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Phase II of a Six Sigma Initiative to Study DWPF SME Analytical Turnaround Times: SRNL's Evaluation of Carbonate-Based Dissolution Methods

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Phase II of a Six Sigma Initiative to Study DWPF SME Analytical Turnaround Times: SRNL's Evaluation of Carbonate-Based Dissolution Methods

1.0 Introduction

The Analytical Development Section (ADS) and the Statistical Consulting Section (SCS) of the Savannah River National Laboratory (SRNL) are participating in a Six Sigma initiative to improve the Defense Waste Processing Facility (DWPF) Laboratory. The Six Sigma initiative has focused on reducing the analytical turnaround time of samples from the Slurry Mix Evaporator (SME) by developing streamlined sampling and analytical methods [1]. The objective of Phase I was to evaluate the sub-sampling of a larger sample bottle and the performance of a cesium carbonate (Cs_2CO_3) digestion method. Successful implementation of the Cs_2CO_3 fusion method in the DWPF would have important time savings and convenience benefits because this single digestion would replace the dual digestion scheme now used. A single digestion scheme would result in more efficient operations in both the DWPF shielded cells and the inductively coupled plasma – atomic emission spectroscopy (ICP-AES) laboratory. By taking a small aliquot of SME slurry from a large sample bottle and dissolving the vitrified SME sample with carbonate fusion methods, an analytical turnaround time reduction from 27 hours to 9 hours could be realized in the DWPF. This analytical scheme has the potential for not only dramatically reducing turnaround times, but also streamlining operations to minimize wear and tear on critical shielded cell components that are prone to fail, including the Hydragard™ sampling valves and manipulators.

Favorable results from the Phase I tests [2] led to the recommendation for a Phase II effort as outlined in the DWPF Technical Task Request (TTR) [3]. There were three

major tasks outlined in the TTR, and SRNL issued a Task Technical and QA Plan [4] with a corresponding set of three major task activities:

1) Compare weight percent (wt%) total solids measurements of large volume samples versus peanut vial samples.
2) Evaluate Cs_2CO_3 and K_2CO_3 fusion methods using DWPF simulated glass (part 1) and (to the extent possible) using DWPF radioactive glass (part 2).
3) Recommend specific equipment to implement the new methods and work with SRNL's Equipment Engineering Section (EES) to ensure compatibility of the equipment with the DWPF shielded cells.

The focus of this report is major task activity #2 (parts 1 and 2). The other two major task activities are to be addressed separately. The measurements supporting task activity #1 are being conducted at the DWPF. EES is currently designing and fabricating the DWPF cell equipment needed for the new method as part of major task activity #3.

As part of the discussion of the results in [2], it was noted that a potential drawback of using Cs_2CO_3 or any Cs salt to dissolve radioactive glass is that the large amount of stable Cs introduced would not be compatible with ion exchange techniques to remove ^{137}Cs from solutions to lower the whole body dose to personnel from ^{137}Cs gamma radiation. The DWPF has thus far processed only waste with relatively low amounts of ^{137}Cs. However, beginning in 2007, the Modular Caustic Side Solvent Extraction Unit is scheduled to feed high ^{137}Cs-bearing solutions to the DWPF. One possible remedy for the potential dose problems associated with ^{137}Cs is to use ion exchange techniques to remove the ^{137}Cs from dissolved samples before removing the solutions from the shielded cells for ICP-AES analysis. For this reason, and because it is unlikely that K determinations will be required for DWPF process control due to the low concentration of K in SRS waste, the analogous dissolution scheme using K_2CO_3 was added to the Phase II investigation scope.

The remainder of this report may be outlined as follows. Section 2 provides a summary of recommendations supported by the results of the Phase II tests. Section 3 provides a summary of the experimental results of the carbonate-based digestions. A discussion of the experimental details is provided in Section 4. Section 5 provides a discussion of the details of the statistical comparisons performed as part of this study. References are provided in Section 6. Appendix A and Appendix B provide the statistical details supporting the analyses of the simulant and radioactive sets of samples, respectively. Appendix C provides the details of the analytical procedures that help meet the Six Sigma team's goal of improved turnaround times and efficiency for the DWPF Lab.

2.0 Summary of Recommendations

- Proceed with testing the Cs_2CO_3 fusion digestion in the DWPF with the ultimate goal of establishing this method as the reference digestion method for SME samples.

Additional refinements to the Cs_2CO_3 fusion methods are possible (such as lowering the fusion temperature and using Cs_2CO_3 fusion blanks as the substrate for preparing ICP-AES calibration standards). However, at this point in the testing program, method refinements are not required to initiate testing in the DWPF.

- Perform additional testing of the K_2CO_3 fusion digestion method at SRNL to determine if subtle method changes can provide results comparable to the Cs_2CO_3 fusion method. Possible modifications to the method include optimization of the flux time and temperature. Also, a mixture of K_2CO_3 and KNO_3 should be investigated as a way to both lower the temperature of flux and increase the oxidizing power of the flux which could help to dissolve the most refractory oxides and metallic inclusions in the glass. Should this testing be successful, the solutions should be treated with an ion exchange material designed to remove ^{137}Cs to determine if this method would be viable for reducing the gamma dose from high-^{137}Cs solutions before elemental analysis.

3.0 Summary of Experimental Results

- The Cs_2CO_3 fusion digestion yielded elemental analyses on both simulated and actual DWPF glass samples that were comparable in both accuracy and precision to the combined results of the reference DWPF methods, the Na_2O_2 fusion and the mixed-acid method. The Phase II experimental results strongly support the concept of using the Cs_2CO_3 fusion digestion as a single digestion method to replace the DWPF tandem digestion scheme for SME samples.

- The authors believe that the Cs_2CO_3 fusion *may* produce B determinations that are slightly biased low (5-10 %) due to B volatility at the 1100 °C fusion temperature coupled with a possible carrier effect from the volatility of cesium atoms. The authors feel it is prudent to declare this possibility, despite the fact that some data sets show no statistically significant difference in B determinations as a function of sample digestion technique. Should a negative bias in B determinations be confirmed by subsequent tests, possible solutions to this problem include modifying the flux conditions to minimize B loss or by bias corrections.

- The K_2CO_3 fusion digestion results were inferior in both precision and accuracy to the Cs_2CO_3 fusion. However, some of the *individual* analyses from the K_2CO_3 fusion were of high quality. This result suggests that method refinements could make the K_2CO_3 fusion a viable technique.

4.0 Experimental Details

Experimental details of how the simulant samples were prepared, dissolved, and analyzed are provided in Sections 4.1 through 4.5 while Sections 4.6 through 4.8 pertain to the digestion and analysis of the DWPF radioactive glass sample. Appendix C provides the

integrated procedure for taking a slurry sample from a large sample bottle and measuring the wt. % solids after drying at 115 °C and after vitrifying the resulting powder at 1100 °C, and then dissolving the resulting glass wafer with the Cs_2CO_3 fusion method.

4.1 Preparation of Non-radioactive Glass Wafers for Digestion and Analysis

The alkali fusion digestions (Cs_2CO_3, K_2CO_3, and Na_2O_2) of glass wafers eliminates the tedious glass crushing step needed to obtain the fine powdered sample that is required for effective digestions with the mixed acid method. A set of glass wafers was prepared from a large volume of SME simulant in a manner that would ensure, for all practical purposes, identical composition of each of the wafers. This technique eliminated the possibility that analytical differences could result from sub-sampling the SME slurry to create individual glass samples. Note that the technique used to make the glass wafers for dissolution in this study is different than will be used on actual SME samples in which small aliquots of SME slurry will be rapidly dried and vitrified. However, the form and weight (about 0.65 g on average) of the wafer approximate that of 1 mL of SME slurry converted to glass by heating at 1100 °C.

The SME simulant (of Sludge Batch 2/3 Blend) used for digestion tests was obtained from M.E. Stone of the Immobilization Technology Section. The simulant was in a 2-liter bottle that was mixed overnight in a Toxicity Characteristic Leach Procedure (TCLP) vessel rotator at the rate of 30 rotations per minute. Approximately 35 mL of slurry was transferred to a 50 mL Pt-Au crucible. The slurry was first heated in a drying oven at 115 °C to remove free water and form a powder. The powder was vitrified by heating at 1100 °C for three hours to form approximately 20 g of glass. The glass was crushed in a mechanical crusher equipped with an agate mortar and agate balls. The glass powder was sieved and the glass particles that passed through the 200 mesh sieve were collected. Approximately 0.65 g of glass powder was transferred to a 50 mL Pt-Au crucible and heated at 1100 °C for 10 minutes to form a thin glass wafer. This process was repeated until enough glass wafers were obtained to perform all the digestion experiments. Some of the -200 mesh powdered glass was not re-melted to form a wafer but set aside for tests with the mixed acid digestion method.

The ARG-1 glass standard was similarly heated at 1100 °C for 10 minutes to form glass wafers analogous to those prepared from the SME simulant. Approximately 0.65 g of ARG-1 glass standard (already in the form of a -200 mesh powder) was heated in Pt-Au crucibles to form the wafers. Note that should the proposed analytical scheme be adopted by the DWPF, in a matter of one day the DWPF Laboratory or SRNL could convert ARG-1 glass standard powder into enough glass wafers to last a year or longer. The glass wafers could be individually stored in wide-mouth plastic bottles (in a non-radiological area until ready to be used in the shielded cells) and then transferred into the Pt crucibles to obtain the weight of record prior to the digestion. The proposed analytical scheme completely eliminates the tedious operation of weighing glass powders in the shielded cell.

4.2 Cs_2CO_3 Fusion Digestions of Vitrified SME Simulant and ARG-1 Standard Glass

The Cs_2CO_3 fusions were carried out in 50 mL Pt-Au alloy crucibles. A glass wafer was transferred to the Pt-Au crucible and the weight of the glass wafer obtained. Approximately 6 g of Alfa Aesar Puratronic® grade (99.994 % -metals basis) Cs_2CO_3 was added to the crucible which was placed in the 1100 °C furnace and heated for 10 minutes after the furnace re-equilibrated to 1100 °C. The crucible was allowed to cool for 5 minutes and then dropped into a 1000 mL wide-mouth bottle that was pre-charged with 100 mL of 3 % H_2O_2 prepared by diluting 10 mL of 30 % H_2O_2 to 100 mL in a plastic volumetric flask. The decomposition of H_2O_2 in the highly caustic solution created a warm, frothy solution that rapidly dissolved most of the flux residue. After 15 minutes, 250 mL of de-ionized water (measured in a 250 mL plastic volumetric flask) was added to dilute the solution and minimize the potential for silicates to precipitate upon addition of the acid solution. The final addition was 100 mL of a 50 % solution prepared by diluting 50 mL of concentrated HNO_3 to 100 mL with de-ionized water in a plastic volumetric flask. The acid solution was added slowly with occasional swirling of the 1000 mL bottle. Although in most cases the acid solution instantaneously dissolved the metal oxide and hydrous oxide residue, 30 minutes was conservatively allowed for complete dissolution. The volume of solution at this point was 450 mL. A 20-fold serial dilution of this solution with de-ionized water was performed prior to ICP-AES analysis to yield a final effective digestion volume of 9,000 mL.

4.3 K_2CO_3 Fusion Digestions of Vitrified SME Simulant and ARG-1 Standard Glass

The K_2CO_3 fusions of vitrified SME simulant and ARG-1 glass standards were carried out analogously to the Cs_2CO_3 fusions. The K_2CO_3 was Alfa Aesar Puratronic® grade (99.997 % -metals basis).

4.4 Na_2O_2-NaOH Fusions of Vitrified SME Simulant and ARG-1 Standard Glass

Na_2O_2-NaOH fusions were carried out in zirconium crucibles to avoid the aggressive attack of Na_2O_2 and NaOH on Pt-Au crucibles. A mixture of 4.0 g Na_2O_2 and 2.0 g NaOH was used to dissolve the glass wafers. The workup was analogous to that used for Cs_2CO_3 and K_2CO_3 fusions, with an initial dilution to 450 mL followed by a 20-fold serial dilution with de-ionized water. Na and Zr were not measured from this digestion because these elements are introduced through the fusion reagents (Na_2O_2 and NaOH) or the crucible material (Zr crucible).

4.5 Mixed Acid Digestions of Vitrified SME Simulant and ARG-1 Standard Glass

The mixed acid digestions were carried out on the -200 mesh powder in contrast to the alkali fusions that were carried out on the glass wafers. Approximately 0.65 g of -200

mesh glass powder was transferred into a CEM Teflon pressure vessel. A mixture of 10 mL concentrated HF and 10 mL concentrated HNO_3 was added and mixed with the powdered glass. The vessel was capped with the CEM capping station to maintain pressure and heated for 2 hours at 115 °C. After cooling, 80 mL of 0.6 M H_3BO_3 and 10 mL concentrated HCl were added and the solution heated for 1 hour at 75 °C. This solution was diluted to 450 mL. A 20-fold serial dilution with de-ionized water was made prior to ICP-AES determinations. Si and B were not measured from this preparation technique because Si determinations tend to be biased high from HF attack on the nebulizer/torch assembly and B is added with the H_3BO_3 reagent.

4.6 Cs_2CO_3 Fusion Digestions of DWPF Pour Stream Samples and ARG-1 Standard Glass

Since the DWPF glass pour stream sample had been crushed to a powder to support ITS-directed analyses of this sample, the Cs_2CO_3 fusions were carried out on this material "as-received" versus converting it to glass wafers by re-melting. However, there was only enough powder to perform four digestions. The last two digestions out of a total of six were performed on glass "chunks" that did not get adequately pulverized. This occurrence was fortuitous because it allowed comparison of elemental analysis data obtained on glass powder with that from glass chunks. The data revealed no significant difference as a function of glass particle size, further corroborating the efficacy of alkali fusions on glass chunks, wafers, shards, pellets, etc. Approximately 0.33-0.40 g of the glass (powder or chunk) and 4.0 g of Cs_2CO_3 were transferred into a Pt-Au crucible. The workup was identical to that used for the fusion digestions of non-radioactive simulated waste glass except that, because of the smaller sample weight, the serial dilution was 10-fold rather than the 20-fold used for simulants.

4.7 Na_2O_2 Fusion Digestions of DWPF Pour Stream Samples and ARG-1 Standard Glass (performed under guidance of ITS)

0.25 g of crushed glass was heated at 675 °C with a mixture of 1.5 g Na_2O_2 and 1.0 g NaOH in a Zr crucible. The flux residue was diluted to 100 mL with water and 25 mL of concentrated HCl. A serial dilution was performed before ICP-AES analysis.

4.8 Mixed Acid Digestions of DWPF Pour Stream Samples and ARG-1 Standard Glass (performed under guidance of ITS)

0.25 g of crushed glass was heated with 5 mL concentrated HF and 5 mL concentrated HNO_3 for 2 hours in a pressurized CEM Teflon vessel at 115 °C. After cooling, 40 mL of 0.6 M H_3BO_3 and 5 mL concentrated HCl were added, the vessel re-capped, and the solution re-heated at 115 °C for 1 hour. The solution was then diluted to 100 mL. A serial dilution was performed before ICP-AES analysis.

5.0 Statistical Analyses

In this section, the data from the glass analyses of the Phase 2 study are presented and statistically evaluated. As described in the experimental section, these data include elemental measurements of glass samples made from a SME simulant, actual radioactive glass samples from the DWPF's pour stream, ARG-1 glass standards, and reagent blanks. The DWPF radioactive glass samples were available for this study from a separate task performed under the direction of ITS [5]. There was only enough radioactive glass to support a set of Cs_2CO_3 dissolutions. The elemental analyses of the radioactive glass from the Cs_2CO_3 fusion are compared to the Na_2O_2 and mixed acid results summarized in the ITS report [5] as part of the discussion that follows. The dissolved samples were analyzed with ICP-AES techniques under the guidance of an analytical plan[1]. For the radioactive glass, the available portions were dissolved by Cs_2CO_3. The set of elements analyzed was not identical for the simulant and radioactive glass samples. While both sets covered the major oxides typically in DWPF glasses (with the radioactive set adding uranium), there were some differences in the minor oxides. These differences are of no practical concern.

The elemental analyses are presented in the sections that follow and statistical comparisons are conducted, first for the simulant and then for the radioactive sample measurements, to assess the relative performances of the dissolution methods for each type of sample. The statistical comparisons were conducted using JMP Version 5.1.2 from SAS Institute, Inc. [6].

5.1 Comparisons of the Compositional Measurements of the Simulant Set of Samples

A primary objective of this test phase was the continued evaluation of the performance of the Cs_2CO_3 dissolution as well as an initial evaluation of the K_2CO_3 method. Table A1 in Appendix A provides the elemental concentration data generated for the simulant samples for the two carbonate-based preparations as well as the Na_2O_2 and mixed acid methods. In addition to the prepared glass samples of the simulant, samples of the ARG-1 standard glass and reagent blanks were included in the analytical plan that was used to guide the measurement of the chemical compositions of the simulant samples. The elemental concentrations were converted to oxide concentrations by multiplying the values for each element by the gravimetric factor for the corresponding oxide. In order to assign an oxide concentration for determinations below the detection limit, an arbitrary value of half the detection limit of the element was used.

[1] The analytical plan was provided in the memorandum: Edwards, TB, "An Analytical Plan Supporting the DWPF Laboratory Six Sigma Process Improvement Project," SRNL-SCS-2005-00030, June 13, 2005.

Exhibit A1 in Appendix A provides a plot of the concentrations in weight percent (wt%) of each oxide in analytical sequence. Exhibit A2 in Appendix A provides plots of each oxide's concentration values by prep method grouped by type of sample.

5.1.1 Measurements of Reagent Blanks in Simulant Set

Table 1 provides a listing of the average measurement by oxide for the reagent blank samples for each of the preparation methods. Yellow shading is used to highlight averages that appear to be significantly higher than those generated by the other preparation methods. Specifically, note that the Na_2O_2 method yields CaO and K_2O measurements for the blanks that are larger than the measurements from the other preparation methods, indicating contamination introduced by impurities in the Na_2O_2 reagent.

Table 1. Comparison of Measurement Averages for Blanks in Simulant Set

Preparation Method	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Type of Sample	blank	blank	blank	blank
N Rows	2	2	2	2
Ag_2O (wt%)	0.018	0.018	0.018	0.018
Al_2O_3 (wt%)	0.044	0.044	0.044	0.044
B_2O_3 (wt%)	0.038	0.038	.	0.072
BaO (wt%)	0.008	0.003	0.003	0.003
CaO (wt%)	0.011	0.011	0.011	0.199
CdO (wt%)	0.004	0.004	0.004	0.004
Ce_2O_3 (wt%)	0.038	0.038	0.038	0.038
CoO (wt%)	0.007	0.007	0.007	0.011
Cr_2O_3 (wt%)	0.009	0.009	0.009	0.009
CuO (wt%)	0.003	0.003	0.003	0.003
Fe_2O_3 (wt%)	0.006	0.006	0.006	0.006
K_2O (wt%)	0.169	.	0.169	0.306
La_2O_3 (wt%)	0.008	0.008	0.008	0.008
Li_2O (wt%)	0.012	0.012	0.012	0.012
MgO (wt%)	0.027	0.027	0.027	0.027
MnO (wt%)	0.003	0.003	0.003	0.003
MoO_3 (w%)	0.021	0.021	0.021	0.021
Na_2O (wt%)	0.042	0.042	0.042	.
Nb_2O_5 (wt%)	0.010	0.010	0.010	0.010
Nd_2O_3 (wt%)	0.050	0.050	0.050	0.050
NiO (wt%)	0.006	0.006	0.006	0.006
P_2O_5 (wt%)	0.083	0.083	0.083	0.083
PbO (wt%)	0.022	0.022	0.022	0.022
ReO_2 (wt%)	0.008	0.008	0.008	0.008
SO_4 (wt%)	0.141	0.141	0.141	0.141
SiO_2 (wt%)	0.015	0.015	.	0.015
SnO_2 (wt%)	0.021	0.021	0.021	0.021
SrO (wt%)	0.003	0.003	0.003	0.003
TiO_2 (wt%)	0.001	0.001	0.001	0.001
V_2O_5 (wt%)	0.021	0.021	0.021	0.021
ZnO (wt%)	0.003	0.003	0.003	0.003
ZrO_2 (wt%)	0.009	0.009	0.009	.

5.1.2 Measurements of ARG-1 in Simulant Set

Exhibit A3 provides comparisons across the preparation methods by oxide for the ARG-1 measurements. There are pairwise comparisons among the averages of the preparations as well as statistical tests for differences in the variances (i.e., precisions) of the preparation methods. Tables 2a and 2b provide summary information of these measurements in the form of the average measurement, standard deviation, and % relative standard deviation for each oxide by each preparation method. Yellow shading is used in Table 2b to highlight the biases that are 5% or greater relative to the ARG-1 reference composition (also given in Table 2b).

Table 2a. Measurement Averages, Standard Deviations, and % Relative Standard Deviations for ARG-1 Samples in Simulant Set

Preparation Method	Cs_2CO_3			K_2CO_3			Mixed Acid			Na_2O_2		
N Rows (3)	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev
Ag_2O (wt%)	0.025	0.0131	52.7%	0.017	0.0002	0.9%	0.018	0.0002	1.1%	0.017	0.0001	0.5%
Al_2O_3 (wt%)	4.654	0.0218	0.5%	4.560	0.1796	3.9%	4.434	0.0393	0.9%	4.535	0.2146	4.7%
B_2O_3 (wt%)	7.964	0.1131	1.4%	8.329	0.3547	4.3%	.	.		8.275	0.4186	5.1%
BaO (wt%)	0.098	0.0011	1.2%	0.087	0.0036	4.1%	0.089	0.0006	0.6%	0.092	0.0061	6.7%
CaO (wt%)	1.445	0.0581	4.0%	1.424	0.0963	6.8%	1.455	0.0000	0.0%	1.595	0.0740	4.6%
CdO (wt%)	0.004	0.0001	3.1%	0.004	0.0000	1.0%	0.004	0.0000	1.1%	0.004	0.0000	0.5%
Ce_2O_3 (wt%)	0.037	0.0012	3.1%	0.036	0.0004	1.0%	0.038	0.0004	1.1%	0.036	0.0002	0.5%
CoO (wt%)	0.009	0.0050	53.2%	0.006	0.0001	1.0%	0.014	0.0007	4.7%	0.009	0.0049	53.2%
Cr_2O_3 (wt%)	0.100	0.0045	4.5%	0.095	0.0049	5.2%	0.097	0.0005	0.5%	0.090	0.0036	4.0%
CuO (wt%)	0.006	0.0050	81.2%	0.003	0.0000	1.0%	0.003	0.0000	1.0%	0.003	0.0000	0.5%
Fe_2O_3 (wt%)	14.097	0.3362	2.4%	13.692	0.7234	5.3%	14.211	0.0378	0.3%	13.811	0.5478	4.0%
K_2O (wt%)	2.791	0.0502	1.8%	.	.		2.879	0.0241	0.8%	3.321	0.1840	5.5%
La_2O_3 (wt%)	0.007	0.0002	3.0%	0.010	0.0044	45.1%	0.007	0.0001	1.2%	0.012	0.0091	73.0%
Li_2O (wt%)	3.366	0.0448	1.3%	3.251	0.0938	2.9%	3.308	0.0124	0.4%	3.186	0.1492	4.7%
MgO (wt%)	0.854	0.0152	1.8%	0.835	0.0440	5.3%	0.857	0.0085	1.0%	0.812	0.0310	3.8%
MnO (wt%)	1.907	0.0325	1.7%	1.877	0.0969	5.2%	1.911	0.0000	0.0%	1.825	0.0757	4.1%
MoO_3 (w%)	0.021	0.0007	3.2%	0.020	0.0002	0.9%	0.021	0.0002	1.1%	0.020	0.0001	0.4%
Na_2O (wt%)	11.696	0.1364	1.2%	11.319	0.3603	3.2%	11.835	0.0404	0.3%	.	.	
Nb_2O_5 (wt%)	0.081	0.0060	7.4%	0.084	0.0093	11.1%	0.093	0.0078	8.4%	0.080	0.0118	14.7%
Nd_2O_3 (wt%)	0.049	0.0015	3.2%	0.048	0.0005	1.0%	0.049	0.0005	1.1%	0.047	0.0002	0.5%
NiO (wt%)	1.037	0.0288	2.8%	0.780	0.0705	9.0%	1.084	0.0078	0.7%	1.022	0.0406	4.0%
P_2O_5 (wt%)	0.217	0.0335	15.4%	0.231	0.0755	32.7%	0.263	0.0138		0.221	0.0147	6.6%
PbO (wt%)	0.021	0.0007	3.2%	0.021	0.0002	0.9%	0.021	0.0002	1.0%	0.021	0.0001	0.5%
ReO_2 (wt%)	0.008	0.0002	2.9%	0.008	0.0001	1.1%	0.008	0.0001	1.1%	0.008	0.0000	0.4%
SO_4 (wt%)	0.139	0.0044	3.2%	0.135	0.0014	1.0%	0.140	0.0015	1.1%	0.134	0.0006	0.5%
SiO_2 (wt%)	49.703	0.6536	1.3%	48.633	3.1173	6.4%	.	.		47.207	2.1106	4.5%
SnO_2 (wt%)	0.020	0.0006	3.2%	0.020	0.0002	1.0%	0.021	0.0002	1.1%	0.020	0.0001	0.5%
SrO (wt%)	0.003	0.0001	3.2%	0.003	0.0000	1.0%	0.003	0.0000	1.1%	0.007	0.0052	74.0%
TiO_2 (wt%)	1.206	0.0058	0.5%	1.172	0.0463	3.9%	1.171	0.0042	0.4%	1.145	0.0531	4.6%
V_2O_5 (wt%)	0.021	0.0007	3.2%	0.020	0.0002	0.9%	0.021	0.0002	1.1%	0.020	0.0001	0.5%
ZnO (wt%)	0.023	0.0009	3.9%	0.022	0.0020	8.9%	0.024	0.0005	2.3%	0.023	0.0014	6.3%
ZrO_2 (wt%)	0.137	0.0016	1.1%	0.129	0.0067	5.2%	0.137	0.0030	2.2%	.	.	

Table 2b. Comparison of Measurement Averages for ARG-1 Samples in Simulant Set

Preparation Method	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2	Reference				
Type of Sample	ARG-1	ARG-1	ARG-1	ARG-1	Value	% Bias	% Bias	% Bias	% Bias
N Rows	3	3	3	3		Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Ag_2O (wt%)	0.025	0.017	0.018	0.017					
Al_2O_3 (wt%)	4.654	4.560	4.434	4.535	4.724	-1.5%	-3.5%	-6.1%	-4.0%
B_2O_3 (wt%)	7.964	8.329	.	8.275	8.662	-8.1%	-3.8%		-4.5%
BaO (wt%)	0.098	0.087	0.089	0.092	0.089	9.3%	-3.0%	0.1%	2.8%
CaO (wt%)	1.445	1.424	1.455	1.595	1.427	1.2%	-0.2%	2.0%	11.8%
CdO (wt%)	0.004	0.004	0.004	0.004					
Ce_2O_3 (wt%)	0.037	0.036	0.038	0.036					
CoO (wt%)	0.009	0.006	0.014	0.009					
Cr_2O_3 (wt%)	0.100	0.095	0.097	0.090	0.088	14.3%	8.1%	11.0%	2.8%
CuO (wt%)	0.006	0.003	0.003	0.003	0.0001				
Fe_2O_3 (wt%)	14.097	13.692	14.211	13.811	13.997	0.7%	-2.2%	1.5%	-1.3%
K_2O (wt%)	2.791	.	2.879	3.321	2.710	3.0%		6.2%	22.5%
La_2O_3 (wt%)	0.007	0.010	0.007	0.012					
Li_2O (wt%)	3.366	3.251	3.308	3.186	3.208	4.9%	1.3%	3.1%	-0.7%
MgO (wt%)	0.854	0.835	0.857	0.812	0.862	-0.9%	-3.1%	-0.6%	-5.8%
MnO (wt%)	1.907	1.877	1.911	1.825	1.885	1.1%	-0.5%	1.4%	-3.2%
MoO_3 (w%)	0.021	0.020	0.021	0.020					
Na_2O (wt%)	11.696	11.319	11.835	.	11.498	1.7%	-1.6%	2.9%	
Nb_2O_5 (wt%)	0.081	0.084	0.093	0.080					
Nd_2O_3 (wt%)	0.049	0.048	0.049	0.047					
NiO (wt%)	1.037	0.780	1.084	1.022	1.056	-1.8%	-26.1%	2.6%	-3.2%
P_2O_5 (wt%)	0.217	0.231	0.263	0.221	0.229	-5.2%	0.7%	14.7%	-3.4%
PbO (wt%)	0.021	0.021	0.021	0.021					
ReO_2 (wt%)	0.008	0.008	0.008	0.008					
SO_4 (wt%)	0.139	0.135	0.140	0.134					
SiO_2 (wt%)	49.703	48.633	.	47.207	47.899	3.8%	1.5%		-1.4%
SnO_2 (wt%)	0.020	0.020	0.021	0.020					
SrO (wt%)	0.003	0.003	0.003	0.007					
TiO_2 (wt%)	1.206	1.172	1.171	1.145	1.151	4.8%	1.8%	1.8%	-0.5%
V_2O_5 (wt%)	0.021	0.020	0.021	0.020					
ZnO (wt%)	0.023	0.022	0.024	0.023	0.012				
ZrO_2 (wt%)	0.137	0.129	0.137	.	0.135	1.7%	-4.4%	1.7%	

While there are potentially a large number of observations that one might make regarding Tables 2a and 2b and Exhibit A3, comments about B_2O_3 and NiO will be made to demonstrate the interpretation of the statistical tests of the exhibit. From Table 2a, the smallest average measurement for B_2O_3 was 7.964 wt% from the Cs_2CO_3 method while the largest average was 8.329 wt% from the K_2CO_3 method with the largest % relative standard deviation for the measurements being 5.1% for the Na_2O_2 method and the smallest being 1.4% for the Cs_2CO_3 method. From Exhibit A3, the pairwise comparisons of the means indicate no statistically significant differences (since the letter associated with averages of all three methods is the same, "A" in the middle of the left-hand side of the exhibit). Also, the "Levene Test" for differences in the variances of the measurements indicates (by a "Prob>F" value of 0.1810, which is greater than 0.05) no statistically significant differences in the variances at the 5% significance level.

From Table 2a, the smallest average measurement for NiO was 0.780 wt% from the K_2CO_3 method while the largest average was 1.084 wt% from the mixed acid method with the largest % relative standard deviation for the measurements being 9.0% for the K_2CO_3 method and the smallest being 0.7% for the mixed acid method. From Exhibit A3, the pairwise comparisons of the means indicate that the mean of the K_2CO_3 method is statistically significantly different (since the letter associated with its average is a "B" while the letter associated with the other averages is an "A" in the middle of the left-hand side of the exhibit). The "Levene Test" for differences in the variances of the measurements indicates (by a "Prob>F" value of 0.1278, which is greater than 0.05) no statistically significant differences in the variances at the 5% significance level.

5.1.3 Measurements of Simulant Samples

Exhibit A4 in Appendix A provides comparisons across the preparation methods by oxide for the simulant sample measurements. There are pairwise comparisons among the averages of the preparations as well as statistical tests for differences in the variances (i.e., precisions) of the preparation methods. For those oxides at concentrations greater than 0.1 wt%, a difference among the means is indicated for CaO (Na_2O_2 yielding a larger mean and K_2CO_3 a smaller), Fe_2O_3 (Cs_2CO_3 yielding a larger mean relative to that from K_2CO_3), K_2O (Na_2O_2 yielding a larger mean), MgO (Cs_2CO_3 yielding a larger mean relative to that from K_2CO_3), NiO (K_2CO_3 yielding a smaller mean), SO_4 (mixed acid yielding a smaller mean), ZnO (Cs_2CO_3 yielding a larger mean), and ZrO_2 (K_2CO_3 yielding a smaller mean).

Table 3 provides a summary of this information in the form of the average measurement, standard deviation, and % relative standard deviation for each oxide by each preparation method. Table 4 provides pairwise comparisons of the average oxide concentrations across the four preparation methods. An entry in Table 4 that shows a pairwise comparison that is 5% or greater is highlighted.

Table 3. Average Oxide Measurements, Standard Deviations, and % Relative Standard Deviations for Simulant Samples by Preparation Method

Preparation Method	Cs_2CO_3			K_2CO_3			Mixed Acid			Na_2O_2		
N Rows (3)	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev
Ag_2O (wt%)	0.018	0.0004	2.2%	0.018	0.0007	3.7%	0.017	0.0005	2.6%	0.018	0.0006	3.5%
Al_2O_3 (wt%)	6.333	0.0347	0.5%	6.031	0.1565	2.6%	6.012	0.3566	5.9%	6.144	0.2400	3.9%
B_2O_3 (wt%)	5.066	0.0926	1.8%	5.012	0.1464		.	.		5.125	0.2207	4.3%
BaO (wt%)	0.075	0.0009	1.2%	0.062	0.0020	3.2%	0.064	0.0042	6.6%	0.067	0.0065	9.7%
CaO (wt%)	1.388	0.0088	0.6%	1.271	0.0493	3.9%	1.319	0.0902	6.8%	1.553	0.0680	4.4%
CdO (wt%)	0.004	0.0001	2.2%	0.004	0.0001	3.7%	0.004	0.0001	2.6%	0.004	0.0001	3.5%
Ce_2O_3 (wt%)	0.038	0.0008	2.2%	0.038	0.0014	3.7%	0.037	0.0010	2.6%	0.038	0.0014	3.5%
CoO (wt%)	0.007	0.0001	2.1%	0.007	0.0003	3.7%	0.007	0.0002	2.5%	0.007	0.0002	3.6%
Cr_2O_3 (wt%)	0.085	0.0019	2.3%	0.077	0.0028	3.6%	0.079	0.0055	6.9%	0.076	0.0035	4.6%
CuO (wt%)	0.060	0.0007	1.2%	0.051	0.0033	6.4%	0.059	0.0040	6.8%	0.060	0.0031	5.2%
Fe_2O_3 (wt%)	14.535	0.0738	0.5%	13.554	0.3870	2.9%	13.801	0.8518	6.2%	14.128	0.5943	
K_2O (wt%)	0.167	0.0037	2.2%	.	.		0.199	0.0792	39.9%	0.604	0.1794	29.7%
La_2O_3 (wt%)	0.007	0.0002	2.3%	0.008	0.0003	3.6%	0.007	0.0002	2.4%	0.009	0.0041	43.7%
Li_2O (wt%)	5.206	0.0162	0.3%	5.013	0.1456	2.9%	5.088	0.2822	5.5%	4.991	0.2116	4.2%
MgO (wt%)	1.467	0.0102	0.7%	1.371	0.0402	2.9%	1.386	0.0924	6.7%	1.387	0.0544	3.9%
MnO (wt%)	2.154	0.0127	0.6%	2.027	0.0554	2.7%	2.034	0.1319	6.5%	2.040	0.0880	4.3%
MoO_3 (w%)	0.021	0.0005	2.2%	0.021	0.0008	3.7%	0.021	0.0005	2.6%	0.021	0.0008	
Na_2O (wt%)	13.271	0.0433	0.3%	12.802	0.3617	2.8%	13.152	0.6975	5.3%	.	.	
Nb_2O_5 (wt%)	0.010	0.0002	2.2%	0.010	0.0004	3.6%	0.009	0.0003	2.7%	0.010	0.0003	3.4%
Nd_2O_3 (wt%)	0.049	0.0011	2.2%	0.050	0.0018	3.6%	0.048	0.0013	2.6%	0.050	0.0018	3.5%
NiO (wt%)	0.465	0.0051	1.1%	0.373	0.0119	3.2%	0.460	0.0287	6.2%	0.462	0.0170	3.7%
P_2O_5 (wt%)	0.082	0.0018	2.2%	0.084	0.0031		0.081	0.0021		0.084	0.0030	3.6%
PbO (wt%)	0.062	0.0137	21.9%	0.045	0.0185	40.8%	0.046	0.0125	27.1%	0.038	0.0184	48.1%
ReO_2 (wt%)	0.008	0.0002	2.2%	0.008	0.0003	3.6%	0.008	0.0002	2.7%	0.008	0.0003	3.5%
SO_4 (wt%)	0.646	0.0276	4.3%	0.606	0.0503	8.3%	0.469	0.0672	14.3%	0.633	0.0835	13.2%
SiO_2 (wt%)	50.024	1.2578	2.5%	47.635	1.4551	3.1%	.	.		48.099	2.0178	4.2%
SnO_2 (wt%)	0.020	0.0005	2.2%	0.021	0.0008	3.7%	0.020	0.0005	2.7%	0.021	0.0007	3.6%
SrO (wt%)	0.008	0.0001	0.8%	0.007	0.0002	3.1%	0.007	0.0006	8.0%	0.010	0.0031	29.3%
TiO_2 (wt%)	0.040	0.0004	1.0%	0.037	0.0012	3.3%	0.038	0.0014	3.6%	0.038	0.0021	5.4%
V_2O_5 (wt%)	0.021	0.0005	2.2%	0.022	0.0008	3.6%	0.021	0.0005	2.6%	0.022	0.0007	3.5%
ZnO (wt%)	0.149	0.0029	1.9%	0.137	0.0044	3.2%	0.138	0.0086	6.2%	0.139	0.0056	4.0%
ZrO_2 (wt%)	0.268	0.0046	1.7%	0.253	0.0056	2.2%	0.269	0.0118	4.4%	.	.	

Table 4. Pairwise Measurement Comparisons of Preparation Methods by Oxide for Simulant Samples

Ag_2O (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		Ce_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-2.4%	1.3%	-2.3%		Cs_2CO_3	0.0%	-2.5%	1.3%	-2.3%
K_2CO_3	2.5%	0.0%	3.8%	0.1%		K_2CO_3	2.5%	0.0%	3.9%	0.1%
Mixed Acid	-1.3%	-3.7%	0.0%	-3.5%		Mixed Acid	-1.3%	-3.7%	0.0%	-3.6%
Na_2O_2	2.3%	-0.1%	3.7%	0.0%		Na_2O_2	2.4%	-0.1%	3.7%	0.0%
Al_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		CoO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	5.0%	5.3%	3.1%		Cs_2CO_3	0.0%	-2.5%	1.3%	-2.3%
K_2CO_3	-4.8%	0.0%	0.3%	-1.8%		K_2CO_3	2.6%	0.0%	3.9%	0.2%
Mixed Acid	-5.1%	-3.7%	0.0%	-3.6%		Mixed Acid	-1.3%	-3.8%	0.0%	-3.6%
Na_2O_2	-3.0%	1.9%	2.2%	0.0%		Na_2O_2	2.4%	-0.2%	3.7%	0.0%
B_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		Cr_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	1.1%		-1.2%		Cs_2CO_3	0.0%	10.0%	7.7%	12.2%
K_2CO_3	-1.1%	0.0%		-2.2%		K_2CO_3	-9.1%	0.0%	-2.1%	2.0%
Mixed Acid						Mixed Acid	-7.1%	2.2%	0.0%	4.2%
Na_2O_2	1.2%	2.2%		0.0%		Na_2O_2	-10.9%	-2.0%	-4.1%	0.0%
BaO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		CuO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	20.7%	18.1%	11.6%		Cs_2CO_3	0.0%	16.7%	1.8%	0.1%
K_2CO_3	-17.1%	0.0%	-2.1%	-7.5%		K_2CO_3	-14.3%	0.0%	-12.8%	-14.3%
Mixed Acid	-15.3%	2.2%	0.0%	-5.5%		Mixed Acid	-1.8%	14.6%	0.0%	-1.7%
Na_2O_2	-10.4%	8.1%	5.9%	0.0%		Na_2O_2	-0.1%	16.6%	1.7%	0.0%
CaO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		Fe_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	9.2%	5.3%	-10.6%		Cs_2CO_3	0.0%	7.2%	5.3%	2.9%
K_2CO_3	-8.4%	0.0%	-3.6%	-18.1%		K_2CO_3	-6.8%	0.0%	-1.8%	-4.1%
Mixed Acid	-5.0%	3.7%	0.0%	-15.1%		Mixed Acid	-5.0%	1.8%	0.0%	-2.3%
Na_2O_2	11.9%	22.2%	17.8%	0.0%		Na_2O_2	-2.8%	4.2%	2.4%	0.0%
CdO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		K_2O (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-2.5%	1.2%	-2.3%		Cs_2CO_3	0.0%		-15.7%	-72.3%
K_2CO_3	2.5%	0.0%	3.8%	0.1%		K_2CO_3				
Mixed Acid	-1.2%	-3.6%	0.0%	-3.5%		Mixed Acid	18.6%		0.0%	-67.1%
Na_2O_2	2.4%	-0.1%	3.6%	0.0%		Na_2O_2	260.8%		204.1%	0.0%

Table 4. Pairwise Measurement Comparisons of Preparation Methods by Oxide for Simulant Samples (continued)

La_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		Nb_2O_5 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-2.2%	1.5%	-20.0%		Cs_2CO_3	0.0%	-2.5%	1.1%	-2.4%
K_2CO_3	2.2%	0.0%	3.7%	-18.2%		K_2CO_3	2.6%	0.0%	3.8%	0.1%
Mixed Acid	-1.4%	-3.6%	0.0%	-21.1%		Mixed Acid	-1.1%	-3.6%	0.0%	-3.5%
Na_2O_2	24.9%	22.2%	26.8%	0.0%		Na_2O_2	2.5%	-0.1%	3.6%	0.0%
Li_2O (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		Nd_2O_3 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	3.9%	2.3%	4.3%		Cs_2CO_3	0.0%	-2.5%	1.3%	-2.3%
K_2CO_3	-3.7%	0.0%	-1.5%	0.4%		K_2CO_3	2.5%	0.0%	3.8%	0.1%
Mixed Acid	-2.3%	1.5%	0.0%	1.9%		Mixed Acid	-1.3%	-3.7%	0.0%	-3.6%
Na_2O_2	-4.1%	-0.4%	-1.9%	0.0%		Na_2O_2	2.4%	-0.1%	3.7%	0.0%
MgO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		NiO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	7.0%	5.8%	5.7%		Cs_2CO_3	0.0%	24.5%	1.0%	0.6%
K_2CO_3	-6.6%	0.0%	-1.1%	-1.2%		K_2CO_3	-19.7%	0.0%	-18.9%	-19.2%
Mixed Acid	-5.5%	1.1%	0.0%	-0.1%		Mixed Acid	-1.0%	23.3%	0.0%	-0.4%
Na_2O_2	-5.4%	1.2%	0.1%	0.0%		Na_2O_2	-0.6%	23.8%	0.4%	0.0%
MnO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		P_2O_5 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	6.3%	5.9%	5.6%		Cs_2CO_3	0.0%	-2.4%	1.3%	-2.3%
K_2CO_3	-5.9%	0.0%	-0.3%	-0.6%		K_2CO_3	2.5%	0.0%	3.9%	0.1%
Mixed Acid	-5.6%	0.3%	0.0%	-0.3%		Mixed Acid	-1.3%	-3.7%	0.0%	-3.6%
Na_2O_2	-5.3%	0.6%	0.3%	0.0%		Na_2O_2	2.4%	-0.1%	3.7%	0.0%
MoO_3 (w%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		PbO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-2.6%	1.2%	-2.4%		Cs_2CO_3	0.0%	38.0%	36.0%	62.8%
K_2CO_3	2.6%	0.0%	3.9%	0.1%		K_2CO_3	-27.5%	0.0%	-1.4%	18.0%
Mixed Acid	-1.2%	-3.7%	0.0%	-3.6%		Mixed Acid	-26.5%	1.5%	0.0%	19.7%
Na_2O_2	2.5%	-0.1%	3.7%	0.0%		Na_2O_2	-38.6%	-15.3%	-16.5%	0.0%
Na_2O (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		ReO_2 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	3.7%	0.9%			Cs_2CO_3	0.0%	-2.5%	1.3%	-2.4%
K_2CO_3	-3.5%	0.0%	-2.7%			K_2CO_3	2.6%	0.0%	3.9%	0.1%
Mixed Acid	-0.9%	2.7%	0.0%			Mixed Acid	-1.3%	-3.8%	0.0%	-3.7%
Na_2O_2						Na_2O_2	2.5%	-0.1%	3.8%	0.0%

Table 4. Pairwise Measurement Comparisons of Preparation Methods by Oxide for Simulant Samples (continued)

SO_4 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		ZnO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	6.6%	37.8%	2.1%		Cs_2CO_3	0.0%	8.9%	7.9%	7.0%
K_2CO_3	-6.2%	0.0%	29.3%	-4.3%		K_2CO_3	-8.2%	0.0%	-1.0%	-1.8%
Mixed Acid	-27.4%	-22.7%	0.0%	-25.9%		Mixed Acid	-7.3%	1.0%	0.0%	-0.8%
Na_2O_2	-2.0%	4.4%	35.0%	0.0%		Na_2O_2	-6.5%	1.8%	0.8%	0.0%
SiO_2 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2		ZrO_2 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	5.0%		4.0%		Cs_2CO_3	0.0%	5.8%	-0.5%	
K_2CO_3	-4.8%	0.0%		-1.0%		K_2CO_3	-5.5%	0.0%	-5.9%	
Mixed Acid						Mixed Acid	0.5%	6.3%	0.0%	
Na_2O_2	-3.8%	1.0%		0.0%		Na_2O_2				
SnO_2 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2						
Cs_2CO_3	0.0%	-2.5%	1.3%	-2.3%						
K_2CO_3	2.5%	0.0%	3.9%	0.2%						
Mixed Acid	-1.3%	-3.7%	0.0%	-3.6%						
Na_2O_2	2.4%	-0.2%	3.7%	0.0%						
SrO (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2						
Cs_2CO_3	0.0%	22.8%	21.1%	-18.8%						
K_2CO_3	-18.6%	0.0%	-1.4%	-33.9%						
Mixed Acid	-17.5%	1.4%	0.0%	-33.0%						
Na_2O_2	23.2%	51.3%	49.2%	0.0%						
TiO_2 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2						
Cs_2CO_3	0.0%	7.6%	3.8%	4.4%						
K_2CO_3	-7.0%	0.0%	-3.5%	-3.0%						
Mixed Acid	-3.6%	3.7%	0.0%	0.6%						
Na_2O_2	-4.2%	3.1%	-0.6%	0.0%						
V_2O_5 (wt%)	Cs_2CO_3	K_2CO_3	Mixed Acid	Na_2O_2						
Cs_2CO_3	0.0%	-2.4%	1.4%	-2.3%						
K_2CO_3	2.5%	0.0%	3.9%	0.1%						
Mixed Acid	-1.4%	-3.8%	0.0%	-3.7%						
Na_2O_2	2.4%	-0.1%	3.9%	0.0%						

5.2 Comparisons of the Compositional Measurements for the Radioactive Set of Measurements

As described earlier, a limited amount of radioactive glass from the DWPF pour stream was available to support this study. Since there was not enough glass for both the Cs_2CO_3 and the K_2CO_3 methods to be investigated, only the Cs_2CO_3 method was performed. Table B1 in Appendix B provides the elemental concentration data generated for the radioactive samples as well as for samples of ARG-1 and for reagent blanks by the Cs_2CO_3 method. These chemical composition measurements were compared to the measurements generated by mixed acid and Na_2O_2 methods as reported by Bannochie and Bibler [5]. Tables B2 and B3 in Appendix B provide the elemental concentration data generated for radioactive samples, ARG-1 samples, and reagent blanks by the Na_2O_2 and mixed acid methods, respectively. The elemental concentrations were converted to oxide concentrations by multiplying the values for each element by the gravimetric factor for the corresponding oxide. During this process, an elemental concentration that was determined to be below the detection limit of the analytical procedures used by ADS was reduced to half of that detection limit as the oxide concentration was determined.

Exhibit B1 in Appendix B provides a plot of the concentrations in weight percent (wt%) of each oxide in Laboratory Information Management System (LIMS) number sequence. Exhibit B2 in Appendix B provides plots of each oxide's concentration values by prep method grouped by type of sample.

5.2.1 Measurements of Reagent Blanks in Radioactive Set

Table 5 provides a listing of the average measurement by oxide for the reagent blank samples for each of the preparation methods. Yellow shading is used to highlight averages that appear to be significantly higher than those generated by the other preparation methods. For the Cs_2CO_3 fusion method, the level of B_2O_3 in the blank is notable because B was actually detected and measured in the ICP-AES analysis, as opposed to the blank level being calculated from the ICP-AES detection limit. Moreover, B is not normally detected in the blank. Since the Cs_2CO_3 came from the same chemical vendor lot as Cs_2CO_3 that had not shown B contamination and no detectable B was reported in the vendor's assay of this Cs_2CO_3, the source of the B is unknown. It is also not clear if B contamination affects the analysis of the DWPF pour stream sample and ARG-1 glass standard. The B values from the Cs_2CO_3 fusion were about 0.3 wt% higher versus the Na_2O_2 method on the ARG-1 glass standard (Table 6a) but there was no significant difference in B values on the DWPF pour stream glass (Table 6b) as a function of digestion method.

The relatively high levels of K_2O and PbO shown in Table 5 are not the result of ICP-AES measurement of K and Pb, but rather the relatively high detection limits for these two elements. For example, the vendor reported a K concentration of 3 micrograms per gram of Cs_2CO_3. For 4 grams of Cs_2CO_3 used in fusions of radioactive glass, about 12 micrograms or 0.012 milligrams of K would be contributed by the Cs_2CO_3. Therefore,

the actual contribution of K contamination from Cs_2CO_3 to the measured K concentration in a blank or sample analysis would be negligible (less than 0.01 %) for 330 milligram samples (to make blank measurements more meaningful, a similar sample weight factor was applied to the calculations of blanks even though no sample was involved so that the blank measurement was put on the same relative concentration basis as the actual samples). The vendor reported no detectable Pb in the assay of its high-purity Cs_2CO_3.

Table 5. Comparison of Measurement Averages for Blanks in Radioactive Set

Preparation Method	**Cs_2CO_3**	**Mixed Acid**	**Na_2O_2**
Type of Sample	blank	blank	blank
N Rows	2	1	1
Ag_2O (wt%)	0.008	0.002	0.005
Al_2O_3 (wt%)	0.054	0.016	0.032
B_2O_3 (wt%)	0.335	.	0.068
BaO (wt%)	0.017	0.005	0.010
CaO (wt%)	0.009	0.003	0.014
CdO (wt%)	0.003	0.001	0.002
Ce_2O_3 (wt%)	0.107	0.032	0.063
Cr_2O_3 (wt%)	0.003	0.008	0.015
CuO (wt%)	0.008	0.003	0.005
Fe_2O_3 (wt%)	0.026	0.003	0.007
K_2O (wt%)	0.632	0.189	0.374
La_2O_3 (wt%)	0.041	0.012	0.024
Li_2O (wt%)	0.070	0.021	0.041
MgO (wt%)	0.004	0.001	0.003
MnO (wt%)	0.002	0.001	0.001
MoO_3 (wt%)	0.135	0.040	0.080
Na_2O (wt%)	0.324	0.096	.
NiO (wt%)	0.034	0.010	0.020
P_2O_5 (wt%)	0.414	0.123	0.244
PbO (wt%)	0.555	0.165	0.326
SO_4 (wt%)	0.019	0.072	0.074
SiO_2 (wt%)	0.703	.	0.414
SnO_2 (wt%)	0.257	0.698	0.152
SrO (wt%)	0.008	0.002	0.005
TiO_2 (wt%)	0.003	0.001	0.002
U_3O_8 (wt%)	0.156	0.046	0.092
V_2O_5 (wt%)	0.024	0.007	0.014
ZnO (wt%)	0.006	0.002	0.003
ZrO_2 (wt%)	0.007	0.002	.

5.2.2 Measurements of ARG-1 in Radioactive Set

Exhibit B3 provides comparisons across the preparation methods by oxide for the ARG-1 measurements. There are pairwise comparisons among the averages of the preparations as well as statistical tests for differences in the variances (i.e., precisions) of the preparation methods.

Tables 6a and 6b provide summary information in the form of the average measurement for each oxide by each preparation method. Yellow shading is used to highlight biases that are 5% or greater relative to the ARG-1 reference composition (also given in Table 6b).

Table 6a. Measurement Averages, Standard Deviations, and % Relative Standard Deviations for ARG-1 Samples from Radioactive Set
(Concentrations in wt%)

Preparation	Cs_2CO_3			Mixed Acid			Na_2O_2		
N Rows (3)	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev
Ag_2O	0.041	0.0589	142.0%	0.002	0.0000	1.0%	0.046	0.0075	16.3%
Al_2O_3	4.062	0.0189	0.5%	4.119	0.0500	1.2%	4.069	0.0545	1.3%
B_2O_3	8.125	0.1035	1.3%	.	.		7.835	0.1773	2.3%
BaO	0.089	0.0007	0.8%	0.085	0.0009	1.0%	0.105	0.0033	3.1%
CaO	1.383	0.0016	0.1%	1.405	0.0137	1.0%	1.665	0.0560	3.4%
CdO	0.003	0.0001	1.7%	0.001	0.0000	1.2%	0.002	0.0004	15.8%
Ce_2O_3	0.101	0.0017	1.7%	0.032	0.0003	1.0%	0.823	0.0704	8.6%
Cr_2O_3	0.084	0.0035	4.2%	0.072	0.0062	8.5%	0.060	0.0247	41.4%
CuO	0.008	0.0001	1.8%	0.003	0.0000	1.1%	0.006	0.0009	15.7%
Fe_2O_3	13.978	0.0083	0.1%	13.725	0.1271	0.9%	14.097	0.1825	1.3%
K_2O	1.763	1.1739	66.6%	2.164	0.4394	20.3%	.	.	
La_2O_3	0.039	0.0006	1.7%	0.012	0.0001	1.0%	0.105	0.0096	9.1%
Li_2O	3.064	0.0124	0.4%	3.150	0.0249	0.8%	3.473	0.0542	1.6%
MgO	0.824	0.0025	0.3%	0.827	0.0075	0.9%	0.826	0.0033	0.4%
MnO	1.855	0.0075	0.4%	1.834	0.0129	0.7%	1.885	0.0224	1.2%
MoO_3	0.127	0.0017	1.4%	0.040	0.0004	1.0%	0.128	0.0510	39.9%
Na_2O	11.148	0.0934	0.8%	11.040	0.1519	1.4%	.	.	
NiO	1.034	0.0193	1.9%	1.054	0.0089	0.8%	1.027	0.0115	1.1%
P_2O_5	0.390	0.0060	1.5%	0.123	0.0018	1.4%	0.283	0.0450	15.9%
PbO	0.522	0.0087	1.7%	0.165	0.0016	1.0%	0.380	0.0600	15.8%
SO_4	0.170	0.1060	62.4%	0.097	0.0516	53.1%	0.086	0.0136	15.8%
SiO_2	48.776	0.9804	2.0%	.	.		49.347	0.6536	1.3%
SnO_2	0.242	0.0040	1.7%	0.835	0.0097	1.2%	0.176	0.0278	15.8%
SrO	0.197	0.0058	3.0%	0.225	0.0030	1.3%	0.341	0.0031	0.9%
TiO_2	1.168	0.0010	0.1%	1.146	0.0121	1.1%	1.145	0.0200	1.7%
U_3O_8	0.147	0.0024	1.6%	0.047	0.0005	1.0%	0.539	0.1374	25.5%
V_2O_5	0.064	0.0722	111.9%	0.014	0.0121	85.2%	0.017	0.0026	15.8%
ZnO	0.006	0.0001	1.7%	0.010	0.0003	3.1%	0.006	0.0031	50.7%
ZrO_2	0.122	0.0026	2.1%	0.124	0.0016	1.3%	.	.	

Table 6b. Comparison of Measurement Averages for ARG-1 Samples from Radioactive Set

Preparation	Cs_2CO_3	Mixed Acid	Na_2O_2				
Type of Sample	ARG-1	ARG-1	ARG-1	Reference	% Bias	% Bias	% Bias
N Rows	3	3	3	Value	Cs_2CO_3	Mixed Acid	Na_2O_2
Ag_2O (wt%)	0.041	0.002	0.046				
Al_2O_3 (wt%)	4.062	4.119	4.069	4.724	-14.0%	-12.8%	-13.9%
B_2O_3 (wt%)	8.125	.	7.835	8.662	-6.2%		-9.5%
BaO (wt%)	0.089	0.085	0.105	0.089	-0.3%	-4.3%	17.5%
CaO (wt%)	1.383	1.405	1.665	1.427	-3.1%	-1.5%	16.7%
CdO (wt%)	0.003	0.001	0.002				
Ce_2O_3 (wt%)	0.101	0.032	0.823				
Cr_2O_3 (wt%)	0.084	0.072	0.060	0.088	-4.6%	-17.6%	-32.0%
CuO (wt%)	0.008	0.003	0.006	0.0001	6266.7%	1913.3%	4526.7%
Fe_2O_3 (wt%)	13.978	13.725	14.097	13.997	-0.1%	-1.9%	0.7%
K_2O (wt%)	1.763	2.164	.	2.710	-34.9%	-20.1%	
La_2O_3 (wt%)	0.039	0.012	0.105				
Li_2O (wt%)	3.064	3.150	3.473	3.208	-4.5%	-1.8%	8.3%
MgO (wt%)	0.824	0.827	0.826	0.862	-4.5%	-4.1%	-4.2%
MnO (wt%)	1.855	1.834	1.885	1.885	-1.6%	-2.7%	0.0%
MoO_3 (w%)	0.127	0.040	0.128				
Na_2O (wt%)	11.148	11.040	.	11.498	-3.0%	-4.0%	
NiO (wt%)	1.034	1.054	1.027	1.056	-2.1%	-0.2%	-2.7%
P_2O_5 (wt%)	0.390	0.123	0.283	0.229	70.0%	-46.2%	23.7%
PbO (wt%)	0.522	0.165	0.380				
SO_4 (wt%)	0.170	0.097	0.086				
SiO_2 (wt%)	48.776	.	49.347	47.899	1.8%		3.0%
SnO_2 (wt%)	0.242	0.835	0.176				
SrO (wt%)	0.197	0.225	0.341				
TiO_2 (wt%)	1.168	1.146	1.145	1.151	1.5%	-0.4%	-0.5%
U_3O_8 (wt%)	0.147	0.047	0.539				
V_2O_5 (wt%)	0.064	0.014	0.017				
ZnO (wt%)	0.006	0.010	0.006	0.012	-53.8%	-14.3%	-49.2%
ZrO_2 (wt%)	0.122	0.124	.	0.135	-9.8%	-7.9%	

5.2.3 Measurements of Radioactive Samples

Exhibit B4 in Appendix B provides comparisons across the three preparation methods by oxide for the radioactive sample measurements. There are pairwise comparisons among the averages of the preparations as well as statistical tests for differences in the variances (i.e., precisions) of the preparation methods.

Table 7 provides a summary of this information in the form of the average measurement, the standard deviation, and the % relative standard deviation for each oxide by each

preparation method. Table 8 provides pairwise comparisons of the average oxide concentrations across the four preparation methods. Those entries in Table 8 that show differences greater than or equal to 5% are highlighted. Once again, to aid in the interpretation of the exhibit and tables, an example will be discussed. The example is U_3O_8. From Table 7, the smallest average measurement for U_3O_8 was 3.266 wt% from the Cs_2CO_3 method while the largest average was 3.664 wt% from the Na_2O_2 method with the largest % relative standard deviation for the measurements being 5.5% for the Na_2O_2 method and the smallest being 1.0% for the mixed acid method. From Exhibit B4, the pairwise comparisons of the means indicate that the mean of the Na_2O_2 method is statistically significantly larger (since the letter associated with its average is an "A" while the letter associated with the other averages is a "B" in the middle of the right-hand side of the exhibit). The "Levene Test" for differences in the variances of the measurements indicates (by a "Prob>F" value of 0.0220, which is less than 0.05) that there is a statistically significant difference in the variances at the 5% significance level.

Table 7. Average Measurements, Standard Deviations, and % Relative Standard Deviations for Each Oxide for Radioactive Samples by Preparation Method

Type of Preparation	Cs_2CO_3			Mixed Acid			Na_2O_2		
N Rows (6, 4, 4)	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev	Mean	Std Dev	% Rel Std Dev
Ag_2O (wt%)	0.082	0.0625	76.1%	0.002	0.0001	2.8%	0.040	0.0032	8.1%
Al_2O_3 (wt%)	4.743	0.0902	1.9%	4.823	0.0679	1.4%	4.762	0.1282	2.7%
B_2O_3 (wt%)	4.476	0.2401	5.4%	.	.		4.443	0.0872	2.0%
BaO (wt%)	0.050	0.0057	11.3%	0.040	0.0005	1.2%	0.055	0.0057	10.4%
CaO (wt%)	1.009	0.0041	0.4%	1.031	0.0164	1.6%	1.253	0.0263	2.1%
CdO (wt%)	0.045	0.0061	13.6%	0.070	0.0018	2.6%	0.056	0.0028	4.9%
Ce_2O_3 (wt%)	0.169	0.1528	90.6%	0.031	0.0009	2.9%	0.692	0.1820	26.3%
Cr_2O_3 (wt%)	0.062	0.0076	12.2%	0.059	0.0022	3.7%	0.058	0.0094	16.2%
CuO (wt%)	0.009	0.0011	13.4%	0.013	0.0004	3.1%	0.005	0.0002	4.6%
Fe_2O_3 (wt%)	10.921	0.1352	1.2%	10.619	0.1615	1.5%	10.905	0.2483	2.3%
K_2O (wt%)	0.637	0.0856	13.4%	0.184	0.0053	2.9%	1.447	1.1333	
La_2O_3 (wt%)	0.041	0.0056	13.4%	0.012	0.0003	2.9%	0.099	0.0241	24.3%
Li_2O (wt%)	4.679	0.0503	1.1%	4.796	0.0711	1.5%	5.124	0.1179	2.3%
MgO (wt%)	1.166	0.0184	1.6%	1.152	0.0174	1.5%	1.174	0.0282	2.4%
MnO (wt%)	2.109	0.0194	0.9%	2.059	0.0307	1.5%	2.111	0.0563	2.7%
MoO_3 (wt%)	0.136	0.0180	13.3%	0.039	0.0011	2.8%	0.098	0.0354	36.0%
Na_2O (wt%)	12.179	0.2925	2.4%	11.869	0.1649	1.4%	.	.	
NiO (wt%)	0.547	0.0264	4.8%	0.568	0.0140	2.5%	0.537	0.0218	4.1%
P_2O_5 (wt%)	0.416	0.0557	13.4%	0.202	0.0970	48.0%	0.242	0.0111	4.6%
PbO (wt%)	0.556	0.0743	13.4%	0.161	0.0046	2.9%	0.325	0.0148	4.6%
SO_4 (wt%)	0.513	0.0548	10.7%	0.460	0.0468	10.2%	0.436	0.0334	7.7%
SiO_2 (wt%)	52.306	0.9827	1.9%	.	.		51.022	0.9958	2.0%
SnO_2 (wt%)	0.259	0.0345	13.4%	0.821	0.0334	4.1%	0.189	0.0709	37.4%
SrO (wt%)	0.159	0.0200	12.6%	0.182	0.0025	1.4%	0.282	0.0205	7.3%
TiO_2 (wt%)	0.053	0.0014	2.6%	0.063	0.0015	2.5%	0.061	0.0014	2.2%
U_3O_8 (wt%)	3.266	0.1160	3.6%	3.343	0.0340	1.0%	3.664	0.2009	5.5%
V_2O_5 (wt%)	0.073	0.1199	164.3%	0.014	0.0142	101.0%	0.081	0.0790	97.9%
ZnO (wt%)	0.006	0.0008	13.4%	0.008	0.0005	6.7%	0.005	0.0028	57.2%
ZrO_2 (wt%)	0.053	0.0014	2.7%	0.054	0.0015	2.8%	.	.	

Table 8. Pairwise Comparison of Average Oxide Measurements for Radioactive Samples Across Preparation Methods

Ag_2O (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		CuO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	3439.4%	105.5%		Cs_2CO_3	0.0%	-34.5%	71.5%
Mixed Acid	-97.2%	0.0%	-94.2%		Mixed Acid	52.6%	0.0%	161.8%
Na_2O_2	-51.3%	1622.2%	0.0%		Na_2O_2	-41.7%	-61.8%	0.0%
Al_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		Fe_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-1.7%	-0.4%		Cs_2CO_3	0.0%	2.8%	0.1%
Mixed Acid	1.7%	0.0%	1.3%		Mixed Acid	-2.8%	0.0%	-2.6%
Na_2O_2	0.4%	-1.3%	0.0%		Na_2O_2	-0.1%	2.7%	0.0%
B_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		K_2O (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%		0.7%		Cs_2CO_3	0.0%	245.9%	-55.9%
Mixed Acid					Mixed Acid	-71.1%	0.0%	-87.3%
Na_2O_2	-0.7%		0.0%		Na_2O_2	127.0%	685.1%	0.0%
BaO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		La_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	23.7%	-8.5%		Cs_2CO_3	0.0%	245.7%	-58.3%
Mixed Acid	-19.2%	0.0%	-26.1%		Mixed Acid	-71.1%	0.0%	-87.9%
Na_2O_2					Na_2O_2	140.0%	729.9%	0.0%
CaO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		Li_2O (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-2.2%	-19.5%		Cs_2CO_3	0.0%	-2.4%	-8.7%
Mixed Acid	2.2%	0.0%	-17.7%		Mixed Acid	2.5%	0.0%	-6.4%
Na_2O_2	24.2%	21.5%	0.0%		Na_2O_2	9.5%	6.8%	0.0%
CdO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		MgO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-36.3%	-20.9%		Cs_2CO_3	0.0%	1.3%	-0.7%
Mixed Acid	56.9%	0.0%	24.1%		Mixed Acid	-1.3%	0.0%	-1.9%
Na_2O_2	26.4%	-19.4%	0.0%		Na_2O_2	0.7%	2.0%	0.0%
Ce_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		MnO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	443.1%	-75.6%		Cs_2CO_3	0.0%	2.4%	-0.1%
Mixed Acid	-81.6%	0.0%	-95.5%		Mixed Acid	-2.3%	0.0%	-2.4%
Na_2O_2	310.3%	2128.3%	0.0%		Na_2O_2	0.1%	2.5%	0.0%
Cr_2O_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		MoO_3 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	4.7%	7.1%		Cs_2CO_3	0.0%	246.1%	37.8%
Mixed Acid	-4.5%	0.0%	2.3%		Mixed Acid	-71.1%	0.0%	-60.2%
Na_2O_2	-6.7%	-2.3%	0.0%		Na_2O_2	-27.4%	151.2%	0.0%

Table 8. Pairwise Comparison of Average Oxide Measurements for Radioactive Samples Across Preparation Methods (continued)

Na_2O (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		TiO_2 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	2.6%			Cs_2CO_3	0.0%	-15.1%	-12.7%
Mixed Acid	-2.5%	0.0%			Mixed Acid	17.7%	0.0%	2.8%
Na_2O_2					Na_2O_2	14.5%	-2.7%	0.0%
NiO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		U_3O_8 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	-3.8%	1.7%		Cs_2CO_3	0.0%	-2.3%	-10.9%
Mixed Acid	3.9%	0.0%	5.7%		Mixed Acid	2.3%	0.0%	-8.8%
Na_2O_2	-1.7%	-5.4%	0.0%		Na_2O_2	12.2%	9.6%	0.0%
P_2O_5 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		V_2O_5 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	105.5%	71.5%		Cs_2CO_3	0.0%	419.4%	-9.5%
Mixed Acid	-51.3%	0.0%	-16.5%		Mixed Acid	-80.7%	0.0%	-82.6%
Na_2O_2	-41.7%	19.8%	0.0%		Na_2O_2	10.5%	473.9%	0.0%
PbO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		ZnO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	245.5%	71.3%		Cs_2CO_3	0.0%	-22.5%	19.9%
Mixed Acid	-71.1%	0.0%	-50.4%		Mixed Acid	29.0%	0.0%	54.6%
Na_2O_2	-41.6%	101.7%	0.0%		Na_2O_2	-16.6%	-35.3%	0.0%
SO_4 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2		ZrO_2 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2
Cs_2CO_3	0.0%	11.5%	17.6%		Cs_2CO_3	0.0%	-3.6%	
Mixed Acid	-10.3%	0.0%	5.5%		Mixed Acid	3.8%	0.0%	
Na_2O_2	-15.0%	-5.2%	0.0%		Na_2O_2			
SiO_2 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2					
Cs_2CO_3	0.0%		2.5%					
Mixed Acid								
Na_2O_2	-2.5%		0.0%					
SnO_2 (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2					
Cs_2CO_3	0.0%	-68.5%	36.5%					
Mixed Acid	217.7%	0.0%	333.5%					
Na_2O_2	-26.7%	-76.9%	0.0%					
SrO (wt%)	Cs_2CO_3	Mixed Acid	Na_2O_2					
Cs_2CO_3	0.0%	-12.4%	-43.5%					
Mixed Acid	14.1%	0.0%	-35.6%					
Na_2O_2	77.1%	55.2%	0.0%					

5.2.4 Acceptability of Radioactive Sample Measurements

Another point of interest for the radioactive samples is the assessment of their acceptability via DWPF's Process Composition Control System (PCCS). The acceptability process as described in [7] was conducted using the average compositions provided in Table 7. For the Cs_2CO_3 method, the composition data from this table were used directly while the averages of the mixed acid and Na_2O_2 composition data were used to represent the measurements from those methods. The critical predicted properties and measured concentrations derived from the compositions of Table 7 are listed in Table 9. These values were compared against the PCCS acceptance criteria at their Measurement Acceptance Region (MAR) as defined in [7]. All of the criteria were met with the exception of Na_2SO_4. For this criterion, both the Cs_2CO_3 and mixed acid/Na_2O_2 results failed to satisfy the MAR. However, a special SO_4 solubility study was conducted for the Sludge Batch 3 (SB3)/Frit 418 glass system [8], and the results from that study increased the limit for SO_4 from 0.40 wt% to 0.60 wt%, or in terms of Na_2SO_4, the limit was increased from 0.59 wt% to 0.88 wt%. Using this limit for Na_2SO_4, the glass compositions for both the Cs_2CO_3 and the mixed acid/Na_2O_2 dissolutions are acceptable at the MAR. As seen by these results, measurements from the Cs_2CO_3 and mixed acid/Na_2O_2 dissolutions for the pour stream samples provide very consistent PCCS performance.

Table 9. PCCS Acceptance Criteria

PCCS Criteria	Cs_2CO_3	Mixed Acid/ Na_2O_2	Acceptable at the MAR
NL[B (g/L)]	0.96	1.06	Yes
NL[Li (g/L)]	0.96	1.04	Yes
NL[Na (g/L)]	0.95	1.04	Yes
T_L Pred (^oC)	873.5	871.7	Yes
Visc Pred (P)	66.1	58.4	Yes
Sum of Oxides	99.7	98.4	Yes
Al_2O_3 wt%	4.74	4.79	Yes
Ti_2O wt%	0.05	0.06	Yes
NaCl wt%	0	0	Yes
NaF wt%	0	0	Yes
Cr_2O_3 wt%	0.06	0.06	Yes
Na_2SO_4 wt%	0.79	0.69	No
Cu wt%	0.01	0.01	Yes
R_2O wt%	17.50	17.64	Yes

6.0 References

[1] C.M. Hidlay, "DWPF Lab Sampling and Analytical Improvement" SS-PIP-2003-0070, January 13, 2004.

[2] Coleman, C.J., T.B. Edwards, and D.R. Click, "SRNL Evaluation of Sub-Sampling Precision and Accuracy of DWPF Slurry Mix Evaporator Simulant," WSRC-TR-2004-00339, Revision 0, August 2004.

[3] Mahannah, R.N., "Technical Task Request: Phase II of 6 DWPF Sigma SME TAT," HLW/TTR-2005-0008, Revision 0, April 2005.

[4] C. J. Coleman and T. B. Edwards, "Task Technical & QA Plan: Phase II of Six Sigma DWPF SME Analytical Turnaround Time Study," WSRC-RP-2005-01571, Revision 0, May 12, 2005.

[5] Bannochie, C. J. and N. E. Bibler, "Analysis of Sludge Batch 3 (Macrobatch 4) DWPF Pour Stream Glass Sample for Canister S02312," WSRC-TR-2005-00354, Revision A, August 2005.

[6] SAS Institute, **JMP®: Statistics and Graphics Guide**, Version 5, SAS Institute, Inc., Cary, NC, 2002.

[7] Brown, K. G., R. L. Postles, and T. B. Edwards, "SME Acceptability Determination for DWPF Process Control**,"** WSRC-TR-95-0364, Revision 4, August 2002.

[8] Peeler, D. K., et al., "An Assessment of the Sulfate Solubility Limit for the Frit 418 – Sludge Batch 2/3 System," WSRC-TR-2004-00081, Revision 0, February 2004.

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APPENDIX A.

SUPPLEMENTAL TABLES AND EXHIBITS FOR DWPF SIMULANT RESULTS

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Table A1. Elemental Measurements (μg/g) for DWPF Simulated Glass Prepared Using Cs_2CO_3 Digestions

Sample ID	CB1	CA3	CB2	CD2	CD5	CD1	CA1	CD4	CA2	CD6	CD3
Type of Sample	blank	ARG-1	blank	Simulant	Simulant	Simulant	ARG-1	Simulant	ARG-1	Simulant	Simulant
LIMS #	219780/1.1	219781/1.1	219782/1.1	219783/1.1	219784/1.1	219785/1.1	219786/1.1	219787/1.1	219788/1.1	219789/1.1	219790/1.1
Ag	<331	<314	<331	<332	<318	<334	373	<319	<332	<333	<327
Al	<467	24700	<467	33700	33300	33500	24500	33700	24700	33600	33300
B	<238	24700	<238	15400	15900	15400	24400	15900	25100	16100	15700
Ba	73.2	884	73.2	672	658	672	864	681	876	677	671
Ca	<164	10700	<164	10000	9850	9910	9880	9910	10400	9990	9860
Cd	<70.9	<67.3	<70.9	<71.2	<68.1	<71.6	<71.0	<68.3	<71.2	<71.3	<70.1
Ce	<648	<615	<648	<650	<622	<654	<649	<624	<650	<651	<641
Co	<105	<100	<105	<106	<101	<106	120	<102	<106	<106	<104
Cr	<118	718	<118	582	574	569	656	602	684	574	595
Cu	<53.6	<50.9	<53.6	479	487	479	95.4	479	<53.8	480	469
Fe	<83.2	101000	<83.2	102000	101000	102000	96300	102000	98500	102000	101000
K	<2810	22700	<2810	<2820	<2700	<2840	23500	<2710	23300	<2830	<2780
La	<128	<122	<128	<129	<123	<130	<128	<124	<129	<129	<127
Li	<108	15400	<108	24200	24300	24200	15800	24200	15700	24100	24100
Mg	<329	5230	<329	8920	8770	8820	5050	8920	5170	8820	8820
Mn	<47.1	15000	<47.1	16800	16600	16800	14500	16700	14800	16600	16600
Mo	<282	<268	<282	<283	<271	<285	<283	<272	<284	<284	<279
Na	<628	85600	<628	98300	98700	98900	87400	98500	87300	98300	98000
Nb	<136	609	<136	<136	<130	<137	525	<131	566	<136	<134
Nd	<852	<809	<852	<855	<818	<860	<854	<821	<856	<857	<843
Ni	<86.9	8390	<86.9	3650	3640	3610	7940	3730	8120	3650	3640
P	<724	1110	<724	<727	<696	<731	908	<698	826	<729	<717
Pb	<400	<380	<400	543	453	498	<401	523	<402	672	791
Re	<143	<136	<143	<143	<137	<144	<143	<138	<143	<144	<141
S	<939	<891	<939	2230	2220	2240	<940	2160	<943	2020	2070
Si	<137	235000	<137	237000	223000	237000	229000	238000	233000	231000	237000
Sn	<326	<309	<326	<327	<313	<329	<326	<314	<327	<328	<322
Sr	<47.4	<45.0	<47.4	71.8	71	71.7	<47.5	71.8	<47.6	71.8	72.8
Ti	<12.1	7250	<12.1	241	237	236	7190	242	7250	237	240
V	<238	<226	<238	<239	<229	<241	<239	<230	<239	<240	<236
Zn	<47.6	197	<47.6	1200	1240	1170	183	1190	186	1200	1190
Zr	<126	1010	<126	2000	1920	1990	1010	2020	1030	1980	1990

Table A2. Elemental Measurements (μg/g) for DWPF Simulated Glass Prepared Using K_2CO_3 Digestions[2]

Sample ID	KA1	KB1	KD5	KD6	KB2	KD4	KD3	KD1	KA2	KD2	KA3
Type of Sample	ARG-1	blank	Simulant	Simulant	blank	Simulant	Simulant	Simulant	ARG-1	Simulant	ARG-1
LIMS #	219791/1.1	219792/1.1	219793/1.1	219794/1.1	219795/1.1	219796/1.1	219797/1.1	219798/1.1	219799/1.1	219800/1.1	219801/1.1
Ag	<321	<331	<330	<343	<331	<357	<328	<326	<318	<328	<315
Al	24100	<467	33100	31000	<467	32200	31100	31600	23200	32500	25100
B	25800	<238	16000	15100	<238	15500	15000	15700	24800	16100	27000
Ba	774	<60.1	586	553	<60.1	557	533	548	745	564	809
Ca	10100	<164	9620	8890	<164	9030	8690	8890	9530	9400	10900
Cd	<68.8	<70.9	<70.8	<73.5	<70.9	<76.5	<70.4	<69.8	<68.1	<70.2	<67.5
Ce	<628	<648	<647	<671	<648	<699	<643	<638	<622	<641	<616
Co	<102	<105	<105	<109	<105	<114	<105	<104	<101	<104	<100
Cr	652	<118	554	513	<118	539	511	514	613	547	680
Cu	<52.0	<53.6	407	411	<53.6	427	360	425	<51.5	431	<51.0
Fe	95400	<83.2	98600	92800	<83.2	95000	91200	94200	90900	97000	101000
K	4920000	5140000	5160000	5010000	5070000	5160000	4760000	4710000	4680000	4860000	4750000
La	<124	<128	<128	<133	<128	<138	<127	<126	<123	<127	127
Li	15300	<108	24100	22400	<108	23800	22600	23200	14600	23600	15400
Mg	5020	<329	8660	8120	<329	8330	7960	8160	4780	8360	5310
Mn	14500	<47.1	16300	15400	<47.1	15800	15100	15600	13800	16000	15300
Mo	<274	<282	<282	<293	<282	<305	<280	<278	<271	<280	<269
Na	85200	<628	98300	91100	<628	96600	92800	94500	80900	96500	85800
Nb	575	<136	<135	<141	<136	<146	<135	<134	531	<134	659
Nd	<827	<852	<851	<883	<852	<919	<845	<839	<818	<844	<811
Ni	6050	<86.9	2940	2930	<86.9	2880	2800	2970	5620	3080	6720
P	756	<724	<723	<751	<724	<782	<719	<713	884	<717	1380
Pb	<388	<400	484	474	<400	<432	<397	601	<384	549	<381
Re	<139	<143	<143	<148	<143	<154	<142	<141	<137	<141	<136
S	<911	<939	1800	2270	<939	2120	1880	2040	<901	2030	<893
Si	229000	<137	234000	219000	<137	225000	214000	220000	212000	224000	241000
Sn	<316	<326	<325	<338	<326	<352	<323	<321	<313	<323	<310
Sr	<46.0	<47.4	60.4	55.5	<47.4	57.5	59.9	58.3	<45.5	59.2	<45.1
Ti	7070	<12.1	229	216	<12.1	225	217	214	6730	231	7280
V	<231	<238	<238	<247	<238	<257	<237	<235	<229	<236	<227
Zn	175	<47.6	1140	1080	<47.6	1080	1070	1080	167	1150	198
Zr	946	<126	1930	1830	<126	1900	1830	1860	913	1900	1010

[2] The K values generated by this digestion method are ignored in this study.

Table A3. Elemental Measurements (μg/g) for DWPF Simulated Glass Prepared Using Na_2O_2 Digestions[3]

Sample ID	ND3	ND6	ND5	NA2	ND2	NA3	ND1	NA1	NB2	ND4	NB1
Type of Sample	Simulant	Simulant	Simulant	ARG-1	Simulant	ARG-1	Simulant	ARG-1	blank	Simulant	blank
LIMS #	219802/1.1	219803/1.1	219804/1.1	219805/1.1	219806/1.1	219807/1.1	219808/1.1	219809/1.1	219810/1.1	219811/1.1	219812/1.1
Ag	<328	<339	<331	<318	<328	<315	<326	<315	<331	<357	<331
Al	34100	31300	31500	23200	31600	23500	34000	25300	<467	32600	<467
B	16600	15300	15400	25000	15400	24900	16900	27200	329	15900	<238
Ba	615	570	567	767	570	877	716	823	<60.1	575	<60.1
Ca	11600	10600	10800	11000	10800	11200	11800	12000	1540	11000	1310
Cd	<70.4	<72.7	<71.0	<68.1	<70.2	<67.5	<69.8	<67.6	<70.9	<76.5	<70.9
Ce	<643	<664	<649	<622	<641	<616	<638	<617	<648	<699	<648
Co	<105	<108	<105	<101	<104	<100	<104	117	<105	<114	122
Cr	540	508	507	598	510	608	557	645	<118	493	<118
Cu	503	456	458	<51.5	464	<51.0	515	<51.1	<53.6	474	<53.6
Fe	104000	95400	95500	94000	95700	94800	104000	101000	<83.2	98300	<83.2
K	3690	5380	4150	25900	3460	27900	6300	28900	<2810	7110	3680
La	<127	<132	<128	<123	<127	195	150	<122	<128	<138	<128
Li	24200	22200	22400	14400	22500	14400	24500	15600	<108	23300	<108
Mg	8800	8160	8160	4760	8050	4820	8760	5110	<329	8270	<329
Mn	16600	15200	15300	13700	15300	13900	16700	14800	<47.1	15700	<47.1
Mo	<280	<290	<283	<271	<280	<269	<278	<269	<282	<305	<282
Na	5330000	5090000	5000000	4900000	5120000	4810000	5370000	5160000	5330000	5700000	5130000
Nb	<135	<139	<136	467	<134	606	<134	613	<136	<146	<136
Nd	<845	<874	<853	<818	<844	<811	<839	<812	<852	<919	<852
Ni	3810	3520	3570	7820	3510	7880	3790	8400	<86.9	3590	<86.9
P	<719	<743	<726	1030	<717	967	<713	902	<724	<782	<724
Pb	443	504	<401	<384	<396	<381	576	<381	<400	<432	<400
Re	<142	<147	<143	<137	<141	<136	<141	<136	<143	<154	<143
S	2400	1890	2120	<901	1850	<893	2500	<895	<939	1920	<939
Si	236000	216000	218000	214000	218000	216000	237000	232000	<137	224000	<137
Sn	<323	<334	<326	<313	<323	<310	<321	<311	<326	<352	<326
Sr	82	75.7	78.1	<45.5	73.1	109	141	48	<47.4	80.8	<47.4
Ti	249	221	220	6660	217	6700	238	7230	<12.1	228	<12.1
V	<237	<245	<239	<229	<236	<227	<235	<227	<238	<257	<238
Zn	1190	1080	1090	172	1090	178	1160	194	<47.6	1110	<47.6
Zr	41300	33100	35000	31900	25000	32000	43000	59300	33800	74600	44900

[3] The Na and Zr values generated by this digestion method are ignored in this study.

Table A4. Elemental Measurements (μg/g) for DWPF Simulated Glass Prepared Using Mixed Acid Digestions[4]

Sample ID	MA3	MA2	MD1	MD6	MD2	MB1	MD5	MD4	MD3	MA1	MB2
Type of Sample	ARG-1	ARG-1	Simulant	Simulant	Simulant	blank	Simulant	Simulant	Simulant	ARG-1	blank
LIMS #	219813/1.1	219814/1.1	219815/1.1	219816/1.1	219817/1.1	219818/1.1	219819/1.1	219820/1.1	219821/1.1	219822/1.1	219823/1.1
Ag	<326	<328	<316	<334	<333	<331	<314	<320	<321	<333	<331
Al	23400	23700	33000	28600	30400	<467	32800	32,900	33200	23300	<467
B											
Ba	798	807	595	505	542	<60.1	586	586	599	798	<60.1
Ca	10400	10400	9840	8330	8950	<164	9720	9,750	9960	10400	<164
Cd	<69.8	<70.4	<67.7	<71.5	<71.4	<70.9	<67.3	<69	<68.7	<71.3	<70.9
Ce	<637	<643	<619	<653	<652	<648	<614	<626	<628	<651	<648
Co	108	110	<101	<106	<106	<105	<99.9	<102	<102	118	<105
Cr	670	664	555	485	505	<118	555	570	577	664	<118
Cu	<52.8	<53.2	488	412	453	<53.6	488	485	495	<53.9	<53.6
Fe	99100	99500	100000	86300	92200	<83.2	99800	99,900	101000	99600	<83.2
K	24100	23700	<2690	<2840	<2830	<2810	2990	<2,720	<2730	23900	<2810
La	<126	<127	<123	<129	<129	<128	<122	<124	<124	<129	<128
Li	15400	15400	24600	21400	22700	<108	24100	24,300	24700	15300	<108
Mg	5180	5210	8660	7410	7940	<329	8650	8,710	8780	5110	<329
Mn	14800	14800	16400	14000	15000	<47.1	16300	16,300	16500	14800	<47.1
Mo	<278	<280	<270	<285	<284	<282	<268	<273	<274	<284	<282
Na	87800	88100	101000	88800	93600	<628	101000	100,000	101000	87500	<628
Nb	709	635	<130	<137	<137	<136	<129	<131	<131	603	<136
Nd	<839	<846	<814	<859	<858	<852	<808	<824	<826	<857	<852
Ni	8450	8530	3750	3240	3440	<86.9	3710	3,750	3810	8570	<86.9
P	1140	1210	<692	<731	<729	<724	<687	<700	<702	1090	<724
Pb	<394	<397	443	<403	454	<400	465	541	455	<402	<400
Re	<141	<142	<136	<144	<144	<143	<136	<138	<138	<144	<143
S	<924	<932	1680	1230	1730	<939	1350	1,790	1610	<944	<939
Si											
Sn	<321	<323	<311	<329	<328	<326	<309	<315	<316	<328	<326
Sr	<46.7	<47.1	63.3	51.6	55.3	<47.4	62.4	62	61.1	<47.7	<47.4
Ti	7000	7050	232	218	225	<12.1	239	239	228	7020	<12.1
V	<235	<237	<228	<240	<240	<238	<226	<230	<231	<240	<238
Zn	198	190	1150	994	1060	<47.6	1140	1,150	1170	191	<47.6
Zr	1030	992	2050	1840	1940	<126	2020	2,060	2050	1030	<126

[4] The B and Si values generated by this digestion method were ignored in this study.

Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

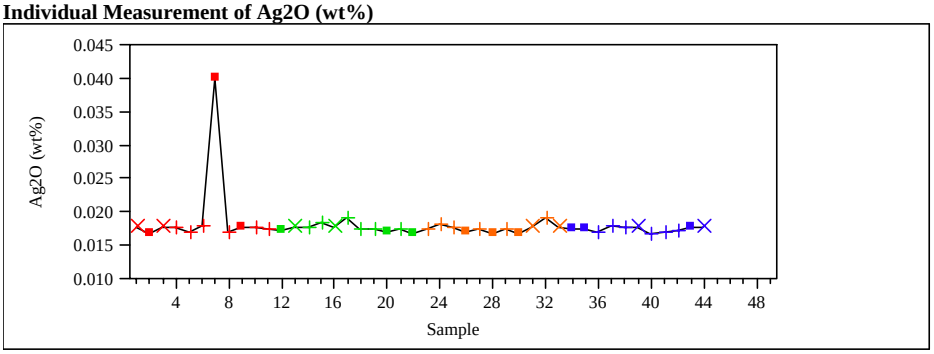
(Concentrations are in wt%.)

Legend

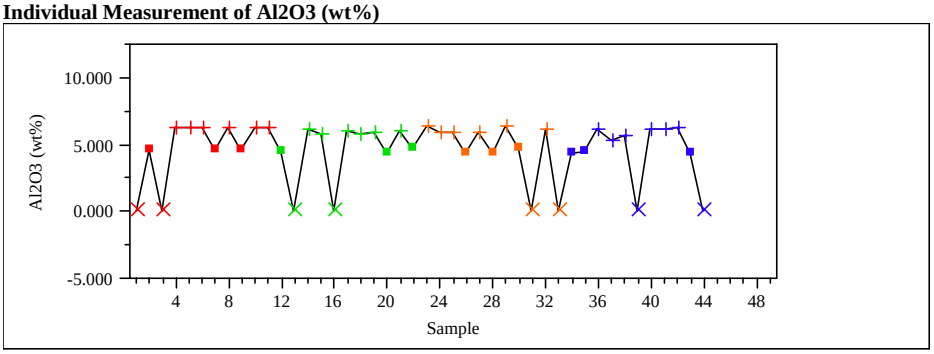
Preparation Method
- Cs2CO3
- K2CO3
- Mixed Acid
- Na2O2

Type of Sample
- ARG-1
- Simulant
- blank

Individual Measurement of Ag2O (wt%)



Individual Measurement of Al2O3 (wt%)



Individual Measurement of B2O3 (wt%)

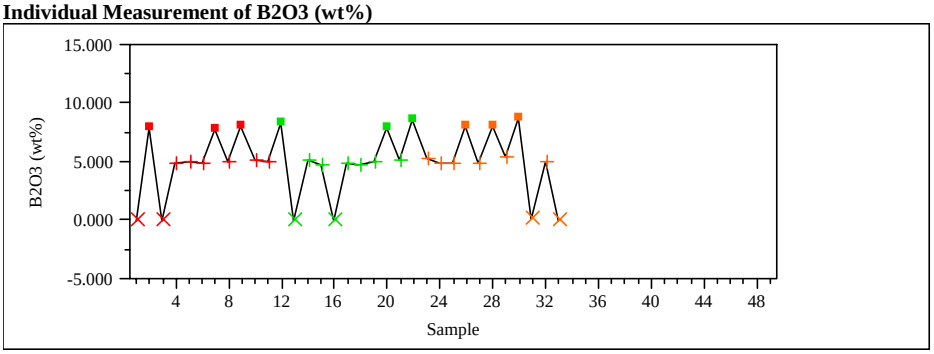
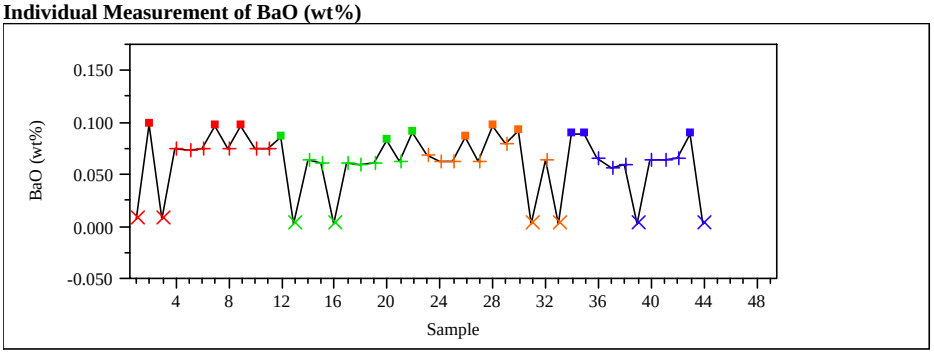


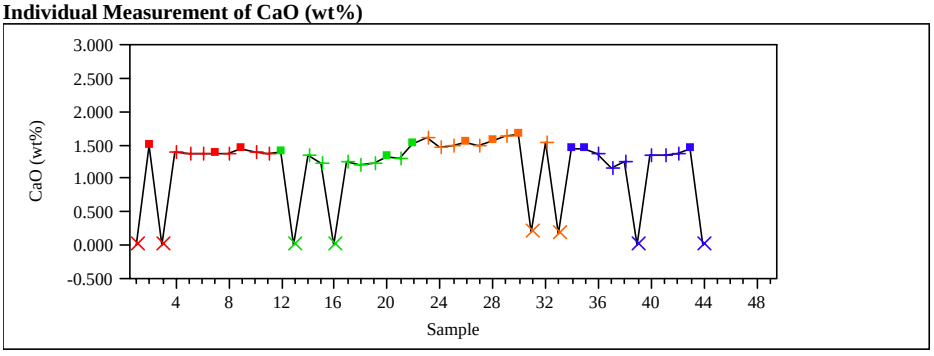
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

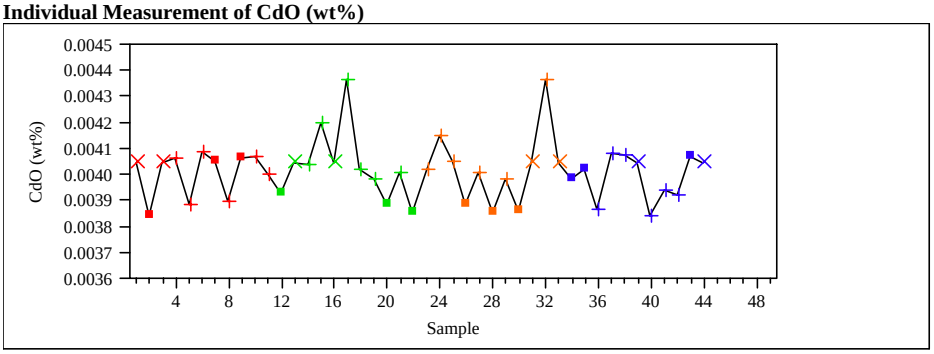
Individual Measurement of BaO (wt%)



Individual Measurement of CaO (wt%)



Individual Measurement of CdO (wt%)



Individual Measurement of Ce2O3 (wt%)

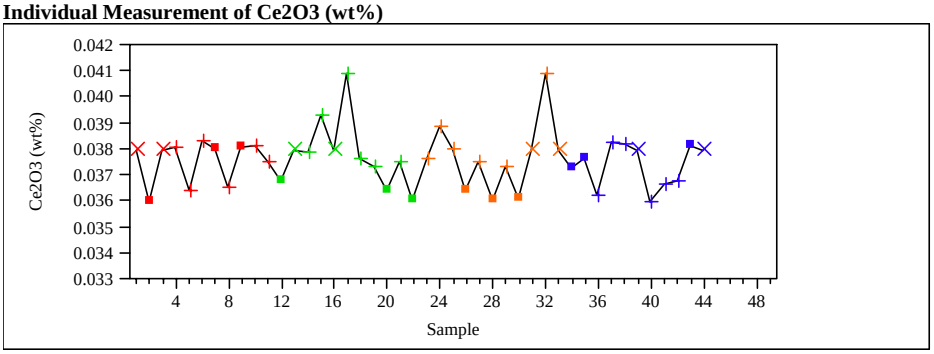
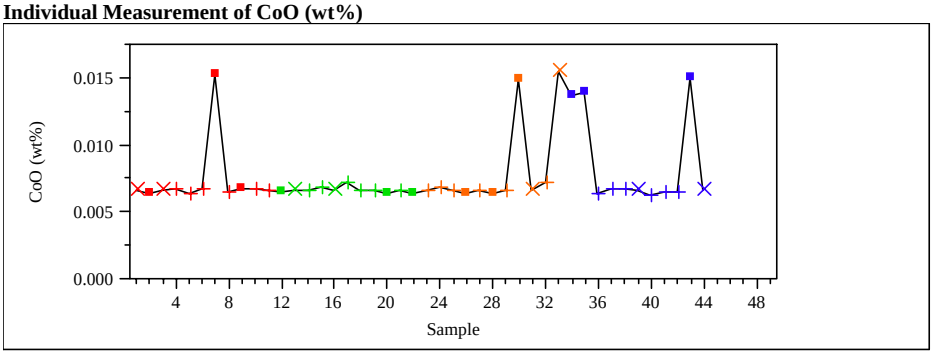


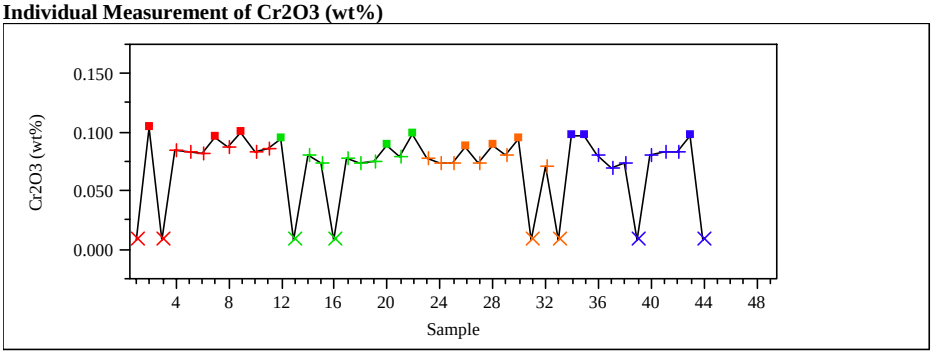
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

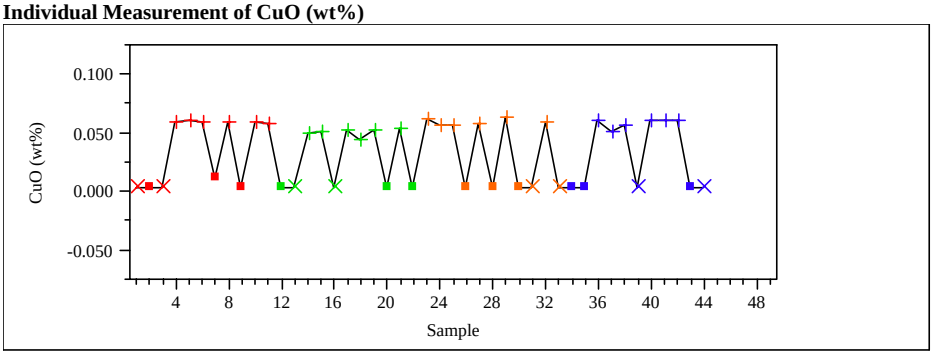
Individual Measurement of CoO (wt%)



Individual Measurement of Cr2O3 (wt%)



Individual Measurement of CuO (wt%)



Individual Measurement of Fe2O3 (wt%)

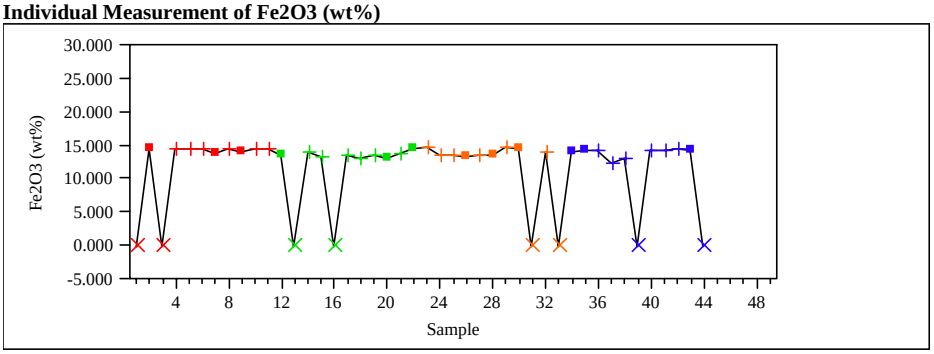
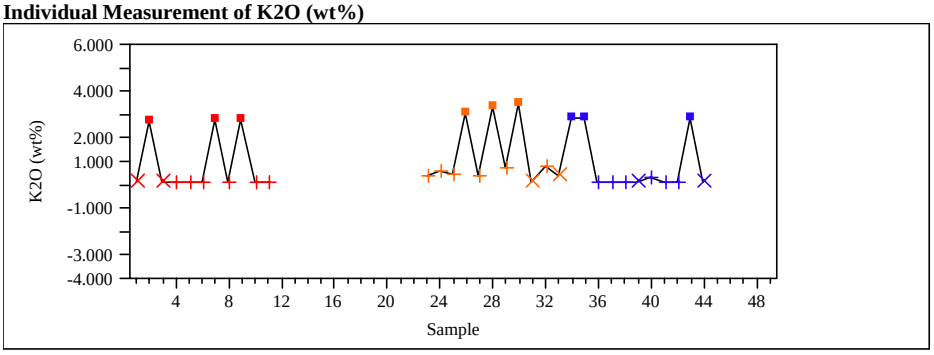


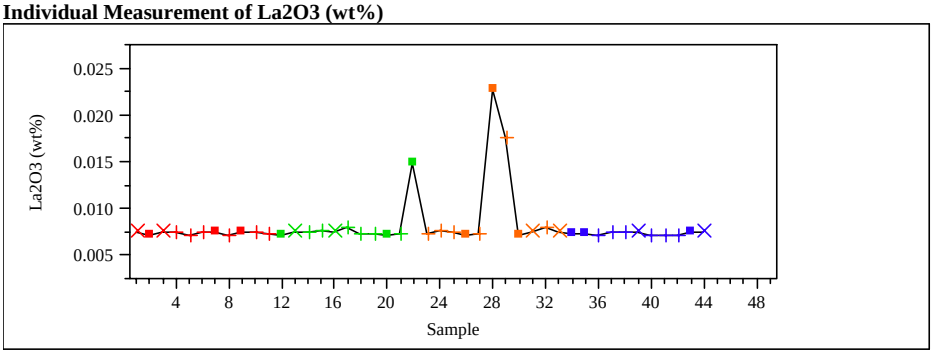
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

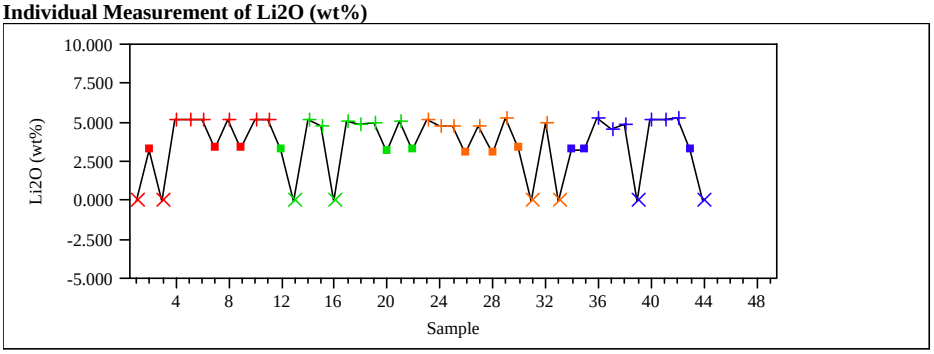
Individual Measurement of K2O (wt%)



Individual Measurement of La2O3 (wt%)



Individual Measurement of Li2O (wt%)



Individual Measurement of MgO (wt%)

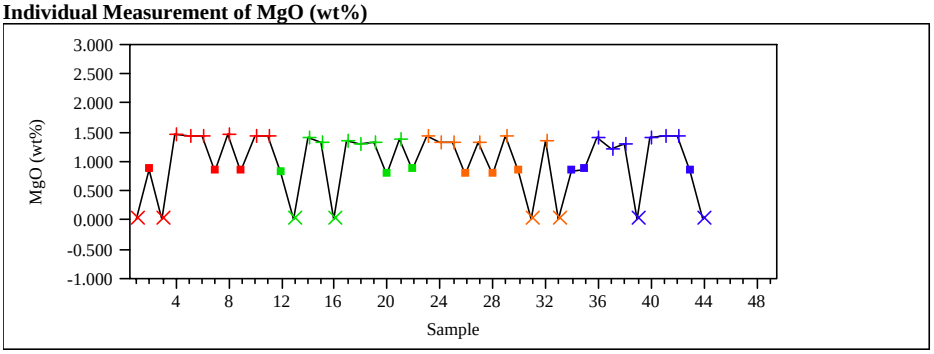
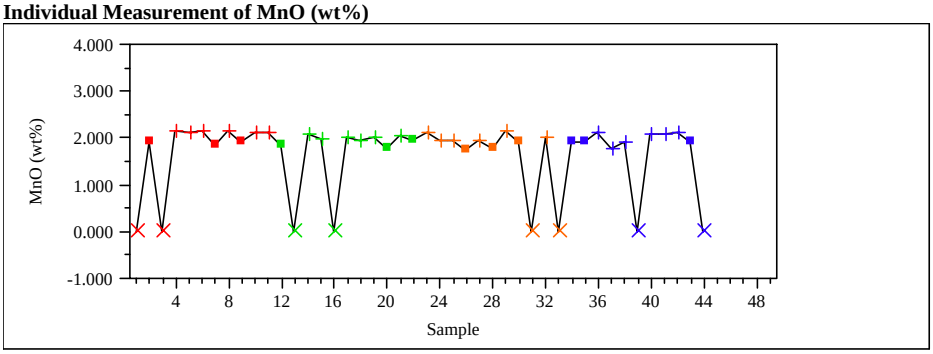


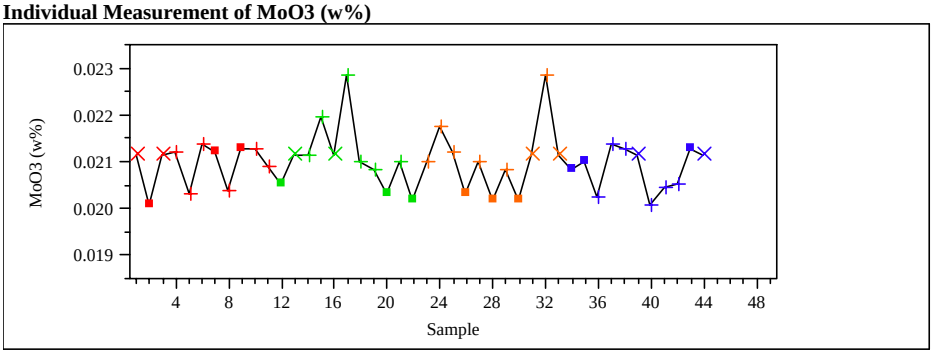
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of MnO (wt%)



Individual Measurement of MoO3 (w%)



Individual Measurement of Na2O (wt%)

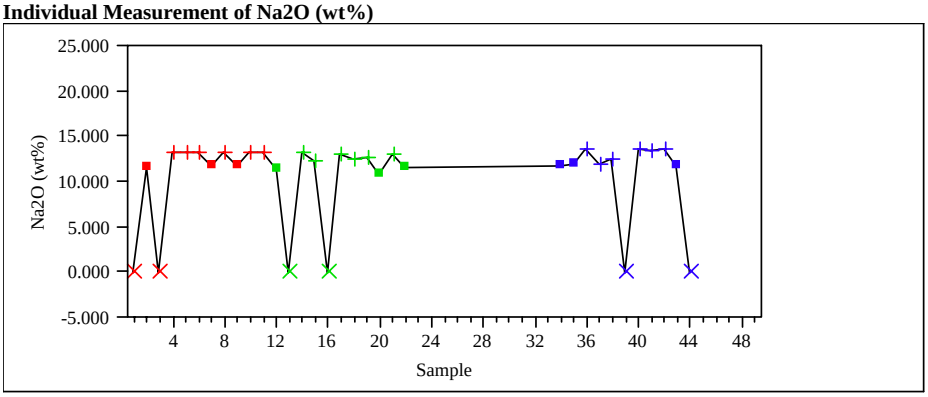
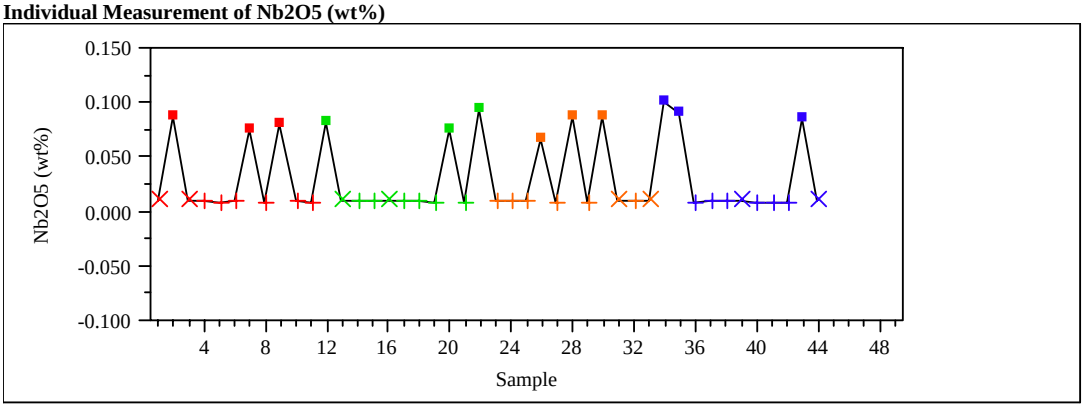


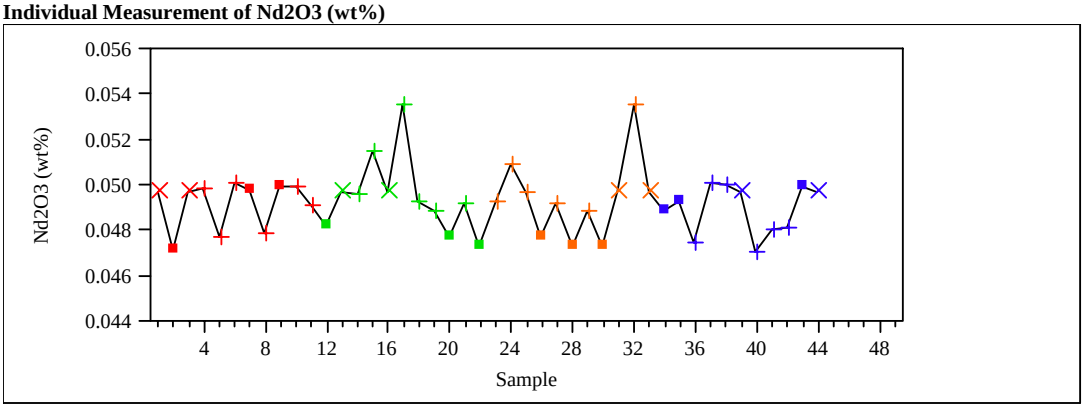
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of Nb2O5 (wt%)



Individual Measurement of Nd2O3 (wt%)



Individual Measurement of NiO (wt%)

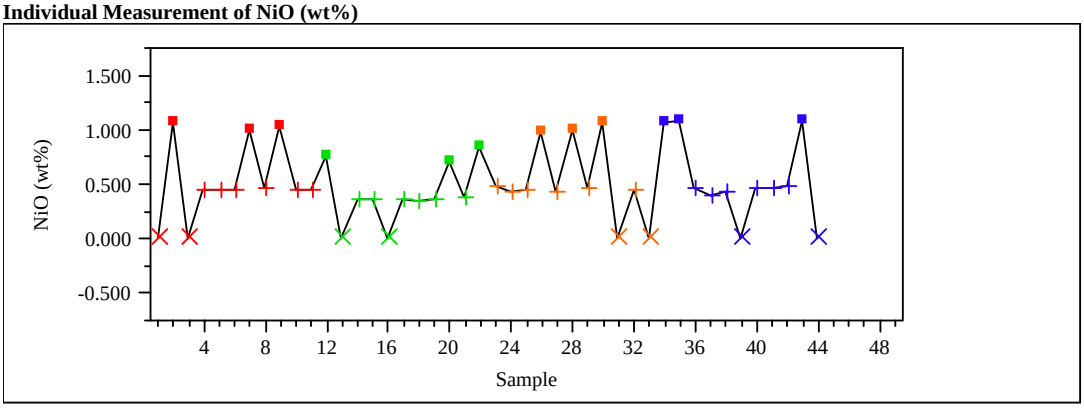
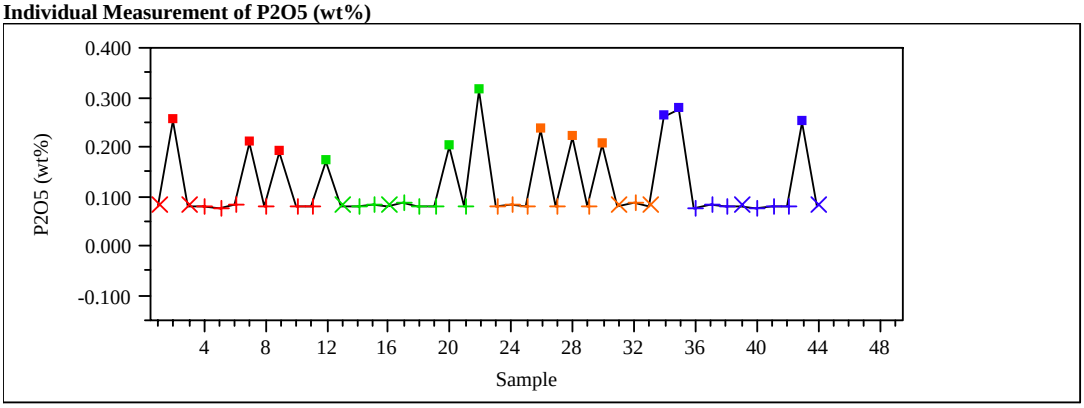


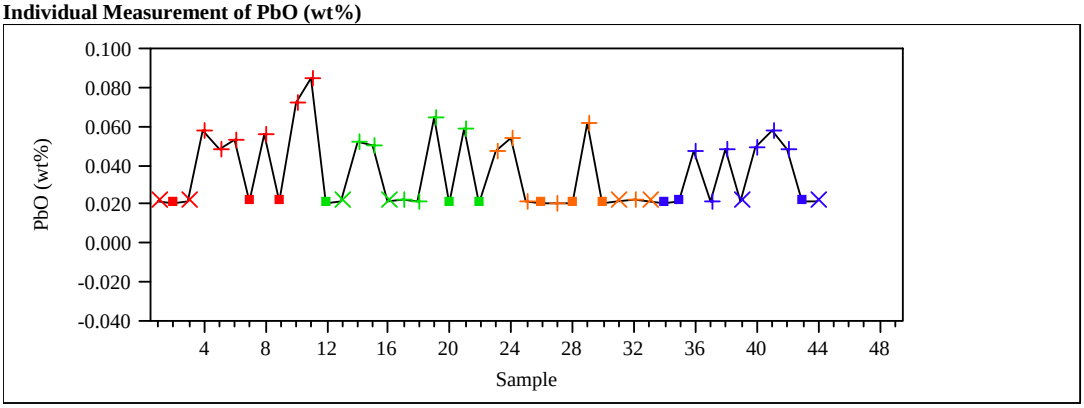
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of P2O5 (wt%)



Individual Measurement of PbO (wt%)



Individual Measurement of ReO2 (wt%)

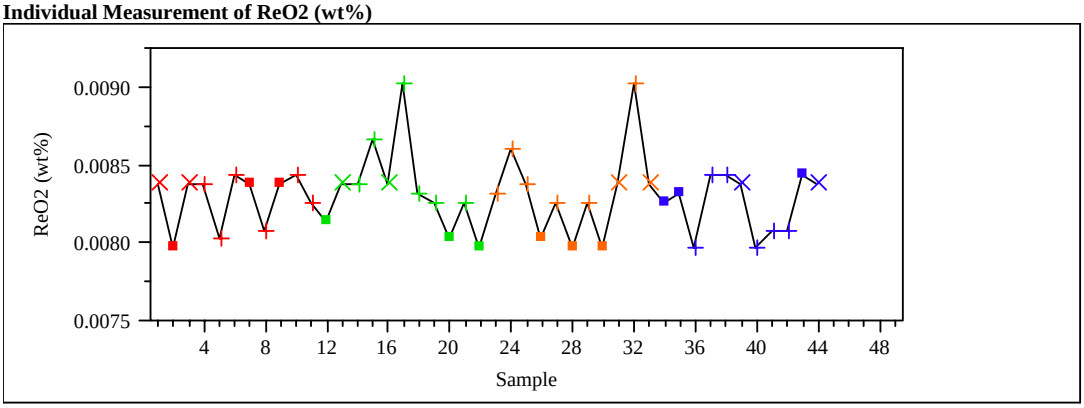
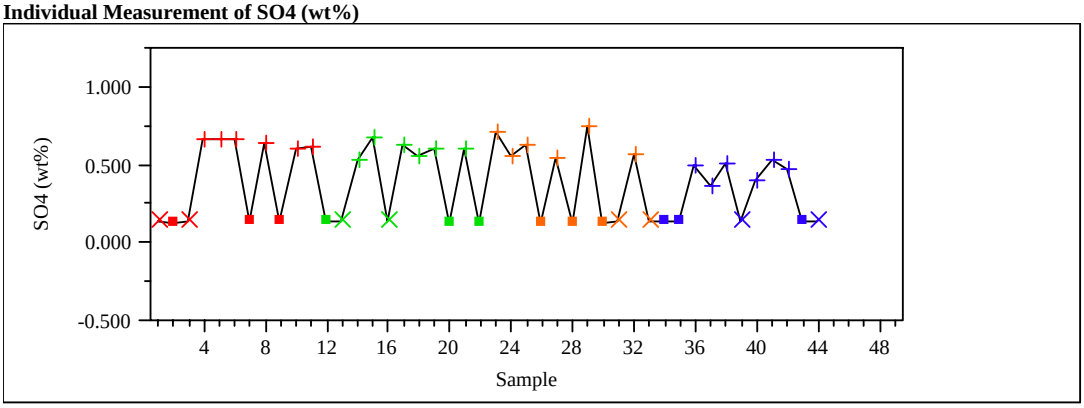


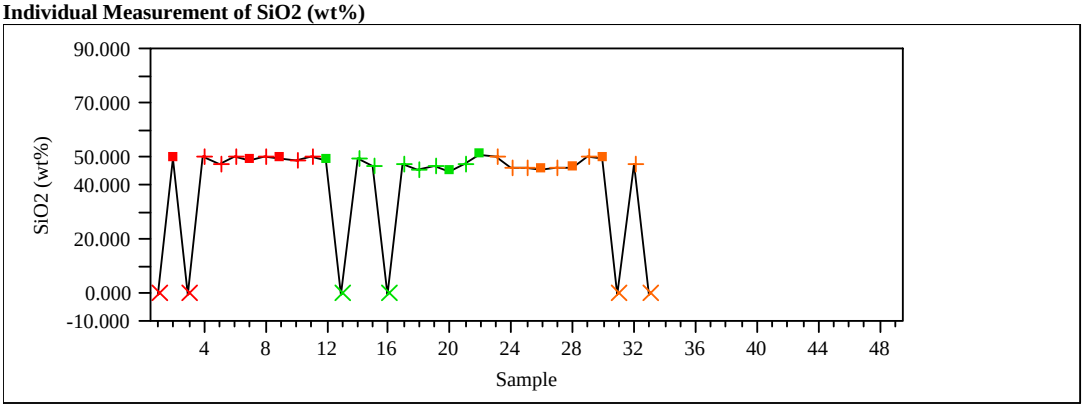
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of SO4 (wt%)



Individual Measurement of SiO2 (wt%)



Individual Measurement of SnO2 (wt%)

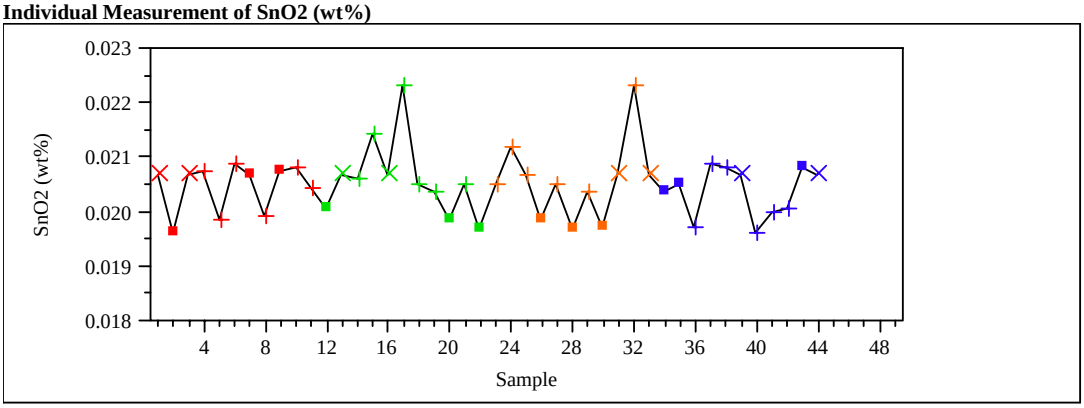
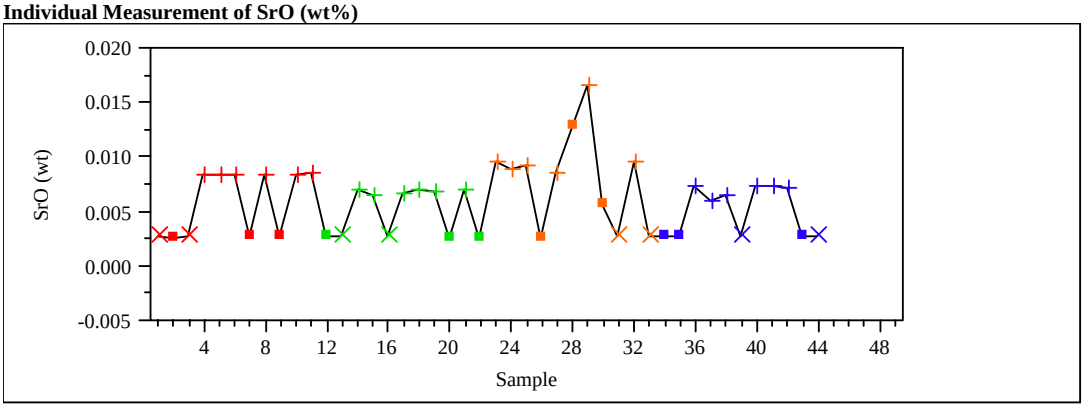


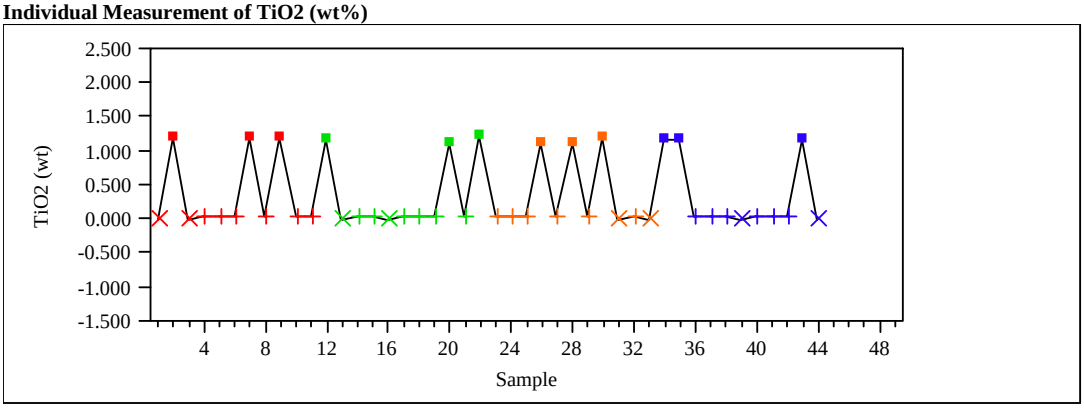
Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of SrO (wt%)



Individual Measurement of TiO2 (wt%)



Individual Measurement of V2O5 (wt%)

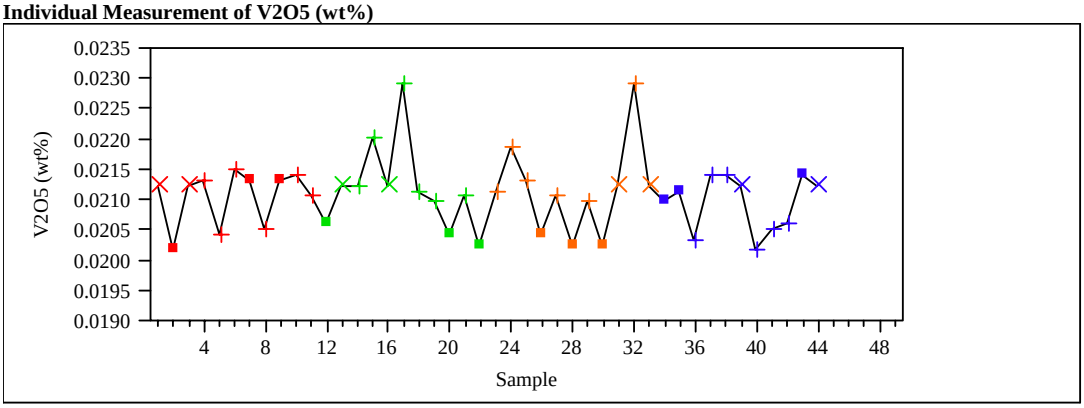
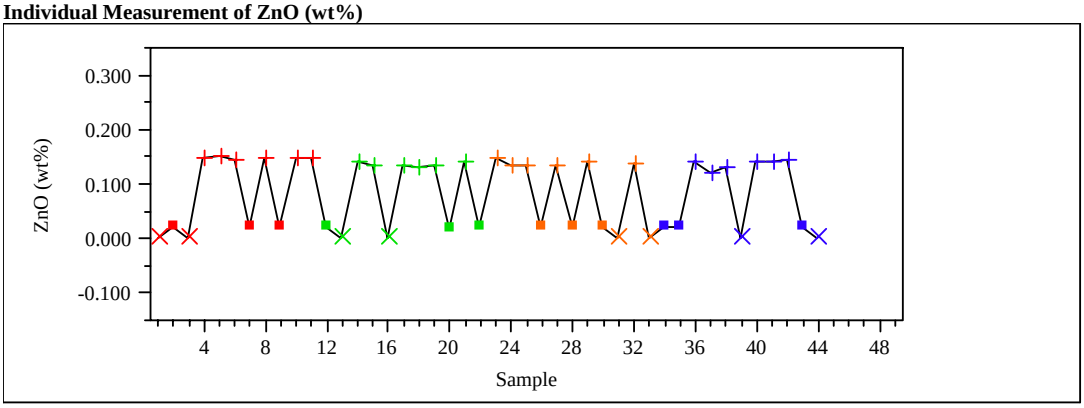


Exhibit A1. Chemical Composition Measurements in Analytical Sequence by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Individual Measurement of ZnO (wt%)



Individual Measurement of ZrO2 (wt%)

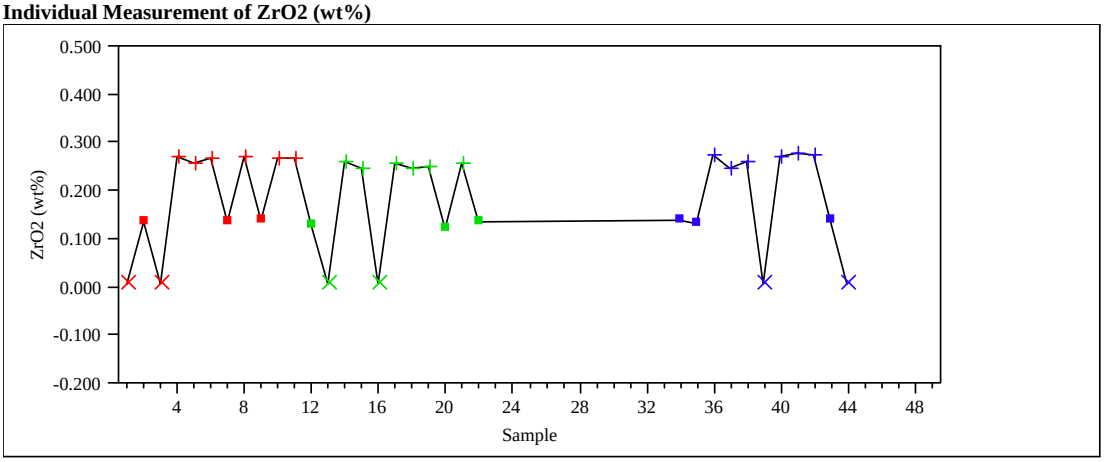


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

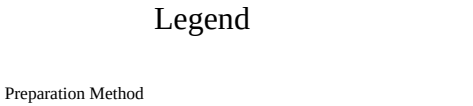


Chart for Al2O3 (wt%)

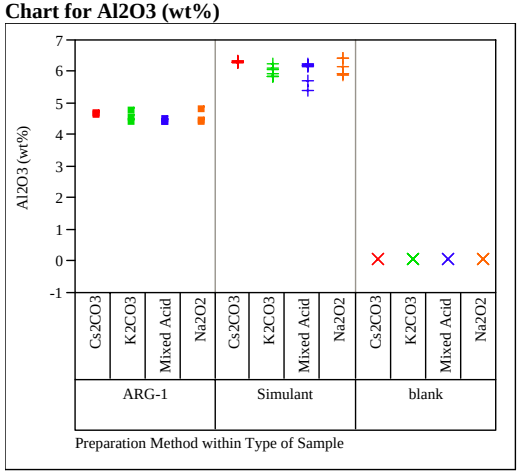


Chart for B2O3 (wt%)

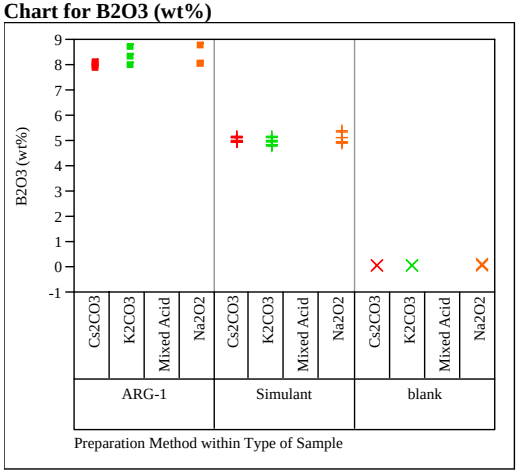


Chart for CaO (wt%)

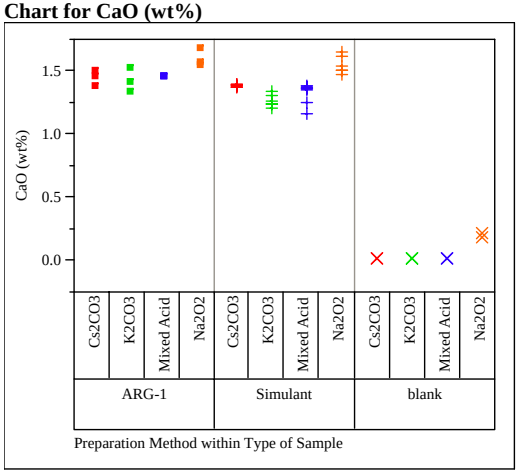


Chart for BaO (wt%)

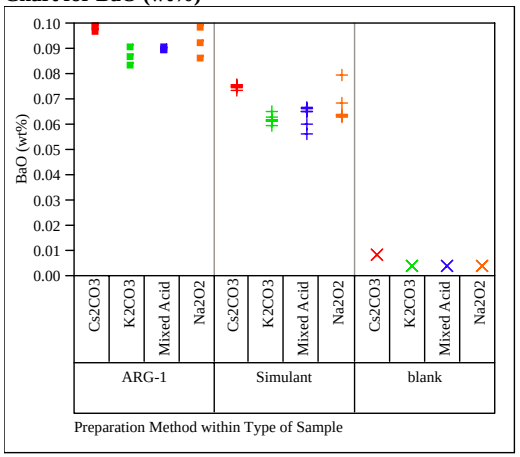


Chart for CdO (wt%)

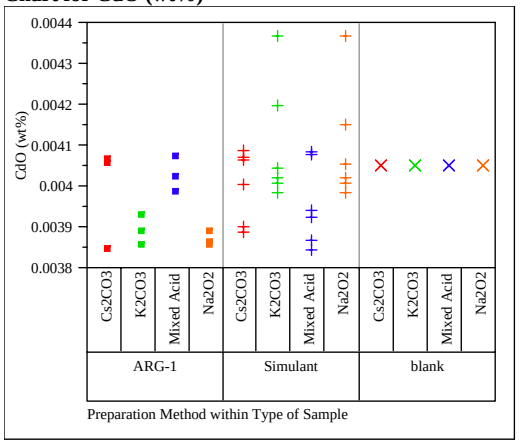


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Chart for Ce2O3 (wt%)

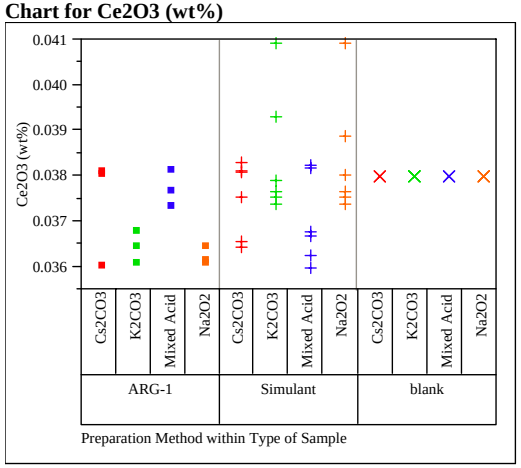


Chart for Cr2O3 (wt%)

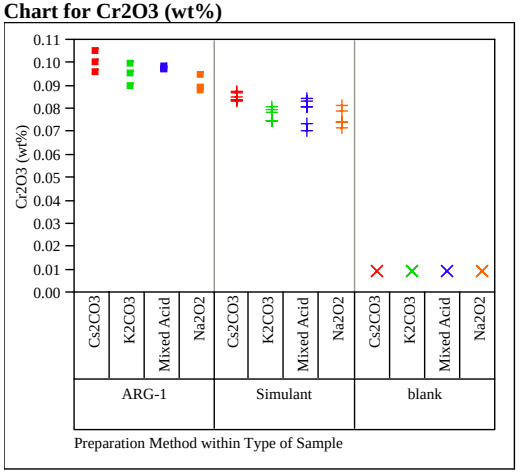


Chart for Fe2O3 (wt%)

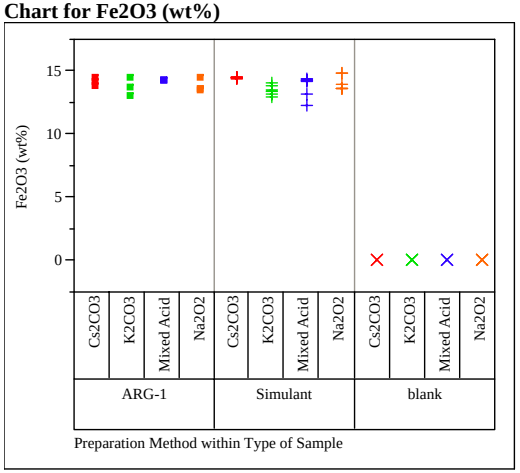


Chart for CoO (wt%)

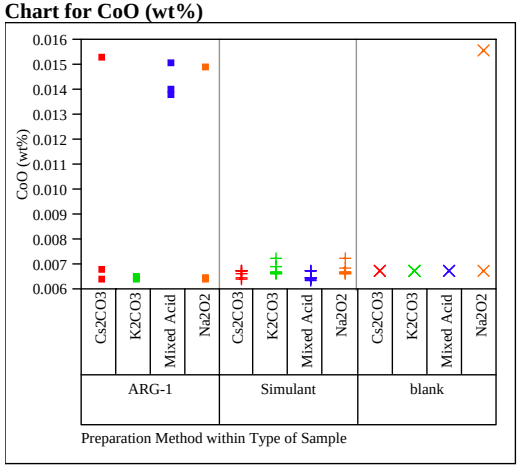


Chart for CuO (wt%)

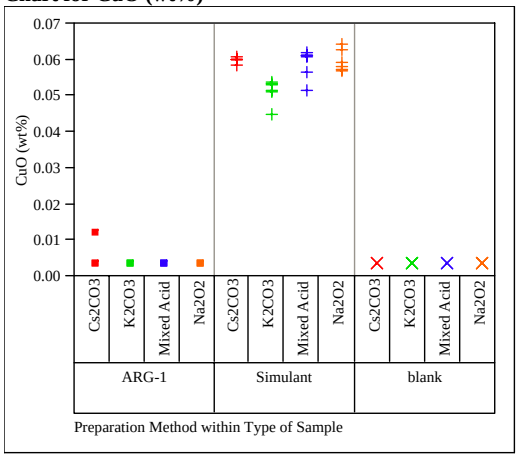


Chart for K2O (wt%)

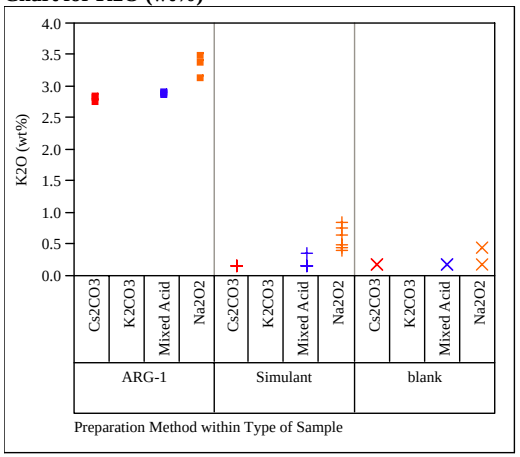


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Chart for La2O3 (wt%)

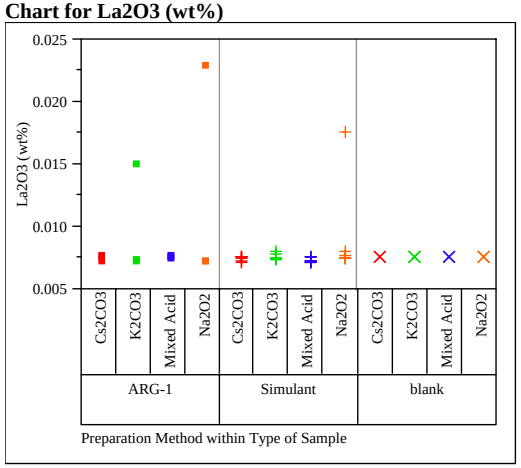


Chart for MgO (wt%)

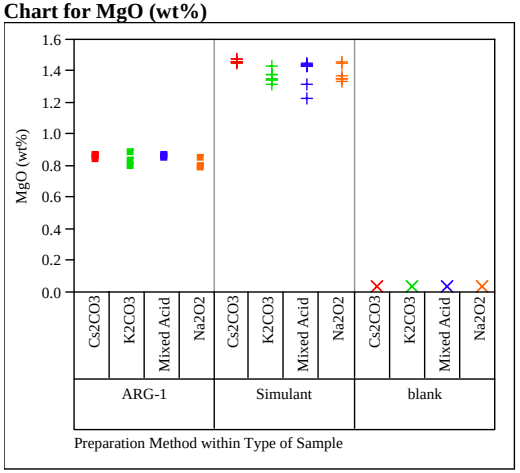


Chart for MoO3 (w%)

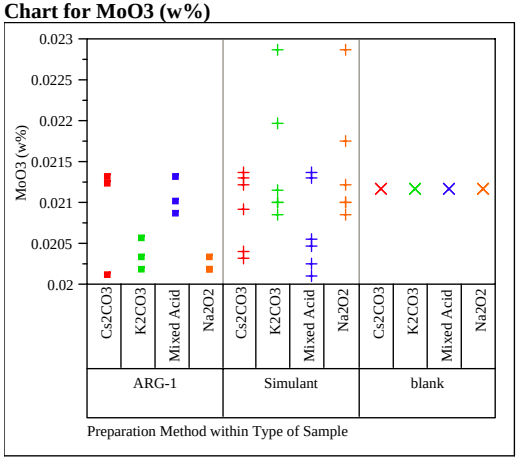


Chart for Li2O (wt%)

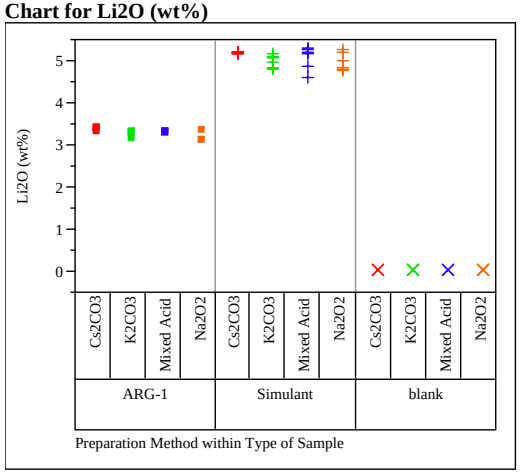


Chart for MnO (wt%)

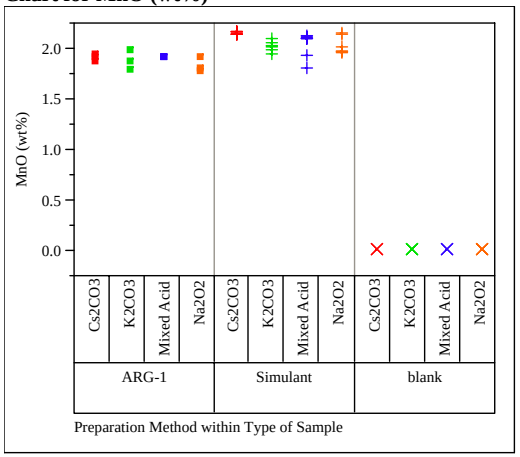


Chart for Na2O (wt%)

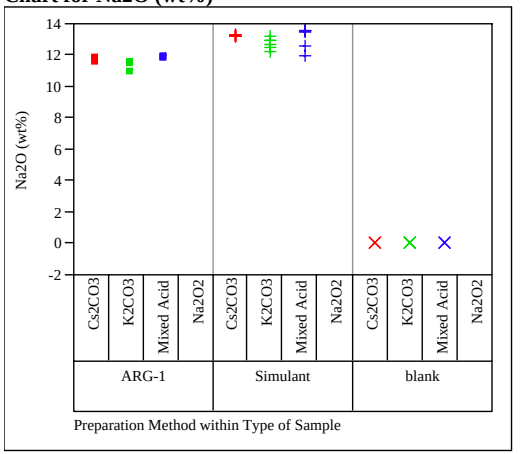


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Chart for Nb2O5 (wt%)

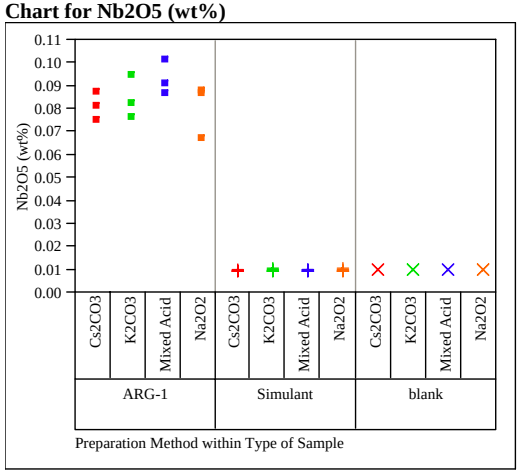


Chart for NiO (wt%)

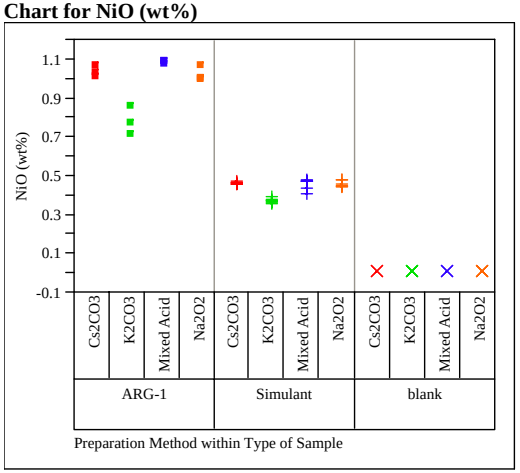


Chart for PbO (wt%)

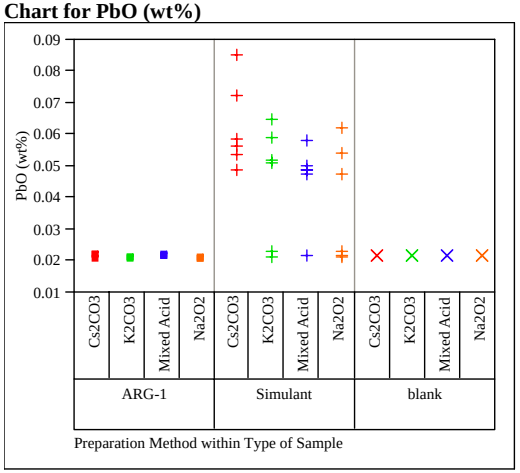


Chart for Nd2O3 (wt%)

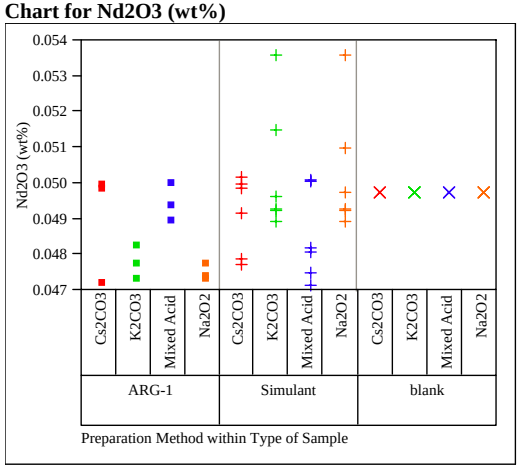


Chart for P2O5 (wt%)

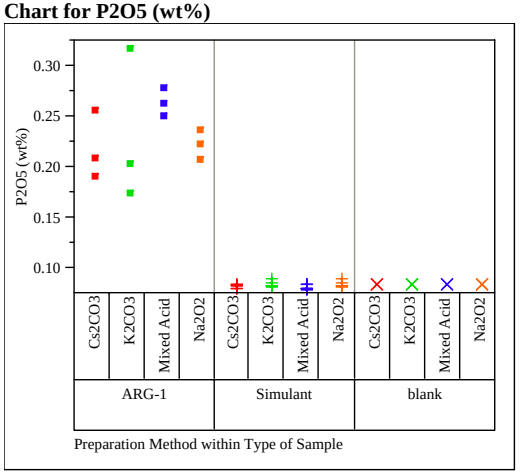


Chart for ReO2 (wt%)

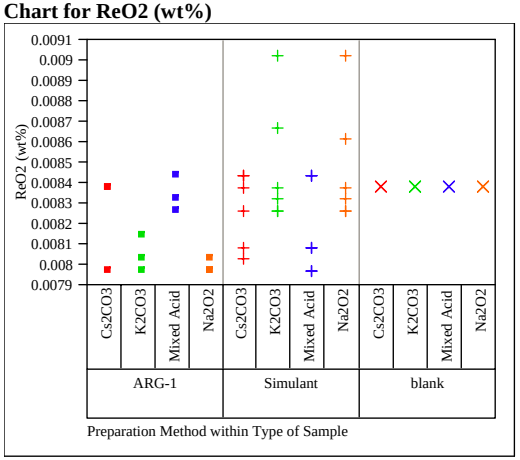


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Chart for SO4 (wt%)

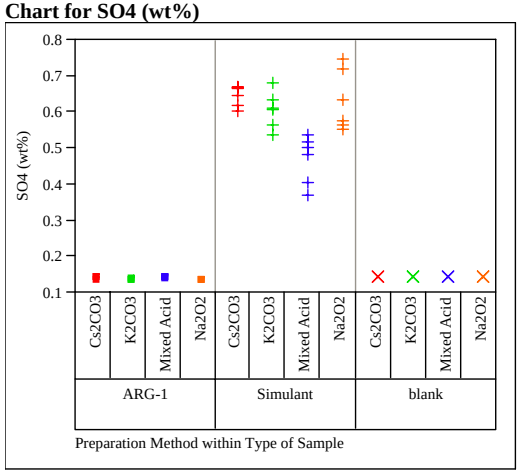


Chart for SnO2 (wt%)

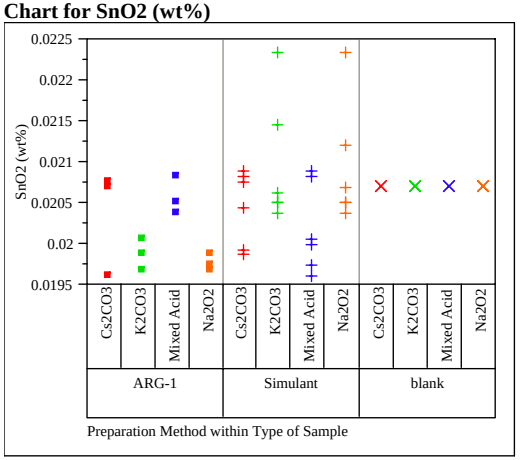


Chart for TiO2 (wt%)

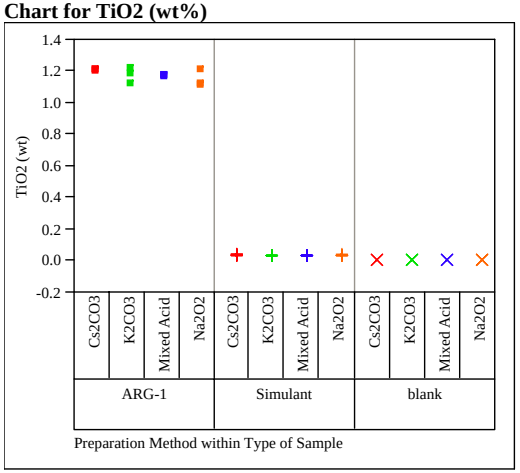


Chart for SiO2 (wt%)

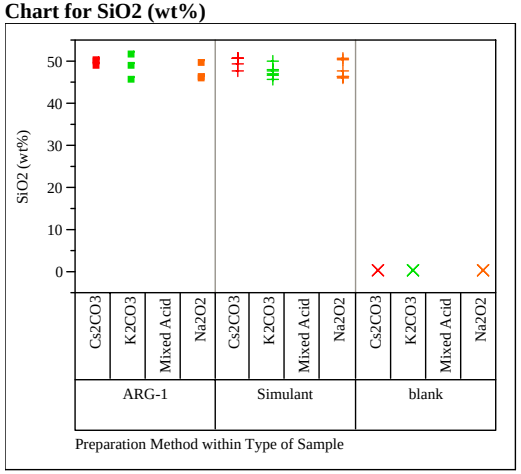


Chart for SrO (wt%)

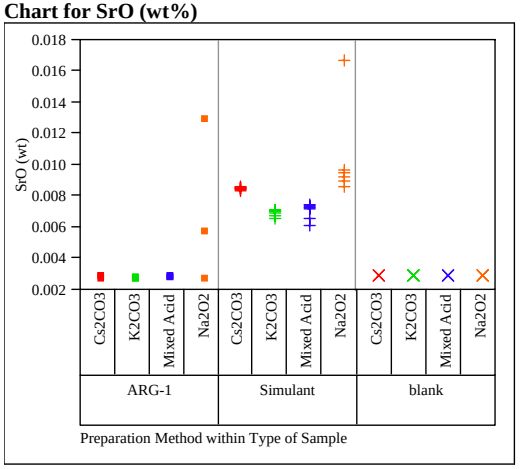


Chart for V2O5 (wt%)

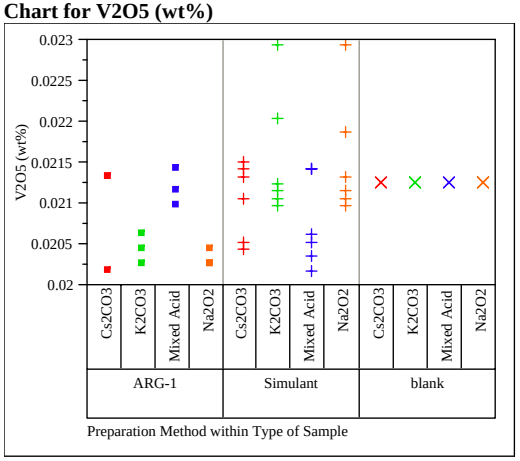


Exhibit A2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Simulated Glass

(Concentrations are in wt%.)

Chart for ZnO (wt%)

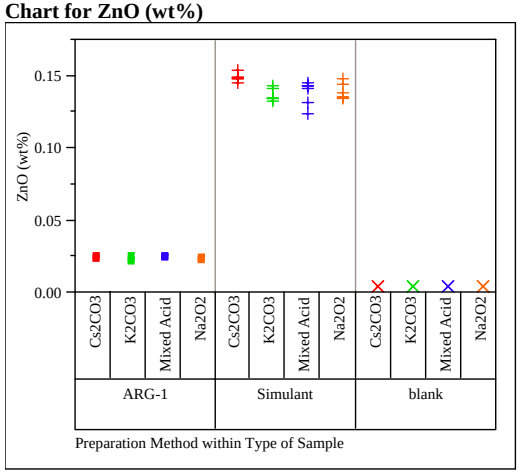


Chart for ZrO2 (wt%)

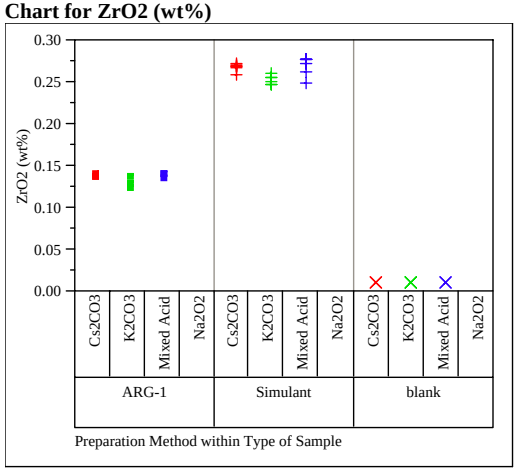
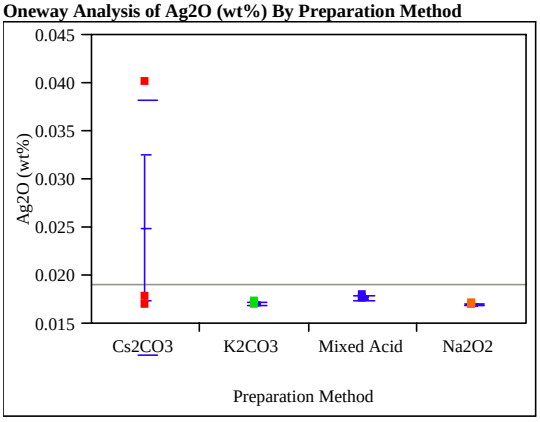


Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ag2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

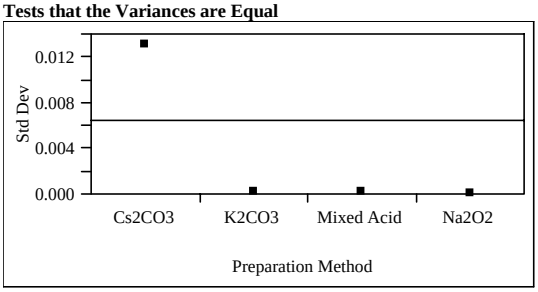
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.01716	-0.00991	-0.00932	-0.00921
Mixed Acid	-0.00991	-0.01716	-0.01657	-0.01647
K2CO3	-0.00932	-0.01657	-0.01716	-0.01706
Na2O2	-0.00921	-0.01647	-0.01706	-0.01716

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.02492144
Mixed Acid	A	0.01767059
K2CO3	A	0.01707978
Na2O2	A	0.01697236

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



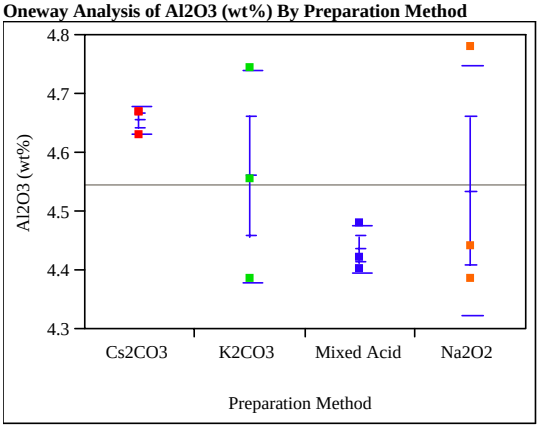
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0131259	0.0100975	0.0080565
K2CO3	3	0.0001611	0.0001074	0.0001611
Mixed Acid	3	0.0001937	0.0001432	0.0001611
Na2O2	3	0.0000930	0.0000716	0.0000537

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7773	3	8	0.2291
Brown-Forsythe	1.2515	3	8	0.3539
Levene	15.4597	3	8	0.0011
Bartlett	11.9107	3	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.2206	3	4.0389	0.0341

Oneway Analysis of Al2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

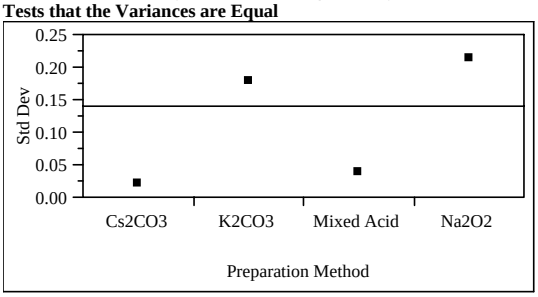
Abs(Dif)-LSD	Cs2CO3	K2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.37054	-0.27607	-0.25087	-0.15010
K2CO3	-0.27607	-0.37054	-0.34535	-0.24457
Na2O2	-0.25087	-0.34535	-0.37054	-0.26977
Mixed Acid	-0.15010	-0.24457	-0.26977	-0.37054

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	4.6544683
K2CO3	A	4.5599933
Na2O2	A	4.5348000
Mixed Acid	A	4.4340267

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0218181	0.0167956	0.0125967
K2CO3	3	0.1795854	0.1217678	0.1763533
Mixed Acid	3	0.0393331	0.0293922	0.0314917
Na2O2	3	0.2146059	0.1637567	0.1511600

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1617	3	8	0.3825
Brown-Forsythe	2.9558	3	8	0.0979
Levene	3.7860	3	8	0.0587
Bartlett	2.7597	3	.	0.0406

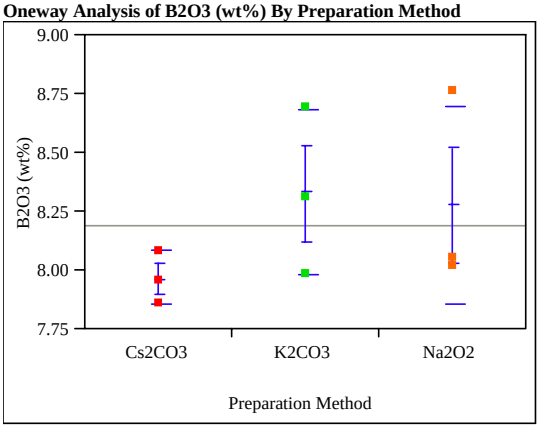
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
17.9210	3	3.822	0.0101

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of B2O3 (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

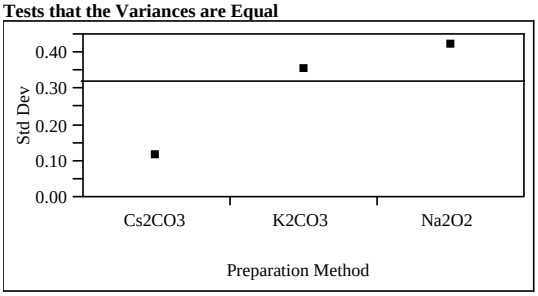
q*	Alpha
3.06815	0.05

Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3
K2CO3	-0.81021	-0.75654	-0.44528
Na2O2	-0.75654	-0.81021	-0.49895
Cs2CO3	-0.44528	-0.49895	-0.81021

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	8.3288080
Na2O2	A	8.2751430
Cs2CO3	A	7.9638860

Levels not connected by same letter are significantly different
Tests that the Variances are Equal



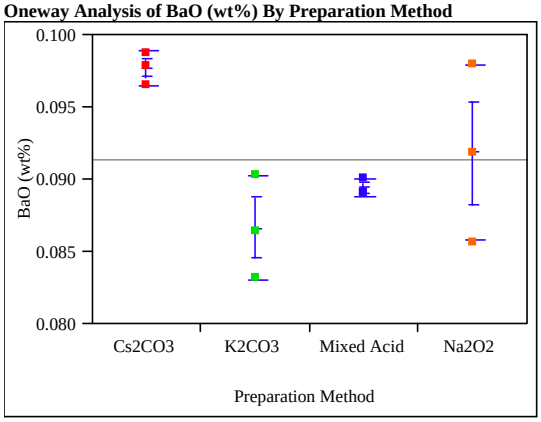
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.1130792	0.0787087	0.1073300
K2CO3	3	0.3546765	0.2432813	0.3434560
Na2O2	3	0.4185870	0.3219900	0.2575920

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7919	2	6	0.4952
Brown-Forsythe	0.8341	2	6	0.4790
Levene	2.3036	2	6	0.1810
Bartlett	1.1465	2	.	0.3177

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.6927	2	3.072	0.3195

Oneway Analysis of BaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

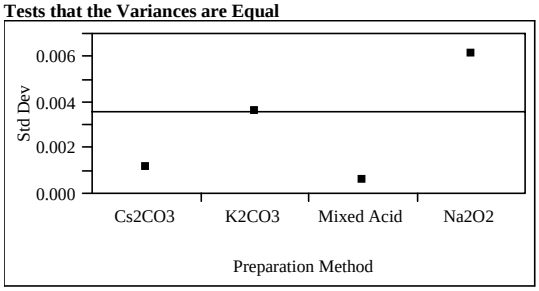
q*	Alpha
3.20238	0.05

Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.00944	-0.00359	-0.00121	0.00158
Na2O2	-0.00359	-0.00944	-0.00706	-0.00426
Mixed Acid	-0.00121	-0.00706	-0.00944	-0.00665
K2CO3	0.00158	-0.00426	-0.00665	-0.00944

Positive values show pairs of means that are significantly different.

Level			Mean
Cs2CO3	A		0.09765653
Na2O2	A	B	0.09181352
Mixed Acid	A	B	0.08943165
K2CO3		B	0.08664040

Levels not connected by same letter are significantly different
Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0011239	0.0007940	0.0010421
K2CO3	3	0.0035780	0.0024563	0.0034612
Mixed Acid	3	0.0005802	0.0004466	0.0003350
Na2O2	3	0.0061411	0.0041186	0.0061035

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3568	3	8	0.3235
Brown-Forsythe	144.0487	3	8	<.0001
Levene	2.0900	3	8	0.1799
Bartlett	2.7279	3	.	0.0424

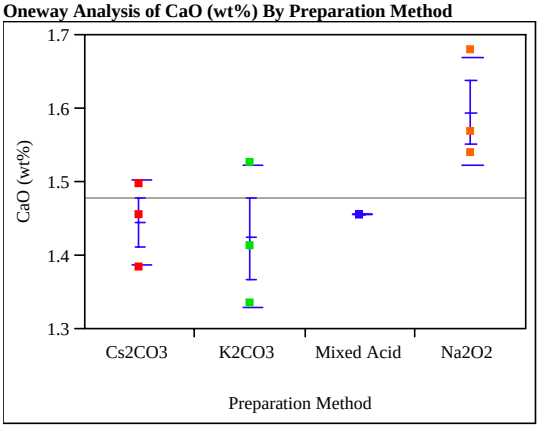
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
32.4688	3	3.7986	0.0036

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of CaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

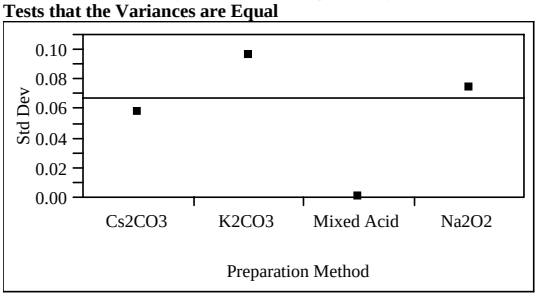
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3	K2CO3
Na2O2	-0.17601	-0.03609	-0.02583	-0.00484
Mixed Acid	-0.03609	-0.17601	-0.16575	-0.14476
Cs2CO3	-0.02583	-0.16575	-0.17601	-0.15502
K2CO3	-0.00484	-0.14476	-0.15502	-0.17601

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.5950880
Mixed Acid	A	1.4551680
Cs2CO3	A	1.4449072
K2CO3	A	1.4239192

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



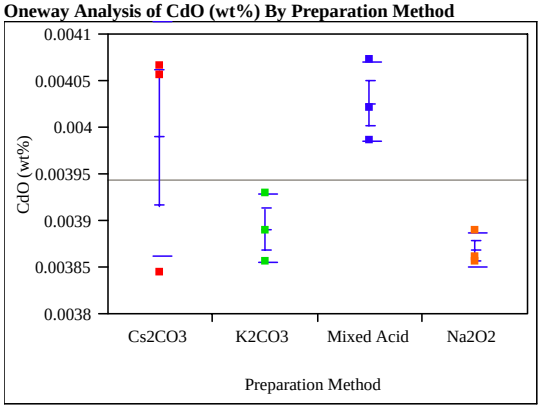
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0580513	0.0416651	0.0522368
K2CO3	3	0.0962944	0.0674725	0.0904816
Mixed Acid	3	2.719e-16	2.22e-16	0.0000000
Na2O2	3	0.0740387	0.0559680	0.0559680

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8423	3	8	0.5081
Brown-Forsythe	5.5527	3	8	0.0234
Levene	2.6106	3	8	0.1236
Bartlett	36.2342	3	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.6486	3	3.3333	0.2080

Oneway Analysis of CdO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

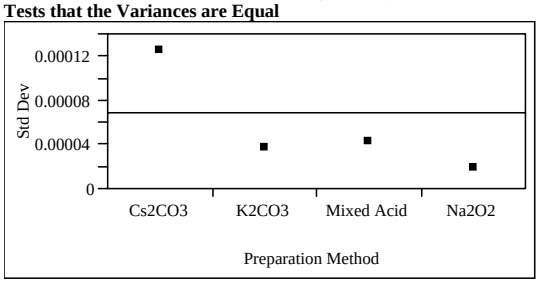
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00018	-0.00014	-0.00005	-0.00002
Cs2CO3	-0.00014	-0.00018	-0.00008	-0.00006
K2CO3	-0.00005	-0.00008	-0.00018	-0.00016
Na2O2	-0.00002	-0.00006	-0.00016	-0.00018

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.00402661
Cs2CO3	A	0.00398853
K2CO3	A	0.00389144
Na2O2	A	0.00386859

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0001254	0.0000965	0.0000781
K2CO3	3	0.0000372	0.0000254	0.0000362
Mixed Acid	3	0.0000431	0.0000305	0.0000400
Na2O2	3	0.0000184	0.0000140	0.0000133

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4970	3	8	0.2876
Brown-Forsythe	0.6352	3	8	0.6130
Levene	6.1549	3	8	0.0179
Bartlett	2.0338	3	.	0.1068

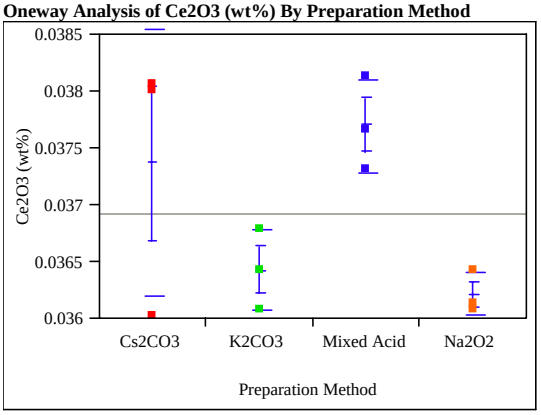
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.9393	3	3.9649	0.0307

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ce2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

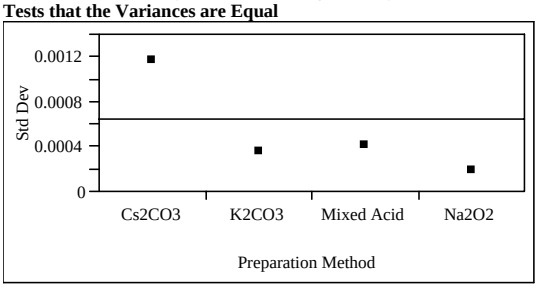
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00170	-0.00137	-0.00043	-0.00022
Cs2CO3	-0.00137	-0.00170	-0.00076	-0.00055
K2CO3	-0.00043	-0.00076	-0.00170	-0.00148
Na2O2	-0.00022	-0.00055	-0.00148	-0.00170

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.03769634
Cs2CO3	A	0.03736447
K2CO3	A	0.03642743
Na2O2	A	0.03621269

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



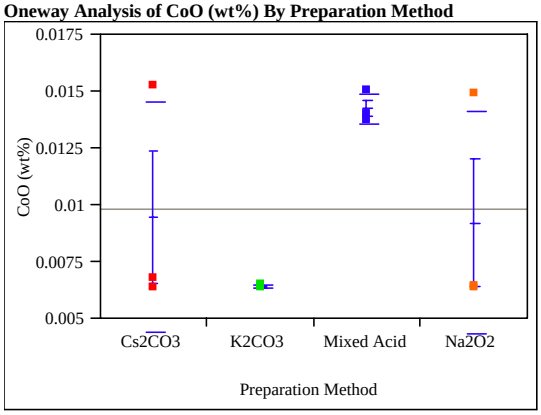
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0011669	0.0008980	0.0007028
K2CO3	3	0.0003514	0.0002343	0.0003514
Mixed Acid	3	0.0004113	0.0002863	0.0003904
Na2O2	3	0.0001883	0.0001432	0.0001367

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4795	3	8	0.2918
Brown-Forsythe	0.5155	3	8	0.6831
Levene	5.7995	3	8	0.0209
Bartlett	1.9050	3	.	0.1263

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.5290	3	4.0223	0.0323

Oneway Analysis of CoO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

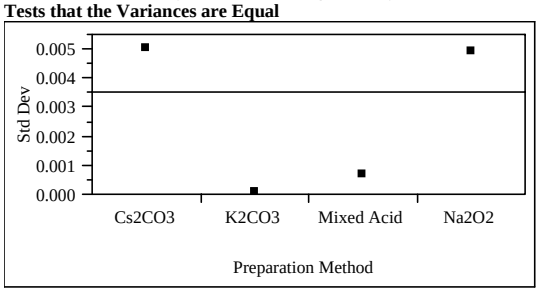
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2	K2CO3
Mixed Acid	-0.00923	-0.00444	-0.00420	-0.00141
Cs2CO3	-0.00444	-0.00923	-0.00899	-0.00619
Na2O2	-0.00420	-0.00899	-0.00923	-0.00643
K2CO3	-0.00141	-0.00619	-0.00643	-0.00923

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.01424080
Cs2CO3	A	0.00945148
Na2O2	A	0.00921838
K2CO3	A	0.00642108

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0050322	0.0038710	0.0030940
K2CO3	3	0.0000636	0.0000424	0.0000636
Mixed Acid	3	0.0006728	0.0005086	0.0005086
Na2O2	3	0.0049002	0.0037721	0.0028609

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1642	3	8	0.3817
Brown-Forsythe	0.6444	3	8	0.6079
Levene	9.0939	3	8	0.0059
Bartlett	5.5060	3	.	0.0009

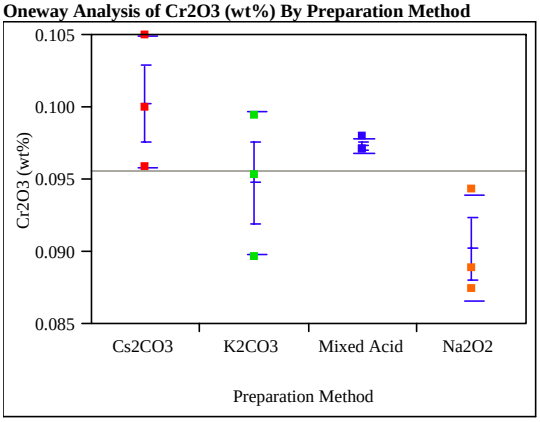
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
96.2674	3	3.3537	0.0010

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Cr2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

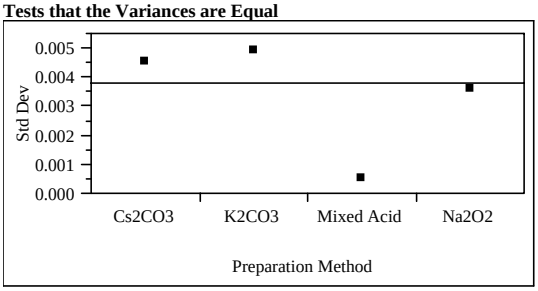
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.00997	-0.00704	-0.00446	0.00012
Mixed Acid	-0.00704	-0.00997	-0.00739	-0.00281
K2CO3	-0.00446	-0.00739	-0.00997	-0.00539
Na2O2	0.00012	-0.00281	-0.00539	-0.00997

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.10026576
Mixed Acid	A B	0.09734256
K2CO3	A B	0.09476040
Na2O2	B	0.09018072

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



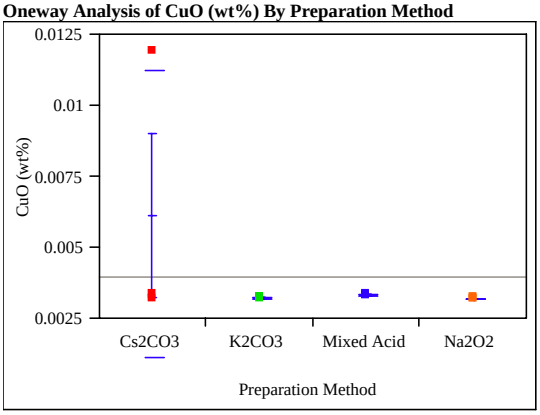
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0045380	0.0031181	0.0043848
K2CO3	3	0.0049183	0.0034429	0.0046284
Mixed Acid	3	0.0005063	0.0003898	0.0002923
Na2O2	3	0.0036188	0.0027283	0.0027770

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6742	3	8	0.5916
Brown-Forsythe	7.2798	3	8	0.0113
Levene	1.5998	3	8	0.2643
Bartlett	1.8118	3	.	0.1425

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.2698	3	3.4241	0.1603

Oneway Analysis of CuO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

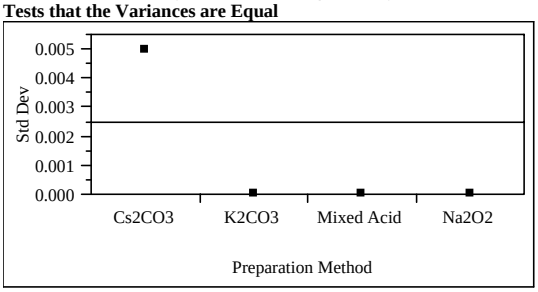
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.00654	-0.00371	-0.00360	-0.00358
Mixed Acid	-0.00371	-0.00654	-0.00643	-0.00641
K2CO3	-0.00360	-0.00643	-0.00654	-0.00652
Na2O2	-0.00358	-0.00641	-0.00652	-0.00654

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.00616511
Mixed Acid	A	0.00333605
K2CO3	A	0.00322339
Na2O2	A	0.00320461

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0050039	0.0038514	0.0029793
K2CO3	3	0.0000313	0.0000209	0.0000313
Mixed Acid	3	0.0000348	0.0000250	0.0000313
Na2O2	3	0.0000166	0.0000125	0.0000125

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7777	3	8	0.2291
Brown-Forsythe	1.1150	3	8	0.3985
Levene	15.7883	3	8	0.0010
Bartlett	14.3228	3	.	<.0001

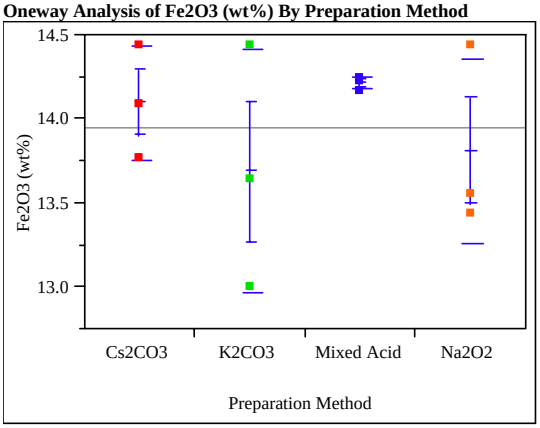
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.9825	3	4.0031	0.0299

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Fe2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

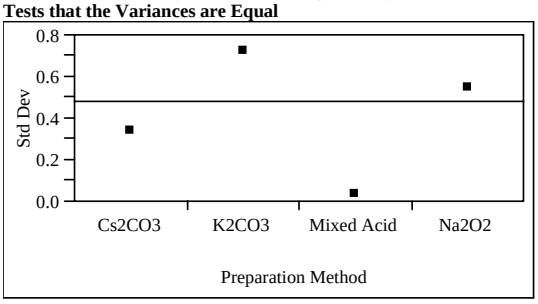
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2	K2CO3
Mixed Acid	-1.2661	-1.1517	-0.8658	-0.7466
Cs2CO3	-1.1517	-1.2661	-0.9802	-0.8610
Na2O2	-0.8658	-0.9802	-1.2661	-1.1470
K2CO3	-0.7466	-0.8610	-1.1470	-1.2661

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	14.211218
Cs2CO3	A	14.096842
Na2O2	A	13.810902
K2CO3	A	13.691760

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



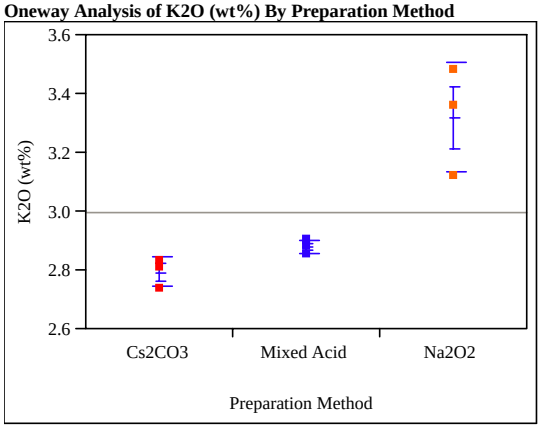
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.3362076	0.2287520	0.3288310
K2CO3	3	0.7234244	0.4988064	0.6957873
Mixed Acid	3	0.0378263	0.0285940	0.0285940
Na2O2	3	0.5477822	0.4193787	0.3717220

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9867	3	8	0.4464
Brown-Forsythe	4.2975	3	8	0.0440
Levene	2.3943	3	8	0.1439
Bartlett	2.6367	3	.	0.0479

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.8243	3	3.3772	0.5542

Oneway Analysis of K2O (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

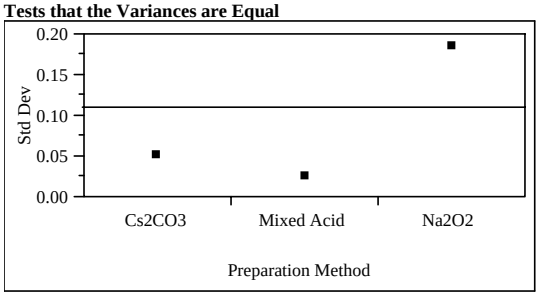
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.27804	0.16365	0.25199
Mixed Acid	0.16365	-0.27804	-0.18970
Cs2CO3	0.25199	-0.18970	-0.27804

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	3.3206807
Mixed Acid	B	2.8789940
Cs2CO3	B	2.7906567

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0501515	0.0374764	0.0401533
Mixed Acid	3	0.0240920	0.0160613	0.0240920
Na2O2	3	0.1840057	0.1338444	0.1606133

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6139	2	6	0.2749
Brown-Forsythe	8.9310	2	6	0.0159
Levene	4.6686	2	6	0.0599
Bartlett	2.9722	2	.	0.0512

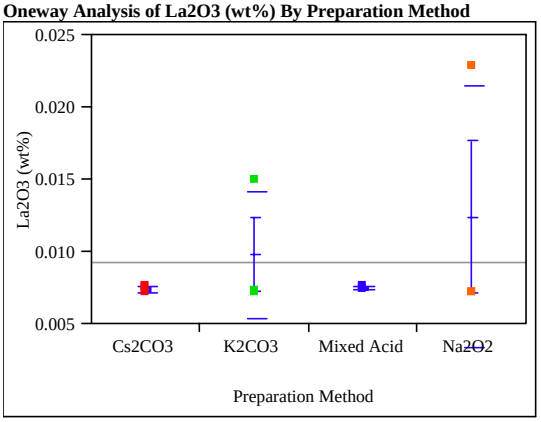
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
10.7118	2	3.1812	0.0386

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of La2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

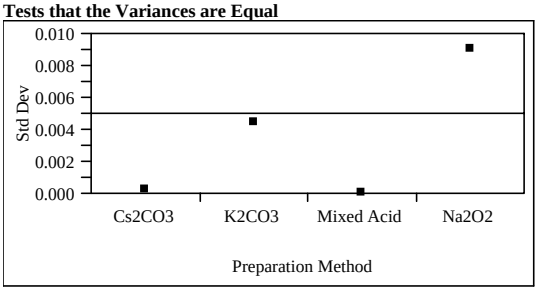
Abs(Dif)-LSD	Na2O2	K2CO3	Mixed Acid	Cs2CO3
Na2O2	-0.01318	-0.01056	-0.00823	-0.00817
K2CO3	-0.01056	-0.01318	-0.01085	-0.01079
Mixed Acid	-0.00823	-0.01085	-0.01318	-0.01312
Cs2CO3	-0.00817	-0.01079	-0.01312	-0.01318

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.01241213
K2CO3	A	0.00979288
Mixed Acid	A	0.00746683
Cs2CO3	A	0.00740819

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



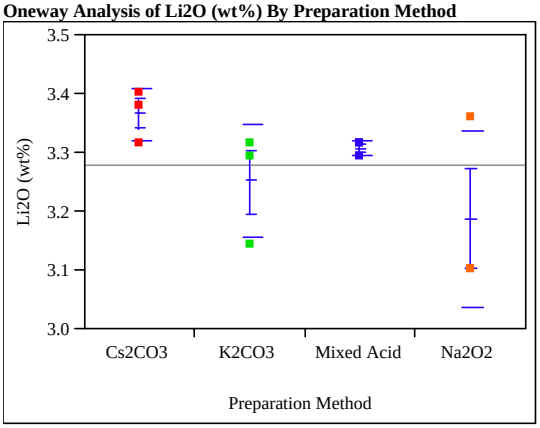
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0002220	0.0001694	0.0001564
K2CO3	3	0.0044183	0.0034011	0.0025802
Mixed Acid	3	0.0000896	0.0000652	0.0000782
Na2O2	3	0.0090565	0.0069716	0.0052581

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5098	3	8	0.2846
Brown-Forsythe	0.7202	3	8	0.5674
Levene	11.3625	3	8	0.0030
Bartlett	7.3909	3	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.4665	3	3.6251	0.7230

Oneway Analysis of Li2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

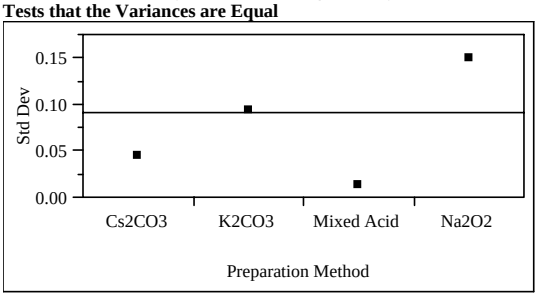
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.23828	-0.18086	-0.12345	-0.05887
Mixed Acid	-0.18086	-0.23828	-0.18086	-0.11628
K2CO3	-0.12345	-0.18086	-0.23828	-0.17369
Na2O2	-0.05887	-0.11628	-0.17369	-0.23828

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	3.3657003
Mixed Acid	A	3.3082897
K2CO3	A	3.2508790
Na2O2	A	3.1862920

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0448162	0.0334896	0.0358817
K2CO3	3	0.0938427	0.0717633	0.0645870
Mixed Acid	3	0.0124298	0.0095684	0.0071763
Na2O2	3	0.1491573	0.1148213	0.0861160

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2363	3	8	0.3586
Brown-Forsythe	0.4955	3	8	0.6954
Levene	6.5316	3	8	0.0152
Bartlett	2.4053	3	.	0.0653

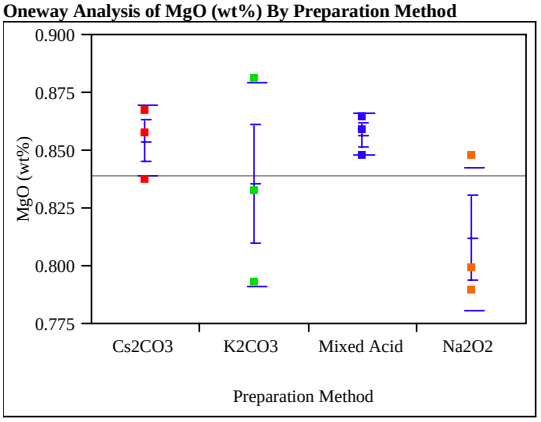
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9210	3	3.5342	0.2821

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of MgO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

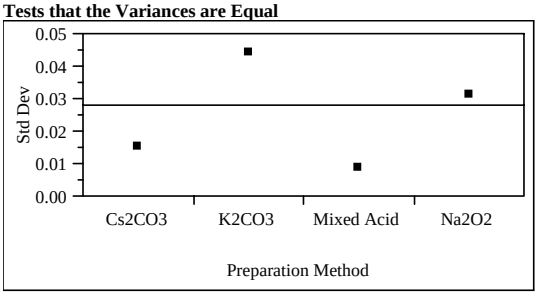
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.07400	-0.07123	-0.05244	-0.02922
Cs2CO3	-0.07123	-0.07400	-0.05520	-0.03199
K2CO3	-0.05244	-0.05520	-0.07400	-0.05078
Na2O2	-0.02922	-0.03199	-0.05078	-0.07400

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.85678833
Cs2CO3	A	0.85402450
K2CO3	A	0.83523043
Na2O2	A	0.81201423

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



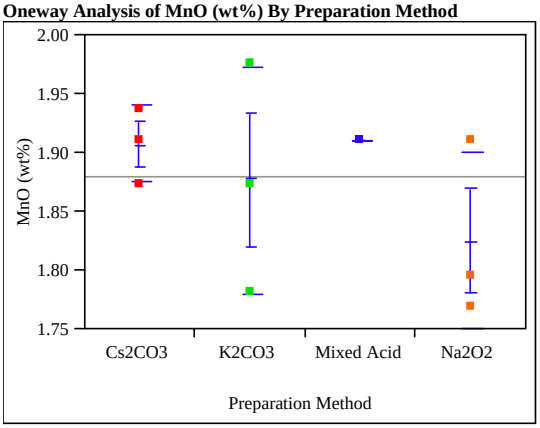
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0151986	0.0110553	0.0132664
K2CO3	3	0.0440101	0.0302179	0.0425630
Mixed Acid	3	0.0085097	0.0062647	0.0071860
Na2O2	3	0.0310387	0.0235847	0.0226634

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0867	3	8	0.4085
Brown-Forsythe	5.1678	3	8	0.0282
Levene	1.9339	3	8	0.2027
Bartlett	1.4229	3	.	0.2339

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.5742	3	3.9315	0.3293

Oneway Analysis of MnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

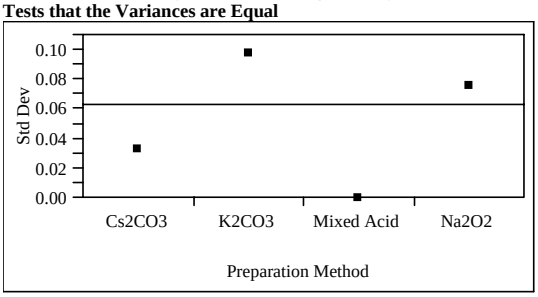
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.16626	-0.16195	-0.13182	-0.08018
Cs2CO3	-0.16195	-0.16626	-0.13613	-0.08448
K2CO3	-0.13182	-0.13613	-0.16626	-0.11461
Na2O2	-0.08018	-0.08448	-0.11461	-0.16626

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	1.9109760
Cs2CO3	A	1.9066720
K2CO3	A	1.8765440
Na2O2	A	1.8248960

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0324945	0.0229547	0.0301280
K2CO3	3	0.0969117	0.0659947	0.0946880
Mixed Acid	3	0.0000000	0.0000000	0.0000000
Na2O2	3	0.0756574	0.0573867	0.0559520

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1010	3	8	0.4034
Brown-Forsythe	6.8235	3	8	0.0135
Levene	2.8878	3	8	0.1024
Bartlett	.	3	.	0.0000

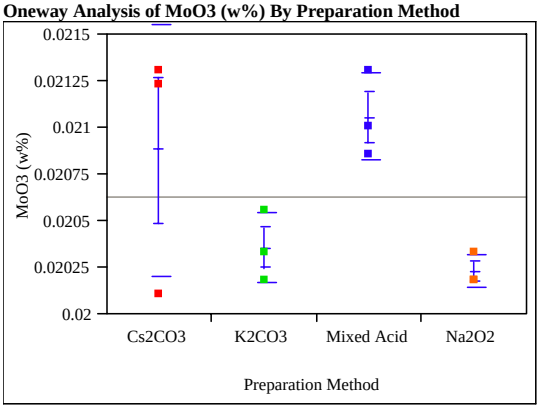
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
.	3	.	.

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of MoO3 (w%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

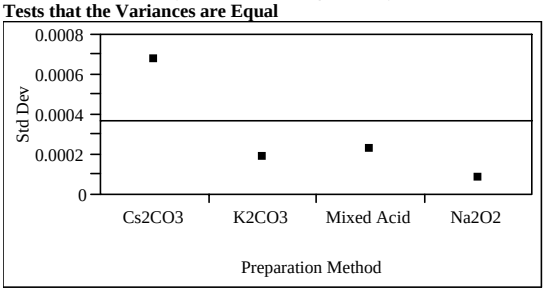
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00097	-0.00079	-0.00027	-0.00014
Cs2CO3	-0.00079	-0.00097	-0.00044	-0.00032
K2CO3	-0.00027	-0.00044	-0.00097	-0.00084
Na2O2	-0.00014	-0.00032	-0.00084	-0.00097

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.02105421
Cs2CO3	A	0.02087918
K2CO3	A	0.02035407
Na2O2	A	0.02022905

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



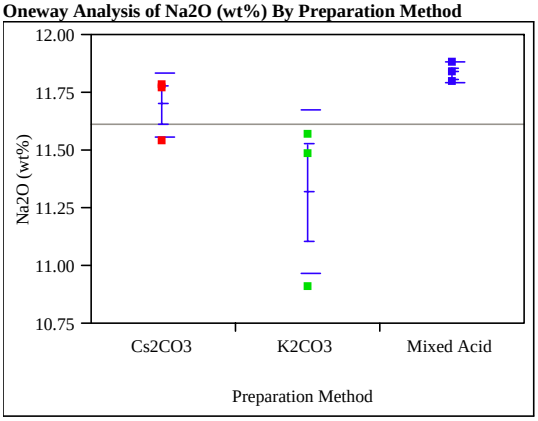
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0006724	0.0005168	0.0004251
K2CO3	3	0.0001888	0.0001334	0.0001750
Mixed Acid	3	0.0002292	0.0001667	0.0002000
Na2O2	3	0.0000866	0.0000667	0.0000500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5175	3	8	0.2828
Brown-Forsythe	0.7610	3	8	0.5468
Levene	6.7630	3	8	0.0138
Bartlett	2.2147	3	.	0.0842

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.9403	3	3.8949	0.0319

Oneway Analysis of Na2O (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

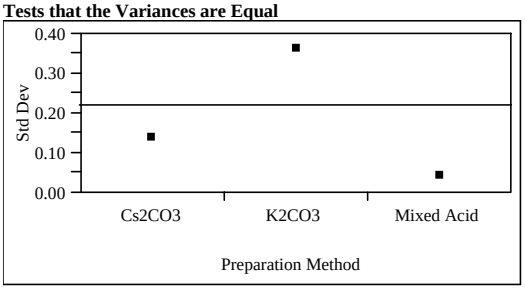
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3
Mixed Acid	-0.56023	-0.42093	-0.04349
Cs2CO3	-0.42093	-0.56023	-0.18279
K2CO3	-0.04349	-0.18279	-0.56023

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	11.835440
Cs2CO3	A	11.696147
K2CO3	A	11.318707

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.1363636	0.1048444	0.0853733
K2CO3	3	0.3602802	0.2755911	0.2471333
Mixed Acid	3	0.0404400	0.0269600	0.0404400

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5032	2	6	0.2957
Brown-Forsythe	1.0806	2	6	0.3974
Levene	7.8562	2	6	0.0211
Bartlett	2.8276	2	.	0.0592

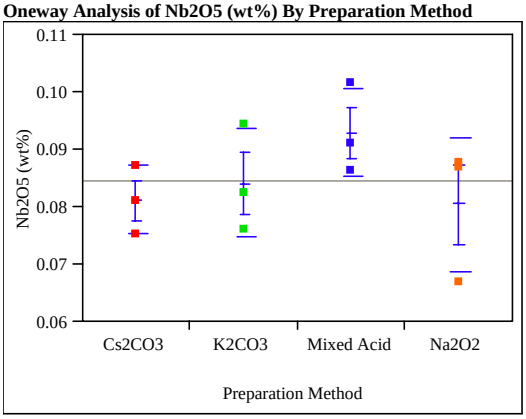
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.5455	2	2.911	0.1659

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Nb2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

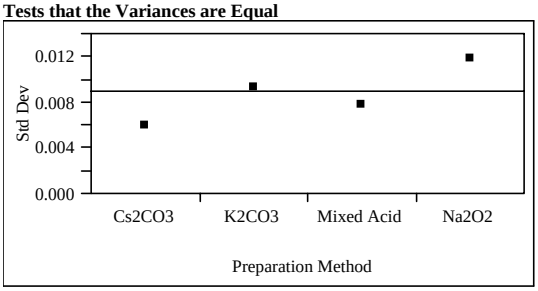
q*	Alpha			
3.20238	0.05			
Abs(Dif)-LSD	Mixed Acid	K2CO3	Cs2CO3	Na2O2
Mixed Acid	-0.02346	-0.01478	-0.01168	-0.01101
K2CO3	-0.01478	-0.02346	-0.02036	-0.01969
Cs2CO3	-0.01168	-0.02036	-0.02346	-0.02279
Na2O2	-0.01101	-0.01969	-0.02279	-0.02346

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.09283945
K2CO3	A	0.08416108
Cs2CO3	A	0.08106167
Na2O2	A	0.08039410

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



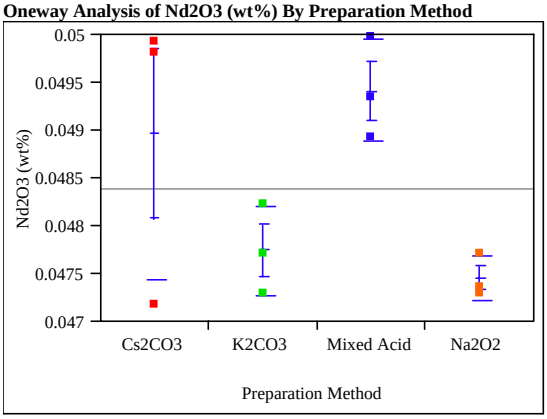
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0060087	0.0040372	0.0059604
K2CO3	3	0.0093030	0.0067392	0.0082015
Mixed Acid	3	0.0077775	0.0057220	0.0065803
Na2O2	3	0.0117797	0.0090598	0.0072956

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4338	3	8	0.7347
Brown-Forsythe	0.0786	3	8	0.9698
Levene	0.9270	3	8	0.4708
Bartlett	0.2590	3	.	0.8549

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.2224	3	4.331	0.4038

Oneway Analysis of Nd2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

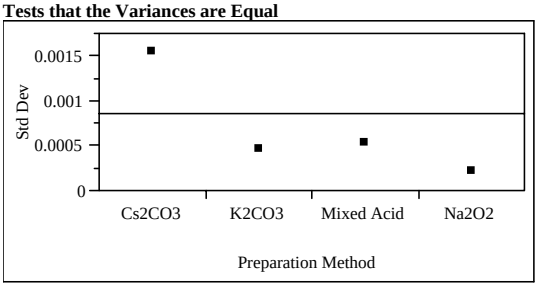
q*	Alpha			
3.20238	0.05			
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00225	-0.00180	-0.00057	-0.00028
Cs2CO3	-0.00180	-0.00225	-0.00102	-0.00073
K2CO3	-0.00057	-0.00102	-0.00225	-0.00195
Na2O2	-0.00028	-0.00073	-0.00195	-0.00225

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.04941648
Cs2CO3	A	0.04896936
K2CO3	A	0.04774464
Na2O2	A	0.04745304

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0015500	0.0011923	0.0009526
K2CO3	3	0.0004678	0.0003240	0.0004471
Mixed Acid	3	0.0005292	0.0003758	0.0004860
Na2O2	3	0.0002208	0.0001685	0.0001555

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4963	3	8	0.2878
Brown-Forsythe	0.6074	3	8	0.6287
Levene	6.2588	3	8	0.0171
Bartlett	2.0519	3	.	0.1043

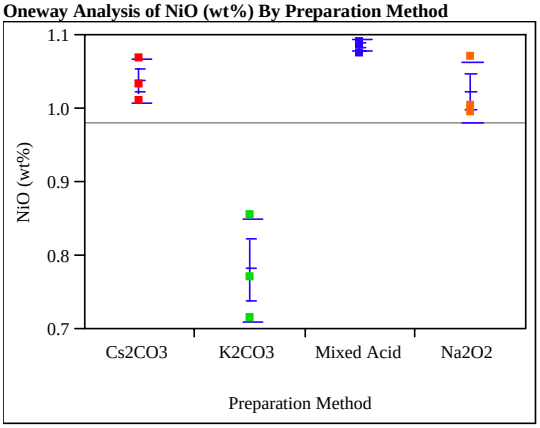
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
9.2209	3	3.9402	0.0295

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of NiO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

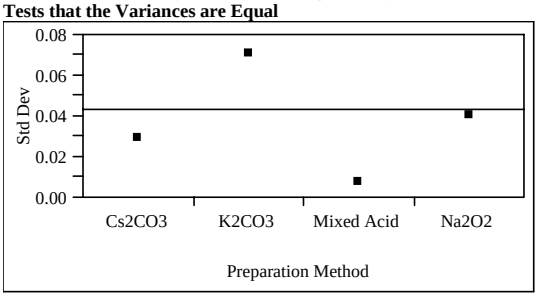
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2	K2CO3
Mixed Acid	-0.11333	-0.06667	-0.05183	0.19037
Cs2CO3	-0.06667	-0.11333	-0.09848	0.14371
Na2O2	-0.05183	-0.09848	-0.11333	0.12887
K2CO3	0.19037	0.14371	0.12887	-0.11333

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	1.0837458
Cs2CO3	A	1.0370875
Na2O2	A	1.0222417
K2CO3	B	0.7800425

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



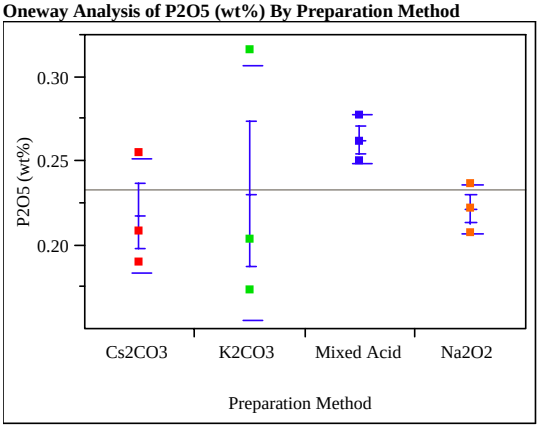
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0288215	0.0203600	0.0267225
K2CO3	3	0.0705406	0.0500517	0.0648975
Mixed Acid	3	0.0077751	0.0056556	0.0067867
Na2O2	3	0.0405872	0.0311056	0.0271467

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1824	3	8	0.3757
Brown-Forsythe	4.6975	3	8	0.0356
Levene	2.5624	3	8	0.1278
Bartlett	1.8812	3	.	0.1303

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
16.1399	3	3.5711	0.0148

Oneway Analysis of P2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

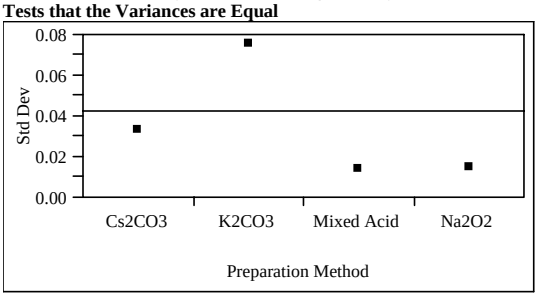
Abs(Dif)-LSD	Mixed Acid	K2CO3	Na2O2	Cs2CO3
Mixed Acid	-0.11117	-0.07909	-0.06985	-0.06565
K2CO3	-0.07909	-0.11117	-0.10193	-0.09773
Na2O2	-0.06985	-0.10193	-0.11117	-0.10697
Cs2CO3	-0.06565	-0.09773	-0.10697	-0.11117

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.26274720
K2CO3	A	0.23066760
Na2O2	A	0.22142562
Cs2CO3	A	0.21722472

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0334921	0.0247471	0.0279551
K2CO3	3	0.0755222	0.0570304	0.0574378
Mixed Acid	3	0.0138119	0.0096748	0.0129846
Na2O2	3	0.0146656	0.0098276	0.0145886

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4556	3	8	0.2977
Brown-Forsythe	1.9347	3	8	0.2026
Levene	5.1914	3	8	0.0278
Bartlett	2.0446	3	.	0.1053

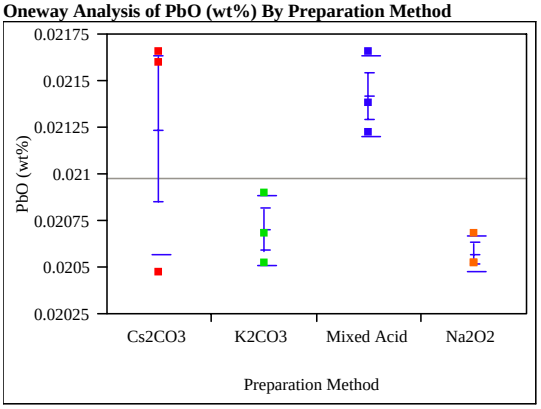
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.6179	3	4.1395	0.1192

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of PbO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

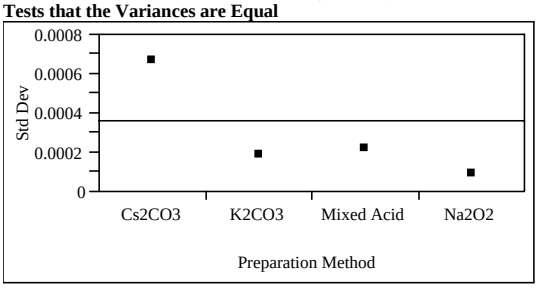
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00096	-0.00078	-0.00024	-0.00012
Cs2CO3	-0.00078	-0.00096	-0.00042	-0.00030
K2CO3	-0.00024	-0.00042	-0.00096	-0.00083
Na2O2	-0.00012	-0.00030	-0.00083	-0.00096

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.02141833
Cs2CO3	A	0.02123879
K2CO3	A	0.02070019
Na2O2	A	0.02057452

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



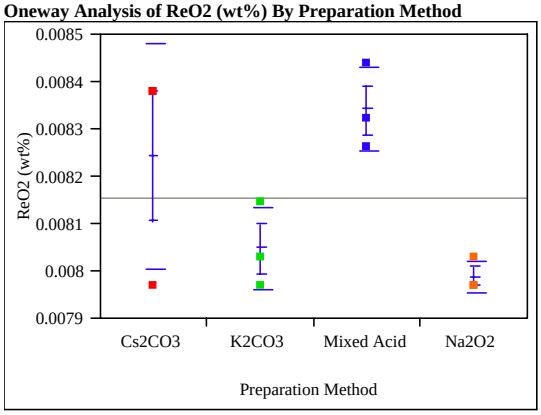
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0006691	0.0005147	0.0004129
K2CO3	3	0.0001892	0.0001317	0.0001795
Mixed Acid	3	0.0002177	0.0001556	0.0001975
Na2O2	3	0.0000933	0.0000718	0.0000539

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5248	3	8	0.2811
Brown-Forsythe	0.6659	3	8	0.5962
Levene	6.6885	3	8	0.0143
Bartlett	2.1598	3	.	0.0905

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
9.9712	3	3.9641	0.0255

Oneway Analysis of ReO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

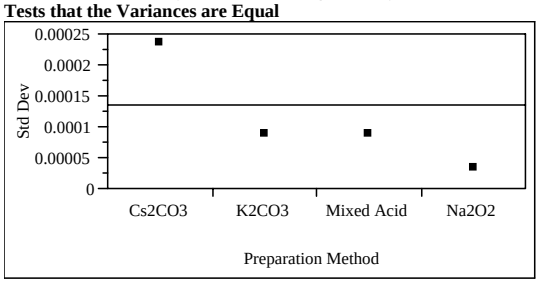
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00035	-0.00026	-0.00006	-0.00000
Cs2CO3	-0.00026	-0.00035	-0.00016	-0.00010
K2CO3	-0.00006	-0.00016	-0.00035	-0.00030
Na2O2	-0.00000	-0.00010	-0.00030	-0.00035

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.00834002
Cs2CO3	A	0.00824236
K2CO3	A	0.00804705
Na2O2	A	0.00798845

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0002368	0.0001823	0.0001367
K2CO3	3	0.0000895	0.0000651	0.0000781
Mixed Acid	3	0.0000895	0.0000651	0.0000781
Na2O2	3	0.0000338	0.0000260	0.0000195

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3995	3	8	0.3120
Brown-Forsythe	0.4615	3	8	0.7168
Levene	5.6842	3	8	0.0221
Bartlett	1.8244	3	.	0.1403

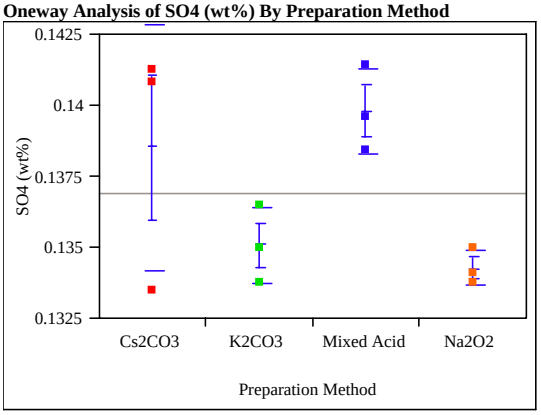
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
10.5973	3	3.8309	0.0249

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SO4 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

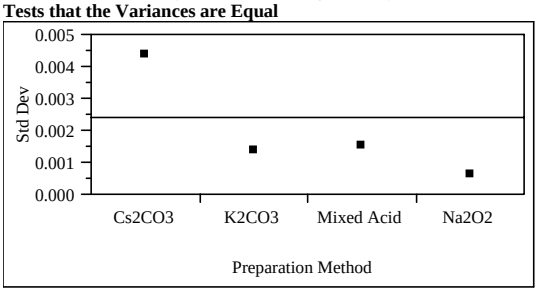
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00635	-0.00505	-0.00161	-0.00081
Cs2CO3	-0.00505	-0.00635	-0.00291	-0.00211
K2CO3	-0.00161	-0.00291	-0.00635	-0.00555
Na2O2	-0.00081	-0.00211	-0.00555	-0.00635

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.13980867
Cs2CO3	A	0.13851044
K2CO3	A	0.13506516
Na2O2	A	0.13426625

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



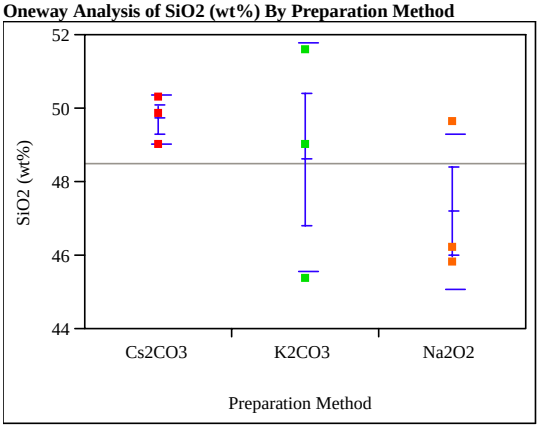
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0043732	0.0033621	0.0027462
K2CO3	3	0.0013509	0.0009321	0.0012982
Mixed Acid	3	0.0015079	0.0010652	0.0013981
Na2O2	3	0.0006236	0.0004660	0.0004993

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4879	3	8	0.2898
Brown-Forsythe	0.6473	3	8	0.6063
Levene	6.0605	3	8	0.0186
Bartlett	2.0261	3	.	0.1079

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
9.0680	3	3.9293	0.0306

Oneway Analysis of SiO2 (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

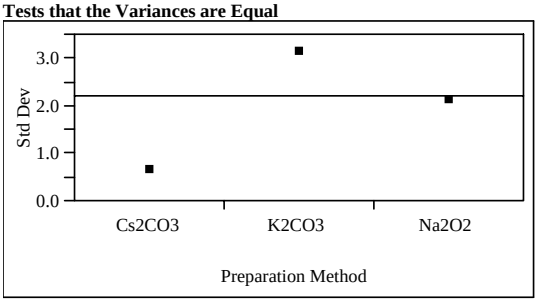
Abs(Dif)-LSD	Cs2CO3	K2CO3	Na2O2
Cs2CO3	-5.5263	-4.4567	-3.0305
K2CO3	-4.4567	-5.5263	-4.1001
Na2O2	-3.0305	-4.1001	-5.5263

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	49.703070
K2CO3	A	48.633420
Na2O2	A	47.207220

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.653567	0.475400	0.570480
K2CO3	3	3.117316	2.186840	2.923710
Na2O2	3	2.110583	1.616360	1.426200

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0114	2	6	0.4183
Brown-Forsythe	3.7200	2	6	0.0890
Levene	2.1573	2	6	0.1968
Bartlett	1.4971	2	.	0.2238

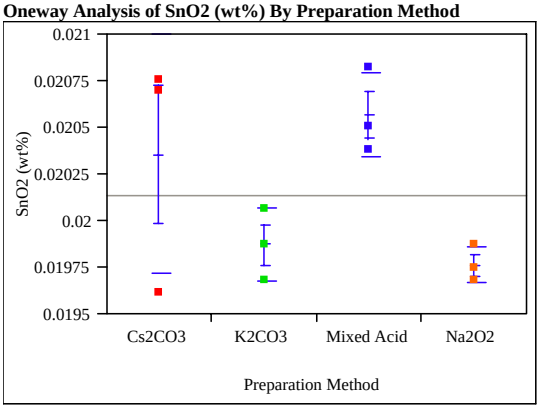
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.6540	2	2.9992	0.3280

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SnO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

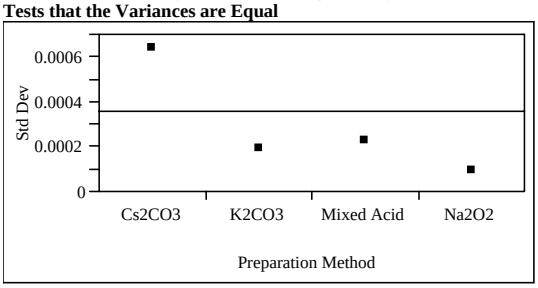
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00093	-0.00072	-0.00024	-0.00013
Cs2CO3	-0.00072	-0.00093	-0.00045	-0.00034
K2CO3	-0.00024	-0.00045	-0.00093	-0.00083
Na2O2	-0.00013	-0.00034	-0.00083	-0.00093

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.02056752
Cs2CO3	A	0.02035592
K2CO3	A	0.01986924
Na2O2	A	0.01976344

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



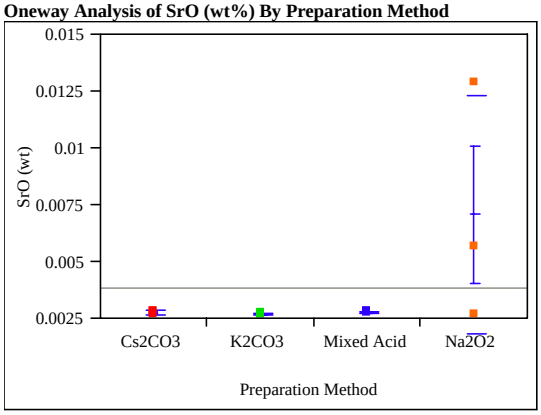
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0006422	0.0004937	0.0004020
K2CO3	3	0.0001904	0.0001270	0.0001904
Mixed Acid	3	0.0002289	0.0001693	0.0001904
Na2O2	3	0.0000970	0.0000705	0.0000846

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4841	3	8	0.2907
Brown-Forsythe	0.5952	3	8	0.6356
Levene	6.1816	3	8	0.0177
Bartlett	1.9770	3	.	0.1150

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.2409	3	3.9763	0.0350

Oneway Analysis of SrO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

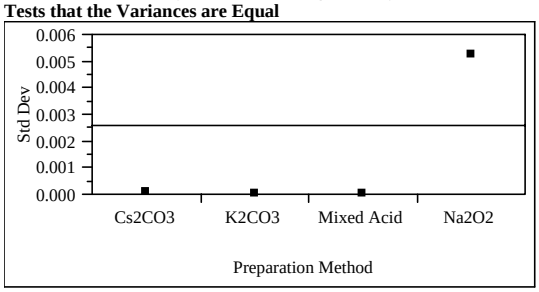
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3	K2CO3
Na2O2	-0.00686	-0.00256	-0.00253	-0.00246
Mixed Acid	-0.00256	-0.00686	-0.00683	-0.00676
Cs2CO3	-0.00253	-0.00683	-0.00686	-0.00679
K2CO3	-0.00246	-0.00676	-0.00679	-0.00686

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.00708575
Mixed Acid	A	0.00278897
Cs2CO3	A	0.00276137
K2CO3	A	0.00269239

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0000871	0.0000670	0.0000532
K2CO3	3	0.0000267	0.0000184	0.0000256
Mixed Acid	3	0.0000298	0.0000210	0.0000276
Na2O2	3	0.0052440	0.0038697	0.0043953

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7774	3	8	0.2291
Brown-Forsythe	9.5605	3	8	0.0051
Levene	8.7552	3	8	0.0066
Bartlett	12.9975	3	.	<.0001

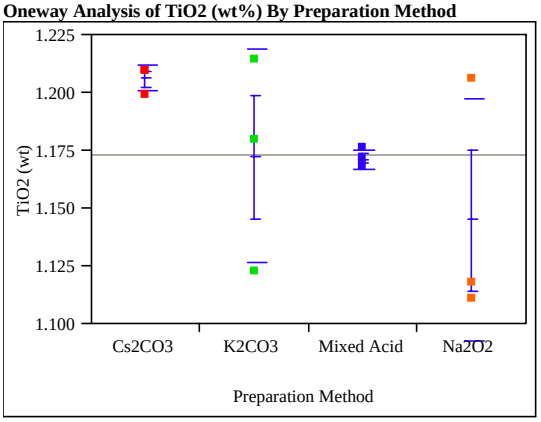
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.9808	3	4.0656	0.0759

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of TiO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

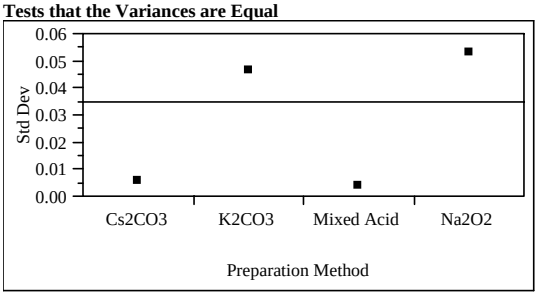
Abs(Dif)-LSD	Cs2CO3	K2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.09254	-0.05863	-0.05807	-0.03138
K2CO3	-0.05863	-0.09254	-0.09199	-0.06530
Mixed Acid	-0.05807	-0.09199	-0.09254	-0.06586
Na2O2	-0.03138	-0.06530	-0.06586	-0.09254

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	1.2059640
K2CO3	A	1.1720480
Mixed Acid	A	1.1714920
Na2O2	A	1.1448040

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



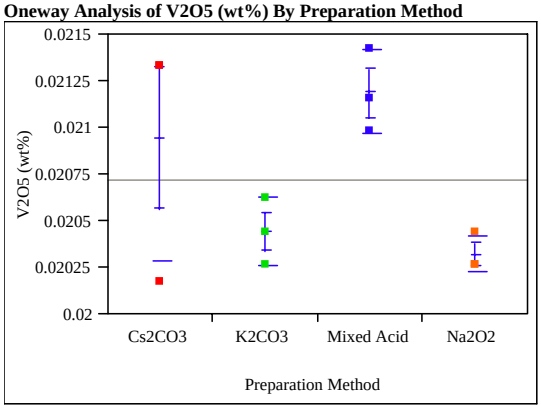
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0057781	0.0044480	0.0033360
K2CO3	3	0.0462951	0.0329893	0.0422560
Mixed Acid	3	0.0041977	0.0029653	0.0038920
Na2O2	3	0.0530711	0.0407733	0.0339160

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1827	3	8	0.3756
Brown-Forsythe	2.0238	3	8	0.1892
Levene	5.3789	3	8	0.0254
Bartlett	3.6092	3	.	0.0127

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
17.8444	3	3.9408	0.0093

Oneway Analysis of V2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

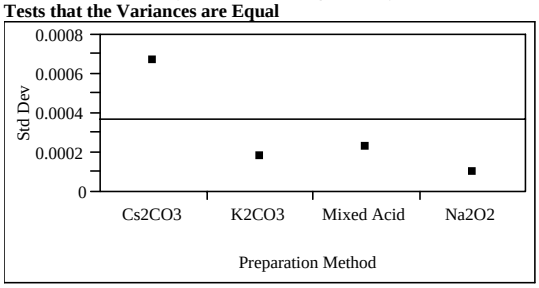
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3	Na2O2
Mixed Acid	-0.00096	-0.00072	-0.00022	-0.00010
Cs2CO3	-0.00072	-0.00096	-0.00046	-0.00034
K2CO3	-0.00022	-0.00046	-0.00096	-0.00084
Na2O2	-0.00010	-0.00034	-0.00084	-0.00096

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.02118437
Cs2CO3	A	0.02094635
K2CO3	A	0.02044054
Na2O2	A	0.02032153

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0006699	0.0005157	0.0003868
K2CO3	3	0.0001785	0.0001190	0.0001785
Mixed Acid	3	0.0002246	0.0001587	0.0002083
Na2O2	3	0.0001031	0.0000793	0.0000595

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5224	3	8	0.2816
Brown-Forsythe	0.4751	3	8	0.7082
Levene	6.5185	3	8	0.0153
Bartlett	2.0865	3	.	0.0996

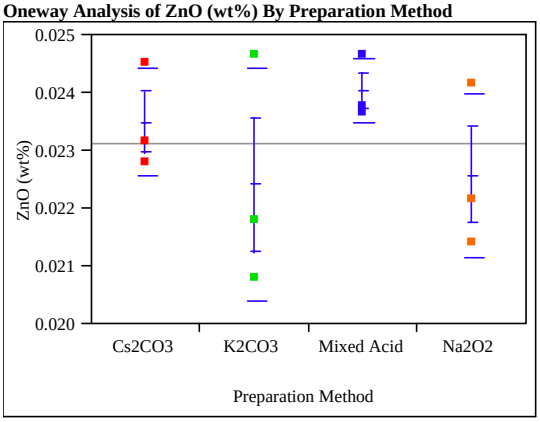
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
9.5689	3	4.0478	0.0262

Exhibit A3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of ZnO (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.20238	0.05

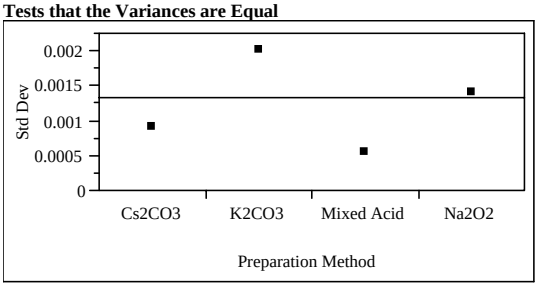
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2	K2CO3
Mixed Acid	-0.00350	-0.00296	-0.00204	-0.00188
Cs2CO3	-0.00296	-0.00350	-0.00258	-0.00242
Na2O2	-0.00204	-0.00258	-0.00350	-0.00333
K2CO3	-0.00188	-0.00242	-0.00333	-0.00350

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.02402464
Cs2CO3	A	0.02348523
Na2O2	A	0.02257237
K2CO3	A	0.02240640

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0009176	0.0006916	0.0007054
K2CO3	3	0.0020033	0.0014938	0.0016182
Mixed Acid	3	0.0005426	0.0004149	0.0003734
Na2O2	3	0.0014156	0.0010512	0.0011618

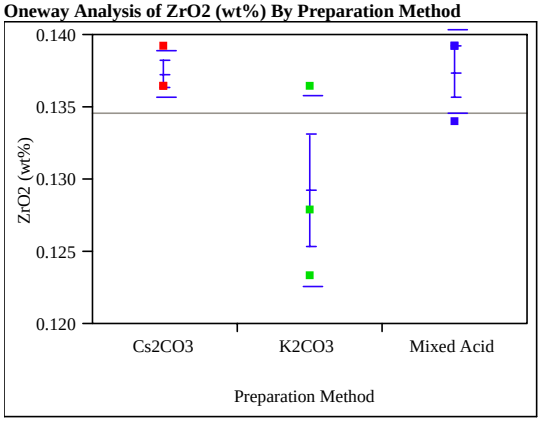
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9206	3	8	0.4735
Brown-Forsythe	1.6086	3	8	0.2624
Levene	2.2272	3	8	0.1625
Bartlett	0.9023	3	.	0.4391

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.1017	3	4.0547	0.4447

Oneway Analysis of ZrO2 (wt%) By Preparation Method



Missing Rows

3**Means Comparisons**

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

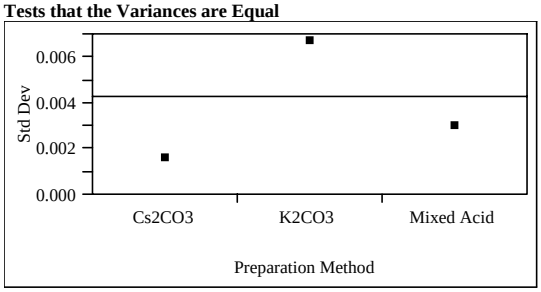
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3
Mixed Acid	-0.01078	-0.01069	-0.00254
Cs2CO3	-0.01069	-0.01078	-0.00263
K2CO3	-0.00254	-0.00263	-0.01078

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.13742139
Cs2CO3	A	0.13733133
K2CO3	A	0.12918151

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0015598	0.0012007	0.0009005
K2CO3	3	0.0066620	0.0048329	0.0058535
Mixed Acid	3	0.0029636	0.0022814	0.0017110

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3282	2	6	0.3330
Brown-Forsythe	3.7234	2	6	0.0888
Levene	2.9553	2	6	0.1278
Bartlett	1.5577	2	.	0.2106

Warning: Small sample sizes. Use Caution.

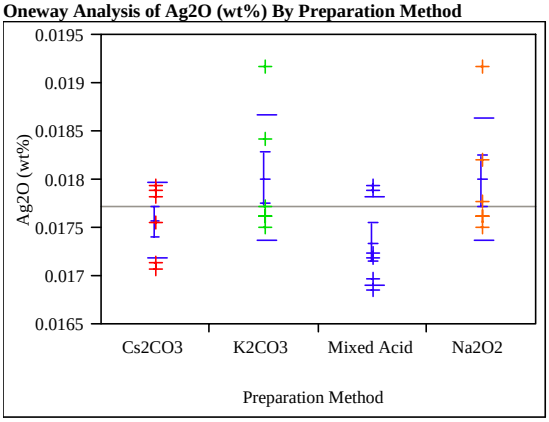
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8016	2	3.3152	0.2954

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ag2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

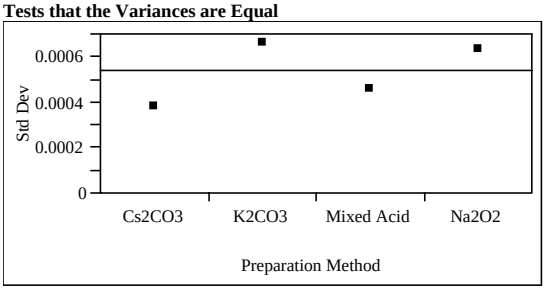
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00088	-0.00086	-0.00044	-0.00022
Na2O2	-0.00086	-0.00088	-0.00047	-0.00025
Cs2CO3	-0.00044	-0.00047	-0.00088	-0.00066
Mixed Acid	-0.00022	-0.00025	-0.00066	-0.00088

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.01801075
Na2O2	A	0.01798390
Cs2CO3	A	0.01757212
Mixed Acid	A	0.01734833

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



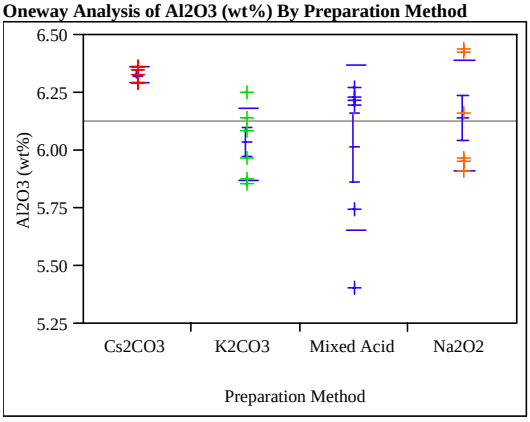
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0003834	0.0003133	0.0003133
K2CO3	6	0.0006584	0.0005252	0.0004297
Mixed Acid	6	0.0004583	0.0003760	0.0003402
Na2O2	6	0.0006332	0.0004715	0.0004028

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4724	3	20	0.7049
Brown-Forsythe	0.0878	3	20	0.9659
Levene	0.7057	3	20	0.5598
Bartlett	0.5894	3	.	0.6219

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8658	3	10.867	0.1945

Oneway Analysis of Al2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

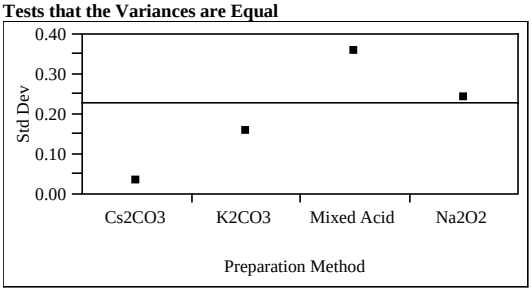
Abs(Dif)-LSD	Cs2CO3	Na2O2	K2CO3	Mixed Acid
Cs2CO3	-0.37066	-0.18171	-0.06834	-0.04945
Na2O2	-0.18171	-0.37066	-0.25729	-0.23840
K2CO3	-0.06834	-0.25729	-0.37066	-0.35177
Mixed Acid	-0.04945	-0.23840	-0.35177	-0.37066

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	6.3329742
Na2O2	A	6.1440242
K2CO3	A	6.0306542
Mixed Acid	A	6.0117592

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0346695	0.0283425	0.0283425
K2CO3	6	0.1564600	0.1291158	0.1291158
Mixed Acid	6	0.3565936	0.2918228	0.2298892
Na2O2	6	0.2400235	0.1983975	0.1983975

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.1655	3	20	0.1239
Brown-Forsythe	1.4483	3	20	0.2586
Levene	7.4144	3	20	0.0016
Bartlett	5.4937	3	.	0.0009

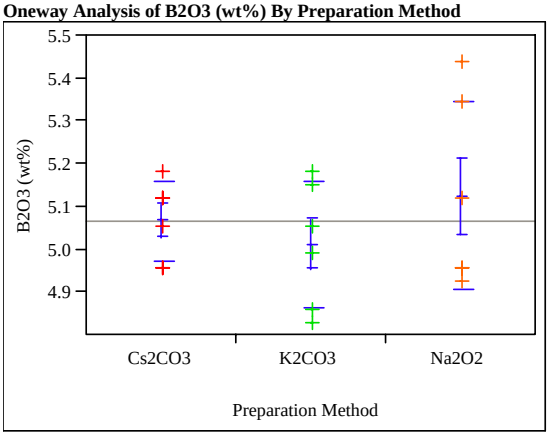
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.3251	3	8.7389	0.0062

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of B2O3 (wt%) By Preparation Method



Missing Rows
6**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.59747	0.05

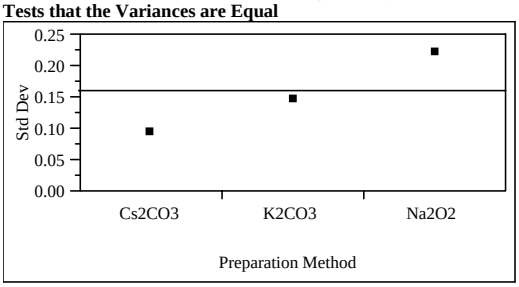
Abs(Dif)-LSD	Na2O2	Cs2CO3	K2CO3
Na2O2	-0.24288	-0.18385	-0.13018
Cs2CO3	-0.18385	-0.24288	-0.18922
K2CO3	-0.13018	-0.18922	-0.24288

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	5.1250075
Cs2CO3	A	5.0659760
K2CO3	A	5.0123110

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



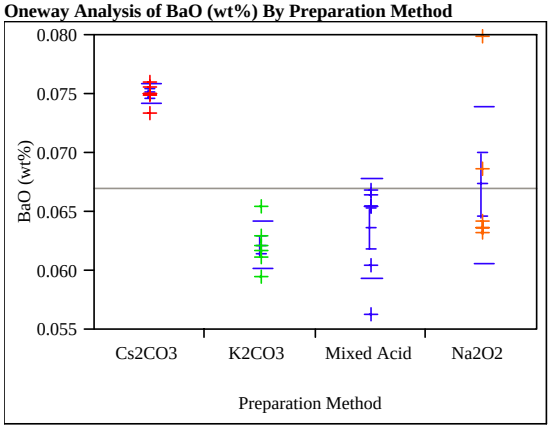
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0925780	0.0751310	0.0751310
K2CO3	6	0.1463786	0.1180630	0.1180630
Na2O2	6	0.2206669	0.1788833	0.1770945

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	3.0809	2	15	0.0757
Brown-Forsythe	1.7411	2	15	0.2089
Levene	2.9133	2	15	0.0853
Bartlett	1.6122	2	.	0.1994

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.5500	2	9.0121	0.5952

Oneway Analysis of BaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

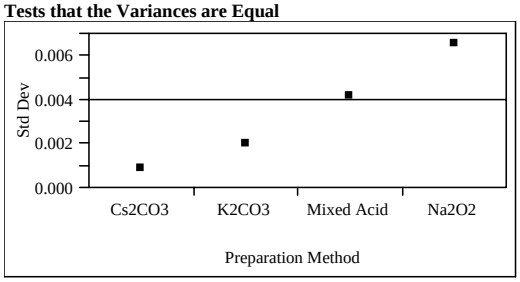
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.00651	0.00127	0.00499	0.00633
Na2O2	0.00127	-0.00651	-0.00278	-0.00145
Mixed Acid	0.00499	-0.00278	-0.00651	-0.00517
K2CO3	0.00633	-0.00145	-0.00517	-0.00651

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.07501019
Na2O2	B	0.06723191
Mixed Acid	B	0.06351024
K2CO3	B	0.06217044

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0008689	0.0005458	0.0005396
K2CO3	6	0.0019739	0.0013584	0.0013584
Mixed Acid	6	0.0041712	0.0033743	0.0027354
Na2O2	6	0.0065421	0.0047141	0.0037031

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1566	3	20	0.3508
Brown-Forsythe	0.8748	3	20	0.4706
Levene	3.9325	3	20	0.0234
Bartlett	5.3095	3	.	0.0012

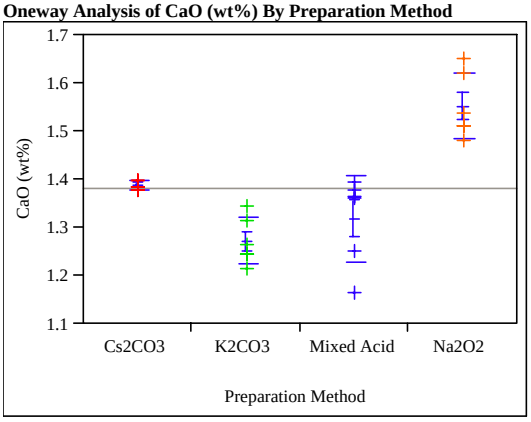
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
71.8507	3	9.3973	<.0001

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of CaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

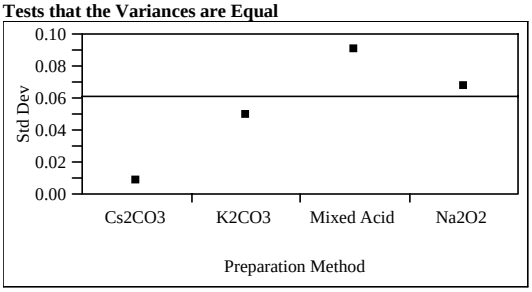
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid	K2CO3
Na2O2	-0.09980	0.06531	0.13457	0.18191
Cs2CO3	0.06531	-0.09980	-0.03054	0.01680
Mixed Acid	0.13457	-0.03054	-0.09980	-0.05246
K2CO3	0.18191	0.01680	-0.05246	-0.09980

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.5531120
Cs2CO3	B	1.3880064
Mixed Acid	B C	1.3187460
K2CO3	C	1.2714064

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



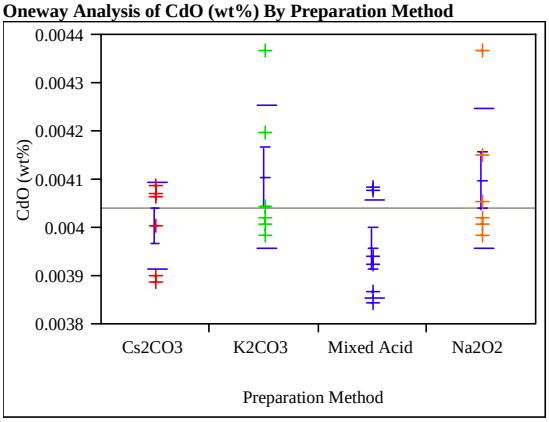
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0088493	0.0069960	0.0065296
K2CO3	6	0.0492921	0.0394885	0.0368456
Mixed Acid	6	0.0901534	0.0732248	0.0594660
Na2O2	6	0.0679729	0.0559680	0.0513040

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.8217	3	20	0.1757
Brown-Forsythe	1.3360	3	20	0.2908
Levene	6.0952	3	20	0.0041
Bartlett	5.2127	3	.	0.0013

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
20.8850	3	8.6408	0.0003

Oneway Analysis of CdO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

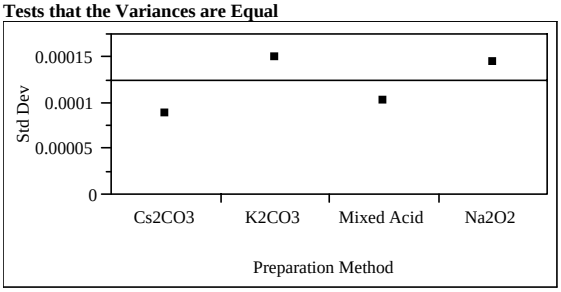
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00020	-0.00020	-0.00010	-0.00005
Na2O2	-0.00020	-0.00020	-0.00011	-0.00006
Cs2CO3	-0.00010	-0.00011	-0.00020	-0.00015
Mixed Acid	-0.00005	-0.00006	-0.00015	-0.00020

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.00410466
Na2O2	A	0.00409895
Cs2CO3	A	0.00400376
Mixed Acid	A	0.00395617

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0000890	0.0000723	0.0000723
K2CO3	6	0.0001500	0.0001193	0.0000990
Mixed Acid	6	0.0001030	0.0000831	0.0000781
Na2O2	6	0.0001446	0.0001079	0.0000933

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4761	3	20	0.7024
Brown-Forsythe	0.0973	3	20	0.9606
Levene	0.6913	3	20	0.5680
Bartlett	0.5763	3	.	0.6306

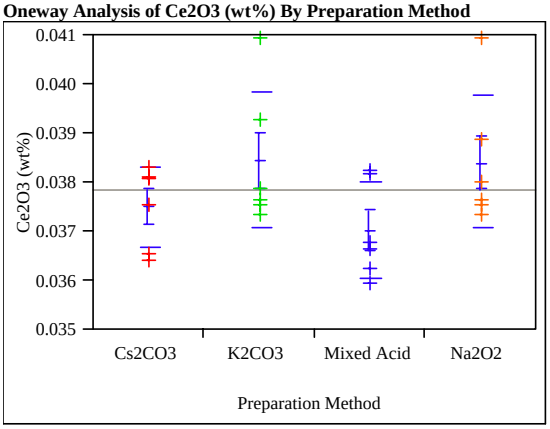
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8413	3	10.882	0.1986

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ce2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

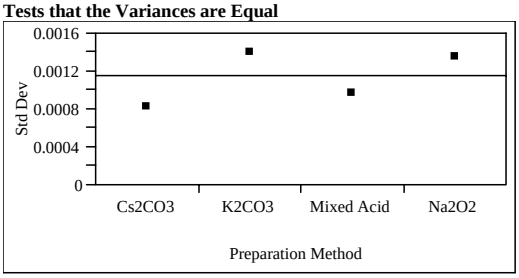
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00188	-0.00184	-0.00094	-0.00045
Na2O2	-0.00184	-0.00188	-0.00099	-0.00050
Cs2CO3	-0.00094	-0.00099	-0.00188	-0.00140
Mixed Acid	-0.00045	-0.00050	-0.00140	-0.00188

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.03844792
Na2O2	A	0.03839912
Cs2CO3	A	0.03750112
Mixed Acid	A	0.03701308

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



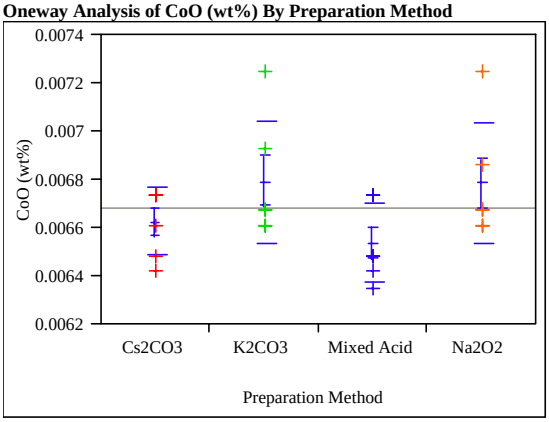
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0008271	0.0006768	0.0006637
K2CO3	6	0.0014035	0.0011127	0.0009273
Mixed Acid	6	0.0009751	0.0008004	0.0007223
Na2O2	6	0.0013557	0.0010086	0.0008785

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4663	3	20	0.7090
Brown-Forsythe	0.1082	3	20	0.9543
Levene	0.6592	3	20	0.5867
Bartlett	0.5775	3	.	0.6297

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9349	3	10.876	0.1831

Oneway Analysis of CoO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

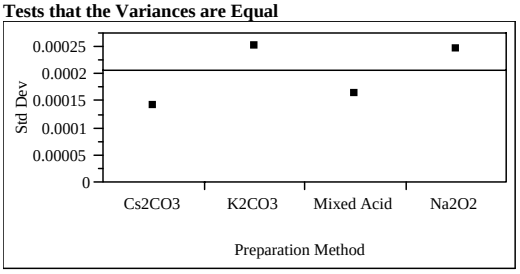
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00033	-0.00032	-0.00017	-0.00008
Na2O2	-0.00032	-0.00033	-0.00018	-0.00009
Cs2CO3	-0.00017	-0.00018	-0.00033	-0.00025
Mixed Acid	-0.00008	-0.00009	-0.00025	-0.00033

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.00679193
Na2O2	A	0.00678133
Cs2CO3	A	0.00662240
Mixed Acid	A	0.00653657

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0001417	0.0001166	0.0001166
K2CO3	6	0.0002524	0.0001978	0.0001589
Mixed Acid	6	0.0001643	0.0001349	0.0001176
Na2O2	6	0.0002468	0.0001837	0.0001483

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5145	3	20	0.6770
Brown-Forsythe	0.0941	3	20	0.9624
Levene	0.7789	3	20	0.5195
Bartlett	0.7363	3	.	0.5302

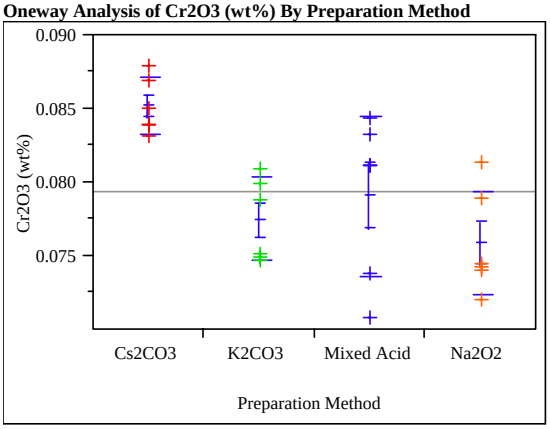
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9620	3	10.829	0.1791

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Cr2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

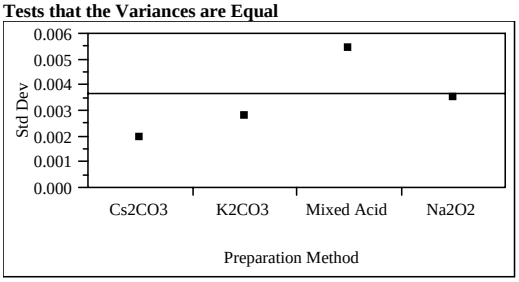
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.00592	0.00014	0.00182	0.00336
Mixed Acid	0.00014	-0.00592	-0.00424	-0.00271
K2CO3	0.00182	-0.00424	-0.00592	-0.00439
Na2O2	0.00336	-0.00271	-0.00439	-0.00592

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.08516256
Mixed Acid	B	0.07909692
K2CO3	B	0.07741608
Na2O2	B	0.07588140

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



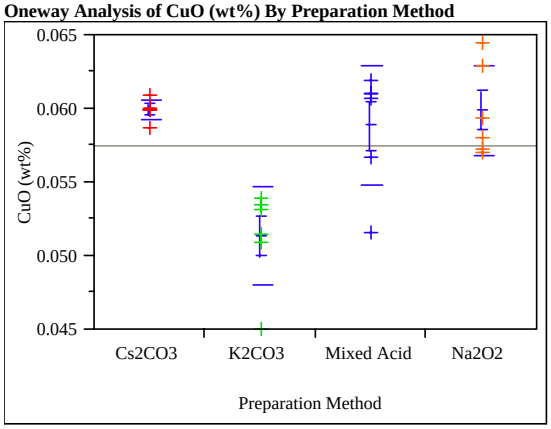
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0019206	0.0015428	0.0015103
K2CO3	6	0.0028125	0.0024847	0.0024847
Mixed Acid	6	0.0054535	0.0044985	0.0038245
Na2O2	6	0.0035241	0.0028582	0.0024116

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.4951	3	20	0.0893
Brown-Forsythe	0.7951	3	20	0.5109
Levene	3.8778	3	20	0.0246
Bartlett	1.7041	3	.	0.1638

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
15.0473	3	10.545	0.0004

Oneway Analysis of CuO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

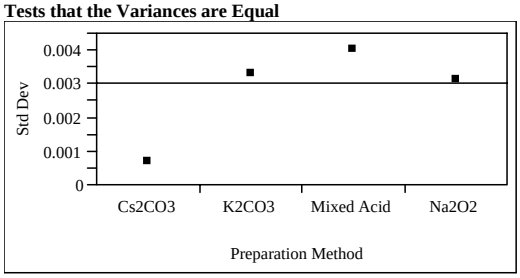
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.00493	-0.00487	-0.00384	0.00367
Na2O2	-0.00487	-0.00493	-0.00391	0.00361
Mixed Acid	-0.00384	-0.00391	-0.00493	0.00258
K2CO3	0.00367	0.00361	0.00258	-0.00493

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.05994036
Na2O2	A	0.05987777
Mixed Acid	A	0.05885546
K2CO3	B	0.05134466

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0007187	0.0004103	0.0003964
K2CO3	6	0.0032953	0.0022254	0.0021907
Mixed Acid	6	0.0040178	0.0031434	0.0025245
Na2O2	6	0.0031116	0.0025592	0.0023784

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8409	3	20	0.4875
Brown-Forsythe	0.9619	3	20	0.4300
Levene	2.9418	3	20	0.0580
Bartlett	3.2983	3	.	0.0195

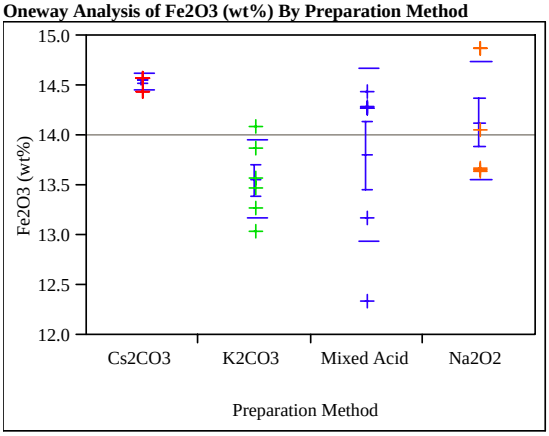
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
11.3824	3	8.9803	0.0021

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Fe2O3 (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

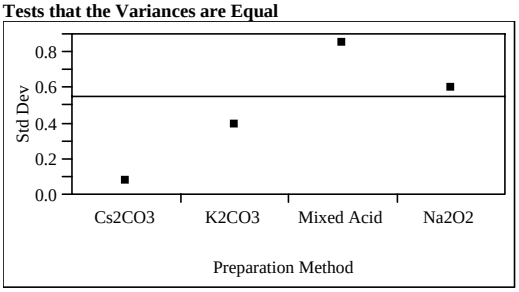
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.89753	-0.49006	-0.16361	0.08420
Na2O2	-0.49006	-0.89753	-0.57108	-0.32326
Mixed Acid	-0.16361	-0.57108	-0.89753	-0.64971
K2CO3	0.08420	-0.32326	-0.64971	-0.89753

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	14.535283
Na2O2	A B	14.127819
Mixed Acid	A B	13.801371
K2CO3	B	13.553556

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



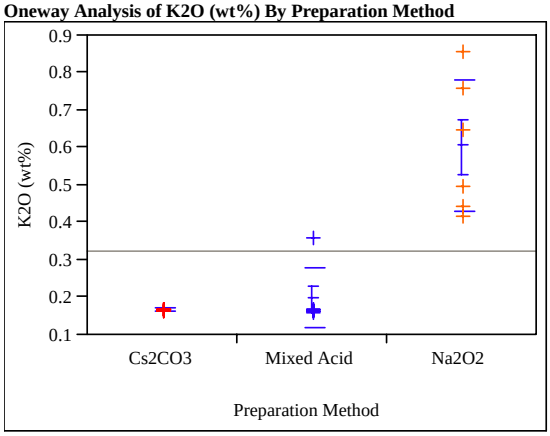
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0738294	0.0635422	0.0476567
K2CO3	6	0.3870238	0.2954713	0.2954713
Mixed Acid	6	0.8517781	0.6941988	0.5385203
Na2O2	6	0.5942750	0.4940408	0.4694182

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0252	3	20	0.1427
Brown-Forsythe	1.3226	3	20	0.2949
Levene	6.9160	3	20	0.0022
Bartlett	5.7967	3	.	0.0006

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.5719	3	8.6429	0.0016

Oneway Analysis of K2O (wt%) By Preparation Method



Missing Rows
6**Means Comparisons**

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.59747	0.05

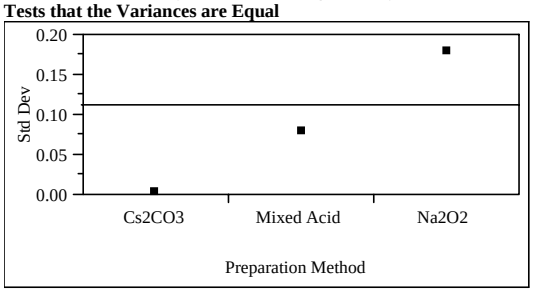
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.16986	0.23559	0.26681
Mixed Acid	0.23559	-0.16986	-0.13864
Cs2CO3	0.26681	-0.13864	-0.16986

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.60410690
Mixed Acid	B	0.19865862
Cs2CO3	B	0.16743940

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0037128	0.0030115	0.0030115
Mixed Acid	6	0.0792123	0.0538389	0.0352345
Na2O2	6	0.1794438	0.1503742	0.1503742

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	5.0743	2	15	0.0207
Brown-Forsythe	8.9192	2	15	0.0028
Levene	12.8244	2	15	0.0006
Bartlett	15.2241	2	.	<.0001

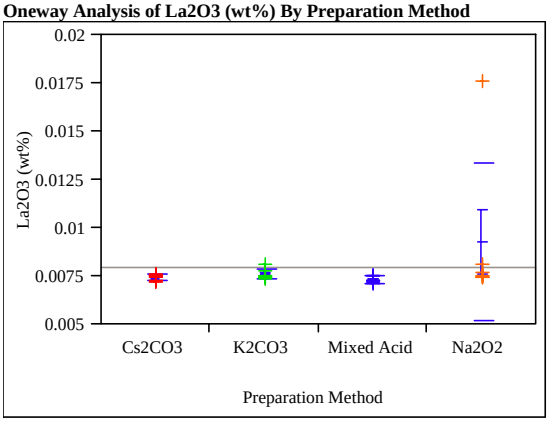
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
16.5647	2	6.6841	0.0026

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of La2O3 (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

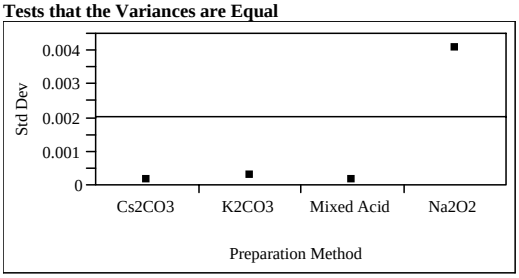
Abs(Dif)-LSD	Na2O2	K2CO3	Cs2CO3	Mixed Acid
Na2O2	-0.00330	-0.00161	-0.00144	-0.00134
K2CO3	-0.00161	-0.00330	-0.00313	-0.00303
Cs2CO3	-0.00144	-0.00313	-0.00330	-0.00319
Mixed Acid	-0.00134	-0.00303	-0.00319	-0.00330

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.00930421
K2CO3	A	0.00761343
Cs2CO3	A	0.00744728
Mixed Acid	A	0.00733977

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



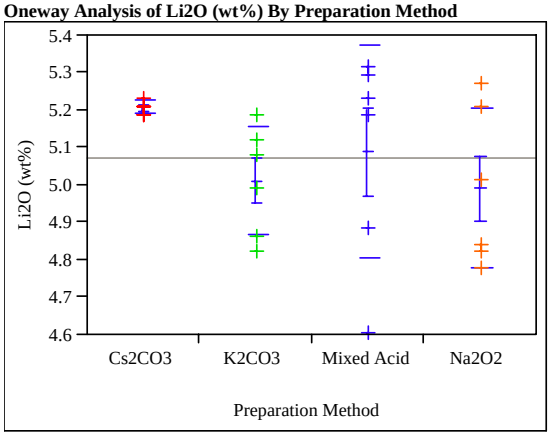
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0001700	0.0001368	0.0001368
K2CO3	6	0.0002761	0.0002215	0.0001857
Mixed Acid	6	0.0001795	0.0001499	0.0001271
Na2O2	6	0.0040677	0.0027626	0.0018374

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2382	3	20	0.3221
Brown-Forsythe	1.0707	3	20	0.3838
Levene	5.4444	3	20	0.0067
Bartlett	19.1699	3	.	<.0001

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.6251	3	10.524	0.2423

Oneway Analysis of Li2O (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

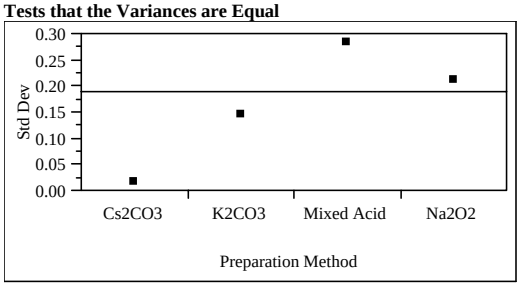
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.30862	-0.19021	-0.11486	-0.09333
Mixed Acid	-0.19021	-0.30862	-0.23327	-0.21174
K2CO3	-0.11486	-0.23327	-0.30862	-0.28709
Na2O2	-0.09333	-0.21174	-0.28709	-0.30862

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	5.2064298
Mixed Acid	A	5.0880203
K2CO3	A	5.0126688
Na2O2	A	4.9911398

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0162064	0.0119606	0.0107645
K2CO3	6	0.1456460	0.1184095	0.1184095
Mixed Acid	6	0.2822407	0.2272506	0.1937610
Na2O2	6	0.2115619	0.1758202	0.1758202

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.9805	3	20	0.1494
Brown-Forsythe	2.3358	3	20	0.1045
Levene	6.8600	3	20	0.0023
Bartlett	6.9071	3	.	0.0001

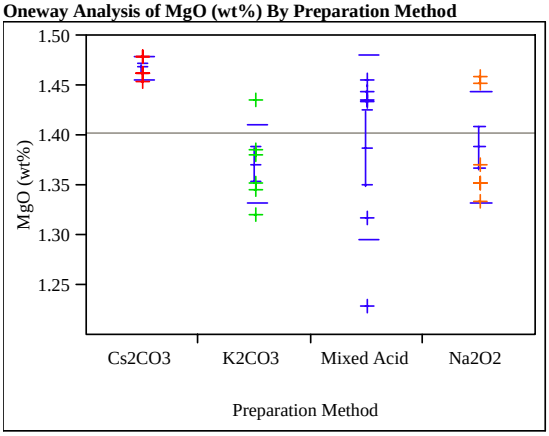
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.0444	3	8.4504	0.0277

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of MgO (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

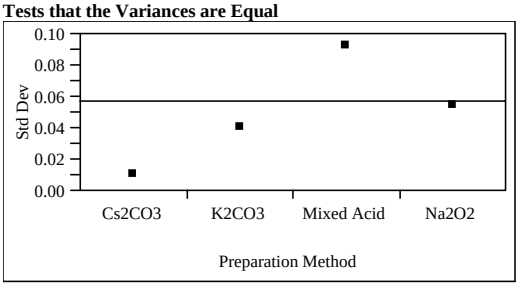
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.09288	-0.01356	-0.01217	0.00330
Na2O2	-0.01356	-0.09288	-0.09150	-0.07602
Mixed Acid	-0.01217	-0.09150	-0.09288	-0.07740
K2CO3	0.00330	-0.07602	-0.07740	-0.09288

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	1.4667664
Na2O2	A B	1.3874443
Mixed Acid	A B	1.3860624
K2CO3	B	1.3705850

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



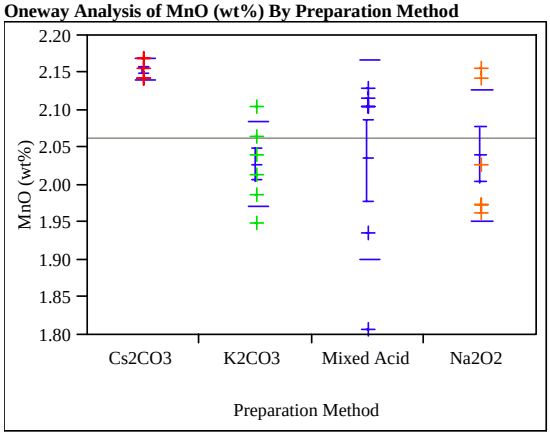
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0101550	0.0082915	0.0069096
K2CO3	6	0.0402356	0.0306786	0.0306786
Mixed Acid	6	0.0923863	0.0755448	0.0594224
Na2O2	6	0.0543727	0.0456954	0.0403520

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.1623	3	20	0.1243
Brown-Forsythe	1.2010	3	20	0.3349
Levene	7.2160	3	20	0.0018
Bartlett	5.1411	3	.	0.0015

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
13.4859	3	8.8808	0.0012

Oneway Analysis of MnO (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

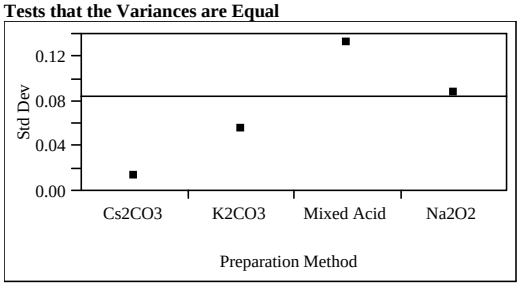
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.13605	-0.02200	-0.01554	-0.00908
Na2O2	-0.02200	-0.13605	-0.12960	-0.12314
Mixed Acid	-0.01554	-0.12960	-0.13605	-0.12960
K2CO3	-0.00908	-0.12314	-0.12960	-0.13605

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	2.1541520
Na2O2	A	2.0400960
Mixed Acid	A	2.0336400
K2CO3	A	2.0271840

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0126950	0.0107600	0.0107600
K2CO3	6	0.0553863	0.0430400	0.0430400
Mixed Acid	6	0.1318669	0.1076000	0.0839280
Na2O2	6	0.0879534	0.0731680	0.0688640

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.1062	3	20	0.1315
Brown-Forsythe	1.2511	3	20	0.3178
Levene	7.2527	3	20	0.0018
Bartlett	5.5947	3	.	0.0008

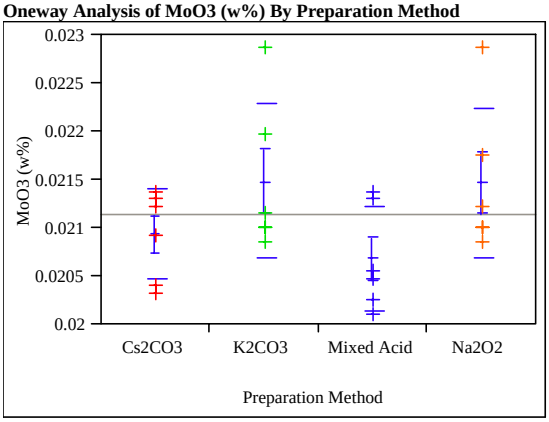
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.4617	3	8.7536	0.0016

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of MoO3 (w%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

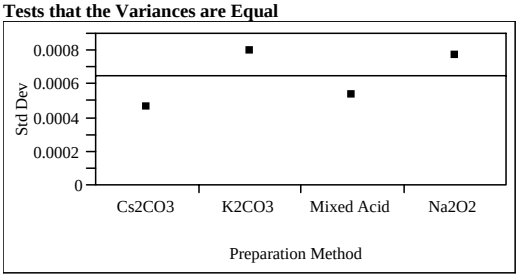
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00106	-0.00104	-0.00051	-0.00026
Na2O2	-0.00104	-0.00106	-0.00054	-0.00029
Cs2CO3	-0.00051	-0.00054	-0.00106	-0.00081
Mixed Acid	-0.00026	-0.00029	-0.00081	-0.00106

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.02147929
Na2O2	A	0.02145429
Cs2CO3	A	0.02092918
Mixed Acid	A	0.02067913

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



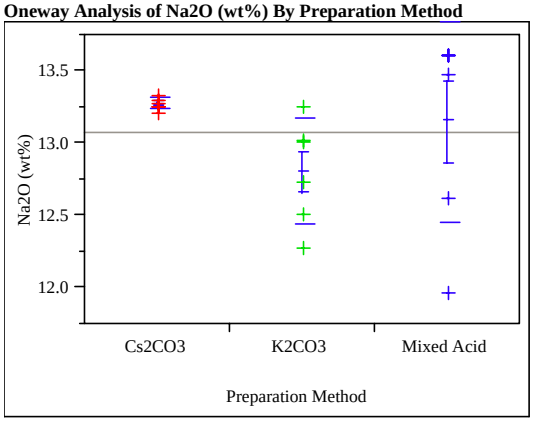
Level	Count	Std Dev	MAD to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0004624	0.0003751	0.0003751
K2CO3	6	0.0007948	0.0006335	0.0005251
Mixed Acid	6	0.0005382	0.0004418	0.0004001
Na2O2	6	0.0007665	0.0005751	0.0005001

Test	F-ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5087	3	20	0.6808
Brwn-Frsthe	0.1163	3	20	0.9495
Levene	0.7667	3	20	0.5260
Bartlett	0.6204	3	.	0.6017

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9473	3	10.866	0.1812

Oneway Analysis of Na2O (wt%) By Preparation Method



Missing Rows

6**Means Comparisons**

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.59747	0.05

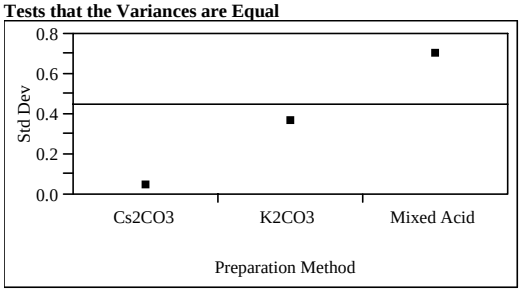
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3
Cs2CO3	-0.68131	-0.56224	-0.21176
Mixed Acid	-0.56224	-0.68131	-0.33083
K2CO3	-0.21176	-0.33083	-0.68131

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	13.271060
Mixed Acid	A	13.151987
K2CO3	A	12.801507

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0432622	0.0337000	0.0337000
K2CO3	6	0.3616729	0.2920667	0.2920667
Mixed Acid	6	0.6975124	0.5721511	0.4628133

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.4897	2	15	0.1165
Brown-Forsythe	1.8574	2	15	0.1902
Levene	10.6434	2	15	0.0013
Bartlett	9.8762	2	.	<.0001

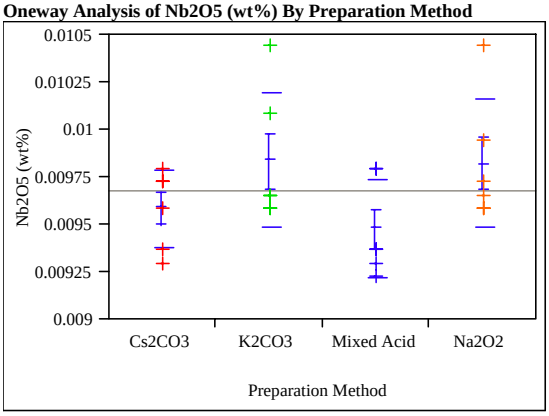
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.6100	2	6.7859	0.0544

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Nb2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

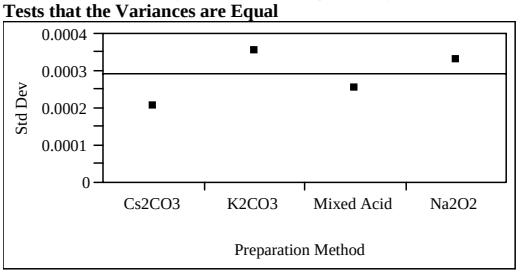
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00047	-0.00046	-0.00022	-0.00011
Na2O2	-0.00046	-0.00047	-0.00023	-0.00013
Cs2CO3	-0.00022	-0.00023	-0.00047	-0.00037
Mixed Acid	-0.00011	-0.00013	-0.00037	-0.00047

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.00983469
Na2O2	A	0.00982277
Cs2CO3	A	0.00958435
Mixed Acid	A	0.00947706

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



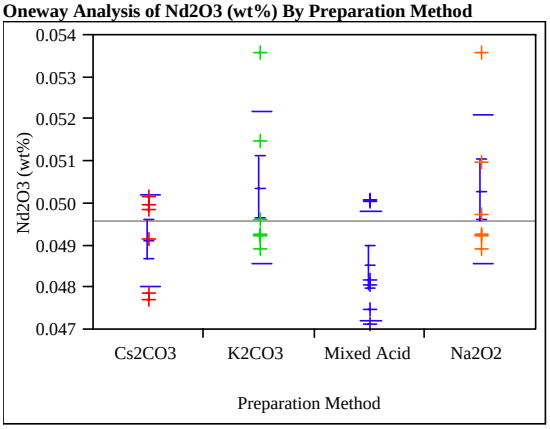
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0002073	0.0001669	0.0001669
K2CO3	6	0.0003526	0.0002861	0.0002265
Mixed Acid	6	0.0002549	0.0002146	0.0001788
Na2O2	6	0.0003314	0.0002464	0.0002146

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4653	3	20	0.7097
Brown-Forsythe	0.0831	3	20	0.9684
Levene	0.7409	3	20	0.5401
Bartlett	0.5213	3	.	0.6676

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9312	3	10.882	0.1837

Oneway Analysis of Nd2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

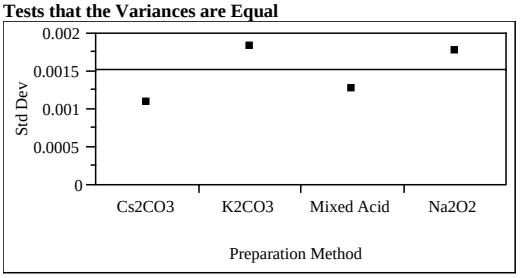
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00247	-0.00240	-0.00123	-0.00060
Na2O2	-0.00240	-0.00247	-0.00130	-0.00067
Cs2CO3	-0.00123	-0.00130	-0.00247	-0.00183
Mixed Acid	-0.00060	-0.00067	-0.00183	-0.00247

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.05035932
Na2O2	A	0.05029128
Cs2CO3	A	0.04912488
Mixed Acid	A	0.04849308

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0010865	0.0008878	0.0008748
K2CO3	6	0.0018330	0.0014580	0.0012150
Mixed Acid	6	0.0012787	0.0010498	0.0009428
Na2O2	6	0.0017719	0.0013284	0.0011470

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4694	3	20	0.7069
Brown-Forsythe	0.1042	3	20	0.9566
Levene	0.6783	3	20	0.5755
Bartlett	0.5658	3	.	0.6375

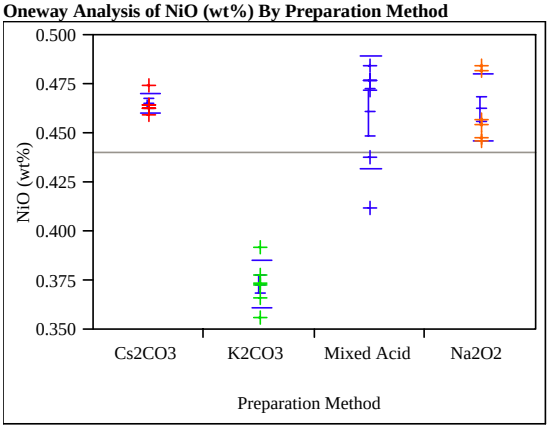
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9084	3	10.88	0.1873

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of NiO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

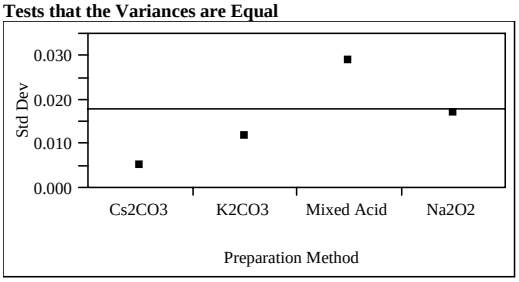
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.02894	-0.02618	-0.02427	0.06268
Na2O2	-0.02618	-0.02894	-0.02703	0.05992
Mixed Acid	-0.02427	-0.02703	-0.02894	0.05802
K2CO3	0.06268	0.05992	0.05802	-0.02894

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.46488667
Na2O2	A	0.46212958
Mixed Acid	A	0.46022083
K2CO3	B	0.37326667

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



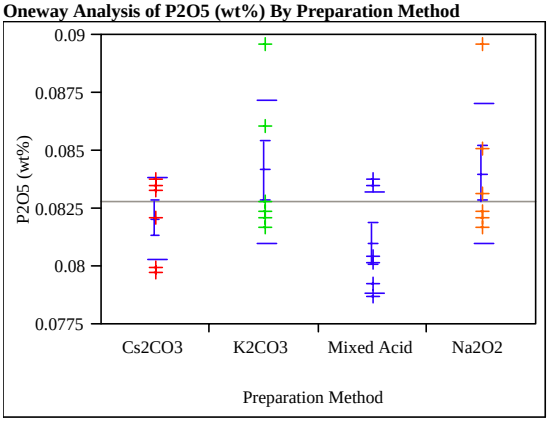
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0051322	0.0032519	0.0029692
K2CO3	6	0.0118736	0.0080592	0.0080592
Mixed Acid	6	0.0287221	0.0234706	0.0195117
Na2O2	6	0.0170423	0.0142803	0.0125129

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.3053	3	20	0.1077
Brown-Forsythe	1.3859	3	20	0.2760
Levene	6.3855	3	20	0.0033
Bartlett	3.8082	3	.	0.0096

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
89.0095	3	9.5824	<.0001

Oneway Analysis of P2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

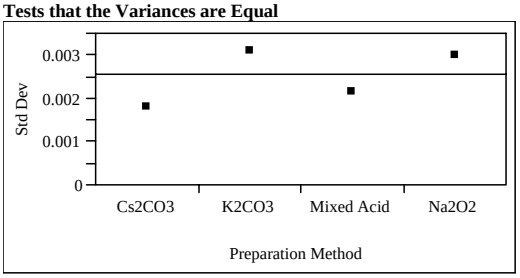
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00415	-0.00406	-0.00211	-0.00102
Na2O2	-0.00406	-0.00415	-0.00221	-0.00112
Cs2CO3	-0.00211	-0.00221	-0.00415	-0.00307
Mixed Acid	-0.00102	-0.00112	-0.00307	-0.00415

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.08411347
Na2O2	A	0.08401800
Cs2CO3	A	0.08207031
Mixed Acid	A	0.08098189

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0018038	0.0014767	0.0014512
K2CO3	6	0.0031035	0.0024696	0.0020432
Mixed Acid	6	0.0021488	0.0017695	0.0015849
Na2O2	6	0.0029882	0.0022277	0.0019477

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4863	3	20	0.6956
Brown-Forsythe	0.1139	3	20	0.9509
Levene	0.7059	3	20	0.5597
Bartlett	0.5987	3	.	0.6158

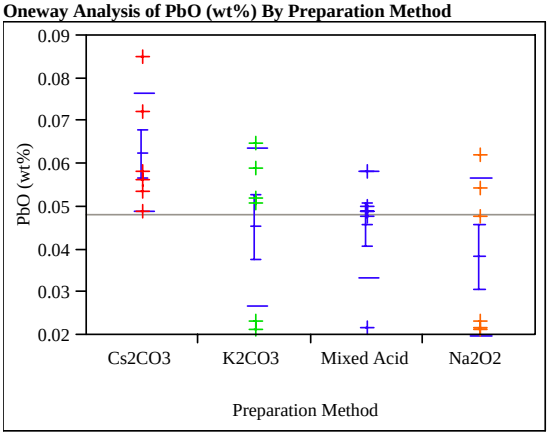
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8948	3	10.865	0.1896

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of PbO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

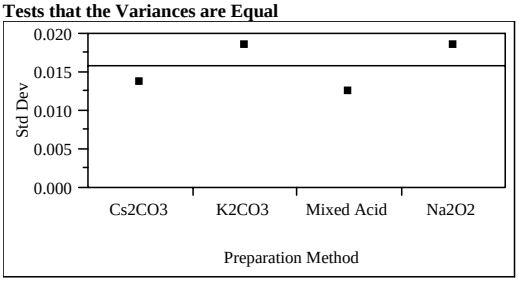
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	K2CO3	Na2O2
Cs2CO3	-0.02585	-0.00933	-0.00866	-0.00175
Mixed Acid	-0.00933	-0.02585	-0.02519	-0.01828
K2CO3	-0.00866	-0.02519	-0.02585	-0.01894
Na2O2	-0.00175	-0.01828	-0.01894	-0.02585

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.06247760
Mixed Acid	A	0.04595156
K2CO3	A	0.04528728
Na2O2	A	0.03837525

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



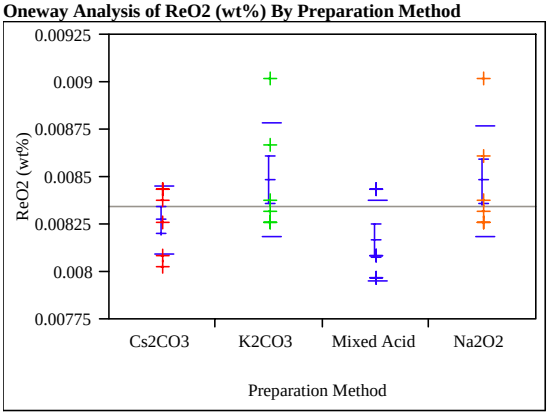
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0136644	0.0108797	0.0095512
K2CO3	6	0.0184759	0.0153082	0.0133842
Mixed Acid	6	0.0124749	0.0080820	0.0065081
Na2O2	6	0.0184460	0.0163106	0.0163106

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7824	3	20	0.5177
Brown-Forsythe	1.0334	3	20	0.3991
Levene	1.7517	3	20	0.1888
Bartlett	0.3706	3	.	0.7742

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.4937	3	10.965	0.1144

Oneway Analysis of ReO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

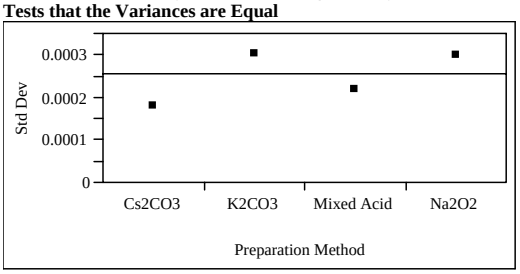
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00041	-0.00040	-0.00020	-0.00009
Na2O2	-0.00040	-0.00041	-0.00021	-0.00010
Cs2CO3	-0.00020	-0.00021	-0.00041	-0.00031
Mixed Acid	-0.00009	-0.00010	-0.00031	-0.00041

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.00848651
Na2O2	A	0.00847674
Cs2CO3	A	0.00827166
Mixed Acid	A	0.00816424

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0001793	0.0001465	0.0001465
K2CO3	6	0.0003043	0.0002409	0.0002051
Mixed Acid	6	0.0002182	0.0001823	0.0001563
Na2O2	6	0.0002980	0.0002279	0.0001953

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4818	3	20	0.6986
Brown-Forsythe	0.1226	3	20	0.9457
Levene	0.7075	3	20	0.5588
Bartlett	0.5647	3	.	0.6382

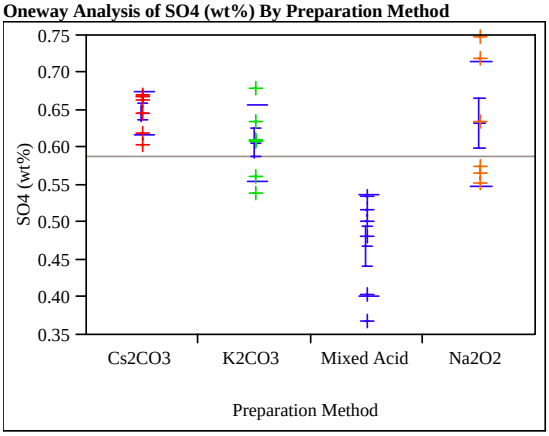
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.0283	3	10.868	0.1690

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SO4 (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

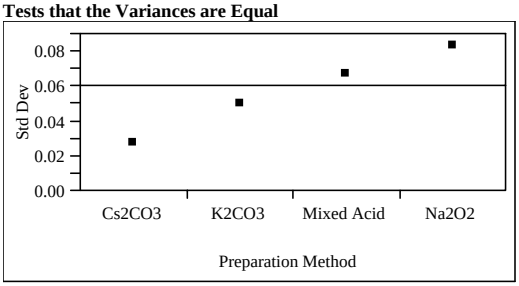
Abs(Dif)-LSD	Cs2CO3	Na2O2	K2CO3	Mixed Acid
Cs2CO3	-0.09823	-0.08525	-0.05828	0.07903
Na2O2	-0.08525	-0.09823	-0.07127	0.06605
K2CO3	-0.05828	-0.07127	-0.09823	0.03908
Mixed Acid	0.07903	0.06605	0.03908	-0.09823

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.64611577
Na2O2	A	0.63313353
K2CO3	A	0.60617043
Mixed Acid	B	0.46885835

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



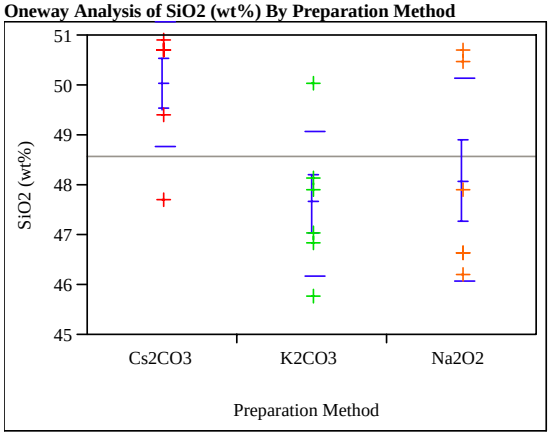
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0276317	0.0223028	0.0219699
K2CO3	6	0.0502978	0.0366166	0.0359508
Mixed Acid	6	0.0671977	0.0549248	0.0504310
Na2O2	6	0.0834920	0.0679071	0.0679071

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.4324	3	20	0.0950
Brown-Forsythe	1.5970	3	20	0.2215
Levene	2.8253	3	20	0.0648
Bartlett	1.7235	3	.	0.1597

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
10.6977	3	10.191	0.0017

Oneway Analysis of SiO2 (wt%) By Preparation Method



Missing Rows
6**Means Comparisons**

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.59747	0.05

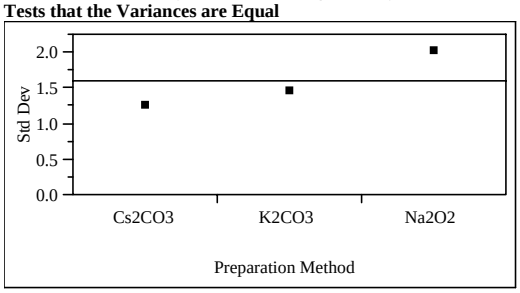
Abs(Dif)-LSD	Cs2CO3	Na2O2	K2CO3
Cs2CO3	-2.4136	-0.4883	-0.0247
Na2O2	-0.4883	-2.4136	-1.9501
K2CO3	-0.0247	-1.9501	-2.4136

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	50.023965
Na2O2	A	48.098595
K2CO3	A	47.635080

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	1.257768	0.974570	0.748755
K2CO3	6	1.455143	1.069650	1.069650
Na2O2	6	2.017834	1.663900	1.604475

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0690	2	15	0.3681
Brown-Forsythe	0.8371	2	15	0.4522
Levene	1.2975	2	15	0.3022
Bartlett	0.5567	2	.	0.5731

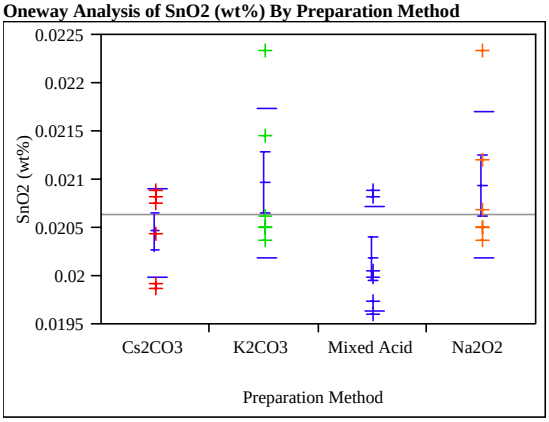
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.7909	2	9.6989	0.0357

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SnO2 (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

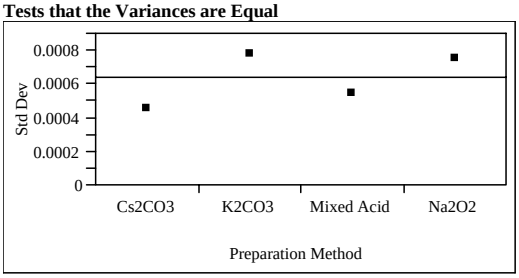
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00104	-0.00101	-0.00052	-0.00026
Na2O2	-0.00101	-0.00104	-0.00056	-0.00029
Cs2CO3	-0.00052	-0.00056	-0.00104	-0.00078
Mixed Acid	-0.00026	-0.00029	-0.00078	-0.00104

Positive values show pairs of means that are significantly different.

Level		Mean
K2CO3	A	0.02096956
Na2O2	A	0.02093782
Cs2CO3	A	0.02045114
Mixed Acid	A	0.02018664

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



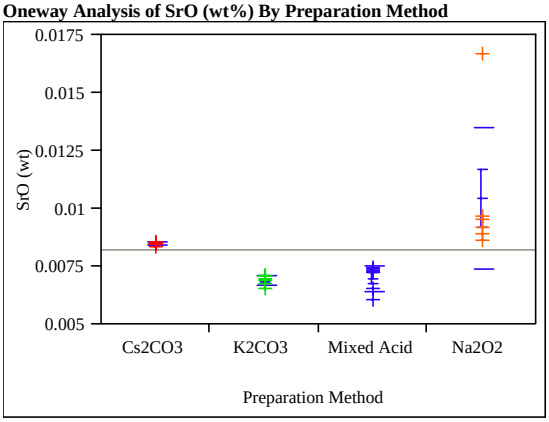
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0004532	0.0003703	0.0003703
K2CO3	6	0.0007782	0.0006207	0.0005078
Mixed Acid	6	0.0005416	0.0004444	0.0004020
Na2O2	6	0.0007483	0.0005572	0.0004761

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4724	3	20	0.7049
Brown-Forsythe	0.0878	3	20	0.9659
Levene	0.7057	3	20	0.5598
Bartlett	0.5894	3	.	0.6219

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8658	3	10.867	0.1945

Oneway Analysis of SrO (wt%) By Preparation Method



Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

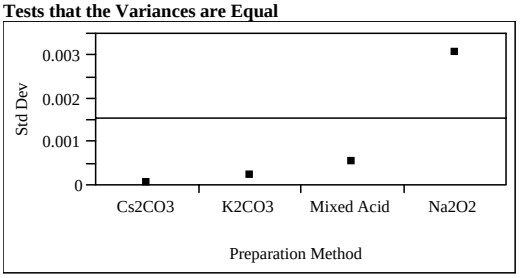
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid	K2CO3
Na2O2	-0.00253	-0.00056	0.00092	0.00102
Cs2CO3	-0.00056	-0.00253	-0.00104	-0.00095
Mixed Acid	0.00092	-0.00104	-0.00253	-0.00243
K2CO3	0.00102	-0.00095	-0.00243	-0.00253

Positive values show pairs of means that are significantly different.

Level			Mean
Na2O2	A		0.01046010
Cs2CO3	A	B	0.00849304
Mixed Acid		B	0.00701085
K2CO3		B	0.00691427

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0000679	0.0000388	0.0000374
K2CO3	6	0.0002122	0.0001616	0.0001616
Mixed Acid	6	0.0005583	0.0004599	0.0003883
Na2O2	6	0.0030688	0.0020715	0.0015157

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2473	3	20	0.3191
Brown-Forsythe	1.3276	3	20	0.2934
Levene	4.9089	3	20	0.0102
Bartlett	16.8910	3	.	<.0001

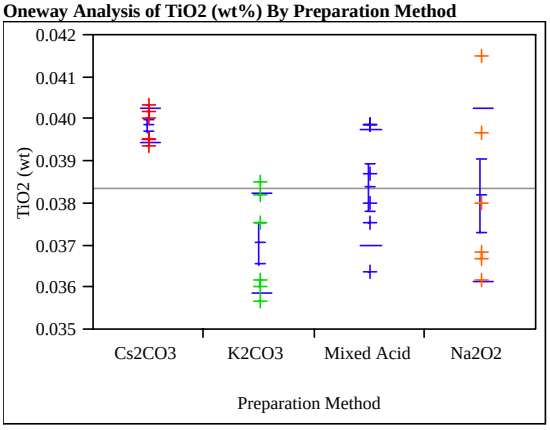
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
98.0264	3	8.8998	<.0001

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of TiO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

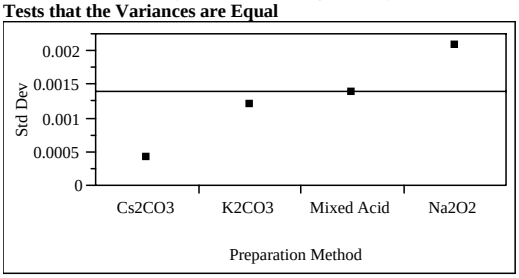
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2	K2CO3
Cs2CO3	-0.00226	-0.00081	-0.00059	0.00055
Mixed Acid	-0.00081	-0.00226	-0.00204	-0.00090
Na2O2	-0.00059	-0.00204	-0.00226	-0.00112
K2CO3	0.00055	-0.00090	-0.00112	-0.00226

Positive values show pairs of means that are significantly different.

Level			Mean
Cs2CO3	A		0.03983740
Mixed Acid	A	B	0.03839180
Na2O2	A	B	0.03816940
K2CO3		B	0.03702960

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



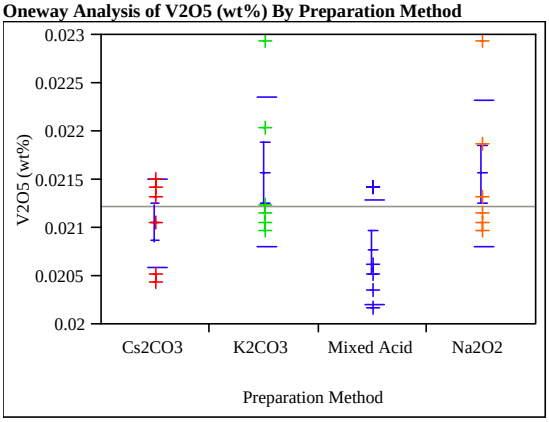
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0004142	0.0003614	0.0003614
K2CO3	6	0.0012120	0.0010564	0.0010564
Mixed Acid	6	0.0013731	0.0010842	0.0010842
Na2O2	6	0.0020711	0.0016309	0.0015846

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0600	3	20	0.1378
Brown-Forsythe	2.3681	3	20	0.1012
Levene	3.7825	3	20	0.0267
Bartlett	3.0262	3	.	0.0283

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
10.2132	3	9.4078	0.0026

Oneway Analysis of V2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

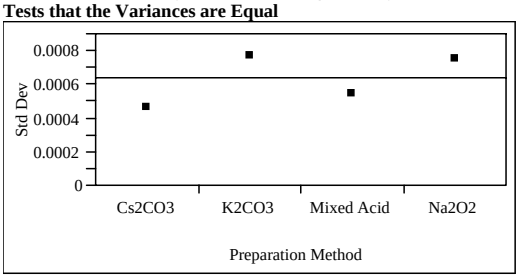
Abs(Dif)-LSD	K2CO3	Na2O2	Cs2CO3	Mixed Acid
K2CO3	-0.00104	-0.00103	-0.00052	-0.00022
Na2O2	-0.00103	-0.00104	-0.00054	-0.00024
Cs2CO3	-0.00052	-0.00054	-0.00104	-0.00075
Mixed Acid	-0.00022	-0.00024	-0.00075	-0.00104

Positive values show pairs of means that are significantly different.

Level			Mean
K2CO3	A		0.02157117
Na2O2	A		0.02155629
Cs2CO3	A		0.02105048
Mixed Acid			0.02075295

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0004635	0.0003769	0.0003719
K2CO3	6	0.0007734	0.0006149	0.0005058
Mixed Acid	6	0.0005407	0.0004463	0.0004017
Na2O2	6	0.0007484	0.0005653	0.0004909

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4676	3	20	0.7081
Brown-Forsythe	0.0984	3	20	0.9600
Levene	0.6784	3	20	0.5755
Bartlett	0.5481	3	.	0.6494

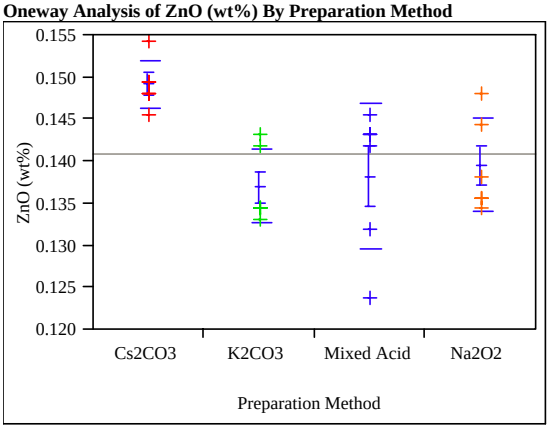
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.0727	3	10.889	0.1626

Exhibit A4. Statistical Comparisons of Chemical Composition Measurements of Simulant Samples Across Preparation Methods by Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of ZnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79894	0.05

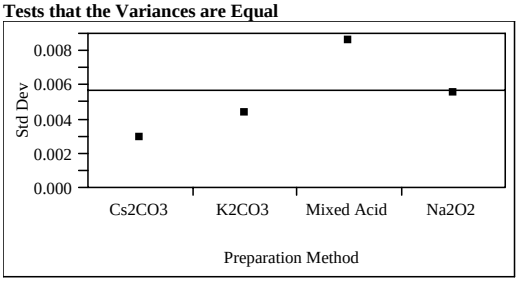
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid	K2CO3
Cs2CO3	-0.00928	0.00047	0.00164	0.00296
Na2O2	0.00047	-0.00928	-0.00812	-0.00679
Mixed Acid	0.00164	-0.00812	-0.00928	-0.00795
K2CO3	0.00296	-0.00679	-0.00795	-0.00928

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.14916853
Na2O2	B	0.13941760
Mixed Acid	B	0.13825579
K2CO3	B	0.13692800

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



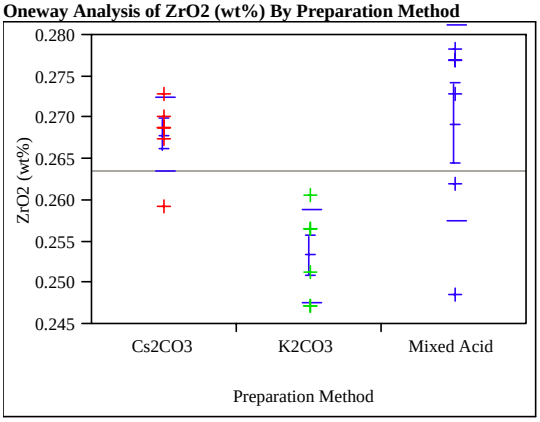
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0028837	0.0018672	0.0018672
K2CO3	6	0.0043834	0.0037344	0.0029045
Mixed Acid	6	0.0085617	0.0069432	0.0057261
Na2O2	6	0.0055669	0.0045643	0.0041493

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6224	3	20	0.2158
Brown-Forsythe	0.7020	3	20	0.5619
Levene	3.7904	3	20	0.0266
Bartlett	1.8132	3	.	0.1423

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.3123	3	10.476	0.0009

Oneway Analysis of ZrO2 (wt%) By Preparation Method



Missing Rows
6**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.59747	0.05

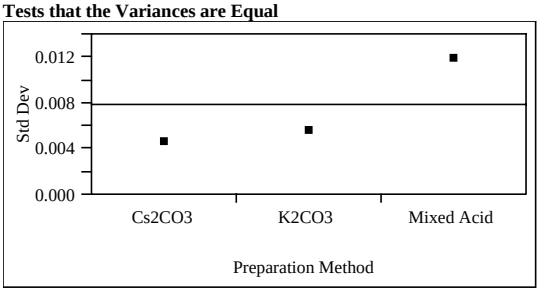
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	K2CO3
Mixed Acid	-0.01195	-0.01060	0.00403
Cs2CO3	-0.01060	-0.01195	0.00268
K2CO3	0.00403	0.00268	-0.01195

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.26925947
Cs2CO3	A	0.26790867
K2CO3	B	0.25327500

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0045741	0.0030018	0.0027016
K2CO3	6	0.0055858	0.0047278	0.0047278
Mixed Acid	6	0.0117657	0.0093055	0.0081048

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6513	2	15	0.2248
Brown-Forsythe	1.1593	2	15	0.3403
Levene	3.8975	2	15	0.0433
Bartlett	2.3931	2	.	0.0913

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.4627	2	9.2355	0.0024

APPENDIX B.

SUPPLEMENTAL TABLES AND EXHIBITS FOR DWPF RADIOACTIVE GLASS RESULTS

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Table B1. Elemental Measurements (μg/g) for DWPF Radioactive Glass Prepared Using Cs_2CO_3 Digestions

Sample ID	CB1	CA3	CB2	CD2	CD5	CD1	CA1	CD4	CA2	CD6	CD3
Type of Sample	blank	ARG-1	blank	Pour Stream	Pour Stream	Pour Stream	ARG-1	Pour Stream	ARG-1	Pour Stream	Pour Stream
LIMS	220611 10x	220612 10x	220613 10x	220614 10x	220615 10x	220616 10x	220617 10x	220618 10x	220619 10x	220620 10x	220621 10x
Ag	<149	<139	<149	1570	<158	1340	1020	416	<139	415	767
Al	<568	21500	<568	24500	25400	25200	21600	25500	21400	25500	24500
B	1290	25000	793	14600	13700	14300	25600	14600	25100	12700	13500
Ba	<311	798	<311	547	438	447	791	406	804	424	423
Be	<20.9	<19.5	<20.9	<21.8	<22.3	<21.8	<20.1	<22.7	<19.5	<15.3	<22.2
Ca	<122	9880	<122	7240	7190	7220	9900	7230	9880	7210	7160
Cd	<58.1	<54.2	<58.1	312	373	396	<55.8	368	<54.2	463	433
Ce	<1820	<1700	<1820	4090	<1940	<1900	<1750	<1980	<1700	<1340	<1930
Cr	<38.6	558	<38.6	382	408	372	559	515	600	445	427
Cu	<135	<126	<135	<141	<144	<141	<130	<147	<126	<98.9	<143
Fe	288	97800	<162	75200	76700	77100	97700	77600	97800	76300	75400
Gd	<230	<214	<230	262	<244	<240	<220	<249	<214	171	<244
K	<10500	<9820	<10500	<11000	<11200	<11000	24400	<11400	14600	<7700	<11200
La	<703	<655	<703	<734	<748	<734	<674	<762	<655	<514	<745
Li	<649	14300	<649	21500	21900	21800	14200	22000	14200	21800	21400
Mg	<54.1	4980	<54.1	6850	7090	7110	4970	7110	4950	7100	6940
Mn	<27.0	14400	<27.0	16200	16400	16400	14300	16500	14400	16400	16100
Mo	<1800	<1680	<1800	<1880	<1910	<1880	<1720	<1950	<1680	<1320	<1910
Na	<4810	81900	<4810	89500	93400	91700	83100	91400	83100	88000	88100
Ni	<541	8230	<541	4200	4610	4370	7950	4280	8190	4330	3980
P	<3610	<3370	<3610	<3770	<3840	<3770	<3460	<3910	<3370	<2640	<3830
Pb	<10300	<9590	<10300	<10700	<10900	<10700	<9870	<11200	<9590	<7530	<10900
S	<128	430	<128	1630	1510	2030	302	1710	969	1600	1790
Sb	<1570	<1460	<1570	<1640	<1670	<1640	<1500	<1700	<1460	<1150	<1660
Si	<6570	223000	<6570	239000	244000	244000	232000	253000	229000	244000	243000
Sn	<4050	<3780	<4050	<4230	<4310	<4230	<3890	<4400	<3780	<2970	<4300
Sr	<135	1720	<135	1670	1270	1290	1640	1190	1630	1370	1280
Ti	<40.5	7000	<40.5	324	318	325	7010	312	7000	333	312
U	<2650	<2470	<2650	29600	27700	26900	<2540	27400	<2470	27600	27000
V	<270	828	<270	<282	<288	1780	<259	<293	<252	<198	<287
Zn	<94.6	<88.2	<94.6	<98.7	<101	<98.7	<90.8	<103	<88.2	<69.2	<100
Zr	<108	881	<108	401	389	401	903	384	919	381	376

Table B2. Elemental Measurements (μg/g) for DWPF Radioactive Glass Prepared Using Na_2O_2 Digestions

Sample ID	PR1	PR2	PR3	PR4	ARG-1 (PF)	ARG-2 (PF)	ARG-3 (PF)	Blank
Type of Sample	Pour Stream	Pour Stream	Pour Stream	Pour Stream	ARG-1	ARG-1	ARG-1	blank
LIMS	3-220491	3-220492	3-220493	3-220494	3-220495	3-220496	3-220497	3-220498
Ag	331	368	393	396	391	509	385	<87.6
Al	25500	24200	25400	25700	21700	21700	21200	<335
B	13900	13400	13900	14000	24300	24900	23800	<422
Ba	426	480	503	548	911	939	970	<183
Be	10.8	88	40.6	86.7	28.9	114	71.1	<35.1
Ca	9110	8680	9010	9010	11900	12300	11500	98.6
Cd	501	471	479	525	<38.9	<46.5	<34.0	<34.3
Ce	4310	5140	6270	7900	6440	6990	7640	<1076
Cr	434	448	399	305	487	523	214	<207
Cu	<79.7	<82.6	<80.3	<74.1	<90.5	<108	<79.1	<79.7
Fe	77000	73700	76900	77500	98300	100000	97500	<95.6
Gd	426	539	617	691	464	568	604	<135
K	6930	<6440	24700	13200				<6210
La	670	723	867	1130	831	864	986	<414
Li	24100	23000	23900	24200	16100	16400	15900	<382
Mg	7160	6830	7140	7200	4980	5000	4960	<31.9
Mn	16500	15700	16600	16600	14500	14800	14500	<15.9
Mo	<1060	<1100	<1070	1010	<1200	<1440	1240	<1060
Na								
Ni	4300	3990	4210	4390	8110	8140	7970	<319
P	<2130	<2210	<2140	<1980	<2420	<2890	<2110	<2130
Pb	<6060	<6290	<6110	<5640	<6890	<8230	<6020	<6060
S	1450	1300	1550	1520	<561	<670	<490	<494
Sb	<924	1050	1180	1020	1270	1280	1390	<924
Si	234000	235000	242000	243000	230000	234000	228000	<3870
Sn	<2390	<2480	<2410	2330	<2710	<3240	<2370	<2390
Sr	2280	2220	2420	2610	2850	2900	2890	<79.7
Ti	373	355	370	371	6860	6990	6750	<23.9
U	30100	29200	32200	32800	3410	4550	5740	<1560
V	946	<165	705	<148	<181	<216	<158	<159
Zn	<55.8	<57.9	<56.2	73.7	<63.3	<75.7	77.4	<55.8
Zr	36700	29800	27600	17400	49100	64100	29800	3730

Table B3. Elemental Measurements (μg/g) for DWPF Radioactive Glass Prepared Using Mixed Acid Digestions

Sample ID	AR1	AR2	AR3	AR4	ARG-1 (MA)	ARG-2 (MA)	ARG-3 (MA)	Blank
Type of Sample	Pour Stream	Pour Stream	Pour Stream	Pour Stream	ARG-1	ARG-1	ARG-1	blank
LIMS	3-220481	3-220482	3-220483	3-220484	3-220485	3-220486	3-220487	3-220488
Ag	<44.2	<41.5	<44.0	<43.1	<44.7	<43.8	<44.4	<44.2
Al	25000	25700	25800	25600	22000	21500	21900	<169
B	920000	887000	970000	918000	956000	946000	957000	960000
Ba	356	363	362	366	772	757	768	<92.4
Be	<6.22	<5.84	<6.19	<6.07	17.9	17	16.3	<6.22
Ca	7210	7430	7480	7360	10100	9930	10100	<36.1
Cd	595	615	634	609	<17.5	<17.1	<17.3	<17.3
Ce	<542	<509	<540	<529	<549	<538	<544	<542
Cr	401	399	428	395	450	534	499	<104
Cu	105	99.5	107	103	<40.7	<39.8	<40.3	<40.2
Fe	72600	75000	74900	74600	96300	95000	96700	<48.2
Gd	119	121	117	121	<69.1	<67.7	<68.5	<68.3
K	<3130	<2940	<3120	<3050	22000	14900	17000	<3130
La	<209	<196	<208	<204	<211	<207	<210	<209
Li	21800	22500	22500	22300	14700	14500	14700	<193
Mg	6790	7010	7010	6970	4990	4940	5030	<16.1
Mn	15600	16100	16100	16000	14200	14100	14300	<8.03
Mo	<534	<502	<532	<522	<541	<530	<536	<534
Na	86400	88700	89200	87900	82500	80600	82600	<1430
Ni	4330	4520	4420	4580	8200	8310	8330	<161
P	1320	<1010	<1070	1170	<1090	<1060	<1080	<1070
Pb	<3060	<2870	<3040	<2980	<3090	<3030	<3070	<3060
S	1760	1480	1500	1400	515	179	280	241
Sb	<466	<438	<464	<455	<472	<462	<468	<466
Si	193000	202000	207000	203000	166000	189000	189000	2950
Sn	6510	6130	6770	6470	6490	6590	6640	5500
Sr	1510	1530	1560	1540	1910	1880	1930	<40.2
Ti	368	378	390	374	6910	6790	6920	<12.0
U	28000	28700	28400	28300	<797	<781	<790	<787
V	198	<75.5	<80.0	<78.4	<81.3	158	<80.6	<80.3
Zn	56.9	66.5	62.4	59.5	80.7	81.6	85.5	<28.1
Zr	387	404	411	411	931	908	923	<32.1

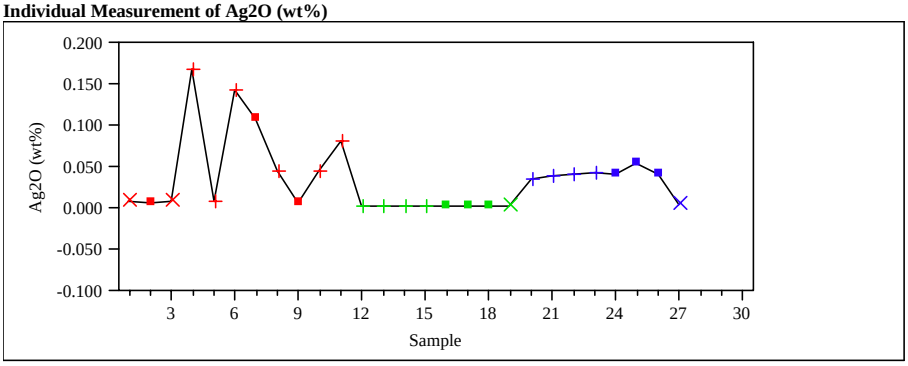
Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

Legend

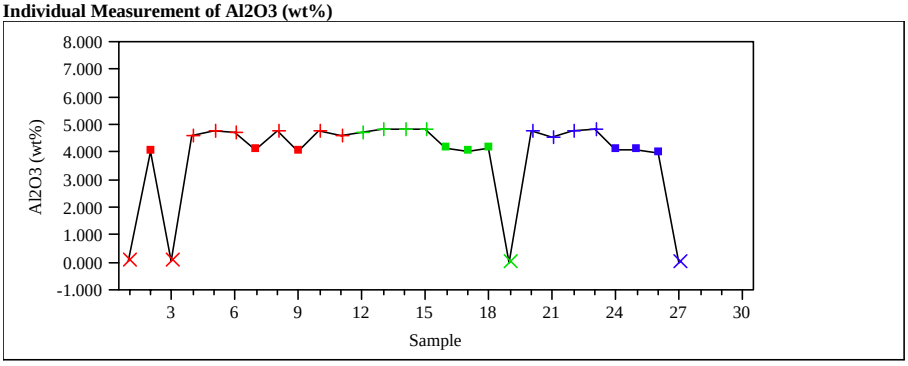
Preparation Method
- Cs2CO3
- Mixed Acid
- Na2O2

Type of Sample
- ARG-1
- Pour Stream
- blank

Individual Measurement of Ag2O (wt%)



Individual Measurement of Al2O3 (wt%)



Individual Measurement of B2O3 (wt%)

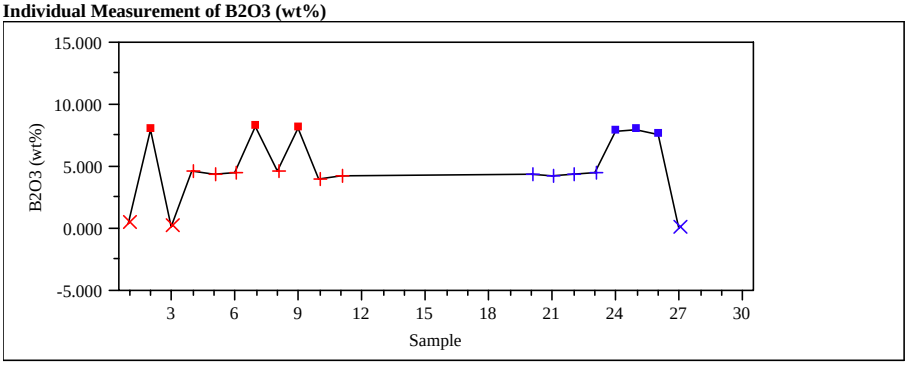
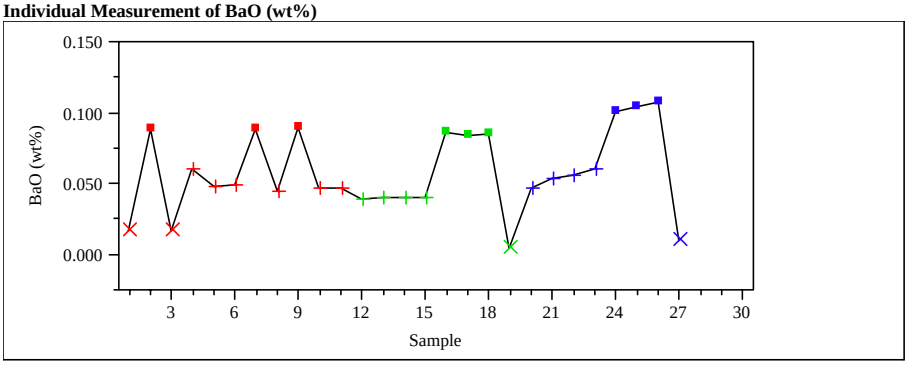
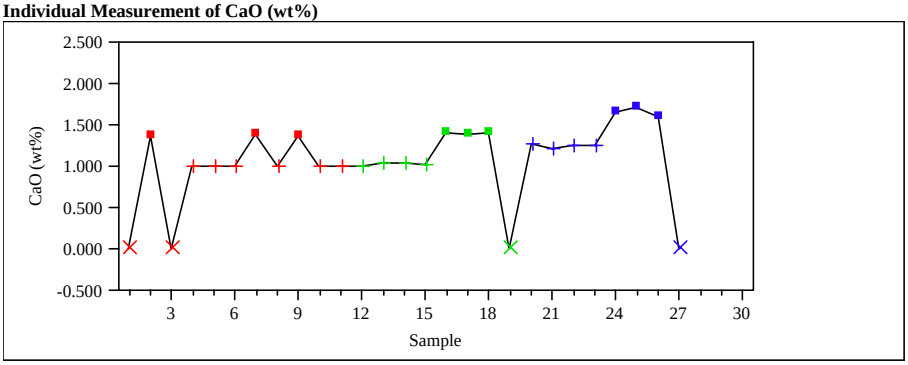


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

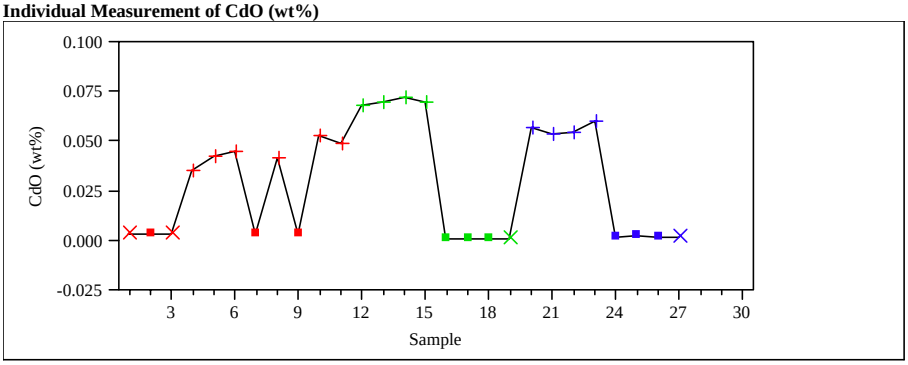
Individual Measurement of BaO (wt%)



Individual Measurement of CaO (wt%)



Individual Measurement of CdO (wt%)



Individual Measurement of Ce2O3 (wt%)

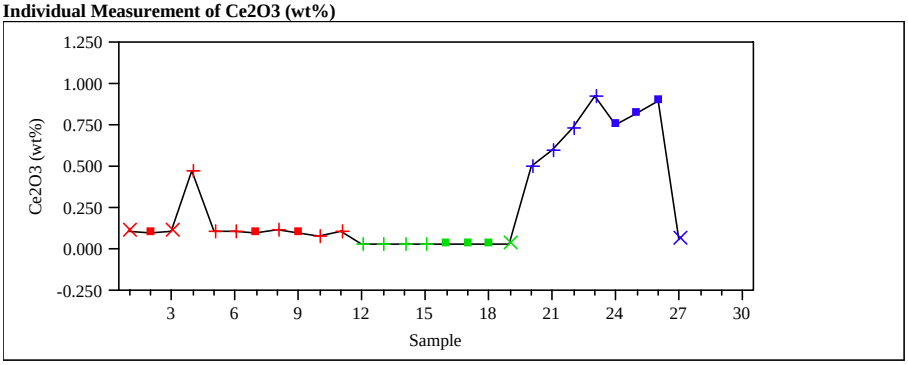
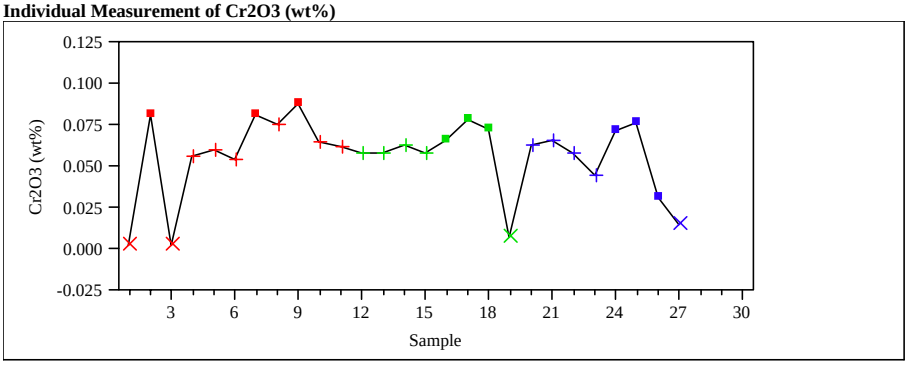
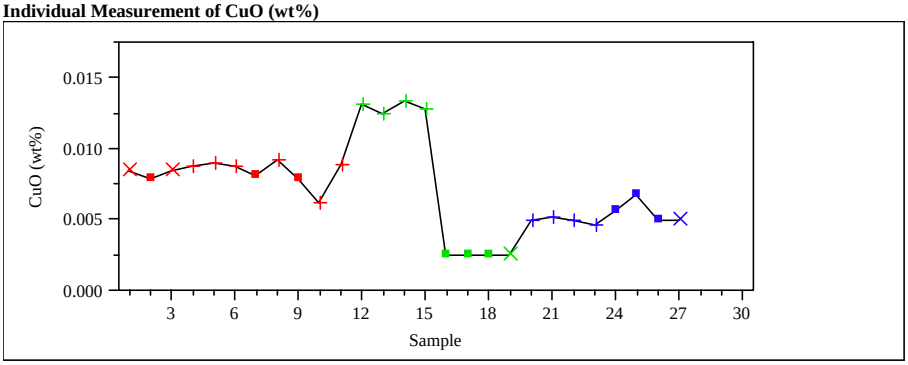


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

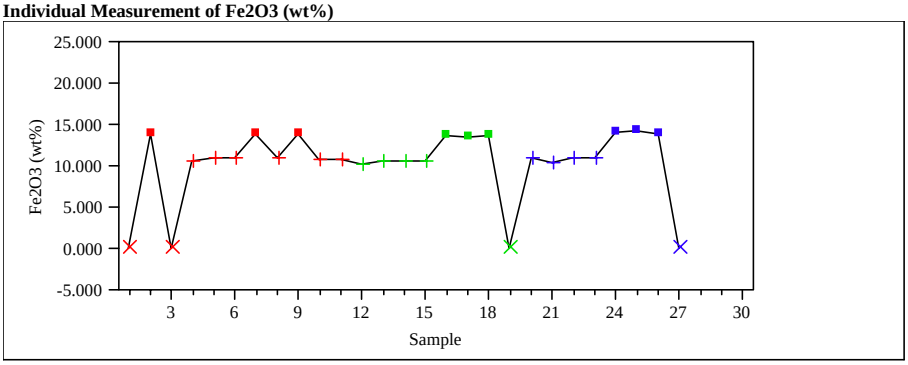
Individual Measurement of Cr2O3 (wt%)



Individual Measurement of CuO (wt%)



Individual Measurement of Fe2O3 (wt%)



Individual Measurement of K2O (wt%)

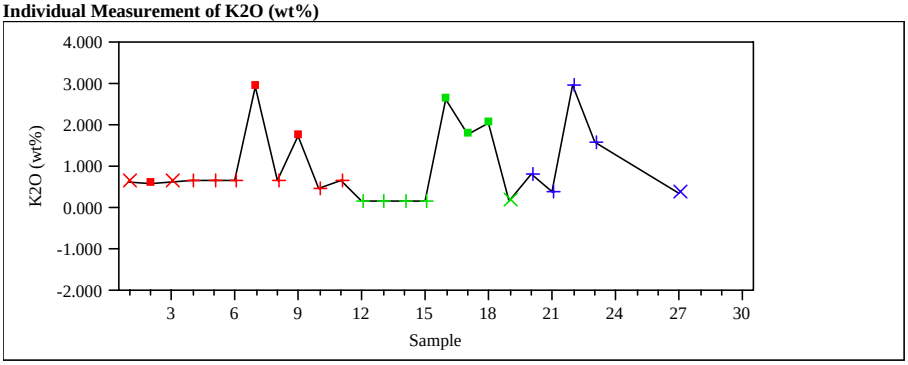
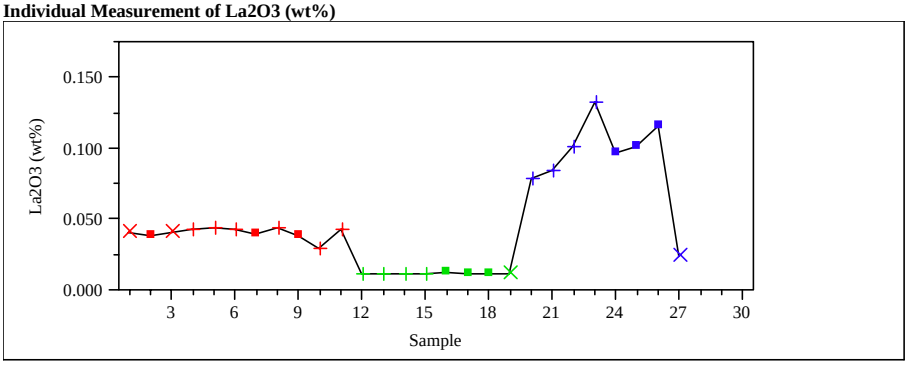
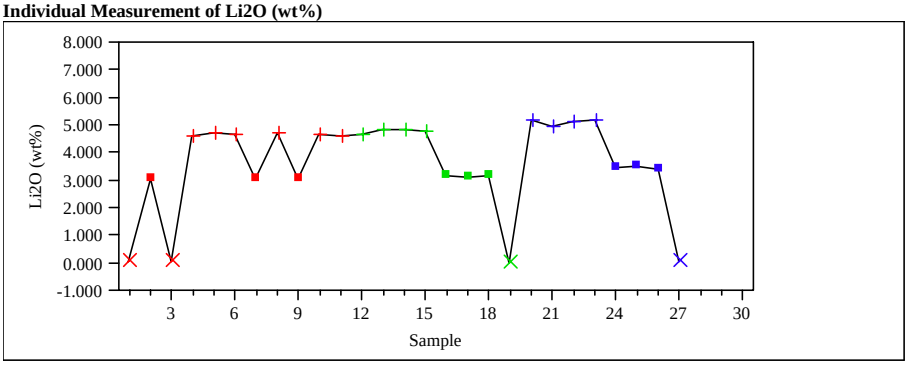


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

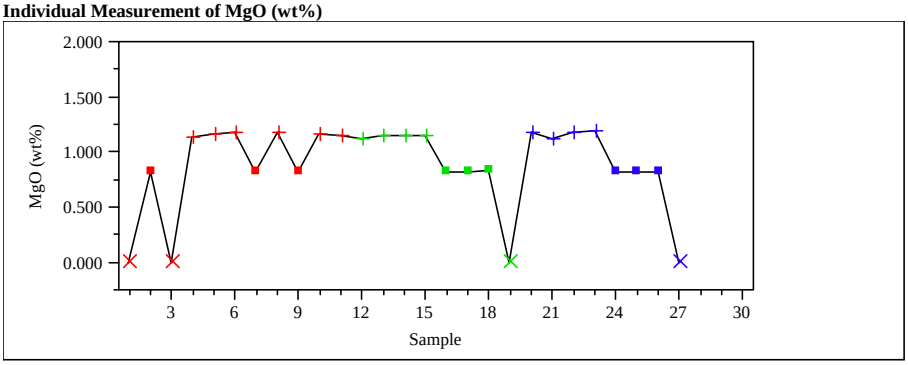
Individual Measurement of La2O3 (wt%)



Individual Measurement of Li2O (wt%)



Individual Measurement of MgO (wt%)



Individual Measurement of MnO (wt%)

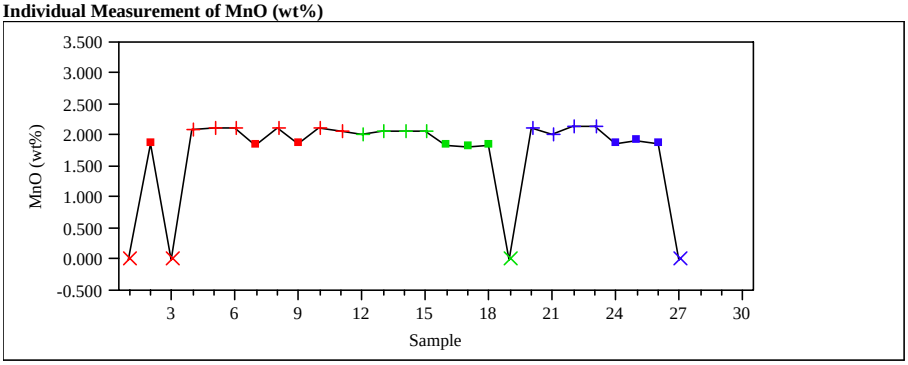
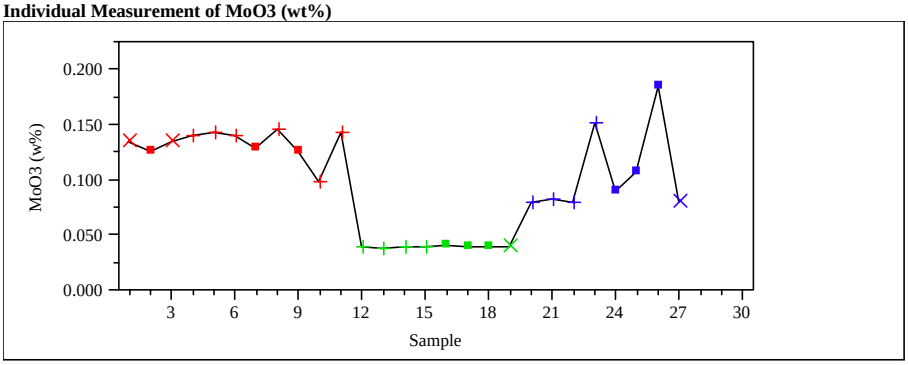
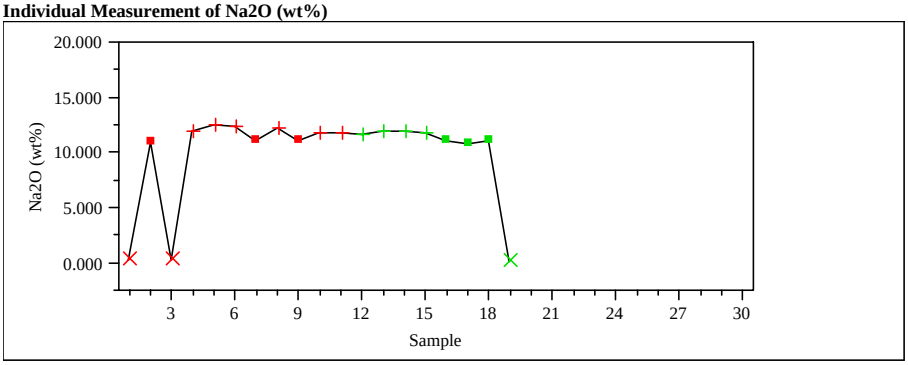


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

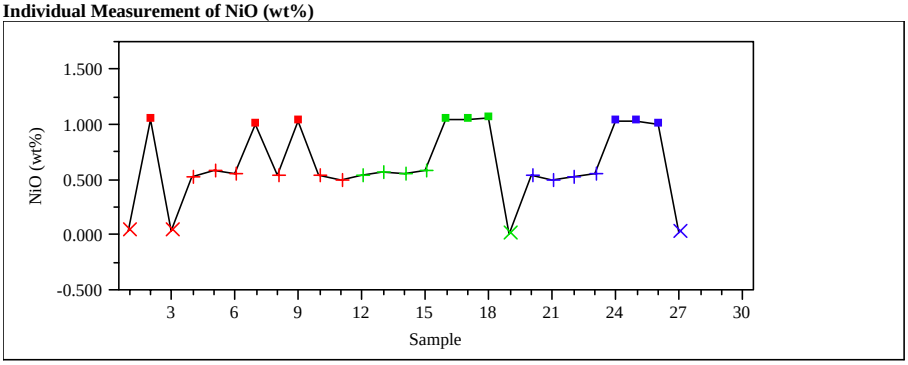
Individual Measurement of MoO3 (wt%)



Individual Measurement of Na2O (wt%)



Individual Measurement of NiO (wt%)



Individual Measurement of P2O5 (wt%)

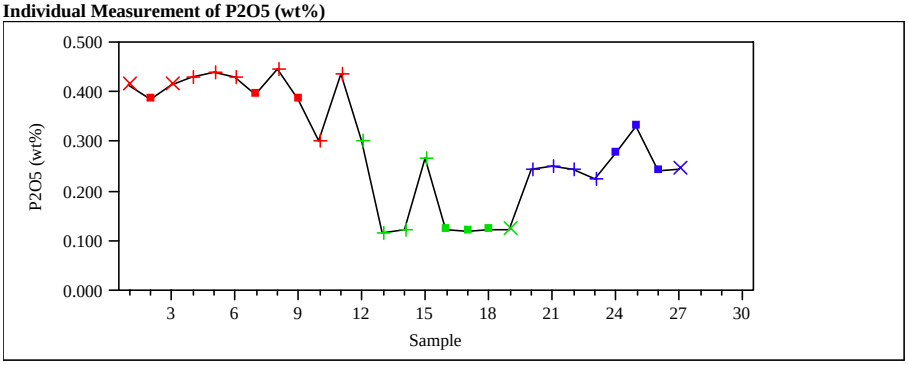
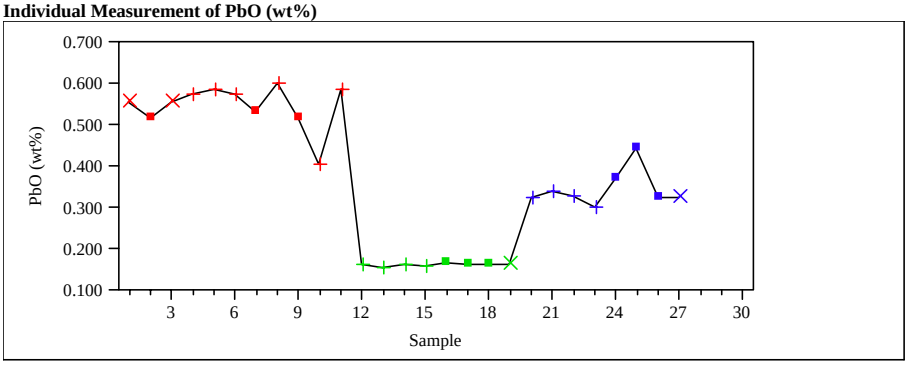
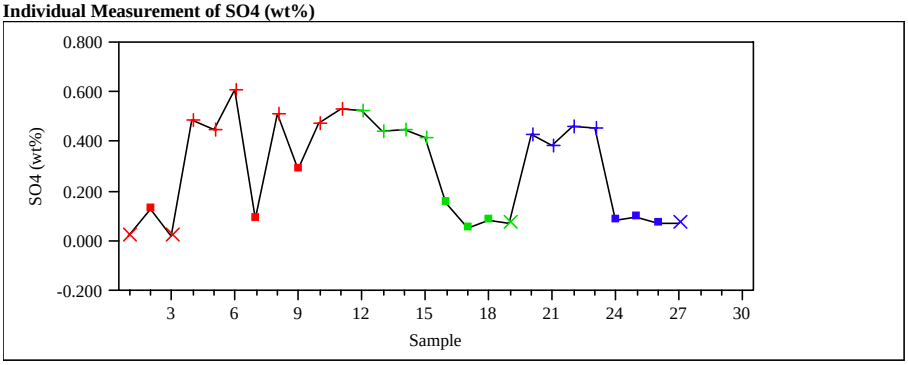


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

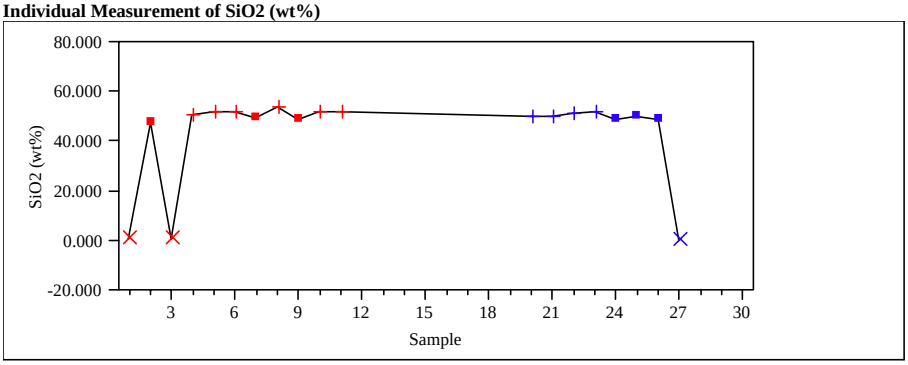
Individual Measurement of PbO (wt%)



Individual Measurement of SO4 (wt%)



Individual Measurement of SiO2 (wt%)



Individual Measurement of SnO2 (wt%)

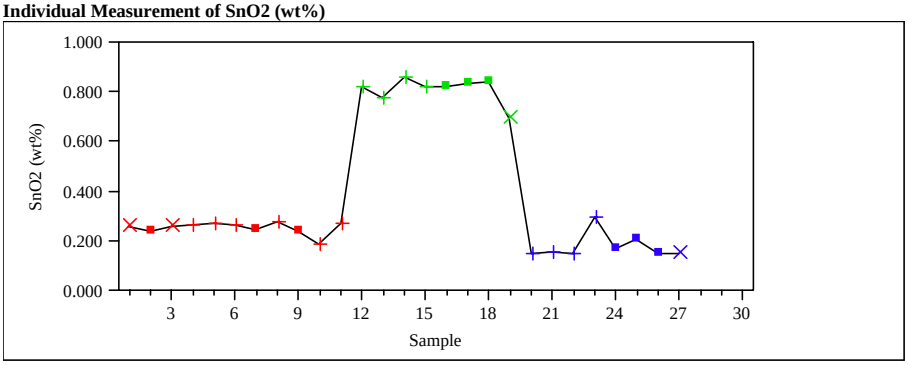
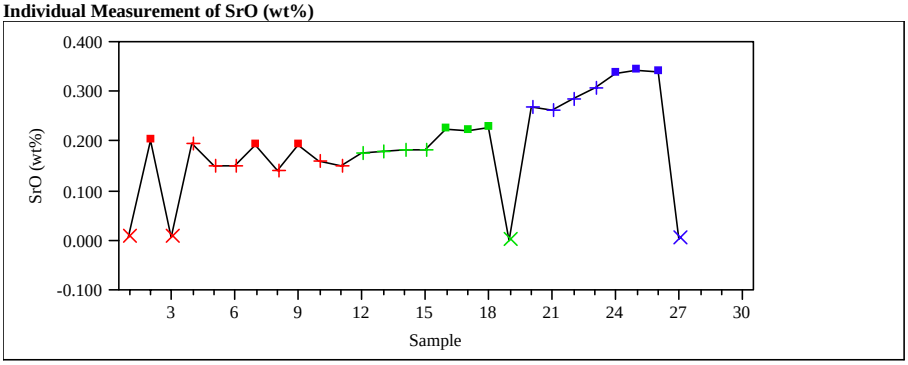
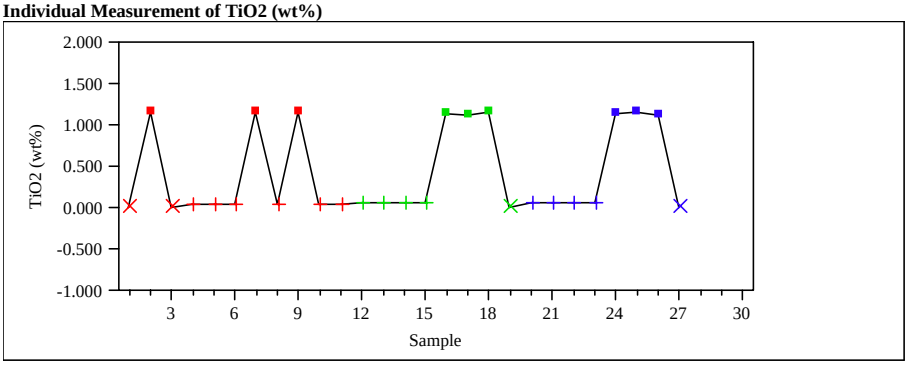


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

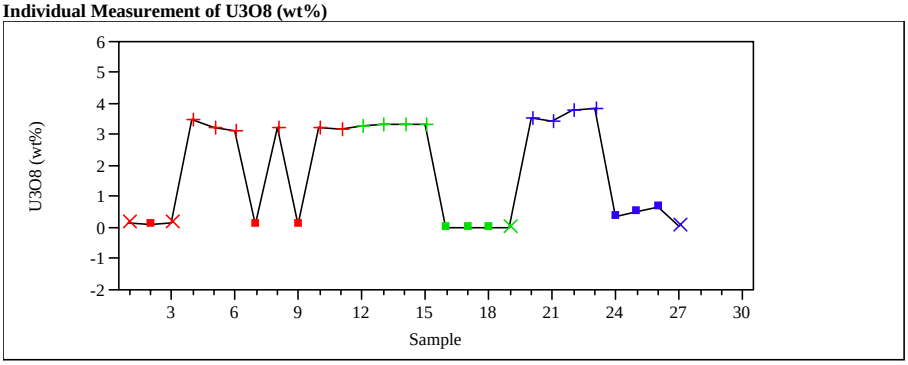
Individual Measurement of SrO (wt%)



Individual Measurement of TiO2 (wt%)



Individual Measurement of U3O8 (wt%)



Individual Measurement of V2O5 (wt%)

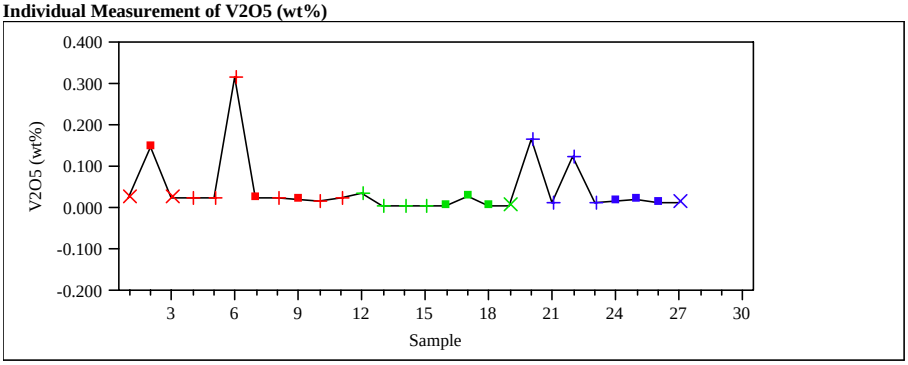
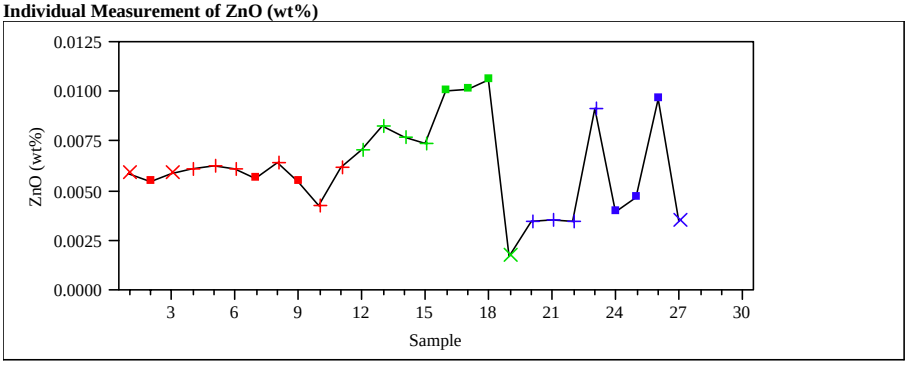


Exhibit B1. Chemical Composition Measurements in LIMS Order by Oxide for DWPF Radioactive Glass Set

Individual Measurement of ZnO (wt%)



Individual Measurement of ZrO2 (wt%)

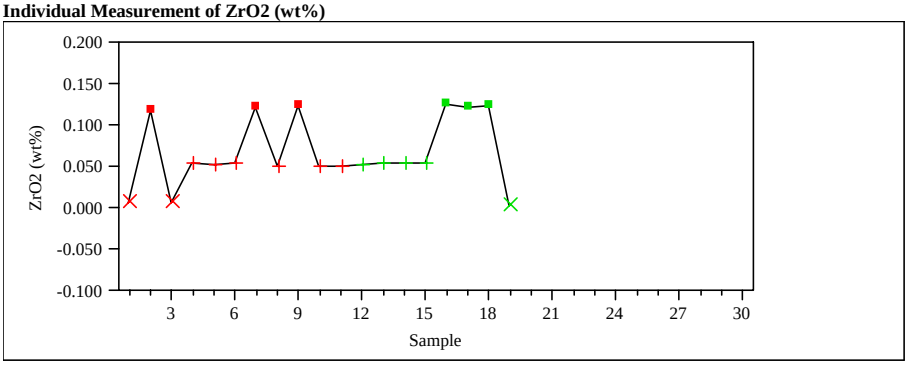


Exhibit B2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Legend

Preparation Method
- Cs2CO3
- Mixed Acid
- Na2O2

Type of Sample
- ARG-1
- Pour Stream
- blank

Chart for Ag2O (wt%)

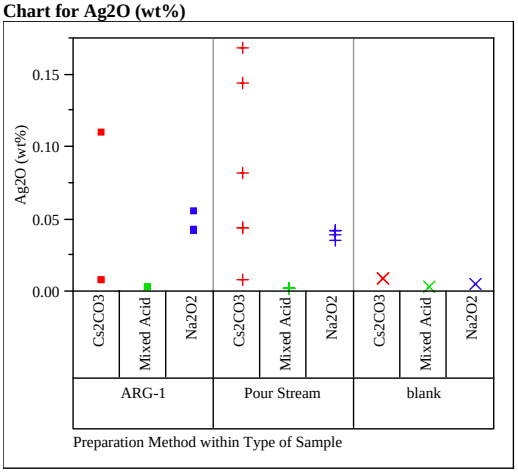


Chart for Al2O3 (wt%)

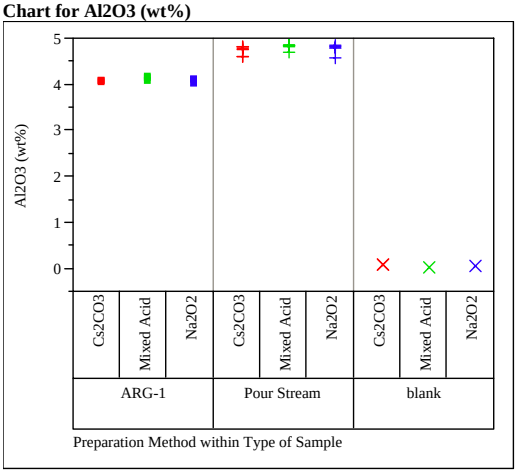


Chart for B2O3 (wt%)

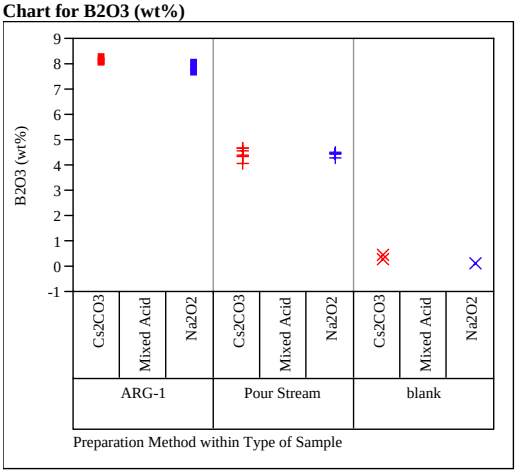


Chart for BaO (wt%)

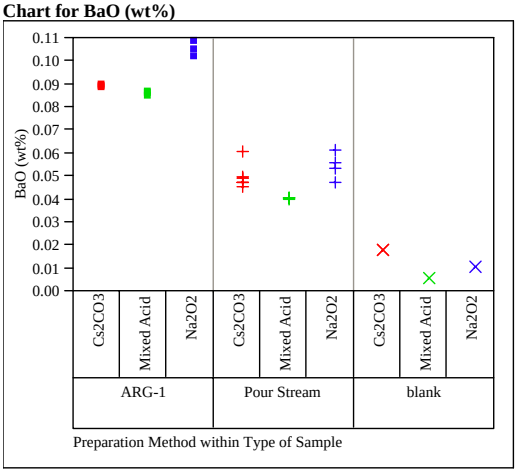


Chart for CaO (wt%)

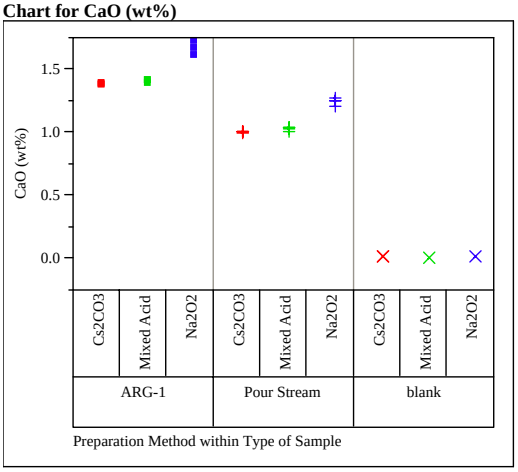


Exhibit B2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Chart for CdO (wt%)

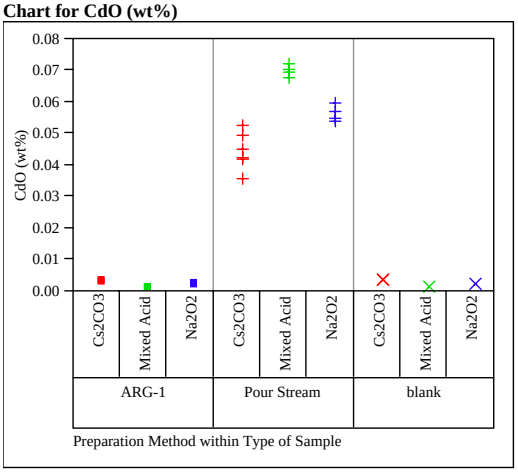


Chart for CuO (wt%)

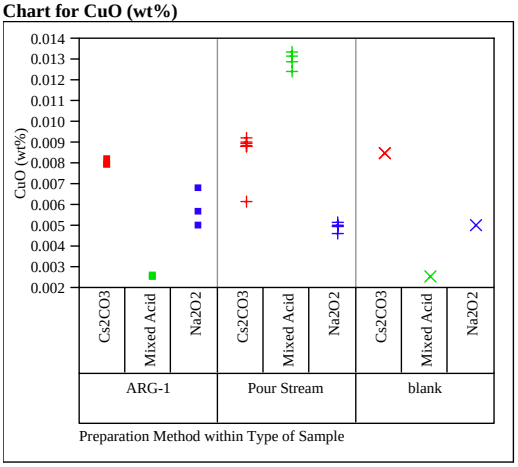


Chart for Ce2O3 (wt%)

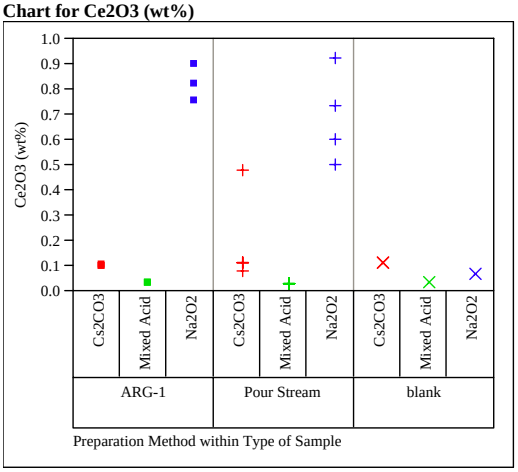


Chart for Fe2O3 (wt%)

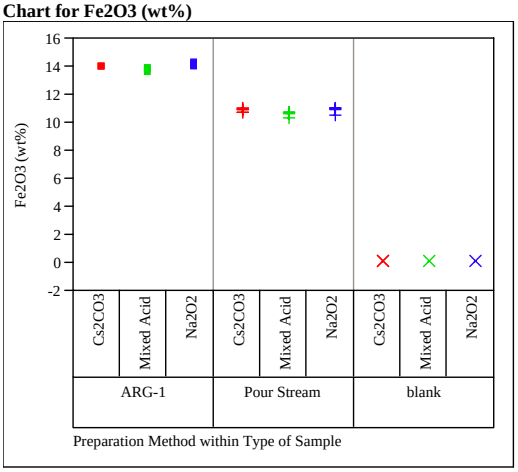


Chart for Cr2O3 (wt%)

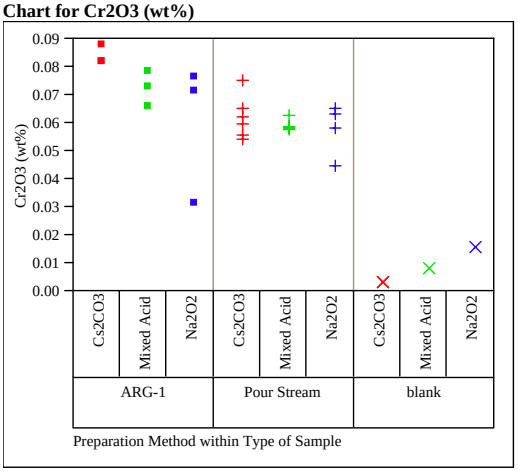


Chart for K2O (wt%)

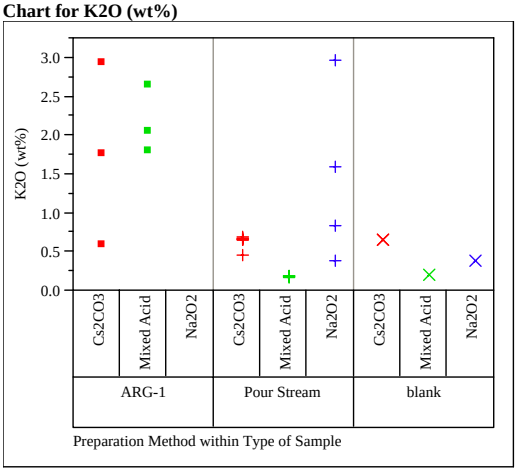


Exhibit B2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Chart for La2O3 (wt%)

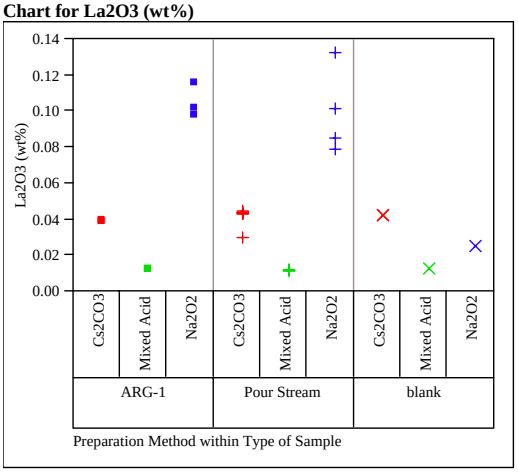


Chart for MnO (wt%)

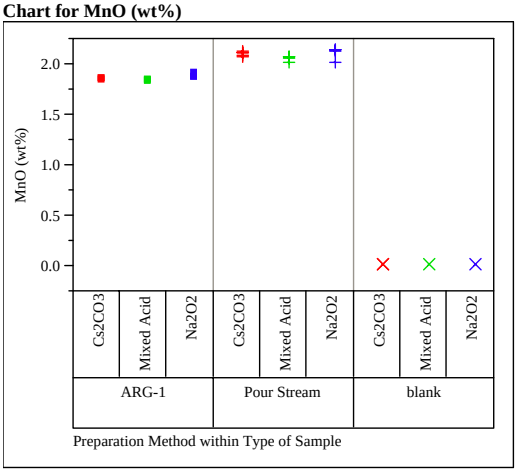


Chart for Li2O (wt%)

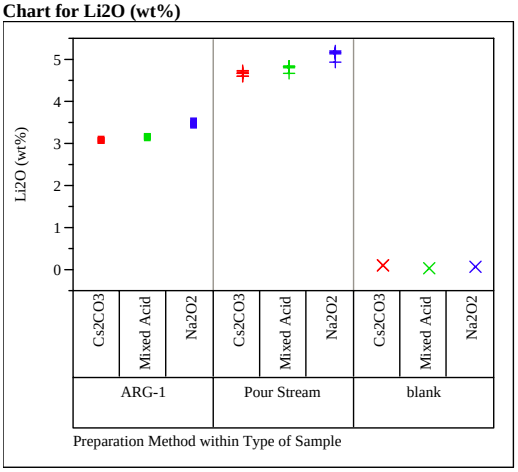


Chart for MoO3 (wt%)

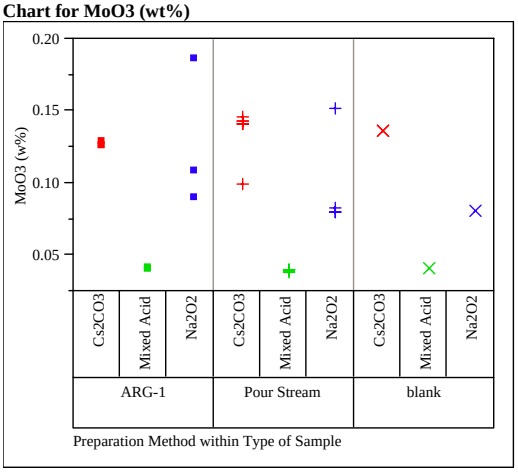


Chart for MgO (wt%)

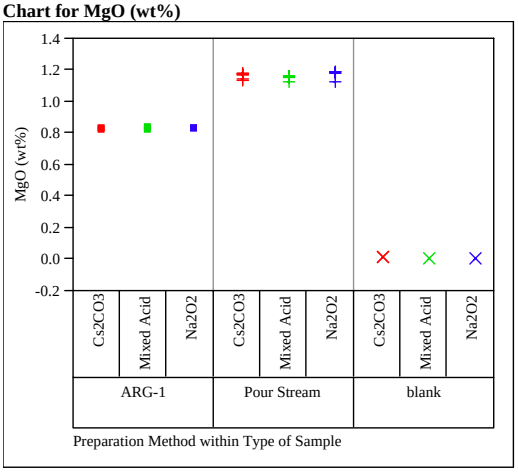


Chart for Na2O (wt%)

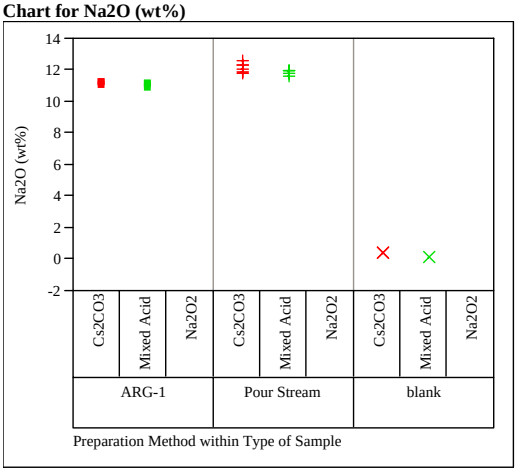


Exhibit B2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Chart for NiO (wt%)

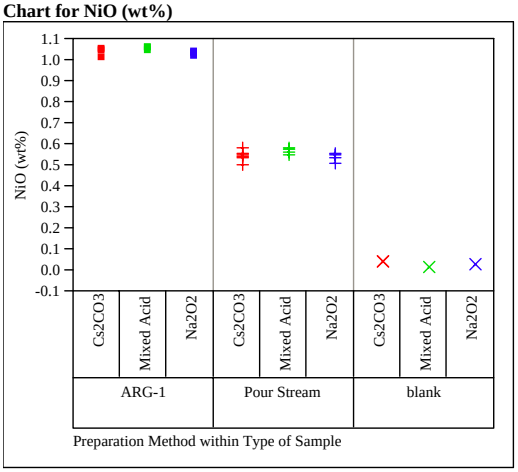


Chart for SO4 (wt%)

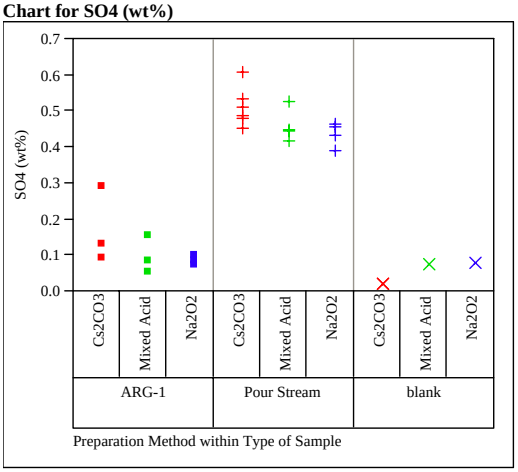


Chart for P2O5 (wt%)

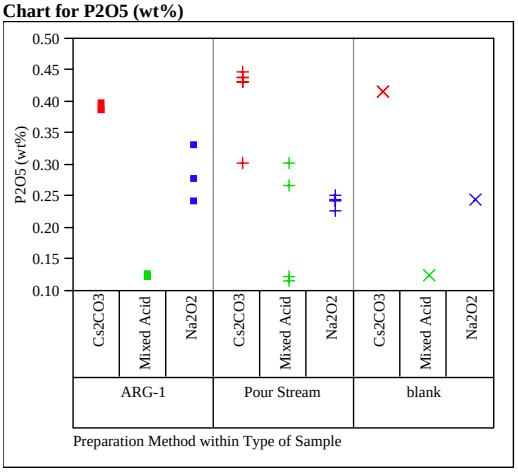


Chart for SiO2 (wt%)

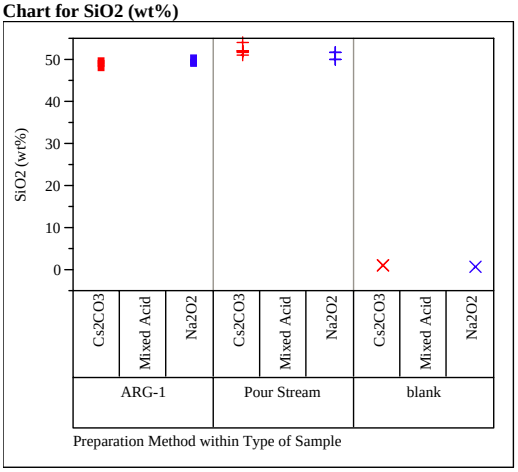


Chart for PbO (wt%)

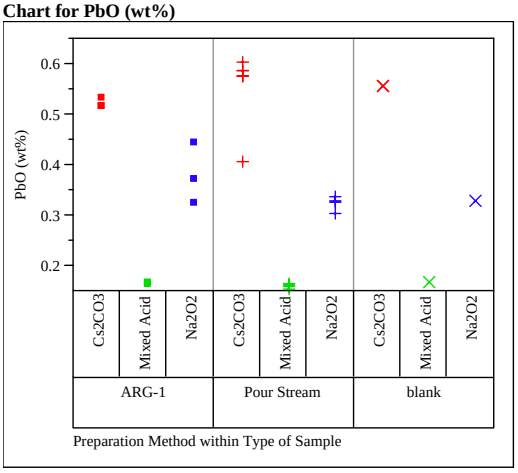


Chart for SnO2 (wt%)

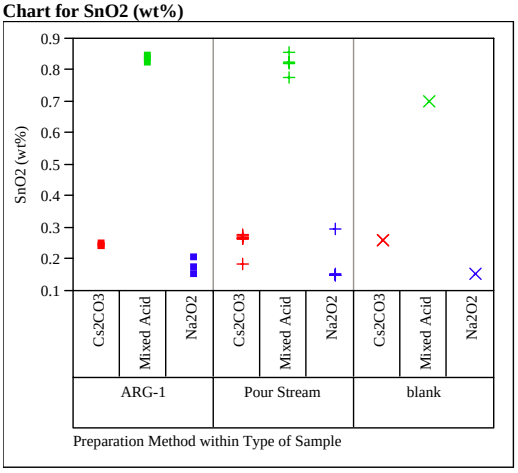


Exhibit B2. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Chart for SrO (wt%)

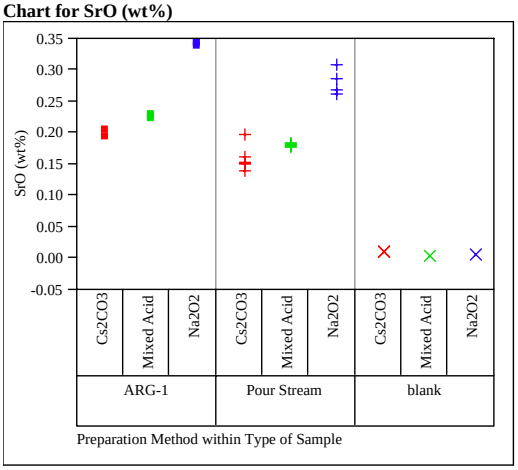


Chart for V2O5 (wt%)

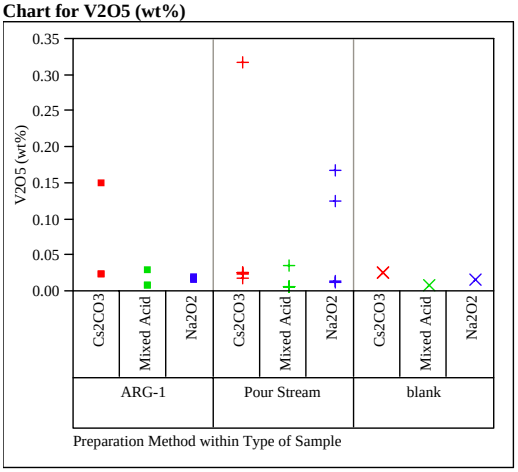


Chart for TiO2 (wt%)

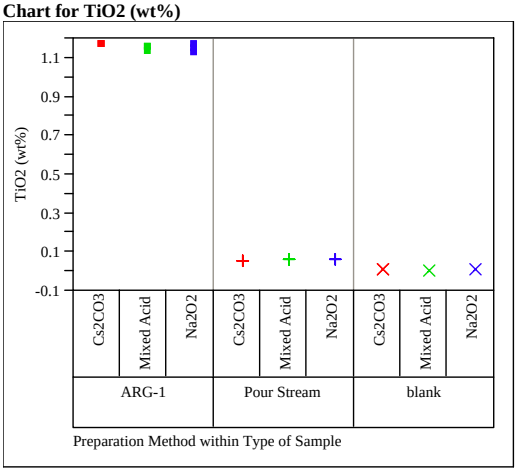


Chart for ZnO (wt%)

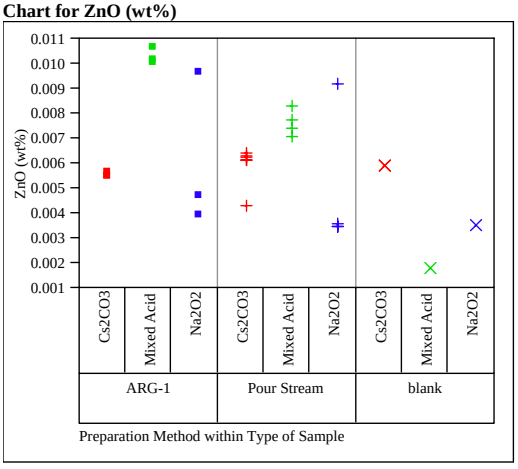


Chart for U3O8 (wt%)

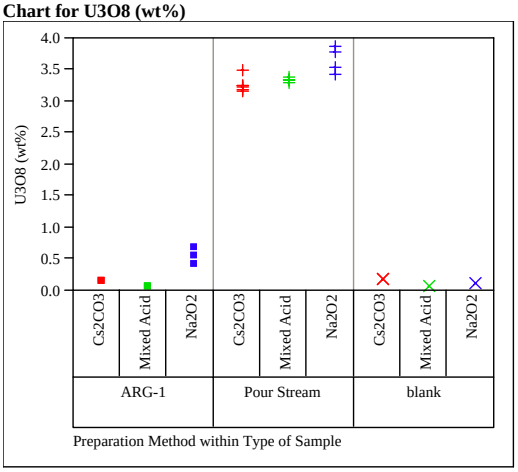


Chart for ZrO2 (wt%)

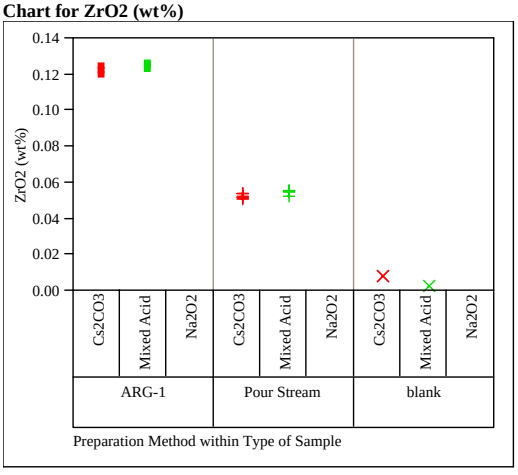
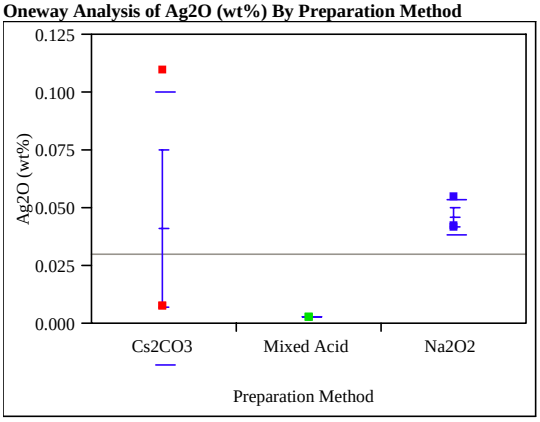


Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ag2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

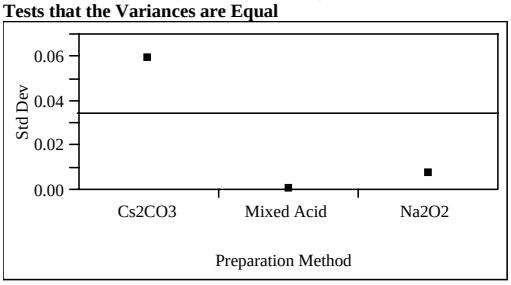
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.08595	-0.08144	-0.04232
Cs2CO3	-0.08144	-0.08595	-0.04683
Mixed Acid	-0.04232	-0.04683	-0.08595

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.04601157
Cs2CO3	A	0.04149993
Mixed Acid	A	0.00237935

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



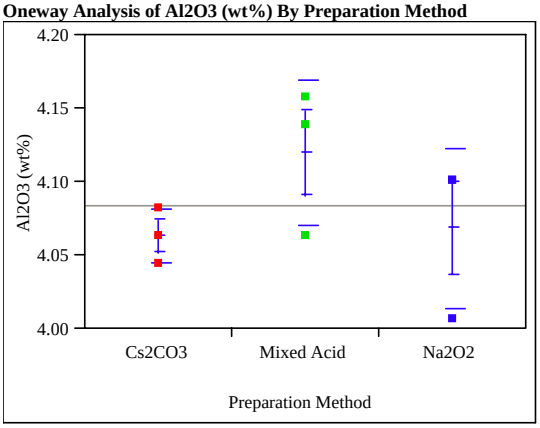
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0589490	0.0453790	0.0340342
Mixed Acid	3	0.0000246	0.0000179	0.0000215
Na2O2	3	0.0075112	0.0057768	0.0046549

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7489	2	6	0.2521
Brown-Forsythe	0.8692	2	6	0.4661
Levene	13.9850	2	6	0.0055
Bartlett	13.4471	2	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
41.0207	2	2.6667	0.0099

Oneway Analysis of Al2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

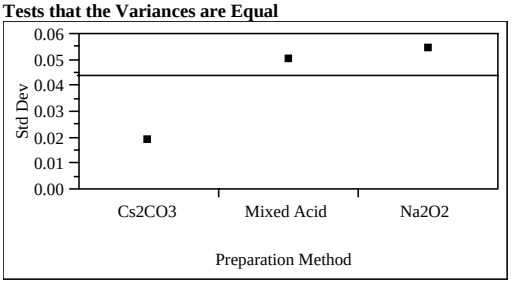
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.11045	-0.06006	-0.05376
Na2O2	-0.06006	-0.11045	-0.10415
Cs2CO3	-0.05376	-0.10415	-0.11045

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	4.1191100
Na2O2	A	4.0687233
Cs2CO3	A	4.0624250

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0188950	0.0125967	0.0188950
Mixed Acid	3	0.0499915	0.0377900	0.0377900
Na2O2	3	0.0545452	0.0419889	0.0314917

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6813	2	6	0.5412
Brown-Forsythe	0.2059	2	6	0.8194
Levene	2.8197	2	6	0.1370
Bartlett	0.8326	2	.	0.4349

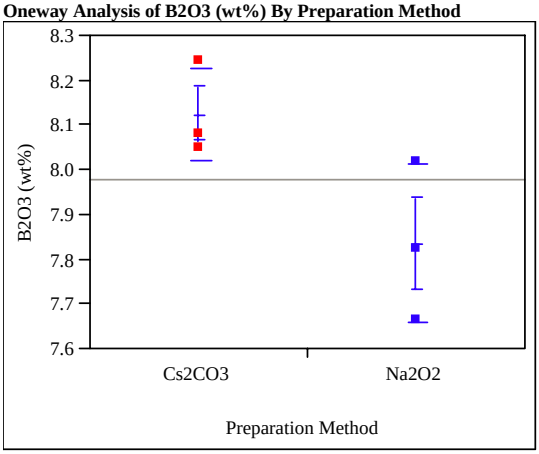
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.3994	2	3.2346	0.3649

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of B2O3 (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

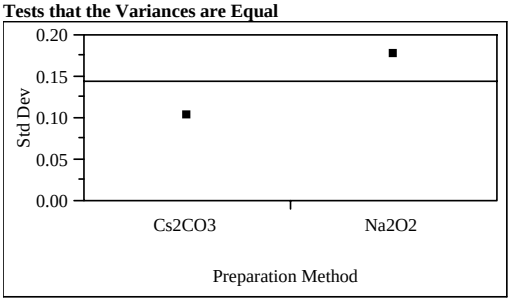
q*	Alpha
2.77646	0.05

Abs(Dif)-LSD	Cs2CO3	Na2O2
Cs2CO3	-0.32915	-0.03936
Na2O2	-0.03936	-0.32915

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Cs2CO3	Na2O2	0.2897910	-0.039358	0.6189396

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.1035053	0.0787087	0.0751310
Na2O2	3	0.1773383	0.1216407	0.1717280

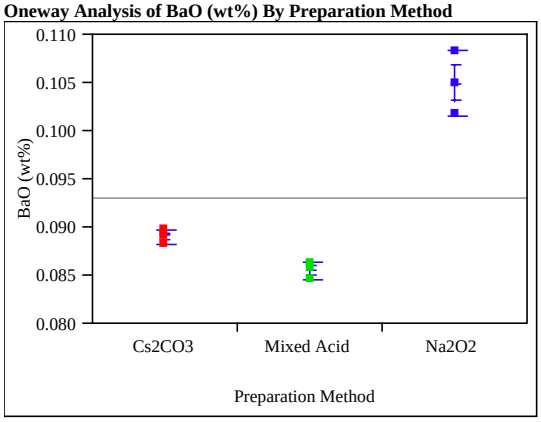
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6925	1	4	0.4521
Brown-Forsythe	4.7647	1	4	0.0944
Levene	0.5180	1	4	0.5115
Bartlett	0.4430	1	.	0.5057
F Test 2-sided	2.9355	2	2	0.5082

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.9754	1	3.2209	0.0863

t Test
2.4445

Oneway Analysis of BaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

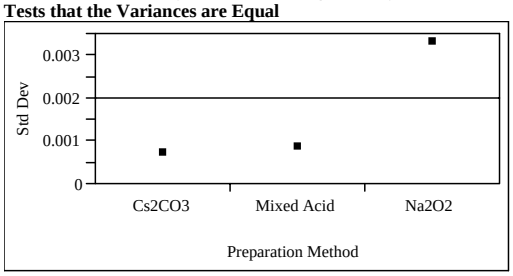
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.00504	0.01085	0.01443
Cs2CO3	0.01085	-0.00504	-0.00147
Mixed Acid	0.01443	-0.00147	-0.00504

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.10495100
Cs2CO3	B	0.08905948
Mixed Acid	B	0.08548668

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0007264	0.0004962	0.0007071
Mixed Acid	3	0.0008672	0.0006451	0.0007071
Na2O2	3	0.0032951	0.0022330	0.0032379

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5638	2	6	0.2840
Brown-Forsythe	78.3729	2	6	<.0001
Levene	2.2759	2	6	0.1839
Bartlett	2.2355	2	.	0.1069

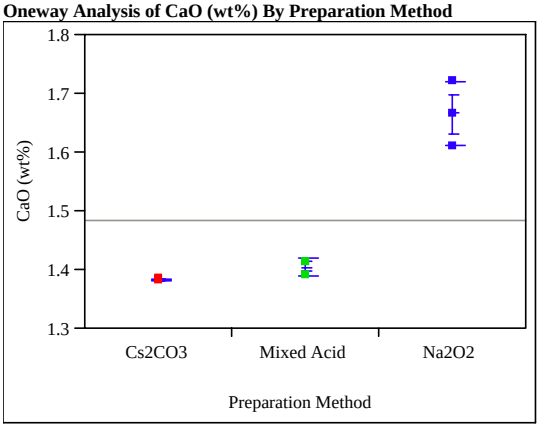
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
46.7639	2	3.5844	0.0027

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of CaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

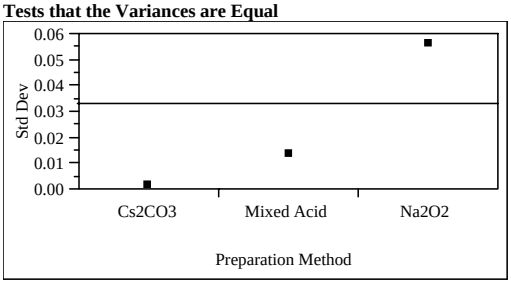
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.08338	0.17640	0.19832
Mixed Acid	0.17640	-0.08338	-0.06146
Cs2CO3	0.19832	-0.06146	-0.08338

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.6650480
Mixed Acid	B	1.4052632
Cs2CO3	B	1.3833424

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



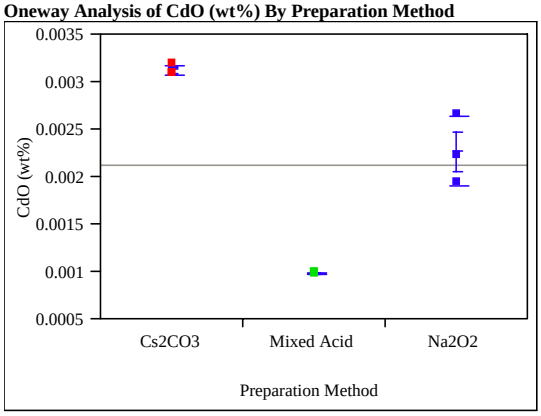
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0016157	0.0012437	0.0009328
Mixed Acid	3	0.0137331	0.0105717	0.0079288
Na2O2	3	0.0559680	0.0373120	0.0559680

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6696	2	6	0.2652
Brown-Forsythe	42.2491	2	6	0.0003
Levene	2.9609	2	6	0.1275
Bartlett	5.5489	2	.	0.0039

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
33.4229	2	2.7053	0.0124

Oneway Analysis of CdO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

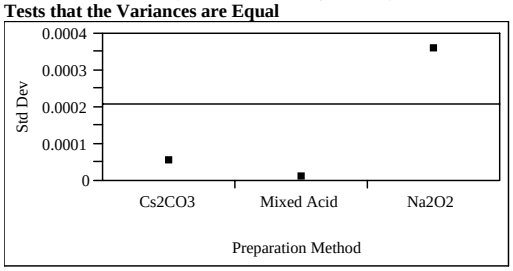
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.00053	0.00033	0.00161
Na2O2	0.00033	-0.00053	0.00076
Mixed Acid	0.00161	0.00076	-0.00053

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.00312609
Na2O2	B	0.00227318
Mixed Acid	C	0.00098809

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0000528	0.0000406	0.0000305
Mixed Acid	3	0.0000114	0.0000076	0.0000114
Na2O2	3	0.0003597	0.0002551	0.0003313

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7377	2	6	0.2539
Brown-Forsythe	27.0497	2	6	0.0010
Levene	5.0575	2	6	0.0516
Bartlett	6.1443	2	.	0.0021

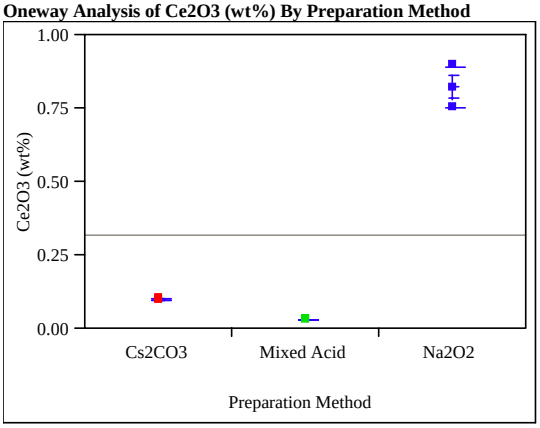
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1912.0793	2	2.7884	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Ce2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

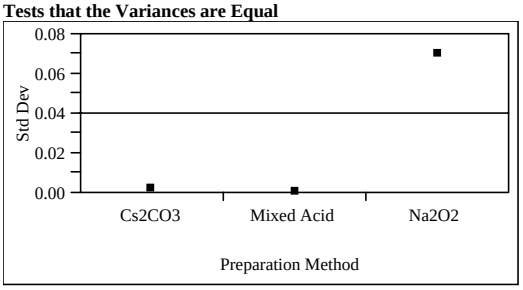
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.10179	0.62031	0.68901
Cs2CO3	0.62031	-0.10179	-0.03310
Mixed Acid	0.68901	-0.03310	-0.10179

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.82264303
Cs2CO3	B	0.10053658
Mixed Acid	B	0.03183984

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



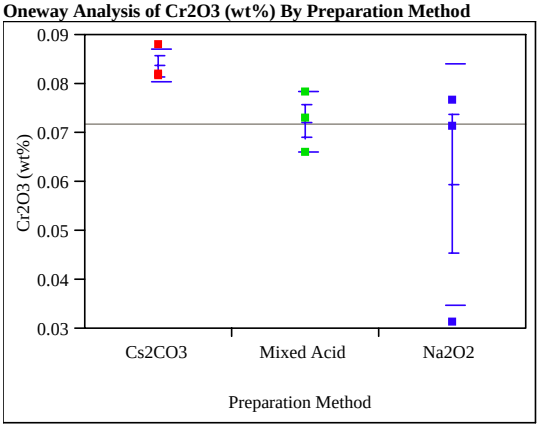
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0016906	0.0013014	0.0009761
Mixed Acid	3	0.0003226	0.0002212	0.0003123
Na2O2	3	0.0703593	0.0481534	0.0683258

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7767	2	6	0.2477
Brown-Forsythe	282.8394	2	6	<.0001
Levene	4.5772	2	6	0.0621
Bartlett	12.2181	2	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2076.4965	2	2.7603	<.0001

Oneway Analysis of Cr2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

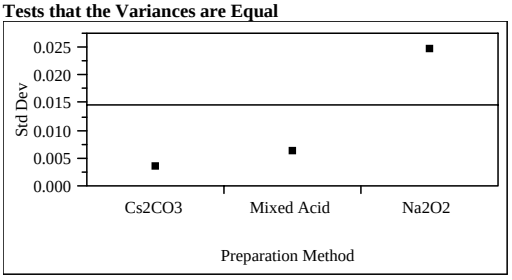
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.03716	-0.02576	-0.01314
Mixed Acid	-0.02576	-0.03716	-0.02455
Na2O2	-0.01314	-0.02455	-0.03716

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.08365224
Mixed Acid	A	0.07225176
Na2O2	A	0.05963328

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0035028	0.0026958	0.0020950
Mixed Acid	3	0.0061671	0.0043198	0.0057977
Na2O2	3	0.0246967	0.0189034	0.0168084

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6296	2	6	0.2721
Brown-Forsythe	1.2771	2	6	0.3451
Levene	8.4025	2	6	0.0182
Bartlett	2.9643	2	.	0.0516

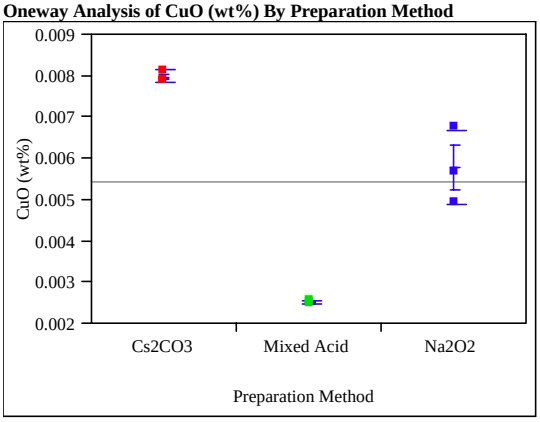
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.1349	2	3.3073	0.1260

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of CuO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

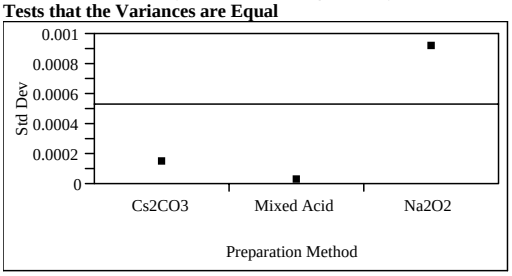
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.00133	0.00084	0.00411
Na2O2	0.00084	-0.00133	0.00194
Mixed Acid	0.00411	0.00194	-0.00133

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.00796979
Na2O2	B	0.00579166
Mixed Acid	C	0.00252029

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



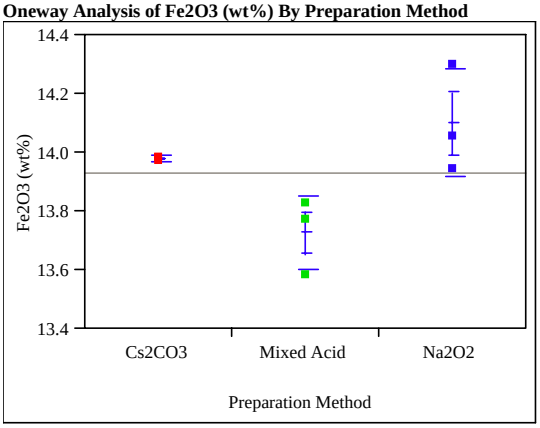
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0001445	0.0001113	0.0000835
Mixed Acid	3	0.0000282	0.0000195	0.0000271
Na2O2	3	0.0009111	0.0006454	0.0008408

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7313	2	6	0.2549
Brown-Forsythe	26.7379	2	6	0.0010
Levene	4.9449	2	6	0.0538
Bartlett	6.0650	2	.	0.0023

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1668.7120	2	2.7669	<.0001

Oneway Analysis of Fe2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

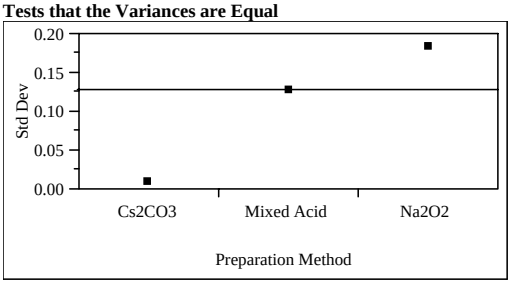
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.32190	-0.20276	0.04982
Cs2CO3	-0.20276	-0.32190	-0.06932
Mixed Acid	0.04982	-0.06932	-0.32190

Positive values show pairs of means that are significantly different.

Level			Mean
Na2O2	A		14.096842
Cs2CO3	A	B	13.977700
Mixed Acid		B	13.725120

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0082544	0.0063542	0.0047657
Mixed Acid	3	0.1270745	0.0953133	0.1000790
Na2O2	3	0.1825319	0.1334387	0.1572670

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0757	2	6	0.3988
Brown-Forsythe	4.8098	2	6	0.0567
Levene	4.1889	2	6	0.0727
Bartlett	3.9359	2	.	0.0195

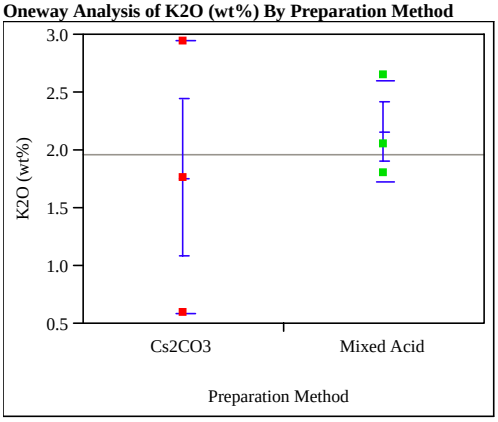
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.2468	2	2.6833	0.1182

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of K2O (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

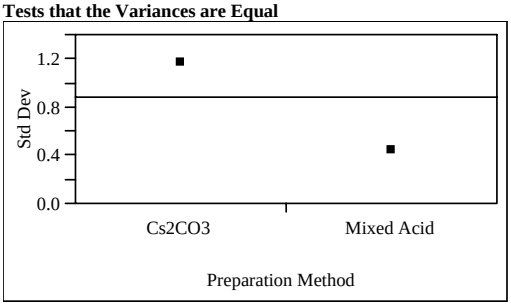
q*	Alpha
2.77646	0.05

Abs(Dif)-LSD	Mixed Acid	Cs2CO3
Mixed Acid	-2.0092	-1.6081
Cs2CO3	-1.6081	-2.0092

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Mixed Acid	Cs2CO3	0.4011318	-1.60808	2.410345

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	1.173889	0.7840608	1.171674
Mixed Acid	3	0.439363	0.3239036	0.369411

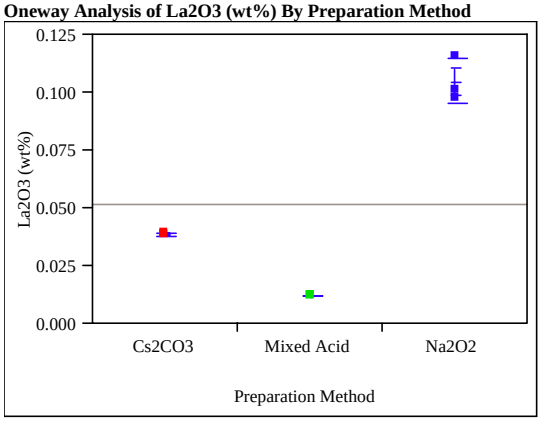
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2893	1	4	0.3196
Brown-Forsythe	47.3992	1	4	0.0023
Levene	1.2923	1	4	0.3191
Bartlett	1.3463	1	.	0.2459
F Test 2-sided	7.1385	2	2	0.2457

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.3073	1	2.5496	0.6242

t Test
0.5543

Oneway Analysis of La2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

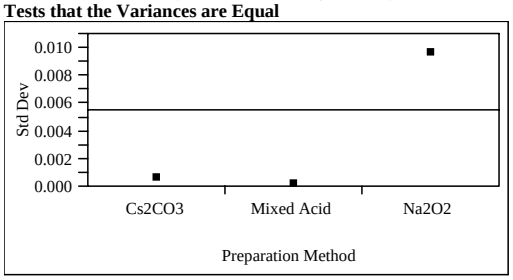
q*	Alpha
3.06815	0.05

Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.01388	0.05215	0.07865
Cs2CO3	0.05215	-0.01388	0.01262
Mixed Acid	0.07865	0.01262	-0.01388

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.10480923
Cs2CO3	B	0.03878059
Mixed Acid	C	0.01227531

Levels not connected by same letter are significantly different
Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0006433	0.0004952	0.0003714
Mixed Acid	3	0.0001221	0.0000912	0.0000977
Na2O2	3	0.0095756	0.0072192	0.0073495

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7695	2	6	0.2489
Brown-Forsythe	4.1388	2	6	0.0742
Levene	10.6359	2	6	0.0106
Bartlett	8.8722	2	.	0.0001

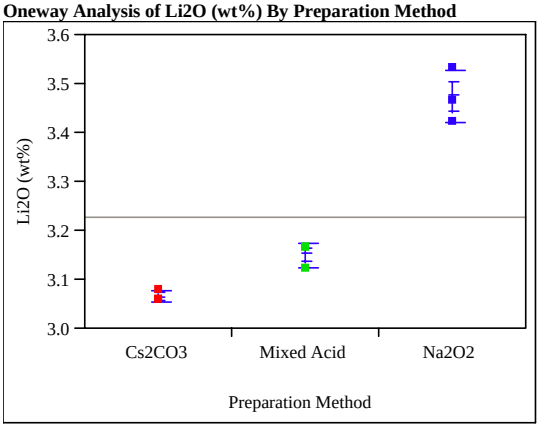
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2090.4731	2	2.7597	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Li2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

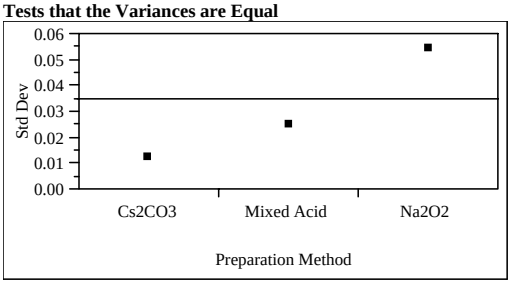
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.08807	0.23486	0.32098
Mixed Acid	0.23486	-0.08807	-0.00196
Cs2CO3	0.32098	-0.00196	-0.08807

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	3.4733453
Mixed Acid	B	3.1504103
Cs2CO3	B	3.0642943

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



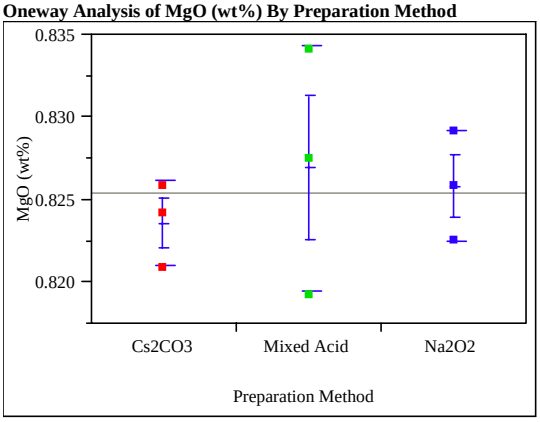
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0124298	0.0095684	0.0071763
Mixed Acid	3	0.0248595	0.0191369	0.0143527
Na2O2	3	0.0541801	0.0382738	0.0502343

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3122	2	6	0.3367
Brown-Forsythe	5.1667	2	6	0.0496
Levene	2.3333	2	6	0.1780
Bartlett	1.5608	2	.	0.2100

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
74.5191	2	3.2764	0.0019

Oneway Analysis of MgO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

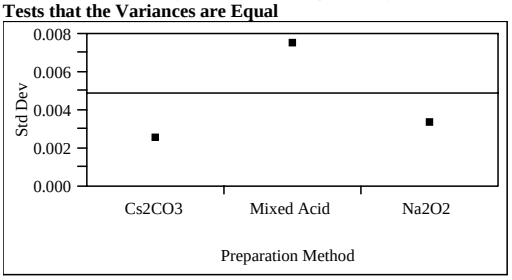
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.01239	-0.01128	-0.00907
Na2O2	-0.01128	-0.01239	-0.01017
Cs2CO3	-0.00907	-0.01017	-0.01239

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.82693893
Na2O2	A	0.82583340
Cs2CO3	A	0.82362233

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0025331	0.0018426	0.0022111
Mixed Acid	3	0.0074777	0.0051592	0.0071860
Na2O2	3	0.0033166	0.0022111	0.0033166

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2132	2	6	0.3610
Brown-Forsythe	33.5000	2	6	0.0006
Levene	1.4175	2	6	0.3132
Bartlett	1.0706	2	.	0.3428

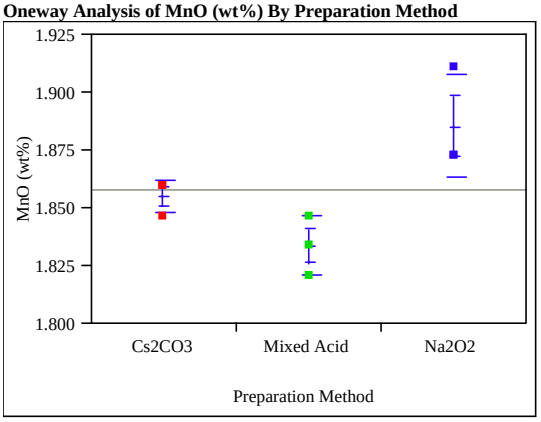
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.4880	2	3.6297	0.6491

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of MnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

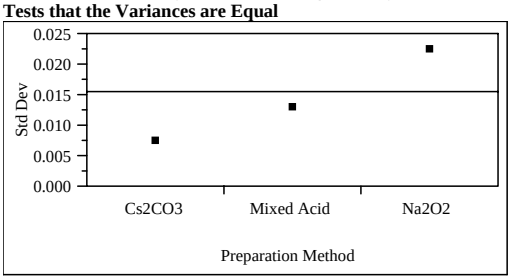
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.03888	-0.00875	0.01277
Cs2CO3	-0.00875	-0.03888	-0.01736
Mixed Acid	0.01277	-0.01736	-0.03888

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.8851520
Cs2CO3	A B	1.8550240
Mixed Acid	B	1.8335040

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



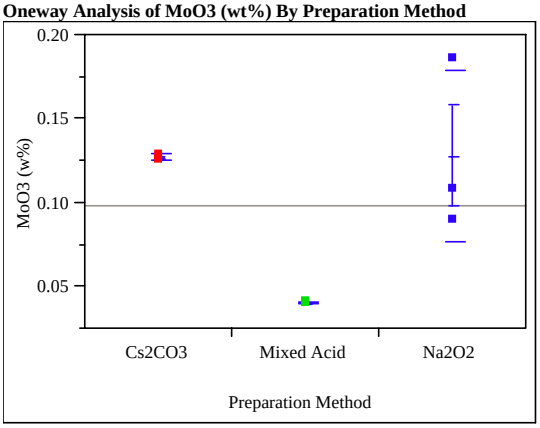
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0074547	0.0057387	0.0043040
Mixed Acid	3	0.0129120	0.0086080	0.0129120
Na2O2	3	0.0223642	0.0172160	0.0129120

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0159	2	6	0.4169
Brown-Forsythe	0.4000	2	6	0.6870
Levene	2.7368	2	6	0.1430
Bartlett	0.9026	2	.	0.4055

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.5484	2	3.4667	0.0831

Oneway Analysis of MoO3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

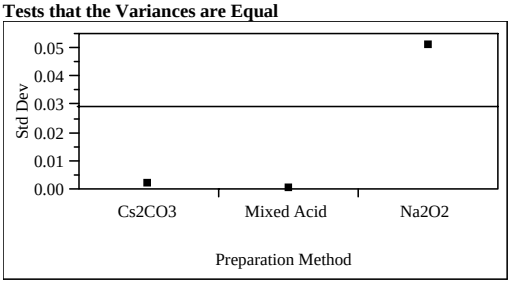
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.07387	-0.07287	0.01398
Cs2CO3	-0.07287	-0.07387	0.01298
Mixed Acid	0.01398	0.01298	-0.07387

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.12802560
Cs2CO3	A	0.12702540
Mixed Acid	B	0.04018303

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0017324	0.0013336	0.0010002
Mixed Acid	3	0.0004132	0.0002834	0.0004001
Na2O2	3	0.0510396	0.0386744	0.0380076

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7756	2	6	0.2479
Brown-Forsythe	3.4702	2	6	0.0997
Levene	11.8939	2	6	0.0082
Bartlett	10.7240	2	.	<.0001

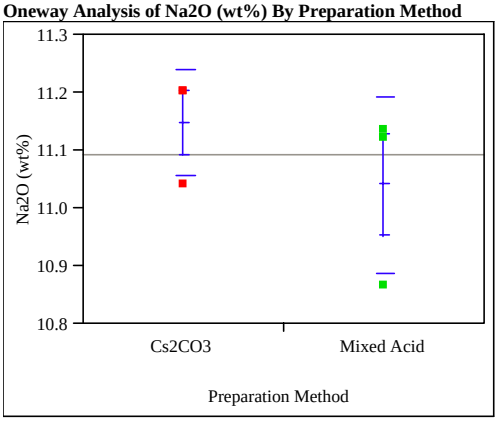
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2885.7648	2	2.8099	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of Na2O (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

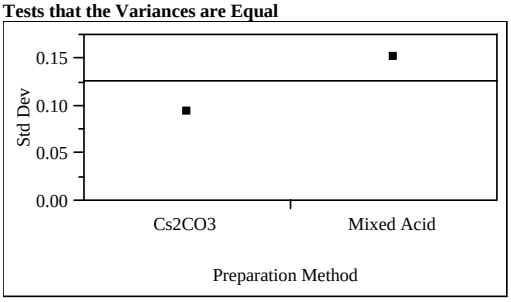
q*	Alpha
2.77646	0.05

Abs(Dif)-LSD	Cs2CO3	Mixed Acid
Cs2CO3	-0.28585	-0.17801
Mixed Acid	-0.17801	-0.28585

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Cs2CO3	Mixed Acid	0.1078400	-0.178011	0.3936907

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0933922	0.0718933	0.0539200
Mixed Acid	3	0.1519119	0.1168267	0.0943600

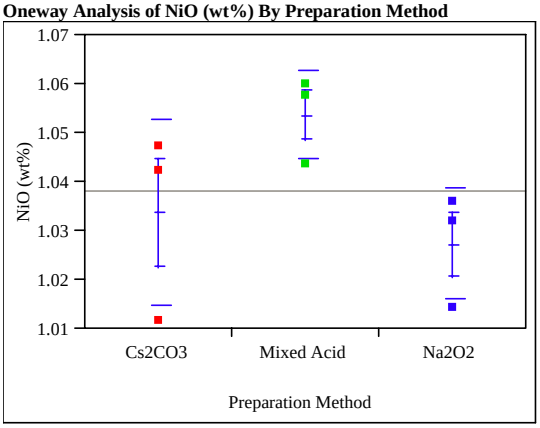
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6019	1	4	0.4812
Brown-Forsythe	0.1731	1	4	0.6987
Levene	1.6949	1	4	0.2629
Bartlett	0.3646	1	.	0.5459
F Test 2-sided	2.6458	2	2	0.5486

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.0971	1	3.3228	0.3650

t Test
1.0474

Oneway Analysis of NiO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

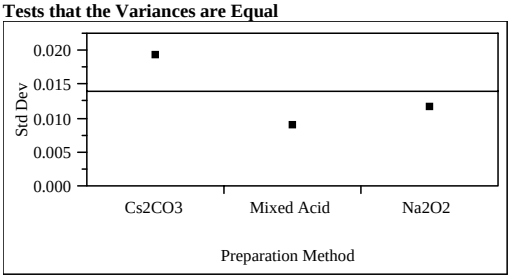
q*	Alpha
3.06815	0.05

Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.03495	-0.01502	-0.00865
Cs2CO3	-0.01502	-0.03495	-0.02859
Na2O2	-0.00865	-0.02859	-0.03495

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	1.0536300
Cs2CO3	A	1.0336942
Na2O2	A	1.0273317

Levels not connected by same letter are significantly different
Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0192704	0.0147044	0.0135733
Mixed Acid	3	0.0089075	0.0067867	0.0063625
Na2O2	3	0.0115464	0.0087661	0.0084833

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7949	2	6	0.4940
Brown-Forsythe	0.3804	2	6	0.6990
Levene	2.0287	2	6	0.2123
Bartlett	0.5157	2	.	0.5971

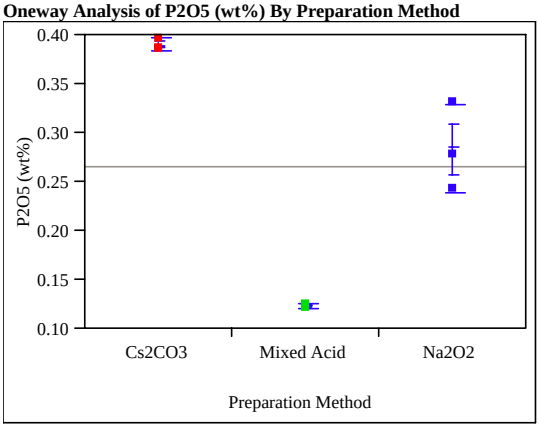
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.4492	2	3.7352	0.1027

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of P2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

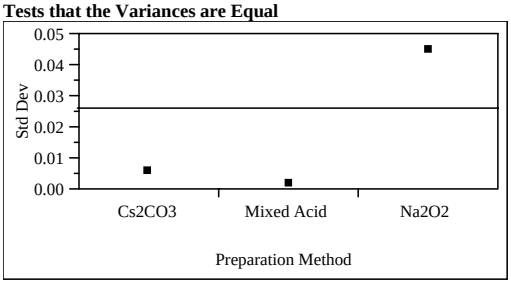
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.06569	0.04047	0.20049
Na2O2	0.04047	-0.06569	0.09432
Mixed Acid	0.20049	0.09432	-0.06569

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.38953800
Na2O2	B	0.28336980
Mixed Acid	C	0.12335370

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



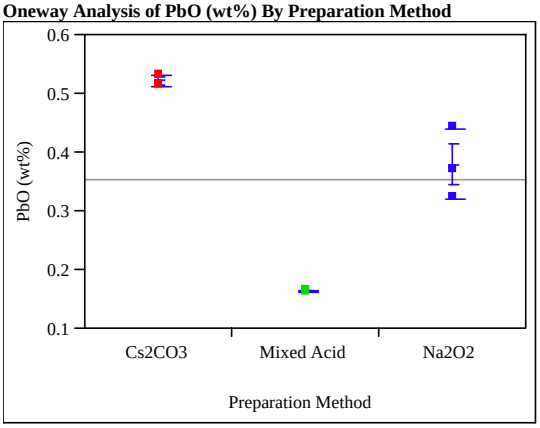
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0059532	0.0045828	0.0034371
Mixed Acid	3	0.0017501	0.0012730	0.0015276
Na2O2	3	0.0449946	0.0318250	0.0416271

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7439	2	6	0.2529
Brown-Forsythe	31.1391	2	6	0.0007
Levene	4.9620	2	6	0.0535
Bartlett	5.9724	2	.	0.0025

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2253.1616	2	2.881	<.0001

Oneway Analysis of PbO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

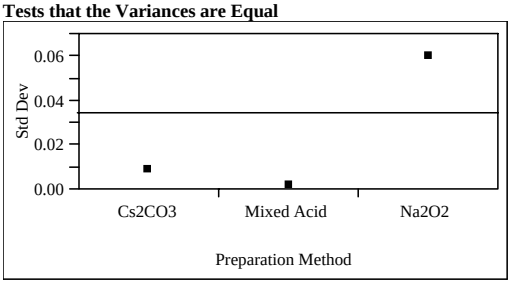
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.08767	0.05434	0.26889
Na2O2	0.05434	-0.08767	0.12687
Mixed Acid	0.26889	0.12687	-0.08767

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.52154433
Na2O2	B	0.37953347
Mixed Acid	C	0.16499113

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0087069	0.0067026	0.0050269
Mixed Acid	3	0.0016455	0.0011969	0.0014363
Na2O2	3	0.0599623	0.0424896	0.0552963

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7389	2	6	0.2537
Brown-Forsythe	28.1615	2	6	0.0009
Levene	5.0470	2	6	0.0518
Bartlett	6.3978	2	.	0.0017

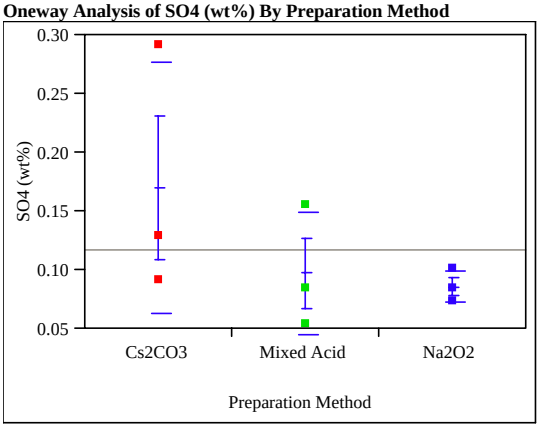
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1969.9802	2	2.7604	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SO4 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

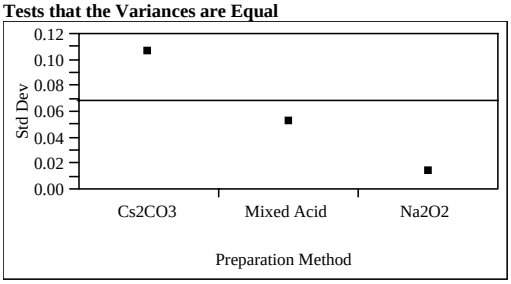
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.17173	-0.09913	-0.08780
Mixed Acid	-0.09913	-0.17173	-0.16040
Na2O2	-0.08780	-0.16040	-0.17173

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.16986753
Mixed Acid	A	0.09726689
Na2O2	A	0.08593240

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



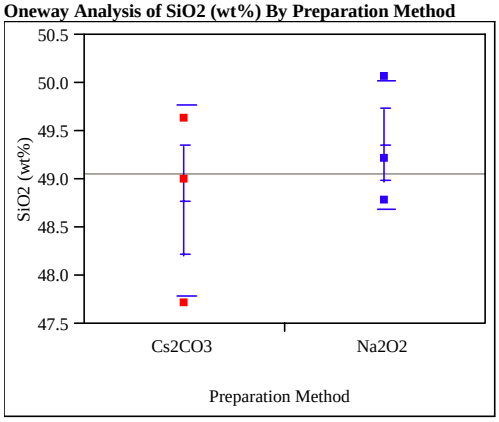
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.1060477	0.0802901	0.0793913
Mixed Acid	3	0.0516481	0.0380146	0.0436403
Na2O2	3	0.0135813	0.0096202	0.0125328

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3445	2	6	0.3293
Brown-Forsythe	1.7983	2	6	0.2444
Levene	5.3640	2	6	0.0461
Bartlett	2.3985	2	.	0.0909

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.7932	2	2.8784	0.5316

Oneway Analysis of SiO2 (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

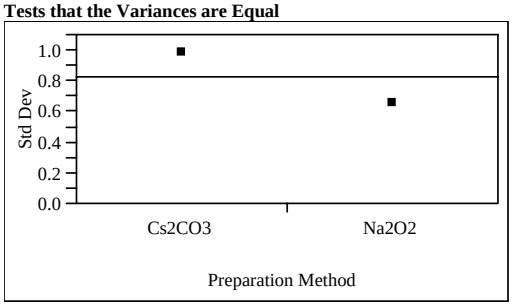
q*	Alpha
2.77646	0.05

Abs(Dif)-LSD	Na2O2	Cs2CO3
Na2O2	-1.8887	-1.3182
Cs2CO3	-1.3182	-1.8887

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Na2O2	Cs2CO3	0.5704800	-1.31822	2.459176

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.9803504	0.7131000	0.8557200
Na2O2	3	0.6535669	0.4754000	0.5704800

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4582	1	4	0.5356
Brown-Forsythe	1.2308	1	4	0.3295
Levene	0.5917	1	4	0.4847
Bartlett	0.2561	1	.	0.6128
F Test 2-sided	2.2500	2	2	0.6154

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

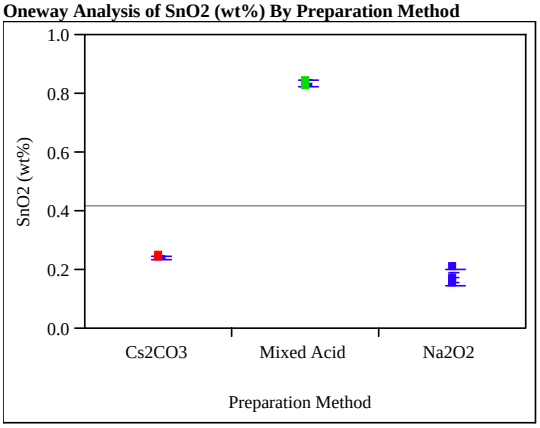
F Ratio	DFNum	DFDen	Prob > F
0.7033	1	3.4845	0.4553

t Test
0.8386

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of SnO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

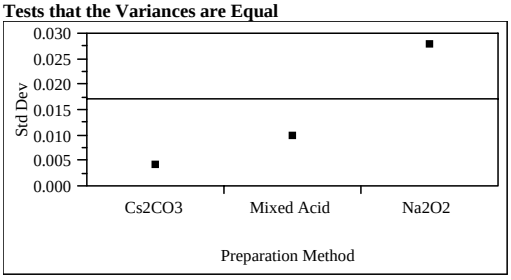
q*	Alpha		
3.06815	0.05		
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.04303	0.54924	0.61547
Cs2CO3	0.54924	-0.04303	0.02321
Na2O2	0.61547	0.02321	-0.04303

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.83455040
Cs2CO3	B	0.24228200
Na2O2	C	0.17605120

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



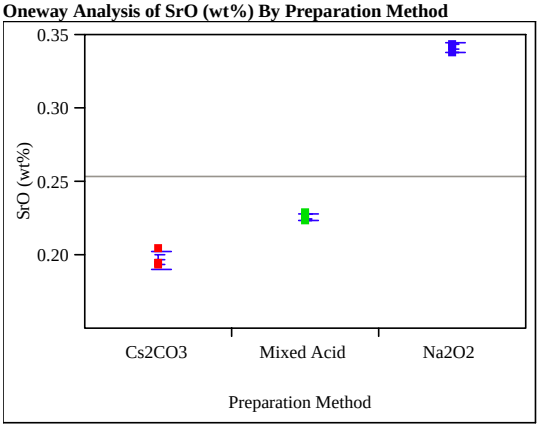
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0040315	0.0031035	0.0023276
Mixed Acid	3	0.0096967	0.0070533	0.0084640
Na2O2	3	0.0278324	0.0197493	0.0256036

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5240	2	6	0.2916
Brown-Forsythe	16.7543	2	6	0.0035
Levene	3.2297	2	6	0.1117
Bartlett	2.5171	2	.	0.0807

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3962.6763	2	3.0955	<.0001

Oneway Analysis of SrO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

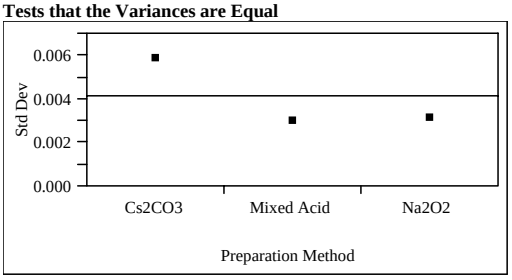
q*	Alpha		
3.06815	0.05		
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.01050	0.10461	0.13339
Mixed Acid	0.10461	-0.01050	0.01828
Cs2CO3	0.13339	0.01828	-0.01050

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.34058880
Mixed Acid	B	0.22548240
Cs2CO3	C	0.19670580

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0058336	0.0044676	0.0039420
Mixed Acid	3	0.0029761	0.0021024	0.0027594
Na2O2	3	0.0031289	0.0023652	0.0023652

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8154	2	6	0.4861
Brown-Forsythe	0.2203	2	6	0.8085
Levene	1.9597	2	6	0.2213
Bartlett	0.4966	2	.	0.6086

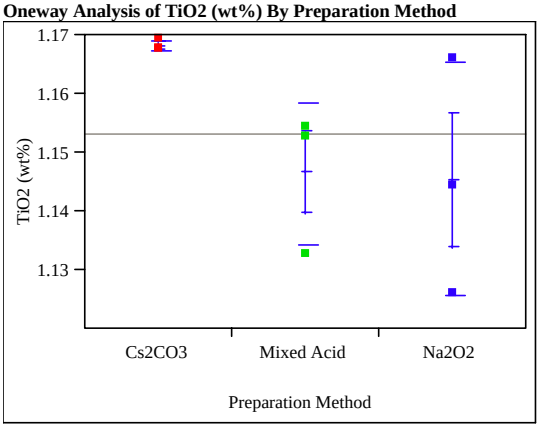
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1136.6107	2	3.8029	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of TiO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

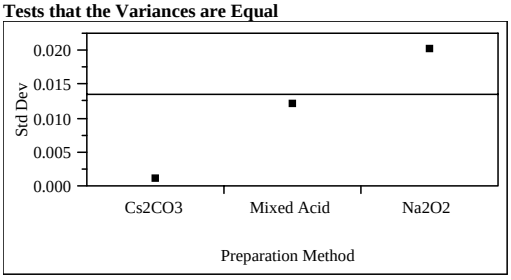
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.03386	-0.01218	-0.01107
Mixed Acid	-0.01218	-0.03386	-0.03275
Na2O2	-0.01107	-0.03275	-0.03386

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	1.1681560
Mixed Acid	A	1.1464720
Na2O2	A	1.1453600

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



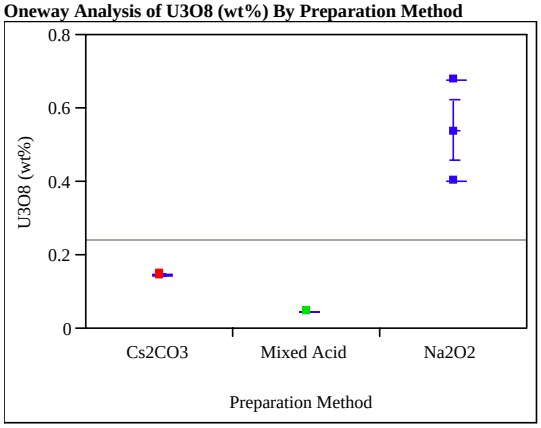
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0009630	0.0007413	0.0005560
Mixed Acid	3	0.0120666	0.0092667	0.0077840
Na2O2	3	0.0200392	0.0137147	0.0194600

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2031	2	6	0.3636
Brown-Forsythe	7.0079	2	6	0.0269
Levene	2.8692	2	6	0.1335
Bartlett	3.8640	2	.	0.0210

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.3906	2	2.6896	0.1146

Oneway Analysis of U3O8 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

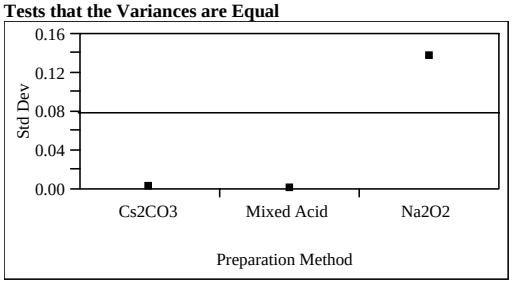
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.19874	0.19275	0.29322
Cs2CO3	0.19275	-0.19874	-0.09827
Mixed Acid	0.29322	-0.09827	-0.19874

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.53850133
Cs2CO3	B	0.14700693
Mixed Acid	B	0.04653909

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0023828	0.0018343	0.0013757
Mixed Acid	3	0.0004729	0.0003276	0.0004520
Na2O2	3	0.1373873	0.0922396	0.1363941

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7772	2	6	0.2476
Brown-Forsythe	3188.5399	2	6	<.0001
Levene	4.0785	2	6	0.0761
Bartlett	13.2197	2	.	<.0001

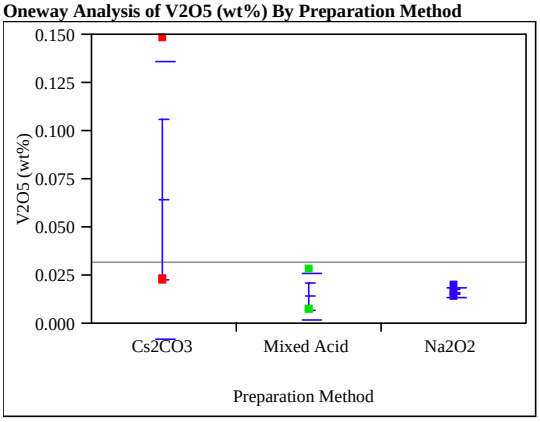
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2082.7694	2	2.7676	<.0001

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of V2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

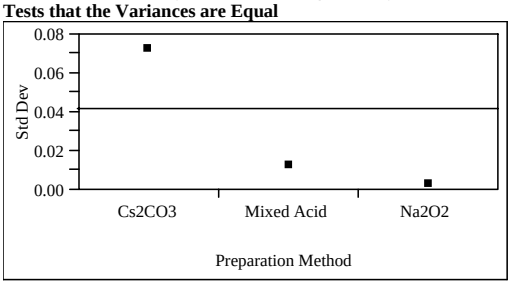
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.10592	-0.05795	-0.05566
Na2O2	-0.05795	-0.10592	-0.10362
Mixed Acid	-0.05566	-0.10362	-0.10592

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.06447547
Na2O2	A	0.01651310
Mixed Acid	A	0.01421912

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



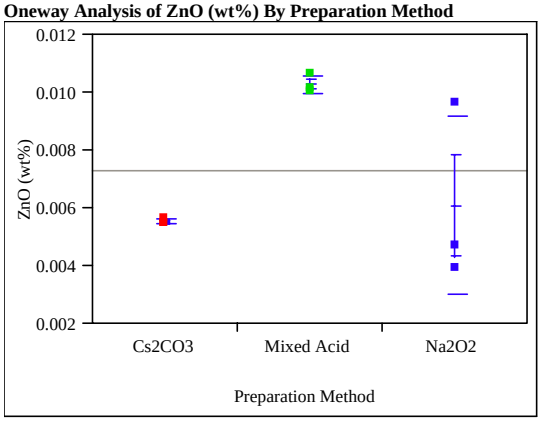
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0721744	0.0555594	0.0419820
Mixed Acid	3	0.0121132	0.0093247	0.0070248
Na2O2	3	0.0026069	0.0018447	0.0024100

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7254	2	6	0.2559
Brown-Forsythe	0.7985	2	6	0.4926
Levene	12.7636	2	6	0.0069
Bartlett	5.7295	2	.	0.0032

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.5777	2	2.7878	0.6167

Oneway Analysis of ZnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
3.06815	0.05

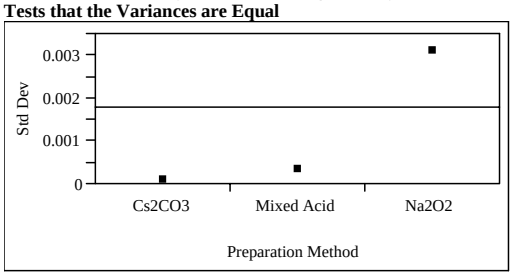
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.00449	-0.00031	0.00024
Na2O2	-0.00031	-0.00449	-0.00394
Cs2CO3	0.00024	-0.00394	-0.00449

Positive values show pairs of means that are significantly different.

Level			Mean
Mixed Acid	A		0.01028205
Na2O2	A	B	0.00609537
Cs2CO3		B	0.00554351

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0000934	0.0000719	0.0000539
Mixed Acid	3	0.0003176	0.0002407	0.0002365
Na2O2	3	0.0030894	0.0023596	0.0021556

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7573	2	6	0.2508
Brown-Forsythe	2.1034	2	6	0.2031
Levene	12.1108	2	6	0.0078
Bartlett	6.7789	2	.	0.0011

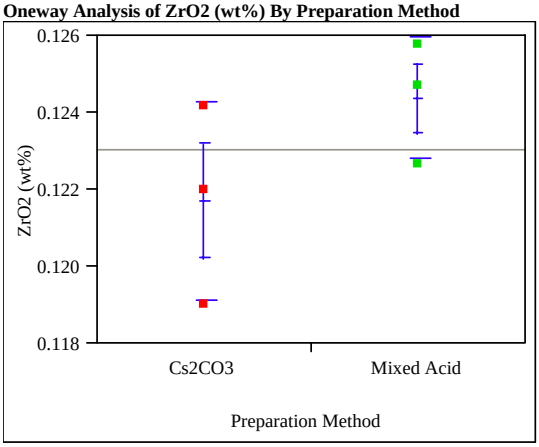
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
249.5345	2	2.8798	0.0006

Exhibit B3. Statistical Comparisons of Chemical Composition Measurements of ARG-1 Samples in Radioactive Set by Dissolution Method for Each Oxide

(Concentrations in Wt% Oxides)

Oneway Analysis of ZrO2 (wt%) By Preparation Method



Missing Rows
3**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

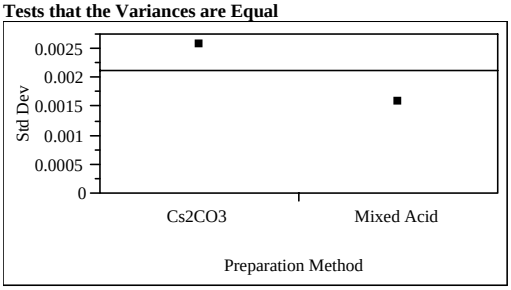
q*	Alpha
2.77646	0.05

Abs(Dif)-LSD	Mixed Acid	Cs2CO3
Mixed Acid	-0.00484	-0.00219
Cs2CO3	-0.00219	-0.00484

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Mixed Acid	Cs2CO3	0.0026566	-0.002187	0.0075000

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	3	0.0025772	0.0018011	0.0024314
Mixed Acid	3	0.0015772	0.0011407	0.0013958

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6099	1	4	0.4785
Brown-Forsythe	6.2235	1	4	0.0671
Levene	0.5659	1	4	0.4937
Bartlett	0.3712	1	.	0.5424
F Test 2-sided	2.6699	2	2	0.5450

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

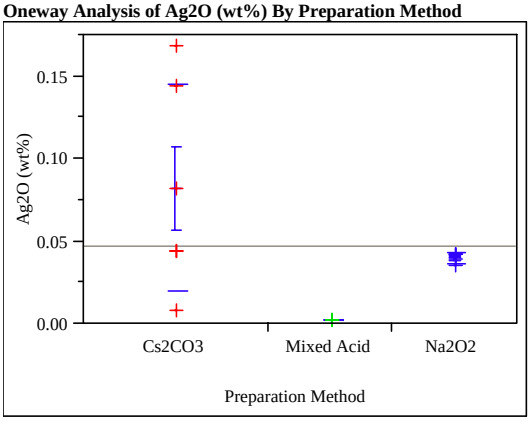
F Ratio	DFNum	DFDen	Prob > F
2.3191	1	3.3139	0.2167

t Test
1.5229

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of Ag2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

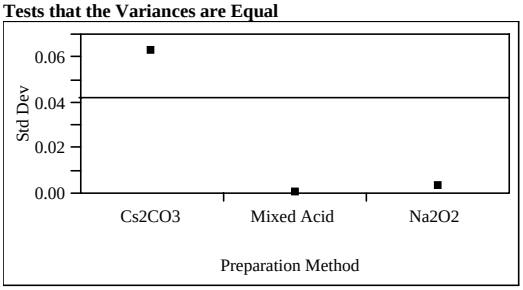
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.06578	-0.03138	0.00626
Na2O2	-0.03138	-0.08056	-0.04292
Mixed Acid	0.00626	-0.04292	-0.08056

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.08212259
Na2O2	A B	0.03996024
Mixed Acid	B	0.00232027

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



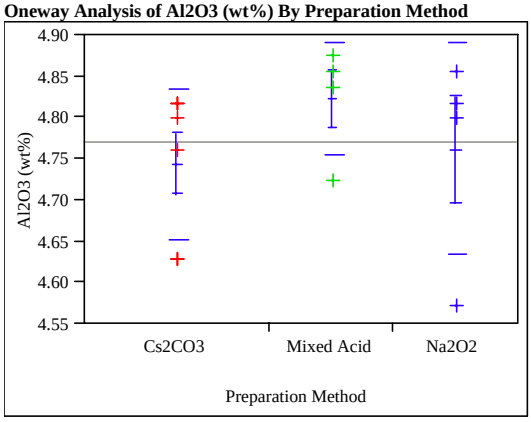
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0625171	0.0495385	0.0495385
Mixed Acid	4	0.0000661	0.0000483	0.0000483
Na2O2	4	0.0032309	0.0024169	0.0024169

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	3.9053	2	11	0.0523
Brown-Forsythe	6.3852	2	11	0.0144
Levene	9.1315	2	11	0.0046
Bartlett	22.2419	2	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
243.7299	2	5.0026	<.0001

Oneway Analysis of Al2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

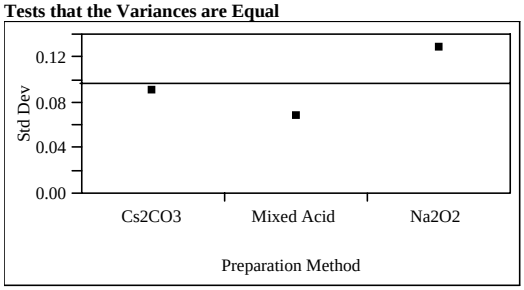
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.18552	-0.12411	-0.08905
Na2O2	-0.12411	-0.18552	-0.15046
Cs2CO3	-0.08905	-0.15046	-0.15148

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	4.8229487
Na2O2	A	4.7615400
Cs2CO3	A	4.7426450

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0902224	0.0755800	0.0692817
Mixed Acid	4	0.0679082	0.0495994	0.0425137
Na2O2	4	0.1281521	0.0944750	0.0755800

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6546	2	11	0.5388
Brown-Forsythe	0.2166	2	11	0.8086
Levene	0.9334	2	11	0.4223
Bartlett	0.5424	2	.	0.5814

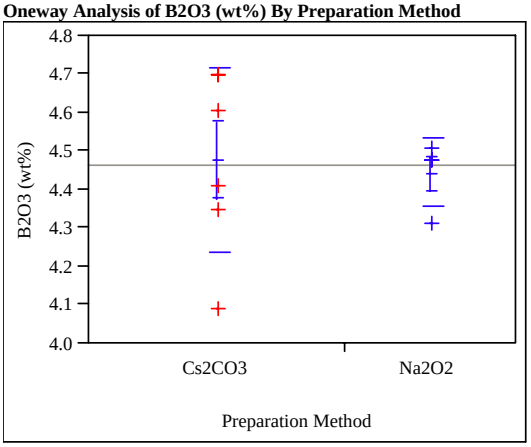
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.2210	2	6.3888	0.3556

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of B2O3 (wt%) By Preparation Method



Missing Rows
4**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

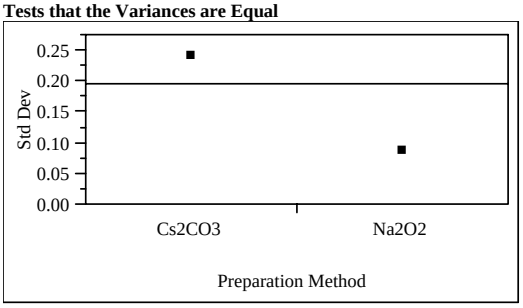
q*	Alpha
2.30593	0.05

Abs(Dif)-LSD	Cs2CO3	Na2O2
Cs2CO3	-0.26251	-0.26129
Na2O2	-0.26129	-0.32151

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Cs2CO3	Na2O2	0.0321990	-0.261294	0.3256924

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.2400932	0.1931940	0.1931940
Na2O2	4	0.0871953	0.0643980	0.0482985

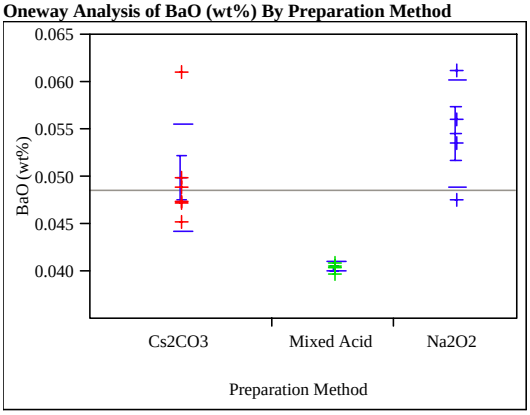
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.8290	1	8	0.2132
Brown-Forsythe	4.5741	1	8	0.0649
Levene	4.5176	1	8	0.0663
Bartlett	2.5759	1	.	0.1085
F Test 2-sided	7.5818	5	3	0.1261

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.0901	1	6.7348	0.7731

t Test
0.3002

Oneway Analysis of BaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

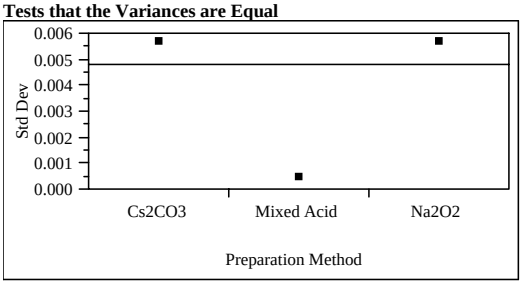
q*	Alpha
2.70081	0.05

Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.00924	-0.00377	0.00500
Cs2CO3	-0.00377	-0.00754	0.00114
Mixed Acid	0.00500	0.00114	-0.00924

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.05462476
Cs2CO3	A	0.04996338
Mixed Acid	B	0.04038939

Levels not connected by same letter are significantly different
Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0056635	0.0037031	0.0033309
Mixed Acid	4	0.0004682	0.0003210	0.0003070
Na2O2	4	0.0056663	0.0040473	0.0040473

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5999	2	11	0.5659
Brown-Forsythe	1.2299	2	11	0.3296
Levene	1.7980	2	11	0.2110
Bartlett	5.0846	2	.	0.0062

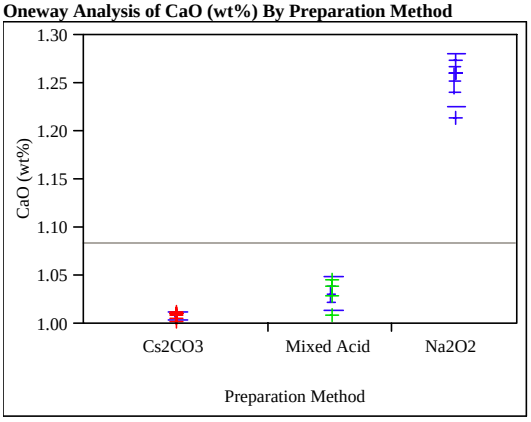
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
18.4347	2	5.0798	0.0047

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of CaO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

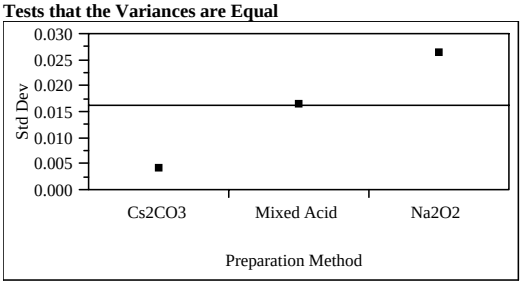
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.03134	0.19008	0.21543
Mixed Acid	0.19008	-0.03134	-0.00599
Cs2CO3	0.21543	-0.00599	-0.02559

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.2526338
Mixed Acid	B	1.0312104
Cs2CO3	B	1.0085900

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



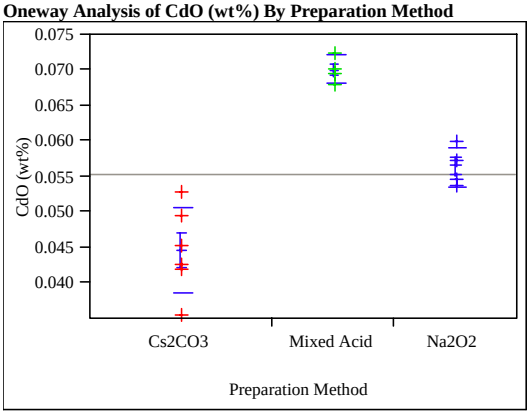
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0040953	0.0031093	0.0030316
Mixed Acid	4	0.0164369	0.0118932	0.0118932
Na2O2	4	0.0262606	0.0190641	0.0150414

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4985	2	11	0.2657
Brown-Forsythe	1.2355	2	11	0.3281
Levene	3.8962	2	11	0.0526
Bartlett	4.8940	2	.	0.0075

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
148.9471	2	4.2225	0.0001

Oneway Analysis of CdO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

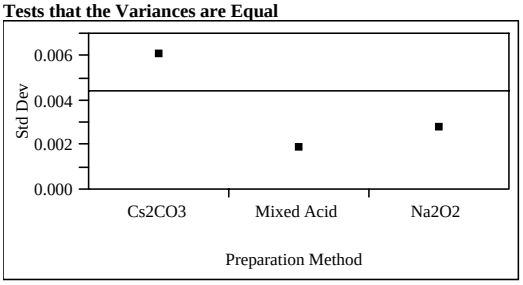
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.00848	0.00514	0.01767
Na2O2	0.00514	-0.00848	0.00404
Cs2CO3	0.01767	0.00404	-0.00692

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.07005155
Na2O2	B	0.05642962
Cs2CO3	C	0.04464489

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0060589	0.0045502	0.0045502
Mixed Acid	4	0.0018475	0.0012851	0.0012851
Na2O2	4	0.0027699	0.0021704	0.0021704

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6021	2	11	0.2451
Brown-Forsythe	2.2311	2	11	0.1537
Levene	2.3659	2	11	0.1398
Bartlett	2.2054	2	.	0.1102

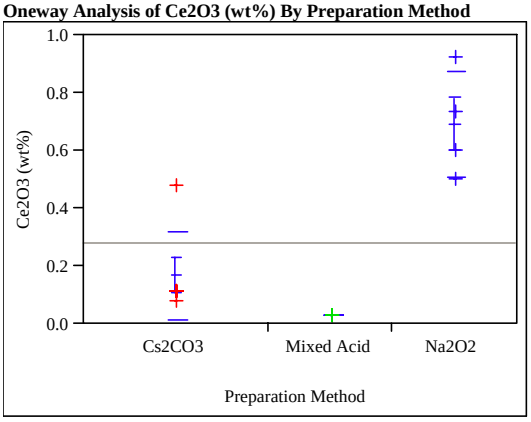
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
61.1406	2	6.9426	<.0001

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of Ce2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

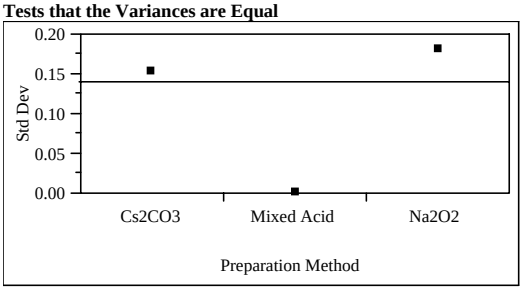
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.26764	0.27876	0.39297
Cs2CO3	0.27876	-0.21853	-0.10679
Mixed Acid	0.39297	-0.10679	-0.26764

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.69165265
Cs2CO3	B	0.16856959
Mixed Acid	B	0.03103945

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



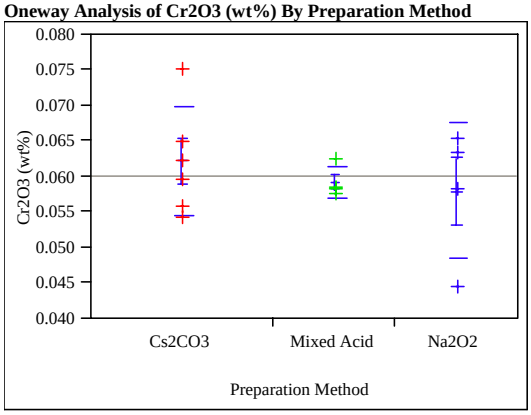
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.1527594	0.1034974	0.0676426
Mixed Acid	4	0.0008856	0.0006442	0.0006442
Na2O2	4	0.1819918	0.1382134	0.1382134

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7189	2	11	0.5088
Brown-Forsythe	1.5694	2	11	0.2514
Levene	3.0529	2	11	0.0882
Bartlett	12.3773	2	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
25.3968	2	5.0003	0.0024

Oneway Analysis of Cr2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

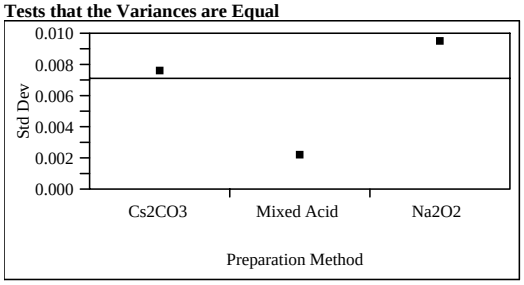
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.01120	-0.00973	-0.00838
Mixed Acid	-0.00973	-0.01372	-0.01237
Na2O2	-0.00838	-0.01237	-0.01372

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.06209364
Mixed Acid	A	0.05930442
Na2O2	A	0.05795244

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0075809	0.0054810	0.0054810
Mixed Acid	4	0.0021985	0.0016260	0.0012789
Na2O2	4	0.0094108	0.0066868	0.0065041

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8732	2	11	0.4447
Brown-Forsythe	1.3623	2	11	0.2961
Levene	1.5911	2	11	0.2472
Bartlett	2.1888	2	.	0.1121

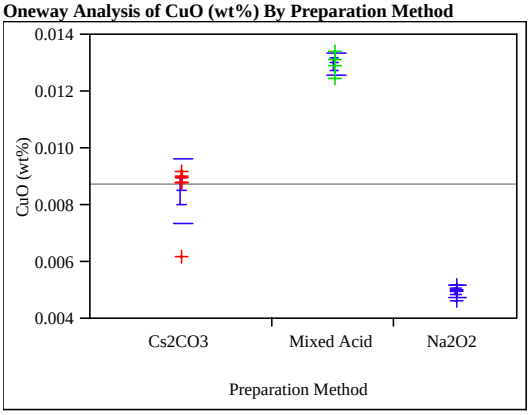
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.3761	2	5.6667	0.7025

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of CuO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

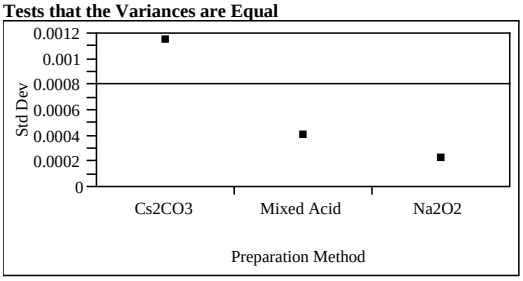
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.00154	0.00307	0.00648
Cs2CO3	0.00307	-0.00126	0.00214
Na2O2	0.00648	0.00214	-0.00154

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.01297178
Cs2CO3	B	0.00850077
Na2O2	C	0.00495556

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



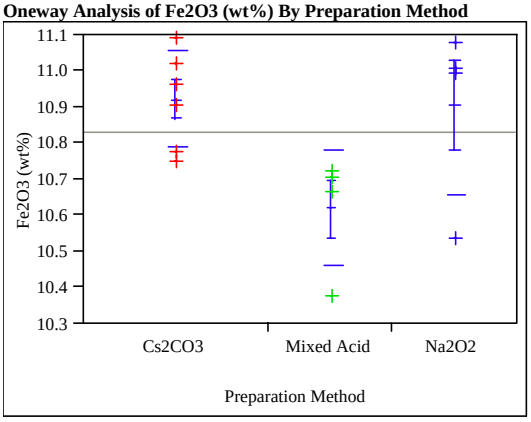
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0011405	0.0007702	0.0005539
Mixed Acid	4	0.0004004	0.0002973	0.0002973
Na2O2	4	0.0002258	0.0001588	0.0001424

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6780	2	11	0.5277
Brown-Forsythe	0.4098	2	11	0.6735
Levene	1.8417	2	11	0.2042
Bartlett	3.6969	2	.	0.0248

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
557.5837	2	6.5779	<.0001

Oneway Analysis of Fe2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

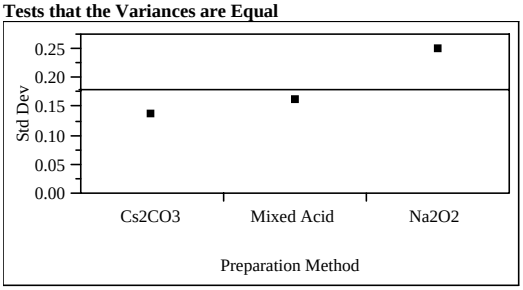
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.27993	-0.29748	-0.01154
Na2O2	-0.29748	-0.34284	-0.05690
Mixed Acid	-0.01154	-0.05690	-0.34284

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	10.920525
Na2O2	A	10.905037
Mixed Acid	A	10.619097

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.1351552	0.1072275	0.1072275
Mixed Acid	4	0.1614886	0.1197374	0.0965048
Na2O2	4	0.2482839	0.1840739	0.1393957

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7037	2	11	0.5157
Brown-Forsythe	0.0983	2	11	0.9072
Levene	0.8978	2	11	0.4353
Bartlett	0.6766	2	.	0.5083

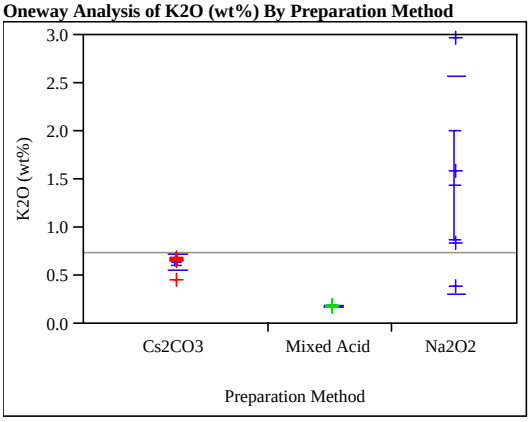
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.4228	2	5.7555	0.0686

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of K2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

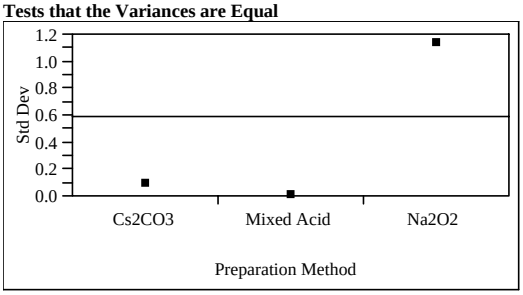
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-1.1356	-0.2271	0.1271
Cs2CO3	-0.2271	-0.9272	-0.5835
Mixed Acid	0.1271	-0.5835	-1.1356

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.4470258
Cs2CO3	A B	0.6374342
Mixed Acid	B	0.1843038

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



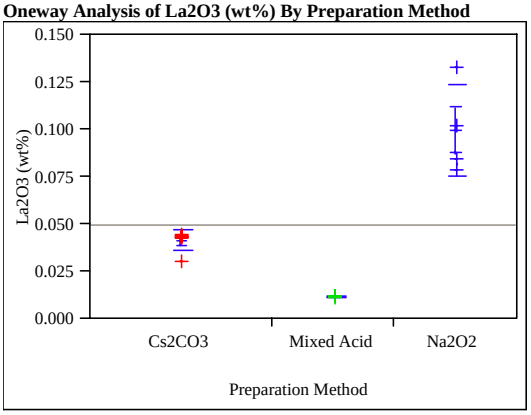
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.085553	0.0578877	0.0411572
Mixed Acid	4	0.005274	0.0039150	0.0039150
Na2O2	4	1.133269	0.8356913	0.8356913

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.9471	2	11	0.0944
Brown-Forsythe	7.8625	2	11	0.0076
Levene	9.3693	2	11	0.0042
Bartlett	19.4237	2	.	<.0001

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
76.0556	2	5.0213	0.0002

Oneway Analysis of La2O3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

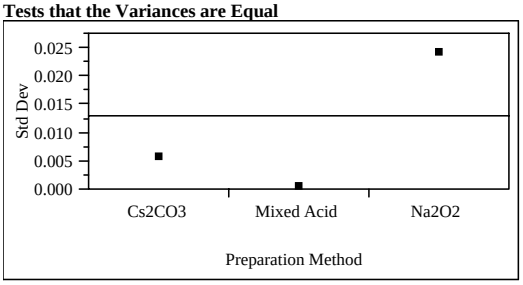
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.02513	0.03505	0.06229
Cs2CO3	0.03505	-0.02052	0.00650
Mixed Acid	0.06229	0.00650	-0.02513

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.09939480
Cs2CO3	B	0.04140961
Mixed Acid	C	0.01197722

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0055540	0.0037562	0.0026681
Mixed Acid	4	0.0003465	0.0002492	0.0002492
Na2O2	4	0.0241488	0.0177093	0.0177093

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.6541	2	11	0.1147
Brown-Forsythe	5.2537	2	11	0.0250
Levene	6.8493	2	11	0.0117
Bartlett	11.8663	2	.	<.0001

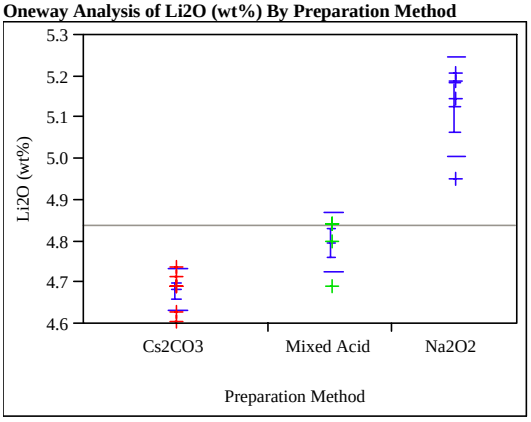
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
96.9879	2	5.023	<.0001

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of Li2O (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

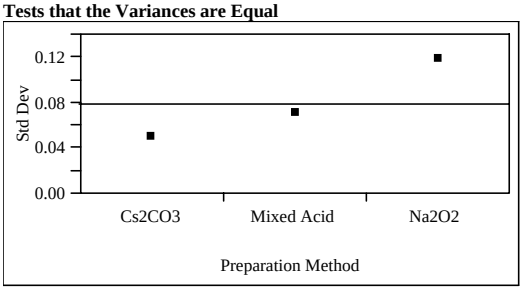
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.15187	0.17645	0.30629
Mixed Acid	0.17645	-0.15187	-0.02202
Cs2CO3	0.30629	-0.02202	-0.12400

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	5.1239020
Mixed Acid	B	4.7955847
Cs2CO3	B	4.6789693

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



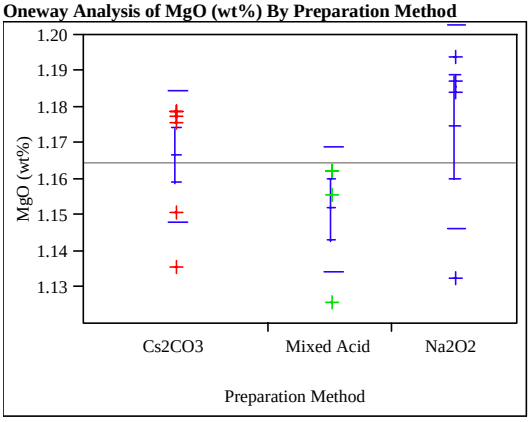
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0503367	0.0406659	0.0358817
Mixed Acid	4	0.0711326	0.0511314	0.0484402
Na2O2	4	0.1179192	0.0861160	0.0753515

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0759	2	11	0.3743
Brown-Forsythe	0.5020	2	11	0.6185
Levene	1.4448	2	11	0.2772
Bartlett	1.2744	2	.	0.2796

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
23.8492	2	5.3598	0.0021

Oneway Analysis of MgO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

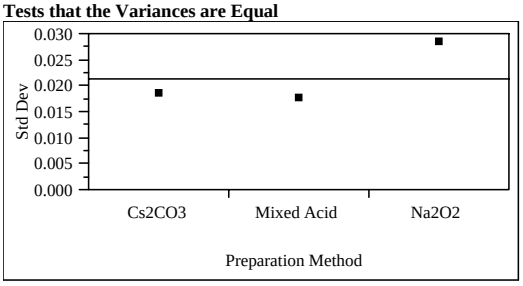
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.04070	-0.02900	-0.01790
Cs2CO3	-0.02900	-0.03323	-0.02251
Mixed Acid	-0.01790	-0.02251	-0.04070

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	1.1744910
Cs2CO3	A	1.1663377
Mixed Acid	A	1.1516893

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0184263	0.0152932	0.0121609
Mixed Acid	4	0.0174187	0.0128518	0.0107790
Na2O2	4	0.0282195	0.0209360	0.0161684

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5227	2	11	0.6070
Brown-Forsythe	0.0891	2	11	0.9154
Levene	0.6504	2	11	0.5408
Bartlett	0.4349	2	.	0.6473

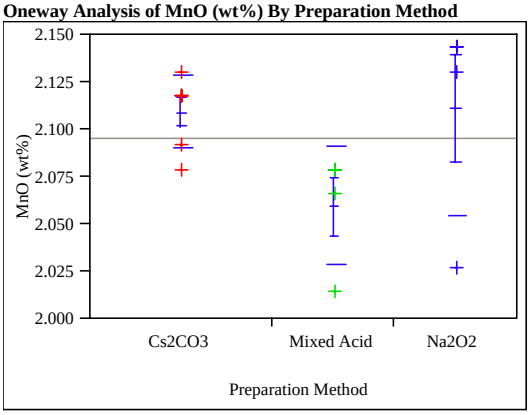
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.1362	2	6.1813	0.3800

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of MnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

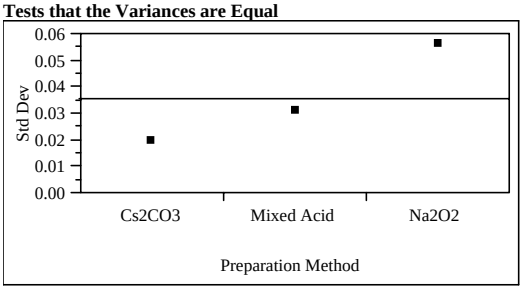
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.06868	-0.06054	-0.01703
Cs2CO3	-0.06054	-0.05608	-0.01320
Mixed Acid	-0.01703	-0.01320	-0.06868

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	2.1111120
Cs2CO3	A	2.1089600
Mixed Acid	A	2.0594640

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



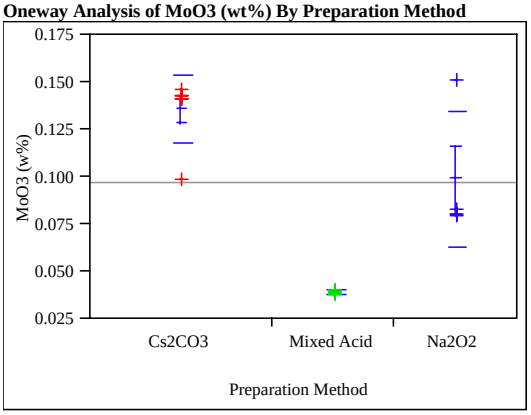
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0194396	0.0157813	0.0129120
Mixed Acid	4	0.0307367	0.0225960	0.0193680
Na2O2	4	0.0562821	0.0419640	0.0322800

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2031	2	11	0.3369
Brown-Forsythe	0.4391	2	11	0.6555
Levene	2.5394	2	11	0.1240
Bartlett	1.9511	2	.	0.1421

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.7043	2	5.1018	0.1015

Oneway Analysis of MoO3 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

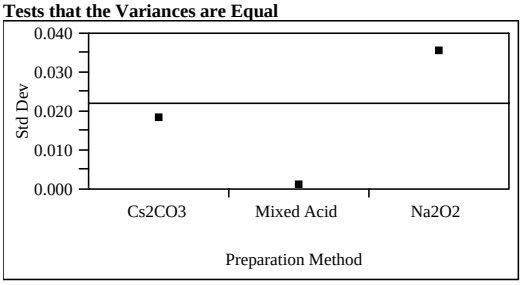
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.03453	-0.00141	0.05785
Na2O2	-0.00141	-0.04229	0.01698
Mixed Acid	0.05785	0.01698	-0.04229

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.13565213
Na2O2	A	0.09845719
Mixed Acid	B	0.03919534

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0180499	0.0122108	0.0086267
Mixed Acid	4	0.0010982	0.0007877	0.0007877
Na2O2	4	0.0354050	0.0265366	0.0185662

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2178	2	11	0.3329
Brown-Forsythe	0.7017	2	11	0.5166
Levene	4.3665	2	11	0.0402
Bartlett	7.6376	2	.	0.0005

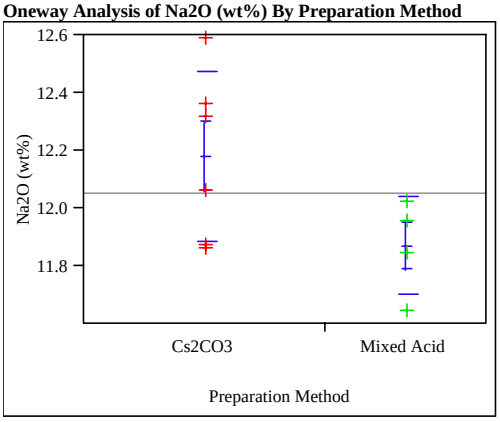
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
80.0761	2	5.0266	0.0002

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of Na2O (wt%) By Preparation Method



Missing Rows
4**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

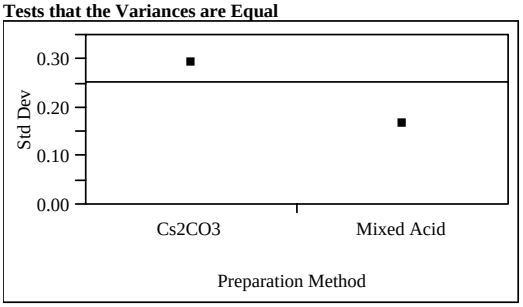
q*	Alpha
2.30593	0.05

Abs(Dif)-LSD	Cs2CO3	Mixed Acid
Cs2CO3	-0.33589	-0.06550
Mixed Acid	-0.06550	-0.41139

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Cs2CO3	Mixed Acid	0.3100400	-0.065502	0.6855815

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.2924570	0.2448867	0.2448867
Mixed Acid	4	0.1649121	0.1213200	0.1213200

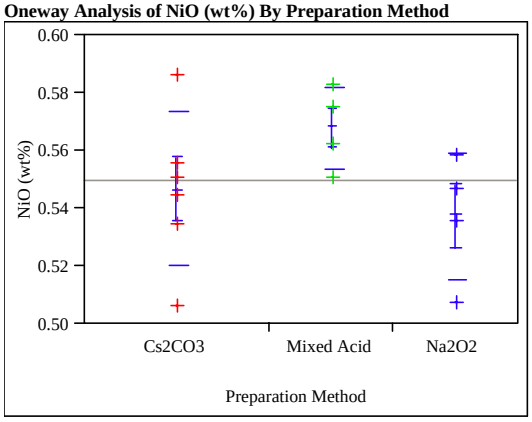
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7523	1	8	0.2222
Brown-Forsythe	3.0479	1	8	0.1190
Levene	3.2375	1	8	0.1097
Bartlett	0.9456	1	.	0.3309
F Test 2-sided	3.1450	5	3	0.3745

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.5656	1	7.9085	0.0655

t Test
2.1367

Oneway Analysis of NiO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

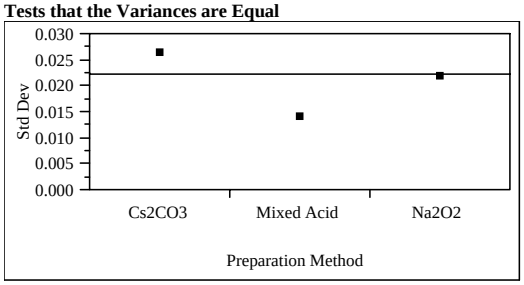
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.04268	-0.01765	-0.01214
Cs2CO3	-0.01765	-0.03485	-0.02974
Na2O2	-0.01214	-0.02974	-0.04268

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.56785312
Cs2CO3	A	0.54653875
Na2O2	A	0.53731312

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0263595	0.0180271	0.0180271
Mixed Acid	4	0.0140312	0.0111344	0.0111344
Na2O2	4	0.0218281	0.0155881	0.0155881

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4530	2	11	0.6471
Brown-Forsythe	0.2913	2	11	0.7529
Levene	0.3028	2	11	0.7447
Bartlett	0.5684	2	.	0.5664

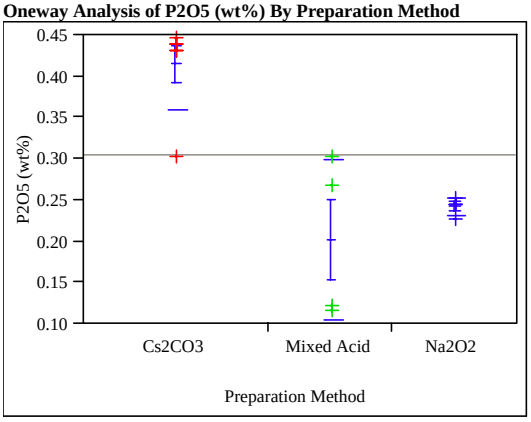
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.9896	2	6.8757	0.1163

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of P2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

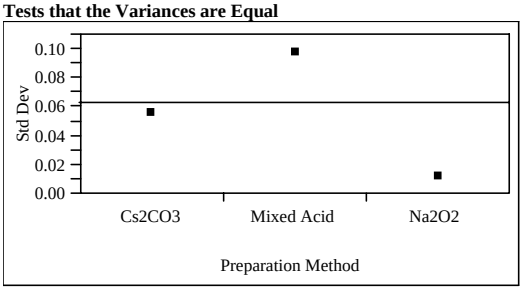
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.09872	0.06282	0.10291
Na2O2	0.06282	-0.12091	-0.08081
Mixed Acid	0.10291	-0.08081	-0.12091

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.41550720
Na2O2	B	0.24231555
Mixed Acid	B	0.20221605

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



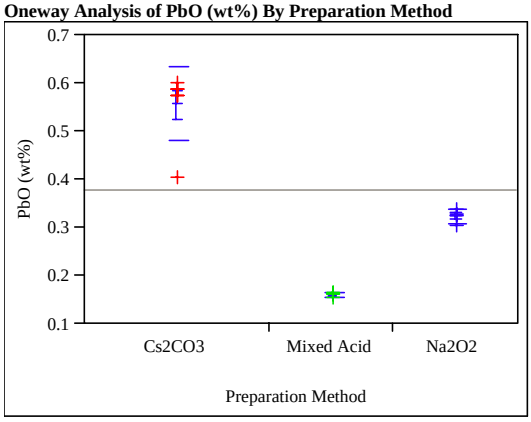
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0556988	0.0376808	0.0267330
Mixed Acid	4	0.0969748	0.0830632	0.0830633
Na2O2	4	0.0110883	0.0077335	0.0068742

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	3.6294	2	11	0.0616
Brown-Forsythe	4.8049	2	11	0.0316
Levene	8.2133	2	11	0.0066
Bartlett	4.0628	2	.	0.0172

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
24.7709	2	5.2782	0.0021

Oneway Analysis of PbO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

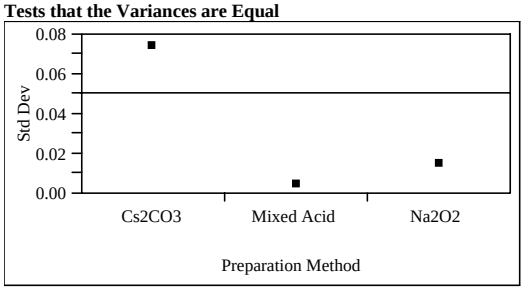
Abs(Dif)-LSD	Cs2CO3	Na2O2	Mixed Acid
Cs2CO3	-0.07915	0.14293	0.30653
Na2O2	0.14293	-0.09693	0.06667
Mixed Acid	0.30653	0.06667	-0.09693

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.55592497
Na2O2	B	0.32450650
Mixed Acid	C	0.16090675

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0743193	0.0501197	0.0365350
Mixed Acid	4	0.0045992	0.0033662	0.0033662
Na2O2	4	0.0148123	0.0103680	0.0094255

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7723	2	11	0.4855
Brown-Forsythe	0.7318	2	11	0.5031
Levene	2.8001	2	11	0.1040
Bartlett	7.9621	2	.	0.0003

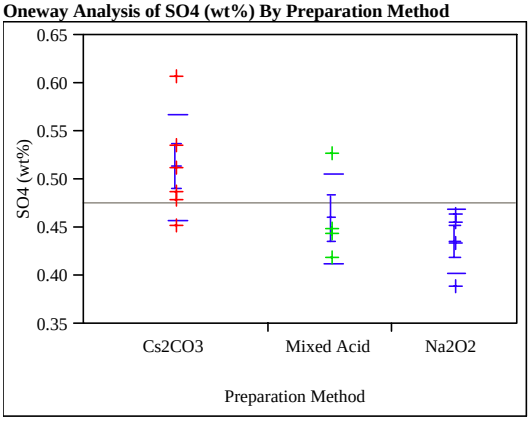
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
268.6755	2	5.5747	<.0001

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of SO4 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

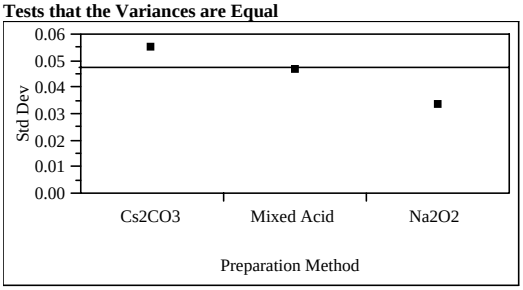
Abs(Dif)-LSD	Cs2CO3	Mixed Acid	Na2O2
Cs2CO3	-0.07422	-0.03006	-0.00609
Mixed Acid	-0.03006	-0.09090	-0.06694
Na2O2	-0.00609	-0.06694	-0.09090

Positive values show pairs of means that are significantly different.

Level		Mean
Cs2CO3	A	0.51279822
Mixed Acid	A	0.45987065
Na2O2	A	0.43590345

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



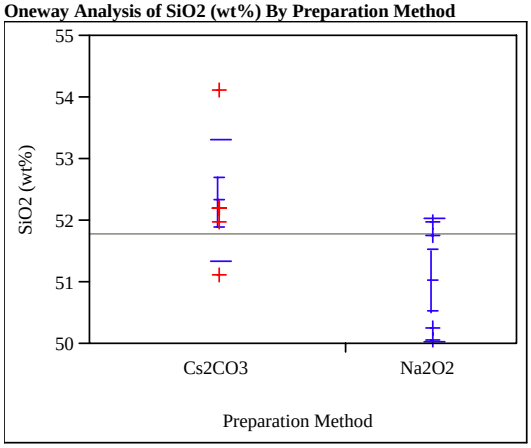
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0547985	0.0396125	0.0394460
Mixed Acid	4	0.0467655	0.0337039	0.0284611
Na2O2	4	0.0334057	0.0239672	0.0239672

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.3085	2	11	0.7407
Brown-Forsythe	0.2928	2	11	0.7518
Levene	0.3730	2	11	0.6970
Bartlett	0.3641	2	.	0.6948

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.4680	2	6.9319	0.0904

Oneway Analysis of SiO2 (wt%) By Preparation Method



Missing Rows
4**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

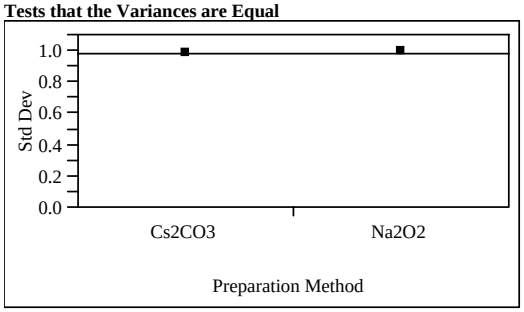
q*	Alpha
2.30593	0.05

Abs(Dif)-LSD	Cs2CO3	Na2O2
Cs2CO3	-1.3148	-0.1865
Na2O2	-0.1865	-1.6103

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Cs2CO3	Na2O2	1.283580	-0.186460	2.753620

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.9826818	0.6061350	0.5348250
Na2O2	4	0.9957900	0.8557200	0.8557200

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.0008	1	8	0.9785
Brown-Forsythe	0.6128	1	8	0.4563
Levene	0.4480	1	8	0.5221
Bartlett	0.0006	1	.	0.9808
F Test 2-sided	1.0269	3	5	0.9106

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

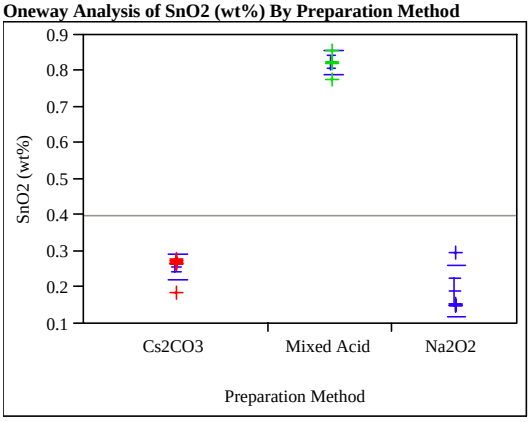
F Ratio	DFNum	DFDen	Prob > F
4.0299	1	6.5128	0.0877

t Test
2.0074

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of SnO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

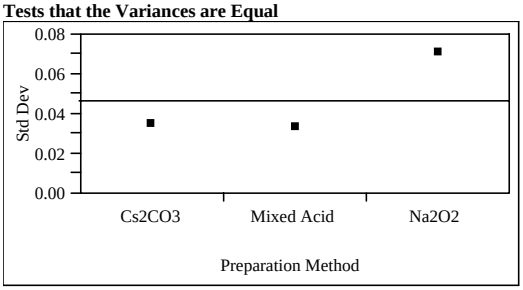
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.08994	0.48075	0.54200
Cs2CO3	0.48075	-0.07344	-0.01302
Na2O2	0.54200	-0.01302	-0.08994

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.82143120
Cs2CO3	B	0.25857520
Na2O2	B	0.18948780

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



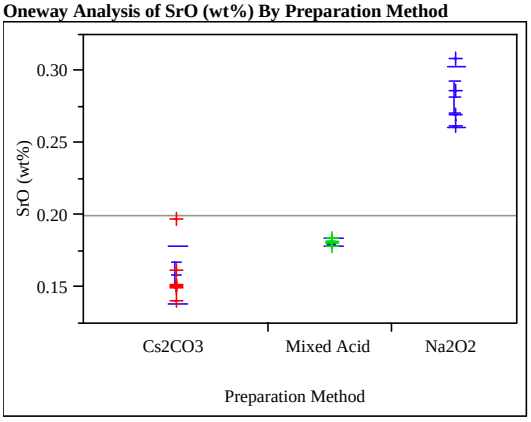
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0345431	0.0233465	0.0167164
Mixed Acid	4	0.0333658	0.0215832	0.0215832
Na2O2	4	0.0709283	0.0531645	0.0371358

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9351	2	11	0.4217
Brown-Forsythe	0.2708	2	11	0.7677
Levene	1.8447	2	11	0.2038
Bartlett	1.2003	2	.	0.3011

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
328.5265	2	5.9215	<.0001

Oneway Analysis of SrO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

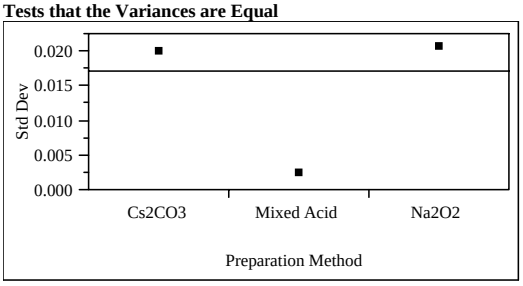
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.03298	0.06725	0.09259
Mixed Acid	0.06725	-0.03298	-0.00763
Cs2CO3	0.09259	-0.00763	-0.02693

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.28175445
Mixed Acid	B	0.18152910
Cs2CO3	B	0.15905970

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0200101	0.0137970	0.0116289
Mixed Acid	4	0.0024618	0.0017739	0.0017739
Na2O2	4	0.0204918	0.0156695	0.0156695

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6737	2	11	0.5297
Brown-Forsythe	1.2443	2	11	0.3257
Levene	2.2830	2	11	0.1481
Bartlett	4.0675	2	.	0.0171

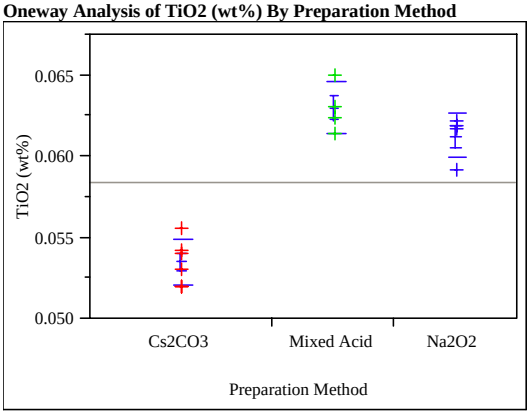
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
45.4818	2	5.1691	0.0005

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of TiO2 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

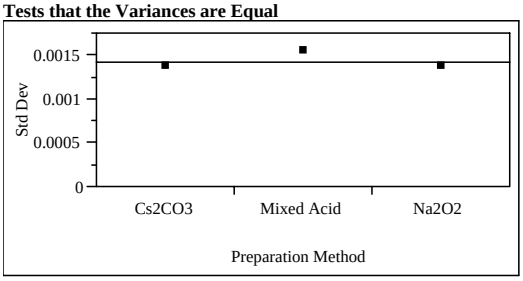
Abs(Dif)-LSD	Mixed Acid	Na2O2	Cs2CO3
Mixed Acid	-0.00272	-0.00101	0.00700
Na2O2	-0.00101	-0.00272	0.00529
Cs2CO3	0.00700	0.00529	-0.00222

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.06296700
Na2O2	A	0.06125730
Cs2CO3	B	0.05348720

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



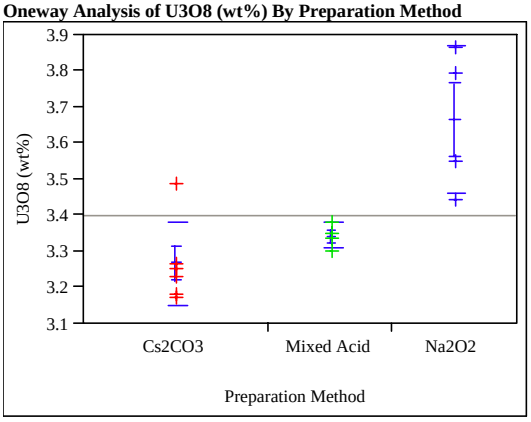
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0013741	0.0011120	0.0011120
Mixed Acid	4	0.0015498	0.0010842	0.0010842
Na2O2	4	0.0013780	0.0010217	0.0007923

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.0479	2	11	0.9535
Brown-Forsythe	0.1645	2	11	0.8503
Levene	0.0180	2	11	0.9822
Bartlett	0.0285	2	.	0.9719

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
58.0297	2	6.4487	<.0001

Oneway Analysis of U3O8 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

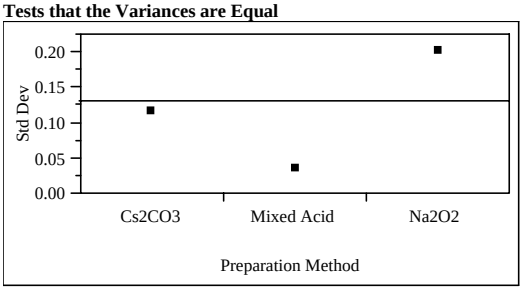
Abs(Dif)-LSD	Na2O2	Mixed Acid	Cs2CO3
Na2O2	-0.25221	0.06912	0.16774
Mixed Acid	0.06912	-0.25221	-0.15359
Cs2CO3	0.16774	-0.15359	-0.20593

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	3.6643640
Mixed Acid	B	3.3430320
Cs2CO3	B	3.2663840

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.1160179	0.0746827	0.0707520
Mixed Acid	4	0.0340406	0.0235840	0.0235840
Na2O2	4	0.2008971	0.1680360	0.1680360

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.9773	2	11	0.0926
Brown-Forsythe	4.7984	2	11	0.0318
Levene	5.5053	2	11	0.0220
Bartlett	3.0608	2	.	0.0468

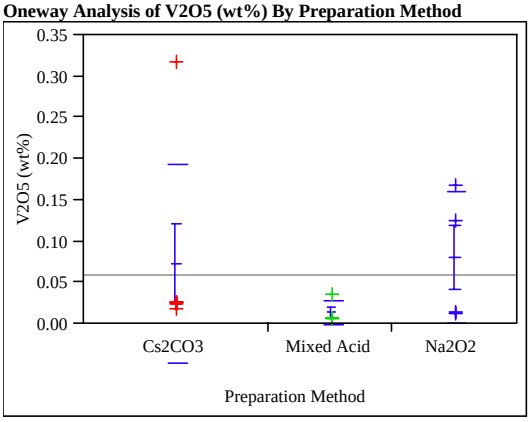
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.7356	2	5.5431	0.0447

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of V2O5 (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

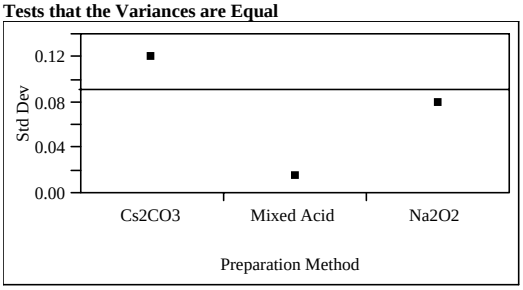
Abs(Dif)-LSD	Na2O2	Cs2CO3	Mixed Acid
Na2O2	-0.17395	-0.15114	-0.10734
Cs2CO3	-0.15114	-0.14203	-0.09984
Mixed Acid	-0.10734	-0.09984	-0.17395

Positive values show pairs of means that are significantly different.

Level		Mean
Na2O2	A	0.08066872
Cs2CO3	A	0.07301468
Mixed Acid	A	0.01405622

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



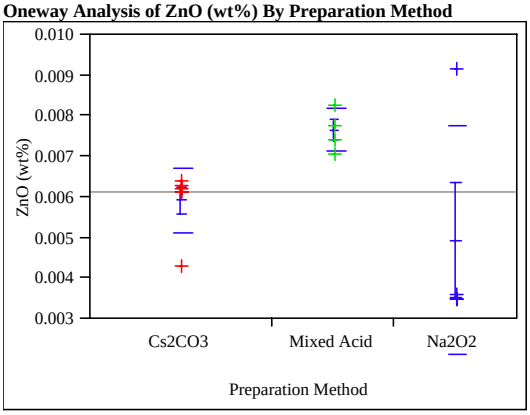
Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.1199460	0.0815836	0.0501939
Mixed Acid	4	0.0141948	0.0106454	0.0071877
Na2O2	4	0.0789978	0.0666995	0.0666995

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5430	2	11	0.5958
Brown-Forsythe	0.5853	2	11	0.5734
Levene	2.0946	2	11	0.1695
Bartlett	4.0978	2	.	0.0166

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.8096	2	5.2684	0.2522

Oneway Analysis of ZnO (wt%) By Preparation Method



Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.70081	0.05

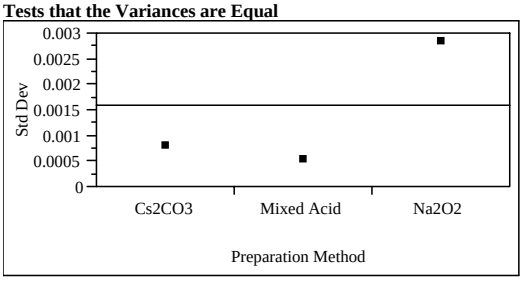
Abs(Dif)-LSD	Mixed Acid	Cs2CO3	Na2O2
Mixed Acid	-0.00304	-0.00106	-0.00035
Cs2CO3	-0.00106	-0.00248	-0.00179
Na2O2	-0.00035	-0.00179	-0.00304

Positive values show pairs of means that are significantly different.

Level		Mean
Mixed Acid	A	0.00763374
Cs2CO3	A	0.00591902
Na2O2	A	0.00493719

Levels not connected by same letter are significantly different

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0007961	0.0005373	0.0003880
Mixed Acid	4	0.0005125	0.0003890	0.0003890
Na2O2	4	0.0028252	0.0021185	0.0014517

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6381	2	11	0.2384
Brown-Forsythe	0.6813	2	11	0.5261
Levene	5.5936	2	11	0.0211
Bartlett	4.5600	2	.	0.0105

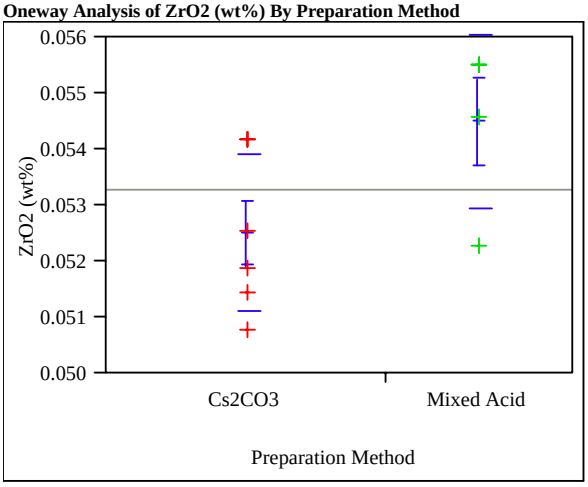
Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.6326	2	5.9217	0.0176

Exhibit B4. Chemical Composition Measurements by Type of Prepared Sample by Oxide for DWPF Radioactive Glass

(Concentrations are in wt%.)

Oneway Analysis of ZrO2 (wt%) By Preparation Method



Missing Rows
4**Means Comparisons**
Comparisons for all pairs using Tukey-Kramer HSD

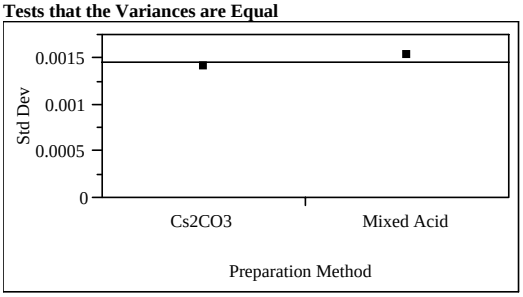
q*	Alpha
2.30593	0.05

Abs(Dif)-LSD	Mixed Acid	Cs2CO3
Mixed Acid	-0.00237	-0.00020
Cs2CO3	-0.00020	-0.00194

Positive values show pairs of means that are significantly different.

Level	- Level	Difference	Lower CL	Upper CL
Mixed Acid	Cs2CO3	0.0019699	-0.000198	0.0041379

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Cs2CO3	6	0.0014107	0.0011257	0.0011257
Mixed Acid	4	0.0015297	0.0010975	0.0010469

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.0444	1	8	0.8383
Brown-Forsythe	0.0175	1	8	0.8981
Levene	0.0033	1	8	0.9553
Bartlett	0.0219	1	.	0.8823
F Test 2-sided	1.1759	3	5	0.8132

Warning: Small sample sizes. Use Caution.
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.2331	1	6.1751	0.0840

t Test
2.0575

APPENDIX C.

SUPPORTING ANALYTICAL PROCEDURES

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Procedure for Measuring Wt.% Solids by Drying at 115 °C and Wt. % Vitrified Solids at 1100 °C followed by Cs_2CO_3 Fusion Digestion of the Resulting Glass Wafers

General Comment: The following procedure conveniently combines the measurements of wt. % solids SME samples, after both drying to constant weight at 115 °C and after vitrifying the sample at 1100 °C, with the digestion of the resulting glass wafer. The manipulator operations required are straightforward, but a clean, dry work area must be maintained in order to achieve accurate weight measurements.

Steps 1-22 pertain to measuring the wt. % solids of SME samples after drying at 115 °C

1. Preheat the drying oven to 115 °C and the muffle furnace to 1100 °C.

2. Calibrate the cell balance and record the calibration data in the cell balance logbook.

3. Tare the balance with nothing on the balance pan.

4. Place a clean, dry 50 mL Pt crucible on the balance pan. Record the weight of the empty 50 mL Pt crucible in the Data Table.

5. Place the 50 mL Pt crucible in a clean, dry area convenient to the mixer used for mixing the SME sample.

6. Uncap the 250 mL SME sample bottle and place the stirring shaft at the prescribed depth.

7. Turn on the stirring motor and slowly increase the rpm until the prescribed maximum rpm is attained.

8. Mix the SME at the prescribed rpm for two minutes.

9. Using a plastic slurry transfer pipette that has 1 ¼ inch of the tip cut off, transfer about a pipette full (about 1 mL) to the 50 mL Pt crucible.

10. Place the 50 mL Pt crucible on the balance pan and record the weight of the 50 mL Pt crucible + SME sample.

11. Subtract the weight of the empty 50 mL Pt crucible (Step 4) from the weight of the 50 mL Pt crucible + SME sample (Step 10) and record the wet weight of SME sample in the Data Table.

12. Repeat for all of the required replicate determinations.

13. Place the crucibles in the drying oven and close the oven door.

14. Monitor the oven temperature. When the oven temperature re-equilibrates to 115 ± 5 °C, record this time in the Data Table.

15. Heat for 1 hour after the oven temperature re-equilibrates to 115 ± 5 °C and then remove the crucibles and place them on clean, dry surface convenient to the cell balance. Record the time that the crucibles are removed from the oven and record this time in the Data Table.

16. After cooling for 5 minutes, weigh each of the crucibles as quickly as possible to minimize re-absorption of moisture from the air (if a dessicator is used, then the crucibles will be allowed to cool in it for 5-10 minutes before weighing). Record the weight of the 50 mL crucible + dry SME sample after 1st drying step in the Data Table.

17. Place the crucibles back in the drying oven. Monitor the time and record the time that the drying oven re-equilibrates to 115 °C.

18. Heat for 30 minutes or for the length of time prescribed by the Task Supervisor. Record the time that the crucibles are removed from the oven in the Data Table.

19. After cooling for 5 minutes, weigh each of the crucibles as quickly as possible to minimize re-absorption of moisture from the air (if a dessicator is used, then the crucibles will be allowed to cool in it for 5-10 minutes before weighing). Record the weight of the 50 mL crucible + dry SME sample after 2nd drying step in the Data Table.

20. Compare the weights of crucible + dry SME sample after the 1st and 2nd drying step (Steps 16 and 19) and record the difference in weights in the Data Table. If the weights differ by no more than 10 mg (0.010 g), the dry weight is considered to be constant and weight of 50 mL crucible + dry SME sample after the 2nd drying step (Step 19) is used to calculate wt. % solids.

    If the weights differ by more than 0.010 g, consult with the Task Supervisor.

21. Subtract the weight of the 50 mL Pt crucible (Step 4) from the weight of the 50 mL Pt crucible + dry SME after 2nd drying step (Step 19) and record the weight of SME sample after drying at 115 °C in the Data Table.

22. Divide the weight of the SME sample after drying at 115 °C (Step 21) by the wet weight of SME sample (Step 11) and multiply this quotient by 100 to obtain the wt. % SME solids after drying at 115 °C. Record this result in the Data Table.

Steps 23-29 pertain to vitrifying the dried SME sample and measuring the wt. % vitrified solids

23. Place the 50 mL Pt crucibles (the number of crucibles will be determined by the size of the muffle furnace) in the muffle furnace. Close the door.

24. Monitor the temperature. Record the time that the furnace re-equilibrates to 1100 °C.

25. Heat the crucibles for 30 minutes after the muffle furnace temperature re-equilibrates to 1100 °C. Record the time that the samples are removed from the furnace and the elapsed time of heating at 1100 °C.

26. Remove the crucibles and place them on a dry, clean Kevlar board.

27. After cooling for 10 minutes, weigh each of the crucibles and record the weight of 50 mL Pt crucibles + vitrified SME sample in the Data Sheet.

28. Subtract the weight of the 50 mL Pt crucible + vitrified SME (Step 27) from the weight of 50 mL Pt crucible (Step 4) and record this remainder as the weight of vitrified SME sample.

29. Divide the weight of the vitrified SME sample (Step 28) by the wet weight of SME sample (Step 11) and multiply this quotient by 100 to obtain the wt. % SME solids after vitrifying at 1100 °C. Record this result in the Data Table.

    Comment: This procedure specifies only one heating and weighing step because 30 minutes at 1100 °C produces a stable glass wafer for which an accurate weight for both the wt. % vitrified solids and the Cs_2CO_3 fusion digestion procedure can be obtained. Prolonged heating beyond 30 minutes or using two heating and weighing cycles will unnecessarily add both time and handling steps to the procedure.

Steps 30-42 pertain to the Cs_2CO_3 fusion digestion of the glass wafer formed by vitrifying the SME sample

30. Add the pre-measured 6-7 g portion (depending on the average weight of the glass wafer following the SME sample vitrification step-this procedure assumes that a 0.6-0.7 g glass wafer is formed) of Cs_2CO_3 to the 50 mL Pt crucible containing the vitrified SME sample. The required grade of Cs_2CO_3 is 99.994 % minimum purity (Alfa Puratronic® grade is recommended).

31. Place the 50 mL Pt crucibles in the furnace and heat for 10 minutes after the temperature re-equilibrates to 1100 °C.

32. Remove the crucibles from the furnace and let them cool for 5 minutes.

33. Drop the first crucible into a wide-mouth bottle (either 500 mL or 1000 mL can be used) that has been pre-charged with 100 mL of 3 % H_2O_2 solution. [The H_2O_2 solution was prepared by diluting 10 mL of 30 % H_2O_2 solution to 100 mL in a plastic volumetric flask, then transferring all of this solution to the wide-mouth bottle.] Swirl the wide-mouth bottle to tilt the crucible on its side to promote contact of the flux residue with the 3 % H_2O_2 solution.

    Comment: The 100 mL of 3 % H_2O_2 is enough solution to ensure adequate contact with the flux residue, but small enough volume that the decomposition of the H_2O_2 warms the solution. It is believed that the warm solution helps to dissolve the caustic flux residue and that the resulting warm caustic solution helps to dissolve any high-cesium glass that forms from attack of the cesium carbonate on the glass sample.

34. The decomposition of H_2O_2 solution in strong caustic solution will create a warm, frothy solution that dissolves the flux residue in the bottom of the Pt crucible, leaving metal oxides and hydrous oxides that are insoluble in highly caustic solution. Let this reaction take place for 15 minutes. The fizzing should stop within this time, indicating that H_2O_2 decomposition is complete.

35. Add 250 mL de-ionized water that has been pre-measured in a 250 mL plastic volumetric flask.

    Comment: The 250 mL de-ionized water is added at this point, before the acid addition, to dilute the mixture and minimize the potential for silicates to irreversibly precipitate upon addition of strong acid.

36. Swirl the wide-mouth bottle gently to mix the water with the strong caustic solution.

37. Slowly add 100 mL of approximately 7.8 M HNO_3 solution. [The HNO_3 solution was prepared by adding 25 mL of de-ionized water to a 100 mL plastic volumetric flask, then slowly adding 50 mL concentrated HNO_3. After the solution cooled, de-ionized water was added to the mark on the volumetric flask. The volumetric flask was capped and the solution mixed by inverting the flask several times.] Add about 15 mL of the 7.8 M HNO_3 solution and then swirl the wide-mouth bottle. Continue addition of the 7.8 M HNO_3 solution until all of it has been added. Set aside for 15 minutes.

    Comment: Slow, step-wise acid addition is specified for two reasons: (1) to avoid loss of solution (by overflowing the wide-mouth bottle-only a potential problem if 500 mL wide-mouth bottles are used rather than 1000 mL bottles) from excess evolution of CO_2 that could occur from too rapid decomposition of carbonate brought on by acid addition; and (2) to minimize the possibility of silicates precipitating upon rapid addition of strong acid solution.

38. Add 3-5 drops of 30 % H_2O_2 solution.

39. Cap the bottle and mix well.

    Comment: No insolubles should be apparent at this point. If insoluble particles are apparent, notify the Task Supervisor and await further instructions.

    A tell-tale gray color may be apparent after the digestion. This gray color is usually the result of minute amounts of the Pt or Pt-Au from attack of the cesium carbonate on the crucible at high temperature. The particles are extremely small and in such low concentration that filtration is not necessary before the serial dilution or the ICP-AES analysis. The particles do not affect the ICP-AES performance.

40. Perform a serial dilution as directed by the Task Supervisor and transfer the sample bottles to the ICP-AES laboratory.

41. Record the total dilution volume of the digestion + serial dilution performed in the cells.

42. After the ICP-AES analyses are completed satisfactorily, discard the acid solution as directed by the Task Supervisor. Rinse thoroughly the wide-mouth bottles and 50 mL Pt crucibles with de-ionized water and allow them to dry in a clean area before the next SME sample batch.

Data Table for SME Samples
Wt. % Solids at 115 °C Drying
Wt. % Vitrified Solids at 1100 °C
Cs_2CO_3 Fusion Digestion

Procedure Step #	Measurement Operation	Measurement
4	Wt. of empty 50 mL Pt crucible	**g**
10	Wt. of 50 mL Pt crucible + wet SME sample	**g**
11	Wt. of wet SME sample	**g**
14	Military Time that oven re-equilbrates to 115 °C (1st drying step)	**hr.**
15	Military Time that samples are removed from oven (1st drying step); Elapsed Time of 1st drying step	**hr.** **hr.**
16	Wt. of 50 mL Pt crucible + dry SME sample after 1st drying step	**g**
17	Military Time that oven re-equilbrates to 115 °C (2nd drying step)	**hr.**
18	Military Time that samples are removed from oven (2nd drying step); Elapsed Time of 2nd drying step	**hr.**
19	Wt. of 50 mL Pt crucible + dry SME sample after 2nd drying step	**g**
20	Difference in 50 mL Pt crucible + dry SME sample after 1st and 2nd drying steps	**g**
21	Wt. of dry SME sample	**g**
22	Wt. % of SME sample after drying at 115 °C	**%**
24	Military Time that furnace re-equilbrates to 1100 °C	**hr.**
25	Military Time that samples are removed from furnace; elapsed time for heating at 1100 °C.	**hr.** **hr.**
27	Wt. of 50 mL Pt crucible + vitrified SME sample	**g**
28	Wt. of vitrified SME sample (glass wafer)	**g**
29	Wt. % of vitrified SME sample after vitrifying at 1100 °C	**%**
41	Total volume of dilution (initial fusion digest + serial dilution performed in cells).	**mL**