1.2240808	0.0713415	1.3310811	0.2298901	0.0055920	0.2614257	0.1769008	0.1212823	0.9937309	4.09E+00	4.54E+00	5.57E+00	6.59E+00
MCU285	5.1571138	0.0601836	0.0004133	1.6936865	0.1591961	1.3556173	0.1390910	0.1082052	0.0630593	0.2322895	0.0880755	0.9320065	5.43E+00	6.00E+00	7.30E+00	8.56E+00
MCU286	5.1669380	0.0495391	0.0000320	3.6548266	0.0093914	0.1365747	0.0800084	0.1978689	0.0213481	0.3260367	0.1431772	0.1353669	3.97E+00	4.43E+00	5.48E+00	6.53E+00
MCU287	5.2224565	0.0789180	0.0001880	0.9771484	0.0988125	0.5062500	1.2603125	0.1329063	0.0146328	0.1066641	0.8078516	0.4532031	4.50E+00	5.03E+00	6.26E+00	7.49E+00
MCU288	5.2261664	0.0073867	0.0003556	0.2382735	0.0914457	0.4325178	2.6355352	0.0530995	0.1773808	0.3455565	0.0644702	0.4308410	1.71E+01	1.95E+01	2.53E+01	3.12E+01
MCU289	5.2640726	0.0065352	0.0002805	1.3998400	0.0371438	0.6345569	2.5406028	0.0927628	0.0551860	0.0159006	0.0578128	0.2529970	1.66E+01	1.87E+01	2.35E+01	2.83E+01
MCU290	5.2859369	0.0137734	0.0002246	1.2602535	0.0149785	0.0610033	2.7756450	0.0645996	0.0168990	0.2005478	0.2601943	0.1512738	1.51E+01	1.70E+01	2.14E+01	2.59E+01
MCU291	5.2865980	0.0533711	0.0000340	0.5550153	0.0990903	0.3229589	2.9775058	0.0313343	0.1195359	0.1120348	0.3444501	0.0825210	7.44E+00	8.35E+00	1.05E+01	1.27E+01
MCU292	5.3091929	0.1070195	0.0002285	0.8411470	0.0798397	1.6173428	0.4754140	0.0270551	0.1363641	0.0099099	0.4430149	1.0607002	3.35E+00	3.74E+00	4.66E+00	5.56E+00
MCU293	5.3124087	0.0478359	0.0003093	0.4542682	0.0900739	2.0773045	1.8646555	0.0498481	0.0056499	0.1752221	0.0339828	0.3890442	6.56E+00	7.41E+00	9.41E+00	1.14E+01
MCU294	5.3185454	0.0342109	0.0002593	0.4808594	0.1184688	1.7254688	0.3731250	0.2016875	0.0827969	0.4891680	0.3402734	0.5461328	4.79E+00	5.38E+00	6.76E+00	8.15E+00
MCU295	5.3202485	0.0593320	0.0003960	2.9472656	0.2768750	0.4026563	0.1774219	0.0075469	0.0364453	0.3074258	0.1918359	0.4603516	5.99E+00	6.58E+00	7.91E+00	9.19E+00
MCU296	5.3368237	0.0772148	0.0003382	0.2560099	0.1908580	1.1656677	2.2041001	0.1366701	0.1430551	0.2027908	0.1609759	0.3043723	4.95E+00	5.59E+00	7.11E+00	8.65E+00
MCU297	5.3473958	0.1010586	0.0001784	1.3080078	0.0479375	1.5900000	0.1643750	0.1462188	0.0418984	0.2398008	0.4738672	0.6390625	3.52E+00	3.91E+00	4.82E+00	5.73E+00
MCU298	5.4078656	0.0520938	0.0004576	1.1325420	0.1647605	1.0748784	1.5572193	0.0790987	0.0125320	0.4125339	0.1603145	0.2686250	6.71E+00	7.50E+00	9.35E+00	1.12E+01
MCU299	5.4128225	0.1082969	0.0003325	0.2673575	0.2247809	0.0609054	2.4378977	0.0032411	0.0014738	0.1984106	0.6411903	0.8436459	3.55E+00	4.00E+00	5.06E+00	6.13E+00
MCU300	5.4187883	0.0776406	0.0004461	0.5259766	0.1959375	0.5221875	0.4775000	0.1994688	0.1864063	0.0474922	0.5443750	1.8328516	3.69E+00	4.13E+00	5.14E+00	6.16E+00

Table C-1 Cont'd. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU301	5.4196362	0.0252695	0.0004769	2.0003895	0.0639886	0.8985679	1.4596330	0.0613791	0.0037488	0.0445409	0.3552412	0.1506141	9.15E+00	1.02E+01	1.25E+01	1.48E+01
MCU302	5.4243818	0.0559258	0.0003171	1.3493680	0.0450095	1.1985182	0.9910282	0.0045845	0.0059368	0.1114242	0.0103502	1.6307571	6.15E+00	6.84E+00	8.44E+00	1.00E+01
MCU303	5.4377717	0.0103672	0.0002381	2.2922684	0.1597010	0.7885342	1.5572739	0.1129547	0.0172687	0.0982329	0.0155489	0.2582752	1.10E+01	1.22E+01	1.50E+01	1.79E+01
MCU304	5.4456675	0.0367656	0.0003517	1.4469318	0.1227837	0.3544894	0.1953283	0.0090246	0.0905218	0.2284162	0.7902054	1.0454181	5.45E+00	6.02E+00	7.33E+00	8.61E+00
MCU305	5.4777684	0.0669961	0.0004981	2.3066624	0.0229637	0.8548839	1.4041147	0.0171676	0.0332720	0.1078573	0.2979805	0.0279786	6.74E+00	7.44E+00	9.05E+00	1.06E+01
MCU306	5.4786600	0.0095156	0.0003748	1.2700667	0.0859166	0.4953672	0.5788656	0.0854774	0.2247774	0.0153356	0.7020113	0.8638308	7.56E+00	8.42E+00	1.04E+01	1.23E+01
MCU307	5.4789417	0.1053164	0.0003113	2.6745627	0.0729388	0.7741469	0.8595378	0.1637255	0.0256020	0.0552017	0.0428627	0.7667228	5.15E+00	5.68E+00	6.87E+00	8.03E+00
MCU308	5.4915293	0.0921172	0.0003652	0.9621094	0.1150000	0.2034375	2.2127344	0.0308438	0.3431836	0.2799531	0.0693750	0.3316797	5.13E+00	5.74E+00	7.15E+00	8.57E+00
MCU309	5.4975783	0.0882852	0.0000783	2.9122632	0.0675795	0.5362605	0.3812789	0.0344147	0.0039921	0.1847968	0.0502095	1.1721562	3.99E+00	4.43E+00	5.44E+00	6.45E+00
MCU310	5.4997639	0.0129219	0.0003536	2.3143411	0.0390193	0.3656992	1.0376747	0.1417931	0.0248197	0.0996530	0.4100732	0.5206002	9.77E+00	1.08E+01	1.32E+01	1.56E+01
MCU311	5.5032962	0.0546484	0.0002227	1.7647269	0.1772090	0.8397311	0.6978201	0.0535202	0.0084429	0.2111964	0.5547534	0.4679319	5.41E+00	6.00E+00	7.38E+00	8.73E+00
MCU312	5.5074542	0.0878594	0.0002997	1.4283203	0.0236563	0.5859375	0.6601563	0.1162656	0.0787070	0.5166406	0.1361719	1.2395313	5.08E+00	5.63E+00	6.89E+00	8.13E+00
MCU313	5.5115284	0.0916914	0.0000224	0.4357422	0.0386875	1.1517188	2.2388281	0.1661875	0.2981953	0.1024375	0.0990625	0.2744922	4.89E+00	5.49E+00	6.89E+00	8.30E+00
MCU314	5.5616460	0.0955234	0.0001148	2.4508928	0.1579000	0.1664282	1.9669189	0.0421638	0.0544987	0.0029689	0.2698754	0.1637959	4.71E+00	5.23E+00	6.45E+00	7.65E+00
MCU315	5.6005282	0.0291016	0.0004210	0.1800781	0.0444688	0.4743750	1.5864844	0.1295781	0.1495977	0.4595820	0.6111719	0.6247656	7.17E+00	8.15E+00	1.05E+01	1.29E+01
MCU316	5.6124886	0.0308047	0.0004191	0.4299297	0.0983143	1.9902051	1.0540226	0.1555607	0.0737945	0.0898095	0.4854990	0.5436796	5.99E+00	6.77E+00	8.62E+00	1.05E+01
MCU317	5.6170841	0.0942461	0.0004018	2.7912960	0.1153871	0.2717388	1.2170323	0.0055412	0.0093933	0.5031603	0.0109432	0.2543497	6.11E+00	6.73E+00	8.13E+00	9.49E+00
MCU318	5.6363065	0.0452813	0.0003999	1.8797041	0.1937156	1.7319807	0.7801046	0.0352504	0.1074592	0.2744217	0.0405928	0.1088258	6.35E+00	7.04E+00	8.63E+00	1.02E+01
MCU319	5.6412216	0.1095742	0.0002015	1.3420751	0.0731489	1.1927606	1.8628404	0.0664257	0.0623455	0.2123816	0.1003480	0.4012510	4.40E+00	4.91E+00	6.09E+00	7.26E+00
MCU320	5.6599684	0.0865820	0.0004153	2.5760469	0.2363119	0.0711969	1.3659801	0.0073277	0.2220362	0.2498445	0.0686569	0.1869911	6.29E+00	6.93E+00	8.39E+00	9.81E+00
MCU321	5.6743564	0.0525195	0.0001611	1.7343954	0.1849093	0.0915637	1.6800496	0.1174855	0.0329090	0.1854560	0.0430510	1.3628923	7.17E+00	7.98E+00	9.87E+00	1.18E+01
MCU322	5.7313915	0.0648672	0.0000109	0.7666016	0.1508438	1.3987500	0.9993750	0.1650781	0.1577773	0.0157930	0.2141016	1.3825000	4.92E+00	5.52E+00	6.91E+00	8.31E+00
MCU323	5.7351616	0.0150508	0.0004095	1.9989428	0.0965851	0.7901030	1.8103116	0.0297523	0.0366525	0.1411384	0.1691976	0.2942975	1.12E+01	1.25E+01	1.54E+01	1.84E+01
MCU324	5.7560884	0.0282500	0.0000243	1.1372151	0.0269144	1.7243423	0.7482758	0.1736993	0.0151327	0.0658394	0.4902360	0.8163669	6.09E+00	6.82E+00	8.53E+00	1.02E+01
MCU325	5.7715475	0.0746602	0.0004673	1.5643341	0.0955347	0.2099195	2.1355277	0.0917174	0.0416897	0.1413629	0.1106697	1.1205071	6.65E+00	7.39E+00	9.08E+00	1.08E+01
MCU326	5.7855388	0.0320820	0.0003190	1.5605911	0.1622380	0.7977427	1.5857901	0.0082835	0.2140529	0.1908633	0.0638275	0.5517542	8.50E+00	9.48E+00	1.18E+01	1.40E+01
MCU327	5.8222009	0.0410234	0.0001476	0.6776235	0.0381634	0.8726187	2.8314874	0.1043882	0.2067284	0.0198302	0.0622417	0.5547618	8.84E+00	9.95E+00	1.26E+01	1.52E+01
MCU328	5.8256105	0.0750859	0.0004403	0.3605469	0.2155938	0.6975000	2.7476563	0.1573125	0.0405352	0.1954219	0.6000391	0.0100000	4.78E+00	5.41E+00	6.89E+00	8.40E+00
MCU329	5.8329892	0.0069609	0.0002631	0.3400841	0.2396058	1.4352159	1.1812684	0.1016001	0.0701175	0.0792814	0.2734131	1.6266973	9.48E+00	1.07E+01	1.36E+01	1.65E+01
MCU330	5.9222752	0.0610352	0.0004865	0.7365234	0.2271563	1.2792188	1.2994531	0.0752188	0.2054922	0.0052266	0.0211328	1.6970313	5.37E+00	6.04E+00	7.59E+00	9.16E+00
MCU331	5.9268216	0.0035547	0.0000378	0.8869141	0.0710625	0.7771875	2.0300781	0.0985156	0.3500000	0.1299102	0.2697656	0.2173047	1.65E+01	1.86E+01	2.33E+01	2.80E+01
MCU332	5.9398510	0.0827500	0.0004827	1.4602701	0.0671033	0.1421816	2.7341396	0.0091216	0.1685952	0.3740481	0.0322100	0.2919656	6.34E+00	7.06E+00	8.72E+00	1.04E+01
MCU333	5.9785784	0.0010000	0.0003825	0.2101563	0.2283125	0.8568750	2.8781250	0.1728438	0.0091797	0.0348125	0.4701563	0.5961719	2.15E+01	2.47E+01	3.21E+01	3.95E+01
MCU334	6.0108847	0.0989297	0.0002208	2.1351563	0.0780000	0.3628125	0.9080469	0.2394063	0.1877695	0.4278828	0.0248438	0.9178516	5.09E+00	5.63E+00	6.88E+00	8.10E+00
MCU335	6.0339654	0.0644414	0.0001091	1.0849156	0.1031284	1.0593284	2.4345215	0.0748407	0.0319206	0.0916808	0.4765212	0.1096155	5.83E+00	6.53E+00	8.18E+00	9.84E+00
MCU336	6.0368652	0.0801953	0.0000879	1.9396484	0.0860938	0.2114063	2.2779688	0.1251406	0.1809531	0.0115664	0.0322656	0.8463672	5.47E+00	6.10E+00	7.57E+00	9.04E+00
MCU337	6.0479699	0.0674219	0.0004384	1.8843223	0.1442665	0.0798960	1.9587268	0.0392422	0.1186328	0.1363378	0.1441156	1.0925711	7.04E+00	7.80E+00	9.55E+00	1.13E+01
MCU338	6.0507490	0.0542227	0.0001572	1.9546875	0.1311875	1.8370313	1.2733594	0.2549375	0.0350820	0.1277969	0.0879297	0.1172266	5.88E+00	6.55E+00	8.10E+00	9.65E+00
MCU339	6.0512409	0.0184570	0.0001341	1.7441406	0.1161563	0.8887500	0.6471094	0.0097656	0.0541680	0.2313477	0.6891016	0.6605078	6.57E+00	7.32E+00	9.06E+00	1.08E+01
MCU340	6.0564939	0.0027031	0.0001745	3.8817829	0.0435901	0.6886630	0.5062903	0.1071420	0.1981156	0.0074313	0.0782841	0.0661255	6.81E+00	7.53E+00	9.18E+00	1.08E+01

Table C-1 Cont'd. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU341	6.1153534	0.0665703	0.0004056	0.3487796	0.0196281	1.2556672	1.4974976	0.0704944	0.2002837	0.5060061	0.4510805	0.4752382	4.81E+00	5.43E+00	6.91E+00	8.41E+00
MCU342	6.1419942	0.0376172	0.0001822	3.3107761	0.0875027	0.7790219	0.4450240	0.1409763	0.1872389	0.0325841	0.2694195	0.2507686	5.52E+00	6.10E+00	7.44E+00	8.74E+00
MCU343	6.1422004	0.0857305	0.0000301	0.5560547	0.2213750	0.9285938	1.1428906	0.1883750	0.2791094	0.3222188	0.3848047	0.9392969	4.27E+00	4.79E+00	6.00E+00	7.22E+00
MCU344	6.1462478	0.0141992	0.0003421	2.1501953	0.1126875	1.1357813	0.1904688	0.0896406	0.2245781	0.0622852	0.1398828	1.4039453	6.76E+00	7.47E+00	9.08E+00	1.07E+01
MCU345	6.1697338	0.0976523	0.0001842	1.3380859	0.0155625	0.6496875	2.1735938	0.1384531	0.2382109	0.0665117	0.5258203	0.0528906	4.47E+00	4.99E+00	6.20E+00	7.41E+00
MCU346	6.1732003	0.1100000	0.0001245	2.0225317	0.0215482	1.2888755	0.5955587	0.0269006	0.2623518	0.0669517	0.3032552	0.8004409	3.59E+00	3.99E+00	4.92E+00	5.84E+00
MCU347	6.1971699	0.0738086	0.0001765	2.4018196	0.1827712	0.1052942	2.4421381	0.0124726	0.1332289	0.0166572	0.2741256	0.1454069	5.86E+00	6.51E+00	8.01E+00	9.50E+00
MCU348	6.2114290	0.0891367	0.0002034	0.3441829	0.0316677	1.1772933	2.4434610	0.1053726	0.1109182	0.0714922	0.2397807	1.2434913	4.59E+00	5.16E+00	6.52E+00	7.89E+00
MCU349	6.2157235	0.0269727	0.0000070	1.4583984	0.1785938	0.3150000	2.6432813	0.2316406	0.0228125	0.5293203	0.0285547	0.2316016	1.13E+01	1.27E+01	1.60E+01	1.93E+01
MCU350	6.2214269	0.0393203	0.0003440	3.0734116	0.1850852	1.7688243	0.3194198	0.0237729	0.0472371	0.2809168	0.0875352	0.0119621	5.49E+00	6.06E+00	7.35E+00	8.60E+00
MCU351	6.2230881	0.0188828	0.0001418	2.9819208	0.1701333	1.1708458	0.5193175	0.2561898	0.0039501	0.0517871	0.4169807	0.1943196	6.03E+00	6.69E+00	8.20E+00	9.70E+00
MCU352	6.2271651	0.0499648	0.0000205	2.9747787	0.0258599	0.4597740	1.4051700	0.0044123	0.0775553	0.2807186	0.2386236	0.1358052	5.41E+00	6.05E+00	7.54E+00	9.04E+00
MCU353	6.2276688	0.1087227	0.0002342	1.2172504	0.0487986	0.9764430	1.6020747	0.1374349	0.0610065	0.3917034	0.4548839	0.4784299	4.13E+00	4.61E+00	5.72E+00	6.82E+00
MCU354	6.2444150	0.1036133	0.0001514	0.9921875	0.0722188	1.6617188	0.7514844	0.1739531	0.1564141	0.0284727	0.6334375	0.9035547	3.44E+00	3.85E+00	4.80E+00	5.74E+00
MCU355	6.2475965	0.0440039	0.0000089	0.3455078	0.2734063	0.4584375	1.1037500	0.2693594	0.3036484	0.4236563	0.2215234	1.6398438	6.54E+00	7.33E+00	9.19E+00	1.11E+01
MCU356	6.2558776	0.0414492	0.0002554	3.5475338	0.0083559	0.0683728	1.2048743	0.0312933	0.1717203	0.1195182	0.2926527	0.0976494	7.01E+00	7.74E+00	9.41E+00	1.10E+01
MCU357	6.2602637	0.0278242	0.0003613	2.2404297	0.1670313	0.3548438	0.0860938	0.0408281	0.1741367	0.3412383	0.6668359	0.8606641	6.17E+00	6.79E+00	8.20E+00	9.56E+00
MCU358	6.3298496	0.0205859	0.0003690	3.0485232	0.1723632	0.9760086	0.4904329	0.0394523	0.0782644	0.3417391	0.3014681	0.1028168	6.95E+00	7.66E+00	9.29E+00	1.09E+01
MCU359	6.3562468	0.0725313	0.0003363	1.1717038	0.1390070	0.4465732	2.4900484	0.0330113	0.1309940	0.1856939	0.0730242	1.2383523	6.03E+00	6.74E+00	8.40E+00	1.01E+01
MCU360	6.3643040	0.0405977	0.0004538	1.3681641	0.0733750	1.2871875	1.7691406	0.1750625	0.2150352	0.3095391	0.0396875	0.3888672	7.83E+00	8.76E+00	1.09E+01	1.31E+01
MCU361	6.3998593	0.0474102	0.0000821	0.2552734	0.2479688	0.5142188	1.3255469	0.1684063	0.2600234	0.4553555	0.7744531	0.6962500	5.93E+00	6.67E+00	8.39E+00	1.01E+01
MCU362	6.4194124	0.0116445	0.0003845	1.2929688	0.2722500	1.5501563	1.3516406	0.0264063	0.1795898	0.1658359	0.1213281	0.8249219	9.25E+00	1.04E+01	1.30E+01	1.56E+01
MCU363	6.4261627	0.0350625	0.0002670	1.0373047	0.2352500	0.7134375	2.0822656	0.2272031	0.1018828	0.0496055	0.3180078	1.1251563	8.32E+00	9.34E+00	1.17E+01	1.42E+01
MCU364	6.4286402	0.0265469	0.0000551	0.5710938	0.1924688	1.8131250	1.4951563	0.1351250	0.2436641	0.2778398	0.4293359	0.1029297	8.11E+00	9.10E+00	1.14E+01	1.38E+01
MCU365	6.4307687	0.0014258	0.0003055	1.8644531	0.2144375	0.1396875	1.6386719	0.2027969	0.2736563	0.0728516	0.0545313	1.2967188	1.49E+01	1.66E+01	2.07E+01	2.48E+01
MCU366	6.4461221	0.1091484	0.0002959	1.1425781	0.1138438	1.4226563	0.8819531	0.2427344	0.0105430	0.2989727	0.1732813	1.7756641	4.04E+00	4.50E+00	5.57E+00	6.62E+00
MCU367	6.4753725	0.0239922	0.0002708	0.6058341	0.0607176	1.2477728	1.7175139	0.0358953	0.1894700	0.0731947	0.4330985	1.2509055	8.59E+00	9.70E+00	1.23E+01	1.49E+01
MCU368	6.4828172	0.0861563	0.0004345	2.5352444	0.0889692	0.9727698	0.8722801	0.2230397	0.1501743	0.0117462	0.4961979	0.4106938	5.29E+00	5.84E+00	7.08E+00	8.28E+00
MCU369	6.5053645	0.0384688	0.0001707	1.7140625	0.1173125	1.2553125	0.7253906	0.2227656	0.1414180	0.0580586	0.9043359	0.1601172	5.51E+00	6.13E+00	7.59E+00	9.04E+00
MCU370	6.5089521	0.0176055	0.0002901	1.8794922	0.1647188	0.1556250	0.5166406	0.2837813	0.2941055	0.1404766	0.9228906	0.5175391	7.26E+00	8.04E+00	9.84E+00	1.16E+01
MCU371	6.5348537	0.0870078	0.0002362	3.3683594	0.2248438	0.1237500	0.8950000	0.1395625	0.1523242	0.0559453	0.3885156	0.5246875	4.85E+00	5.35E+00	6.49E+00	7.60E+00
MCU372	6.5605308	0.0056836	0.0001957	0.4056641	0.2017188	1.3429688	2.0561719	0.0530313	0.0705273	0.4638086	0.5072656	0.3531250	1.41E+01	1.60E+01	2.03E+01	2.47E+01
MCU373	6.5672549	0.0295273	0.0002920	0.7214844	0.2109688	1.0481250	1.7560938	0.2771250	0.0269023	0.0390391	0.5889063	1.2466797	7.92E+00	8.93E+00	1.13E+01	1.37E+01
MCU374	6.5823726	0.0371914	0.0003305	0.9320313	0.0167188	2.0840625	0.5427344	0.2726875	0.0378086	0.3243320	0.6816797	0.6462109	5.20E+00	5.82E+00	7.27E+00	8.72E+00
MCU375	6.6655510	0.0133477	0.0003228	2.7193624	0.0383792	0.1597682	0.6470370	0.1197994	0.0823894	0.3454975	0.1544347	1.7478426	9.00E+00	9.93E+00	1.21E+01	1.41E+01
MCU376	6.6825144	0.0039805	0.0002785	2.3607422	0.0872500	0.2751563	1.7430469	0.2405156	0.0037266	0.2250078	0.5221094	0.4746484	1.32E+01	1.47E+01	1.82E+01	2.17E+01
MCU377	6.6909091	0.0980781	0.0001534	1.0523438	0.2063438	0.3787500	1.3646875	0.1473281	0.3200078	0.2884063	0.4924219	1.1180078	4.10E+00	4.58E+00	5.71E+00	6.84E+00
MCU378	6.6988180	0.0614609	0.0004750	0.1650391	0.1762813	2.0760938	1.6517188	0.0397188	0.3295508	0.1594961	0.5777734	0.1887109	4.55E+00	5.16E+00	6.60E+00	8.08E+00
MCU379	6.7024069	0.0022773	0.0002728	0.3003906	0.2086563	1.1915625	1.6647656	0.1062813	0.2750195	0.0939844	0.4367578	1.3467578	1.35E+01	1.53E+01	1.95E+01	2.38E+01
MCU380	6.7148153	0.0512422	0.0000128	0.9019531	0.1658750	1.9964063	0.2426563	0.0829844	0.2900156	0.4257695	0.0359766	1.5826563	4.16E+00	4.66E+00	5.82E+00	6.99E+00

Table C-1 Cont'd. Waste Compositions of the Second Test Matrix Along with D-value for Various Extractant Concentrations

													Extractant Concentration			
													0.005, M	0.0056, M	0.007, M	0.0084, M
Test ID	Na^+, M	K^+, M	Cs^+, M	NO_3^-, M	Cl^-, M	NO_2^-, M	OH^-, M	F^-, M	PO_4^{3-}, M	SO_4^{2-}, M	CO_3^{2-}, M	AlO_2^-, M	Extraction D-values at 23 °C			
MCU381	6.7269065	0.0261211	0.0002419	2.7968750	0.0213438	0.1715625	0.2296094	0.2604844	0.2041289	0.4299961	0.3736719	1.0536719	6.65E+00	7.33E+00	8.87E+00	1.04E+01
MCU382	6.7331929	0.0780664	0.0004711	0.6613281	0.1450625	1.7493750	1.4560156	0.2848906	0.0187227	0.3010859	0.6445703	0.5675781	4.29E+00	4.83E+00	6.09E+00	7.36E+00
MCU383	6.7332213	0.1061680	0.0001303	2.7066406	0.1716563	0.7692188	1.8474219	0.0807656	0.2613867	0.0432656	0.1844141	0.0242969	4.11E+00	4.57E+00	5.62E+00	6.67E+00
MCU384	6.7640791	0.0606094	0.0001591	2.6164063	0.1635625	0.4823438	0.7775781	0.0929688	0.1686836	0.0305859	0.6928125	0.7391406	4.91E+00	5.44E+00	6.67E+00	7.88E+00
MCU385	6.7702938	0.0691250	0.0001437	1.1275391	0.2514375	1.0640625	1.6778125	0.2150000	0.2327578	0.3496914	0.1584375	0.7891797	5.46E+00	6.12E+00	7.65E+00	9.18E+00
MCU386	6.8485212	0.0618867	0.0000648	2.0449219	0.2907500	1.5820313	0.5557813	0.0874219	0.2286680	0.4976211	0.2326563	0.2030078	4.24E+00	4.73E+00	5.88E+00	7.02E+00
MCU387	6.8501420	0.0721055	0.0004596	1.4132813	0.0595000	2.0282813	0.6210156	0.1617500	0.1550508	0.4786016	0.2994531	0.6176172	4.74E+00	5.28E+00	6.51E+00	7.73E+00
MCU388	6.8576803	0.0929688	0.0003883	3.4139984	0.0121014	1.2605553	1.2774819	0.0163085	0.0091040	0.1233290	0.1371751	0.4222716	4.99E+00	5.50E+00	6.66E+00	7.78E+00
MCU389	6.8800203	0.0946719	0.0001399	0.7515625	0.1820625	1.6218750	0.1121875	0.0707813	0.2859258	0.4722617	0.7187891	0.9964844	2.88E+00	3.22E+00	4.01E+00	4.80E+00
MCU390	6.8954071	0.0759375	0.0002400	2.3890662	0.0290632	1.1971942	0.6377630	0.0329362	0.2424860	0.1762205	0.4901907	0.6252814	4.54E+00	5.03E+00	6.15E+00	7.25E+00
MCU391	6.9045822	0.0444297	0.0001014	3.7593750	0.2583750	0.8010938	0.4905469	0.0020000	0.1196055	0.0094531	0.2103906	0.8392188	4.25E+00	4.72E+00	5.79E+00	6.85E+00
MCU392	6.9280655	0.0853047	0.0000840	1.1216461	0.0099184	0.8562844	2.4236710	0.0256882	0.0662971	0.2251668	0.6268420	0.6733373	4.57E+00	5.12E+00	6.41E+00	7.70E+00
MCU393	6.9412213	0.0938203	0.0004076	1.1576172	0.2757188	1.8928125	1.9257031	0.0219688	0.0596211	0.0179063	0.4182031	0.7105469	4.12E+00	4.61E+00	5.74E+00	6.87E+00
MCU394	6.9534868	0.0154766	0.0003922	1.2779297	0.1439063	0.8090625	1.0254688	0.1284688	0.1386914	0.5398867	0.2029688	1.6827344	9.00E+00	1.01E+01	1.26E+01	1.51E+01
MCU395	6.9882111	0.0848789	0.0002651	1.1244387	0.1669274	1.4540607	3.1366202	0.0071513	0.1136450	0.0917110	0.1050015	0.4497966	4.99E+00	5.59E+00	6.99E+00	8.39E+00

Table C-2. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order

Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU333	3.95E+01		MCU333	3.21E+01		MCU333	2.47E+01		MCU333	2.15E+01
MCU257	3.61E+01		MCU257	2.99E+01		MCU257	2.36E+01		MCU257	2.10E+01
MCU288	3.12E+01		MCU288	2.53E+01		MCU288	1.95E+01		MCU288	1.71E+01
MCU289	2.83E+01		MCU289	2.35E+01		MCU289	1.87E+01		MCU289	1.66E+01
MCU331	2.80E+01		MCU331	2.33E+01		MCU331	1.86E+01		MCU331	1.65E+01
MCU290	2.59E+01		MCU290	2.14E+01		MCU290	1.70E+01		MCU290	1.51E+01
MCU365	2.48E+01		MCU365	2.07E+01		MCU365	1.66E+01		MCU365	1.49E+01
MCU372	2.47E+01		MCU372	2.03E+01		MCU372	1.60E+01		MCU372	1.41E+01
MCU253	2.45E+01		MCU253	2.01E+01		MCU253	1.58E+01		MCU253	1.40E+01
MCU379	2.38E+01		MCU379	1.95E+01		MCU379	1.53E+01		MCU379	1.35E+01
MCU376	2.17E+01		MCU376	1.82E+01		MCU376	1.47E+01		MCU376	1.32E+01
MCU252	2.11E+01		MCU252	1.73E+01		MCU248	1.37E+01		MCU248	1.23E+01
MCU248	2.04E+01		MCU248	1.71E+01		MCU252	1.35E+01		MCU252	1.19E+01
MCU349	1.93E+01		MCU349	1.60E+01		MCU349	1.27E+01		MCU349	1.13E+01
MCU283	1.89E+01		MCU283	1.57E+01		MCU283	1.25E+01		MCU323	1.12E+01
MCU323	1.84E+01		MCU323	1.54E+01		MCU323	1.25E+01		MCU283	1.11E+01
MCU303	1.79E+01		MCU303	1.50E+01		MCU303	1.22E+01		MCU303	1.10E+01
MCU216	1.78E+01		MCU216	1.47E+01		MCU216	1.17E+01		MCU216	1.04E+01
MCU329	1.65E+01		MCU329	1.36E+01		MCU310	1.08E+01		MCU310	9.77E+00
MCU282	1.60E+01		MCU282	1.34E+01		MCU282	1.07E+01		MCU282	9.58E+00
MCU362	1.56E+01		MCU310	1.32E+01		MCU329	1.07E+01		MCU329	9.48E+00
MCU310	1.56E+01		MCU362	1.30E+01		MCU362	1.04E+01		MCU362	9.25E+00
MCU327	1.52E+01		MCU394	1.26E+01		MCU301	1.02E+01		MCU301	9.15E+00
MCU394	1.51E+01		MCU327	1.26E+01		MCU394	1.01E+01		MCU394	9.00E+00
MCU273	1.50E+01		MCU301	1.25E+01		MCU273	9.99E+00		MCU375	9.00E+00
MCU367	1.49E+01		MCU273	1.25E+01		MCU327	9.95E+00		MCU273	8.92E+00
MCU301	1.48E+01		MCU367	1.23E+01		MCU375	9.93E+00		MCU327	8.84E+00
MCU276	1.43E+01		MCU375	1.21E+01		MCU367	9.70E+00		MCU367	8.59E+00
MCU363	1.42E+01		MCU326	1.18E+01		MCU326	9.48E+00		MCU326	8.50E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU375	1.41E+01		MCU363	1.17E+01		MCU363	9.34E+00		MCU363	8.32E+00
MCU326	1.40E+01		MCU276	1.17E+01		MCU276	9.22E+00		MCU202	8.29E+00
MCU231	1.39E+01		MCU231	1.15E+01		MCU231	9.19E+00		MCU231	8.18E+00
MCU215	1.38E+01		MCU215	1.15E+01		MCU202	9.17E+00		MCU276	8.15E+00
MCU364	1.38E+01		MCU364	1.14E+01		MCU215	9.14E+00		MCU215	8.15E+00
MCU206	1.37E+01		MCU206	1.14E+01		MCU364	9.10E+00		MCU280	8.13E+00
MCU373	1.37E+01		MCU373	1.13E+01		MCU280	9.06E+00		MCU364	8.11E+00
MCU235	1.35E+01		MCU280	1.12E+01		MCU206	9.01E+00		MCU240	8.06E+00
MCU280	1.34E+01		MCU202	1.12E+01		MCU240	8.97E+00		MCU206	8.00E+00
MCU202	1.32E+01		MCU235	1.12E+01		MCU235	8.94E+00		MCU235	7.98E+00
MCU240	1.32E+01		MCU240	1.11E+01		MCU373	8.93E+00		MCU373	7.92E+00
MCU360	1.31E+01		MCU360	1.09E+01		MCU360	8.76E+00		MCU232	7.86E+00
MCU315	1.29E+01		MCU291	1.05E+01		MCU232	8.66E+00		MCU360	7.83E+00
MCU291	1.27E+01		MCU315	1.05E+01		MCU236	8.46E+00		MCU236	7.62E+00
MCU214	1.24E+01		MCU232	1.05E+01		MCU306	8.42E+00		MCU306	7.56E+00
MCU236	1.23E+01		MCU236	1.04E+01		MCU279	8.35E+00		MCU201	7.55E+00
MCU279	1.23E+01		MCU306	1.04E+01		MCU291	8.35E+00		MCU279	7.49E+00
MCU306	1.23E+01		MCU279	1.03E+01		MCU201	8.32E+00		MCU291	7.44E+00
MCU222	1.23E+01		MCU222	1.02E+01		MCU227	8.18E+00		MCU198	7.42E+00
MCU232	1.23E+01		MCU214	1.02E+01		MCU198	8.16E+00		MCU227	7.42E+00
MCU201	1.18E+01		MCU201	1.01E+01		MCU222	8.15E+00		MCU277	7.38E+00
MCU247	1.18E+01		MCU227	9.90E+00		MCU315	8.15E+00		MCU222	7.27E+00
MCU321	1.18E+01		MCU277	9.89E+00		MCU277	8.15E+00		MCU370	7.26E+00
MCU193	1.17E+01		MCU321	9.87E+00		MCU214	8.06E+00		MCU321	7.17E+00
MCU370	1.16E+01		MCU370	9.84E+00		MCU370	8.04E+00		MCU315	7.17E+00
MCU277	1.16E+01		MCU198	9.81E+00		MCU321	7.98E+00		MCU214	7.15E+00
MCU227	1.16E+01		MCU247	9.77E+00		MCU337	7.80E+00		MCU337	7.04E+00
MCU293	1.14E+01		MCU193	9.61E+00		MCU247	7.77E+00		MCU356	7.01E+00
MCU198	1.14E+01		MCU337	9.55E+00		MCU356	7.74E+00		MCU358	6.95E+00
MCU337	1.13E+01		MCU293	9.41E+00		MCU358	7.66E+00		MCU281	6.93E+00
MCU298	1.12E+01		MCU356	9.41E+00		MCU281	7.65E+00		MCU247	6.91E+00
MCU355	1.11E+01		MCU298	9.35E+00		MCU340	7.53E+00		MCU340	6.81E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU356	1.10E+01		MCU281	9.29E+00		MCU193	7.52E+00		MCU344	6.76E+00
MCU262	1.10E+01		MCU358	9.29E+00		MCU298	7.50E+00		MCU305	6.74E+00
MCU256	1.09E+01		MCU208	9.20E+00		MCU208	7.48E+00		MCU208	6.74E+00
MCU281	1.09E+01		MCU355	9.19E+00		MCU344	7.47E+00		MCU229	6.73E+00
MCU208	1.09E+01		MCU340	9.18E+00		MCU305	7.44E+00		MCU298	6.71E+00
MCU358	1.09E+01		MCU256	9.18E+00		MCU256	7.44E+00		MCU256	6.69E+00
MCU241	1.08E+01		MCU325	9.08E+00		MCU229	7.42E+00		MCU325	6.65E+00
MCU340	1.08E+01		MCU344	9.08E+00		MCU293	7.41E+00		MCU381	6.65E+00
MCU339	1.08E+01		MCU262	9.06E+00		MCU325	7.39E+00		MCU193	6.64E+00
MCU325	1.08E+01		MCU339	9.06E+00		MCU355	7.33E+00		MCU217	6.57E+00
MCU344	1.07E+01		MCU305	9.05E+00		MCU381	7.33E+00		MCU339	6.57E+00
MCU305	1.06E+01		MCU229	9.00E+00		MCU339	7.32E+00		MCU293	6.56E+00
MCU229	1.05E+01		MCU241	8.98E+00		MCU217	7.22E+00		MCU355	6.54E+00
MCU316	1.05E+01		MCU381	8.87E+00		MCU241	7.14E+00		MCU241	6.35E+00
MCU381	1.04E+01		MCU332	8.72E+00		MCU262	7.13E+00		MCU318	6.35E+00
MCU332	1.04E+01		MCU217	8.69E+00		MCU332	7.06E+00		MCU332	6.34E+00
MCU242	1.03E+01		MCU318	8.63E+00		MCU318	7.04E+00		MCU262	6.31E+00
MCU324	1.02E+01		MCU316	8.62E+00		MCU270	6.94E+00		MCU320	6.29E+00
MCU318	1.02E+01		MCU242	8.58E+00		MCU320	6.93E+00		MCU270	6.28E+00
MCU361	1.01E+01		MCU324	8.53E+00		MCU242	6.85E+00		MCU254	6.21E+00
MCU217	1.01E+01		MCU270	8.46E+00		MCU302	6.84E+00		MCU357	6.17E+00
MCU223	1.01E+01		MCU302	8.44E+00		MCU254	6.82E+00		MCU302	6.15E+00
MCU359	1.01E+01		MCU359	8.40E+00		MCU324	6.82E+00		MCU317	6.11E+00
MCU302	1.00E+01		MCU223	8.40E+00		MCU357	6.79E+00		MCU242	6.10E+00
MCU270	9.94E+00		MCU320	8.39E+00		MCU316	6.77E+00		MCU278	6.10E+00
MCU335	9.84E+00		MCU361	8.39E+00		MCU278	6.76E+00		MCU324	6.09E+00
MCU320	9.81E+00		MCU278	8.26E+00		MCU359	6.74E+00		MCU351	6.03E+00
MCU272	9.80E+00		MCU272	8.26E+00		MCU317	6.73E+00		MCU359	6.03E+00
MCU278	9.74E+00		MCU254	8.21E+00		MCU223	6.71E+00		MCU272	6.03E+00
MCU351	9.70E+00		MCU351	8.20E+00		MCU272	6.70E+00		MCU316	5.99E+00
MCU338	9.65E+00		MCU357	8.20E+00		MCU351	6.69E+00		MCU223	5.99E+00
MCU357	9.56E+00		MCU335	8.18E+00		MCU361	6.67E+00		MCU295	5.99E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU254	9.55E+00		MCU317	8.13E+00		MCU295	6.58E+00		MCU361	5.93E+00
MCU347	9.50E+00		MCU338	8.10E+00		MCU338	6.55E+00		MCU338	5.88E+00
MCU183	9.49E+00		MCU347	8.01E+00		MCU335	6.53E+00		MCU347	5.86E+00
MCU317	9.49E+00		MCU183	7.96E+00		MCU347	6.51E+00		MCU335	5.83E+00
MCU221	9.42E+00		MCU295	7.91E+00		MCU183	6.43E+00		MCU228	5.80E+00
MCU195	9.30E+00		MCU195	7.87E+00		MCU195	6.42E+00		MCU195	5.79E+00
MCU234	9.26E+00		MCU221	7.81E+00		MCU228	6.40E+00		MCU183	5.77E+00
MCU243	9.20E+00		MCU243	7.80E+00		MCU243	6.38E+00		MCU243	5.76E+00
MCU295	9.19E+00		MCU234	7.78E+00		MCU234	6.28E+00		MCU234	5.64E+00
MCU385	9.18E+00		MCU228	7.76E+00		MCU221	6.21E+00		MCU219	5.57E+00
MCU330	9.16E+00		MCU385	7.65E+00		MCU200	6.15E+00		MCU200	5.56E+00
MCU228	9.09E+00		MCU330	7.59E+00		MCU369	6.13E+00		MCU221	5.53E+00
MCU352	9.04E+00		MCU369	7.59E+00		MCU219	6.12E+00		MCU342	5.52E+00
MCU336	9.04E+00		MCU336	7.57E+00		MCU385	6.12E+00		MCU369	5.51E+00
MCU369	9.04E+00		MCU352	7.54E+00		MCU342	6.10E+00		MCU350	5.49E+00
MCU260	9.00E+00		MCU200	7.51E+00		MCU336	6.10E+00		MCU265	5.48E+00
MCU207	8.98E+00		MCU238	7.48E+00		MCU350	6.06E+00		MCU336	5.47E+00
MCU238	8.95E+00		MCU207	7.45E+00		MCU265	6.06E+00		MCU385	5.46E+00
MCU200	8.84E+00		MCU342	7.44E+00		MCU352	6.05E+00		MCU304	5.45E+00
MCU342	8.74E+00		MCU260	7.43E+00		MCU330	6.04E+00		MCU285	5.43E+00
MCU311	8.73E+00		MCU311	7.38E+00		MCU304	6.02E+00		MCU311	5.41E+00
MCU374	8.72E+00		MCU219	7.37E+00		MCU311	6.00E+00		MCU352	5.41E+00
MCU265	8.66E+00		MCU265	7.37E+00		MCU285	6.00E+00		MCU330	5.37E+00
MCU211	8.66E+00		MCU350	7.35E+00		MCU238	6.00E+00		MCU238	5.37E+00
MCU267	8.66E+00		MCU304	7.33E+00		MCU207	5.93E+00		MCU368	5.29E+00
MCU296	8.65E+00		MCU285	7.30E+00		MCU260	5.87E+00		MCU207	5.28E+00
MCU304	8.61E+00		MCU374	7.27E+00		MCU267	5.87E+00		MCU267	5.26E+00
MCU204	8.60E+00		MCU267	7.27E+00		MCU368	5.84E+00		MCU258	5.22E+00
MCU350	8.60E+00		MCU211	7.22E+00		MCU374	5.82E+00		MCU260	5.21E+00
MCU219	8.59E+00		MCU204	7.17E+00		MCU211	5.78E+00		MCU374	5.20E+00
MCU308	8.57E+00		MCU308	7.15E+00		MCU258	5.76E+00		MCU211	5.16E+00
MCU251	8.56E+00		MCU296	7.11E+00		MCU308	5.74E+00		MCU245	5.16E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU285	8.56E+00		MCU251	7.09E+00		MCU204	5.74E+00		MCU237	5.16E+00
MCU250	8.43E+00		MCU368	7.08E+00		MCU237	5.72E+00		MCU307	5.15E+00
MCU341	8.41E+00		MCU250	7.06E+00		MCU245	5.69E+00		MCU308	5.13E+00
MCU328	8.40E+00		MCU258	7.00E+00		MCU250	5.68E+00		MCU204	5.13E+00
MCU196	8.39E+00		MCU237	7.00E+00		MCU307	5.68E+00		MCU250	5.09E+00
MCU395	8.39E+00		MCU395	6.99E+00		MCU251	5.63E+00		MCU334	5.09E+00
MCU322	8.31E+00		MCU196	6.98E+00		MCU334	5.63E+00		MCU312	5.08E+00
MCU313	8.30E+00		MCU322	6.91E+00		MCU312	5.63E+00		MCU264	5.03E+00
MCU368	8.28E+00		MCU341	6.91E+00		MCU395	5.59E+00		MCU251	5.01E+00
MCU237	8.26E+00		MCU328	6.89E+00		MCU296	5.59E+00		MCU388	4.99E+00
MCU258	8.21E+00		MCU312	6.89E+00		MCU196	5.56E+00		MCU189	4.99E+00
MCU189	8.19E+00		MCU313	6.89E+00		MCU189	5.56E+00		MCU395	4.99E+00
MCU294	8.15E+00		MCU189	6.88E+00		MCU264	5.55E+00		MCU196	4.96E+00
MCU312	8.13E+00		MCU334	6.88E+00		MCU322	5.52E+00		MCU296	4.95E+00
MCU261	8.10E+00		MCU245	6.87E+00		MCU388	5.50E+00		MCU322	4.92E+00
MCU334	8.10E+00		MCU307	6.87E+00		MCU313	5.49E+00		MCU384	4.91E+00
MCU378	8.08E+00		MCU294	6.76E+00		MCU384	5.44E+00		MCU313	4.89E+00
MCU307	8.03E+00		MCU261	6.76E+00		MCU341	5.43E+00		MCU371	4.85E+00
MCU245	8.02E+00		MCU264	6.75E+00		MCU261	5.41E+00		MCU261	4.83E+00
MCU264	7.92E+00		MCU384	6.67E+00		MCU328	5.41E+00		MCU341	4.81E+00
MCU348	7.89E+00		MCU388	6.66E+00		MCU294	5.38E+00		MCU269	4.80E+00
MCU384	7.88E+00		MCU378	6.60E+00		MCU371	5.35E+00		MCU294	4.79E+00
MCU192	7.86E+00		MCU269	6.60E+00		MCU269	5.34E+00		MCU271	4.78E+00
MCU269	7.85E+00		MCU192	6.54E+00		MCU271	5.29E+00		MCU328	4.78E+00
MCU182	7.81E+00		MCU182	6.53E+00		MCU387	5.28E+00		MCU387	4.74E+00
MCU388	7.78E+00		MCU348	6.52E+00		MCU182	5.25E+00		MCU314	4.71E+00
MCU387	7.73E+00		MCU387	6.51E+00		MCU314	5.23E+00		MCU182	4.70E+00
MCU392	7.70E+00		MCU371	6.49E+00		MCU192	5.22E+00		MCU205	4.67E+00
MCU255	7.66E+00		MCU271	6.45E+00		MCU205	5.20E+00		MCU192	4.66E+00
MCU205	7.65E+00		MCU314	6.45E+00		MCU348	5.16E+00		MCU348	4.59E+00
MCU314	7.65E+00		MCU205	6.43E+00		MCU378	5.16E+00		MCU392	4.57E+00
MCU371	7.60E+00		MCU392	6.41E+00		MCU392	5.12E+00		MCU378	4.55E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order									
Extractant Conc. = 0.0084 M			Extractant Conc. = 0.007 M			Extractant Conc. = 0.0056 M			Extractant Conc. = 0.005 M	
Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value		Test ID	Extraction D-value
MCU271	7.59E+00		MCU255	6.35E+00		MCU255	5.04E+00		MCU390	4.54E+00
MCU275	7.51E+00		MCU287	6.26E+00		MCU259	5.03E+00		MCU259	4.51E+00
MCU287	7.49E+00		MCU259	6.24E+00		MCU287	5.03E+00		MCU287	4.50E+00
MCU259	7.45E+00		MCU275	6.22E+00		MCU390	5.03E+00		MCU187	4.49E+00
MCU345	7.41E+00		MCU345	6.20E+00		MCU345	4.99E+00		MCU255	4.49E+00
MCU268	7.36E+00		MCU390	6.15E+00		MCU187	4.97E+00		MCU345	4.47E+00
MCU382	7.36E+00		MCU382	6.09E+00		MCU275	4.94E+00		MCU319	4.40E+00
MCU319	7.26E+00		MCU319	6.09E+00		MCU319	4.91E+00		MCU275	4.40E+00
MCU390	7.25E+00		MCU268	6.08E+00		MCU382	4.83E+00		MCU382	4.29E+00
MCU343	7.22E+00		MCU187	6.07E+00		MCU268	4.81E+00		MCU343	4.27E+00
MCU187	7.15E+00		MCU343	6.00E+00		MCU343	4.79E+00		MCU268	4.27E+00
MCU213	7.05E+00		MCU386	5.88E+00		MCU386	4.73E+00		MCU391	4.25E+00
MCU386	7.02E+00		MCU213	5.87E+00		MCU391	4.72E+00		MCU386	4.24E+00
MCU186	7.01E+00		MCU186	5.84E+00		MCU213	4.70E+00		MCU213	4.19E+00
MCU380	6.99E+00		MCU218	5.83E+00		MCU218	4.68E+00		MCU218	4.19E+00
MCU212	6.99E+00		MCU380	5.82E+00		MCU186	4.67E+00		MCU186	4.17E+00
MCU218	6.98E+00		MCU212	5.80E+00		MCU380	4.66E+00		MCU266	4.16E+00
MCU225	6.96E+00		MCU391	5.79E+00		MCU225	4.62E+00		MCU380	4.16E+00
MCU263	6.93E+00		MCU225	5.79E+00		MCU263	4.62E+00		MCU353	4.13E+00
MCU233	6.89E+00		MCU263	5.77E+00		MCU212	4.62E+00		MCU263	4.12E+00
MCU393	6.87E+00		MCU393	5.74E+00		MCU393	4.61E+00		MCU393	4.12E+00
MCU391	6.85E+00		MCU353	5.72E+00		MCU353	4.61E+00		MCU225	4.12E+00
MCU377	6.84E+00		MCU377	5.71E+00		MCU266	4.60E+00		MCU220	4.12E+00
MCU353	6.82E+00		MCU220	5.70E+00		MCU220	4.59E+00		MCU212	4.11E+00
MCU220	6.81E+00		MCU233	5.70E+00		MCU377	4.58E+00		MCU274	4.11E+00
MCU194	6.71E+00		MCU274	5.64E+00		MCU274	4.57E+00		MCU383	4.11E+00
MCU274	6.70E+00		MCU194	5.64E+00		MCU194	4.57E+00		MCU194	4.10E+00
MCU383	6.67E+00		MCU383	5.62E+00		MCU383	4.57E+00		MCU377	4.10E+00
MCU366	6.62E+00		MCU266	5.62E+00		MCU284	4.54E+00		MCU284	4.09E+00
MCU266	6.61E+00		MCU284	5.57E+00		MCU233	4.51E+00		MCU244	4.05E+00
MCU188	6.59E+00		MCU366	5.57E+00		MCU366	4.50E+00		MCU366	4.04E+00
MCU284	6.59E+00		MCU244	5.51E+00		MCU244	4.49E+00		MCU233	4.01E+00

Table C-2 Cont'd. D-values (at 23 °C) at Various Extractant Concentrations for the Second Test Matrix Sorted in Descending Order							
Extractant Conc. = 0.0084 M		Extractant Conc. = 0.007 M		Extractant Conc. = 0.0056 M		Extractant Conc. = 0.005 M	
Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value	Test ID	Extraction D-value
MCU249	6.56E+00	MCU286	5.48E+00	MCU309	4.43E+00	MCU309	3.99E+00
MCU286	6.53E+00	MCU188	5.47E+00	MCU286	4.43E+00	MCU286	3.97E+00
MCU244	6.52E+00	MCU309	5.44E+00	MCU188	4.34E+00	MCU188	3.87E+00
MCU309	6.45E+00	MCU249	5.43E+00	MCU249	4.31E+00	MCU230	3.83E+00
MCU230	6.39E+00	MCU230	5.34E+00	MCU230	4.28E+00	MCU249	3.83E+00
MCU203	6.25E+00	MCU203	5.24E+00	MCU184	4.24E+00	MCU184	3.81E+00
MCU209	6.18E+00	MCU184	5.21E+00	MCU203	4.21E+00	MCU203	3.77E+00
MCU184	6.17E+00	MCU209	5.19E+00	MCU209	4.19E+00	MCU209	3.75E+00
MCU300	6.16E+00	MCU300	5.14E+00	MCU300	4.13E+00	MCU239	3.69E+00
MCU299	6.13E+00	MCU239	5.10E+00	MCU239	4.12E+00	MCU300	3.69E+00
MCU239	6.09E+00	MCU299	5.06E+00	MCU299	4.00E+00	MCU346	3.59E+00
MCU346	5.84E+00	MCU346	4.92E+00	MCU346	3.99E+00	MCU299	3.55E+00
MCU354	5.74E+00	MCU297	4.82E+00	MCU297	3.91E+00	MCU297	3.52E+00
MCU297	5.73E+00	MCU354	4.80E+00	MCU185	3.88E+00	MCU185	3.49E+00
MCU226	5.71E+00	MCU185	4.77E+00	MCU354	3.85E+00	MCU354	3.44E+00
MCU185	5.65E+00	MCU226	4.74E+00	MCU226	3.77E+00	MCU190	3.36E+00
MCU190	5.64E+00	MCU190	4.70E+00	MCU190	3.76E+00	MCU226	3.35E+00
MCU292	5.56E+00	MCU292	4.66E+00	MCU292	3.74E+00	MCU292	3.35E+00
MCU246	5.54E+00	MCU246	4.63E+00	MCU246	3.72E+00	MCU246	3.33E+00
MCU181	5.47E+00	MCU210	4.58E+00	MCU210	3.71E+00	MCU210	3.33E+00
MCU210	5.44E+00	MCU181	4.56E+00	MCU181	3.65E+00	MCU181	3.26E+00
MCU191	5.27E+00	MCU191	4.41E+00	MCU191	3.54E+00	MCU191	3.17E+00
MCU197	5.15E+00	MCU197	4.28E+00	MCU197	3.41E+00	MCU197	3.04E+00
MCU389	4.80E+00	MCU389	4.01E+00	MCU389	3.22E+00	MCU389	2.88E+00
MCU199	4.47E+00	MCU199	3.75E+00	MCU199	3.02E+00	MCU199	2.70E+00
MCU224	3.80E+00	MCU224	3.16E+00	MCU224	2.51E+00	MCU224	2.24E+00
Maximum	3.95E+01	Maximum	3.21E+01	Maximum	2.47E+01	Maximum	2.15E+01
Minimum	3.80E+00	Minimum	3.16E+00	Minimum	2.51E+00	Minimum	2.24E+00
Median	9.04E+00	Median	7.54E+00	Median	6.10E+00	Median	5.49E+00