**VERIFICATION OF THE DEFENSE WASTE
PROCESSING FACILITY'S (DWPF) PROCESS
DIGESTION METHOD FOR THE SLUDGE BATCH 7A
QUALIFICATION SAMPLE**

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March 14, 2011

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Prepared for the U.S. Department of Energy Under Contract Number
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TABLE OF CONTENTS

LIST OF AND FIGURES AND TABLES	IX
LIST OF ACRONYMS	XI
1.0 SUMMARY	13
2.0 EXPERIMENTAL.....	15
3.0 INTRODUCTION AND RESULTS	17
4.0 CONCLUSIONS	29
5.0 RECOMMENDATIONS.....	31
6.0 REFERENCES	33
7.0 ACKNOWLEDGEMENTS.....	35
8.0 APPENDIX A. SUPPORTING INFORMATION	37

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LIST OF AND FIGURES AND TABLES

Table 3-1. Elemental concentrations of SB7a SRAT Receipt radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (wt%) of total dried solids basis.	19
Table 3-2 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB7a SRAT Receipt sludge. Digestions not having the same font, those that are not underlined or those separated with a less than sign are statistically different at the 5% significance level.	20
Table 3-3. Elemental concentrations of SB7a SRAT Product radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) total dried solids basis.	22
Table 3-4. Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB7a SRAT Product sludge. Digestions not having the same font, those that are not underlined or those separated with a less than sign are statistically different at the 5% significance level.	23
Table 3-5. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.	25
Table 3-6. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.	26
Table 3-7. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.	27
Table 3-8. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.	28

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LIST OF ACRONYMS

AD	Analytical Development
AR	Aqua Regia
ARG	Analytical Reference Glass
CC	Cold Chem
DI	De-Ionized
DOE	Department of Energy
DWPF	Defense Waste Processing Facility
ICP-AES	Inductively Coupled Plasma – Atomic Emission Spectroscopy
LWO	Liquid Waste Operations
PF	Sodium Peroxide/Hydroxide Fusion
SB	Sludge Batch
SME	Slurry Mix Evaporator
SRAT	Sludge Receipt and Adjustment Tank
SRNL	Savannah River National Laboratory
WAPS	Waste Acceptance Product Specification
C-XRD	Contained - X-Ray Diffraction

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1.0 SUMMARY

For each sludge batch that is processed in the Defense Waste Processing Facility (DWPF), the Savannah River National Laboratory (SRNL) performs confirmation of the applicability of the digestion method to be used by the DWPF lab for elemental analysis of Sludge Receipt and Adjustment Tank (SRAT) receipt samples and SRAT product process control samples. DWPF SRAT samples are typically dissolved using a room temperature HF-HNO₃ acid dissolution (i.e., DWPF Cold Chem Method, see DWPF Procedure SW4-15.201) and then analyzed by inductively coupled plasma – atomic emission spectroscopy (ICP-AES).

This report contains the results and comparison of data generated from performing the Aqua Regia (AR), Sodium Peroxide/Hydroxide Fusion (PF) and DWPF Cold Chem (CC) method digestions of Sludge Batch 7a (SB7a) SRAT Receipt and SB7a SRAT Product samples. The SB7a SRAT Receipt and SB7a SRAT Product samples were prepared in the SRNL Shielded Cells, and the SRAT Receipt material is representative of the sludge that constitutes the SB7a Batch or qualification composition. This is the sludge in Tank 51 that is to be transferred into Tank 40, which will contain the heel of Sludge Batch 6 (SB6), to form the SB7a Blend composition.

Observations and results from the SRAT Receipt digestions include the following:

- Brown undissolved solids and white solids remained in the solutions generated from the CC digestions after all acid addition steps and dilutions were performed.
- Statistically larger Al concentration measurements are seen in the PF digestions when compared to the AR and CC methods.
- The mean Fe concentration is ~9% and ~12% lower in the CC digestions relative to the PF and AR digestions, respectively.
- The means for K were also statistically significant and in this round of experiments a large relative difference between the digestions was noted as well.
- For Mn, the relative difference between the AR mean and CC mean is ~6% and a statistical difference in the means is observed. The relative difference between the PF and CC mean is ~4% and there is not a statistical difference in the means,
- The mean Ni concentration is ~10% and ~13% lower in the CC digestions relative to the PF and AR digestions, respectively.
- Thorium should be determined from the PF digestion.
- A statistical difference of means was also noted for the minor elements Cr, Cu and Ti.
- Ca, Mg, Mn, Na, Ti, U and Zr appear to dissolve in the time allotted based upon results from ICP-AES data (please see the complete statistical comparison).

Observations and results from the SRAT Product digestions include the following:

- Brown undissolved solids and white solids remained in the solutions generated from the CC digestions after all acid addition steps and dilutions were performed.
- Statistically larger Al concentration measurements are seen in the PF digestions when compared against the AR and CC methods.
- Fe is ~7% lower in the CC digestions relative to the PF and AR digestion.
- A statistical difference of means is observed for Mg comparing the CC mean to the AR and PF means. The AR and PF means are ~47% lower than the CC mean. However, the large %RSD associated with the CC measurements indicates the concentration in the diluted sample was very close to the ICP-AES detection limit and therefore it is the opinion of the author that the CC

value, in this case, should not be used. No statistical difference was noted for Mg between the AR and PF means. There was no statistical difference observed for the SRAT Receipt between the three digestion methods.

- Ni is ~10% and ~12% lower in the CC digestions relative to the PF and AR digestions, respectively.
- Thorium should be determined from the PF digestion.
- A statistical difference of means was also noted for the minor elements Cr, Cu, K and Ti.
- Ca, Mn, Na, Ti, U and Zr appear to dissolve in the time allotted based upon the results from ICP-AES data (please see the complete statistical comparison).

Based on the SB7a analytical comparisons, SRNL recommends the following:

- Al, Fe, Ni and Th should be analyzed by the peroxide fusion method for SB7a. Mn can be measured using either the CC or PF method but monitored closely and the highest Mn concentration between the two digestions should be used. Although K is a minor element, large relative differences are noted in this report between the different digestions and the DWPF should also monitor the K concentration. ICP-AES detection limit issues resulted in an abnormally high concentration for Mg in the SRAT product. The %RSD associated with sample results should be monitored to indicate potential issues with ICP-AES detection limits.
- The DWPF CC method was originally developed to be used for SME analyses. Given continuous visual observations of solids in the CC digestions prior to this report, undissolved Fe observed and noted in this report for SB7a, and potential issues with accurate Al measurements when processing HM waste, the DWPF lab should consider a different digestion scheme that relieves some of these issues.
- The results of this study need to be assessed against the glass processing control algorithms of the DWPF to determine the potential impact of any statistical difference of the means between elements. Specifically, the DWPF should investigate if comparisons between the elemental concentrations of the SME product (adjusted for frit addition) obtained by the mixed acid and peroxide fusion digestion and the SRAT Receipt and SRAT Product elemental concentrations obtained *via* the DWPF CC method provide insight into the adequacy of the CC method for analysis of the SRAT Product. If a consistent difference in elemental concentrations is revealed, another type of digestion (i.e. sodium peroxide/hydroxide fusion) should be used to determine the concentration of the element in question. Particular emphasis should be placed on monitoring Al, Fe, K, Ni, Mn and Th concentrations in SB7a.

2.0 EXPERIMENTAL

The radioactive sludge slurry used in this study for verification of the DWPF CC method is from the three liter qualification sample of Tank 51 sludge slurry received at SRNL on September 18th, 2010. The sample was delivered to SRNL, characterized and then modified by a series of wash/decant cycles to match the Tank Farm endpoint as of October 13, 2010. The sludge used in this testing corresponded to SC-11, the washed SB7a sample identified by Pareizs et al. in SRNL-L3100-2010-00252, which is the SB7a qualification sample or the SRAT Receipt sample.

The sludge samples were dissolved in quadruplicate in the SRNL Shielded Cells facility in a manner similar to the DWPF CC method, and by PF and AR digestion. For detailed steps of the PF digestion, see ADS procedure 2502.¹ For detailed steps of the AR digestion, see ADS procedure 2226.² Three replicate dissolutions of the analytical reference glass (ARG) standard were performed concurrently with each set of digestions for quality control purposes. The ARG results are then evaluated by comparing the measured results against a two sigma variation of the standard deviation associated with measured concentrations obtained from a round-robin consensus study. For the SRAT Receipt material, Si and Zr (as expected) were low and flagged as being outside of the 2 sigma limits for the AR digestions. Ca and K were flagged as being outside the 2 sigma limits (slightly high) for the PF digestions. For the SRAT product material, Si and Zr (as expected) were flagged as being outside of the 2 sigma limits for the AR digestions as well as Ti. Ca and Mg were flagged as being outside of the 2 sigma limits for the CC digestions. Ca and Mn were flagged as being outside of the 2 sigma limits for the PF digestions. Additional quality control measures included ICP-AES analyses of a multi-element standard as a check for ICP-AES accuracy independent of digestions. Elements in this standard included Al, Fe, Mn, Ni, Na and S. All measured values were within 10% of the known concentrations for these elements in the standard analyzed concurrently with the PF and AR digestions. For the standard analyzed concurrently with the CC samples, Ni was 10-11% low.

The CC method digestion (see DWPF Procedure SW4-15.201) involved adding 25 mL of concentrated HF to radioactive sludge slurry (~3.5 g for the SRAT Receipt at 18.1 wt% total solids and ~3.5 g for the SRAT Product at 25.4 wt% total solids) and stirring for 1 hr. Then, 25 mL of concentrated HNO₃ was added and the mixture was stirred for an additional 30 minutes. Undissolved brown solids remained in each digestion bottle after all the acid addition was complete. Each sample was then diluted with de-ionized (DI) water to 250 mL in a pre-weighed volumetric flask. The density of the solution was obtained from the weight of the 250 mL of solution. Approximately 15 g of solution was taken from the 250 mL volumetric flask and added to a 100 mL volumetric flask and subsequently diluted with DI water. After several days, an attempt was made to recover the insoluble/precipitated solids from one of the samples by filtration but the extremity dose rate of the solids prevented personnel from removing the sample from the shielded cells.

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3.0 INTRODUCTION AND RESULTS

The DWPF is currently processing and immobilizing radioactive sludge slurry into a durable borosilicate glass. The DWPF has already processed six sludge batches (Sludge Batch 1A, Sludge Batch 1B, Sludge Batch 2, Sludge Batch 3, Sludge Batch 4, and Sludge Batch 5) and is currently processing a seventh (Sludge Batch 6). A sludge batch is defined as a single tank of sludge or a combination of sludges from different tanks that has been or will be qualified before being transferred to DWPF. Thus, following the sludge batch preparation plan of the Liquid Waste Organization (LWO), the qualified sludge in Tank 51 is to be blended with the heel of the previous sludge batch in Tank 40. The sludge being qualified at the SRNL (referred to as a “batch” composition in sludge batch planning) is to be combined with the heel of the previous sludge batch in DWPF to yield the “blend” composition. The next batch of radioactive sludge slurry to be processed by the DWPF is SB7a. The subject of this report is the SB7a material from Tank 51 that is being qualified at SRNL.

The statistical results of the SB7a samples generated from this study are provided in Table A1 of Appendix A. The results from each type of digestion are summarized in Table 3-1 for the SRAT Receipt and Table 3-3 for the SRAT Product samples. The ICP-AES results of the seventeen elements that are analyzed by the DWPF lab are presented on a weight percent (wt%) of total solids basis. A statistical comparison of the means from the SRAT Receipt and SRAT Product for all three digestions could not be performed for B, Ca, Li, Na, Si or Zr. B was less than the detection limit in the AR and PF digestions and B is leached from the borosilicate spray chamber of the ICP-AES instrument due to the presence of HF in the CC digestions. Ca is a contaminant in the PF reagents (the PF blank Ca concentration was 1500 µg/g) and therefore only the means from the AR and CC digestions were compared. A less than value was reported for the Li concentration from the solutions generated by the CC and PF digestions. Na is added as part of the reagents used for PF digestions and only the means of the CC and AR digestions were compared. Si is leached from the ICP-AES instrument due to the presence of HF in the CC digestions and Si is known to not dissolve well in AR digestions. Zr could not be included in a statistical comparison of the means because the PF digestion utilizes a Zr crucible; therefore, only the AR and CC results were compared. However, the Zr result from the AR digestions was low. Zr dissolves better when HF is present and this can readily be seen from the ARG-1 analysis results. In addition, for the SRAT Product, the K concentrations could not be compared because K was less than the minimum detection limit in the PF and CC digestions.

Statistical comparisons of the data from the three digestion methods (for Na and Zr there are only two digestion methods) are provided in Exhibit A1 in Appendix A. The results were generated using JMP Version 7.0.2.³ The plots of this exhibit show a 95% confidence interval for the mean (a mean diamond) of each set of measurements. For each element, the mean concentration of the samples by each digestion method is provided, and means that are not connected by the same letter in the listing of the exhibit are significantly different at a significance level of 5%. For example consider the SRAT Product Fe measurements. The results of the exhibit indicate that the mean of the CC results differs from the means of the PF and AR results.

For the Na and Zr comparisons, the JMP output from an analysis of variance of the measurements for two digestions is provided, and only the 95% confidence mean diamond of each digestion is shown. Overlap marks show for each diamond, and overlap marks in one diamond that are closer to the mean of another diamond than that diamond's overlap marks indicate that those two groups are not different at the 95% confidence level. The visual comparisons are supported by an F test that compares the means of the AR and CC digestions for Na and Zr and the means of the AR and PF digestions for Si. If the p value is less than 0.05, then the means are statistically different at the 5% level. From Exhibit A1, there is no

statistical difference in the AR and CC means for Na for the SRAT Product or the SRAT Receipt samples.

Summaries of the statistical comparisons of Exhibit A1 are shown in Table 3-3 and Table 3-4. Digestion types not having a similar font, those that are not underlined or those separated by a less than sign are statistically different at the 5% significance level. Consider the SRAT Product Fe results, the averages of the Fe measurements by PF and AR method digestions are statistically the same, but these means are statistically different from the average obtained from the DWPF CC digestion (which is indicated by a less than sign separating the digestion types). ARG results are presented and compared for each digestion type for the SRAT Receipt and SRAT Product samples in Table 3-5 through Table 3-8, including a similar statistical comparison of the means.

During verification of the DWPF CC method for previous sludge batches, boehmite ($\text{AlO}(\text{OH})$), muscovite ($(\text{K},\text{Na})(\text{Al}, \text{Mg}, \text{Fe})_2(\text{Si}_{3.1}\text{Al}_{0.9})\text{O}_{10}(\text{OH})_2$), silicon dioxide (SiO_2), dipotassium sodium aluminum fluoride ($\text{K}_2\text{NaAl}_3\text{F}_{12}$), dipotassium aluminum pentafluoride (K_2AlF_5), aluminum fluoride (AlF_3), chiolite ($\text{Na}_5\text{Al}_3\text{F}_{14}$), cryolite (Na_3AlF_6), sodium magnesium aluminum hexafluoride (NaMgAlF_6), iron zirconium hexafluoride (FeZrF_6), disodium iron aluminum heptafluoride ($\text{Na}_2\text{FeAlF}_7$), and calcium thorium fluoride ($\text{Ca}_{0.5}\text{Th}_{0.5}\text{F}_3$) have been found.⁴

Table 3-1. Elemental concentrations of SB7a SRAT Receipt radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (wt%) of total dried solids basis.

Digestion Method →	Aqua Regia		Na ₂ O ₂ /NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]
Al	9.67E+00	3.7E+01	1.06E+01	3.1E+00	9.83E+00	1.2E+00
B	<2.85E-02	NA	<2.90E-02	NA	NA	NA
Ca	5.56E-01	2.0E+00	6.82E-01	4.2E+00	7.02E-01 [^]	2.4E+01
Cr	4.34E-02	6.9E+00	5.18E-02	6.6E+00	4.59E-02	4.7E-01
Cu	3.94E-02	4.6E+00	4.13E-02	3.4E+00	3.64E-02	2.6E+00
Fe	1.34E+01	7.5E+00	1.31E+01	3.1E+00	1.19E+01	8.0E-01
K	6.72E-02	5.3E+00	4.63E-01	1.2E+01	3.29E-01	6.9E+00
Li	2.80E-02	3.4E+00	<5.82E-02	NA	<4.11E-02	NA
Mg	2.76E-01	5.9E-01	2.78E-01	3.1E+00	4.13E-01	3.8E+01
Mn	3.16E+00	2.8E+00	3.10E+00	3.0E+00	2.99E+00	7.9E-01
Na	1.40E+01	9.3E-01	NA	NA	1.41E+01	5.8E-01
Ni	2.34E+00	1.5E+00	2.27E+00	3.3E+00	2.05E+00	8.3E-01
Si	6.21E-01	4.4E+01	1.48E+00	2.9E+00	NA	NA
Th	9.75E-01	4.8E-01	8.64E-01	5.4E+00	6.89E-01	1.3E+01
Ti	1.69E-02	3.8E+00	1.93E-02	7.2E+00	1.75E-02	2.2E+00
U	5.42E+00	2.3E+00	5.19E+00	3.6E+00	5.14E+00	7.9E-01
Zr	1.23E-01	1.5E+01	NA	NA	2.33E-01	1.2E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations except for Al from the AR digestions which is based upon two replicates. NA = Not Applicable. [#]%RSD is the percent relative standard deviation for the measurements. [^]Value not used in statistical comparison since calcium is a contaminant in the fusion reagents.

Table 3-2 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB7a SRAT Receipt sludge. Digestions not having the same font, those that are not underlined or those separated with a less than sign are statistically different at the 5% significance level.

Element	Statistical Comparisons
Al	AR, CC < PF
B	NA
Ca	AR, CC
Cr	AR, CC < PF
Cu	CC < AR, PF
Fe	CC, <u>PF</u> , <u>AR</u>
K	AR < CC < PF
Li	NA
Mg	AR, PF, CC
Mn	CC, <u>PF</u> , <u>AR</u>
Na	AR, CC
Ni	CC < PF, AR
Si	NA
Th	CC < PF, AR
Ti	AR, CC < PF
U	CC, <u>PF</u> , <u>AR</u>
Zr	AR < CC

*Analysis is based on averages from four replicate dissolutions and ICP-AES determinations except for Al from the AR digestions, which is based on two measurements. NA = Not Applicable.

For the SRAT Receipt sample:

- The SRAT Receipt CC digestion solutions contained visible brown and white solids. The PF and AR digestion solutions did not contain visible solids.
- A statistical difference of means is observed for Al when comparing the PF results to the CC and AR results. The mean PF Al concentration is 7-8% higher than the CC and AR means.
- A statistical difference of means is observed for Cu when the CC mean is compared to the PF and AR means. The CC results are ~8% lower than the AR digestion and ~13% lower than the PF mean.
- A statistical difference of means is observed for Cr when comparing the PF results to the CC and AR results. The mean PF Cr concentration is 12% and 18% higher than the CC and AR means, respectively.
- A statistical difference of means is observed for Fe comparing the AR mean to the CC mean. The CC mean is ~12% lower than the AR mean. There is no statistical difference between the CC and PF means although the PF mean is ~9% higher than the CC mean. However, the brown visible solids in the digestions, indicate the CC method is not adequate for Fe determination.
- A statistical difference of means is noted for K when the three digestion methods are compared. The PF mean is 34% and 150% higher relative to the AR and CC means, respectively.
- A statistical difference of means is noted for Mn when comparing the AR and CC results. No statistical difference is noted between the PF and CC means. The relative difference between the AR mean and CC mean is ~6%. The relative difference between the PF and CC mean is

~4%. The small relative difference indicates there is very little spread in the results even if there is a statistical difference.

- A statistical difference of means is observed for Ni when comparing the CC results to the PF and AR results. The mean CC Ni concentration is 10% and 13% lower than the AR and PF means, respectively.
- A statistical difference of means is observed for Th when comparing the CC results to the PF and AR results. The mean CC Th concentration is 23% and 34% lower than the AR and PF means, respectively.
- A statistical difference of means is observed for Ti when the AR and CC results are compared to the PF mean. The mean CC concentration is ~9% lower than the PF mean and the AR mean is ~13% lower. There is not a statistical difference between the means of AR and CC.
- A statistical difference of means is observed for U when the AR mean is compared to the CC mean. The mean CC concentration is ~5% lower than the AR mean. There is not a statistical difference between the means of PF and CC.
- It is expected that Si and Zr have statistical differences between the digestion types. The PF method is the only method that can be used at SRNL to obtain reliable Si values from sludge matrices. The CC method is the only method from which reliable Zr values can be obtained.

A statistical comparison of means from the results of digesting the glass standard ARG-1 was not performed. However, relative differences are listed in Tables 3-5 – 3-8. For the AR digestions, Cu was the only element with a relative difference greater than 10% compared to the known concentration of Cu in ARG-1. Si and Zr are not considered because the means of these elements are expected to be greater than 10% different. For the PF digestions, Ca, Cr and K means were greater than 10% different than the known concentrations in ARG-1. Ca is a contaminant in the PF reagents. For the CC digestions, Ni was the only element which had a mean greater than 10% different than the known Ni concentration in ARG-1. Low recovery of Ni in the SB7a samples and ARG-1 glass underscores the importance of using a different digestion method to determine Ni for SB7a. Low recovery of Ni has occurred before when method validation was carried out for SB6.⁴

Table 3-3 contains the elemental concentrations of the SB7a SRAT Product sample.

Table 3-3. Elemental concentrations of SB7a SRAT Product radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) total dried solids basis.

Digestion Method →	Aqua Regia		Na ₂ O ₂ /NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]
Al	8.42E+00	2.0E+00	8.92E+00	1.2E+00	8.06E+00	2.8E+00
B	3.09E-03	2.3E-01	<2.50E-02	NA	NA	NA
Ca	4.66E-01	1.2E+00	6.17E-01	2.6E+00	5.73E-01 [^]	1.7E+01
Cr	4.09E-02	1.7E+00	3.78E-02	2.5E+00	3.94E-02	1.2E+00
Cu	3.27E-02	1.7E+00	3.26E-02	5.4E+00	3.00E-02	2.8E+00
Fe	1.11E+01	1.7E+00	1.10E+01	1.7E+00	1.03E+01	1.5E+00
Li	2.64E-02	1.3E+00	<5.04E-02	NA	<3.01E-02	NA
K	7.00E-02	5.6E+00	<2.33E-01	NA	2.14E-01	2.4E+01
Mg	2.13E-01	1.3E+00	2.14E-01	1.4E+00	3.46E-01	2.6E+01
Mn	2.32E+00	2.0E+00	2.34E+00	1.1E+00	2.36E+00	1.2E+00
Na	1.53E+01	1.4E+00	NA	NA	1.55E+01	6.5E-01
Ni	2.02E+00	1.3E+00	1.98E+00	1.7E+00	1.78E+00	1.1E+00
Si	NA	NA	1.21E+00	1.4E+00	NA	NA
Th	8.64E-01	1.2E+00	9.27E-01	3.7E+00	4.32E-01	2.5E+01
Ti	1.42E-02	1.5E+00	1.43E-02	3.2E+00	1.51E-02	3.7E+00
U	4.49E+00	7.6E-01	4.45E+00	2.1E+00	4.50E+00	9.4E-01
Zr	1.12E-01	2.1E+01	NA	NA	1.96E-01	1.7E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations except for B which is based upon two replicates. NA = Not Applicable. [#]%RSD is the percent relative standard deviation for the measurements.

[^]Value not used in statistical comparison since calcium is a contaminant in the fusion reagents.

A statistical comparison of means from SB7a SRAT product digestions is presented in Table 3-4.

Table 3-4. Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB7a SRAT Product sludge. Digestions not having the same font, those that are not underlined or those separated with a less than sign are statistically different at the 5% significance level.

Element	Statistical Comparisons
Al	CC < AR < PF
B	NA
Ca	AR, CC
Cr	PF < CC < AR
Cu	CC < PF, AR
Fe	CC < PF, AR
K	AR < CC
Li	NA
Mg	AR, PF, < CC
Mn	AR, PF, CC
Na	AR, CC
Ni	CC < PF, AR
Si	NA
Th	CC < AR, PF
Ti	<u>AR, PF, CC</u>
U	PF, AR, CC
Zr	AR < CC

*All averages are based upon four replicate dissolutions and ICP-AES determinations. NA = Not Applicable.

For the SRAT Product sample:

- The SRAT Product CC digestion solutions contained visible brown and white solids. The PF and AR digestion solutions did not contain visible solids.
- A statistical difference of means is observed for Al when comparing the results from the three digestions. The mean PF Al concentration is ~10% higher than the CC mean and the AR mean is ~4% higher than the CC mean.
- A statistical difference of means is observed for Cr when the three digestion methods are compared. The mean PF Cr concentration is 4-8% lower than the CC and AR means. The small relative difference indicates there is very little spread in the results even if there is a statistical difference.
- A statistical difference of means is observed for Cu when the CC mean is compared to the PF and AR means. The mean CC Cu concentration is ~8% lower than the PF and AR means. The small relative difference with a statistical difference indicates a very small spread in the results for each digestion method.
- A statistical difference of means is observed for Fe comparing the CC mean to the AR and PF means. The CC mean is ~7% lower than the AR and PF means.
- A statistical difference of means is observed for Mg comparing the CC mean to the AR and PF means. The AR and PF means are ~47% lower than the CC mean. However, the large %RSD associated with the CC measurements indicates the concentration in the diluted sample was very close to the ICP-AES detection limit and therefore it is the opinion of the author that the CC value, in this case, should not be used. No statistical difference was noted for Mg between the AR and PF means.

- A statistical difference of means is observed for Ni when comparing the CC results to the PF and AR results. The mean CC Ni concentration is 10% and 12% lower than the AR and PF means, respectively.
- A statistical difference of means is observed for Th when comparing the CC results to the PF and AR results. The mean CC Th concentration is 67% and 73% lower than the AR and PF means, respectively.
- A statistical difference of means is observed for Ti when the AR and CC results are compared. The mean CC concentration is ~6% higher than the AR mean. There is not a statistical difference between the means of AR and PF and there is not a statistical difference between the means of PF and CC.
- It is expected that Si and Zr have statistical differences between the digestion types. The PF method is the only method that can be used at SRNL to obtain reliable Si values from sludge matrices. The CC method is the only method from which reliable Zr values can be obtained.

A statistical comparison of means from the results of digesting the glass standard ARG-1 was not performed. However, relative differences are listed in Tables 3-5 through table 3-8. For the AR digestions, Cu and Ti are elements having greater than 10% difference compared to the known concentration of Cu and Ti in ARG-1. Si and Zr are not considered because the means of these elements are expected to be greater than 10% different. For the PF digestions, B and Ca means were greater than 10% different than the known concentrations in ARG-1. Ca is a contaminant in the PF reagents. For the CC digestions, Ca and Mg were greater than 20% higher than the known concentrations in ARG-1, the cause of this is not known for sure but based upon the %RSDs, the concentration of these elements must be very close to the ICP-AES detection limit and Ca is a contaminant in the PF reagents.

Table 3-5 through Table 3-8 contain the ICP-AES measured weight percent elemental results from triplicate digestions of the ARG standard performed concurrently with the SB7a SRAT samples to determine if the dissolutions were complete and the resulting analyses accurate. Comparison to the known elemental weight percent in the ARG standard is also given in Tables 3-5 through 3-8.

Table 3-5. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.

Aqua Regia*				
Element	Average Wt%	%RSD	Standard Value	%Difference (Measured vs Standard Value)
Al	2.44E+00	3.4E+00	2.50E+00	-2.4
B	2.63E+00	2.6E+00	2.69E+00	-2.4
Ca	1.02E+00	3.0E+00	1.02E+00	-0.2
Cr	6.55E-02	2.2E+00	6.40E-02	2.3
Cu	2.54E-03	2.9E+00	3.00E-03	-15.4
Fe	9.88E+00	2.7E+00	9.79E+00	0.9
K	2.25E+00	2.0E+00	2.26E+00	-0.3
Li	1.47E+00	2.6E+00	1.49E+00	-1.1
Mg	5.11E-01	2.8E+00	5.20E-01	-1.8
Mn	1.45E+00	2.6E+00	1.46E+00	-0.5
Na	8.55E+00	2.6E+00	8.52E+00	0.4
Ni	8.28E-01	2.9E+00	8.27E-01	0.2
Si	4.89E-01	2.1E+01	2.24E+01	-97.8
Ti	6.43E-01	3.7E+00	6.90E-01	-6.8
Zr	6.65E-02	2.6E+00	9.60E-02	-30.7
Sodium Peroxide/Hydroxide Fusion*				
Element	Average Wt%	%RSD	Standard Value	%Difference (Measured vs Standard Value)
Al	2.50E+00	8.2E+00	2.50E+00	-0.2
B	2.50E+00	7.4E+00	2.69E+00	-7.1
Ca	1.17E+00	7.4E+00	1.02E+00	14.7
Cr	7.48E-02	1.5E+01	6.40E-02	16.8
Cu	<1.07E-02	NA	3.00E-03	NA
Fe	9.65E+00	8.9E+00	9.79E+00	-1.4
K	2.58E+00	6.6E+00	2.26E+00	13.9
Li	1.40E+00	8.3E+00	1.49E+00	-6.0
Mg	5.14E-01	7.6E+00	5.20E-01	-1.2
Mn	1.40E+00	1.1E+01	1.46E+00	-4.5
Na	NA	NA	8.52E+00	NA
Ni	7.91E-01	8.3E+00	8.27E-01	-4.4
Si	2.23E+01	3.2E+00	2.24E+01	-0.4
Ti	7.02E-01	1.1E+01	6.90E-01	1.7
Zr	NA	NA	9.60E-02	NA

*All averages are based upon three replicate dissolutions and ICP-AES determinations except for the PF results which are based upon two replicates. NA = Not applicable.

Table 3-6. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	Average	%RSD	Known Value	%Difference (Measured vs Known Value)
Al	2.36E+00	7.3E-01	2.50E+00	-5.6
B	NA	NA	2.69E+00	NA
Ca	1.05E+00	5.5E-01	1.02E+00	3.3
Cr	6.39E-02	1.9E+00	6.40E-02	-0.2
Cu	<6.48E-03	NA	3.00E-03	NA
Fe	9.38E+00	3.4E-01	9.79E+00	-4.2
K	2.27E+00	1.8E+00	2.26E+00	0.3
Li	1.48E+00	3.9E-01	1.49E+00	-0.9
Mg	5.04E-01	5.2E-01	5.20E-01	-3.1
Mn	1.40E+00	1.5E-06	1.46E+00	-4.1
Na	8.62E+00	5.3E-01	8.52E+00	1.2
Ni	7.30E-01	3.4E-01	8.27E-01	-11.7
Si	NA	NA	2.24E+01	NA
Ti	6.73E-01	5.2E-01	6.90E-01	-2.4
Zr	9.51E-02	6.1E-01	9.60E-02	-0.9

*All averages are based upon three replicate dissolutions and ICP-AES determinations NA = Not applicable. <MDL = less than minimum detection limit.

Table 3-7. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

Aqua Regia*				
Element	Average	%RSD	Standard Value	%Difference (Measured vs Standard Value)
Al	2.46E+00	4.7E-01	2.50E+00	-1.5
B	2.62E+00	8.8E-01	2.69E+00	-2.5
Ca	9.93E-01	1.2E-01	1.02E+00	-2.7
Cr	6.43E-02	1.6E+00	6.40E-02	0.4
Cu	2.31E-03	6.6E+00	3.00E-03	-22.9
Fe	9.80E+00	1.8E-01	9.79E+00	0.1
K	2.25E+00	2.6E-01	2.26E+00	-0.6
Li	1.46E+00	0.0E+00	1.49E+00	-2.0
Mg	5.02E-01	4.1E-01	5.20E-01	-3.5
Mn	1.41E+00	4.1E-01	1.46E+00	-3.7
Na	8.58E+00	4.2E-01	8.52E+00	0.7
Ni	8.48E-01	2.5E-01	8.27E-01	2.6
Si	NA	NA	2.24E+01	NA
Ti	5.93E-01	1.5E+00	6.90E-01	-14.0
Zr	1.09E-02	9.2E-01	9.60E-02	-88.6
Sodium Peroxide/Hydroxide Fusion*				
Element	Average	%RSD	Known Value	%Difference (Measured vs Known Value)
Al	2.46E+00	3.3E+00	2.50E+00	-1.5
B	2.41E+00	2.7E+00	2.69E+00	-10.3
Ca	1.17E+00	4.2E+00	1.02E+00	15.0
Cr	6.60E-02	4.0E+00	6.40E-02	3.2
Cu	<1.17E-02	NA	3.00E-03	NA
Fe	9.36E+00	3.1E+00	9.79E+00	-4.4
K	2.30E+00	4.1E+00	2.26E+00	1.8
Li	1.47E+00	2.7E+00	1.49E+00	-1.3
Mg	5.01E-01	3.0E+00	5.20E-01	-3.7
Mn	1.35E+00	2.6E+00	1.46E+00	-7.3
Na	NA	NA	8.52E+00	NA
Ni	8.01E-01	4.1E+00	8.27E-01	-3.1
Si	2.16E+01	1.6E+00	2.24E+01	-3.7
Ti	6.64E-01	2.2E+00	6.90E-01	-3.7
Zr	2.46E+00	3.3E+00	9.60E-02	NA

*All averages are based upon three replicate dissolutions and ICP-AES determinations NA = Not applicable.

Table 3-8. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB7a SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	Average	%RSD	Known Value	%Difference (Measured vs Known Value)
Al	2.45E+00	3.6E+00	2.50E+00	-2.0
B	NA	NA	2.69E+00	NA
Ca	1.24E+00	1.3E+01	1.02E+00	21.2
Cr	6.45E-02	6.3E-01	6.40E-02	0.8
Cu	<6.23E-03	NA	3.00E-03	NA
Fe	9.59E+00	1.6E-01	9.79E+00	-2.0
K	2.26E+00	1.3E+00	2.26E+00	0.1
Li	1.49E+00	6.7E-01	1.49E+00	0.0
Mg	6.66E-01	2.0E+01	5.20E-01	28.1
Mn	1.43E+00	0.0E+00	1.46E+00	-2.1
Na	8.72E+00	2.3E-01	8.52E+00	2.3
Ni	7.49E-01	4.3E-01	8.27E-01	-9.5
Si	NA	NA	2.24E+01	NA
Ti	6.84E-01	2.2E-01	6.90E-01	-0.9
Zr	9.67E-02	5.1E-01	9.60E-02	0.8

*All averages are based upon three replicate dissolutions and ICP-AES determinations NA = Not applicable. <MDL = less than minimum detection limit.

Good recoveries were observed for most elements of significant weight percent in the ARG standards. There are a few anomalies but based upon the %RSDs some of these elements were near the ICP-AES detection limit. Upon review of the SRAT Receipt, Product and ARG data it is evident that not all of the digestion issues seen with the radioactive sample are mirrored with the ARG standard. For instance, the Fe in the ARG appears to dissolve well in each digestion method as well as Al. The SRAT Receipt and SRAT product have ~4 wt% more Fe than the ARG standard and the one and one-half hour time frame allotted for the digestion does not appear to be sufficient for dissolving all of the Fe. SB7a also contains some HM waste and the different phases of aluminum species present SRAT in the sludge slurry (*boehmite* and *gibbsite* among others) have varying solubility in the acid matrices. The Ni concentration measured in CC digestions of the ARG standards are consistently lower than the known concentration and the CC measured Ni concentrations are also lower than the PF and AR digestions of the SRAT Receipt/SRAT Product. Ni recovery in the ARG standards could be improved with the addition of HCl and Fe dissolution in the SRAT Receipt/SRAT Product could be improved with the addition of HCl but this is not an option for the DWPF.

4.0 CONCLUSIONS

The results presented in this report document potential problems with the DWPF CC method and the accuracy of this digestion for certain elements contained in SB7a. Al, Fe, Ni, Mn and Th should be determined with an alternate digestion method such as the PF method or in some cases in conjunction with the CC method, which may be more suitable for Ni and Mn. A statistical difference for other elements was seen as well but that does not mean that the DWPF should seek an alternate method for all elements having a statistical difference between digestion methods especially when the relative percent difference between the digestions is small. It is beyond the scope of this report to determine how accurate the data needs to be to stay within the glass processing parameters for SB7a.

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5.0 RECOMMENDATIONS

The following recommendations are based upon results in this report:

- A statistically significant difference in the means (at the 5% significance level) was observed for Al, Cr, Cu, Fe, K, Mn, Ni, Ti, and Th for SB7a for the SRAT Receipt or SRAT Product samples or both. The relative difference of 10% or greater for Fe and Ni in the CC digestions versus the AR and PF digestions may be a potential issue and therefore needs to be evaluated by the DWPF for its impact. Although K is a minor element, large relative differences are noted in this report between the different digestions and the DWPF should also monitor the K concentration. Al, Fe, Ni and Th should be analyzed by the peroxide fusion method for SB7a. Mn can be measured using either the CC or PF method but monitored closely and the highest Mn concentration between the two digestions should be used.
- A dissolution study should be performed on the SB7a WAPS sample by SRNL which consists of the final composition of the sludge (the SB7a Blend) to determine if the Fe, Mn, and Ni concentrations are consistently low in the CC digestions versus the AR and PF methods for SB7a given the blending that will occur with SB7a.
- The DWPF CC method was originally developed to be used for SME analyses. Given continuous visual observations of solids in the CC digestions both at SRNL and DWPF, potential issues with accurate Al measurements when processing HM waste, and the results in this report, SRNL recommends that the DWPF consider a different digestion scheme that relieves some of these issues.
- The results of this study need to be assessed against the glass processing control algorithms of the DWPF to determine the potential impact of any statistical difference of the means between elements. Specifically, the DWPF lab should investigate if comparisons between the elemental concentrations of the SME product (adjusted for frit addition) obtained by the mixed acid and peroxide fusion digestion and the SRAT Receipt and SRAT Product elemental concentrations obtained *via* the DWPF CC method provide insight into the adequacy of the CC method for analysis of the SRAT Product. It is beyond the scope of this report to determine how accurate the data needs to be to stay within the glass processing parameters for SB7a. If a consistent difference in elemental concentrations is revealed, another type of digestion (i.e. sodium peroxide/hydroxide fusion) should be used to determine the concentration of the element in question. Particular emphasis should be placed on monitoring Al, Fe, K, Mn, Ni and Th concentrations in SB7a.

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6.0 REFERENCES

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8.0 APPENDIX A. SUPPORTING INFORMATION

Variability Summary for Measurement (wt%)									
	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	2.425556	0.096297	0.022698		2.377668	2.473443	2.14	2.55	18
Target (wt%)[2.5]	2.425556	0.096297	0.022698		2.377668	2.473443	2.14	2.55	18
Target (wt%)[2.5] Type[ARG-1 (P)]	2.458889	0.060093	0.020031		2.412698	2.50508	2.39	2.55	9
Target (wt%)[2.5] Type[ARG-1 (R)]	2.392222	0.116595	0.038865		2.302599	2.481845	2.14	2.51	9
Target (wt%)[2.5] Type[ARG-1 (P)] Prep[Aqua Regia]	2.463333	0.011547	0.006667		2.434649	2.492018	2.45	2.47	3
Target (wt%)[2.5] Type[ARG-1 (P)] Prep[Cold Chem]	2.45	0.087178	0.050332		2.233438	2.666562	2.39	2.55	3
Target (wt%)[2.5] Type[ARG-1 (P)] Prep[Peroxide Fusion]	2.463333	0.080829	0.046667		2.262543	2.664124	2.39	2.55	3
Target (wt%)[2.5] Type[ARG-1 (R)] Prep[Aqua Regia]	2.44	0.081854	0.047258		2.236665	2.643335	2.35	2.51	3
Target (wt%)[2.5] Type[ARG-1 (R)] Prep[Cold Chem]	2.36	0.017321	0.01		2.316973	2.403027	2.35	2.38	3
Target (wt%)[2.5] Type[ARG-1 (R)] Prep[Peroxide Fusion]	2.376667	0.20502	0.118369		1.867368	2.885965	2.14	2.5	3

Variability Gauge Grouping=ARG-1, Element=B
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[2.69]	2.514167	0.146254	0.04222	2.421241	2.607092	2.18	2.68	12	
Target (wt%)[2.69] Type[ARG-1 (P)]	2.514167	0.146254	0.04222	2.421241	2.607092	2.18	2.68	12	
Target (wt%)[2.69] Type[ARG-1 (R)]	2.518333	0.123031	0.050227	2.38922	2.647447	2.35	2.65	6	
Target (wt%)[2.69] Type[ARG-1 (R)]	2.51	0.17855	0.072893	2.322624	2.697376	2.18	2.68	6	
Target (wt%)[2.69] Type[ARG-1 (P)] Prep[Aqua Regia]	2.623333	0.023094	0.013333	2.565965	2.680702	2.61	2.65	3	
Target (wt%)[2.69] Type[ARG-1 (P)] Prep[Cold Chem]								0	
Target (wt%)[2.69] Type[ARG-1 (P)] Prep[Peroxide Fusion]	2.413333	0.065064	0.037565	2.251705	2.574961	2.35	2.48	3	
Target (wt%)[2.69] Type[ARG-1 (R)] Prep[Aqua Regia]	2.626667	0.068069	0.039299	2.457575	2.795758	2.55	2.68	3	
Target (wt%)[2.69] Type[ARG-1 (R)] Prep[Cold Chem]								0	
Target (wt%)[2.69] Type[ARG-1 (R)] Prep[Peroxide Fusion]	2.393333	0.185023	0.106823	1.933712	2.852955	2.18	2.51	3	

VVariability Gauge Grouping=ARG-1, Element=Ca
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[1.02]	1.098944	0.109714	0.02586	0.02586	1.04385	1.15304	0.983	1.35	18
Target (wt%)[1.02] Type[ARG-1 (P)]	1.098944	0.109714	0.02586	0.02586	1.04385	1.15304	0.983	1.35	18
Target (wt%)[1.02] Type[ARG-1 (R)]	1.134222	0.13653	0.04551	0.04551	1.029276	1.239168	0.992	1.35	9
Target (wt%)[1.02] Type[ARG-1 (P)] Prep[Aqua Regia]	1.063667	0.064331	0.021444	0.021444	1.014217	1.113116	0.983	1.17	9
Target (wt%)[1.02] Type[ARG-1 (P)] Prep[Cold Chem]	0.992667	0.001155	0.000667	0.000667	0.989798	0.995535	0.992	0.994	3
Target (wt%)[1.02] Type[ARG-1 (P)] Prep[Fusion]	1.236667	0.155027	0.089505	0.089505	0.851559	1.621775	1.06	1.35	3
Target (wt%)[1.02] Type[ARG-1 (R)] Prep[Aqua Regia]	1.173333	0.049329	0.02848	0.02848	1.050794	1.295873	1.14	1.23	3
Target (wt%)[1.02] Type[ARG-1 (R)] Prep[Cold Chem]	1.017667	0.030436	0.017572	0.017572	0.94206	1.093273	0.983	1.04	3
Target (wt%)[1.02] Type[ARG-1 (R)] Prep[Fusion]	1.053333	0.005774	0.003333	0.003333	1.038991	1.067676	1.05	1.06	3
Target (wt%)[1.02] Type[ARG-1 (R)] Prep[Peroxide Fusion]	1.12	0.086603	0.05	0.05	0.904867	1.335133	1.02	1.17	3

Variability Gauge Grouping=ARG-1, Element=Cr
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.065583	0.004484	0.001057	0.063353	0.067813	0.0584	0.0811	18	
Target (wt%)[0.06]	0.065583	0.004484	0.001057	0.063353	0.067813	0.0584	0.0811	18	
Target (wt%)[0.06] Type[ARG-1 (P)]	0.064944	0.001649	0.00055	0.063677	0.066212	0.063	0.0678	9	
Target (wt%)[0.06] Type[ARG-1 (R)]	0.066222	0.006252	0.002084	0.061416	0.071028	0.0584	0.0811	9	
Target (wt%)[0.06] Type[ARG-1 (P)] Prep[Aqua Regia]	0.064267	0.001012	0.000584	0.061754	0.06678	0.0631	0.0649	3	
Target (wt%)[0.06] Type[ARG-1 (P)] Prep[Cold Chem]	0.064533	0.00404	0.000233	0.063529	0.065537	0.0641	0.0649	3	
Target (wt%)[0.06] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.066033	0.002639	0.001524	0.059478	0.072589	0.063	0.0678	3	
Target (wt%)[0.06] Type[ARG-1 (R)] Prep[Aqua Regia]	0.0655	0.001442	0.000833	0.061917	0.069083	0.0639	0.0667	3	
Target (wt%)[0.06] Type[ARG-1 (R)] Prep[Cold Chem]	0.063867	0.001242	0.000717	0.060781	0.066953	0.0631	0.0653	3	
Target (wt%)[0.06] Type[ARG-1 (R)] Prep[Peroxide Fusion]	0.0693	0.011377	0.006568	0.041039	0.097561	0.0584	0.0811	3	

Variability Gauge Grouping=ARG-1, Element=Cu
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[0]	14.33882	41.9167	9.879861	9.879861	-6.50586	35.18351	0.00215	141	18
Target (wt%)[0] Type[ARG-1 (P)]	14.33882	41.9167	9.879861	9.879861	-6.50586	35.18351	0.00215	141	18
Target (wt%)[0] Type[ARG-1 (R)]	28.67092	57.19682	19.06561	19.06561	-15.2944	72.63628	0.00215	141	9
Target (wt%)[0] Type[ARG-1 (P)] Prep[Aqua Regia]	0.006727	0.00385	0.001283	0.001283	0.003767	0.009686	0.00248	0.0123	9
Target (wt%)[0] Type[ARG-1 (P)] Prep[ARG-1 (P)] Prep[Aqua Regia]	0.002313	0.000152	8.762e-5	0.001936	0.001936	0.00269	0.00215	0.00245	3
Target (wt%)[0] Type[ARG-1 (P)] Prep[ARG-1 (P)] Prep[Cold Chem]	0.006447	0.000202	0.000117	0.005945	0.005945	0.006949	0.00623	0.00663	3
Target (wt%)[0] Type[ARG-1 (P)] Prep[Peroxide Fusion]	86.004	75.43188	43.55061	43.55061	-101.379	273.3872	0.012	141	3
Target (wt%)[0] Type[ARG-1 (R)] Prep[Aqua Regia]	0.002537	7.371e-5	4.256e-5	0.002354	0.002354	0.00272	0.00248	0.00262	3
Target (wt%)[0] Type[ARG-1 (R)] Prep[Cold Chem]	0.006477	0.000272	0.000157	0.000157	0.005801	0.007153	0.0063	0.00679	3
Target (wt%)[0] Type[ARG-1 (R)] Prep[Peroxide Fusion]	0.011167	0.001793	0.001035	0.001035	0.006714	0.01562	0.0091	0.0123	3

Variability Summary for Measurement (wt%)									
	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	9.528333	0.417038	0.098297	9.320945	9.735721	8.18	10.1		18
Target (wt%)[9.79]	9.528333	0.417038	0.098297	9.320945	9.735721	8.18	10.1		18
Target (wt%)[9.79] Type[ARG-1 (P)]	9.584444	0.239797	0.079932	9.40012	9.768769	9.07	9.82		9
Target (wt%)[9.79] Type[ARG-1 (R)]	9.472222	0.552263	0.184088	9.047715	9.896729	8.18	10.1		9
Target (wt%)[9.79] Type[ARG-1 (P)] Prep[Aqua Regia]	9.8	0.017321	0.01	9.756973	9.843027	9.79	9.82		3
Target (wt%)[9.79] Type[ARG-1 (P)] Prep[Cold Chem]	9.593333	0.015275	0.008819	9.555388	9.631279	9.58	9.61		3
Target (wt%)[9.79] Type[ARG-1 (P)] Prep[Peroxide Fusion]	9.36	0.29	0.167432	8.6396	10.0804	9.07	9.65		3
Target (wt%)[9.79] Type[ARG-1 (R)] Prep[Aqua Regia]	9.88	0.269072	0.155349	9.211587	10.54841	9.58	10.1		3
Target (wt%)[9.79] Type[ARG-1 (R)] Prep[Cold Chem]	9.376667	0.032146	0.018559	9.296813	9.456521	9.34	9.4		3
Target (wt%)[9.79] Type[ARG-1 (R)] Prep[Peroxide Fusion]	9.16	0.858604	0.495715	7.027111	11.29289	8.18	9.78		3

VVVariability Gauge Grouping=ARG-1, Element=K
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%) [2.25]	2.301667	0.10988	0.025899	2.247025	2.356309	2.2	2.62	18
Target (wt%) [2.25] Type[ARG-1 (P)]	2.301667	0.10988	0.025899	2.247025	2.356309	2.2	2.62	18
Target (wt%) [2.25] Type[ARG-1 (R)]	2.27	0.055227	0.018409	2.227549	2.312451	2.21	2.4	9
Target (wt%) [2.25] Type[ARG-1 (P)] Prep[Aqua Regia]	2.333333	0.142653	0.047551	2.22368	2.442986	2.2	2.62	9
Target (wt%) [2.25] Type[ARG-1 (P)] Prep[Aqua Regia]	2.246667	0.005774	0.003333	2.232324	2.261009	2.24	2.25	3
Target (wt%) [2.25] Type[ARG-1 (P)] Prep[Cold Chem]	2.263333	0.028868	0.016667	2.191622	2.335044	2.23	2.28	3
Target (wt%) [2.25] Type[ARG-1 (P)] Prep[Peroxide Fusion]	2.3	0.095394	0.055076	2.063028	2.536972	2.21	2.4	3
Target (wt%) [2.25] Type[ARG-1 (R)] Prep[Aqua Regia]	2.253333	0.046188	0.026667	2.138596	2.368071	2.2	2.28	3
Target (wt%) [2.25] Type[ARG-1 (R)] Prep[Cold Chem]	2.266667	0.040415	0.023333	2.166271	2.367062	2.22	2.29	3
Target (wt%) [2.25] Type[ARG-1 (R)] Prep[Peroxide Fusion]	2.48	0.170587	0.098489	2.056238	2.903762	2.29	2.62	3

Variability Summary for Measurement (wt%)									
Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[1.49]	1.450556	0.070333	0.016578	1.41558	1.485531	1.2	1.51	1.51	18
Target (wt%)[1.49] Type[ARG-1 (P)]	1.450556	0.070333	0.016578	1.41558	1.485531	1.2	1.51	1.51	18
Target (wt%)[1.49] Type[ARG-1 (R)]	1.473333	0.024495	0.008165	1.454505	1.492162	1.43	1.51	1.51	9
Target (wt%)[1.49] Type[ARG-1 (R)]	1.427778	0.093512	0.031171	1.355898	1.499657	1.2	1.5	1.5	9
Target (wt%)[1.49] Type[ARG-1 (P)] Prep[Aqua Regia]	1.46	0	0	1.46	1.46	1.46	1.46	1.46	3
Target (wt%)[1.49] Type[ARG-1 (P)] Prep[Cold Chem]	1.49	0.01	0.005774	1.465159	1.514841	1.48	1.5	1.5	3
Target (wt%)[1.49] Type[ARG-1 (P)] Prep[Peroxide Fusion]	1.47	0.04	0.023094	1.370634	1.569366	1.43	1.51	1.51	3
Target (wt%)[1.49] Type[ARG-1 (R)] Prep[Aqua Regia]	1.473333	0.037859	0.021858	1.379285	1.567381	1.43	1.5	1.5	3
Target (wt%)[1.49] Type[ARG-1 (R)] Prep[Cold Chem]	1.476667	0.005774	0.003333	1.462324	1.491009	1.47	1.48	1.48	3
Target (wt%)[1.49] Type[ARG-1 (R)] Prep[Peroxide Fusion]	1.333333	0.115902	0.066916	1.045416	1.621251	1.2	1.41	1.41	3

Variability Gauge Grouping=ARG-1, Element=Mg
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[0.52]	0.529167	0.079439	0.018724	0.489662	0.568671	0.447	0.753	18	
Target (wt%)[0.52] Type[ARG-1 (P)]	0.529167	0.079439	0.018724	0.489662	0.568671	0.447	0.753	18	
Target (wt%)[0.52] Type[ARG-1 (R)]	0.556222	0.106101	0.035367	0.474666	0.637779	0.487	0.753	9	
Target (wt%)[0.52] Type[ARG-1 (R)]	0.502111	0.022486	0.007495	0.484827	0.519395	0.447	0.523	9	
Target (wt%)[0.52] Type[ARG-1 (P)] Prep[Aqua Regia]	0.501667	0.002082	0.001202	0.496496	0.506838	0.5	0.504	3	
Target (wt%)[0.52] Type[ARG-1 (P)] Prep[Cold Chem]	0.666333	0.132342	0.076408	0.337578	0.995088	0.514	0.753	3	
Target (wt%)[0.52] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.500667	0.015177	0.008762	0.462966	0.538368	0.487	0.517	3	
Target (wt%)[0.52] Type[ARG-1 (R)] Prep[Aqua Regia]	0.510667	0.014295	0.008253	0.475157	0.546176	0.495	0.523	3	
Target (wt%)[0.52] Type[ARG-1 (R)] Prep[Cold Chem]	0.504	0.002646	0.001528	0.497428	0.510572	0.502	0.507	3	
Target (wt%)[0.52] Type[ARG-1 (R)] Prep[Peroxide Fusion]	0.491667	0.039145	0.0226	0.394425	0.588908	0.447	0.52	3	

Variability Gauge Grouping=ARG-1, Element=Mn
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[1.46]	1.391667	0.074931	0.017661	0.017661	1.354404	1.428929	1.13	1.48	18
Target (wt%)[1.46] Type[ARG-1 (P)]	1.391667	0.074931	0.017661	0.017661	1.354404	1.428929	1.13	1.48	18
Target (wt%)[1.46] Type[ARG-1 (R)]	1.396667	0.038406	0.012802	0.012802	1.367145	1.426188	1.32	1.43	9
Target (wt%)[1.46] Type[ARG-1 (P)]	1.386667	0.10198	0.033993	0.033993	1.308278	1.465056	1.13	1.48	9
Target (wt%)[1.46] Type[Aqua Regia] Prep[Aqua Regia]	1.406667	0.005774	0.003333	0.003333	1.392324	1.421009	1.4	1.41	3
Target (wt%)[1.46] Type[ARG-1 (P)] Prep[Cold Chem]	1.43	0	0	0	1.43	1.43	1.43	1.43	3
Target (wt%)[1.46] Type[ARG-1 (P)] Prep[Peroxide Fusion]	1.353333	0.035119	0.020276	0.020276	1.266093	1.440573	1.32	1.39	3
Target (wt%)[1.46] Type[ARG-1 (R)] Prep[Aqua Regia]	1.453333	0.037859	0.021858	0.021858	1.359285	1.547381	1.41	1.48	3
Target (wt%)[1.46] Type[ARG-1 (R)] Prep[Cold Chem]	1.4	0	0	0	1.4	1.4	1.4	1.4	3
Target (wt%)[1.46] Type[ARG-1 (R)] Prep[Peroxide Fusion]	1.306667	0.153731	0.088757	0.088757	0.924777	1.688557	1.13	1.41	3

VV Variability Gauge Grouping=ARG-1, Element=Na
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[8.53]	8.618333	0.118769	0.034286	8.542871	8.693796	8.3	8.3	8.74	12
Target (wt%)[8.53] Type[ARG-1 (P)]	8.618333	0.118769	0.034286	8.542871	8.693796	8.3	8.3	8.74	12
Target (wt%)[8.53] Type[ARG-1 (R)]	8.65	0.080994	0.033066	8.565002	8.734998	8.54	8.54	8.74	6
Target (wt%)[8.53] Type[ARG-1 (P)] Prep[Aqua Regia]	8.586667	0.148549	0.060645	8.430775	8.742559	8.3	8.3	8.72	6
Target (wt%)[8.53] Type[ARG-1 (P)] Prep[Cold Chem]	8.58	0.036056	0.020817	8.490433	8.669567	8.54	8.54	8.61	3
Target (wt%)[8.53] Type[ARG-1 (P)] Prep[Fusion]	8.72	0.02	0.011547	8.670317	8.769683	8.7	8.7	8.74	3
Target (wt%)[8.53] Type[ARG-1 (R)] Prep[Aqua Regia]	8.553333	0.22301	0.128755	7.999346	9.10732	8.3	8.3	8.72	0
Target (wt%)[8.53] Type[ARG-1 (R)] Prep[Cold Chem]	8.62	0.045826	0.026458	8.506163	8.733837	8.58	8.58	8.67	3
Target (wt%)[8.53] Type[ARG-1 (R)] Prep[Fusion]									0

Variability Gauge Grouping=ARG-1, Element=Ni
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[0.83]	0.784889	0.052248	0.012315	0.784889	0.758906	0.810871	0.677	0.851	18
Target (wt%)[0.83] Type[ARG-1 (P)]	0.784889	0.052248	0.012315	0.784889	0.758906	0.810871	0.677	0.851	18
Target (wt%)[0.83] Type[ARG-1 (R)]	0.799333	0.046174	0.015391	0.763841	0.726965	0.834825	0.745	0.85	9
Target (wt%)[0.83] Type[ARG-1 (P)] Prep[Aqua Regia]	0.770444	0.056564	0.018855	0.726965	0.843162	0.813924	0.677	0.851	9
Target (wt%)[0.83] Type[ARG-1 (P)] Prep[Aqua Regia]	0.848333	0.002082	0.001202	0.843162	0.756652	0.853504	0.846	0.85	3
Target (wt%)[0.83] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.748667	0.003215	0.001856	0.740681	0.720237	0.756652	0.745	0.751	3
Target (wt%)[0.83] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.801	0.032512	0.018771	0.720237	0.881763	0.851	0.769	0.834	3
Target (wt%)[0.83] Type[ARG-1 (R)] Prep[Aqua Regia]	0.828333	0.024111	0.01392	0.768439	0.888228	0.803	0.803	0.851	3
Target (wt%)[0.83] Type[ARG-1 (R)] Prep[Aqua Regia]	0.730333	0.002517	0.001453	0.724082	0.736585	0.733	0.728	0.733	3
Target (wt%)[0.83] Type[ARG-1 (R)] Prep[Cold Chem]	0.752667	0.065546	0.037843	0.58984	0.915493	0.677	0.677	0.792	3
Target (wt%)[0.83] Type[ARG-1 (R)] Prep[Peroxide Fusion]

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[22.39]	13.44078	10.42579	3.475264	5.426804	21.45475	22.8	0.387	22.8	9
Target (wt%)[22.39] Type[ARG-1 (P)]	13.44078	10.42579	3.475264	5.426804	21.45475	22.8	0.387	22.8	9
Target (wt%)[22.39] Type[ARG-1 (P)]	21.56667	0.351188	0.202759	20.69427	22.43907	21.9	21.2	21.9	3
Target (wt%)[22.39] Type[ARG-1 (R)]	9.377833	10.69762	4.367285	-1.84863	20.6043	22.8	0.387	22.8	6
Target (wt%)[22.39] Type[ARG-1 (P)] Prep[Aqua Regia]	.	.	.	.	.	.	.	.	0
Target (wt%)[22.39] Type[ARG-1 (P)] Prep[Cold Chem]	.	.	.	.	.	.	.	.	0
Target (wt%)[22.39] Type[ARG-1 (P)] Prep[Peroxide Fusion]	21.56667	0.351188	0.202759	20.69427	22.43907	21.9	21.2	21.9	3
Target (wt%)[22.39] Type[ARG-1 (R)] Prep[Aqua Regia]	0.489	0.101015	0.058321	0.238065	0.739935	0.589	0.387	0.589	3
Target (wt%)[22.39] Type[ARG-1 (R)] Prep[Cold Chem]	.	.	.	.	.	.	.	.	0
Target (wt%)[22.39] Type[ARG-1 (R)] Prep[Peroxide Fusion]	18.26667	7.003808	4.043651	0.868242	35.66509	22.8	10.2	22.8	3

Variability Summary for Measurement (wt%)									
Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[0.69]	0.652222	0.041924	0.009882		0.631374	0.67307	0.564	0.707	18
Target (wt%)[0.69] Type[ARG-1 (P)]	0.652222	0.041924	0.009882		0.631374	0.67307	0.564	0.707	18
Target (wt%)[0.69] Type[ARG-1 (R)]	0.647111	0.042085	0.014028		0.614762	0.67946	0.583	0.685	9
Target (wt%)[0.69] Type[ARG-1 (R)]	0.657333	0.043646	0.014549		0.623784	0.690883	0.564	0.707	9
Target (wt%)[0.69] Type[ARG-1 (P)] Prep[Aqua Regia]	0.593333	0.009074	0.005239		0.570793	0.615874	0.583	0.6	3
Target (wt%)[0.69] Type[ARG-1 (P)] Prep[Cold Chem]	0.683667	0.001528	0.000882		0.679872	0.687461	0.682	0.685	3
Target (wt%)[0.69] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.664333	0.014572	0.008413		0.628135	0.700531	0.649	0.678	3
Target (wt%)[0.69] Type[ARG-1 (R)] Prep[Aqua Regia]	0.643	0.024062	0.013892		0.583226	0.702774	0.62	0.668	3
Target (wt%)[0.69] Type[ARG-1 (R)] Prep[Cold Chem]	0.673333	0.003512	0.002028		0.664609	0.682057	0.67	0.677	3
Target (wt%)[0.69] Type[ARG-1 (R)] Prep[Peroxide Fusion]	0.655667	0.079576	0.045943		0.457989	0.853344	0.564	0.707	3

Variability Gauge Grouping--ARG-1, Element=Zr
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

Measurement (wt%)	Mean	Std Dev	Std Err	Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Target (wt%)[0.1]	0.067392	0.036207	0.010452	0.010452	0.044387	0.090397	0.00837	0.0973	12
Target (wt%)[0.1] Type[ARG-1 (P)]	0.067392	0.036207	0.010452	0.010452	0.044387	0.090397	0.00837	0.0973	12
Target (wt%)[0.1] Type[ARG-1 (R)]	0.053967	0.04695	0.019167	0.019167	0.004696	0.103238	0.00837	0.0973	6
Target (wt%)[0.1] Type[ARG-1 (P)] Prep[Aqua Regia]	0.080817	0.015724	0.006419	0.006419	0.064315	0.097318	0.0648	0.0958	6
Target (wt%)[0.1] Type[ARG-1 (P)] Prep[Cold Chem]	0.0112	0.00485	0.0028	-0.00085	0.023248	0.00837	0.00837	0.0168	3
Target (wt%)[0.1] Type[ARG-1 (P)] Prep[Peroxide Fusion]	0.096733	0.000493	0.000285	0.000285	0.095508	0.097959	0.0964	0.0973	3
Target (wt%)[0.1] Type[ARG-1 (R)] Prep[Peroxide Fusion]	0.0665	0.0017	0.000981	0.000981	0.062277	0.070723	0.0648	0.0682	3
Target (wt%)[0.1] Type[ARG-1 (R)] Prep[Aqua Regia]	0.095133	0.000577	0.000333	0.000333	0.093699	0.096568	0.0948	0.0958	3
Target (wt%)[0.1] Type[ARG-1 (R)] Prep[Cold Chem]									3
Target (wt%)[0.1] Type[ARG-1 (R)] Prep[Peroxide Fusion]									0

Variability Gauge Grouping=SRAT, Element=Al
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	8.958333	1.219325	0.248894	8.443458	9.473209	5.76	11	24
Type[Product]	8.463333	0.399871	0.115433	8.209267	8.717399	7.76	9.07	12
Type[Receipt]	9.453333	1.55376	0.448532	8.466121	10.44055	5.76	11	12
Type[Product] Prep[Aqua Regia]	8.415	0.167631	0.083815	8.148262	8.681738	8.26	8.64	4
Type[Product] Prep[Cold Chem]	8.0575	0.222017	0.111009	7.704221	8.410779	7.76	8.29	4
Type[Product] Prep[Peroxide Fusion]	8.9175	0.105633	0.052817	8.749414	9.085586	8.83	9.07	4
Type[Receipt] Prep[Aqua Regia]	7.9775	2.006861	1.003431	4.784136	11.17086	5.76	9.92	4
Type[Receipt] Prep[Cold Chem]	9.8325	0.122848	0.061424	9.637021	10.02798	9.65	9.91	4
Type[Receipt] Prep[Peroxide Fusion]	10.55	0.331662	0.165831	10.02225	11.07775	10.3	11	4

Variability Gauge Grouping=SRAT, Element=B
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.022046	0.011473	0.002868	0.015932	0.028159	0.00249	0.0294	16
Type[Product]	0.015266	0.013299	0.004702	0.004148	0.026385	0.00249	0.0294	8
Type[Receipt]	0.028825	0.000345	0.000122	0.028536	0.029114	0.0285	0.0294	8
Type[Product] Prep[Aqua Regia]	0.002883	0.000281	0.00014	0.002436	0.003329	0.00249	0.00309	4
Type[Product] Prep[Cold Chem]								0
Type[Product] Prep[Peroxide Fusion]	0.02765	0.001914	0.000957	0.024604	0.030696	0.025	0.0294	4
Type[Receipt] Prep[Aqua Regia]	0.0288	0.000294	0.000147	0.028332	0.029268	0.0285	0.0292	4
Type[Receipt] Prep[Cold Chem]								0
Type[Receipt] Prep[Peroxide Fusion]	0.02885	0.000436	0.000218	0.028156	0.029544	0.0285	0.0294	4

Variability Gauge Grouping=SRAT, Element=Ca
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.599208	0.10908	0.022266	0.553148	0.645269	0.441	0.857	24
Type[Product]	0.551583	0.08406	0.024266	0.498174	0.604993	0.441	0.67	12
Type[Receipt]	0.646833	0.113419	0.032741	0.574771	0.718896	0.548	0.857	12
Type[Product] Prep[Aqua Regia]	0.4655	0.005686	0.002843	0.456452	0.474548	0.457	0.469	4
Type[Product] Prep[Cold Chem]	0.57275	0.097575	0.048788	0.417486	0.728014	0.441	0.67	4
Type[Product] Prep[Peroxide Fusion]	0.6165	0.016093	0.008047	0.590892	0.642108	0.593	0.629	4
Type[Receipt] Prep[Aqua Regia]	0.55625	0.010905	0.005452	0.538898	0.573602	0.548	0.572	4
Type[Receipt] Prep[Cold Chem]	0.70225	0.17189	0.085945	0.428734	0.975766	0.548	0.857	4
Type[Receipt] Prep[Peroxide Fusion]	0.682	0.028601	0.0143	0.63649	0.72751	0.659	0.718	4

Variability Gauge Grouping=SRAT, Element=Cr
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.043188	0.005053	0.001031	0.041054	0.045321	0.0364	0.0551	24
Type[Product]	0.039342	0.001467	0.000423	0.03841	0.040274	0.0364	0.0415	12
Type[Receipt]	0.047033	0.004355	0.001257	0.044266	0.049801	0.0419	0.0551	12
Type[Product] Prep[Aqua Regia]	0.04085	0.000676	0.000338	0.039775	0.041925	0.0399	0.0415	4
Type[Product] Prep[Cold Chem]	0.0394	0.00049	0.000245	0.03862	0.04018	0.0388	0.04	4
Type[Product] Prep[Peroxide Fusion]	0.037775	0.000939	0.00047	0.03628	0.03927	0.0364	0.0385	4
Type[Receipt] Prep[Aqua Regia]	0.043425	0.002984	0.001492	0.038677	0.048173	0.0419	0.0479	4
Type[Receipt] Prep[Cold Chem]	0.0459	0.000216	0.000108	0.045556	0.046244	0.0457	0.0462	4
Type[Receipt] Prep[Peroxide Fusion]	0.051775	0.003399	0.0017	0.046366	0.057184	0.0474	0.0551	4

Variability Gauge Grouping=SRAT, Element=Cu
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.035413	0.004251	0.000868	0.033617	0.037208	0.0291	0.0429	24
Type[Product]	0.031775	0.001674	0.000483	0.030711	0.032839	0.0291	0.0352	12
Type[Receipt]	0.03905	0.002473	0.000714	0.037479	0.040621	0.0352	0.0429	12
Type[Product] Prep[Aqua Regia]	0.0327	0.000572	0.000286	0.031791	0.033609	0.0319	0.0332	4
Type[Product] Prep[Cold Chem]	0.030025	0.000842	0.000421	0.028685	0.031365	0.0291	0.031	4
Type[Product] Prep[Peroxide Fusion]	0.0326	0.001764	0.000882	0.029792	0.035408	0.0313	0.0352	4
Type[Receipt] Prep[Aqua Regia]	0.0394	0.001828	0.000914	0.036492	0.042308	0.0379	0.042	4
Type[Receipt] Prep[Cold Chem]	0.036425	0.000939	0.00047	0.03493	0.03792	0.0352	0.0373	4
Type[Receipt] Prep[Peroxide Fusion]	0.041325	0.001396	0.000698	0.039103	0.043547	0.0395	0.0429	4

Variability Gauge Grouping=SRAT, Element=Fe
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	11.7875	1.229815	0.251035	11.26819	12.30681	10.2	14.9	24
Type[Product]	10.775	0.402549	0.116206	10.51923	11.03077	10.2	11.2	12
Type[Receipt]	12.8	0.873863	0.252262	12.24477	13.35523	11.8	14.9	12
Type[Product] Prep[Aqua Regia]	11.05	0.191485	0.095743	10.7453	11.3547	10.8	11.2	4
Type[Product] Prep[Cold Chem]	10.275	0.15	0.075	10.03632	10.51368	10.2	10.5	4
Type[Product] Prep[Peroxide Fusion]	11	0.182574	0.091287	10.70948	11.29052	10.8	11.2	4
Type[Receipt] Prep[Aqua Regia]	13.425	1.001249	0.500625	11.83179	15.01821	12.8	14.9	4
Type[Receipt] Prep[Cold Chem]	11.925	0.095743	0.047871	11.77265	12.07735	11.8	12	4
Type[Receipt] Prep[Peroxide Fusion]	13.05	0.404145	0.202073	12.40691	13.69309	12.7	13.6	4

Variability Gauge Grouping=SRAT, Element=K
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.233917	0.145828	0.029767	0.172339	0.295495	0.0638	0.511	24
Type[Product]	0.181425	0.08942	0.025813	0.12461	0.23824	0.0665	0.279	12
Type[Receipt]	0.286408	0.174521	0.05038	0.175523	0.397294	0.0638	0.511	12
Type[Product] Prep[Aqua Regia]	0.070025	0.003912	0.001956	0.0638	0.07625	0.0665	0.0745	4
Type[Product] Prep[Cold Chem]	0.2135	0.050633	0.025316	0.132932	0.294068	0.167	0.277	4
Type[Product] Prep[Peroxide Fusion]	0.26075	0.020759	0.010379	0.227719	0.293781	0.233	0.279	4
Type[Receipt] Prep[Aqua Regia]	0.067225	0.003585	0.001792	0.061521	0.072929	0.0638	0.0721	4
Type[Receipt] Prep[Cold Chem]	0.329	0.022701	0.01135	0.292878	0.365122	0.295	0.342	4
Type[Receipt] Prep[Peroxide Fusion]	0.463	0.055642	0.027821	0.374462	0.551538	0.383	0.511	4

Variability Gauge Grouping=SRAT, Element=Li

Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.039983	0.01333	0.002721	0.034354	0.045612	0.026	0.0593	24
Type[Product]	0.0374	0.013796	0.003983	0.028634	0.046166	0.026	0.0593	12
Type[Receipt]	0.042567	0.012909	0.003727	0.034365	0.050769	0.0272	0.0593	12
Type[Product] Prep[Aqua Regia]	0.0264	0.000337	0.000168	0.025864	0.026936	0.026	0.0268	4
Type[Product] Prep[Cold Chem]	0.03005	0.000666	0.000333	0.028991	0.031109	0.0295	0.031	4
Type[Product] Prep[Peroxide Fusion]	0.05575	0.003875	0.001938	0.049584	0.061916	0.0504	0.0593	4
Type[Receipt] Prep[Aqua Regia]	0.028	0.000949	0.000474	0.02649	0.02951	0.0272	0.0293	4
Type[Receipt] Prep[Cold Chem]	0.041525	0.000443	0.000221	0.040821	0.042229	0.0411	0.042	4
Type[Receipt] Prep[Peroxide Fusion]	0.058175	0.000862	0.000431	0.056804	0.059546	0.0575	0.0593	4

Variability Gauge Grouping=SRAT, Element=Mg
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.28975	0.097963	0.019997	0.248384	0.331116	0.209	0.556	24
Type[Product]	0.257417	0.080749	0.02331	0.206111	0.308722	0.209	0.419	12
Type[Receipt]	0.322083	0.106135	0.030639	0.254648	0.389518	0.267	0.556	12
Type[Product] Prep[Aqua Regia]	0.213	0.002828	0.001414	0.208499	0.217501	0.209	0.215	4
Type[Product] Prep[Cold Chem]	0.3455	0.091508	0.045754	0.199891	0.491109	0.219	0.419	4
Type[Product] Prep[Peroxide Fusion]	0.21375	0.002986	0.001493	0.208998	0.218502	0.21	0.217	4
Type[Receipt] Prep[Aqua Regia]	0.276	0.001633	0.000816	0.273402	0.278598	0.274	0.278	4
Type[Receipt] Prep[Cold Chem]	0.41275	0.157432	0.078716	0.16224	0.66326	0.276	0.556	4
Type[Receipt] Prep[Peroxide Fusion]	0.2775	0.008583	0.004291	0.263843	0.291157	0.267	0.285	4

Variability Gauge Grouping=SRAT, Element=Mn
Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	2.710417	0.386461	0.078886	2.547229	2.873605	2.25	3.29	24
Type[Product]	2.339167	0.03704	0.010693	2.315633	2.362701	2.25	2.4	12
Type[Receipt]	3.081667	0.10098	0.02915	3.017507	3.145826	2.97	3.29	12
Type[Product] Prep[Aqua Regia]	2.315	0.047258	0.023629	2.239802	2.390198	2.25	2.35	4
Type[Product] Prep[Cold Chem]	2.36	0.028284	0.014142	2.314993	2.405007	2.34	2.4	4
Type[Product] Prep[Peroxide Fusion]	2.3425	0.025	0.0125	2.302719	2.382281	2.31	2.37	4
Type[Receipt] Prep[Aqua Regia]	3.16	0.088318	0.044159	3.019467	3.300533	3.1	3.29	4
Type[Receipt] Prep[Cold Chem]	2.9875	0.023629	0.011815	2.949901	3.025099	2.97	3.02	4
Type[Receipt] Prep[Peroxide Fusion]	3.0975	0.093229	0.046615	2.949152	3.245848	3.02	3.22	4

Variability Gauge Grouping=SRAT, Element=Na
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	14.6875	0.701308	0.175327	14.3138	15.0612	13.8	15.6	16
Type[Product]	15.35	0.185164	0.065465	15.1952	15.5048	15	15.6	8
Type[Receipt]	14.025	0.128174	0.045316	13.91784	14.13216	13.8	14.2	8
Type[Product] Prep[Aqua Regia]	15.25	0.208167	0.104083	14.91876	15.58124	15	15.5	4
Type[Product] Prep[Cold Chem]	15.45	0.1	0.05	15.29088	15.60912	15.4	15.6	4
Type[Product] Prep[Peroxide Fusion]								0
Type[Receipt] Prep[Aqua Regia]	13.95	0.129099	0.06455	13.74457	14.15543	13.8	14.1	4
Type[Receipt] Prep[Cold Chem]	14.1	0.08165	0.040825	13.97008	14.22992	14	14.2	4
Type[Receipt] Prep[Peroxide Fusion]								0

Variability Gauge Grouping=SRAT, Element=Ni
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	2.071667	0.192482	0.03929	1.990389	2.152945	1.77	2.38	24
Type[Product]	1.925	0.109586	0.031635	1.855372	1.994628	1.77	2.04	12
Type[Receipt]	2.218333	0.136104	0.03929	2.131857	2.30481	2.03	2.38	12
Type[Product] Prep[Aqua Regia]	2.0175	0.0263	0.01315	1.975652	2.059348	1.98	2.04	4
Type[Product] Prep[Cold Chem]	1.7825	0.01893	0.009465	1.752379	1.812621	1.77	1.81	4
Type[Product] Prep[Peroxide Fusion]	1.975	0.034157	0.017078	1.920649	2.029351	1.94	2.02	4
Type[Receipt] Prep[Aqua Regia]	2.335	0.034157	0.017078	2.280649	2.389351	2.3	2.38	4
Type[Receipt] Prep[Cold Chem]	2.0475	0.017078	0.008539	2.020325	2.074675	2.03	2.07	4
Type[Receipt] Prep[Peroxide Fusion]	2.2725	0.074106	0.037053	2.154581	2.390419	2.21	2.37	4

Variability Gauge Grouping=SRAT, Element=Si

Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	1.10125	0.400501	0.115615	0.846784	1.355716	0.372	1.52	12
Type[Product]	1.205	0.017321	0.00866	1.177439	1.232561	1.19	1.22	4
Type[Receipt]	1.049375	0.49265	0.174178	0.63751	1.46124	0.372	1.52	8
Type[Product] Prep[Aqua Regia]	.	.	.	.	.	.	.	0
Type[Product] Prep[Cold Chem]	.	.	.	.	.	.	.	0
Type[Product] Prep[Peroxide Fusion]	1.205	0.017321	0.00866	1.177439	1.232561	1.19	1.22	4
Type[Receipt] Prep[Aqua Regia]	0.62125	0.275029	0.137514	0.183618	1.058882	0.372	1	4
Type[Receipt] Prep[Cold Chem]	.	.	.	.	.	.	.	0
Type[Receipt] Prep[Peroxide Fusion]	1.4775	0.043493	0.021747	1.408292	1.546708	1.42	1.52	4

Variability Gauge Grouping=SRAT, Element=Th

Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.791625	0.19556	0.039919	0.709047	0.874203	0.28	0.979	24
Type[Product]	0.74075	0.23756	0.068578	0.589811	0.891689	0.28	0.976	12
Type[Receipt]	0.8425	0.133725	0.038603	0.757535	0.927465	0.565	0.979	12
Type[Product] Prep[Aqua Regia]	0.86375	0.010012	0.005006	0.847818	0.879682	0.852	0.876	4
Type[Product] Prep[Cold Chem]	0.4315	0.108088	0.054044	0.259508	0.603492	0.28	0.533	4
Type[Product] Prep[Peroxide Fusion]	0.927	0.034737	0.017369	0.871726	0.982274	0.894	0.976	4
Type[Receipt] Prep[Aqua Regia]	0.9745	0.004655	0.002327	0.967093	0.981907	0.97	0.979	4
Type[Receipt] Prep[Cold Chem]	0.68875	0.089343	0.044672	0.546585	0.830915	0.565	0.76	4
Type[Receipt] Prep[Peroxide Fusion]	0.86425	0.046722	0.023361	0.789905	0.938595	0.822	0.926	4

Variability Gauge Grouping=SRAT, Element=Ti
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.0162	0.002004	0.000409	0.015354	0.017046	0.0137	0.0211	24
Type[Product]	0.014508	0.000573	0.000165	0.014144	0.014872	0.0137	0.0156	12
Type[Receipt]	0.017892	0.001351	0.00039	0.017033	0.01875	0.0164	0.0211	12
Type[Product] Prep[Aqua Regia]	0.0142	0.000216	0.000108	0.013856	0.014544	0.0139	0.0144	4
Type[Product] Prep[Cold Chem]	0.015075	0.000556	0.000278	0.01419	0.01596	0.0145	0.0156	4
Type[Product] Prep[Peroxide Fusion]	0.01425	0.000451	0.000225	0.013532	0.014968	0.0137	0.0148	4
Type[Receipt] Prep[Aqua Regia]	0.0169	0.000638	0.000319	0.015885	0.017915	0.0164	0.0178	4
Type[Receipt] Prep[Cold Chem]	0.017475	0.000386	0.000193	0.01686	0.01809	0.0171	0.018	4
Type[Receipt] Prep[Peroxide Fusion]	0.0193	0.001395	0.000698	0.01708	0.02152	0.0181	0.0211	4

Variability Gauge Grouping=SRAT, Element=U
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	4.86375	0.412583	0.084218	4.689532	5.037968	4.32	5.6	24
Type[Product]	4.479167	0.060069	0.017341	4.441	4.517333	4.32	4.55	12
Type[Receipt]	5.248333	0.172091	0.049678	5.138992	5.357674	5.03	5.6	12
Type[Product] Prep[Aqua Regia]	4.4875	0.034034	0.017017	4.433344	4.541656	4.44	4.52	4
Type[Product] Prep[Cold Chem]	4.5	0.042426	0.021213	4.43249	4.56751	4.46	4.55	4
Type[Product] Prep[Peroxide Fusion]	4.45	0.092014	0.046007	4.303584	4.596416	4.32	4.52	4
Type[Receipt] Prep[Aqua Regia]	5.415	0.125033	0.062517	5.216044	5.613956	5.33	5.6	4
Type[Receipt] Prep[Cold Chem]	5.14	0.040825	0.020412	5.075039	5.204961	5.11	5.2	4
Type[Receipt] Prep[Peroxide Fusion]	5.19	0.184572	0.092286	4.896305	5.483695	5.03	5.4	4

Variability Gauge Grouping=SRAT, Element=Zr
 Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	0.166056	0.05362	0.013405	0.137484	0.194628	0.0841	0.235	16
Type[Product]	0.154013	0.047223	0.016696	0.114533	0.193492	0.0841	0.199	8
Type[Receipt]	0.1781	0.059995	0.021211	0.127943	0.228257	0.0958	0.235	8
Type[Product] Prep[Aqua Regia]	0.112275	0.023375	0.011687	0.075081	0.149469	0.0841	0.132	4
Type[Product] Prep[Cold Chem]	0.19575	0.003403	0.001702	0.190334	0.201166	0.191	0.199	4
Type[Product] Prep[Peroxide Fusion]								0
Type[Receipt] Prep[Aqua Regia]	0.1232	0.018812	0.009406	0.093266	0.153134	0.0958	0.136	4
Type[Receipt] Prep[Cold Chem]	0.233	0.002708	0.001354	0.228691	0.237309	0.229	0.235	4
Type[Receipt] Prep[Peroxide Fusion]								0

Note that in the table of statistical comparisons for the SRAT Receipt samples (all of the data), the AI comparisons indicate that the AR results are statistically smaller than those from the CC and PF methods. Here are the averages by prep method for all of these data:

Element	N Rows	Aqua Regia	Cold Chem	Peroxide Fusion	Statistical Comparisons
AI	4	7.9775	9.8325	10.5500	AR, CC, PF

As seen in the figure below, there are two AR values for the SRAT Receipt samples that are lower than the other results. The summary statistics in the table below the figure indicate a large sample standard deviation for the AR results for AI for the SRAT Receipt samples.

Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	8.958333	1.219325	0.248894	8.443458	9.473209	5.76	11	24
Grouping[SRAT]	8.958333	1.219325	0.248894	8.443458	9.473209	5.76	11	24
Grouping[SRAT] Type[Product]	8.463333	0.399871	0.115433	8.209267	8.717399	7.76	9.07	12
Grouping[SRAT] Type[Receipt]	9.453333	1.55376	0.448532	8.466121	10.44055	5.76	11	12
Grouping[SRAT] Type[Product] Prep[Aqua Regia]	8.415	0.167631	0.083815	8.148262	8.681738	8.26	8.64	4
Grouping[SRAT] Type[Product] Prep[Cold Chem]	8.0575	0.222017	0.111009	7.704221	8.410779	7.76	8.29	4
Grouping[SRAT] Type[Product] Prep[Peroxide]	8.9175	0.105633	0.052817	8.749414	9.085586	8.83	9.07	4

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Fusion]								
Grouping[SRAT] Type[Receipt] Prep[Aqua Regia]	7.9775	2.006861	1.003431	4.784136	11.17086	5.76	9.92	4
Grouping[SRAT] Type[Receipt] Prep[Cold Chem]	9.8325	0.122848	0.061424	9.637021	10.02798	9.65	9.91	4
Grouping[SRAT] Type[Receipt] Prep[Peroxide Fusion]	10.55	0.331662	0.165831	10.02225	11.07775	10.3	11	4

If the two low AI values are excluded from the analysis (as indicated in the figure below), the summary statistics for the AR AI values are more in line with the values provided by the other preparation methods.

Variability Gauge

Variability Chart for Measurement (wt%)

Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Measurement (wt%)	9.200909	0.928362	0.197927	8.789296	9.612522	7.76	11	22
Grouping[SRAT]	9.200909	0.928362	0.197927	8.789296	9.612522	7.76	11	22
Grouping[SRAT] Type[Product]	8.463333	0.399871	0.115433	8.209267	8.717399	7.76	9.07	12
Grouping[SRAT] Type[Receipt]	10.086	0.468809	0.148251	9.750634	10.42137	9.41	11	10
Grouping[SRAT] Type[Product] Prep[Aqua Regia]	8.415	0.167631	0.083815	8.148262	8.681738	8.26	8.64	4
Grouping[SRAT] Type[Product] Prep[Cold Chem]	8.0575	0.222017	0.111009	7.704221	8.410779	7.76	8.29	4
Grouping[SRAT] Type[Product] Prep[Peroxide Fusion]	8.9175	0.105633	0.052817	8.749414	9.085586	8.83	9.07	4
Grouping[SRAT] Type[Receipt] Prep[Aqua Regia]	9.665	0.360624	0.255	6.424918	12.90508	9.41	9.92	2
Grouping[SRAT] Type[Receipt] Prep[Cold Chem]	9.8325	0.122848	0.061424	9.637021	10.02798	9.65	9.91	4
Grouping[SRAT] Type[Receipt] Prep[Peroxide Fusion]	10.55	0.331662	0.165831	10.02225	11.07775	10.3	11	4

In addition, with the two low Al values excluded from the analysis provided below, the conclusion would be that the PF method yields statistically larger Al concentration measurements when compared against the AR and CC methods.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Al

Excluded Rows 2

Oneway Anova Summary of Fit

Rsquare	0.744532
Adj Rsquare	0.671542
Root Mean Square Error	0.268681
Mean of Response	10.086
Observations (or Sum Wgts)	10

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	1.4727150	0.736358	10.2004	0.0084
Error	7	0.5053250	0.072189		
C. Total	9	1.9780400			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	2	9.6650	0.18999	9.216	10.114
Cold Chem	4	9.8325	0.13434	9.515	10.150
Peroxide Fusion	4	10.5500	0.13434	10.232	10.868

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
Peroxide Fusion A	10.55000
Cold Chem B	9.83250
Aqua Regia B	9.66500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Al

Oneway Anova Summary of Fit

Rsquare 0.848965
Adj Rsquare 0.815402
Root Mean Square Error 0.171804
Mean of Response 8.463333
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	1.4932167	0.746608	25.2945	0.0002
Error	9	0.2656500	0.029517		
C. Total	11	1.7588667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	8.41500	0.08590	8.2207	8.6093
Cold Chem	4	8.05750	0.08590	7.8632	8.2518
Peroxide Fusion	4	8.91750	0.08590	8.7232	9.1118

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	8.41500	0.167631	0.08382	8.1483	8.6817
Cold Chem	4	8.05750	0.222017	0.11101	7.7042	8.4108
Peroxide Fusion	4	8.91750	0.105633	0.05282	8.7494	9.0856

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.1676305	0.1250000	0.1250000
Cold Chem	4	0.2220173	0.1525000	0.1525000
Peroxide Fusion	4	0.1056330	0.0762500	0.0675000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6676	2	9	0.5366
Brown-Forsythe	0.6435	2	9	0.5480
Levene	0.6180	2	9	0.5604
Bartlett	0.6652	2		0.5142

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
27.4824	2	5.4844	0.0014

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Aqua Regia	Cold Chem
Peroxide Fusion	-0.33918	0.16332	0.52082
Aqua Regia	0.16332	-0.33918	0.01832
Cold Chem	0.52082	0.01832	-0.33918

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	8.9175000
Aqua Regia B	8.4150000
Cold Chem C	8.0575000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=B

Missing Rows
4

Oneway Anova Summary of Fit

Rsquare 0.990933
Adj Rsquare 0.989421
Root Mean Square Error 0.001368
Mean of Response 0.015266
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.00122686	0.001227	655.7071	<.0001
Error	6	0.00001123	1.871e-6		
C. Total	7	0.00123808			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.002883	0.00068	0.00121	0.00456
Cold Chem	0				
Peroxide Fusion	4	0.027650	0.00068	0.02598	0.02932

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.002883	0.000281	0.00014	0.00244	0.00333
Cold Chem	0					
Peroxide Fusion	4	0.027650	0.001914	0.00096	0.02460	0.03070

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0002806	0.0002025	0.0002025
Cold Chem	0		0.0000000	0.0000000
Peroxide Fusion	4	0.0019140	0.0013500	0.0013500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.8927	1	6	0.2180
Brown-Forsythe	3.4228	1	6	0.1138
Levene	4.1888	1	6	0.0866
Bartlett	6.4183	1		0.0113

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
655.7071	1	3.1289	<.0001

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Ca

Oneway Anova Summary of Fit

Rsquare 0.62128
Adj Rsquare 0.53712
Root Mean Square Error 0.05719
Mean of Response 0.551583
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.04829017	0.024145	7.3821	0.0127
Error	9	0.02943675	0.003271		
C. Total	11	0.07772692			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.465500	0.02860	0.40081	0.53019
Cold Chem	4	0.572750	0.02860	0.50806	0.63744
Peroxide Fusion	4	0.616500	0.02860	0.55181	0.68119

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.465500	0.005686	0.00284	0.45645	0.47455
Cold Chem	4	0.572750	0.097575	0.04879	0.41749	0.72801
Peroxide Fusion	4	0.616500	0.016093	0.00805	0.59089	0.64211

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0056862	0.0042500	0.0030000
Cold Chem	4	0.0975752	0.0692500	0.0692500
Peroxide Fusion	4	0.0160935	0.0117500	0.0100000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0007	2	9	0.1910
Brown-Forsythe	4.2755	2	9	0.0495
Levene	4.7274	2	9	0.0395
Bartlett	7.9486	2		0.0004

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
137.6245	2	4.4498	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.11291	-0.06916	0.03809
Cold Chem	-0.06916	-0.11291	-0.00566
Aqua Regia	0.03809	-0.00566	-0.11291

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.61650000
Cold Chem A B	0.57275000
Aqua Regia B	0.46550000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Cr

Oneway Anova Summary of Fit

Rsquare 0.799845
Adj Rsquare 0.755366
Root Mean Square Error 0.000726
Mean of Response 0.039342
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00001893	9.4658e-6	17.9826	0.0007
Error	9	0.00000474	5.2639e-7		
C. Total	11	0.00002367			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.040850	0.00036	0.04003	0.04167
Cold Chem	4	0.039400	0.00036	0.03858	0.04022
Peroxide Fusion	4	0.037775	0.00036	0.03695	0.03860

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.040850	0.000676	0.00034	0.03977	0.04193
Cold Chem	4	0.039400	0.000490	0.00024	0.03862	0.04018
Peroxide Fusion	4	0.037775	0.000939	0.00047	0.03628	0.03927

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0006758	0.0004750	0.0004000
Cold Chem	4	0.0004899	0.0003000	0.0003000
Peroxide Fusion	4	0.0009394	0.0006875	0.0005750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4967	2	9	0.6243
Brown-Forsythe	0.2383	2	9	0.7928
Levene	0.8556	2	9	0.4569
Bartlett	0.5367	2		0.5847

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
13.1622	2	5.6422	0.0075

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Cold Chem	Peroxide Fusion
Aqua Regia	-0.00143	0.00002	0.00164
Cold Chem	0.00002	-0.00143	0.00019
Peroxide Fusion	0.00164	0.00019	-0.00143

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	0.04085000
Cold Chem B	0.03940000
Peroxide Fusion C	0.03777500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Cu

Oneway Anova Summary of Fit

Rsquare	0.596417
Adj Rsquare	0.506732
Root Mean Square Error	0.001176
Mean of Response	0.031775
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00001840	9.1975e-6	6.6501	0.0169
Error	9	0.00001245	1.3831e-6		
C. Total	11	0.00003084			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.032700	0.00059	0.03137	0.03403
Cold Chem	4	0.030025	0.00059	0.02869	0.03136
Peroxide Fusion	4	0.032600	0.00059	0.03127	0.03393

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.032700	0.000572	0.00029	0.03179	0.03361
Cold Chem	4	0.030025	0.000842	0.00042	0.02868	0.03137
Peroxide Fusion	4	0.032600	0.001764	0.00088	0.02979	0.03541

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0005715	0.0004000	0.0004000
Cold Chem	4	0.0008421	0.0006750	0.0006750
Peroxide Fusion	4	0.0017645	0.0013000	0.0010500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0557	2	9	0.3874
Brown-Forsythe	0.5209	2	9	0.6109
Levene	2.3744	2	9	0.1486
Bartlett	1.6980	2		0.1831

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.5765	2	5.3367	0.0096

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.00232	-0.00222	0.00035
Peroxide Fusion	-0.00222	-0.00232	0.00025
Cold Chem	0.00035	0.00025	-0.00232

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	0.03270000
Peroxide Fusion A	0.03260000
Cold Chem B	0.03002500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Fe

Oneway Anova Summary of Fit

Rsquare	0.84432
Adj Rsquare	0.809724
Root Mean Square Error	0.175594
Mean of Response	10.775
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	1.5050000	0.752500	24.4054	0.0002
Error	9	0.2775000	0.030833		
C. Total	11	1.7825000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	11.0500	0.08780	10.851	11.249
Cold Chem	4	10.2750	0.08780	10.076	10.474
Peroxide Fusion	4	11.0000	0.08780	10.801	11.199

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	11.0500	0.191485	0.09574	10.745	11.355
Cold Chem	4	10.2750	0.150000	0.07500	10.036	10.514
Peroxide Fusion	4	11.0000	0.182574	0.09129	10.709	11.291

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.1914854	0.1500000	0.1500000
Cold Chem	4	0.1500000	0.1125000	0.0750000
Peroxide Fusion	4	0.1825742	0.1500000	0.1500000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.1646	2	9	0.8507
Brown-Forsythe	0.6279	2	9	0.5556
Levene	0.3600	2	9	0.7073
Bartlett	0.0834	2		0.9200

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
25.2903	2	5.9268	0.0013

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.34667	-0.29667	0.42833
Peroxide Fusion	-0.29667	-0.34667	0.37833
Cold Chem	0.42833	0.37833	-0.34667

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	11.050000
Peroxide Fusion A	11.000000
Cold Chem B	10.275000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=K

Oneway Anova Summary of Fit

Rsquare 0.897337
Adj Rsquare 0.874523
Root Mean Square Error 0.031675
Mean of Response 0.181425
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.07892489	0.039462	39.3328	<.0001
Error	9	0.00902966	0.001003		
C. Total	11	0.08795454			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.070025	0.01584	0.03420	0.10585
Cold Chem	4	0.213500	0.01584	0.17767	0.24933
Peroxide Fusion	4	0.260750	0.01584	0.22492	0.29658

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.070025	0.003912	0.00196	0.06380	0.07625
Cold Chem	4	0.213500	0.050633	0.02532	0.13293	0.29407
Peroxide Fusion	4	0.260750	0.020759	0.01038	0.22772	0.29378

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0039118	0.0032750	0.0032750
Cold Chem	4	0.0506327	0.0405000	0.0405000
Peroxide Fusion	4	0.0207585	0.0157500	0.0157500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	3.0380	2	9	0.0981
Brown-Forsythe	7.1256	2	9	0.0140
Levene	9.0152	2	9	0.0071
Bartlett	5.3434	2		0.0048

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
153.0566	2	4.1599	0.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.06253	-0.01528	0.12819
Cold Chem	-0.01528	-0.06253	0.08094
Aqua Regia	0.12819	0.08094	-0.06253

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.26075000
Cold Chem A	0.21350000
Aqua Regia B	0.07002500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Li

Oneway Anova Summary of Fit

Rsquare 0.977685
Adj Rsquare 0.972727
Root Mean Square Error 0.002278
Mean of Response 0.0374
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00204698	0.001023	197.1620	<.0001
Error	9	0.00004672	5.191e-6		
C. Total	11	0.00209370			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.026400	0.00114	0.02382	0.02898
Cold Chem	4	0.030050	0.00114	0.02747	0.03263
Peroxide Fusion	4	0.055750	0.00114	0.05317	0.05833

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.026400	0.000337	0.00017	0.02586	0.02694
Cold Chem	4	0.030050	0.000666	0.00033	0.02899	0.03111
Peroxide Fusion	4	0.055750	0.003875	0.00194	0.04958	0.06192

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0003367	0.0002500	0.0002500
Cold Chem	4	0.0006658	0.0004750	0.0004500
Peroxide Fusion	4	0.0038751	0.0027500	0.0027500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.9329	2	9	0.2003
Brown-Forsythe	3.6938	2	9	0.0674
Levene	4.4953	2	9	0.0443
Bartlett	6.8230	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
137.1468	2	4.797	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.00450	0.02120	0.02485
Cold Chem	0.02120	-0.00450	-0.00085
Aqua Regia	0.02485	-0.00085	-0.00450

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.05575000
Cold Chem B	0.03005000
Aqua Regia B	0.02640000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Mg

Oneway Anova Summary of Fit

Rsquare	0.649052
Adj Rsquare	0.571063
Root Mean Square Error	0.052885
Mean of Response	0.257417
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.04655317	0.023277	8.3224	0.0090
Error	9	0.02517175	0.002797		
C. Total	11	0.07172492			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.213000	0.02644	0.15318	0.27282
Cold Chem	4	0.345500	0.02644	0.28568	0.40532
Peroxide Fusion	4	0.213750	0.02644	0.15393	0.27357

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.213000	0.002828	0.00141	0.20850	0.21750
Cold Chem	4	0.345500	0.091508	0.04575	0.19989	0.49111
Peroxide Fusion	4	0.213750	0.002986	0.00149	0.20900	0.21850

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0028284	0.0020000	0.0020000
Cold Chem	4	0.0915077	0.0670000	0.0670000
Peroxide Fusion	4	0.0029861	0.0022500	0.0022500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.1456	2	9	0.1730
Brown-Forsythe	5.0542	2	9	0.0338
Levene	7.0347	2	9	0.0145
Bartlett	13.7289	2		<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.7643	2	5.3299	0.0957

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Peroxide Fusion	Aqua Regia
Cold Chem	-0.10441	0.02734	0.02809
Peroxide Fusion	0.02734	-0.10441	-0.10366
Aqua Regia	0.02809	-0.10366	-0.10441

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem	A 0.34550000
Peroxide Fusion	B 0.21375000
Aqua Regia	B 0.21300000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Mn

Oneway Anova Summary of Fit

Rsquare	0.272777
Adj Rsquare	0.111172
Root Mean Square Error	0.034921
Mean of Response	2.339167
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00411667	0.002058	1.6879	0.2385
Error	9	0.01097500	0.001219		
C. Total	11	0.01509167			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	2.31500	0.01746	2.2755	2.3545
Cold Chem	4	2.36000	0.01746	2.3205	2.3995
Peroxide Fusion	4	2.34250	0.01746	2.3030	2.3820

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	2.31500	0.047258	0.02363	2.2398	2.3902
Cold Chem	4	2.36000	0.028284	0.01414	2.3150	2.4050
Peroxide Fusion	4	2.34250	0.025000	0.01250	2.3027	2.3823

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0472582	0.0350000	0.0350000
Cold Chem	4	0.0282843	0.0200000	0.0200000
Peroxide Fusion	4	0.0250000	0.0175000	0.0175000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8493	2	9	0.4593
Brown-Forsythe	0.7049	2	9	0.5195
Levene	0.9923	2	9	0.4079
Bartlett	0.6334	2		0.5308

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.2427	2	5.7245	0.3563

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Peroxide Fusion	Aqua Regia
Cold Chem	-0.06894	-0.05144	-0.02394
Peroxide Fusion	-0.05144	-0.06894	-0.04144
Aqua Regia	-0.02394	-0.04144	-0.06894

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem	A 2.3600000
Peroxide Fusion	A 2.3425000
Aqua Regia	A 2.3150000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Na

Missing Rows

4

Oneway Anova

Summary of Fit

Rsquare 0.333333
 Adj Rsquare 0.222222
 Root Mean Square Error 0.163299
 Mean of Response 15.35
 Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.08000000	0.080000	3.0000	0.1340
Error	6	0.16000000	0.026667		
C. Total	7	0.24000000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	15.2500	0.08165	15.050	15.450
Cold Chem	4	15.4500	0.08165	15.250	15.650
Peroxide Fusion	0				

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	15.2500	0.208167	0.10408	14.919	15.581
Cold Chem	4	15.4500	0.100000	0.05000	15.291	15.609
Peroxide Fusion	0					

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.2081666	0.1500000	0.1500000
Cold Chem	4	0.1000000	0.0750000	0.0500000
Peroxide Fusion	0		0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[5]	1.2308	1	6	0.3097
Brown-Forsythe	1.7143	1	6	0.2383
Levene	1.4211	1	6	0.2782
Bartlett	1.2737	1		0.2591

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.0000	1	4.3146	0.1531

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Ni

Oneway Anova

Summary of Fit

Rsquare 0.949659
 Adj Rsquare 0.938473
 Root Mean Square Error 0.027183
 Mean of Response 1.925
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.12545000	0.062725	84.8910	<.0001
Error	9	0.00665000	0.000739		
C. Total	11	0.13210000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	2.01750	0.01359	1.9868	2.0482
Cold Chem	4	1.78250	0.01359	1.7518	1.8132
Peroxide Fusion	4	1.97500	0.01359	1.9443	2.0057

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	2.01750	0.026300	0.01315	1.9757	2.0593
Cold Chem	4	1.78250	0.018930	0.00946	1.7524	1.8126
Peroxide Fusion	4	1.97500	0.034157	0.01708	1.9206	2.0294

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0262996	0.0187500	0.0175000
Cold Chem	4	0.0189297	0.0137500	0.0125000
Peroxide Fusion	4	0.0341565	0.0250000	0.0250000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[5]	0.5212	2	9	0.6107
Brown-Forsythe	0.5000	2	9	0.6224
Levene	0.5755	2	9	0.5819
Bartlett	0.4350	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
110.2290	2	5.6776	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
 2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.05367	-0.01117	0.18133
Peroxide Fusion	-0.01117	-0.05367	0.13883
Cold Chem	0.18133	0.13883	-0.05367

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia	A 2.0175000
Peroxide Fusion	A 1.9750000
Cold Chem	B 1.7825000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Si

Missing Rows

8

Oneway Anova
Summary of Fit

Rsquare 1.11e-16
 Adj Rsquare 1.11e-16
 Root Mean Square Error 0.017321
 Mean of Response 1.205
 Observations (or Sum Wgts) 4

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	0	0.00000000			
Error	3	0.00090000	0.000300		
C. Total	3	0.00090000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	0				
Cold Chem	0				
Peroxide Fusion	4	1.20500	0.00866	1.1774	1.2326

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	0					
Cold Chem	0					
Peroxide Fusion	4	1.20500	0.017321	0.00866	1.1774	1.2326

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	0		0.0000000	0.0000000
Cold Chem	0		0.0000000	0.0000000
Peroxide Fusion	4	0.0173205	0.0150000	0.0150000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]		0	3	
Brown-Forsythe		0	3	
Levene		0	3	
Bartlett		0	3	

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
33.4320	2	4.3361	0.0023

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Th

Oneway Anova
Summary of Fit

Rsquare 0.937225
 Adj Rsquare 0.923275
 Root Mean Square Error 0.065803
 Mean of Response 0.74075
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.58181450	0.290907	67.1846	<.0001
Error	9	0.03896975	0.004330		
C. Total	11	0.62078425			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.863750	0.03290	0.78932	0.9382
Cold Chem	4	0.431500	0.03290	0.35707	0.5059
Peroxide Fusion	4	0.927000	0.03290	0.85257	1.0014

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.863750	0.010012	0.00501	0.84782	0.87968
Cold Chem	4	0.431500	0.108088	0.05404	0.25951	0.60349
Peroxide Fusion	4	0.927000	0.034737	0.01737	0.87173	0.98227

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0100125	0.0072500	0.0072500
Cold Chem	4	0.1080879	0.0757500	0.0715000
Peroxide Fusion	4	0.0347371	0.0245000	0.0210000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5924	2	9	0.2558
Brown-Forsythe	2.1346	2	9	0.1743
Levene	3.4087	2	9	0.0791
Bartlett	5.2921	2		0.0050

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
33.4320	2	4.3361	0.0023

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
 2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Aqua Regia	Cold Chem
Peroxide Fusion	-0.12991	-0.06666	0.36559
Aqua Regia	-0.06666	-0.12991	0.30234
Cold Chem	0.36559	0.30234	-0.12991

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.92700000
Aqua Regia A	0.86375000
Cold Chem B	0.43150000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Ti

Oneway Anova Summary of Fit

Rsquare 0.535211
Adj Rsquare 0.431925
Root Mean Square Error 0.000432
Mean of Response 0.014508
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	1.93167e-6	9.6583e-7	5.1818	0.0318
Error	9	1.6775e-6	1.8639e-7		
C. Total	11	3.60917e-6			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.014200	0.00022	0.01371	0.01469
Cold Chem	4	0.015075	0.00022	0.01459	0.01556
Peroxide Fusion	4	0.014250	0.00022	0.01376	0.01474

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.014200	0.000216	0.00011	0.01386	0.01454
Cold Chem	4	0.015075	0.000556	0.00028	0.01419	0.01596
Peroxide Fusion	4	0.014250	0.000451	0.00023	0.01353	0.01497

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0002160	0.0001500	0.0001500
Cold Chem	4	0.0005560	0.0004750	0.0004750
Peroxide Fusion	4	0.0004509	0.0003000	0.0003000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.9235	2	9	0.2016
Brown-Forsythe	2.8222	2	9	0.1118
Levene	2.9308	2	9	0.1047
Bartlett	1.0344	2		0.3554

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.8374	2	5.1139	0.0960

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Peroxide Fusion	Aqua Regia
Cold Chem	-0.00085	-0.00003	0.00002
Peroxide Fusion	-0.00003	-0.00085	-0.00080
Aqua Regia	0.00002	-0.00080	-0.00085

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem A	0.01507500
Peroxide Fusion A B	0.01425000
Aqua Regia B	0.01420000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=U

Oneway Anova Summary of Fit

Rsquare 0.136469
Adj Rsquare -0.05543
Root Mean Square Error 0.061712
Mean of Response 4.479167
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00541667	0.002708	0.7112	0.5167
Error	9	0.03427500	0.003808		
C. Total	11	0.03969167			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	4.48750	0.03086	4.4177	4.5573
Cold Chem	4	4.50000	0.03086	4.4302	4.5698
Peroxide Fusion	4	4.45000	0.03086	4.3802	4.5198

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	4.48750	0.034034	0.01702	4.4333	4.5417
Cold Chem	4	4.50000	0.042426	0.02121	4.4325	4.5675
Peroxide Fusion	4	4.45000	0.092014	0.04601	4.3036	4.5964

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0340343	0.0237500	0.0225000
Cold Chem	4	0.0424264	0.0350000	0.0350000
Peroxide Fusion	4	0.0920145	0.0650000	0.0650000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2711	2	9	0.3264
Brown-Forsythe	1.1948	2	9	0.3466
Levene	1.6018	2	9	0.2540
Bartlett	1.4902	2		0.2253

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.4439	2	5.5094	0.6626

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Aqua Regia	Peroxide Fusion
Cold Chem	-0.12183	-0.10933	-0.07183
Aqua Regia	-0.10933	-0.12183	-0.08433
Peroxide Fusion	-0.07183	-0.08433	-0.12183

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem A	4.5000000
Aqua Regia A	4.4875000
Peroxide Fusion A	4.4500000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Product, Element=Zr

Missing Rows

4

Oneway Anova
Summary of Fit

Rsquare 0.89277
 Adj Rsquare 0.874899
 Root Mean Square Error 0.016703
 Mean of Response 0.154013
 Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.01393615	0.013936	49.9546	0.0004
Error	6	0.00167386	0.000279		
C. Total	7	0.01561001			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.112275	0.00835	0.09184	0.13271
Cold Chem	4	0.195750	0.00835	0.17532	0.21618
Peroxide Fusion	0				

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.112275	0.023375	0.01169	0.07508	0.14947
Cold Chem	4	0.195750	0.003403	0.00170	0.19033	0.20117
Peroxide Fusion	0					

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0233745	0.0192250	0.0192250
Cold Chem	4	0.0034034	0.0023750	0.0022500
Peroxide Fusion	0		0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	5.0576	1	6	0.0655
Brown-Forsythe	13.8947	1	6	0.0098
Levene	19.7063	1	6	0.0044
Bartlett	6.4527	1		0.0111

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
49.9546	1	3.1271	0.0051

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Al

Oneway Anova
Summary of Fit

Rsquare 0.530885
 Adj Rsquare 0.426637
 Root Mean Square Error 1.176518
 Mean of Response 9.453333
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	14.098117	7.04906	5.0925	0.0332
Error	9	12.457750	1.38419		
C. Total	11	26.555867			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	7.9775	0.58826	6.6468	9.308
Cold Chem	4	9.8325	0.58826	8.5018	11.163
Peroxide Fusion	4	10.5500	0.58826	9.2193	11.881

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	7.9775	2.00686	1.0034	4.784	11.171
Cold Chem	4	9.8325	0.12285	0.0614	9.637	10.028
Peroxide Fusion	4	10.5500	0.33166	0.1658	10.022	11.078

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	2.006861	1.687500	1.687500
Cold Chem	4	0.122848	0.091250	0.072500
Peroxide Fusion	4	0.331662	0.250000	0.250000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	8.5469	2	9	0.0083
Brown-Forsythe	30.6007	2	9	<.0001
Levene	35.5155	2	9	<.0001
Bartlett	7.8166	2		0.0004

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.7908	2	4.4877	0.0280

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
 2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-2.3227	-1.6052	0.2498
Cold Chem	-1.6052	-2.3227	-0.4677
Aqua Regia	0.2498	-0.4677	-2.3227

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	10.550000
Cold Chem A B	9.832500
Aqua Regia B	7.977500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=B

Missing Rows

4

Oneway Anova
Summary of Fit

Rsquare 0.005988
Adj Rsquare -0.15968
Root Mean Square Error 0.000372
Mean of Response 0.028825
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	5e-9	5e-9	0.0361	0.8555
Error	6	0.00000083	1.3833e-7		
C. Total	7	8.35e-7			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.028800	0.00019	0.02834	0.02926
Cold Chem	0				
Peroxide Fusion	4	0.028850	0.00019	0.02839	0.02931

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.028800	0.000294	0.00015	0.02833	0.02927
Cold Chem	0					
Peroxide Fusion	4	0.028850	0.000436	0.00022	0.02816	0.02954

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0002944	0.0002000	0.0002000
Cold Chem	0		0.0000000	0.0000000
Peroxide Fusion	4	0.0004359	0.0003500	0.0003500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7994	1	6	0.4057
Brown-Forsythe	1.1739	1	6	0.3202
Levene	1.5000	1	6	0.2666
Bartlett	0.3863	1		0.5342

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.0361	1	5.2655	0.8563

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Ca

Oneway Anova
Summary of Fit

Rsquare 0.353721
Adj Rsquare 0.210104
Root Mean Square Error 0.100802
Mean of Response 0.646833
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.05005217	0.025026	2.4629	0.1402
Error	9	0.09144950	0.010161		
C. Total	11	0.14150167			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.556250	0.05040	0.44223	0.67027
Cold Chem	4	0.702250	0.05040	0.58823	0.81627
Peroxide Fusion	4	0.682000	0.05040	0.56798	0.79602

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.556250	0.010905	0.00545	0.53890	0.57360
Cold Chem	4	0.702250	0.171890	0.08595	0.42873	0.97577
Peroxide Fusion	4	0.682000	0.028601	0.01430	0.63649	0.72751

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0109049	0.0078750	0.0072500
Cold Chem	4	0.1718902	0.1487500	0.1487500
Peroxide Fusion	4	0.0286007	0.0230000	0.0230000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	292.1797	2	9	<.0001
Brown-Forsythe	256.9736	2	9	<.0001
Levene	371.7718	2	9	<.0001
Bartlett	7.7080	2		0.0004

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
30.4041	2	4.5123	0.0024

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Peroxide Fusion	Aqua Regia
Cold Chem	-0.19901	-0.17876	-0.05301
Peroxide Fusion	-0.17876	-0.19901	-0.07326
Aqua Regia	-0.05301	-0.07326	-0.19901

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem	A 0.70225000
Peroxide Fusion	A 0.68200000
Aqua Regia	A 0.55625000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Cr

Oneway Anova Summary of Fit

Rsquare	0.7052
Adj Rsquare	0.639688
Root Mean Square Error	0.002614
Mean of Response	0.047033
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00014715	0.000074	10.7646	0.0041
Error	9	0.00006151	6.835e-6		
C. Total	11	0.00020867			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.043425	0.00131	0.04047	0.04638
Cold Chem	4	0.045900	0.00131	0.04294	0.04886
Peroxide Fusion	4	0.051775	0.00131	0.04882	0.05473

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.043425	0.002984	0.00149	0.03868	0.04817
Cold Chem	4	0.045900	0.000216	0.00011	0.04556	0.04624
Peroxide Fusion	4	0.051775	0.003399	0.00170	0.04637	0.05718

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0029837	0.0022375	0.0015250
Cold Chem	4	0.0002160	0.0001500	0.0001500
Peroxide Fusion	4	0.0033994	0.0026250	0.0026250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0696	2	9	0.3830
Brown-Forsythe	1.6104	2	9	0.2524
Levene	4.6109	2	9	0.0418
Bartlett	5.4837	2		0.0042

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
6.3039	2	4.0369	0.0573

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79201	0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.00516	0.00071	0.00319
Cold Chem	0.00071	-0.00516	-0.00269
Aqua Regia	0.00319	-0.00269	-0.00516

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.05177500
Cold Chem B	0.04590000
Aqua Regia B	0.04342500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Cu

Oneway Anova Summary of Fit

Rsquare	0.724766
Adj Rsquare	0.663603
Root Mean Square Error	0.001434
Mean of Response	0.03905
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00004875	0.000024	11.8497	0.0030
Error	9	0.00001852	2.057e-6		
C. Total	11	0.00006727			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.039400	0.00072	0.03778	0.04102
Cold Chem	4	0.036425	0.00072	0.03480	0.03805
Peroxide Fusion	4	0.041325	0.00072	0.03970	0.04295

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.039400	0.001828	0.00091	0.03649	0.04231
Cold Chem	4	0.036425	0.000939	0.00047	0.03493	0.03792
Peroxide Fusion	4	0.041325	0.001396	0.00070	0.03910	0.04355

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0018276	0.0013000	0.0012500
Cold Chem	4	0.0009394	0.0007250	0.0007250
Peroxide Fusion	4	0.0013961	0.0009125	0.0008750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5384	2	9	0.6014
Brown-Forsythe	0.3099	2	9	0.7411
Levene	0.4897	2	9	0.6283
Bartlett	0.5431	2		0.5810

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
16.0987	2	5.5849	0.0048

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79201	0.05

Abs(Dif)-LSD	Peroxide Fusion	Aqua Regia	Cold Chem
Peroxide Fusion	-0.00283	-0.00091	0.00207
Aqua Regia	-0.00091	-0.00283	0.00014
Cold Chem	0.00207	0.00014	-0.00283

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.04132500
Aqua Regia A	0.03940000
Cold Chem B	0.03642500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Fe

Oneway Anova Summary of Fit

Rsquare	0.580357
Adj Rsquare	0.487103
Root Mean Square Error	0.625833
Mean of Response	12.8
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	4.8750000	2.43750	6.2234	0.0201
Error	9	3.5250000	0.39167		
C. Total	11	8.4000000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	13.4250	0.31292	12.717	14.133
Cold Chem	4	11.9250	0.31292	11.217	12.633
Peroxide Fusion	4	13.0500	0.31292	12.342	13.758

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	13.4250	1.00125	0.50062	11.832	15.018
Cold Chem	4	11.9250	0.09574	0.04787	11.773	12.077
Peroxide Fusion	4	13.0500	0.40415	0.20207	12.407	13.693

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	1.001249	0.7375000	0.6250000
Cold Chem	4	0.095743	0.0750000	0.0750000
Peroxide Fusion	4	0.404145	0.3000000	0.3000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3086	2	9	0.3171
Brown-Forsythe	1.1738	2	9	0.3524
Levene	4.2256	2	9	0.0508
Bartlett	4.8203	2		0.0081

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
16.2285	2	4.2461	0.0103

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79201	0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-1.2355	-0.8605	0.2645
Peroxide Fusion	-0.8605	-1.2355	-0.1105
Cold Chem	0.2645	-0.1105	-1.2355

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	13.425000
Peroxide Fusion A B	13.050000
Cold Chem B	11.925000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=K

Oneway Anova Summary of Fit

Rsquare	0.967548
Adj Rsquare	0.960336
Root Mean Square Error	0.034757
Mean of Response	0.286408
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.32416000	0.162080	134.1654	<.0001
Error	9	0.01087255	0.001208		
C. Total	11	0.33503255			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.067225	0.01738	0.02791	0.10654
Cold Chem	4	0.329000	0.01738	0.28969	0.36831
Peroxide Fusion	4	0.463000	0.01738	0.42369	0.50231

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.067225	0.003585	0.00179	0.06152	0.07293
Cold Chem	4	0.329000	0.022701	0.01135	0.29288	0.36512
Peroxide Fusion	4	0.463000	0.055642	0.02782	0.37446	0.55154

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0035846	0.0025750	0.0025750
Cold Chem	4	0.0227010	0.0170000	0.0120000
Peroxide Fusion	4	0.0556417	0.0400000	0.0350000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3778	2	9	0.3006
Brown-Forsythe	1.4648	2	9	0.2814
Levene	3.8985	2	9	0.0603
Bartlett	5.8194	2		0.0030

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
307.2450	2	4.1134	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79201	0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.06862	0.06538	0.32716
Cold Chem	0.06538	-0.06862	0.19316
Aqua Regia	0.32716	0.19316	-0.06862

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.46300000
Cold Chem B	0.32900000
Aqua Regia C	0.06722500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Li

Oneway Anova Summary of Fit

Rsquare	0.996991
Adj Rsquare	0.996323
Root Mean Square Error	0.000783
Mean of Response	0.042567
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00182757	0.000914	1491.219	<.0001
Error	9	0.00000552	6.128e-7		
C. Total	11	0.00183309			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.028000	0.00039	0.02711	0.02889
Cold Chem	4	0.041525	0.00039	0.04064	0.04241
Peroxide Fusion	4	0.058175	0.00039	0.05729	0.05906

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.028000	0.000949	0.00047	0.02649	0.02951
Cold Chem	4	0.041525	0.000443	0.00022	0.04082	0.04223
Peroxide Fusion	4	0.058175	0.000862	0.00043	0.05680	0.05955

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0009487	0.0007000	0.0007000
Cold Chem	4	0.0004425	0.0003750	0.0003750
Peroxide Fusion	4	0.0008617	0.0006750	0.0006750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7481	2	9	0.5005
Brown-Forsythe	0.7246	2	9	0.5108
Levene	1.0064	2	9	0.4032
Bartlett	0.7373	2		0.4784

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1011.5611	2	5.3016	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.00155	0.01510	0.02863
Cold Chem	0.01510	-0.00155	0.01198
Aqua Regia	0.02863	0.01198	-0.00155

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.05817500
Cold Chem B	0.04152500
Aqua Regia C	0.02800000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Mg

Oneway Anova Summary of Fit

Rsquare	0.398086
Adj Rsquare	0.264327
Root Mean Square Error	0.091033
Mean of Response	0.322083
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.04932717	0.024664	2.9761	0.1018
Error	9	0.07458375	0.008287		
C. Total	11	0.12391092			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.276000	0.04552	0.17303	0.37897
Cold Chem	4	0.412750	0.04552	0.30978	0.51572
Peroxide Fusion	4	0.277500	0.04552	0.17453	0.38047

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.276000	0.001633	0.00082	0.27340	0.27860
Cold Chem	4	0.412750	0.157432	0.07872	0.16224	0.66326
Peroxide Fusion	4	0.277500	0.008583	0.00429	0.26384	0.29116

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0016330	0.0010000	0.0010000
Cold Chem	4	0.1574323	0.1362500	0.1362500
Peroxide Fusion	4	0.0085829	0.0070000	0.0070000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	361.3368	2	9	<.0001
Brown-Forsythe	1175.9706	2	9	<.0001
Levene	1648.6647	2	9	<.0001
Bartlett	15.2450	2		<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.3494	2	4.14	0.3538

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Cold Chem	Peroxide Fusion	Aqua Regia
Cold Chem	-0.17972	-0.04447	-0.04297
Peroxide Fusion	-0.04447	-0.17972	-0.17822
Aqua Regia	-0.04297	-0.17822	-0.17972

Positive values show pairs of means that are significantly different.

Level	Mean
Cold Chem A	0.41275000
Peroxide Fusion A	0.27750000
Aqua Regia A	0.27600000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Mn

Oneway Anova Summary of Fit

Rsquare 0.543982
Adj Rsquare 0.442645
Root Mean Square Error 0.075388
Mean of Response 3.081667
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.06101667	0.030508	5.3680	0.0292
Error	9	0.05115000	0.005683		
C. Total	11	0.11216667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	3.16000	0.03769	3.0747	3.2453
Cold Chem	4	2.98750	0.03769	2.9022	3.0728
Peroxide Fusion	4	3.09750	0.03769	3.0122	3.1828

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	3.16000	0.088318	0.04416	3.0195	3.3005
Cold Chem	4	2.98750	0.023629	0.01181	2.9499	3.0251
Peroxide Fusion	4	3.09750	0.093229	0.04661	2.9492	3.2458

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0883176	0.0650000	0.0550000
Cold Chem	4	0.0236291	0.0175000	0.0175000
Peroxide Fusion	4	0.0932291	0.0725000	0.0725000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9177	2	9	0.4338
Brown-Forsythe	1.1868	2	9	0.3488
Levene	2.6688	2	9	0.1230
Bartlett	2.0628	2		0.1271

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.0324	2	4.4885	0.0329

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.14883	-0.08633	0.02367
Peroxide Fusion	-0.08633	-0.14883	-0.03883
Cold Chem	0.02367	-0.03883	-0.14883

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia	A 3.1600000
Peroxide Fusion	A B 3.0975000
Cold Chem	B 2.9875000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Na

Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.391304
Adj Rsquare 0.289855
Root Mean Square Error 0.108012
Mean of Response 14.025
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.04500000	0.045000	3.8571	0.0972
Error	6	0.07000000	0.011667		
C. Total	7	0.11500000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	13.9500	0.05401	13.818	14.082
Cold Chem	4	14.1000	0.05401	13.968	14.232
Peroxide Fusion	0				

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	13.9500	0.129099	0.06455	13.745	14.155
Cold Chem	4	14.1000	0.081650	0.04082	13.970	14.230
Peroxide Fusion	0					

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.1290994	0.1000000	0.1000000
Cold Chem	4	0.0816497	0.0500000	0.0500000
Peroxide Fusion	0		0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8640	1	6	0.3885
Brown-Forsythe	1.5000	1	6	0.2666
Levene	1.5000	1	6	0.2666
Bartlett	0.5218	1		0.4701

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.8571	1	5.069	0.1060

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Ni

Oneway Anova Summary of Fit

Rsquare 0.897677
Adj Rsquare 0.874939
Root Mean Square Error 0.048132
Mean of Response 2.218333
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.18291667	0.091458	39.4784	<.0001
Error	9	0.02085000	0.002317		
C. Total	11	0.20376667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	2.33500	0.02407	2.2806	2.3894
Cold Chem	4	2.04750	0.02407	1.9931	2.1019
Peroxide Fusion	4	2.27250	0.02407	2.2181	2.3269

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	2.33500	0.034157	0.01708	2.2806	2.3894
Cold Chem	4	2.04750	0.017078	0.00854	2.0203	2.0747
Peroxide Fusion	4	2.27250	0.074106	0.03705	2.1546	2.3904

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0341565	0.0250000	0.0250000
Cold Chem	4	0.0170783	0.0125000	0.0125000
Peroxide Fusion	4	0.0741058	0.0575000	0.0575000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0837	2	9	0.1804
Brown-Forsythe	3.3205	2	9	0.0832
Levene	4.3167	2	9	0.0485
Bartlett	2.4759	2		0.0841

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
108.4510	2	4.9159	<.0001

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q*	Alpha
2.79201	0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.09502	-0.03252	0.19248
Peroxide Fusion	-0.03252	-0.09502	0.12998
Cold Chem	0.19248	0.12998	-0.09502

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	2.3350000
Peroxide Fusion A	2.2725000
Cold Chem B	2.0475000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Si

Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.863091
Adj Rsquare 0.840273
Root Mean Square Error 0.196892
Mean of Response 1.049375
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	1.4663281	1.46633	37.8248	0.0008
Error	6	0.2325978	0.03877		
C. Total	7	1.6989259			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.62125	0.09845	0.3804	0.8621
Cold Chem	0				
Peroxide Fusion	4	1.47750	0.09845	1.2366	1.7184

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.62125	0.275029	0.13751	0.1836	1.0589
Cold Chem	0					
Peroxide Fusion	4	1.47750	0.043493	0.02175	1.4083	1.5467

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.2750289	0.1972500	0.1972500
Cold Chem	0		0.0000000	0.0000000
Peroxide Fusion	4	0.0434933	0.0325000	0.0325000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.9554	1	6	0.2115
Brown-Forsythe	3.6296	1	6	0.1054
Levene	4.4776	1	6	0.0787
Bartlett	6.0471	1		0.0139

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
37.8248	1	3.15	0.0075

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Th

Oneway Anova Summary of Fit

Rsquare 0.844638
Adj Rsquare 0.810113
Root Mean Square Error 0.058272
Mean of Response 0.8425
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.16614450	0.083072	24.4646	0.0002
Error	9	0.03056050	0.003396		
C. Total	11	0.19670500			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.974500	0.02914	0.90859	1.0404
Cold Chem	4	0.688750	0.02914	0.62284	0.7547
Peroxide Fusion	4	0.864250	0.02914	0.79834	0.9302

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.974500	0.004655	0.00233	0.96709	0.98191
Cold Chem	4	0.688750	0.089343	0.04467	0.54658	0.83092
Peroxide Fusion	4	0.864250	0.046722	0.02336	0.78991	0.93859

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0046547	0.0040000	0.0040000
Cold Chem	4	0.0893434	0.0652500	0.0652500
Peroxide Fusion	4	0.0467217	0.0357500	0.0357500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6030	2	9	0.2538
Brown-Forsythe	2.9398	2	9	0.1041
Levene	4.0435	2	9	0.0559
Bartlett	6.0640	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
26.8558	2	4.05	0.0046

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.11504	-0.00479	0.17071
Peroxide Fusion	-0.00479	-0.11504	0.06046
Cold Chem	0.17071	0.06046	-0.11504

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	0.97450000
Peroxide Fusion A	0.86425000
Cold Chem B	0.68875000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Ti

Oneway Anova Summary of Fit

Rsquare 0.625919
Adj Rsquare 0.54279
Root Mean Square Error 0.000913
Mean of Response 0.017892
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00001256	6.2808e-6	7.5295	0.0120
Error	9	0.00000751	8.3417e-7		
C. Total	11	0.00002007			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.016900	0.00046	0.01587	0.01793
Cold Chem	4	0.017475	0.00046	0.01644	0.01851
Peroxide Fusion	4	0.019300	0.00046	0.01827	0.02033

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.016900	0.000638	0.00032	0.01589	0.01791
Cold Chem	4	0.017475	0.000386	0.00019	0.01686	0.01809
Peroxide Fusion	4	0.019300	0.001395	0.00070	0.01708	0.02152

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0006377	0.0004500	0.0004500
Cold Chem	4	0.0003862	0.0002750	0.0002750
Peroxide Fusion	4	0.0013952	0.0011000	0.0011000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.2307	2	9	0.1634
Brown-Forsythe	3.2431	2	9	0.0870
Levene	4.3746	2	9	0.0471
Bartlett	2.0804	2		0.1249

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.4298	2	5.1701	0.0757

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Peroxide Fusion	Cold Chem	Aqua Regia
Peroxide Fusion	-0.00180	0.00002	0.00060
Cold Chem	0.00002	-0.00180	-0.00123
Aqua Regia	0.00060	-0.00123	-0.00180

Positive values show pairs of means that are significantly different.

Level	Mean
Peroxide Fusion A	0.01930000
Cold Chem B	0.01747500
Aqua Regia B	0.01690000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=U

Oneway Anova
Summary of Fit

Rsquare 0.526962
Adj Rsquare 0.421842
Root Mean Square Error 0.130852
Mean of Response 5.248333
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.17166667	0.085833	5.0130	0.0344
Error	9	0.15410000	0.017122		
C. Total	11	0.32576667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	5.41500	0.06543	5.2670	5.5630
Cold Chem	4	5.14000	0.06543	4.9920	5.2880
Peroxide Fusion	4	5.19000	0.06543	5.0420	5.3380

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	5.41500	0.125033	0.06252	5.2160	5.6140
Cold Chem	4	5.14000	0.040825	0.02041	5.0750	5.2050
Peroxide Fusion	4	5.19000	0.184572	0.09229	4.8963	5.4837

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.1250333	0.0925000	0.0750000
Cold Chem	4	0.0408248	0.0300000	0.0250000
Peroxide Fusion	4	0.1845716	0.1550000	0.1550000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.6412	2	9	0.1252
Brown-Forsythe	3.3362	2	9	0.0824
Levene	6.9703	2	9	0.0148
Bartlett	2.2635	2		0.1040

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
7.6520	2	4.5475	0.0351

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

q* Alpha
2.79201 0.05

Abs(Dif)-LSD	Aqua Regia	Peroxide Fusion	Cold Chem
Aqua Regia	-0.25833	-0.03333	0.01667
Peroxide Fusion	-0.03333	-0.25833	-0.20833
Cold Chem	0.01667	-0.20833	-0.25833

Positive values show pairs of means that are significantly different.

Level	Mean
Aqua Regia A	5.4150000
Peroxide Fusion A B	5.1900000
Cold Chem B	5.1400000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (wt%) By Prep Grouping=SRAT, Type=Receipt, Element=Zr

Missing Rows

4

Oneway Anova
Summary of Fit

Rsquare 0.95699
Adj Rsquare 0.949821
Root Mean Square Error 0.013439
Mean of Response 0.1781
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.02411208	0.024112	133.5011	<.0001
Error	6	0.00108368	0.000181		
C. Total	7	0.02519576			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia	4	0.123200	0.00672	0.10676	0.13964
Cold Chem	4	0.233000	0.00672	0.21656	0.24944
Peroxide Fusion	0				

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
Aqua Regia	4	0.123200	0.018812	0.00941	0.09327	0.15313
Cold Chem	4	0.233000	0.002708	0.00135	0.22869	0.23731
Peroxide Fusion	0					

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
Aqua Regia	4	0.0188121	0.0137000	0.0123000
Cold Chem	4	0.0027080	0.0020000	0.0015000
Peroxide Fusion	0		0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5804	1	6	0.2554
Brown-Forsythe	2.0383	1	6	0.2033
Levene	5.1833	1	6	0.0631
Bartlett	6.5090	1		0.0107

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
133.5011	1	3.1243	0.0011

Distribution

M.J. Barnes, 773-A
J.M. Bricker, 704-27S
L.M. Chandler, 773-A
C.J. Coleman, 773-A
T.B. Edwards, 773-42A
M.T. Feller, 704-28S
T.L. Fellingner, 704-26S
C.M. Gregory, 773-A
C.C. Herman, 999-W
E.W. Holtzscheiter, 704-15S
J.F. Iaukea, 704-30S
P.L. Lee, 773-A
S.L. Marra, 773-A
R.T. McNew, 704-S
R.N. Mahannah, 704-28S
A.B. Osteen, 704-28S
J.E. Occhipinti, 704-S
J.M. Pareizs, 773-A
D.K. Peeler, 999-W
H.M. Pittman, 704-27S
J.W. Ray, 704-S
D.C. Sherburne, 704-S
A.V. Staub, 704-27S
M.E. Stone, 999-W

ADS Files