VERIFICATION OF THE DEFENSE WASTE PROCESSING FACILITY'S (DWPF) PROCESS DIGESTION METHODS FOR THE SLUDGE BATCH 8 QUALIFICATION SAMPLE

D. R. Click
T. B. Edwards
B. J. Wiedenman
L.W. Brown

March 18, 2013

Analytical Development
Savannah River National Laboratory
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-08SR22470

SRNL
SAVANNAH RIVER NATIONAL LABORATORY

This page intentionally left blank

DISCLAIMER

Printed in the United States of America

Prepared For
U.S. Department of Energy

This page intentionally left blank

Key Words:
method development, analytical process, SB8, waste compliance

Retention:
Permanent

VERIFICATION OF THE DEFENSE WASTE PROCESSING FACILITY'S (DWPF) PROCESS DIGESTION METHODS FOR THE SLUDGE BATCH 8 QUALIFICATION SAMPLE

D. R. Click
T. B. Edwards
B. J. Wiedenman
L.W. Brown

March 18, 2013

Analytical Development
Savannah River National Laboratory
Aiken, SC 29808

Prepared for the U.S. Department of Energy Under Contract Number DE-AC09-08SR22470

SRNL
SAVANNAH RIVER NATIONAL LABORATORY
TM

REVIEWS AND APPROVALS

AUTHORS:

D.R. Click, Author, Analytical Development, SRNL Date

T.B. Edwards, Co-Author, Applied Computational Engineering and Statistics, SRNL Date

B.J. Wiedenman, Co-Author, Analytical Development, SRNL Date

L.W. Brown, Co-Author, Analytical Development, SRNL Date

TECHNICAL REVIEWER:

C. J. Coleman, Technical Reviewer, Analytical Development, SRNL Date

APPROVERS:

C.C. Herman, Manager, Process Technology Programs, SRNL Date

C. M. Gregory, Manager, Analytcial R&D Programs, SRNL Date

E. J. Freed, Manager, WS Engineering, SRR Date

TABLE OF CONTENTS

This page intentionally left blank

LIST OF AND FIGURES AND TABLES

This page intentionally left blank

LIST OF ACRONYMS

AD	Analytical Development
AR	Aqua Regia
ARG	Analytical Reference Glass
CC	Cold Chem
CPC	Chemical Process Cell
DI	De-Ionized
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

This page intentionally left blank

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 methods used by the DWPF lab for elemental analysis of Sludge Receipt and Adjustment Tank (SRAT) receipt samples and SRAT product process control samples.[1,2] DWPF SRAT samples are typically dissolved using a room temperature HF-HNO_3 acid dissolution (i.e., DWPF Cold Chem Method (CC), see DWPF Procedure SW4-15.201) and 17 elements are analyzed by inductively coupled plasma – atomic emission spectroscopy (ICP-AES). Additional sludge is digested using an oxidizing mixture of acids (according to SW4-15.204 based on a test method from the Environmental Protection Agency's SW-846 publication) and the resulting solution is analyzed for mercury by cold vapor atomic absorption. In recent years, the DWPF has implemented the use of the Sodium Peroxide/Sodium Hydroxide Fusion Dissolution (PF) method on material from either the SRAT Product or SRAT Receipt as necessary to dissolve elements contained in species that are sparingly soluble in acid (i.e., boehmite) or slow to dissolve. The PF has been used in addition to the CC method for the first ten SRAT Receipt batches of Sludge Batch 7a and 7b. The PF was also used in addition to the CC method for at least the first ten SRAT Product batches of SB4, SB5, and SB6.

This report contains the results and comparison of data generated from ICP-AES analysis of AR, PF and CC method digestions and Cold Vapor Atomic Absorption analysis of Hg digestions from the DWPF Hg digestion method of Sludge Batch 8 (SB8) SRAT Receipt and SB8 SRAT Product samples. The SB8 SRAT Receipt and SB8 SRAT Product samples were prepared in the SRNL Shielded Cells, and the SRAT Receipt material is representative of the sludge that constitutes the SB8 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 7b (SB7b), to form the SB8 Blend composition.

Observations and results from digesting SRAT Receipt material using the DWPF process digestion method (i.e, CC method) and Hg digestion method include the following:

- White solids remained in the solutions generated from the AR and CC digestions after all acid addition steps and dilutions were performed. The solids from the CC soutions were recovered by filtration and analyzed by contained x-ray diffraction (C-XRD). Calcium aluminum fluoride ($CaAlF_6$), sodium iron fluoride ($NaFeF_3$) and chiolite ($Na_5Al_3F_{14}$) were identified in the solids recovered from both the SRAT Receipt and SRAT Product CC digestion method solutions.
- A statistically significant (at the 5% level) larger Al concentration is observed in the mean of PF digestions when compared to the AR and CC method means, the PF mean is ~3% larger than the CC mean and the CC mean is ~9% larger than the AR mean.
- A statistically significant (at the 5% level) larger Fe concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the CC mean is ~3.5% larger than the AR mean and 2% larger PF mean.
- A statistically significant (at the 5% level) larger Mn concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the CC mean is ~9.5% larger than the AR mean and 3% larger than the PF mean..
- The mean Ni concentration is ~7% and ~4% higher from the CC digestion relative to the PF and AR digestions, respectively.
- Thorium must be determined from the PF digestion, thorium has preceiptated from solution as calcium thorium fluoride ($Ca_{0.5}Th_{0.5}F_3$) in previous process digestion verification campaigns.

- A statistically significant (at the 5% level) smaller U concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the PF mean is ~9% larger than the CC mean and the AR mean is ~13% larger.
- A statistical difference in the means was also noted for the minor elements (<0.2 wt%) Cr, Cu, K, Li, Mg and Ti (see Table 3-2).
- The average Hg result from the AR digestions is ~21% larger than the average measured concentration in solutions obtained using the DWPF Hg digestion method.

Observations and results from digesting SRAT Product material using the DWPF process digestion method (i.e, CC method) and Hg digestion method include the following:

- White solids remained in the solutions generated from the AR and CC digestions after all acid addition steps and dilutions were performed.
- Thorium must be determined from the PF digestion, thorium has preceiptated from solution as calcium thorium fluoride ($Ca_{0.5}Th_{0.5}F_3$) in previous process digestion verification campaigns.
- A statistical difference in the means was noted for the minor elements Cr, Cu, K, Li, Mg and Ti (see Table 3-5).
- The average Hg result from the AR digestions is ~11% larger than the average measured concentration in solutions obtained using the DWPF Hg digestion method.

The previous DWPF process digestion method verification report issued by SRNL for SB7b (SRNL-STI-2011-00475) recommended Al, Fe, Mn, Ni and Th concentrations be determined by ICP-ES analysis of PF digestion preps in addition to the CC preps and monitored over time. Observations in that report highlighted statistically significant differences between the means of the elements from individual preparation methods, and in some cases large relative differences between the means. Visual observations indicated that some components were not dissolving in an expeditious manner.

In regards to the DWPG Hg digestion method, past documented studies indicate the DWPG Hg digestion method is adequate for dissoving Hg from sludge slurry[3], the reason for the difference seen in the present study is unclear and may warrant further study.

Based on the comparison of analytical data contained in this report for SB8, the previous report, and not knowing the exact “blend” composition, SRNL recommends the following:

- Al and Th concentrations must be determined solely by ICP-AES analysis of PF preparations. Fe, Mn and Ni can be determined from either the CC or PF method preparations but monitored closely and the highest measured concentration between the two digestions should be used.

- DWPF should investigate if comparisons between the elemental concentrations of the Slurry Mix Evaporator (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, Ni, Mn and Th concentrations in SB8.

- The mean Hg result from AA analysis of samples prepared by the DWPF Hg digestion method was ~21% lower than AR digestions for SRAT Receipt material and ~11% lower for SRAT Product material. An additional dissolution study should be performed on the SB8 Waste Acceptance Product Specification (WAPS) sample by SRNL which consists of the final

composition of the sludge (the SB8 Blend) to determine if and how this difference will manifest itself in processing.

- Significant foaming can occur during performance of the DWPF Hg digestion method when concentrated sulfuric acid is added to the sludge slurry resulting in loss of sample or analyte. The DWPF should specify in operating procedure SW4-15.201, that sulfuric acid must be added slowly and drop-wise.

- The DWPF Hg digestion method is based upon SW846, a method used for samples containing a significant amount of organic material. Since the DWPF does not have a significant amount of organic material in the feed, the DPWF should consider using a 6 M HCl/concentrated HNO_3 acid digestion mixture in the future for Hg analysis. The chloride concentration would be nearly equivalent to the 10 weight percent hydroxylamine, 12 weight percent sodium chloride solution used in the DWPF digestion scheme if scaled to a 1 g sludge slurry sample size. As an alternative, a concentrated nitric acid/hydrogen peroxide digestion could be performed (see SRNS-STI-2009-00315) and has been shown to give equivalent results.

This page intentionally left blank

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 20, 2012 (HTF-51-12-80). The sample was washed to a projected target composition provided by the Tank Farm.[4] The washed slurry was then used in DWPF Chemical Process Cell (CPC) simulations with the resulting SRAT Receipt and SRAT Product samples being used for the digestion evaluations.

DWPF Cold Chem Process Digestion Method Verification

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. The CC method digestion (see DWPF Procedure SW4-15.201) involved adding 25 mL of concentrated HF to radioactive sludge slurry (3.5 – 4.0 g for the SRAT Receipt at 22.7 wt% total solids and 3.5 – 4.0 g for the SRAT Product at 31.5 wt% total solids) and stirring for 1 hr. Then, 25 mL of concentrated HNO_3 was added and the mixture was stirred for an additional 30 minutes. Undissolved/precipitated white 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.

For detailed steps of the PF digestion, see ADS procedure 2502.[5] For detailed steps of the AR digestion, see ADS procedure 2226.[6]

Two 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, Ti and Zr were low and flagged as being outside of the 2 sigma limits for the AR digestions. Silicon was not measured from the AR due to low silica solubility in a mixture of concentrated HCl and HNO_3. Ca was flagged outside the 2 sigma limits (slightly high) for the PF digestions, Ca is a contaminant in the fusion reagents (as can be seen from the blank data). For the Cold Chem method, Aluminum (Al) and Ca were flagged outside the 2 sigma limits.

For the SRAT product material, Zr was flagged outside of the 2 sigma limits for the AR digestions as well as Ti. No elements were flagged outside of the 2 sigma limits for the CC digestions. Ca was 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 CC, PF and AR digestions.

The residual solids from each type of sample (SRAT Receipt and SRAT Product) were recovered by filtration and analyzed by Contained X-Ray Diffraction (C-XRD).

Hg Method Validation

For each sample, approximately 10 grams of sludge slurry was digested by the method outlined in SW4-15.204 (without the third dilution). Serial dilutions were used to produce an effective volume of

approximately 50,000 mL. An additional sample was spiked with a NIST Traceable 1,000 mg/L Hg standard at approximately 10X the actual Hg concentration contained in the diluted sludge slurries for QA/QC purposes. The samples were measured using Cold-Vapor Atomic Absorption. Significant foaming can occur when concentrated sulfuric acid is added to the sludge slurry resulting in loss of sample or analyte. The first digestion attempt os a SRAT Receipt sample resulted in foam over of the sample which required that the digestion be repeated with slow addition of sulfuric acid. The DWPF should specify in operating procedure SW4-15.201, that sulfuric acid must be added slowly and drop-wise. The first digestion attempt of a SRAT Receipt sample resulted in foam over of the sample which was repeated.

.

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 eight sludge batches (Sludge Batch 1A, Sludge Batch 1B, Sludge Batch 2, Sludge Batch 3, Sludge Batch 4, Sludge Batch 5, Sludge Batch 6, and Sludge Batch 7a) and is currently processing a ninth (Sludge Batch 7b). 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 SB8. The subject of this report is the SB8 material from Tank 51 that is being qualified at SRNL and the material on which the DWPF process digestion method will be verified.

The statistical results for the SB8 samples generated from this study are provided in Appendix A. The results were generated using JMP Version 7.0.2.[7] 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 Receipt 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. If the p value is less than 0.05, then the means are statistically different at the 5% level. For example, from Exhibit A1, there is a statistical difference in the AR and CC means for Na for the SRAT Product and the SRAT Receipt samples, though a small relative difference.

The results from each type of digestion are summarized in
Table 3-1 for the SRAT Receipt and Table 3-4 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 for the SRAT Receipt results of all three digestions could not be performed for B, K, Li, Na, Si or Zr. B, Li and K were below the ICP-AES detection limits in the PF digestions. Na is added as part of the reagents used for PF digestions so only the means for 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. The Zr result from the AR digestions is inaccurate, HF is needed to completely dissolve Zr and this can readily be seen from the ARG-1 analysis results as well. For the SRAT Product in addition to B, Na, Si and Zr, K and Li concentrations were less than the detection limit and therefore only the means of the AR and CC digestion results were compared.

Summaries of the statistical comparisons from appendix A are shown in Table 3-2 and Table 3-5. Digestion types not having the same letter 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. The averages from duplicate digestion of ARG-1 glass are presented and compared

for each digestion type for the SRAT Receipt and SRAT Product samples in Table 3-7 through Table 3-10.

During verification of the DWPF CC method for previous sludge batches, boehmite (AlO(OH)), muscovite (K,Na)(Al, Mg, Fe)$_2$($Si_{3.1}Al_{0.9}$)O_{10}(OH)$_2$, silicon dioxide (SiO_2), dipotassium sodium aluminum fluoride ($K_2NaAl_3F_{12}$), dipotassium aluminum pentafluoride (K_2AlF_5), aluminum fluoride (AlF_3), chiolite ($Na_5Al_3F_{14}$), cryolite (Na_3AlF_6), sodium magnesium aluminum hexafluoride ($NaMgAlF_6$), iron zirconium hexafluoride ($FeZrF_6$), disodium iron aluminum heptafluoride (Na_2FeAlF_7), and calcium thorium fluoride ($Ca_{0.5}Th_{0.5}F_3$) have been found.[8] As mentioned in the summary section of this report for SB8, white solids were present in the SRAT Receipt and SRAT Product solutions prepared using the CC digestion method. The solids were recovered by filtration and analyzed by C-XRD. Calcium aluminum fluoride ($CaAlF_6$), sodium iron fluoride ($NaFeF_3$) and chiolite ($Na_5Al_3F_{14}$) were identified in the solids recovered from both the SRAT Receipt and SRAT Product CC digestion method solutions. These species are forming during the process digestion method and are precipitating from solution.

Table 3-1. Elemental concentrations of SB8 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_2O_2/NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%*	%RSD[#]	Avg Wt%*	%RSD[#]	Avg Wt%*	%RSD[#]
Al	4.87E+00	1.25E+00	5.50E+00	9.96E-01	5.33E+00	9.12E-01
B	<1.56E+01	--	5.32E-02	3.05E+00	6.28E-02	5.12E+01
Ca	1.12E+00	7.29E-01	1.30E+00	4.57E+00	1.14E+00	1.14E+00
Cr	9.24E-02	4.24E-01	1.11E-01	7.05E+00	9.70E-02	7.67E-01
Cu	5.02E-02	5.39E-01	2.49E-02	1.33E+00	2.39E-02	1.89E+00
Fe	1.71E+01	4.77E-01	1.73E+01	1.10E+00	1.77E+01	2.83E-01
K	8.93E-02	4.20E+00	2.83E-01	6.33E+00	9.32E-02	1.26E+01
Li	6.28E-03	1.43E+00	1.34E-02	1.36E+00	5.82E-03	6.74E+00
Mg	1.64E-01	3.05E-01	1.62E-01	3.25E+00	1.78E-01	1.06E+00
Mn	6.10E+00	3.14E-01	6.53E+00	1.09E+00	6.71E+00	4.95E-01
Na	1.69E+01	4.83E-01	NA	NA	1.75E+01	2.86E-01
Ni	8.20E-01	4.56E-01	8.00E-01	1.19E+00	8.57E-01	8.78E-01
Si	NA	NA	9.07E-01	1.61E+00	NM	NM
Th	6.37E-01	6.15E-01	5.90E-01	4.62E+00	5.82E-01	3.69E+00
Ti	1.15E-02	4.34E-01	1.40E-02	1.43E+01	1.20E-02	5.61E+00
U	2.64E+00	4.90E-01	2.53E+00	4.76E+00	2.31E+00	5.22E+00
Zr	4.49E-02	2.50E+01	NA	NA	1.43E-01	1.19E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility in the ptrep or element present as a contaminant from the reagents or supplies used during preparation.
[#]%RSD is the percent relative standard deviation for the measurements. NM = not measured, HF leaches Si from the ICP-AES sample introduction system.

Table 3-2 Statistical comparison of Aqua Regia, Sodium Peroxide/Hydroxide Fusion and DWPF Cold Chem method digestions of SB8 SRAT Receipt sludge. Digestions not having the same letter are statistically different at the 5% significance level.

Element	Statistical Comparisons (AR, PF CC)
Al	C, A, B
B	*, A, A
Ca	B, *, B
Cr	B, A, B
Cu	A, B, C
Fe	B, B, A
K	B, A, B
Li	B, A, B
Mg	B, B, A
Mn	C, B, A
Na	A, *, B
Ni	B, C, A
Si	*, *, *
Th	A, B, B
Ti	B, A, AB
U	A, A, B
Zr	A, *, B

*Comparison of the means was not applicable due to low solubility of the element in the acids used for the preparation, element present as a contaminant from the reagents or supplies used during preparation or, the elements were below the minimum detection level.

The Hg results obtained using the DWPF Hg digestion method and the AR digestion for the SRAT Receipt sample are contained in Table 3-3.

Table 3-3 SRAT Receipt Hg digestion results for the AR and DWPF Hg digestion method presented on a weight percent (Wt%) of total dried solids basis.

Method of Digestion	Average Wt% (%RSD)	Spike Recovery	% Relative Difference (AR to DWPF Hg Method)
DWPF Hg Digestion Method	1.59 (2.1)	101%	~21%
Aqua Regia	1.96 (2.2)	No Spiked Sample	

For the SRAT Receipt sample:

- White solids remained in the solutions generated from the AR and CC digestions after all acid addition steps and dilutions were performed. The solids from the CC solutions were recovered by filtration and analyzed by C-XRD. Calcium aluminum fluoride ($CaAlF_6$), sodium iron fluoride

($NaFeF_3$) and chiolite ($Na_5Al_3F_{14}$) were identified in the solids recovered from both the SRAT Receipt and SRAT Product CC digestion method solutions.

- A statistically significant (at the 5% level) larger Al concentration is observed in the mean of PF digestions when compared to the AR and CC method means, the PF mean is ~3% larger than the CC mean and the CC mean is ~9% larger than the AR mean.
- A statistically significant (at the 5% level) larger Fe concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the CC mean is ~3.5% larger than the AR mean and 2% larger PF mean.
- A statistically significant (at the 5% level) larger Mn concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the CC mean is ~9.5% larger than the AR mean and 3% larger than the PF mean..
- The mean Ni concentration is ~7% and ~4% higher from the CC digestion relative to the PF and AR digestions, respectively.
- Thorium must be determined from the PF digestion, thorium has preceiptated from solution as calcium thorium fluoride ($Ca_{0.5}Th_{0.5}F_3$) in previous process digestion verification campaigns.
- A statistically significant (at the 5% level) smaller U concentration is observed in the mean of CC digestions when compared to the AR and PF method means, the PF mean is ~9% larger than the CC mean and the AR mean is ~13% larger.
- A statistical difference of means was also noted for the minor elements (<0.2 wt%) Cr, Cu, K, Li, Mg and Ti.
- The average Hg result from the AR digestions is ~21% larger than the average measured concentration in solutions obtained using the DWPF Hg digestion method.

For Hg, there is a statisitical difference between the means obtained from analysis of samples prepped from AR versus the DWPF Hg digestion method, as well as a relatively large statistical difference. The reason for the difference in Hg concentration values measured from AR digestions versus the DWPF Hg digestion method is unclear. Four samples were submitted for analysis and a fifth sample was spiked with an additional 5 ppm Hg. The spike recovery was 101%, indicating that the measured concentration in the four samples submitted was measured correctly. Documented past method verification studies indicate the DWPG Hg digestion method is adequate for dissoving Hg from sludge slurry.[3] A Hg dissolution study should be performed on the SB8 WAPS sample by SRNL which consists of the final composition of the sludge (the SB8 Blend) to determine if and how this difference will manifest itself in processing.

A statistical comparison of means from the results of duplicate ARG-1 samples digested concurrently with the SRAT Receipt samples is not icluded. For the AR digestions, the measured mean Cu and Ti concentrations were greater than 10% different compared to the known concentration 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, the measured mean concentration for Ca was greater than 10% different than the known concentration in ARG-1. Ca is a contaminant in the PF reagents. For the CC digestions, the measured mean Mg concentration was greater than 10% different compared to the known Mg concentration in ARG-1. Although no fluoride salts containing Mg were identified by C-XRD this time, Mg can complex and with fluoride and form insoluble species which may explain the low recovery of Mg in this case.

Table 3-4 contains the elemental concentrations of the SB8 SRAT Product sample.

Table 3-4. Elemental concentrations of SB8 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_2O_2/NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%^	%RSD[#]	Avg Wt%*	%RSD[#]	Avg Wt%*	%RSD[#]
Al	4.40E+00	1.50E+00	4.66E+00	6.56E+00	4.44E+00	4.27E-01
B	1.52E-02	3.64E+00	<1.51E-02	--	1.46E-01	1.88E+01
Ca	9.86E-01	1.94E+00	1.17E+00	6.37E+00	8.90E-01	2.64E+00
Cr	8.29E-02	1.76E+00	9.18E-02	6.41E+00	8.63E-02	8.89E-01
Cu	4.13E-02	1.54E+00	2.47E-02	7.99E+00	2.16E-02	5.08E+00
Fe	1.48E+01	1.66E+00	1.60E+01	6.64E+00	1.50E+01	6.37E-01
Li	8.19E-02	1.69E+00	<2.74E-01	--	1.08E-01	8.84E-01
K	1.32E-02	3.68E+00	<1.31E-02	--	5.20E-03	5.44E-01
Mg	1.49E-01	1.72E+00	1.39E-01	5.90E+00	1.51E-01	1.47E+00
Mn	5.61E+00	1.73E+00	5.82E+00	6.62E+00	5.70E+00	1.17E+00
Na	1.48E+01	1.41E+00	NA	NA	1.53E+01	7.55E-01
Ni	7.15E-01	1.85E+00	7.72E-01	6.43E+00	7.20E-01	9.72E-01
Si	NA	NA	9.25E-01	8.46E+00	NM	NM
Th	5.56E-01	1.71E+00	5.17E-01	5.66E+00	2.32E-01	2.88E+01
Ti	1.00E-02	1.65E+00	1.17E-02	7.03E+00	1.03E-02	0.00E+00
U	2.17E+00	1.69E+00	2.10E+00	7.15E+00	2.17E+00	7.86E-01
Zr	7.23E-02	1.49E+01	NA	NA	1.01E-01	1.73E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility in the prep or element present as a contaminant from the reagents or supplies used during preparation. [#]%RSD is the percent relative standard deviation for the measurements. NM = not measured, HF leaches Si from the ICP-AES sample introduction system.

A statistical comparison of means from SB8 SRAT product digestions is presented in Table 3-5.

Table 3-5. Statistical comparison of Aqua Regia, Sodium Peroxide/Hydroxide Fusion and DWPF Cold Chem method digestions of SB8 SRAT Product sludge. Digestions not having the same font are statistically different at the 5% significance level.

Element	Statistical Comparisons (AR, PF, CC)
Al	A, A, A
B	B, *, A
Ca	B, *, B
Cr	B, A, AB
Cu	A, B, C
Fe	A, A, A
K	C, *, B
Li	A, *, B
Mg	AB, B, A
Mn	A, A, A
Na	A, *, B
Ni	A, A, A
Si	*, *, *
Th	A, A, B
Ti	B, A, B
U	A, A, A
Zr	A, *, B

*Comparison of the means was not applicable due to low solubility of the element in the acids used for the preparation, element present as a contaminant from the reagents or supplies used during preparation or, the elements were below the minimum detection level.

The Hg results obtained using the DWPF Hg digestion method and the AR digestion for the SRAT Product sample are contained in Table 3-6.

Table 3-6 SRAT Product Hg digestion results for the AR and DWPF Hg digestion method presented on a weight percent (Wt%) of total dried solids basis.

Method of Digestion	Average Wt% (%RSD)	Spike Recovery	% Relative Difference (AR to DWPF Hg Method)
DWPF Hg Digestion Method	0.64 (5.7)	78%	~11%
Aqua Regia	0.71 (1.8)	No Spiked Sample	

For the SRAT Product sample:

- White solids remained in the solutions generated from the AR and CC digestions after all acid addition steps and dilutions were performed. The PF method resulted in clear solutions with no apparent solids.
- Thorium must be determined from the PF digestion, thorium has preceiptated from solution as calcium thorium fluoride ($Ca_{0.5}Th_{0.5}F_3$) in previous process digestion verification campaigns.

- A statistical difference of means was noted for the minor elements (<0.2 wt%) Cr, Cu, K, Li, Mg and Ti.
- The average Hg result from the AR digestions is 11% larger when compared to the DWPF Hg digestion method average.

For Hg, there is a statistical difference between the means obtained from Cold-Vapor Atomic Absorption analysis of samples prepped from AR versus the DWPF Hg digestion method, as well as a large relative difference. Four samples were submitted for analysis and a fifth sample was spiked with an additional 5 ppm Hg. The spike recovery was 78%, within standard analytical protocol of ±25% for spike recovery. It is beyond the scope of this report to determine how accurate the DWPF Hg digestion method needs to be in order for the DWPF to take credit for removing enough Hg during the CPC processing in the SRAT.

A statistical comparison of means from the results of duplicate ARG-1 samples digested concurrently with the SRAT Product samples was not performed. However, relative differences are listed in Table 3-9 and Table 3-10. For the AR digestions, the Ti average was greater than 10% difference compared to the known concentration of 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, the average for Ca was greater than 10% different than the knownconcentrations in ARG-1. Ca is a contaminant in the PF reagents. For the CC digestions, the averages for all elements fell within 10% of the accepted ARG-1 elemental concentrations.

Table 3-7. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, Sodium Peroxide/Hydroxide Fusion, DWPF Cold Chem method digestions performed concurrently with SB8 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.

Aqua Regia*				
Element	**Average Wt%**	**%RSD**	**Standard Value**	**% Relative Difference (Measured *vs* Standard Value)**
Al	2.38E+00	1.49E+00	2.50E+00	-5.0
B	2.58E+00	1.10E+00	2.69E+00	-4.1
Ca	1.04E+00	6.83E-01	1.02E+00	1.5
Cr	6.45E-02	1.10E-01	6.40E-02	0.7
Cu	5.00E-03	4.25E-01	3.00E-03	66.5
Fe	9.80E+00	7.94E-01	9.79E+00	0.1
K	2.12E+00	1.00E+00	2.26E+00	-6.4
Li	1.47E+00	9.62E-01	1.49E+00	-1.3
Mg	5.00E-01	1.42E-01	5.20E-01	-3.9
Mn	1.42E+00	9.96E-01	1.46E+00	-2.7
Na	8.62E+00	7.39E-01	8.52E+00	1.1
Ni	8.44E-01	2.18E+00	8.27E-01	2.1
Si	NA	NA	2.24E+01	NA
Ti	6.12E-01	1.39E+00	6.90E-01	-11.3
Zr	2.73E-02	6.89E+01	9.60E-02	-71.6
Sodium Peroxide/Hydroxide Fusion*				
Element	**Average Wt%**	**%RSD**	**Standard Value**	**% Relative Difference (Measured *vs* Standard Value)**
Al	2.63E+00	1.61E+00	2.50E+00	5.2
B	2.59E+00	0.00E+00	2.69E+00	-3.7
Ca	1.27E+00	2.79E+00	1.02E+00	24.0
Cr	6.88E-02	2.06E+00	6.40E-02	7.5
Cu	<7.67E-03	--	3.00E-03	<MDL
Fe	9.81E+00	1.44E-01	9.79E+00	0.2
K	2.42E+00	2.92E+00	2.26E+00	7.1
Li	1.47E+00	9.62E-01	1.49E+00	-1.3
Mg	5.31E-01	6.66E-01	5.20E-01	2.0
Mn	1.45E+00	4.89E-01	1.46E+00	-1.0
Na	NA	NA	8.52E+00	NA
Ni	8.22E-01	6.88E-01	8.27E-01	-0.6
Si	2.31E+01	3.07E-01	2.24E+01	2.9
Ti	6.97E-01	7.11E-01	6.90E-01	0.9
Zr	NA	NA	9.60E-02	NA

*All averages are based upon two replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility or present as a contaminant from the preparation supplies used, or leached from the ICP-AES sample introductions system. <MDL = less than minimum detection limit.

Table 3-8. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, Sodium Peroxide/Hydroxide Fusion, DWPF Cold Chem method digestions performed concurrently with SB8 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	**Average**	**%RSD**	**Known Value**	**% Relative Difference (Measured *vs* Known Value)**
Al	2.43E+00	NA	2.50E+00	-2.8
B	2.80E+00	3.03E+00	2.69E+00	4.1
Ca	1.05E+00	4.11E+01	1.02E+00	2.9
Cr	6.62E-02	2.03E+00	6.40E-02	3.4
Cu	<3.29E-03	--	3.00E-03	<MDL
Fe	9.81E+00	2.74E+00	9.79E+00	0.2
K	2.22E+00	1.60E+00	2.26E+00	-2.0
Li	1.44E+00	6.87E+00	1.49E+00	-3.4
Mg	4.10E-01	4.47E+01	5.20E-01	-21.3
Mn	1.40E+00	6.06E+00	1.46E+00	-4.1
Na	8.74E+00	2.10E+00	8.52E+00	2.6
Ni	9.09E-01	3.66E+00	8.27E-01	9.9
Si	NA	NA	2.24E+01	NA
Ti	6.87E-01	1.75E+00	6.90E-01	-0.5
Zr	9.73E-02	1.38E+00	9.60E-02	1.3

*All averages are based upon two replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility or present as a contaminant from the preparation supplies used, or leached from the ICP-AES sample introductions system. <MDL = less than minimum detection limit.

Table 3-9. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, Sodium Peroxide/Hydroxide Fusion, DWPF Cold Chem method digestions performed concurrently with SB8 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

Aqua Regia*				
Element	**Average**	**%RSD**	**Standard Value**	**% Relative Difference (Measured *vs* Standard Value)**
Al	2.42E+00	2.93E-01	2.50E+00	-3.4
B	2.64E+00	0.00E+00	2.69E+00	-1.9
Ca	1.06E+00	0.00E+00	1.02E+00	3.9
Cr	6.48E-02	1.64E+00	6.40E-02	1.2
Cu	<8.55E-03	--	3.00E-03	<MDL
Fe	9.89E+00	0.00E+00	9.79E+00	1.0
K	2.21E+00	1.28E+00	2.26E+00	-2.2
Li	1.50E+00	4.73E-01	1.49E+00	0.3
Mg	5.23E-01	9.47E-01	5.20E-01	0.5
Mn	1.45E+00	0.00E+00	1.46E+00	-0.7
Na	8.72E+00	4.87E-01	8.52E+00	2.3
Ni	8.54E-01	3.31E-01	8.27E-01	3.3
Si	NA	NA	2.24E+01	NA
Ti	5.58E-01	6.21E+00	6.90E-01	-19.2
Zr	4.08E-02	6.24E+00	9.60E-02	-57.5
Sodium Peroxide/Hydroxide Fusion*				
Element	**Average**	**%RSD**	**Known Value**	**% Relative Difference (Measured *vs* Known Value)**
Al	2.44E+00	5.22E+00	2.50E+00	-2.4
B	2.51E+00	2.54E+00	2.69E+00	-6.9
Ca	1.21E+00	2.34E+00	1.02E+00	18.6
Cr	6.63E-02	4.27E+00	6.40E-02	3.6
Cu	<7.57E-03	--	3.00E-03	NA
Fe	9.95E+00	3.55E+00	9.79E+00	1.6
K	2.25E+00	2.20E+00	2.26E+00	-0.7
Li	1.49E+00	9.49E-01	1.49E+00	0.0
Mg	5.10E-01	2.77E+00	5.20E-01	-1.9
Mn	1.42E+00	3.50E+00	1.46E+00	-3.1
Na	NA	NA	8.52E+00	NA
Ni	8.73E-01	4.46E+00	8.27E-01	5.5
Si	2.18E+01	1.20E+01	2.24E+01	-2.9
Ti	7.00E-01	3.03E+00	6.90E-01	1.4
Zr	NA	NA	9.60E-02	NA

*All averages are based upon two replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility or present as a contaminant from the preparation supplies used, or leached from the ICP-AES sample introductions system. <MDL = less than minimum detection limit.

Table 3-10. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, Sodium Peroxide/Hydroxide Fusion, DWPF Cold Chem method digestions performed concurrently with SB8 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	**Average**	**%RSD**	**Known Value**	**% Relative Difference (Measured *vs* Known Value)**
Al	2.35E+00	9.05E-01	2.50E+00	-6.2
B	2.75E+00	2.06E+00	2.69E+00	2.2
Ca	1.03E+00	2.07E+00	1.02E+00	0.5
Cr	6.73E-02	6.30E-01	6.40E-02	5.2
Cu	3.13E-03	2.94E+00	3.00E-03	4.2
Fe	9.89E+00	2.86E-01	9.79E+00	1.0
K	2.24E+00	0.00E+00	2.26E+00	-0.9
Li	1.52E+00	9.30E-01	1.49E+00	2.0
Mg	5.25E-01	1.89E+00	5.20E-01	1.0
Mn	1.46E+00	4.86E-01	1.46E+00	-0.3
Na	8.88E+00	1.91E+00	8.52E+00	4.2
Ni	8.69E-01	1.14E+00	8.27E-01	5.1
Si	NA	NA	2.24E+01	NA
Ti	6.94E-01	0.00E+00	6.90E-01	0.6
Zr	9.79E-02	7.23E-02	9.60E-02	1.9

*All averages are based upon two replicate dissolutions and ICP-AES determinations. NA = Not applicable due to low solubility or present as a contaminant from the preparation supplies used, or leached from the ICP-AES sample introductions system. <MDL = less than minimum detection limit.

This page intentionally left blank

4.0 CONCLUSIONS

The results presented in this report indicate the DWPF CC method is suitable to dissolve the elements in SB8 measured for process control except aluminum and thorium. Statistical differences of means was noted for many elements when the three digestion methods were compared including some minor elements (<0.2 wt%). Although there were some differences, there may not be a practical impact in terms of process control. The AA results from analysis of solutions generated by the DWPF Hg digestion method are lower than the results obtained from analysis of AR digestions, especially for the SRAT Receipt sample. Previous validation studies indicated the DWPG Hg digestion method is adequate for dissoving Hg from sludge slurry and resulted in smaller relative differences between the two digestion methods, similar to what was seen for the SB8 SRAT Product results. An additional dissolution study for Hg should be performed on the SB8 WAPS sample by SRNL which consists of the final composition of the sludge (the SB8 Blend) to evaluate if this difference will persist and how it may manifest itself during processing of SB8. It is beyond the scope of this report to determine how accurate the data needs to be to stay within melter processing parameters for SB8.

This page intentionally left blank

5.0 RECOMMENDATIONS

The following recommendations are based upon results in this report and the previous DWPF process digestion method verification report issued by SRNL (SRNL-STI-2011-00475):

- Al and Th concentrations must be determined solely by ICP-AES analysis of PF preparations. Fe, Mn and Ni can be determined from either the CC or PF method preparations but monitored closely and the highest measured concentration between the two digestions should be used.

- 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, Ni, Mn and Th concentrations in SB8.

- The mean Hg results from AA analysis of samples prepared by the DWPF Hg digestion method was ~21% lower than AR digestions for SRAT Receipt material and ~11% lower for SRAT Product material. An additional dissolution study should be performed on the SB8 WAPS sample by SRNL which consists of the final composition of the sludge (the SB8 Blend).

- Significant foaming can occur during performance of the DWPF Hg digestion method when concentrated sulfuric acid is added to the sludge slurry resulting in loss of sample or analyte. The DWPF should insert into the operating procedure (SW4-15.201), that sulfuric acid should be added slowly and drop-wise.

- The DWPF Hg digestion method is based upon SW846, a method used for samples containing a significant amount of organic material. Since the DWPF does not have a significant amount of organic material in the feed, the DPWF should consider using a 6 M HCl/Concentrated HNO_3 acid digestion mixture in the future for Hg Analysis. The chloride concentration would be nearly equivalent to the 10 weight percent hydroxylamine, 12 weight percent sodium chloride solution used in the DWPF digestion scheme if scaled to a 1 g sludge slurry sample size. As an alternative, a concentrated nitric acid/hydrogen peroxide digestion could be performed (see SRNS-STI-2009-00315) and has been shown to give equivalent results.

This page intentionally left blank

6.0 REFERENCES

1. Samadi-Dezfoulli, A. *Technical Task Request: Sludge Batch (SB) 8 Qualification Studies*; HLW-DWPF-TTR-2012-0009, Rev. 1; Savannah River Site: Aiken, SC, 2012.
2. Pareiz, J. M.; Click, D. R. *Analytical Study Plan for Sludge Batch (SB) 8 Qualification in the Shielded Cells;* SRNL-RP-2012-00561; Savannah River National Lab: Aiken, SC, 2012.
3. D.R. Click, T.L. White and B.J. Wiedenman, *Validation of the DWPF Hg Analysis Method and Recommendation for Oxalate Analysis by IC for SB7a*, SRNL-L4140-2011-00010 Rev. 1; D.R. Click, C.J. Coleman, K.E. Zeigler, and T.B. Edwards, *Sludge Batch Four (4) Defense Waste Processing (DWPF) Process Analytcial Method Verification*, WSRC-STI-2006-00025, Aiken, SC 2006; C.J. Coleman, T.B. Edwards, L.C. Johnson, and A.Y. Brown, *Evaluation of Sample Preparation Methods for Mercury Determinations in DWPF Sludge*, SRNS-STI-2009-00315, Aiken, SC, 2009.
4. Gillam, J. M. *SB8_103012_47KgalNO2*_1.6M endpoint.xlsm, *Worksheet SB8: Tank Farm Washing Spreadsheet*, Savannah River Remediation: Aiken, SC 2012.
5. C.J. Coleman, "Alkali Fusion Dissolutions of Sludge and Glass for Elemental and Anion Analysis", ADS Procedure ADS-2502, Rev. 6.
6. C.J. Coleman, "Aqua Regia Dissolution of Sludge for Elemental Analysis", ADS Procedure ADS-2226, Rev. 7.
7. JMP Version 9.0.0, SAS Institute, Inc., Cary NC, 1989-2010.
8. C.J. Coleman, F.M. Pennebaker, B.H. Burch and D.R. Click, *Evaluation of the DWPF Cold Chem Dissolution Method with DWPF Sludge Batch 3 Simulant*, WSRC-TR-02-00496, Rev. 0.; D.R. Click, *Evaluation of the DWPF Cold Chem Dissolution Method with Tank 7 and Tank 51 Radioactive Sludges*, WSRC-TR-2003-00580; D.R. Click, C.J. Coleman, K.E. Zeigler and T.B. Edwards, *Sludge Batch Four (4) Defense Waste Processing Facility (DWPF) Process Analytical Method Verification*, WSRC-STI-2006-00025 Rev. 0. Aiken, SC 2006; D.R. Click, H.M. Ajo, and T.B. Edwards, *Defense Waste Processing Facility (DWPF) Analytical Method Verification for the Sludge Batch 5 Qualification Sample*, SRNS-STI-2008-00090, Rev. 0. Aiken, SC 2008; D. R. Click, T. B. Edwards, and M. A. Jones, *Verification of the Defense Waste Processing Facility's (DWPF) Process Digestion Method for the Sludge Batch 6 Qualification Sample* WSRC-STI-2010-00259 Rev. 0. Aiken, SC 2010; D. R. Click, T. B. Edwards, and M.A. Jones, and B. J. Weidenman, *Verification of the Defense Waste Processing Facility's (DWPF) Process Digestion Method for the Sludge Batch 7a Qualification Sample*, SRNL-STI-2011-00158 Rev. 0. Aiken, SC 2011; D. R. Click, T. B. Edwards, and M.A. Jones, and B. J. Weidenman, *Verification of the Defense Waste Processing Facility's (DWPF) Process Digestion Method for the Sludge Batch 7b Blend Sample*", SRNL-STI-2011-00475 Rev. 0. Aiken, SC 2011.

This page intentionally left blank

7.0 ACKNOWLEDGEMENTS

The authors would like to acknowledge Rita Sullivan, Jane Howard, Monica Jenkins and Phyllis Burkhalter.

Distribution

Amanda Shafer/SRR/Srs
Azadeh Samadi-Dezfouli/SRR/Srs
Barbara Hamm/SRR/Srs
Bill Holtzscheiter/SRR/Srs
Carol Sherburne/SRR/Srs
Connie Herman/SRNL/Srs
Terri Fellinger/SRR/Srs
Dan Lambert/SRNL/Srs
Daniel McIlmoyle/SRR/Srs
David Koopman/SRNL/Srs
David Peeler/SRNL/Srs
Dave Sherburne/SRR/Srs
Eric Freed/SRR/Srs
Hasmukh Shah/SRR/Srs
Herbert Elder/SRR/Srs
James Newell/SRNL/Srs
Jason Vitali/SRR/Srs
Jeff Ray/SRR/Srs
Jeffrey Gillam/SRR/Srs
John Iaukea/SRR/Srs
John Pareizs/SRNL/Srs
Jonathan Bricker/SRR/Srs
Karthik Subramanian/SRR/Srs
Keisha Martin/SRR/Srs
Mark Keefer/SRR/Srs
Michael Feller/SRR/Srs
Michael Hay/SRNL/Srs
Michael Stone/SRNL/Srs
Mike Hubbard/SRR/Srs
Roger Mahannah/SRR/srs
Ryan McNew/SRR/Srs
Sharon Marra/SRNL/Srs
Tommy Edwards/SRNL/Srs

8.0 APPENDIX A. SUPPORTING INFORMATION

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT

Levels not connected by same letter are significantly different.

All of the Data

Element=Al

Level		Mean
AR	A	4.7143
PF	A	4.6625
CC	A	4.4375

Element=B

Level			Mean
CC	A		0.14575
AR		B	0.01595
PF		B	0.015075

Element=Ca

Level			Mean
PF	A		1.16500
AR	A	B	1.05317
CC		B	0.89025

Element=Cr

Level		Mean
PF	A	0.09180
AR	A	0.08847
CC	A	0.08632

Element=Cu

Level			Mean
AR	A		0.04460
PF		B	0.02467
CC		B	0.02157

Element=Fe

Level		Mean
PF	A	15.9500
AR	A	15.8333
CC	A	15.0250

Element=K

Level			Mean
PF	A		0.2735
CC		B	0.1082
AR		C	0.0893

Element=Li

Level		Mean
AR	A	0.01382
PF	A	0.01312
CC	B	0.00539

Element=Mg

Level		Mean
AR	A	0.15930
CC	A	0.15125
PF	A	0.13875

Element=Mn

Level		Mean
AR	A	5.9841
PF	A	5.8225
CC	A	5.7000

Element=Ni

Level		Mean
PF	A	0.7720
AR	A	0.7635
CC	A	0.71975

Element=Th

Level			Mean
AR	A		0.59287
PF	A		0.51675
CC		B	0.23175

Element=Ti

Level		Mean
PF	A	0.01165
AR	A	0.01067
CC	A	0.01022

Element=U

Level		Mean
AR	A	2.3230
CC	A	2.1725
PF	A	2.0975

Questionable AR Prep Excluded

Element=Al

Level		Mean
PF	A	4.662
CC	A	4.437
AR	A	4.402

Element=B

Level			Mean
CC	A		0.1457
AR		B	0.0152
PF		B	0.0151

Element=Ca

Level			Mean
PF	A		1.165
AR		B	0.986
CC		B	0.890

Element=Cr

Level			Mean
PF	A		0.0918
CC	A	B	0.0863
AR		B	0.0828

Element=Cu

Level			Mean
AR	A		0.04127
PF		B	0.0247
CC		C	0.0216

Element=Fe

Level		Mean
PF	A	15.950
CC	A	15.025
AR	A	14.836

Element=K

Level			Mean
PF	A		0.2735
CC		B	0.1082
AR		C	0.0819

Element=Li

Level		Mean
AR	A	0.0132
PF	A	0.0131
CC	B	0.0054

Element=Mg

Level			Mean
CC	A		0.1512
AR	A	B	0.1490
PF		B	0.1387

Element=Mn

Level		Mean
PF	A	5.822
CC	A	5.700
AR	A	5.608

Element=Ni

Level		Mean
PF	A	0.7720
CC	A	0.7197
AR	A	0.7154

Element=Th

Level			Mean
AR	A		0.5556
PF	A		0.5167
CC		B	0.2317

Element=Ti

Level			Mean
PF	A		0.0116
CC		B	0.0102
AR		B	0.0100

Element=U

Level		Mean
CC	A	2.172
AR	A	2.171
PF	A	2.097

Means Comparisons
Comparisons for all pairs using Tukey-Kramer HSD
Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT

Levels not connected by same letter are significantly different.

Element=Al

Level			Mean
PF	A		5.5000
CC		B	5.3275
AR		C	4.8725

Element=B

Level		Mean
CC	A	0.0628
PF	A	0.0532
AR	B	0.0022

Element=Ca

Level		Mean
PF	A	1.300
CC	B	1.135
AR	B	1.120

Element=Cr

Level		Mean
PF	A	0.1107
CC	B	0.0970
AR	B	0.0924

Element=Cu

Level			Mean
AR	A		0.0502
PF		B	0.0248
CC		C	0.0238

Element=Fe

Level		Mean
CC	A	17.675
PF	B	17.275
AR	B	17.100

Element=K

Level		Mean
PF	A	0.2830
CC	B	0.0932
AR	B	0.0893

Element=Li

Level		Mean
PF	A	0.0134
AR	B	0.0063

Element=Mg

Level		Mean
CC	A	0.1782
AR	B	0.1637
PF	B	0.1617

Element=Mn

Level			Mean
CC	A		6.705
PF		B	6.527
AR		C	6.095

Element=Ni

Level			Mean
CC	A		0.8570
AR		B	0.8200
PF		C	0.7997

Element=Th

Level		Mean
AR	A	0.63700000
PF	B	0.59025000
CC	B	0.58175000

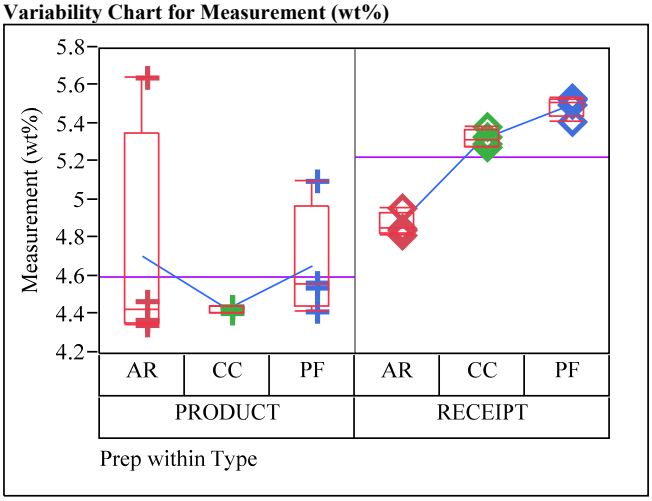
Element=Ti

Level		Mean
PF	A	0.01400000
CC	A B	0.01200000
AR	B	0.01152500

Element=U

Level		Mean
AR	A	2.6350000
PF	A	2.6200000
CC	B	2.3075000

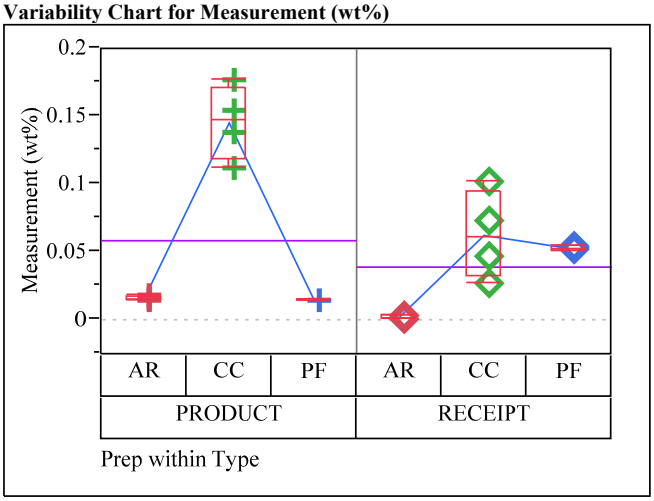
Variability Gauge Process/Standard=SRAT, Element=Al
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	4.604767	0.385262	0.111216	4.359983	4.849551	4.3492	5.6508	12
Type[RECEIPT]	5.233333	0.280886	0.081085	5.054867	5.4118	4.82	5.54	12
Type[PRODUCT] Prep[AR]	4.7143	0.626661	0.31333	3.717143	5.711457	4.3492	5.6508	4
Type[PRODUCT] Prep[CC]	4.4375	0.01893	0.009465	4.407379	4.467621	4.41	4.45	4
Type[PRODUCT] Prep[PF]	4.6625	0.305655	0.152828	4.176135	5.148865	4.42	5.11	4
Type[RECEIPT] Prep[AR]	4.8725	0.060759	0.03038	4.775819	4.969181	4.82	4.96	4
Type[RECEIPT] Prep[CC]	5.3275	0.048563	0.024281	5.250226	5.404774	5.28	5.39	4
Type[RECEIPT] Prep[PF]	5.5	0.054772	0.027386	5.412845	5.587155	5.42	5.54	4

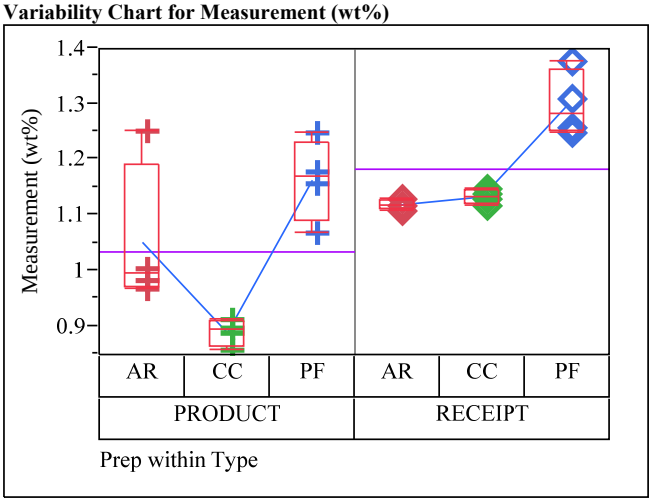
Variability Gauge Process/Standard=SRAT, Element=B
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.058925	0.065704	0.018967	0.017179	0.100671	0.0148	0.177	12
Type[RECEIPT]	0.039416	0.032457	0.00937	0.018793	0.060038	0.00153	0.102	12
Type[PRODUCT] Prep[AR]	0.01595	0.001561	0.00078	0.013466	0.018434	0.0148	0.0182	4
Type[PRODUCT] Prep[CC]	0.14575	0.027366	0.013683	0.102204	0.189296	0.112	0.177	4
Type[PRODUCT] Prep[PF]	0.015075	0.000263	0.000131	0.014657	0.015493	0.0148	0.0153	4
Type[RECEIPT] Prep[AR]	0.002248	0.001402	0.000701	0.000017	0.004478	0.00153	0.00435	4
Type[RECEIPT] Prep[CC]	0.062825	0.032141	0.016071	0.011681	0.113969	0.0277	0.102	4
Type[RECEIPT] Prep[PF]	0.053175	0.001624	0.000812	0.050592	0.055758	0.0517	0.0554	4

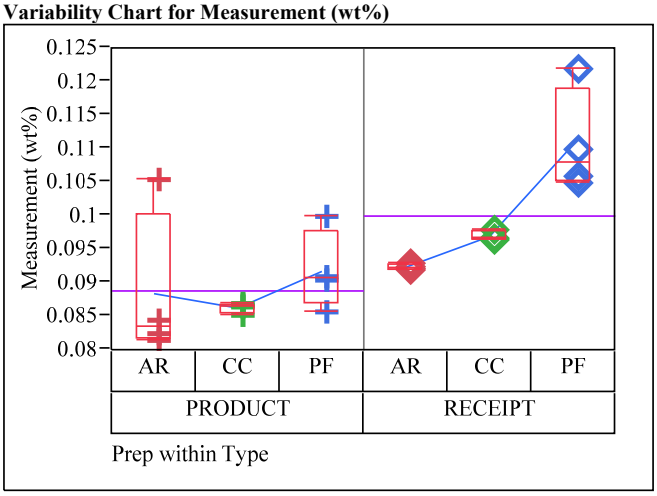
Variability Gauge Process/Standard=SRAT, Element=Ca
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	1.036142	0.143137	0.04132	0.945196	1.127087	0.858	1.254	12
Type[RECEIPT]	1.185	0.091004	0.026271	1.127179	1.242821	1.11	1.38	12
Type[PRODUCT] Prep[AR]	1.053175	0.134788	0.067394	0.838698	1.267652	0.9683	1.254	4
Type[PRODUCT] Prep[CC]	0.89025	0.023472	0.011736	0.852901	0.927599	0.858	0.913	4
Type[PRODUCT] Prep[PF]	1.165	0.074162	0.037081	1.046992	1.283008	1.07	1.25	4
Type[RECEIPT] Prep[AR]	1.12	0.008165	0.004082	1.107008	1.132992	1.11	1.13	4
Type[RECEIPT] Prep[CC]	1.135	0.01291	0.006455	1.114457	1.155543	1.12	1.15	4
Type[RECEIPT] Prep[PF]	1.3	0.059442	0.029721	1.205415	1.394585	1.25	1.38	4

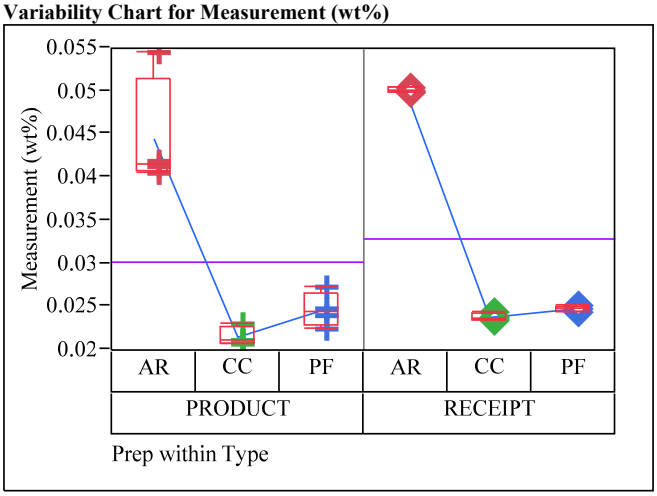
Variability Gauge Process/Standard=SRAT, Element=Cr
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.088867	0.007088	0.002046	0.084363	0.09337	0.0816	0.1054	12
Type[RECEIPT]	0.10005	0.009116	0.002632	0.094258	0.105842	0.092	0.122	12
Type[PRODUCT] Prep[AR]	0.088475	0.011344	0.005672	0.070425	0.106525	0.0816	0.1054	4
Type[PRODUCT] Prep[CC]	0.086325	0.000768	0.000384	0.085104	0.087546	0.0852	0.0869	4
Type[PRODUCT] Prep[PF]	0.0918	0.005886	0.002943	0.082434	0.101166	0.0858	0.0999	4
Type[RECEIPT] Prep[AR]	0.0924	0.000392	0.000196	0.091777	0.093023	0.092	0.0929	4
Type[RECEIPT] Prep[CC]	0.097	0.000744	0.000372	0.095816	0.098184	0.0965	0.0981	4
Type[RECEIPT] Prep[PF]	0.11075	0.007805	0.003902	0.098331	0.123169	0.105	0.122	4

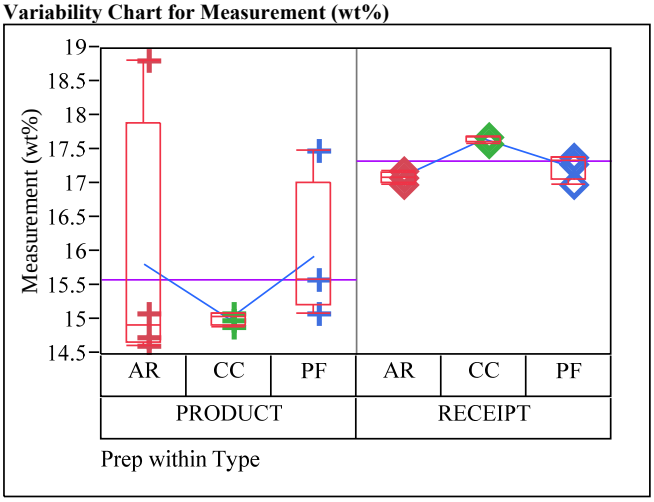
Variability Gauge Process/Standard=SRAT, Element=Cu
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.030283	0.011275	0.003255	0.023119	0.037447	0.0208	0.0546	12
Type[RECEIPT]	0.032967	0.012739	0.003677	0.024873	0.041061	0.0235	0.0506	12
Type[PRODUCT] Prep[AR]	0.0446	0.006688	0.003344	0.033958	0.055242	0.0406	0.0546	4
Type[PRODUCT] Prep[CC]	0.021575	0.001097	0.000548	0.01983	0.02332	0.0208	0.0232	4
Type[PRODUCT] Prep[PF]	0.024675	0.001972	0.000986	0.021537	0.027813	0.0226	0.0273	4
Type[RECEIPT] Prep[AR]	0.0502	0.000271	0.000135	0.049769	0.050631	0.05	0.0506	4
Type[RECEIPT] Prep[CC]	0.02385	0.000451	0.000225	0.023132	0.024568	0.0235	0.0245	4
Type[RECEIPT] Prep[PF]	0.02485	0.000332	0.000166	0.024322	0.025378	0.0244	0.0252	4

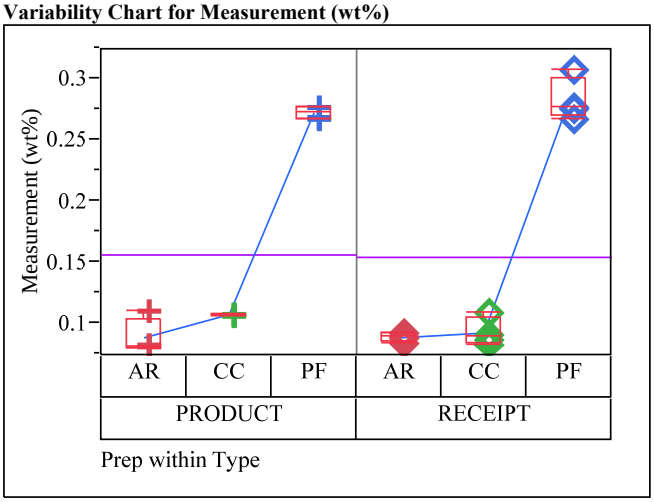
Variability Gauge Process/Standard=SRAT, Element=Fe
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	15.60278	1.260807	0.363964	14.8017	16.40385	14.6349	18.8254	12
Type[RECEIPT]	17.35	0.27469	0.079296	17.17547	17.52453	17	17.7	12
Type[PRODUCT] Prep[AR]	15.83333	2.004852	1.002426	12.64316	19.02349	14.6349	18.8254	4
Type[PRODUCT] Prep[CC]	15.025	0.095743	0.047871	14.87265	15.17735	14.9	15.1	4
Type[PRODUCT] Prep[PF]	15.95	1.059874	0.529937	14.2635	17.6365	15.1	17.5	4
Type[RECEIPT] Prep[AR]	17.1	0.08165	0.040825	16.97008	17.22992	17	17.2	4
Type[RECEIPT] Prep[CC]	17.675	0.05	0.025	17.59544	17.75456	17.6	17.7	4
Type[RECEIPT] Prep[PF]	17.275	0.189297	0.094648	16.97379	17.57621	17	17.4	4

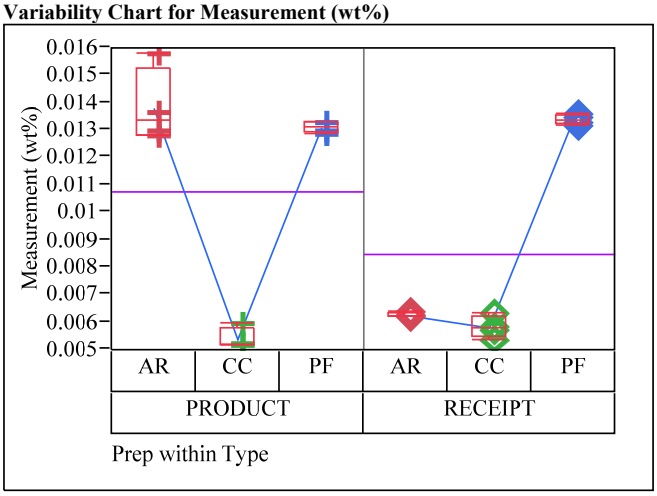
Variability Gauge Process/Standard=SRAT, Element=K
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.157017	0.086796	0.025056	0.101869	0.212164	0.081	0.278	12
Type[RECEIPT]	0.15515	0.095117	0.027458	0.094716	0.215584	0.0835	0.309	12
Type[PRODUCT] Prep[AR]	0.0893	0.014775	0.007388	0.065789	0.112811	0.081	0.1114	4
Type[PRODUCT] Prep[CC]	0.10825	0.000957	0.000479	0.106727	0.109773	0.107	0.109	4
Type[PRODUCT] Prep[PF]	0.2735	0.00526	0.00263	0.26513	0.28187	0.268	0.278	4
Type[RECEIPT] Prep[AR]	0.089275	0.003753	0.001876	0.083304	0.095246	0.0843	0.0933	4
Type[RECEIPT] Prep[CC]	0.093175	0.011706	0.005853	0.074549	0.111801	0.0835	0.11	4
Type[RECEIPT] Prep[PF]	0.283	0.017907	0.008954	0.254506	0.311494	0.268	0.309	4

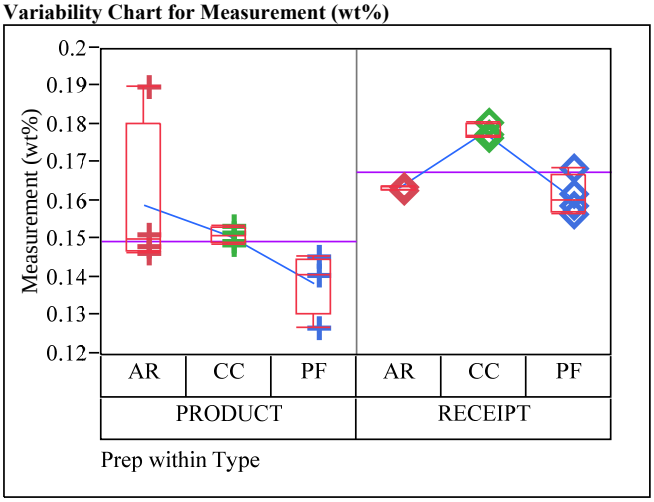
Variability Gauge Process/Standard=SRAT, Element=Li
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.01078	0.004063	0.001173	0.008199	0.013361	0.00516	0.0158	12
Type[RECEIPT]	0.008498	0.003633	0.001049	0.00619	0.010806	0.00538	0.0136	12
Type[PRODUCT] Prep[AR]	0.013825	0.001372	0.000686	0.011642	0.016008	0.0128	0.0158	4
Type[PRODUCT] Prep[CC]	0.00539	0.000407	0.000204	0.004742	0.006038	0.00516	0.006	4
Type[PRODUCT] Prep[PF]	0.013125	0.000206	0.000103	0.012797	0.013453	0.0129	0.0133	4
Type[RECEIPT] Prep[AR]	0.006278	0.00009	0.000045	0.006134	0.006421	0.00621	0.0064	4
Type[RECEIPT] Prep[CC]	0.005818	0.000392	0.000196	0.005193	0.006442	0.00538	0.00633	4
Type[RECEIPT] Prep[PF]	0.0134	0.000183	9.129e-5	0.013109	0.013691	0.0132	0.0136	4

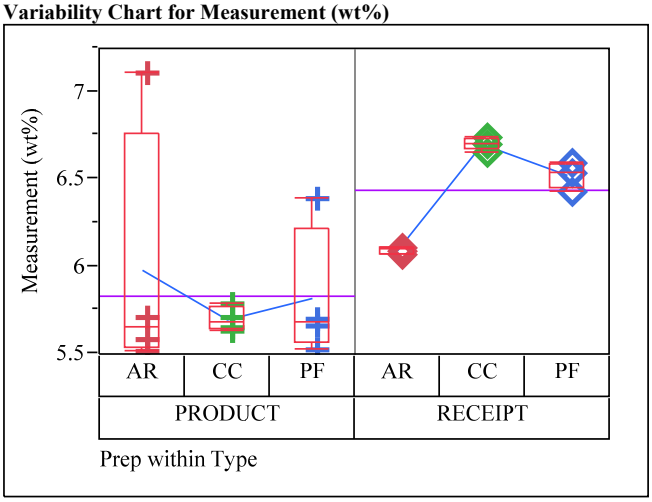
Variability Gauge Process/Standard=SRAT, Element=Mg
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.149767	0.014645	0.004228	0.140462	0.159071	0.127	0.1902	12
Type[RECEIPT]	0.167917	0.008218	0.002372	0.162695	0.173138	0.157	0.181	12
Type[PRODUCT] Prep[AR]	0.1593	0.020703	0.010351	0.126357	0.192243	0.1467	0.1902	4
Type[PRODUCT] Prep[CC]	0.15125	0.002217	0.001109	0.147722	0.154778	0.149	0.154	4
Type[PRODUCT] Prep[PF]	0.13875	0.00818	0.00409	0.125733	0.151767	0.127	0.146	4
Type[RECEIPT] Prep[AR]	0.16375	0.0005	0.00025	0.162954	0.164546	0.163	0.164	4
Type[RECEIPT] Prep[CC]	0.17825	0.001893	0.000946	0.175238	0.181262	0.177	0.181	4
Type[RECEIPT] Prep[PF]	0.16175	0.005252	0.002626	0.153393	0.170107	0.157	0.169	4

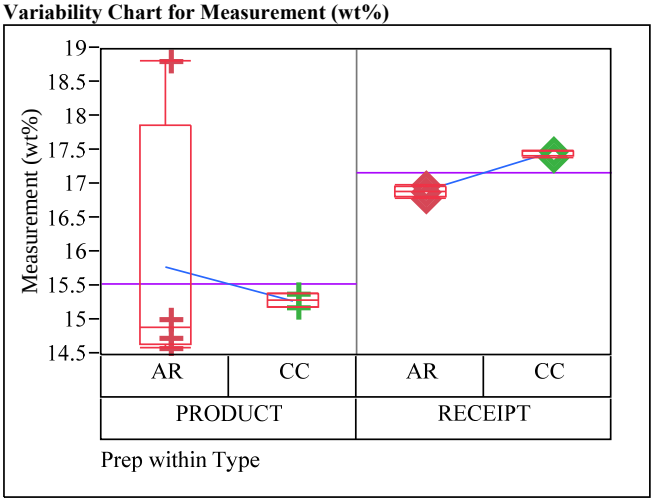
Variability Gauge Process/Standard=SRAT, Element=Mn
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	5.835542	0.460632	0.132973	5.54287	6.128213	5.5238	7.1111	12
Type[RECEIPT]	6.4425	0.270861	0.078191	6.270403	6.614597	6.07	6.74	12
Type[PRODUCT] Prep[AR]	5.984125	0.755479	0.37774	4.781989	7.186261	5.5238	7.1111	4
Type[PRODUCT] Prep[CC]	5.7	0.066833	0.033417	5.593654	5.806346	5.64	5.79	4
Type[PRODUCT] Prep[PF]	5.8225	0.385519	0.19276	5.209053	6.435947	5.53	6.39	4
Type[RECEIPT] Prep[AR]	6.095	0.019149	0.009574	6.06453	6.12547	6.07	6.11	4
Type[RECEIPT] Prep[CC]	6.705	0.033166	0.016583	6.652225	6.757775	6.66	6.74	4
Type[RECEIPT] Prep[PF]	6.5275	0.070887	0.035444	6.414703	6.640297	6.43	6.6	4

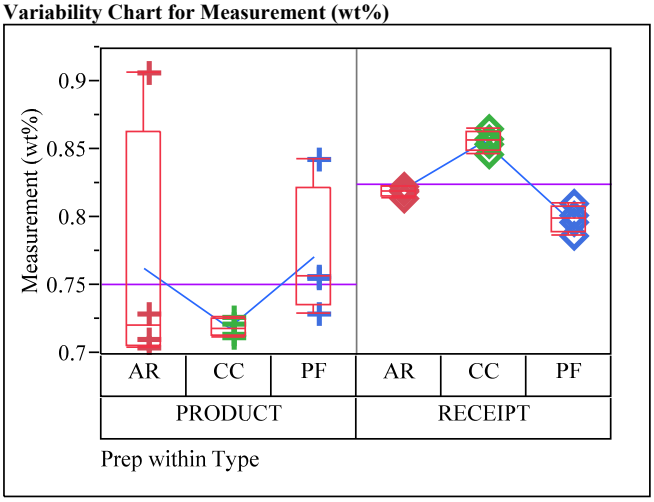
Variability Gauge Process/Standard=SRAT, Element=Na
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	15.5508	1.353357	0.478484	14.41936	16.68224	14.6032	18.8254	8
Type[RECEIPT]	17.1875	0.313676	0.110901	16.92526	17.44974	16.8	17.5	8
Type[PRODUCT] Prep[AR]	15.8016	2.02302	1.01151	12.58252	19.02068	14.6032	18.8254	4
Type[PRODUCT] Prep[CC]	15.3	0.11547	0.057735	15.11626	15.48374	15.2	15.4	4
Type[RECEIPT] Prep[AR]	16.9	0.08165	0.040825	16.77008	17.02992	16.8	17	4
Type[RECEIPT] Prep[CC]	17.475	0.05	0.025	17.39544	17.55456	17.4	17.5	4

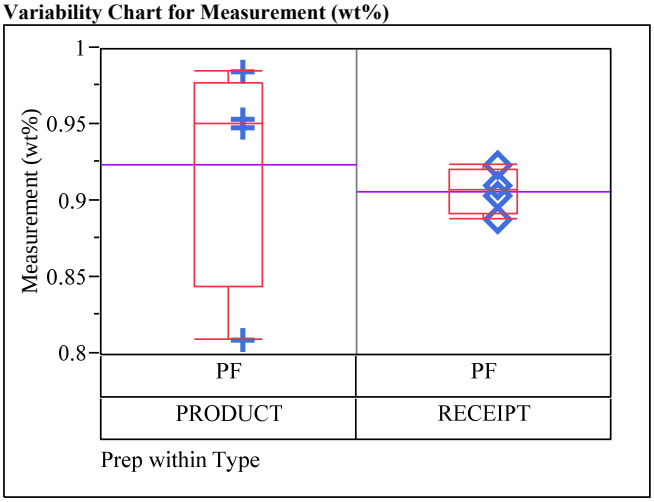
Variability Gauge Process/Standard=SRAT, Element=Ni
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.75175	0.061782	0.017835	0.712496	0.791004	0.7048	0.9079	12
Type[RECEIPT]	0.825583	0.025632	0.007399	0.809298	0.841869	0.788	0.866	12
Type[PRODUCT] Prep[AR]	0.7635	0.096871	0.048435	0.609357	0.917643	0.7048	0.9079	4
Type[PRODUCT] Prep[CC]	0.71975	0.006994	0.003497	0.708621	0.730879	0.713	0.728	4
Type[PRODUCT] Prep[PF]	0.772	0.049666	0.024833	0.692971	0.851029	0.73	0.844	4
Type[RECEIPT] Prep[AR]	0.82	0.003742	0.001871	0.814046	0.825954	0.815	0.824	4
Type[RECEIPT] Prep[CC]	0.857	0.007528	0.003764	0.845022	0.868978	0.848	0.866	4
Type[RECEIPT] Prep[PF]	0.79975	0.009535	0.004768	0.784578	0.814922	0.788	0.811	4

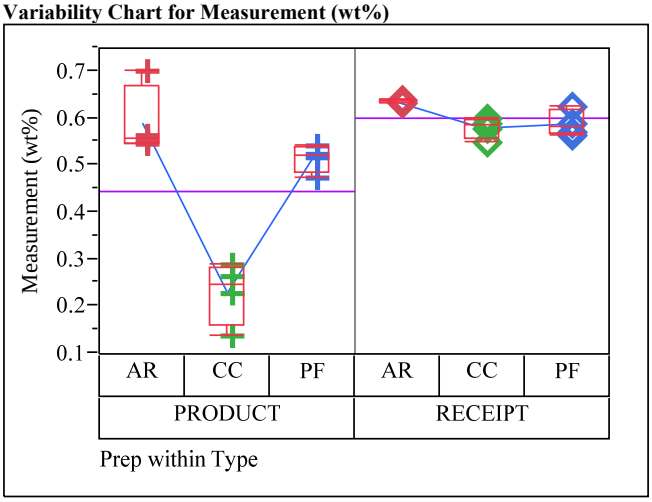
Variability Gauge Process/Standard=SRAT, Element=Si
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.92475	0.078236	0.039118	0.800259	1.049241	0.81	0.986	4
Type[RECEIPT]	0.907	0.014583	0.007292	0.883795	0.930205	0.889	0.924	4
Type[PRODUCT] Prep[PF]	0.92475	0.078236	0.039118	0.800259	1.049241	0.81	0.986	4
Type[RECEIPT] Prep[PF]	0.907	0.014583	0.007292	0.883795	0.930205	0.889	0.924	4

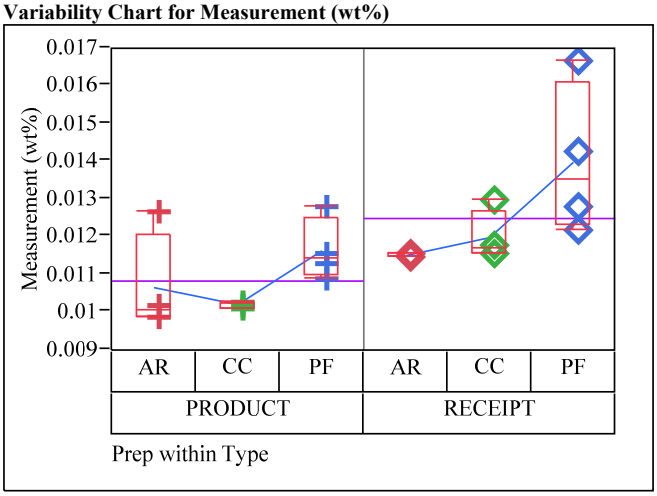
Variability Gauge Process/Standard=SRAT, Element=Th
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.447125	0.171298	0.049449	0.338288	0.555962	0.139	0.7048	12
Type[RECEIPT]	0.603	0.031247	0.00902	0.583147	0.622853	0.552	0.642	12
Type[PRODUCT] Prep[AR]	0.592875	0.075023	0.037511	0.473497	0.712253	0.546	0.7048	4
Type[PRODUCT] Prep[CC]	0.23175	0.066855	0.033427	0.125369	0.338131	0.139	0.292	4
Type[PRODUCT] Prep[PF]	0.51675	0.029262	0.014631	0.470188	0.563312	0.476	0.545	4
Type[RECEIPT] Prep[AR]	0.637	0.003916	0.001958	0.630769	0.643231	0.633	0.642	4
Type[RECEIPT] Prep[CC]	0.58175	0.021453	0.010727	0.547613	0.615887	0.552	0.602	4
Type[RECEIPT] Prep[PF]	0.59025	0.027281	0.01364	0.54684	0.63366	0.567	0.628	4

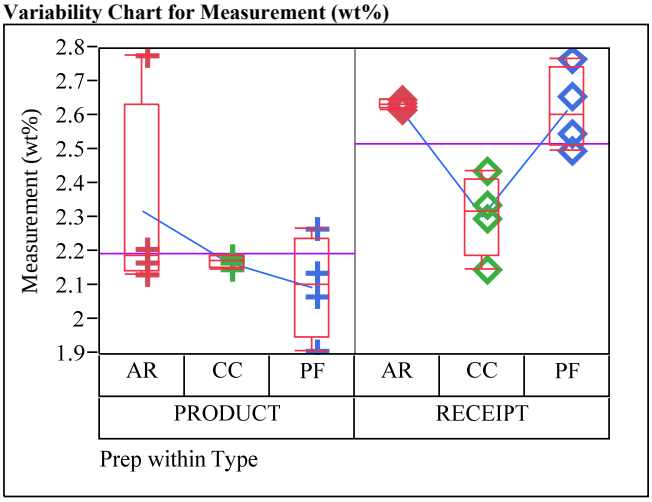
Variability Gauge Process/Standard=SRAT, Element=Ti
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.01085	0.001036	0.000299	0.010192	0.011508	0.0099	0.0128	12
Type[RECEIPT]	0.012508	0.001573	0.000454	0.011509	0.013508	0.0115	0.0167	12
Type[PRODUCT] Prep[AR]	0.010675	0.001357	0.000679	0.008515	0.012835	0.0099	0.0127	4
Type[PRODUCT] Prep[CC]	0.010225	9.574e-5	4.787e-5	0.010073	0.010377	0.0101	0.0103	4
Type[PRODUCT] Prep[PF]	0.01165	0.000819	0.000409	0.010348	0.012952	0.0109	0.0128	4
Type[RECEIPT] Prep[AR]	0.011525	0.00005	0.000025	0.011445	0.011605	0.0115	0.0116	4
Type[RECEIPT] Prep[CC]	0.012	0.000673	0.000337	0.010929	0.013071	0.0116	0.013	4
Type[RECEIPT] Prep[PF]	0.014	0.002005	0.001002	0.01081	0.01719	0.0122	0.0167	4

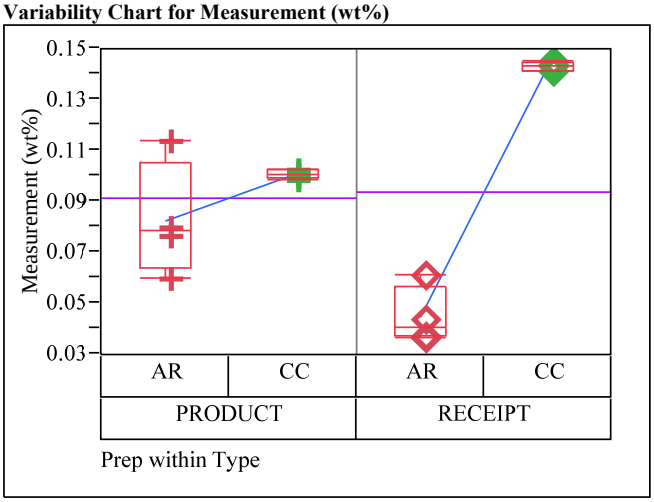
Variability Gauge Process/Standard=SRAT, Element=U
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	2.197675	0.20278	0.058537	2.068835	2.326515	1.91	2.7778	12
Type[RECEIPT]	2.520833	0.181131	0.052288	2.405748	2.635918	2.15	2.77	12
Type[PRODUCT] Prep[AR]	2.323025	0.304653	0.152326	1.838255	2.807795	2.1365	2.7778	4
Type[PRODUCT] Prep[CC]	2.1725	0.017078	0.008539	2.145325	2.199675	2.15	2.19	4
Type[PRODUCT] Prep[PF]	2.0975	0.149972	0.074986	1.858861	2.336139	1.91	2.27	4
Type[RECEIPT] Prep[AR]	2.635	0.01291	0.006455	2.614457	2.655543	2.62	2.65	4
Type[RECEIPT] Prep[CC]	2.3075	0.120381	0.060191	2.115946	2.499054	2.15	2.44	4
Type[RECEIPT] Prep[PF]	2.62	0.120277	0.060139	2.428612	2.811388	2.5	2.77	4

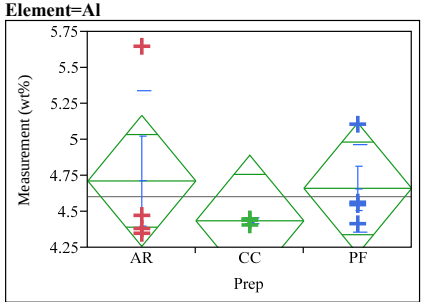
Variability Gauge Process/Standard=SRAT, Element=Zr
Variability Chart for Measurement (wt%)



Variability Summary for Measurement (wt%)

	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%	Minimum	Maximum	Observations
Type[PRODUCT]	0.091713	0.017712	0.006262	0.076905	0.10652	0.06	0.114	8
Type[RECEIPT]	0.094075	0.053094	0.018771	0.049688	0.138462	0.037	0.145	8
Type[PRODUCT] Prep[AR]	0.0827	0.022635	0.011318	0.046682	0.118718	0.06	0.114	4
Type[PRODUCT] Prep[CC]	0.100725	0.001742	0.000871	0.097953	0.103497	0.0989	0.103	4
Type[RECEIPT] Prep[AR]	0.0449	0.01123	0.005615	0.02703	0.06277	0.037	0.061	4
Type[RECEIPT] Prep[CC]	0.14325	0.001708	0.000854	0.140532	0.145968	0.141	0.145	4

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Al



Oneway Anova
Summary of Fit

Rsquare	0.106104
Adj Rsquare	-0.09254
Root Mean Square Error	0.402694
Mean of Response	4.604767
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.1732353	0.086618	0.5341	0.6037
Error	9	1.4594608	0.162162		
C. Total	11	1.6326961			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	4.71430	0.20135	4.2588	5.1698
CC	4	4.43750	0.20135	3.9820	4.8930
PF	4	4.66250	0.20135	4.2070	5.1180

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%
AR	4	4.71430	0.626661	0.31333	3.7171	5.7115
CC	4	4.43750	0.018930	0.00946	4.4074	4.4676
PF	4	4.66250	0.305655	0.15283	4.1761	5.1489

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.6266607	0.4682500	0.3492000
CC	4	0.0189297	0.0137500	0.0125000
PF	4	0.3056550	0.2237500	0.1775000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1355	2	9	0.3633
Brown-Forsythe	0.8407	2	9	0.4627
Levene	4.8837	2	9	0.0366*
Bartlett	7.5537	2	.	0.0005*

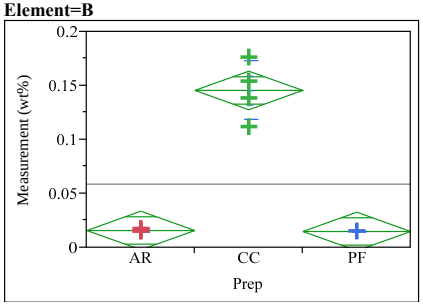
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.2583	2	4.0189	0.3764

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=B



Oneway Anova
Summary of Fit

Rsquare	0.952529
Adj Rsquare	0.94198
Root Mean Square Error	0.015826
Mean of Response	0.058925
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.04523302	0.022617	90.2948	<.0001*
Error	9	0.00225427	0.000250		
C. Total	11	0.04748728			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.015950	0.00791	-0.0020	0.03385
CC	4	0.145750	0.00791	0.1278	0.16365
PF	4	0.015075	0.00791	-0.0028	0.03298

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%
AR	4	0.015950	0.001561	0.00078	0.01347	0.01843
CC	4	0.145750	0.027366	0.01368	0.10220	0.18930
PF	4	0.015075	0.000263	0.00013	0.01466	0.01549

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0015610	0.0011250	0.0010500
CC	4	0.0273663	0.0202500	0.0202500
PF	4	0.0002630	0.0002250	0.0002250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.4183	2	9	0.1444
Brown-Forsythe	7.4926	2	9	0.0121*
Levene	7.5654	2	9	0.0118*
Bartlett	15.3273	2	.	<.0001*

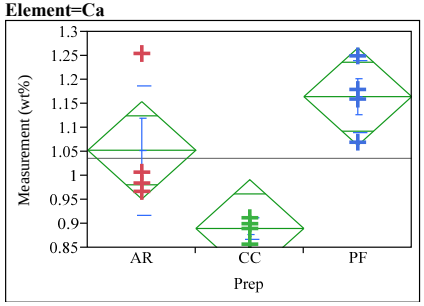
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
39.7459	2	4.1107	0.0020*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ca



Oneway Anova
Summary of Fit

Rsquare	0.677618
Adj Rsquare	0.605977
Root Mean Square Error	0.089849
Mean of Response	1.036142
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.15271593	0.076358	9.4586	0.0061*
Error	9	0.07265582	0.008073		
C. Total	11	0.22537175			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	1.05318	0.04492	0.9515	1.1548
CC	4	0.89025	0.04492	0.7886	0.9919
PF	4	1.16500	0.04492	1.0634	1.2666

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%
AR	4	1.05318	0.134788	0.06739	0.8387	1.2677
CC	4	0.89025	0.023472	0.01174	0.8529	0.9276
PF	4	1.16500	0.074162	0.03708	1.0470	1.2830

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.1347876	0.1004125	0.0769750
CC	4	0.0234716	0.0162500	0.0162500
PF	4	0.0741620	0.0500000	0.0500000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0390	2	9	0.3927
Brown-Forsythe	0.6467	2	9	0.5465
Levene	3.0365	2	9	0.0982
Bartlett	2.9491	2	.	0.0524

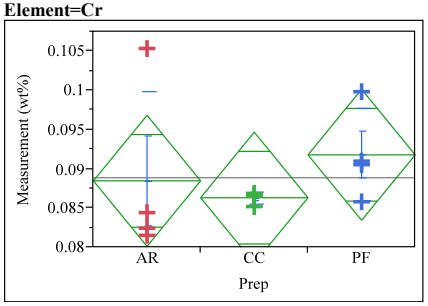
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
23.4834	2	4.4667	0.0043*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Cr



Oneway Anova
Summary of Fit

Rsquare	0.110154
Adj Rsquare	-0.08759
Root Mean Square Error	0.007392
Mean of Response	0.088867
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00006087	0.000030	0.5571	0.5914
Error	9	0.00049174	0.000055		
C. Total	11	0.00055261			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.088475	0.00370	0.08011	0.09684
CC	4	0.086325	0.00370	0.07796	0.09469
PF	4	0.091800	0.00370	0.08344	0.10016

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%
AR	4	0.088475	0.011344	0.00567	0.07042	0.10653
CC	4	0.086325	0.000768	0.00038	0.08510	0.08755
PF	4	0.091800	0.005886	0.00294	0.08243	0.10117

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0113435	0.0084625	0.0064250
CC	4	0.0007676	0.0005625	0.0004750
PF	4	0.0058861	0.0040500	0.0036500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1078	2	9	0.3714
Brown-Forsythe	0.8439	2	9	0.4614
Levene	4.0769	2	9	0.0549
Bartlett	5.3939	2	.	0.0045*

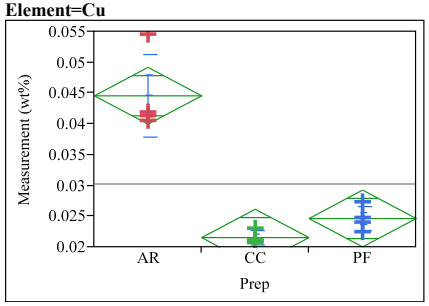
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.5191	2	4.0848	0.3212

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Cu



Oneway Anova
Summary of Fit

Rsquare	0.89313
Adj Rsquare	0.869381
Root Mean Square Error	0.004075
Mean of Response	0.030283
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00124902	0.000625	37.6073	<.0001*
Error	9	0.00014945	0.000017		
C. Total	11	0.00139848			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.044600	0.00204	0.03999	0.04921
CC	4	0.021575	0.00204	0.01697	0.02618
PF	4	0.024675	0.00204	0.02007	0.02928

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%
AR	4	0.044600	0.006688	0.00334	0.03396	0.05524
CC	4	0.021575	0.001097	0.00055	0.01983	0.02332
PF	4	0.024675	0.001972	0.00099	0.02154	0.02781

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0066878	0.0050000	0.0036500
CC	4	0.0010966	0.0008125	0.0006250
PF	4	0.0019721	0.0013750	0.0013750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2929	2	9	0.3209
Brown-Forsythe	0.7200	2	9	0.5128
Levene	4.7374	2	9	0.0393*
Bartlett	4.0319	2	.	0.0177*

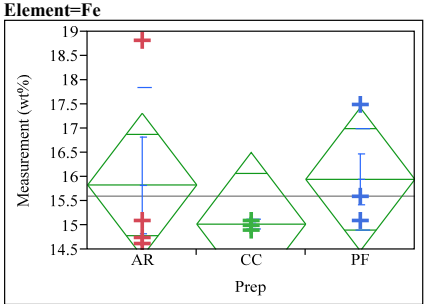
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
22.5209	2	4.9562	0.0033*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Fe



Oneway Anova
Summary of Fit

Rsquare	0.116103
Adj Rsquare	-0.08032
Root Mean Square Error	1.310462
Mean of Response	15.60278
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	2.030170	1.01508	0.5911	0.5739
Error	9	15.455796	1.71731		
C. Total	11	17.485966			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	15.8333	0.65523	14.351	17.316
CC	4	15.0250	0.65523	13.543	16.507
PF	4	15.9500	0.65523	14.468	17.432

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%
AR	4	15.8333	2.00485	1.0024	12.643	19.023
CC	4	15.0250	0.09574	0.0479	14.873	15.177
PF	4	15.9500	1.05987	0.5299	14.264	17.636

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	2.004852	1.496038	1.134925
CC	4	0.095743	0.075000	0.075000
PF	4	1.059874	0.775000	0.600000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0903	2	9	0.3767
Brown-Forsythe	0.8056	2	9	0.4766
Levene	4.4566	2	9	0.0452*
Bartlett	6.2801	2	.	0.0019*

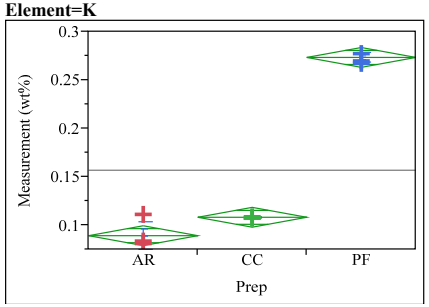
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.5704	2	4.0414	0.3129

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=K



Oneway Anova
Summary of Fit

Rsquare	0.991062
Adj Rsquare	0.989076
Root Mean Square Error	0.009072
Mean of Response	0.157017
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.08212841	0.041064	498.9642	<.0001*
Error	9	0.00074069	0.000082		
C. Total	11	0.08286910			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.089300	0.00454	0.07904	0.09956
CC	4	0.108250	0.00454	0.09799	0.11851
PF	4	0.273500	0.00454	0.26324	0.28376

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%
AR	4	0.089300	0.014775	0.00739	0.06579	0.11281
CC	4	0.108250	0.000957	0.00048	0.10673	0.10977
PF	4	0.273500	0.005260	0.00263	0.26513	0.28187

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0147754	0.0110500	0.0081500
CC	4	0.0009574	0.0007500	0.0007500
PF	4	0.0052599	0.0045000	0.0045000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2877	2	9	0.3222
Brown-Forsythe	0.8448	2	9	0.4611
Levene	5.7879	2	9	0.0242*
Bartlett	6.0253	2	.	0.0024*

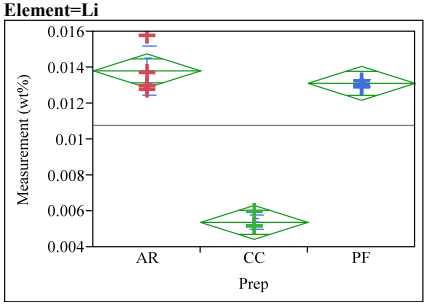
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1650.5811	2	4.1443	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Li



Oneway Anova
Summary of Fit

Rsquare	0.965451
Adj Rsquare	0.957773
Root Mean Square Error	0.000835
Mean of Response	0.01078
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00017529	0.000088	125.7479	<.0001*
Error	9	0.00000627	6.97e-7		
C. Total	11	0.00018157			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.013825	0.00042	0.01288	0.01477
CC	4	0.005390	0.00042	0.00445	0.00633
PF	4	0.013125	0.00042	0.01218	0.01407

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%
AR	4	0.013825	0.001372	0.00069	0.01164	0.01601
CC	4	0.005390	0.000407	0.00020	0.00474	0.00604
PF	4	0.013125	0.000206	0.00010	0.01280	0.01345

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0013720	0.0009875	0.0009250
CC	4	0.0004074	0.0003050	0.0002200
PF	4	0.0002062	0.0001750	0.0001750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5420	2	9	0.2656
Brown-Forsythe	1.7772	2	9	0.2236
Levene	3.6518	2	9	0.0690
Bartlett	4.2310	2	.	0.0145*

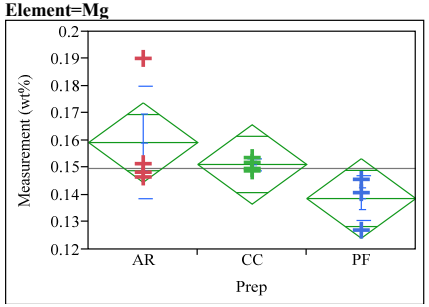
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
509.2147	2	4.8423	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Mg



Oneway Anova
Summary of Fit

Rsquare	0.363612
Adj Rsquare	0.222192
Root Mean Square Error	0.012916
Mean of Response	0.149767
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00085781	0.000429	2.5712	0.1308
Error	9	0.00150132	0.000167		
C. Total	11	0.00235913			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.159300	0.00646	0.14469	0.17391
CC	4	0.151250	0.00646	0.13664	0.16586
PF	4	0.138750	0.00646	0.12414	0.15336

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%
AR	4	0.159300	0.020703	0.01035	0.12636	0.19224
CC	4	0.151250	0.002217	0.00111	0.14772	0.15478
PF	4	0.138750	0.008180	0.00409	0.12573	0.15177

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0207028	0.0154500	0.0116500
CC	4	0.0022174	0.0017500	0.0017500
PF	4	0.0081803	0.0058750	0.0047500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2298	2	9	0.3372
Brown-Forsythe	0.7659	2	9	0.4930
Levene	4.4885	2	9	0.0445*
Bartlett	4.5648	2	.	0.0104*

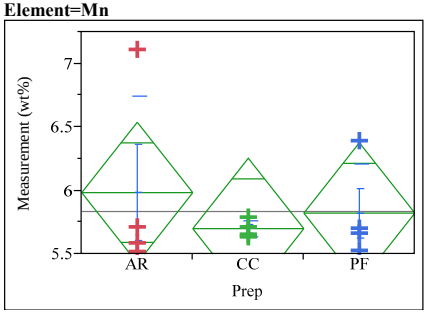
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.0853	2	4.3144	0.1010

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Mn



Oneway Anova
Summary of Fit

Rsquare	0.069612
Adj Rsquare	-0.13714
Root Mean Square Error	0.491203
Mean of Response	5.835542
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.1624745	0.081237	0.3367	0.7228
Error	9	2.1715224	0.241280		
C. Total	11	2.3339969			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	5.98413	0.24560	5.4285	6.5397
CC	4	5.70000	0.24560	5.1444	6.2556
PF	4	5.82250	0.24560	5.2669	6.3781

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%
AR	4	5.98413	0.755479	0.37774	4.7820	7.1863
CC	4	5.70000	0.066833	0.03342	5.5937	5.8063
PF	4	5.82250	0.385519	0.19276	5.2091	6.4359

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.7554794	0.5634875	0.4285750
CC	4	0.0668331	0.0500000	0.0500000
PF	4	0.3855191	0.2837500	0.2225000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1034	2	9	0.3728
Brown-Forsythe	0.7391	2	9	0.5044
Levene	4.1788	2	9	0.0520
Bartlett	4.7200	2	.	0.0089*

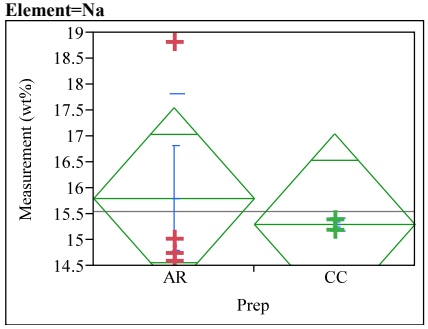
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.4047	2	4.1467	0.6909

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Na



Oneway Anova
Summary of Fit

Rsquare	0.039248
Adj Rsquare	-0.12088
Root Mean Square Error	1.432819
Mean of Response	15.5508
Observations (or Sum Wgts)	8

t Test
CC-AR
Assuming equal variances

Difference	-0.5016	t Ratio	-0.49509
Std Err Dif	1.0132	DF	6
Upper CL Dif	1.9775	Prob > |t|	0.6381
Lower CL Dif	-2.9807	Prob > t	0.6809
Confidence	0.95	Prob < t	0.3191

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.503205	0.50321	0.2451	0.6381
Error	6	12.317830	2.05297		
C. Total	7	12.821035			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	15.8016	0.71641	14.049	17.555
CC	4	15.3000	0.71641	13.547	17.053

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%
AR	4	15.8016	2.02302	1.0115	12.583	19.021
CC	4	15.3000	0.11547	0.0577	15.116	15.484

t Test
CC-AR
Assuming unequal variances

Difference	-0.5016	t Ratio	-0.49509
Std Err Dif	1.0132	DF	3.019547
Upper CL Dif	2.7109	Prob > |t|	0.6543
Lower CL Dif	-3.7141	Prob > t	0.6728
Confidence	0.95	Prob < t	0.3272

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	2.023020	1.511900	1.119050
CC	4	0.115470	0.100000	0.100000

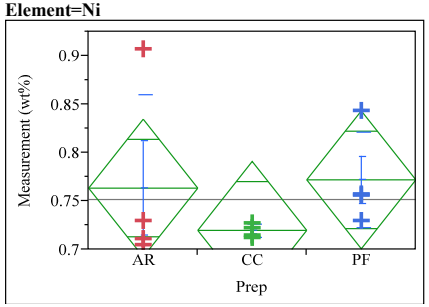
Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	1.4515	1	6	0.2737
Brown-Forsythe	1.1755	1	6	0.3199
Levene	7.6318	1	6	0.0327*
Bartlett	11.1777	1	.	0.0008*
F Test 2-sided	306.9457	3	3	0.0006*

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

F Ratio	DFNum	DFDen	Prob > F
0.2451	1	3.0195	0.6543

t Test
0.4951

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ni



Oneway Anova
Summary of Fit

Rsquare	0.149773
Adj Rsquare	-0.03917
Root Mean Square Error	0.06298
Mean of Response	0.75175
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00628850	0.003144	0.7927	0.4818
Error	9	0.03569845	0.003966		
C. Total	11	0.04198695			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.763500	0.03149	0.69226	0.83474
CC	4	0.719750	0.03149	0.64851	0.79099
PF	4	0.772000	0.03149	0.70076	0.84324

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%
AR	4	0.763500	0.096871	0.04844	0.60936	0.91764
CC	4	0.719750	0.006994	0.00350	0.70862	0.73088
PF	4	0.772000	0.049666	0.02483	0.69297	0.85103

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0968705	0.0722000	0.0555500
CC	4	0.0069940	0.0057500	0.0057500
PF	4	0.0496655	0.0360000	0.0290000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1115	2	9	0.3703
Brown-Forsythe	0.7953	2	9	0.4808
Levene	4.1808	2	9	0.0520
Bartlett	5.2381	2	.	0.0053*

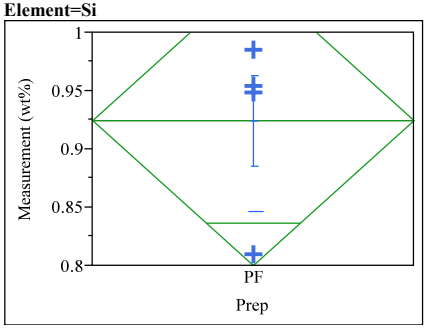
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.1999	2	4.0981	0.2244

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Si



Oneway Anova
Summary of Fit

Rsquare	0
Adj Rsquare	0
Root Mean Square Error	0.078236
Mean of Response	0.92475
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	0.01836275	0.006121		
C. Total	3	0.01836275			

Means for Oneway Anova

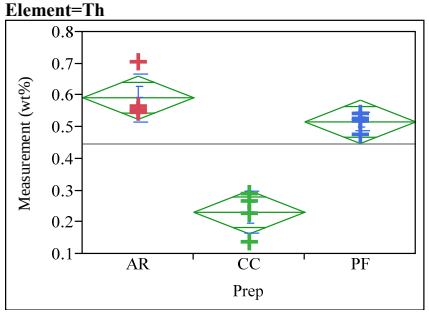
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
PF	4	0.924750	0.03912	0.80026	1.0492

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%
PF	4	0.924750	0.078236	0.03912	0.80026	1.0492

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Th



Oneway Anova
Summary of Fit

Rsquare	0.898185
Adj Rsquare	0.87556
Root Mean Square Error	0.060427
Mean of Response	0.447125
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.28990838	0.144954	39.6980	<.0001*
Error	9	0.03286285	0.003651		
C. Total	11	0.32277122			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.592875	0.03021	0.52453	0.66122
CC	4	0.231750	0.03021	0.16340	0.30010
PF	4	0.516750	0.03021	0.44840	0.58510

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%
AR	4	0.592875	0.075023	0.03751	0.47350	0.71225
CC	4	0.231750	0.066855	0.03343	0.12537	0.33813
PF	4	0.516750	0.029262	0.01463	0.47019	0.56331

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0750230	0.0559625	0.0420750
CC	4	0.0668549	0.0472500	0.0472500
PF	4	0.0292617	0.0203750	0.0192500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.5803	2	9	0.5794
Brown-Forsythe	0.3839	2	9	0.6918
Levene	1.2712	2	9	0.3264
Bartlett	1.0653	2	.	0.3446

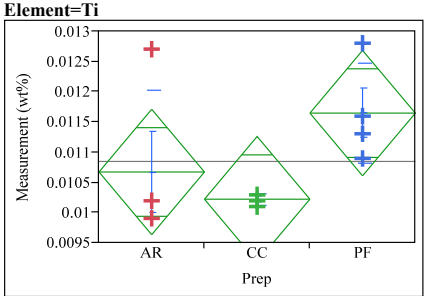
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
31.0781	2	5.041	0.0015*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ti



Oneway Anova
Summary of Fit

Rsquare	0.359441
Adj Rsquare	0.217095
Root Mean Square Error	0.000917
Mean of Response	0.01085
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00000424	2.1225e-6	2.5251	0.1347
Error	9	0.00000757	8.4056e-7		
C. Total	11	0.00001181			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.010675	0.00046	0.00964	0.01171
CC	4	0.010225	0.00046	0.00919	0.01126
PF	4	0.011650	0.00046	0.01061	0.01269

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%
AR	4	0.010675	0.001357	0.00068	0.00852	0.01283
CC	4	0.010225	0.000096	4.79e-5	0.01007	0.01038
PF	4	0.011650	0.000819	0.00041	0.01035	0.01295

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0013574	0.0010125	0.0007750
CC	4	0.0000957	0.0000750	0.0000750
PF	4	0.0008185	0.0005750	0.0005500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0139	2	9	0.4008
Brown-Forsythe	0.8130	2	9	0.4736
Levene	3.7378	2	9	0.0658
Bartlett	5.1741	2	.	0.0057*

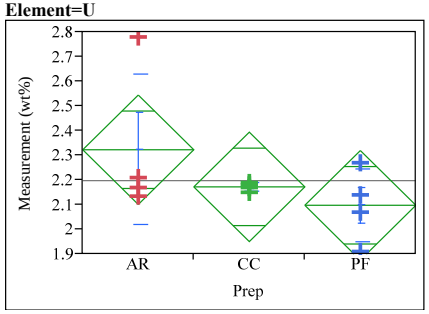
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
5.3110	2	4.0735	0.0733

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=U



Oneway Anova
Summary of Fit

Rsquare	0.233301
Adj Rsquare	0.062924
Root Mean Square Error	0.196296
Mean of Response	2.197675
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.10552574	0.052763	1.3693	0.3026
Error	9	0.34678963	0.038532		
C. Total	11	0.45231536			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	2.32303	0.09815	2.1010	2.5451
CC	4	2.17250	0.09815	1.9505	2.3945
PF	4	2.09750	0.09815	1.8755	2.3195

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%
AR	4	2.32303	0.304653	0.15233	1.8383	2.8078
CC	4	2.17250	0.017078	0.00854	2.1453	2.1997
PF	4	2.09750	0.149972	0.07499	1.8589	2.3361

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.3046526	0.2273875	0.1706250
CC	4	0.0170783	0.0125000	0.0125000
PF	4	0.1499722	0.1075000	0.1075000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1484	2	9	0.3596
Brown-Forsythe	0.8920	2	9	0.4432
Levene	4.4829	2	9	0.0446*
Bartlett	5.9351	2	.	0.0026*

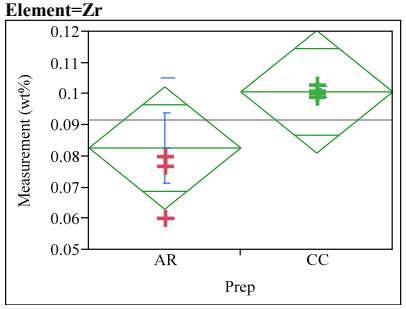
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.8477	2	4.0636	0.4924

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Zr



Oneway Anova
Summary of Fit

Rsquare	0.295904
Adj Rsquare	0.178554
Root Mean Square Error	0.016053
Mean of Response	0.091713
Observations (or Sum Wgts)	8

t Test
CC-AR

Assuming equal variances

Difference	0.01803	t Ratio	1.587943
Std Err Dif	0.01135	DF	6
Upper CL Dif	0.04580	Prob > |t|	0.1634
Lower CL Dif	-0.00975	Prob > t	0.0817
Confidence	0.95	Prob < t	0.9183

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.00064980	0.000650	2.5216	0.1634
Error	6	0.00154619	0.000258		
C. Total	7	0.00219599			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.082700	0.00803	0.06306	0.10234
CC	4	0.100725	0.00803	0.08108	0.12037

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%
AR	4	0.082700	0.022635	0.01132	0.04668	0.11872
CC	4	0.100725	0.001742	0.00087	0.09795	0.10350

t Test
CC-AR

Assuming unequal variances

Difference	0.01803	t Ratio	1.587943
Std Err Dif	0.01135	DF	3.03555
Upper CL Dif	0.05391	Prob > |t|	0.2094
Lower CL Dif	-0.01786	Prob > t	0.1047
Confidence	0.95	Prob < t	0.8953

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0226354	0.0156500	0.0143000
CC	4	0.0017424	0.0012750	0.0012750

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	1.7622	1	6	0.2326
Brown-Forsythe	2.5579	1	6	0.1609
Levene	4.4281	1	6	0.0800
Bartlett	9.6533	1	.	0.0019*
F Test 2-sided	168.7708	3	3	0.0015*

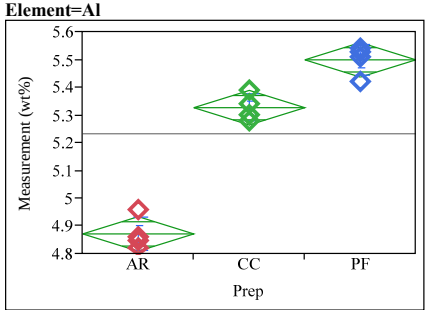
Warning: Small sample sizes. Use Caution.

Welch's Test
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.5216	1	3.0355	0.2094

t Test
1.5879

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Al



Oneway Anova
Summary of Fit

Rsquare	0.968716
Adj Rsquare	0.961764
Root Mean Square Error	0.054924
Mean of Response	5.233333
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.84071667	0.420358	139.3453	<.0001*
Error	9	0.02715000	0.003017		
C. Total	11	0.86786667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	4.87250	0.02746	4.8104	4.9346
CC	4	5.32750	0.02746	5.2654	5.3896
PF	4	5.50000	0.02746	5.4379	5.5621

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%
AR	4	4.87250	0.060759	0.03038	4.7758	4.9692
CC	4	5.32750	0.048563	0.02428	5.2502	5.4048
PF	4	5.50000	0.054772	0.02739	5.4128	5.5872

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0607591	0.0437500	0.0375000
CC	4	0.0485627	0.0375000	0.0375000
PF	4	0.0547723	0.0400000	0.0350000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.0843	2	9	0.9199
Brown-Forsythe	0.0053	2	9	0.9947
Levene	0.0477	2	9	0.9537
Bartlett	0.0651	2	.	0.9370

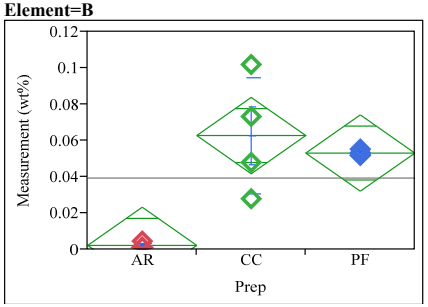
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
111.1345	2	5.9499	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=B



Oneway Anova
Summary of Fit

Rsquare	0.731362
Adj Rsquare	0.671664
Root Mean Square Error	0.018598
Mean of Response	0.039416
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00847516	0.004238	12.2512	0.0027*
Error	9	0.00311303	0.000346		
C. Total	11	0.01158818			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.002248	0.00930	-0.0188	0.02328
CC	4	0.062825	0.00930	0.0418	0.08386
PF	4	0.053175	0.00930	0.0321	0.07421

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%
AR	4	0.002248	0.001402	0.00070	1.7e-5	0.00448
CC	4	0.062825	0.032141	0.01607	0.01168	0.11397
PF	4	0.053175	0.001624	0.00081	0.05059	0.05576

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0014017	0.0010513	0.0007075
CC	4	0.0321415	0.0249250	0.0249250
PF	4	0.0016235	0.0011750	0.0011750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.9880	2	9	0.1011
Brown-Forsythe	10.7992	2	9	0.0041*
Levene	11.0089	2	9	0.0038*
Bartlett	11.6973	2	.	<.0001*

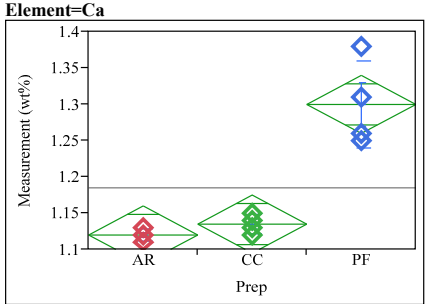
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1004.1010	2	5.2997	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Ca



Oneway Anova
Summary of Fit

Rsquare	0.87596
Adj Rsquare	0.848396
Root Mean Square Error	0.035434
Mean of Response	1.185
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.07980000	0.039900	31.7788	<.0001*
Error	9	0.01130000	0.001256		
C. Total	11	0.09110000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	1.12000	0.01772	1.0799	1.1601
CC	4	1.13500	0.01772	1.0949	1.1751
PF	4	1.30000	0.01772	1.2599	1.3401

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%
AR	4	1.12000	0.008165	0.00408	1.1070	1.1330
CC	4	1.13500	0.012910	0.00645	1.1145	1.1555
PF	4	1.30000	0.059442	0.02972	1.2054	1.3946

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0081650	0.0050000	0.0050000
CC	4	0.0129099	0.0100000	0.0100000
PF	4	0.0594418	0.0450000	0.0450000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.3212	2	9	0.1538
Brown-Forsythe	4.7500	2	9	0.0391*
Levene	6.3333	2	9	0.0192*
Bartlett	5.1217	2	.	0.0060*

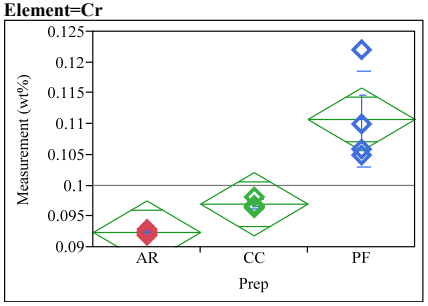
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
16.9467	2	5.0749	0.0057*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Cr



Oneway Anova
Summary of Fit

Rsquare	0.797764
Adj Rsquare	0.752823
Root Mean Square Error	0.004532
Mean of Response	0.10005
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00072926	0.000365	17.7512	0.0008*
Error	9	0.00018487	0.000021		
C. Total	11	0.00091413			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.092400	0.00227	0.08727	0.09753
CC	4	0.097000	0.00227	0.09187	0.10213
PF	4	0.110750	0.00227	0.10562	0.11588

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%
AR	4	0.092400	0.000392	0.00020	0.09178	0.09302
CC	4	0.097000	0.000744	0.00037	0.09582	0.09818
PF	4	0.110750	0.007805	0.00390	0.09833	0.12317

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0003916	0.0003000	0.0003000
CC	4	0.0007439	0.0005500	0.0004500
PF	4	0.0078049	0.0056250	0.0052500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7090	2	9	0.2349
Brown-Forsythe	2.7423	2	9	0.1175
Levene	5.7289	2	9	0.0248*
Bartlett	9.7000	2	.	<.0001*

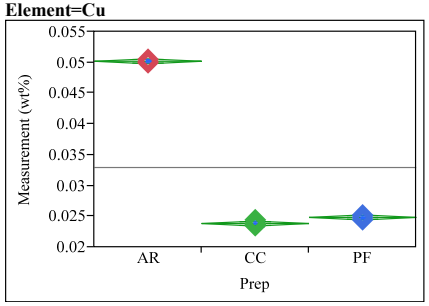
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
61.2868	2	4.8262	0.0004*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Cu



Oneway Anova
Summary of Fit

Rsquare	0.99935
Adj Rsquare	0.999206
Root Mean Square Error	0.000359
Mean of Response	0.032967
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00178393	0.000892	6920.405	<.0001*
Error	9	0.00000116	1.289e-7		
C. Total	11	0.00178509			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.050200	0.00018	0.04979	0.05061
CC	4	0.023850	0.00018	0.02344	0.02426
PF	4	0.024850	0.00018	0.02444	0.02526

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%
AR	4	0.050200	0.000271	0.00014	0.04977	0.05063
CC	4	0.023850	0.000451	0.00023	0.02313	0.02457
PF	4	0.024850	0.000332	0.00017	0.02432	0.02538

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0002708	0.0002000	0.0001500
CC	4	0.0004509	0.0003250	0.0003000
PF	4	0.0003317	0.0002250	0.0002000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.3921	2	9	0.6866
Brown-Forsythe	0.3043	2	9	0.7449
Levene	0.4200	2	9	0.6693
Bartlett	0.3482	2	.	0.7060

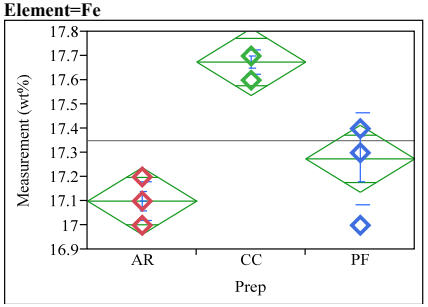
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8191.1162	2	5.7841	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Fe



Oneway Anova
Summary of Fit

Rsquare	0.837349
Adj Rsquare	0.801205
Root Mean Square Error	0.122474
Mean of Response	17.35
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.69500000	0.347500	23.1667	0.0003*
Error	9	0.13500000	0.015000		
C. Total	11	0.83000000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	17.1000	0.06124	16.961	17.239
CC	4	17.6750	0.06124	17.536	17.814
PF	4	17.2750	0.06124	17.136	17.414

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%
AR	4	17.1000	0.081650	0.04082	16.970	17.230
CC	4	17.6750	0.050000	0.02500	17.595	17.755
PF	4	17.2750	0.189297	0.09465	16.974	17.576

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0816497	0.0500000	0.0500000
CC	4	0.0500000	0.0375000	0.0250000
PF	4	0.1892969	0.1375000	0.1250000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2436	2	9	0.3335
Brown-Forsythe	1.1471	2	9	0.3600
Levene	2.4429	2	9	0.1421
Bartlett	2.2626	2	.	0.1041

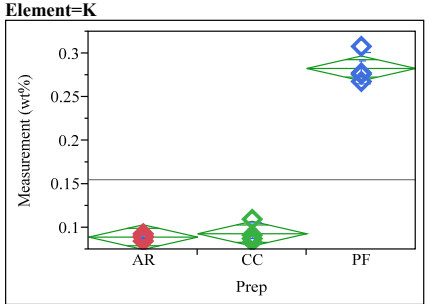
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
66.6726	2	5.1654	0.0002*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=K



Oneway Anova
Summary of Fit

Rsquare	0.985779
Adj Rsquare	0.982618
Root Mean Square Error	0.01254
Mean of Response	0.15515
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.09810416	0.049052	311.9226	<.0001*
Error	9	0.00141531	0.000157		
C. Total	11	0.09951947			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.089275	0.00627	0.07509	0.10346
CC	4	0.093175	0.00627	0.07899	0.10736
PF	4	0.283000	0.00627	0.26882	0.29718

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%
AR	4	0.089275	0.003753	0.00188	0.08330	0.09525
CC	4	0.093175	0.011706	0.00585	0.07455	0.11180
PF	4	0.283000	0.017907	0.00895	0.25451	0.31149

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0037527	0.0025750	0.0025750
CC	4	0.0117057	0.0084125	0.0076750
PF	4	0.0179072	0.0130000	0.0105000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9456	2	9	0.4239
Brown-Forsythe	0.6561	2	9	0.5420
Levene	2.2871	2	9	0.1573
Bartlett	2.4015	2	.	0.0906

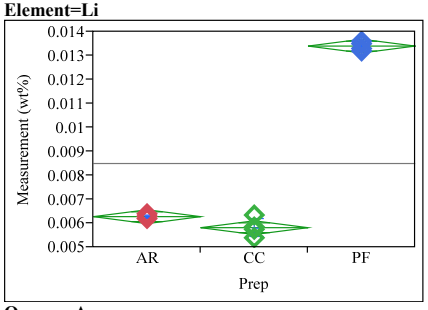
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
195.6110	2	4.5197	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Li



Oneway Anova
Summary of Fit

Rsquare	0.995962
Adj Rsquare	0.995065
Root Mean Square Error	0.000255
Mean of Response	0.008498
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00014458	0.000072	1109.981	<.0001*
Error	9	0.00000059	6.513e-8		
C. Total	11	0.00014517			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.006278	0.00013	0.00599	0.00657
CC	4	0.005818	0.00013	0.00553	0.00611
PF	4	0.013400	0.00013	0.01311	0.01369

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%
AR	4	0.006278	0.000090	4.5e-5	0.00613	0.00642
CC	4	0.005818	0.000392	0.00020	0.00519	0.00644
PF	4	0.013400	0.000183	9.13e-5	0.01311	0.01369

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0000900	0.0000675	0.0000675
CC	4	0.0003924	0.0002625	0.0002625
PF	4	0.0001826	0.0001500	0.0001500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4758	2	9	0.2790
Brown-Forsythe	1.6351	2	9	0.2479
Levene	1.7050	2	9	0.2356
Bartlett	2.4757	2	.	0.0841

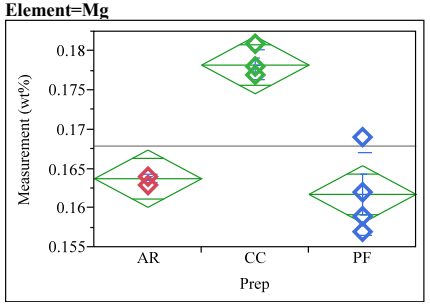
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2193.5015	2	4.8996	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Mg



Oneway Anova
Summary of Fit

Rsquare	0.873135
Adj Rsquare	0.844943
Root Mean Square Error	0.003236
Mean of Response	0.167917
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00064867	0.000324	30.9708	<.0001*
Error	9	0.00009425	0.000010		
C. Total	11	0.00074292			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.163750	0.00162	0.16009	0.16741
CC	4	0.178250	0.00162	0.17459	0.18191
PF	4	0.161750	0.00162	0.15809	0.16541

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%
AR	4	0.163750	0.000500	0.00025	0.16295	0.16455
CC	4	0.178250	0.001893	0.00095	0.17524	0.18126
PF	4	0.161750	0.005252	0.00263	0.15339	0.17011

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0005000	0.0003750	0.0002500
CC	4	0.0018930	0.0013750	0.0012500
PF	4	0.0052520	0.0037500	0.0037500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7460	2	9	0.2287
Brown-Forsythe	2.9068	2	9	0.1062
Levene	3.6213	2	9	0.0702
Bartlett	5.0154	2	.	0.0066*

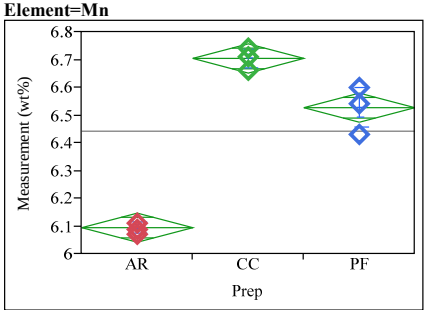
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
95.4909	2	4.2931	0.0003*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Mn



Oneway Anova
Summary of Fit

Rsquare	0.975868
Adj Rsquare	0.970506
Root Mean Square Error	0.046518
Mean of Response	6.4425
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.78755000	0.393775	181.9756	<.0001*
Error	9	0.01947500	0.002164		
C. Total	11	0.80702500			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	6.09500	0.02326	6.0424	6.1476
CC	4	6.70500	0.02326	6.6524	6.7576
PF	4	6.52750	0.02326	6.4749	6.5801

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%
AR	4	6.09500	0.019149	0.00957	6.0645	6.1255
CC	4	6.70500	0.033166	0.01658	6.6522	6.7578
PF	4	6.52750	0.070887	0.03544	6.4147	6.6403

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0191485	0.0150000	0.0150000
CC	4	0.0331662	0.0225000	0.0200000
PF	4	0.0708872	0.0487500	0.0425000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2645	2	9	0.3281
Brown-Forsythe	0.7305	2	9	0.5082
Levene	1.6051	2	9	0.2534
Bartlett	2.1025	2	.	0.1222

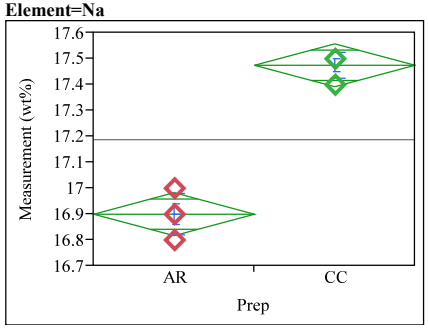
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
475.0577	2	5.1134	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Na



Oneway Anova
Summary of Fit

Rsquare	0.960073
Adj Rsquare	0.953418
Root Mean Square Error	0.0677
Mean of Response	17.1875
Observations (or Sum Wgts)	8

t Test
CC-AR
Assuming equal variances

Difference	0.575000	t Ratio	12.01136
Std Err Dif	0.047871	DF	6
Upper CL Dif	0.692137	Prob > |t|	<.0001*
Lower CL Dif	0.457863	Prob > t	<.0001*
Confidence	0.95	Prob < t	1.0000

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.66125000	0.661250	144.2727	<.0001*
Error	6	0.02750000	0.004583		
C. Total	7	0.68875000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	16.9000	0.03385	16.817	16.983
CC	4	17.4750	0.03385	17.392	17.558

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%
AR	4	16.9000	0.081650	0.04082	16.770	17.030
CC	4	17.4750	0.050000	0.02500	17.395	17.555

t Test
CC-AR
Assuming unequal variances

Difference	0.575000	t Ratio	12.01136
Std Err Dif	0.047871	DF	4.972603
Upper CL Dif	0.698261	Prob > |t|	<.0001*
Lower CL Dif	0.451739	Prob > t	<.0001*
Confidence	0.95	Prob < t	1.0000

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0816497	0.0500000	0.0500000
CC	4	0.0500000	0.0375000	0.0250000

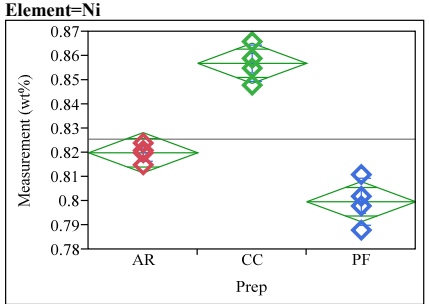
Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	0.6316	1	6	0.4571
Brown-Forsythe	0.4286	1	6	0.5370
Levene	0.1579	1	6	0.7049
Bartlett	0.5951	1	.	0.4404
F Test 2-sided	2.6667	3	3	0.4419

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

F Ratio	DFNum	DFDen	Prob > F
144.2727	1	4.9726	<.0001*

t Test
12.0114

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Ni



Oneway Anova
Summary of Fit

Rsquare	0.932924
Adj Rsquare	0.918019
Root Mean Square Error	0.007339
Mean of Response	0.825583
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00674217	0.003371	62.5884	<.0001*
Error	9	0.00048475	0.000054		
C. Total	11	0.00722692			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.820000	0.00367	0.81170	0.82830
CC	4	0.857000	0.00367	0.84870	0.86530
PF	4	0.799750	0.00367	0.79145	0.80805

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%
AR	4	0.820000	0.003742	0.00187	0.81405	0.82595
CC	4	0.857000	0.007528	0.00376	0.84502	0.86898
PF	4	0.799750	0.009535	0.00477	0.78458	0.81492

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0037417	0.0025000	0.0025000
CC	4	0.0075277	0.0055000	0.0055000
PF	4	0.0095350	0.0067500	0.0067500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8409	2	9	0.4626
Brown-Forsythe	1.0887	2	9	0.3772
Levene	1.0974	2	9	0.3745
Bartlett	1.0099	2	.	0.3642

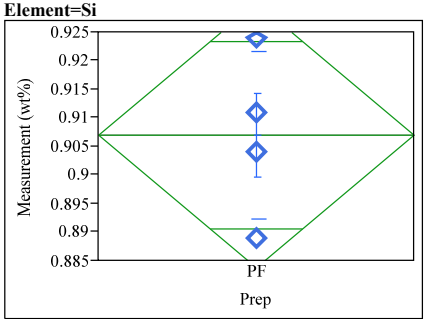
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
47.4944	2	5.1526	0.0005*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Si



Oneway Anova
Summary of Fit

Rsquare	0
Adj Rsquare	0
Root Mean Square Error	0.014583
Mean of Response	0.907
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	0.00063800	0.000213		
C. Total	3	0.00063800			

Means for Oneway Anova

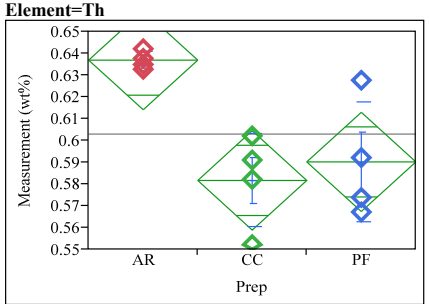
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
PF	4	0.907000	0.00729	0.88380	0.93020

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%
PF	4	0.907000	0.014583	0.00729	0.88380	0.93020

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Th



Oneway Anova
Summary of Fit

Rsquare	0.659264
Adj Rsquare	0.583545
Root Mean Square Error	0.020165
Mean of Response	0.603
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00708050	0.003540	8.7067	0.0079*
Error	9	0.00365950	0.000407		
C. Total	11	0.01074000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.637000	0.01008	0.61419	0.65981
CC	4	0.581750	0.01008	0.55894	0.60456
PF	4	0.590250	0.01008	0.56744	0.61306

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%
AR	4	0.637000	0.003916	0.00196	0.63077	0.64323
CC	4	0.581750	0.021453	0.01073	0.54761	0.61589
PF	4	0.590250	0.027281	0.01364	0.54684	0.63366

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0039158	0.0030000	0.0030000
CC	4	0.0214534	0.0148750	0.0147500
PF	4	0.0272809	0.0197500	0.0197500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0739	2	9	0.3817
Brown-Forsythe	1.7810	2	9	0.2230
Levene	2.2679	2	9	0.1594
Bartlett	3.3307	2	.	0.0358*

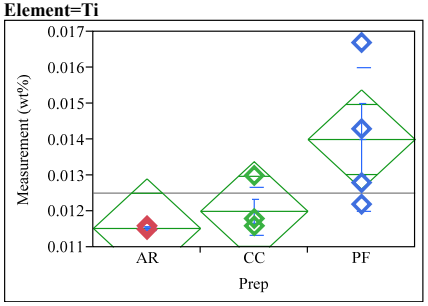
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
15.6802	2	4.2068	0.0112*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Ti



Oneway Anova
Summary of Fit

Rsquare	0.506871
Adj Rsquare	0.397286
Root Mean Square Error	0.001221
Mean of Response	0.012508
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00001380	0.0000069	4.6254	0.0415*
Error	9	0.00001343	1.4919e-6		
C. Total	11	0.00002723			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.011525	0.00061	0.01014	0.01291
CC	4	0.012000	0.00061	0.01062	0.01338
PF	4	0.014000	0.00061	0.01262	0.01538

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%
AR	4	0.011525	0.000050	2.5e-5	0.01145	0.01160
CC	4	0.012000	0.000673	0.00034	0.01093	0.01307
PF	4	0.014000	0.002005	0.00100	0.01081	0.01719

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0000500	0.0000375	0.0000250
CC	4	0.0006733	0.0005000	0.0004000
PF	4	0.0020050	0.0015000	0.0015000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0959	2	9	0.1789
Brown-Forsythe	4.2678	2	9	0.0497*
Levene	5.8789	2	9	0.0233*
Bartlett	8.6115	2	.	0.0002*

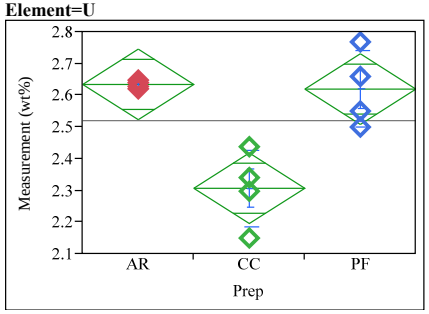
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.4566	2	4.0244	0.1337

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=U



Oneway Anova
Summary of Fit

Rsquare	0.757891
Adj Rsquare	0.704089
Root Mean Square Error	0.098531
Mean of Response	2.520833
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.27351667	0.136758	14.0867	0.0017*
Error	9	0.08737500	0.009708		
C. Total	11	0.36089167			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	2.63500	0.04927	2.5236	2.7464
CC	4	2.30750	0.04927	2.1961	2.4189
PF	4	2.62000	0.04927	2.5086	2.7314

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%
AR	4	2.63500	0.012910	0.00645	2.6145	2.6555
CC	4	2.30750	0.120381	0.06019	2.1159	2.4991
PF	4	2.62000	0.120277	0.06014	2.4286	2.8114

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0129099	0.0100000	0.0100000
CC	4	0.1203813	0.0825000	0.0825000
PF	4	0.1202775	0.0950000	0.0950000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2265	2	9	0.3380
Brown-Forsythe	3.0119	2	9	0.0997
Levene	3.2061	2	9	0.0889
Bartlett	4.2659	2	.	0.0140*

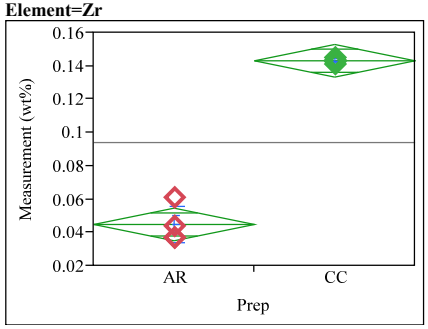
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
12.5983	2	4.0905	0.0178*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=RECEIPT, Element=Zr



Oneway Anova
Summary of Fit

Rsquare	0.980382
Adj Rsquare	0.977113
Root Mean Square Error	0.008032
Mean of Response	0.094075
Observations (or Sum Wgts)	8

t Test
CC-AR
Assuming equal variances

Difference	0.098350	t Ratio	17.31601
Std Err Dif	0.005680	DF	6
Upper CL Dif	0.112248	Prob > |t|	<.0001*
Lower CL Dif	0.084452	Prob > t	<.0001*
Confidence	0.95	Prob < t	1.0000

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.01934544	0.019345	299.8442	<.0001*
Error	6	0.00038711	0.000065		
C. Total	7	0.01973255			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	4	0.044900	0.00402	0.03507	0.05473
CC	4	0.143250	0.00402	0.13342	0.15308

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%
AR	4	0.044900	0.011230	0.00562	0.02703	0.06277
CC	4	0.143250	0.001708	0.00085	0.14053	0.14597

t Test
CC-AR
Assuming unequal variances

Difference	0.098350	t Ratio	17.31601
Std Err Dif	0.005680	DF	3.138683
Upper CL Dif	0.115982	Prob > |t|	0.0003*
Lower CL Dif	0.080718	Prob > t	0.0002*
Confidence	0.95	Prob < t	0.9998

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	4	0.0112303	0.0080500	0.0077000
CC	4	0.0017078	0.0012500	0.0012500

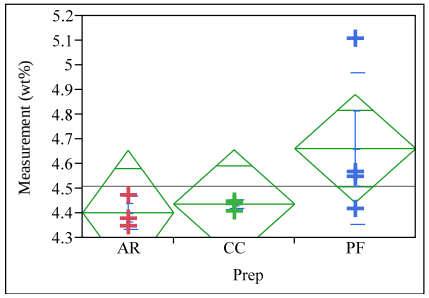
Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	1.7043	1	6	0.2396
Brown-Forsythe	2.3639	1	6	0.1751
Levene	4.5613	1	6	0.0766
Bartlett	6.2389	1	.	0.0125*
F Test 2-sided	43.2411	3	3	0.0115*

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

F Ratio	DFNum	DFDen	Prob > F
299.8442	1	3.1387	0.0003*

t Test
17.3160

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Al



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.339274
Adj Rsquare	0.174092
Root Mean Square Error	0.190422
Mean of Response	4.509673
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.14895448	0.074477	2.0539	0.1906
Error	8	0.29008443	0.036261		
C. Total	10	0.43903890			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	4.40213	0.10994	4.1486	4.6557
CC	4	4.43750	0.09521	4.2179	4.6571
PF	4	4.66250	0.09521	4.4429	4.8821

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%
AR	3	4.40213	0.066085	0.03815	4.2380	4.5663
CC	4	4.43750	0.018930	0.00946	4.4074	4.4676
PF	4	4.66250	0.305655	0.15283	4.1761	5.1489

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0660849	0.0493778	0.0529333
CC	4	0.0189297	0.0137500	0.0125000
PF	4	0.3056550	0.2237500	0.1775000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2666	2	8	0.3327
Brown-Forsythe	1.1684	2	8	0.3588
Levene	4.8289	2	8	0.0421*
Bartlett	6.4949	2	.	0.0015*

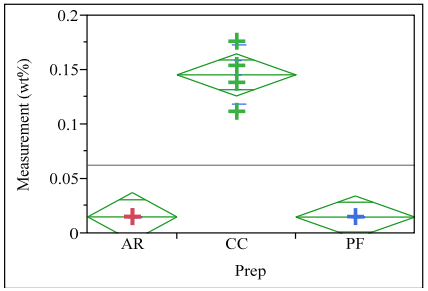
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.2599	2	3.436	0.3887

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=B



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.950796
Adj Rsquare	0.938496
Root Mean Square Error	0.016761
Mean of Response	0.062627
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.04343046	0.021715	77.2950	<.0001*
Error	8	0.00224752	0.000281		
C. Total	10	0.04567798			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.015200	0.00968	-0.0071	0.03752
CC	4	0.145750	0.00838	0.1264	0.16508
PF	4	0.015075	0.00838	-0.0043	0.03440

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%
AR	3	0.015200	0.000529	0.00031	0.01389	0.01651
CC	4	0.145750	0.027366	0.01368	0.10220	0.18930
PF	4	0.015075	0.000263	0.00013	0.01466	0.01549

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0005292	0.0004000	0.0004000
CC	4	0.0273663	0.0202500	0.0202500
PF	4	0.0002630	0.0002250	0.0002250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0579	2	8	0.1901
Brown-Forsythe	6.6111	2	8	0.0202*
Levene	6.6810	2	8	0.0197*
Bartlett	15.2559	2	.	<.0001*

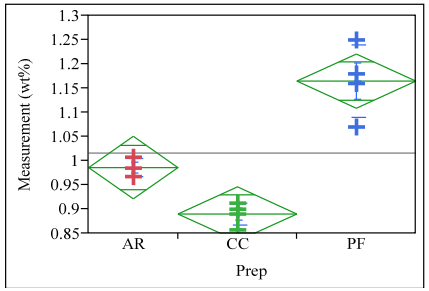
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
38.8774	2	3.824	0.0029*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ca



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.891232
Adj Rsquare	0.86404
Root Mean Square Error	0.048582
Mean of Response	1.016336
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.15471317	0.077357	32.7755	0.0001*
Error	8	0.01888158	0.002360		
C. Total	10	0.17359475			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.98623	0.02805	0.9216	1.0509
CC	4	0.89025	0.02429	0.8342	0.9463
PF	4	1.16500	0.02429	1.1090	1.2210

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%
AR	3	0.98623	0.019090	0.01102	0.9388	1.0337
CC	4	0.89025	0.023472	0.01174	0.8529	0.9276
PF	4	1.16500	0.074162	0.03708	1.0470	1.2830

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0190896	0.0133778	0.0179333
CC	4	0.0234716	0.0162500	0.0162500
PF	4	0.0741620	0.0500000	0.0500000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3958	2	8	0.3020
Brown-Forsythe	1.5213	2	8	0.2755
Levene	1.7172	2	8	0.2396
Bartlett	2.3701	2	.	0.0935

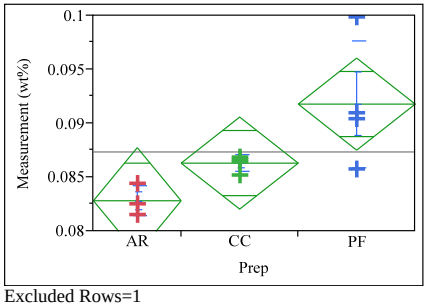
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
31.0665	2	5.0593	0.0014*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Cr



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.568428
Adj Rsquare	0.460536
Root Mean Square Error	0.003705
Mean of Response	0.087364
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00014461	0.000072	5.2685	0.0347*
Error	8	0.00010979	0.000014		
C. Total	10	0.00025441			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.082833	0.00214	0.07790	0.08777
CC	4	0.086325	0.00185	0.08205	0.09060
PF	4	0.091800	0.00185	0.08753	0.09607

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%
AR	3	0.082833	0.001429	0.00083	0.07928	0.08638
CC	4	0.086325	0.000768	0.00038	0.08510	0.08755
PF	4	0.091800	0.005886	0.00294	0.08243	0.10117

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0014295	0.0010444	0.0012333
CC	4	0.0007676	0.0005625	0.0004750
PF	4	0.0058861	0.0040500	0.0036500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4103	2	8	0.2988
Brown-Forsythe	1.5229	2	8	0.2751
Levene	2.8047	2	8	0.1194
Bartlett	4.4630	2	.	0.0115*

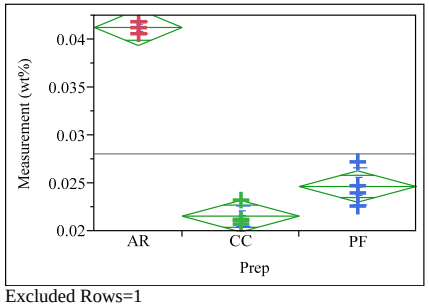
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.1041	2	3.9439	0.0401*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Cu



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.978602
Adj Rsquare	0.973253
Root Mean Square Error	0.00142
Mean of Response	0.028073
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00073730	0.000369	182.9340	<.0001*
Error	8	0.00001612	2.015e-6		
C. Total	10	0.00075342			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.041267	0.00082	0.03938	0.04316
CC	4	0.021575	0.00071	0.01994	0.02321
PF	4	0.024675	0.00071	0.02304	0.02631

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%
AR	3	0.041267	0.000651	0.00038	0.03965	0.04288
CC	4	0.021575	0.001097	0.00055	0.01983	0.02332
PF	4	0.024675	0.001972	0.00099	0.02154	0.02781

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0006506	0.0004444	0.0006333
CC	4	0.0010966	0.0008125	0.0006250
PF	4	0.0019721	0.0013750	0.0013750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9557	2	8	0.4245
Brown-Forsythe	0.7900	2	8	0.4863
Levene	1.1661	2	8	0.3594
Bartlett	1.1491	2	.	0.3169

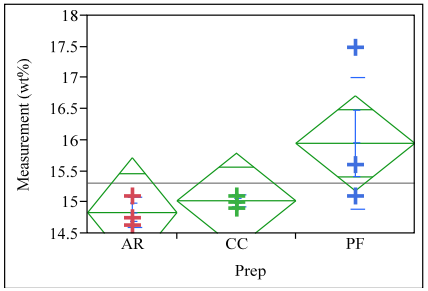
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
432.7252	2	5.1657	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Fe



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.428394
Adj Rsquare	0.285492
Root Mean Square Error	0.663241
Mean of Response	15.30981
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	2.6374224	1.31871	2.9978	0.1068
Error	8	3.5191120	0.43989		
C. Total	10	6.1565344			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	14.8360	0.38292	13.953	15.719
CC	4	15.0250	0.33162	14.260	15.790
PF	4	15.9500	0.33162	15.185	16.715

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%
AR	3	14.8360	0.24659	0.14237	14.223	15.449
CC	4	15.0250	0.09574	0.04787	14.873	15.177
PF	4	15.9500	1.05987	0.52994	14.264	17.636

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.246589	0.1834222	0.2010667
CC	4	0.095743	0.0750000	0.0750000
PF	4	1.059874	0.7750000	0.6000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2546	2	8	0.3358
Brown-Forsythe	0.9622	2	8	0.4222
Levene	4.4597	2	8	0.0500*
Bartlett	5.4353	2	.	0.0044*

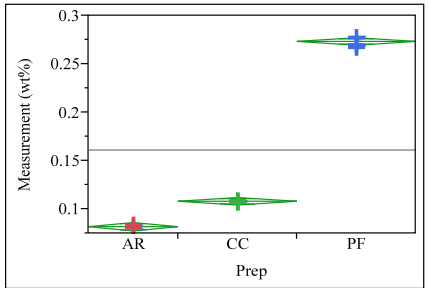
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.9995	2	3.62	0.2600

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=K



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.99889
Adj Rsquare	0.998612
Root Mean Square Error	0.003344
Mean of Response	0.161164
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.08050957	0.040255	3599.131	<.0001*
Error	8	0.00008948	0.000011		
C. Total	10	0.08059905			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.081933	0.00193	0.07748	0.08639
CC	4	0.108250	0.00167	0.10439	0.11211
PF	4	0.273500	0.00167	0.26964	0.27736

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%
AR	3	0.081933	0.001365	0.00079	0.07854	0.08532
CC	4	0.108250	0.000957	0.00048	0.10673	0.10977
PF	4	0.273500	0.005260	0.00263	0.26513	0.28187

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0013650	0.0010444	0.0009333
CC	4	0.0009574	0.0007500	0.0007500
PF	4	0.0052599	0.0045000	0.0045000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	15.1189	2	8	0.0019*
Brown-Forsythe	22.3295	2	8	0.0005*
Levene	45.4633	2	8	<.0001*
Bartlett	3.5667	2	.	0.0282*

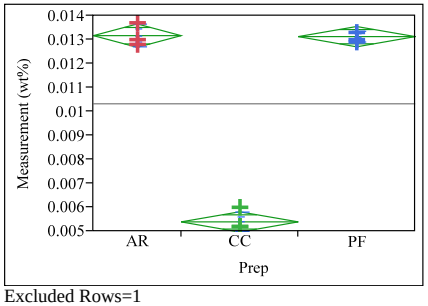
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2169.2404	2	4.3244	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Li



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.993041
Adj Rsquare	0.991302
Root Mean Square Error	0.000366
Mean of Response	0.010324
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00015300	0.000077	570.8146	<.0001*
Error	8	0.00000107	1.34e-7		
C. Total	10	0.00015407			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.013167	0.00021	0.01268	0.01365
CC	4	0.005390	0.00018	0.00497	0.00581
PF	4	0.013125	0.00018	0.01270	0.01355

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%
AR	3	0.013167	0.000473	0.00027	0.01199	0.01434
CC	4	0.005390	0.000407	0.00020	0.00474	0.00604
PF	4	0.013125	0.000206	0.00010	0.01280	0.01345

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0004726	0.0003556	0.0003667
CC	4	0.0004074	0.0003050	0.0002200
PF	4	0.0002062	0.0001750	0.0001750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6176	2	8	0.5631
Brown-Forsythe	0.4269	2	8	0.6666
Levene	1.2694	2	8	0.3320
Bartlett	0.7593	2	.	0.4680

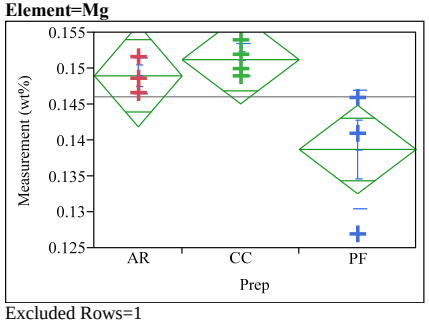
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
506.9765	2	4.0854	<.0001*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Mg



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.603508
Adj Rsquare	0.504386
Root Mean Square Error	0.005341
Mean of Response	0.146091
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00034741	0.000174	6.0885	0.0247*
Error	8	0.00022824	0.000029		
C. Total	10	0.00057565			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.149000	0.00308	0.14189	0.15611
CC	4	0.151250	0.00267	0.14509	0.15741
PF	4	0.138750	0.00267	0.13259	0.14491

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%
AR	3	0.149000	0.002524	0.00146	0.14273	0.15527
CC	4	0.151250	0.002217	0.00111	0.14772	0.15478
PF	4	0.138750	0.008180	0.00409	0.12573	0.15177

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0025239	0.0018000	0.0023000
CC	4	0.0022174	0.0017500	0.0017500
PF	4	0.0081803	0.0058750	0.0047500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1627	2	8	0.3604
Brown-Forsythe	0.5941	2	8	0.5747
Levene	2.5140	2	8	0.1422
Bartlett	2.4353	2	.	0.0876

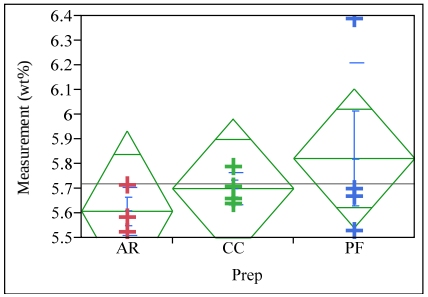
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.0705	2	4.7003	0.0942

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Mn



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.144789
Adj Rsquare	-0.06901
Root Mean Square Error	0.244462
Mean of Response	5.719582
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.08094213	0.040471	0.6772	0.5349
Error	8	0.47809217	0.059762		
C. Total	10	0.55903430			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	5.60847	0.14114	5.2830	5.9339
CC	4	5.70000	0.12223	5.4181	5.9819
PF	4	5.82250	0.12223	5.5406	6.1044

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%
AR	3	5.60847	0.096998	0.05600	5.3675	5.8494
CC	4	5.70000	0.066833	0.03342	5.5937	5.8063
PF	4	5.82250	0.385519	0.19276	5.2091	6.4359

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0969979	0.0705556	0.0846667
CC	4	0.0668331	0.0500000	0.0500000
PF	4	0.3855191	0.2837500	0.2225000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1890	2	8	0.3531
Brown-Forsythe	0.7906	2	8	0.4860
Levene	3.9517	2	8	0.0640
Bartlett	3.7259	2	.	0.0241*

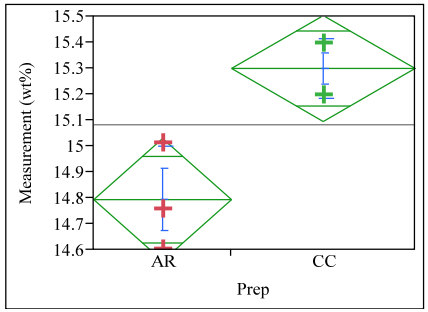
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.0973	2	4.294	0.4121

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Na



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.776262
Adj Rsquare	0.731514
Root Mean Square Error	0.159169
Mean of Response	15.083
Observations (or Sum Wgts)	7

t Test

CC-AR

Assuming equal variances

Difference	0.506333	t Ratio	4.165037
Std Err Dif	0.121568	DF	5
Upper CL Dif	0.818833	Prob > |t|	0.0088*
Lower CL Dif	0.193834	Prob > t	0.0044*
Confidence	0.95	Prob < t	0.9956

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.43949733	0.439497	17.3475	0.0088*
Error	5	0.12667433	0.025335		
C. Total	6	0.56617166			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	14.7937	0.09190	14.557	15.030
CC	4	15.3000	0.07958	15.095	15.505

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%
AR	3	14.7937	0.208176	0.12019	14.277	15.311
CC	4	15.3000	0.115470	0.05774	15.116	15.484

t Test

CC-AR

Assuming unequal variances

Difference	0.506333	t Ratio	3.797364
Std Err Dif	0.133338	DF	2.925635
Upper CL Dif	0.936842	Prob > |t|	0.0335*
Lower CL Dif	0.075824	Prob > t	0.0167*
Confidence	0.95	Prob < t	0.9833

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.2081758	0.1481556	0.1904667
CC	4	0.1154701	0.1000000	0.1000000

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	1.2173	1	5	0.3201
Brown-Forsythe	11.5861	1	5	0.0192*
Levene	0.9545	1	5	0.3734
Bartlett	0.7036	1	.	0.4016
F Test 2-sided	3.2503	2	3	0.3549

Warning: Small sample sizes. Use Caution.

Welch's Test

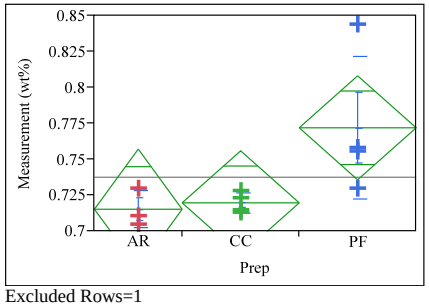
Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
14.4200	1	2.9256	0.0335*

t Test

3.7974

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ni



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.486815
Adj Rsquare	0.358519
Root Mean Square Error	0.031418
Mean of Response	0.737555
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.00749087	0.003745	3.7945	0.0694
Error	8	0.00789664	0.000987		
C. Total	10	0.01538751			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.715367	0.01814	0.67354	0.75720
CC	4	0.719750	0.01571	0.68353	0.75597
PF	4	0.772000	0.01571	0.73578	0.80822

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%
AR	3	0.715367	0.013227	0.00764	0.68251	0.74822
CC	4	0.719750	0.006994	0.00350	0.70862	0.73088
PF	4	0.772000	0.049666	0.02483	0.69297	0.85103

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0132266	0.0098889	0.0105667
CC	4	0.0069940	0.0057500	0.0057500
PF	4	0.0496655	0.0360000	0.0290000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2482	2	8	0.3374
Brown-Forsythe	0.9342	2	8	0.4319
Levene	3.6615	2	8	0.0743
Bartlett	4.1440	2	.	0.0159*

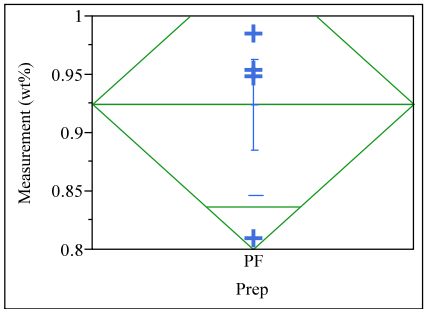
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.0331	2	3.9316	0.2476

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Si



Oneway Anova

Summary of Fit

Rsquare	0
Adj Rsquare	0
Root Mean Square Error	0.078236
Mean of Response	0.92475
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	0.01836275	0.006121		
C. Total	3	0.01836275			

Means for Oneway Anova

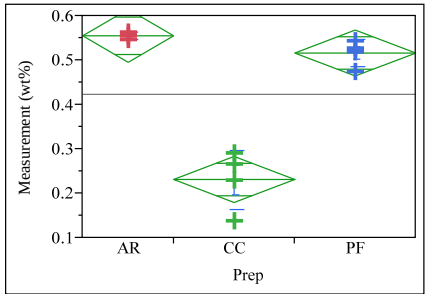
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
PF	4	0.924750	0.03912	0.80026	1.0492

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%
PF	4	0.924750	0.078236	0.03912	0.80026	1.0492

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Th



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.935448
Adj Rsquare	0.91931
Root Mean Square Error	0.044944
Mean of Response	0.4237
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.23417887	0.117089	57.9654	<.0001*
Error	8	0.01615991	0.002020		
C. Total	10	0.25033878			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.555567	0.02595	0.49573	0.61540
CC	4	0.231750	0.02247	0.17993	0.28357
PF	4	0.516750	0.02247	0.46493	0.56857

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%
AR	3	0.555567	0.009550	0.00551	0.53184	0.57929
CC	4	0.231750	0.066855	0.03343	0.12537	0.33813
PF	4	0.516750	0.029262	0.01463	0.47019	0.56331

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0095500	0.0063778	0.0095333
CC	4	0.0668549	0.0472500	0.0472500
PF	4	0.0292617	0.0203750	0.0192500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2866	2	8	0.3277
Brown-Forsythe	1.6497	2	8	0.2513
Levene	2.2667	2	8	0.1660
Bartlett	2.7214	2	.	0.0658

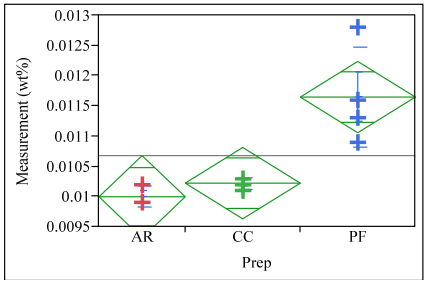
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
41.4799	2	4.5526	0.0012*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Ti



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.740292
Adj Rsquare	0.675364
Root Mean Square Error	0.000512
Mean of Response	0.010682
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	5.97886e-6	2.9894e-6	11.4019	0.0045*
Error	8	2.0975e-6	2.6219e-7		
C. Total	10	8.07636e-6			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.010000	0.00030	0.00932	0.01068
CC	4	0.010225	0.00026	0.00963	0.01082
PF	4	0.011650	0.00026	0.01106	0.01224

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%
AR	3	0.010000	0.000173	0.00010	0.00957	0.01043
CC	4	0.010225	0.000096	4.79e-5	0.01007	0.01038
PF	4	0.011650	0.000819	0.00041	0.01035	0.01295

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0001732	0.0001333	0.0001000
CC	4	0.0000957	0.0000750	0.0000750
PF	4	0.0008185	0.0005750	0.0005500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4546	2	8	0.2892
Brown-Forsythe	2.1402	2	8	0.1801
Levene	3.3191	2	8	0.0892
Bartlett	4.9341	2	.	0.0072*

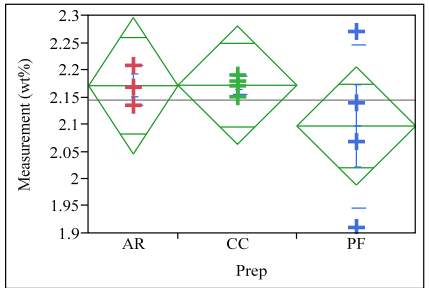
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
7.2033	2	3.972	0.0477*

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=U



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.166082
Adj Rsquare	-0.0424
Root Mean Square Error	0.094227
Mean of Response	2.144936
Observations (or Sum Wgts)	11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	2	0.01414612	0.007073	0.7966	0.4836
Error	8	0.07102923	0.008879		
C. Total	10	0.08517535			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	2.17143	0.05440	2.0460	2.2969
CC	4	2.17250	0.04711	2.0639	2.2811
PF	4	2.09750	0.04711	1.9889	2.2061

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%
AR	3	2.17143	0.036601	0.02113	2.0805	2.2624
CC	4	2.17250	0.017078	0.00854	2.1453	2.1997
PF	4	2.09750	0.149972	0.07499	1.8589	2.3361

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0366007	0.0253778	0.0349333
CC	4	0.0170783	0.0125000	0.0125000
PF	4	0.1499722	0.1075000	0.1075000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7555	2	8	0.2333
Brown-Forsythe	3.5620	2	8	0.0783
Levene	3.7156	2	8	0.0722
Bartlett	4.7892	2	.	0.0083*

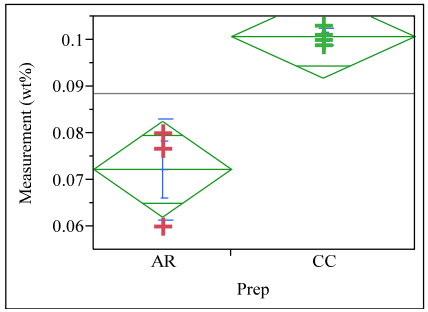
Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
0.4199	2	3.7862	0.6844

Oneway Analysis of Measurement (wt%) By Prep Process/Standard=SRAT, Type=PRODUCT, Element=Zr



Excluded Rows=1

Oneway Anova

Summary of Fit

Rsquare	0.852647
Adj Rsquare	0.823176
Root Mean Square Error	0.006927
Mean of Response	0.088529
Observations (or Sum Wgts)	7

t Test

CC-AR

Assuming equal variances

Difference	0.028458	t Ratio	5.378857
Std Err Dif	0.005291	DF	5
Upper CL Dif	0.042059	Prob > |t|	0.0030*
Lower CL Dif	0.014858	Prob > t	0.0015*
Confidence	0.95	Prob < t	0.9985

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep	1	0.00138836	0.001388	28.9321	0.0030*
Error	5	0.00023993	0.000048		
C. Total	6	0.00162829			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AR	3	0.072267	0.00400	0.06199	0.08255
CC	4	0.100725	0.00346	0.09182	0.10963

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%
AR	3	0.072267	0.010743	0.00620	0.04558	0.09895
CC	4	0.100725	0.001742	0.00087	0.09795	0.10350

t Test

CC-AR

Assuming unequal variances

Difference	0.028458	t Ratio	4.543598
Std Err Dif	0.006263	DF	2.079151
Upper CL Dif	0.054448	Prob > |t|	0.0420*
Lower CL Dif	0.002469	Prob > t	0.0210*
Confidence	0.95	Prob < t	0.9790

Tests that the Variances are Equal

Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AR	3	0.0107431	0.0081778	0.0077333
CC	4	0.0017424	0.0012750	0.0012750

Test	F Ratio	DFNum	DFDen	p-Value
O'Brien[.5]	2.4052	1	5	0.1816
Brown-Forsythe	2.8349	1	5	0.1531
Levene	12.4503	1	5	0.0168*
Bartlett	5.3886	1	.	0.0203*
F Test 2-sided	38.0170	2	3	0.0148*

Warning: Small sample sizes. Use Caution.

Welch's Test

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
20.6443	1	2.0792	0.0420*

t Test

4.5436