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PRODUCTION LOW SLUDGES SIMULATED PUREX WASTE GLASSES, I: EFFECTS OF SLUDGE OXIDE ADDITION TO MELTER OPERATIONS (U)

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Production and Remediation of Low-Sludge, Simulated Purex Waste Glasses, I: Effects of Sludge Oxide Additions On Melter Operation (U)

Introduction and Summary

Glass produced during the Purex 4 campaigns of the Integrated DWPF Melter System (IDMS)[1] and the 774 Research Melter[2] contained a lower fraction of sludge components than targeted by the Product Composition Control System (PCCS).[3] Purex 4 glass was more durable than the benchmark (EA) glass, but less durable than most simulated SRS high-level waste glasses.[1,2,4] Also, Purex 4 glass was considerably less durable than predicted by the algorithm which will be used to control production of DWPF glass.[4]

A melter run was performed using the 774 Research Melter to determine if the initial PCCS target composition determined for Purex 4 would produce acceptable glass whose durability could be accurately modeled by Hydration Thermodynamics. Reagent grade oxides and carbonates were added to Purex 4 melter feed stock to simulate a higher sludge loading. Each canister of glass produced was sampled and the composition, crystallinity, and durability was determined. This document details the melter operation and composition and crystallinity analyses.

Approximately 30 kilograms of glass was produced during this campaign, designated Purex 4 Remediation. The chemical composition of the melter glass was very close to the initial PCCS target. The addition of refractory oxides had no appreciable effect on melter operation. Crystal species observed in the glass were consistent with previous melter experience. This study indicates a low sludge glass may be successfully remediated by adding reagent chemicals to supplement the concentration of major sludge components.

Background and Objectives

The Purex 4 campaigns were performed as a validation exercise for the nitric acid flow sheet. Purex sludge was chosen due to its high copper content. High copper content in the melter feed was identified by Schumacher as leading to copper precipitation from the melt under reducing conditions.[5] Precipitation of a metallic phase from the melt could potentially lead to the formation of a conduction path between two electrodes. This would "short" the melter, effectively ending its service life. Purex 4, therefore, was intended to be a "worst case" product of the nitric acid flow sheet.

During operation of the Defense Waste Processing Facility (DWPF), the PCCS will be used to calculate a target melter feed composition based on the composition of sludge, frit, Precipitate Hydrolysis Aqueous (PHA), and the process vessel heels.[6] A target blend was calculated for Purex 4 melter feed by the PCCS. This target was 24.3% sludge, 9.6% PHA, and 66.1% frit (on a dry oxide basis).[3] However, excess PHA was added to the feed stock. Additional frit was added to offset the PHA content. These additions diluted the sludge content to approximately 20% (versus 11% PHA and 68% frit). The DWPF design basis sludge loading is 28%. The processing (viscosity and liquidus) and durability algorithms developed to control DWPF were based on data from glasses with sludge content varying from 25% to 35%. Actual Purex 4 melter feed, therefore, was considerably lower in sludge than the expected or bounding conditions evaluated for DWPF operations.

Purex 4 feed was successfully processed during one campaign of the IDMS[1] and three campaigns of the 774 Research Melter[2]. The three Research Melter campaigns had increasing copper concentrations to determine if high copper concentrations (up to 2 weight percent) would affect melter operation.[2] No effect was determined as a function of copper concentration.[2] However, during the Purex 4 melter campaigns, the glass durability decreased as a function of time.[1,2] Glass poured during the initial portion of the run (a combination of melter heel and Purex 4 feed) was substantially more durable than glass poured at the end of the run (composition dominated by Purex 4 feed). Also, the measured boron release was significantly higher than predicted by the DWPF durability algorithm.[4]

Analyses performed on Purex 4 glass indicated the presence of glass-in-glass phase separation. Phase separation is a phenomenon that occurs whenever a combination of phases is more thermodynamically stable than a single homogeneous phase. Glass-in-glass is a term used if both phases are amorphous. One of the phases was predominately silica. The other phase consisted of the remaining silica and the other glass oxides. This "low silica" composition was considerably less durable than the DWPF durability algorithm predicted. The DWPF processing and durability algorithms were all developed to predict the properties of homogeneous, single phase glasses.[7] As indicated by the Purex 4 glass, DWPF glass that is significantly depleted in sludge may also be inhomogeneous. The current liquidus or viscosity algorithms have not been demonstrated to model melt properties of phase separated glasses. Essentially, the production variables and waste acceptance criteria of low sludge glasses cannot at this time be controlled to the same degree as glasses previously produced at SRS. SRTC has begun investigations concerning low sludge glasses, but composition-property correlations are not currently available for these glasses.[8]

Research was therefore performed to determine if the Purex 4 melter feed composition could be successfully remediated to yield a homogeneous, single phase glass upon melting. The chosen remediation technique was to add reagent grade oxides and carbonates of sludge cations to "increase" the sludge loading to that specified by the PCCS. Three specific objectives were chosen for this melter campaign. The objectives were to determine if:

1) Melter feed doped with refractory, water insoluble oxides could be successfully processed into glass within the 774 Research Melter.

2) The crystallinity observed upon cooling the remediated glass was consistent with the devitrification characteristics of common SRS glasses.

3) The durability of glass produced from the remediated feed could be successfully modeled using the Hydration Thermodynamic model developed for DWPF.

This report provides data and analyses concerning melter operation and crystallinity. An additional report on glass durability will be subsequently released.

Experimental

Approximately 86 kilograms of Purex 4 melter feed was transferred to the melter feed tank. The melter feed was allowed to agitate within the tank for 12 hours and then five samples were taken. The weight percent solids was determined for two samples (both were approximately 42 percent solids). Two samples were submitted to the SRTC Analytic Development Section (ADS) for Ion Conductivity (IC) analysis for formate and nitrate content. The formate and nitrate content indicated glass produced from this feed would be oxidized. The IC results are shown in Table 1. The fifth sample was vitrified and sent to ADS for elemental analysis. A Corning Engineering Laboratory Services (CELS) analyzed standard glass (EA) was also simultaneously submitted for elemental analysis.[9] The ADS glass analyses were bias corrected against the Corning analysis of the EA glass. The composition of the vitrified melter feed was compared with the PCCS target composition. The amount of individual chemicals needed to "increase" the sludge content to match the target composition was calculated with a spreadsheet developed by K. G. Brown.[10] The methodology used to calculate the additives is given in Appendix 1. Table 2 lists the chemicals added to the melter feed tank.

Table 1. Formate and Nitrate Concentration of PX 4 Melter Feed.

Sample ID	Formate ppm	Nitrate ppm
ADS 3663	19100	26700
ADS 3664	20000	27800

Table 2. Chemicals Added to 86 kilograms of Purex 4 Melter Feed to Simulate a Higher Sludge Loading.

Chemical	Kilograms Added
Al_2O_3	0.068
Fe_2O_3	1.708
MnO_2	0.430
$CaCO_3$	0.298
NiO	0.161
Na_2CO_3	0.834

Melter run Purex 4 Remediation was initiated at 8:00AM, February 24. Approximately 80 kilograms of slurry were fed to the melter. Twenty eight kilograms of glass were poured from the melter into 10 stainless steel cans. Two samples (approximately 100 grams each) were taken from each can. A portion of each sample was sent to ADS for elemental analysis. Two samples of the glass produced immediately prior to the Purex 4 remediation campaign were submitted to ADS to represent the melter "heel". The EA standard was likewise submitted to bias correct the ADS analyses of production glass. Analyzed glass compositions determined for Purex 4 Remediation melter product are shown in Appendix 2.

Results and Discussion

Glass produced at the end of the Purex 4 Remediation campaign was essentially identical in composition and predicted properties to the initial PCCS target. Table 3 compares the composition of the initial Purex 4 target composition, the "as received" melter feed, and the glass sampled from the last canister (#10) poured during the Purex 4 Remediation campaign. Close agreement is observed between the canister glass and target composition with respect to sludge, frit, and PHA components. Likewise, the predicted viscosity is equivalent (52 poise) and the liquidus only 8°C lower for the canister glass versus the target composition. As the remediated feed was based on additions to the "as-received" material, these results also demonstrate good consistency among the multiple ADS analyses.

During the course of the Purex 4 Remediation campaign, the concentrations of sludge components increased significantly versus the initial melter heel composition. Glass produced immediately prior to the campaign was a "Blend" composition, significantly lower in the sludge components iron and copper. This glass was assumed to represent the composition of the melter heel at the start of the campaign. The iron and copper concentrations (on an elemental weight basis) in these glasses was approximately 4.8% and 0.05%, respectively. The last can (#10) of the Purex 4 Remediation campaign had iron and copper concentrations of 9.6% and 0.36%, respectively. Figure 1 is a plot of the change in iron and copper concentration in the glass as a function of the number of melter volumes poured during the run (3 cans $\cong$ 1 melter volume). Iron and copper are shown to increase in an identical manner. Their behavior indicates the melter was acting as a Continuously Stirred Tank Reactor (CSTR).[11] Components added to a CSTR have a theoretical concentration ingrowth behavior described mathematically as:[11]

$$\left(\frac{C - Ci}{Cf - Ci}\right) = 1 - \exp^{-Vm}$$

where,

C	concentration of a component at a given time,
C_i	initial concentration of the given component,
C_f	final concentration of the given component,
V_m	melter volumes poured at the given time.

Figure 1 includes the calculated line for theoretical CSTR behavior. Both iron and copper are shown to closely follow the CSTR predictions. These data indicate the sludge chemical additions were effectively mixed with the existing melter feed prior to being sent to the melter. As SRS melters normally act as CSTR's,[12] this also indicates the remediated feed did not effect the normal mixing behavior within the melter.

Table 3. Comparison Between Initial PCCS Target Composition, "As Received" Purex-4 Melter Feed, and Last Can (#10) Purex 4 Remediated Glass (in oxide weight percent).

	Target	As Received*	Remediated*
Sludge			
Fe_2O_3^	13.56	9.67	13.61
Na_2O^^	8.87	8.09	9.41
Al_2O_3	3.15	3.20	2.51
MnO	2.43	1.59	2.36
CaO	1.27	0.86	1.30
NiO	1.22	0.83	1.20
ZrO_2	0.72	0.67	0.68
P_2O_5	0.34	0.12	0.06
ZnO	0.27	0.28	0.30
PbO	0.15	0.15	0.09
BaO	0.12	0.09	0.07
Frit			
SiO_2	50.91	55.49	51.91
Na_2O^^	8.87	8.09	9.41
B_2O_3**	7.69	8.35	7.50
Li_2O	4.44	4.79	4.48
MgO	1.44	1.73	1.57
PHA			
B_2O_3**	7.69	8.35	7.50
K_2O	2.75	3.22	2.09
CuO	0.47	0.37	0.44
TiO_2	0.14	0.29	0.26
Liquidus	**1018**	**943**	**1010**
Viscosity	**52**	**82**	**52**

* Composite of two separate analyzed glass samples
^ All iron is reported as Fe_2O_3 for all three compositions
^^ Na_2O is listed twice; both sludge & frit are significant sources of sodium
** B_2O_3 is listed twice; both PHA & frit are significant sources of boron

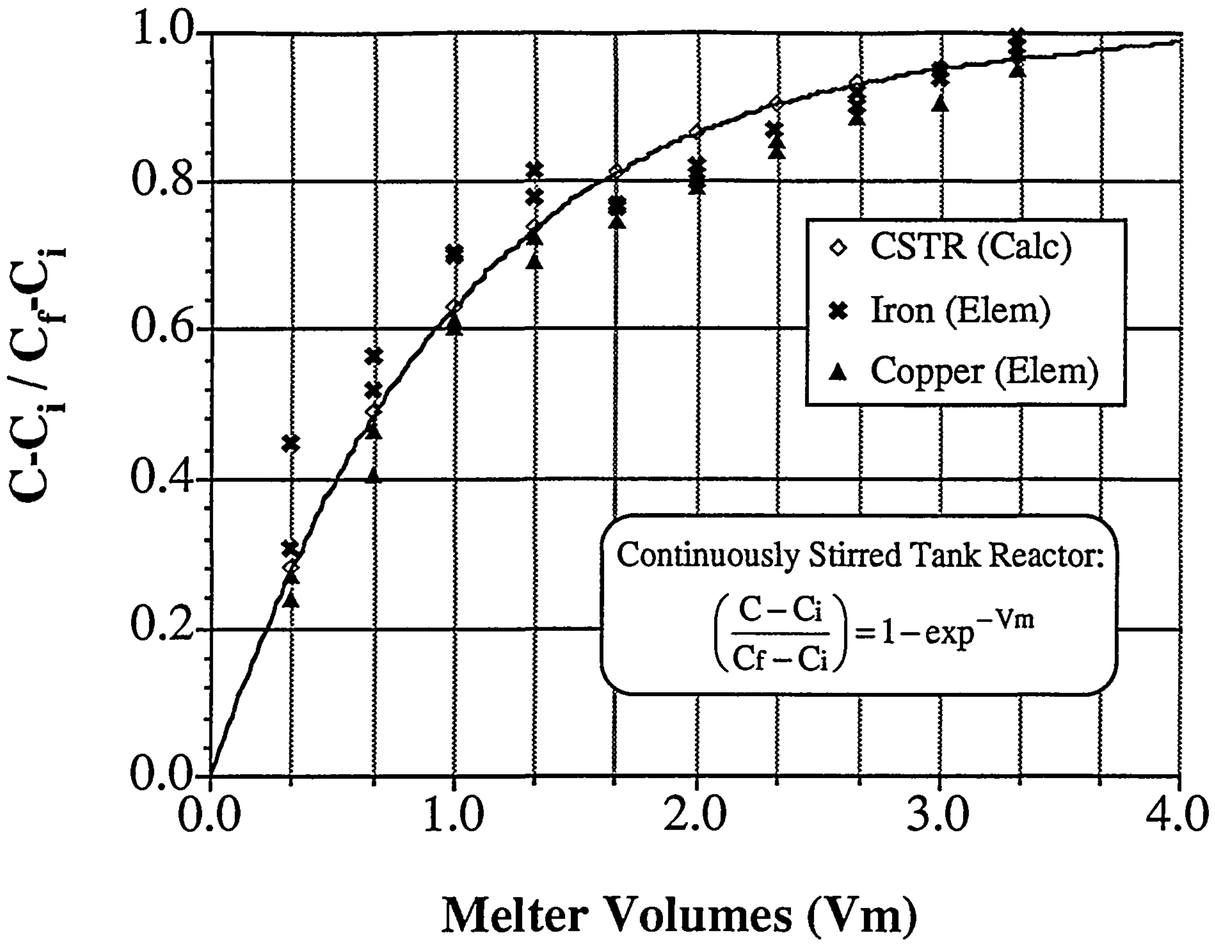

Figure 1. Concentration Gradient of Iron and Copper During the Purex 4 Remediation Campaign.

The devitrification tendencies of Purex 4 Remediation glass also indicate that the sludge additions had no appreciable effect on the melter operation. A sample of glass was taken from the pour stream during operation and allowed to air cool. X-ray diffraction (XRD) analyses on this glass revealed no crystalline species. This indicates that all of the sludge chemicals added to the feed were successfully dissolved into the glass within the melter. Crystalline phases were detected in all of the glass cans poured. The phases were identified by XRD as either a form of spinel or a silicate mineral. These results are again consistent with previous SRS experience.[12] Table 4 lists the crystalline species identified by XRD for each can of glass.

Table 4. Crystalline Species Identified in Purex 4 Remediation Canister Glass.

Can #	Crystalline Species
1	Krinovite, $NaMg_2CrSi_3O_{10}$
2	Krinovite
3	Krinovite
4	Spinel, $MgFeAlO_4$*
5	Aegirine, $NaFeSi_2O_6$ Krinovite
6	Spinel
7	Krinovite Spinel
8	Spinel
9	Krinovite Spinel
10	Spinel

* Several forms of spinel are possible; all of the transition elements may exist in a spinel structure - not just iron.

Conclusions

The 774 research melter successfully processed the Purex 4 Remediated feed. The direct addition of refractory, water insoluble oxides - Fe_2O_3, Al_2O_3, MnO and NiO had no appreciable effect on melter operation. The composition of the resulting glass is very close to that of the initial Purex 4 target composition determined by the PCCS. The lack of crystallinity in the grab sample indicates the oxide additives were effectively dissolved into the glass melt. The spinel and silicate crystalline species detected in the slowly cooled stainless steel cans are consistent with crystalline species commonly observed in SRS melter product. These results indicate low sludge melter feeds, if determined to be unacceptable by DWPF processing algorithms, can be successfully remediated by sludge oxide additions.

Future Work

Further work is being performed to determine the relative durability of Purex 4 Remediation glass by the Product Consistency Test (PCT) method. The durability will then be compared with predictions made by the Hydration Thermodynamics (which predicts durability based on glass composition) model. These results will determine if the sludge oxide additions improve the correlation between predicted and measured glass durability. This report will be issued as Production and Remediation of Low-Sludge, Simulated Purex Waste Glasses, II: Effects of Sludge Oxide Additions On Glass Durability.

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Appendix 1

This appendix includes the methodology used to:

1) Bias correct SRTC-ADS glass analyses (shown in Table I),

2) Determine the As-Received Glass Composition (Table II),

3) Calculate the required amount of trim chemicals needed to approach the PX 4 target composition (Table III).

SRTC-ADS dissolved and analyzed vitrified samples of the as-received PX 4 melter feed and the SRS-EA glass.[9] Bias correction calculations were made versus Corning Engineering Laboratory Services analyses of the EA glass.[9] This methodology is shown in Table I. The bias corrected analysis of vitrified PX 4 melter feed was then converted to normalized oxide weight percent and then to normalized elemental percent. This is shown in Table II. Finally, the analyzed, as-received PX 4 melter feed was compared with the PX 4 target composition determined by PCCS.[3] The additional sludge chemicals needed to supplement the melter feed were calculated to maximize agreement with the initial target composition. The calculations were done on an elemental basis: the units within the calculation are grams of the given element per 100 grams of glass. This is shown in Table III. The spreadsheets used were supplied by C. M. Jantzen (Table II) and K. G. Brown (Table III).

Table I. Sample Bias Correction of SRTC ADS Glass Analysis. Bias Correction Shown is For As-Received PX 4 Melter Feed.

	EA Glass[9] Corning	EA Glass ADS 2/22/93	Bias Correction	PX-4 ADS 2/22/93	**PX-4 Bias Corrected**
	ELEMENT WT%	ELEMENT WT%	Factor no units	ELEMENT WT%	**ELEMENT WT%**
Al_2O_3	1.958	1.952	1.003	1.668	**1.673**
CaO	0.800	0.828	0.967	0.630	**0.609**
Fe_2O_3	5.162				
FeO	1.127				
ΣFe_xO_y	6.289	6.356	0.989	6.750	**6.679**
MgO	1.037	1.036	1.001	1.032	**1.033**
MnO	1.038	1.034	1.004	1.214	**1.218**
Na_2O	12.463	12.32	1.012	5.884	**5.952**
Li_2O	1.979	2.003	0.988	2.225	**2.198**
NiO	0.448	0.47	0.953	0.676	**0.644**
SiO_2	22.778	21.452	1.062	24.130	**25.622**
Cr_2O_3				0.050	**0.050**
B_2O_3	3.509	3.409	1.029	2.489	**2.562**
UO_2					
ThO_2					
SrO				0.014	**0.014**
ZrO_2	0.341	0.375	0.908	0.542	**0.492**
TiO_2	0.420	0.426	0.985	0.176	**0.173**
K_2O	0.033			2.643	**2.643**
Cs_2O					
Sb_2O_3					
P_2O_5				0.051	**0.051**
Nd_2O_3					
La_2O_3	0.358	0.334	1.072	0.024	**0.026**
Y_2O_3					
BaO				0.079	**0.079**
PbO				0.141	**0.141**
CeO_2					
MoO_3					
ZnO				0.221	**0.221**
CuO				0.292	**0.292**

Table II. Spreadsheet Used to Convert the Bias Corrected Elemental Analysis Into Normalized Elemental Weight Percent.

PX4 ADS 2/22B Bias Corrected

	ELEMENT WT%	GRAV FACTOR	OXIDE WT%	NORM OXIDE WT%	**Norm Elem WT%**
Al_2O_3	1.673	1.890	3.161	3.200	**1.694**
CaO	0.609	1.399	0.852	0.863	**0.616**
Fe_2O_3	6.679	1.430	9.549	9.667	**6.761**
FeO	N/A	1.287	N/A	N/A	**N/A**
MgO	1.033	1.658	1.713	1.734	**1.046**
MnO	1.218	1.291	1.573	1.592	**1.233**
Na_2O	5.925	1.348	7.987	8.085	**5.998**
Li_2O	2.198	2.153	4.731	4.789	**2.225**
NiO	0.644	1.273	0.820	0.830	**0.652**
SiO_2	25.622	2.139	54.813	55.488	**25.937**
Cr_2O_3	0.050	1.462	0.073	0.074	**0.051**
B_2O_3	2.562	3.220	8.250	8.351	**2.594**
UO_2		1.134	0.000	0.000	**0.000**
ThO_2		1.138	0.000	0.000	**0.000**
SrO	0.014	1.183	0.017	0.017	**0.014**
ZrO_2	0.492	1.351	0.665	0.673	**0.498**
TiO_2	0.173	1.668	0.289	0.292	**0.175**
K_2O	2.643	1.205	3.184	3.223	**2.676**
Cs_2O	0.076	1.060	0.081	0.082	**0.077**
Sb_2O_3		1.197	0.000	0.000	**0.000**
P_2O_5	0.051	2.291	0.117	0.118	**0.052**
Nd_2O_3		1.166	0.000	0.000	**0.000**
La_2O_3	0.026	1.173	0.030	0.031	**0.026**
Y_2O_3		1.270	0.000	0.000	**0.000**
BaO	0.079	1.117	0.088	0.089	**0.080**
PbO	0.141	1.077	0.152	0.154	**0.143**
CeO_2		1.228	0.000	0.000	**0.000**
MoO_3		1.500	0.000	0.000	**0.000**
ZnO	0.221	1.245	0.275	0.278	**0.224**
CuO	0.292	1.252	0.366	0.370	**0.296**
SUMS	52.421		98.784	100.000	

Table III. Spreadsheet Used to Calculate Concentrations of Trim Chemicals For Melter Feed.

Elem	Desired Target * Elem Wt%	Undesired PX4 ** Elem Wt%	Add Elem gm / 100gm glass	Elem	Composite Elem Wt%
Al	1.688	1.694	0.100	Al	1.694
B	2.415	2.594		B	2.449
Ba	0.109	0.080		Ba	0.076
Ca	0.919	0.617	0.330	Ca	0.894
Cl	0.000	0.000		Cl	0.000
Cr	0.004	0.051		Cr	0.048
Cs	0.066	0.077		Cs	0.073
Cu	0.376	0.296	0.100	Cu	0.374
F	0.000	0.000		F	0.000
Fe(III)	9.593	6.761	3.300	Fe(III)	9.498
K	2.312	2.676		K	2.526
Li	2.084	2.225		Li	2.100
Mg	0.878	1.047		Mg	0.988
Mn	1.907	1.233	0.750	Mn	1.872
Na	6.652	5.998	1.000	Na	6.606
Ni	0.968	0.652	0.350	Ni	0.946
P	0.152	0.052		P	0.049
S	0.000	0.000		S	0.000
Si	24.068	25.938		Si	24.486
Th	0.000	0.000		Th	0.000
Ti	0.084	0.175		Ti	0.165
U	0.000	0.000		U	0.000

Appendix 2

Analyzed Compositions of the Purex 4 Remediation Glasses. Glasses Are Identified by the Can Designation and SRTC Analytic Development Services (ADS) Sample Number. Glass samples 1X and 2X are from glass cans produced immediately prior to the Purex 4 Remediation campaign. The Compositions are Reported in Normalized Weight Percent Oxide.

	Can 1X ADS 4268	Can 2X ADS 4267	Can #1 ADS 4252	Can #2 ADS 4254	Can #3 ADS 4256
Al_2O_3	2.42	2.59	3.29	3.29	3.20
CaO	0.84	0.89	1.08	1.20	1.26
Fe_2O_3	6.10	6.63	8.64	10.58	11.66
FeO	0.16	0.18	0.23	0.29	0.31
MgO	0.78	0.79	0.93	1.18	1.34
MnO	1.21	1.30	1.64	2.00	2.19
Na_2O	12.33	12.62	11.91	11.90	11.42
Li_2O	5.61	5.68	5.24	5.37	5.26
NiO	0.58	0.68	0.99	1.15	1.21
SiO_2	60.15	58.70	55.33	51.39	49.90
Cr_2O_3	0.12	0.14	0.24	0.24	0.23
B_2O_3	8.00	8.06	8.27	8.67	8.97
UO_2	0.00	0.00	0.00	0.00	0.00
ThO_2	0.00	0.00	0.00	0.00	0.00
SrO	0.02	0.03	0.03	0.03	0.02
ZrO_2	0.90	0.89	0.84	0.84	0.81
TiO_2	0.08	0.08	0.13	0.17	0.21
K_2O	0.22	0.24	0.54	0.94	1.18
Cs_2O	0.00	0.00	0.00	0.00	0.00
Sb_2O_3	0.00	0.00	0.00	0.00	0.00
P_2O_5	0.00	0.00	0.04	0.04	0.05
Nd_2O_3	0.00	0.00	0.00	0.00	0.00
La_2O_3	0.02	0.02	0.04	0.03	0.03
Y_2O_3	0.00	0.00	0.00	0.00	0.00
BaO	0.04	0.05	0.05	0.06	0.07
PbO	0.00	0.00	0.03	0.05	0.06
CeO_2	0.00	0.00	0.00	0.00	0.00
MoO_3	0.00	0.00	0.00	0.00	0.00
ZnO	0.36	0.37	0.34	0.33	0.31
CuO	0.06	0.06	0.16	0.25	0.31
Liquidus °C	885	895	933	975	998
Viscosity, poise @ 1150°C	74	63	57	35	31

Analyzed Compositions of the Purex 4 Remediation Glasses. Glasses Are Identified by the Can Designation and SRTC Analytic Development Services (ADS) Sample Number. The Compositions are Reported in Normalized Weight Percent Oxide.

	Can #4 ADS 4258	Can #5 ADS 4263	Can #6 ADS 4242	Can #7 ADS 4244	Can #8 ADS 4246
Al_2O_3	3.04	2.62	2.72	2.66	2.62
CaO	1.29	1.20	1.28	1.26	1.28
Fe_2O_3	12.13	11.69	12.33	12.64	12.82
FeO	0.33	0.32	0.33	0.34	0.35
MgO	1.41	1.40	1.48	1.51	1.55
MnO	2.27	2.20	2.32	2.40	2.41
Na_2O	10.94	9.90	9.88	9.63	9.47
Li_2O	5.10	4.68	4.68	4.64	4.61
NiO	1.23	1.15	1.20	1.23	1.19
SiO_2	50.13	53.64	50.89	50.94	50.96
Cr_2O_3	0.21	0.19	0.16	0.15	0.14
B_2O_3	8.66	7.55	8.98	8.78	8.70
UO_2	0.00	0.00	0.00	0.00	0.00
ThO_2	0.00	0.00	0.00	0.00	0.00
SrO	0.02	0.02	0.01	0.00	0.01
ZrO_2	0.78	0.71	0.72	0.70	0.69
TiO_2	0.22	0.22	0.23	0.24	0.25
K_2O	1.41	1.67	1.91	2.02	2.17
Cs_2O	0.00	0.00	0.00	0.00	0.00
Sb_2O_3	0.00	0.00	0.00	0.00	0.00
P_2O_5	0.05	0.05	0.06	0.06	0.04
Nd_2O_3	0.00	0.00	0.00	0.00	0.00
La_2O_3	0.01	0.01	0.01	0.00	0.00
Y_2O_3	0.00	0.00	0.00	0.00	0.00
BaO	0.07	0.07	0.07	0.07	0.07
PbO	0.07	0.08	0.07	0.08	0.06
CeO_2	0.00	0.00	0.00	0.00	0.00
MoO_3	0.00	0.00	0.00	0.00	0.00
ZnO	0.31	0.29	0.28	0.25	0.21
CuO	0.35	0.36	0.38	0.40	0.41
Liquidus °C	1004	981	1002	1007	1009
Viscosity, poise @ 1150°C	34	59	42	44	44

Analyzed Compositions of the Purex 4 Remediation Glasses. Glasses Are Identified by the Can Designation and SRTC Analytic Development Services (ADS) Sample Number. Sample Target A is a sample of the Purex 4 Remediated feed vitrified in a crucible. This composition was used as the final composition for the elemental profiles (see Figure 1). The Compositions are Reported in Normalized Weight Percent Oxide.

	Can #9 ADS 4248	Can #10 ADS 4265	Target A ADS 4249
Al_2O_3	2.58	2.53	2.52
CaO	1.31	1.31	1.32
Fe_2O_3	13.16	13.24	13.34
FeO	0.36	0.36	0.60
MgO	1.58	1.57	1.65
MnO	2.45	2.36	2.58
Na_2O	9.48	9.44	8.54
Li_2O	4.57	4.49	4.48
NiO	1.24	1.20	1.24
SiO_2	50.33	51.86	51.47
Cr_2O_3	0.13	0.14	0.09
B_2O_3	8.80	7.48	8.29
UO_2	0.00	0.00	0.00
ThO_2	0.00	0.00	0.00
SrO	0.01	0.01	0.01
ZrO_2	0.69	0.69	0.66
TiO_2	0.25	0.26	0.26
K_2O	2.26	2.10	2.05
Cs_2O	0.00	0.00	0.00
Sb_2O_3	0.00	0.00	0.00
P_2O_5	0.00	0.07	0.04
Nd_2O_3	0.00	0.00	0.00
La_2O_3	0.00	0.00	0.00
Y_2O_3	0.00	0.00	0.00
BaO	0.07	0.08	0.07
PbO	0.05	0.09	0.08
CeO_2	0.00	0.00	0.00
MoO_3	0.00	0.00	0.00
ZnO	0.25	0.31	0.26
CuO	0.42	0.44	0.46
Liquidus °C	1017	1012	1019
Viscosity, poise @ 1150°C	41	52	54