

VERIFICATION OF THE DEFENSE WASTE PROCESSING FACILITY'S (DWPF) PROCESS DIGESTION METHOD FOR THE SLUDGE BATCH 6 QUALIFICATION SAMPLE

D. R. Click
T. B. Edwards
M. A. Jones

June 9, 2010

Savannah River National Laboratory
Savannah River Nuclear Solutions, LLC
Aiken, SC 29808

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REVIEWS AND APPROVALS

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

T.B. Edwards, Co-Author, Statistical Consulting, SRNL	Date
---	------

D.K. Peeler, Technical Reviewer, Process Technology Programs, SRNL	Date
--	------

J.M. Pareizs, Technical Reviewer, Process Technology Programs, SRNL	Date
---	------

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

C.C. Herman, Manager, DWPF Programs, SRNL	Date
---	------

C.M. Gregory, Manager, Spectroscopy and Separations, Analytical Development, SRNL	Date
---	------

J.E. Occhipinti, SRR Engineering	Date
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TABLE OF CONTENTS

LIST OF FIGURES AND TABLES	IX
LIST OF ACRONYMS.....	XI
1.0 SUMMARY	13
2.0 EXPERIMENTAL	17
3.0 INTRODUCTION AND RESULTS.....	19
4.0 CONCLUSIONS	33
5.0 RECOMMENDATIONS	35
6.0 REFERENCES.....	37
7.0 ACKNOWLEDGEMENTS	39
8.0 APPENDIX A. SUPPORTING INFORMATION.....	41

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LIST OF FIGURES AND TABLES

Table 3-1 Elemental concentrations of Th and U from ICP-AES and ICP-MS analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) total solids basis and are reported to the first digit of the calculated standard deviation.	20
Table 3-2 Elemental concentrations of SB6 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.	23
Table 3-3 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB6 SRAT Receipt sludge. Digestions not having the same letter are statistically different at the 5% significance level.	24
Table 3-4 Elemental concentrations of SB6 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.	26
Table 3-5 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB6 SRAT Product sludge. Digestions not having the same letter are statistically different at the 5% significance level.	27
Table 3-6. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis. Digestions not having the same letter are statistically different at the 5% significance level.	29
Table 3-7. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.	30
Table 3-8. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.	31
Table 3-9. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.	32
Table 3-10. CV Hg AA results of digested SB6 SRAT Receipt using the DWPF method and an Aqua Regia digestion for comparison. Values are presented on a weight percent (Wt%) total dried solids basis and %RSD is given in parentheses.	32

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LIST OF ACRONYMS

AD	Analytical Development
AR	Aqua Regia
ARP	Actinide Removal Process
ARG	Analytical Reference Glass
CC	Cold Chem
DI	De-Ionized
DOE	Department of Energy
DWPF	Defense Waste Processing Facility
HM	H-Modified (pertaining to PUREX process)
ICP-AES	Inductively Coupled Plasma – Atomic Emission Spectroscopy
IEC	Inter-element Correction
LTAD	Low Temperature Aluminum Dissolution
LWO	Liquid Waste Operations
MCU	Modular Caustic Side Solvent Extraction
MST	Monosodium Titanate
PF	Sodium Peroxide/Hydroxide Fusion
SB	Sludge Batch
SE	Stream Effluent
SME	Slurry Mix Evaporator
SRAT	Sludge Receipt and Adjustment Tank
SRNL	Savannah River National Laboratory
WAPS	Waste Acceptance Product Specification
C-XRD	Contained - X-Ray Diffraction

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1.0 SUMMARY

For each sludge batch that is processed in the Defense Waste Processing Facility (DWPF), the Savannah River National Laboratory (SRNL) confirms applicability of the digestion method to be used by the DWPF lab for elemental analysis of Sludge Receipt and Adjustment Tank (SRAT) receipt samples and SRAT product process control samples.¹ DWPF SRAT samples are typically dissolved using a room temperature HF-HNO₃ acid dissolution (i.e., DWPF Cold Chem (CC) Method, see DWPF Procedure SW4-15.201) and then analyzed by inductively coupled plasma – atomic emission spectroscopy (ICP-AES). In addition to the CC method confirmation, the DWPF lab's mercury (Hg) digestion method was also evaluated for applicability to SB6 (see DWPF procedure "Mercury System Operating Manual", Manual: SW4-15.204. Section 6.1, Revision 5, Effective date: 12-04-03).

This report contains the results and comparison of data generated from performing the Aqua Regia (AR), Sodium Peroxide/Hydroxide Fusion (PF) and DWPF Cold Chem (CC) method digestion of Sludge Batch 6 (SB6) SRAT Receipt and SB6 SRAT Product samples. For validation of the DWPF lab's Hg method, only SRAT receipt material was used and compared to AR digestion results. The SB6 SRAT Receipt and SB6 SRAT Product samples were prepared in the SRNL Shielded Cells, and the SRAT Receipt material is representative of the sludge that constitutes the SB6 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 5 (SB5), to form the SB6 Blend composition. In addition to the 16 elements currently measured by the DWPF, this report includes Hg and thorium (Th) data (Th comprising ~2.5 - 3 Wt% of the total solids in SRAT Receipt and SRAT Product, respectively) and provides specific details of ICP-AES analysis of Th. Thorium was found to interfere with the U 367.007 nm emission line, and an inter-element correction (IEC) had to be applied to U data, which is also discussed. The results for any one particular element should not be used in any way to identify the form or speciation of a particular element without support from XRD analysis or used to estimate ratios of compounds in the sludge.

The results from the SRAT Receipt digestions include the following:

- The SRAT Receipt AR and CC digestion solutions contained white visible solids. The PF digestions solutions did not contain visible solids. The undissolved solids from the AR digestions were identified as boehmite from C-XRD analysis. The undissolved solids from the CC digestions were identified as calcium thorium fluoride (Ca_{0.5}Th_{0.5}F₃).
- No statistical difference of the means is observed in the Al concentration between the three digestions, indicating the undissolved amount of boehmite in the AR digestions is small or of small enough particle size to be still be analyzed by the ICP-ES.
- A statistical difference of means at the 5% significance level is noted for Fe, Mn, Na, Ni, Th, and U (for the elements greater than 1.0 Wt% of total solids). Fe, Mn, Na, Ni, and Th mean concentrations are lower in the CC digestions compared to the AR and PF digestions.
- The DWPF method used for digesting Hg appears to be adequate for the SB6 sludge slurry.

The results from the SRAT Product digestions include the following:

- As with the SRAT Receipt sample, the SRAT Product AR and CC digestion solutions contained visible white solids. The PF digestion solutions did not contain visible solids. The undissolved solids in the AR digestions were assumed to be boehmite based upon C-XRD analysis of the undissolved solids in the SRAT Receipt samples. The undissolved in the CC digestions have not been analyzed to date.
- A statistical difference in the means is observed in the Al concentration comparing the PF digestions to both the AR and CC digestions. The mean Al concentration is higher in the PF

digestions. The average Al concentration in the CC digestions is ~6.6% lower than the PF digestions, and the average Al concentration from the AR digestions is ~7.7% lower than the PF digestions indicating an aluminum species that is sparingly soluble in acid digestions.

- A statistical difference of means at the 5% significance level is noted for Fe, Mn, Na, Ni, and Th (for the elements greater than 1.0 Wt% of total solids). As with the SRAT Receipt sample, Fe, Mn, Na, and Ni concentrations are lower in the CC digestions compared to the AR and PF digestions. The mean Th concentration is statistically different in the CC digestions compared to the AR digestions, but there is no statistically significant difference compared to the PF digestions.

The results from a statistical and relative comparison of the data suggest that the DWPF CC method may not be completely solubilizing the following:

- Fe, which is ~11-16% lower in the CC digestions relative to the PF and AR digestions.
- Mn, which is ~5-7% lower in the CC digestions relative to the PF and AR digestions.
- Ni, which is ~10-12% lower in the CC digestions relative to the PF and AR digestions.
- Th, which is ~4-25% lower in the CC digestions relative to the PF and AR digestions.
- The low results observed for Fe, Mn, and Ni in the CC digestions of the SB6 SRAT Receipt and SRAT Product are not mirrored in the ARG results indicating a potential problem with digestion of the sludge matrix.

In addition, the mean Na concentration is ~4% lower in the CC digestions versus the aqua regia digestions.

The results from Th analysis of SB6 SRAT Receipt and SRAT Product include the following:

- Calcium thorium fluoride ($\text{Ca}_{0.5}\text{Th}_{0.5}\text{F}_3$) is a constituent of the precipitated solids in the SRAT Receipt CC digestions (from C-XRD analysis). Undissolved solids in the SRAT Product have not been analyzed to date, but the C-XRD analysis is expected to yield a similar result.
- ICP-AES measurements of Th in the CC digestions at 1.3 kW using the Th 374.118 nm and Th 401.913 nm emission lines in axial mode gave comparable results to ICP-MS measurements performed at 1.35 kW.
- ICP-AES measurements of Th in the CC digestions at 1.1 kW in both radial and axial modes are ~40% lower than ICP-MS measurements obtained at 1.35 kW.
- ICP-AES Th results from axial and radial modes at 1.1 kW (using the 318.019 nm emission line) of AR and PF digestions were comparable to ICP-MS measurements at 1.35 kW.
- Th interferes with the U 367.007 nm emission line, and an inter-element correction (IEC) was applied to all U data (IEC factor of ~0.2 in radial mode and ~0.15 in axial mode).
- No significant interference from U on Th emission lines utilized in this study was noted.

Based on the comparison of digestion methods tested at SRNL for SB6, we present the following short and long-term recommendations:

- A dissolution study should be performed on the SB6 WAPS sample by SRNL, which consists of the final composition of the sludge (the SB6 Blend), to determine if the Fe, Mn, Ni, and Th concentrations are consistently lower in the CC digestions versus the AR and PF methods for SB6.
- Given the problems seen with measuring Al by the CC method for SB5 and that a SB5 heel remains in Tank 40, the DWPF lab should monitor the Al concentration in the first 10 SRAT

Receipt batches of SB6 using both CC and PF methods to evaluate the adequacy of Al recovery by the CC method for SB6.

- Given the statistical difference and high relative difference in the means for Fe, Mn, Ni, and Th, the DWPF lab should also monitor these elements in the first 10 SRAT Receipt batches of SB6 using both the CC and PF methods to evaluate the adequacy of recovery by the CC method for SB6.
- The DWPF lab should establish an ICP-AES method to measure Th, determine which U emission lines are appropriate, and determine if an IEC needs to be applied to U data due to the presence of Th, using this report only as a guide.
- The DWPF CC method was originally developed to be used for SME analyses. Given continuous visual observations of solids in the CC digestions both at SRNL and DWPF, potential issues with accurate Al measurements when processing HM waste, and the results of this report, the DWPF lab should consider a different digestion scheme that relieves some of these issues. Other digestion methods have been developed at SRNL targeting the DWPF lab's process sample analysis.²
- The impact of the results of this study need to be assessed against the blending spreadsheet used in DWPF for predicting the glass processing properties to determine the potential impact on SME acceptability. Specifically, the DWPF should compare SRAT blending projections to the SME product results. If the difference in elemental concentrations is significant, another type of digestion (i.e. sodium peroxide/hydroxide fusion) should be used to determine the concentration of the element in question. Additional emphasis should be placed on monitoring Al, Fe, Ni and Th concentrations in SB6, and in particular the Mn concentration which could have a potential impact on the calculated acid addition amount.

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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 taken in October of 2009. The sample was delivered to SRNL, characterized and then modified by a series of wash/decant cycles to match the LWO planned preparation strategy. The sludge used in this testing corresponded to Decant I, identified by Bannochie et al. in SRNL-L3100-2010-00027, which is the SB6 qualification sample or the SRAT Receipt sample and the subsequent SRAT Product sample.

The sludge samples were dissolved in quadruplicate in the SRNL Shielded Cells facility in a manner similar to the DWPF CC method (see DWPF Procedure SW4-15.201), and by PF and AR digestion. For detailed steps of the PF digestion, see ADS procedure 2502.³ The PF digestion was modified by adding 3 drops 30% hydrogen peroxide (H_2O_2) to the solutions before the final dilution was complete. For detailed steps of the AR digestion, see ADS procedure 2226.⁴ Three replicate dissolutions of the analytical reference glass (ARG) standard were performed concurrently with each set of digestions as means to indicate problems with performing the digestion protocol and to test the validity of each digestion method for major elements. The ARG results are then evaluated comparing the measured results against a two sigma variation of the standard values. For the SRAT Receipt material, Al (slightly low), Mn (slightly low) and Si (as expected) were flagged as outside of the 2 sigma limits for the AR digestions, Si was flagged as outside the 2 sigma limits (slightly low) for the PF digestions as well as the CC digestions (expected for the CC digestions). For the SRAT product material, Si (as expected) was flagged as outside of the 2 sigma limits for the AR digestions as well as the CC digestions (as expected). No elements were flagged for the three digestions. One feldspar sample and one boehmite sample was also digested along with the PF and CC digestions of the SRAT material. The recovery of Al from PF digestion of the feldspar and boehmite standards was within 5.5% of the standard value. The recovery of Al from CC digestion of the feldspar standard was within 5% of the standard value indicating the CC digestion is valid for digesting sodium aluminum silicates. The recovery of Al from CC digestion of the boehmite standard was low by 84%. Additional quality control measures included ICP-AES analyses of a multi-element standard as a check for ICP-AES accuracy independent of digestions.

The CC method digestion involved adding 25 mL of concentrated HF to radioactive sludge slurry (~3.5 g for the SRAT Receipt at 15.1 Wt% total solids and ~3.5 g for the SRAT Product at 25.93 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 prior to diluting 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 with a known weight, weighed again and then diluted with DI water. Visible solids remained in each 250 mL radioactive sample bottle (the first dilution bottle). The visible solids from one sample of each type (SRAT Receipt and SRAT Product) were recovered by filtration for C-XRD analysis.

ICP-AES measurements were performed using a Leeman Prodigy Simultaneous instrument. In addition to the 16 elements currently analyzed by the DWPF, Th is also included in this report. The best Th measurements were performed using the Th 374.118 nm and Th 401.913 nm emission lines in axial mode at 1.3 kW for the Cold Chem digestions, which gave comparable results to ICP-MS measurements performed at 1.35 kW. The U data in this report is from axial or radial analysis performed at 1.1 kW. Th was found to interfere with the U 367.007 nm emission line and an IEC was applied to all U data (~0.2 in radial mode and ~0.15 in axial mode).

Hg Analysis

The DWPF procedure "Mercury System Operating Manual", Manual: SW4-15.204. Section 6.1, Revision 5, Effective date: 12-04-03 was followed to perform digestions on SRAT Receipt material. To serve as a quality control check on mercury analyses, a soil standard containing a known concentration of mercury was dissolved and analyzed concurrently with the samples.

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 five sludge batches (Sludge Batch 1A, Sludge Batch 1B, Sludge Batch 2, Sludge Batch 3, Sludge Batch 4) and is currently processing a sixth (Sludge Batch 5). 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 SB6. The subject of this report is the SB6 material from Tank 51 that is being qualified at SRNL, which is the SB6 Batch sludge slurry consisting of Tank 12 material that has been transferred to Tank 51 to undergo Low Temperature Aluminum Dissolution (LTAD) to reduce the Al content of the insoluble solids⁵, Tank 4 sludge, and H-Canyon Pu solutions. The Tank 51 material will be blended after qualification with a SB5 heel. As with SB4 and SB5, a stream of sludge/monosodium titanate (MST) from the Actinide Removal Process (ARP) and a Strip Effluent (SE) stream from the Modular Caustic Side Solvent Extraction (MCU) process will also be fed to DWPF during SB6 processing.

The radioactive sludge slurry used in this study for verification of the DWPF CC method is from a three liter qualification sample of Tank 51 sludge slurry taken in October of 2009. The sample was delivered to SRNL, characterized and then modified by a series of wash/decant cycles to match the LWO planned preparation strategy. The sludge used in this testing corresponded to Decant I, identified by Bannochie et al. in SRNL-L3100-2010-00027 Rev. 1, which is the SB6 qualification SRAT Receipt sample and subsequently, the SRAT Product sample.

The SRAT Receipt and SRAT Product analytical sub-samples were digested in quadruplicate using the AR, PF and the DWPF CC methods. Three ARG samples were digested concurrently with each set of digestions and two multi-element ICP-AES standards were submitted along with each sample batch for analysis containing known concentrations of Al, B, Fe, Li, Na, and Si.

Results

SB6 feed was found to contain Th after the initial analysis of the SRAT receipt and SRAT Product samples were complete. Th analysis by ICP-MS is straightforward since Th has 100% of its relative natural abundance at mass 232. However, an ICP-AES method had to be developed at SRNL since Th is not part of the routine suite reported to customers. During development of the Th method at SRNL, it was found that Th interfered with U analysis by ICP-AES. U is measured using the U 367.007 nm and an IEC of ~0.2 had to be applied to U data measured in radial mode, and an IEC of ~0.15 had to be applied to U data measured in axial mode. Table 3-1 presents the results from analysis of Th and U by ICP-MS and ICP-AES both before and after correction for Th interference on the U emission line.

Table 3-1 Elemental concentrations of Th and U from ICP-AES and ICP-MS analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) total solids basis and are reported to the first digit of the calculated standard deviation.

SRAT Receipt			
Digestion Method: PF			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.83E+00	2.21E+00*	N/A
ICP-AES	2.85E+00 (radial mode) 2.79E+00 (axial mode)	2.50E+00 (prior to IEC)	2.18E+00 (radial mode) 2.31E+00 (axial mode)
Digestion Method: AR			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.98E+00	2.33E+00*	N/A
ICP-AES	3.06E+00 (radial mode) 3.07E+00 (axial mode)	2.42E+00 (prior to IEC)	2.41E+00 (radial mode) 2.48E+00(axial mode)
Digestion Method: CC			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.49E+00	2.16E+00*	N/A
ICP-AES	4.E-01 (radial mode) 1.3E+00 (axial mode) 2.6E+00^ (axial@1.3kW)	2.74E+00 (prior to IEC)	2.24E+00 (radial mode) 2.29E+00 (axial mode)
SRAT Product			
Digestion Method: PF			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.37E+00	1.80E+00*	N/A
ICP-AES	2.4E+00 (radial mode) 2.3E+00 (axial mode)	2.26E+00 (prior to IEC)	1.9E+00 (radial mode) 1.77E+00 (axial mode)
Digestion Method: AR			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.89E+00	1.84E+00*	N/A
ICP-AES	2.69E+00 (radial mode) 2.86E+00 (axial mode)	2.18E+00 (prior to IEC)	1.95E+00 (radial mode) 1.99E+00 (axial mode)
Digestion Method: CC			
	Th (Wt%)	U (Wt%)	U (Wt%) after IEC for Th Interference
ICP-MS	2.20E+00	1.86E+00*	N/A
ICP-AES	3.4E-01 (radial mode) 1.6E+00 (axial mode) 2.2E+00 (axial@1.3kW)	2.22E+00 (prior to IEC)	1.99E+00 (radial mode) 2.02E+00 (axial mode)

All data presented in Table 3-1 are an average of four replicates unless noted. *ICP-MS results are a sum of only U-238 and U-235 isotopes. ^Th data for the SRAT Receipt CC digestions is an average of three results. Results are reported to the first digit of the calculated standard deviation.

Undissolved/precipitated solids are visible in the DWPF CC digestion solutions in each case (SRAT Receipt and SRAT Product). A single SRAT Receipt initial dilution bottle was filtered to recover the visible solids, submitted to C-XRD for analysis and identified as calcium thorium fluoride ($\text{Ca}_{0.5}\text{Th}_{0.5}\text{F}_3$). This species most likely formed by reaction with the excess HF added to the sample and precipitated out of solution. Solids from the SRAT Product sample could not be removed from the shielded cells due to the dose rate. Further work is in progress to isolate and wash SRAT product solids to identify the solids and determine if they are different than that observed in the SRAT receipt. Furthermore, undissolved solids were visually observed in the AR digestion solutions of both the SRAT Receipt and SRAT Product

digestions. The solids from the SRAT Receipt AR digestions were recovered by filtration, analyzed by C-XRD and identified as boehmite. No undissolved solids were observed in the resulting solutions from the PF digestions. The solids in the AR digestions of the SRAT Product material were not recovered for analysis but assumed to be boehmite based upon the SRAT Receipt solids C-XRD analysis results.

During verification of the DWPF CC method for previous sludge batches, boehmite ($\text{AlO}(\text{OH})$), muscovite ($(\text{K},\text{Na})(\text{Al}, \text{Mg}, \text{Fe})_2(\text{Si}_{3.1}\text{Al}_{0.9})\text{O}_{10}(\text{OH})_2$), silicon dioxide (SiO_2), dipotassium sodium aluminum fluoride ($\text{K}_2\text{NaAl}_3\text{F}_{12}$), dipotassium aluminum pentafluoride (K_2AlF_5), aluminum fluoride (AlF_3), chiolite ($\text{Na}_5\text{Al}_3\text{F}_{14}$), cryolite (Na_3AlF_6), sodium magnesium aluminum hexafluoride (NaMgAlF_6), iron zirconium hexafluoride (FeZrF_6) and disodium iron aluminum heptafluoride ($\text{Na}_2\text{FeAlF}_7$) have been identified as part of the undissolved/precipitated solids.⁶

The statistical results of the SB6 Batch samples generated from this study are provided in Appendix A. The results from each type of digestion are summarized in Table 3-2 - Table 3-3 for the SRAT Receipt and Table 3-4 and Table 3-5 for the SRAT Product samples. The ICP-AES results of the sixteen elements that are currently analyzed by the DWPF lab in addition to Th are presented on a weight percent (Wt%) of total solids basis. A statistical comparison of means from digestion of SRAT material for all three digestions could not be performed for B, Ca, K, Na, Si or Zr. B was less than the detection limit in the AR and PF digestions and B is leached from the borosilicate spray chamber of the ICP-AES instrument due to the presence of HF in the CC digestions. Ca is a contaminant in the PF reagents (the PF blank Ca concentration was 130 $\mu\text{g/g}$) and therefore only the means from the AR and CC digestions were compared. K was less than the minimum detection limit in the CC digestions. Na is added as part of the reagents used for PF digestions. Si could not be compared because it is leached from the ICP-AES instrument due to the presence of HF in the CC digestions and Si is known not to dissolve well in AR digestions. Zr could not be included in a statistical comparison of the means because the PF digestion utilizes a Zr crucible, therefore only the AR and CC results were compared. However, the Zr result from the AR digestions is low. Zr dissolves better when HF is present and this can readily be seen from the ARG-1 analysis results. Additionally, for the SRAT Product, the Li concentrations could not be compared because Li was less than the minimum detection limit in the PF and CC digestions.

Statistical comparisons of the data from the three digestion methods (for Na and Zr there are only two digestion methods) are provided in Appendix A. The results were generated using JMP Version 7.0.2.⁷ The plots 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. For example consider the SRAT Product Fe measurements. The results of the exhibit indicate that the mean of the CC results differs from the mean of the PF and AR results.

For the Na and Zr comparisons, the JMP output from an analysis of variance of the measurements for two digestions is provided, and only the 95% confidence mean diamond of each digestion is shown. Overlap marks show for each diamond, and overlap marks in one diamond that are closer to the mean of another diamond than that diamond's overlap marks indicate that those two groups are not different at the 95% confidence level. The visual comparisons are supported by an F test that compares the means of the AR and CC digestions for Na and Zr and the means of the AR and PF digestions for Si. If the p value is less than 0.05, then the means are statistically different at the 5% level. From the Appendix, there is an indication of a difference in the AR and CC means for Na for both the SRAT Product and the SRAT Receipt.

Summaries of the statistical comparisons of the Appendix are shown in Table 3-3 and Table 3-5. Following the format used in the exhibit, digestions not having the same letter are statistically different at the 5% significance level. Consider the SRAT Receipt Fe results, the average mean of Fe measured in the

PF and AR method digestions are statistically the same (and both columns have the letter A), but these means are statistically different from the mean average obtained from the DWPF CC digestion (which has the letter B in the column). The letter listed for a particular digestion corresponds to the concentration of a particular element in the sample relative to the other digestion methods. For example, a particular digestion method with the letter A by an element had the highest concentration of those compared, the letter B, the next highest concentration and so on. ARG results are presented and compared for each digestion type for the SRAT Receipt and SRAT Product samples in Table 3-6 – Table 3-9, including a similar statistical comparison of the means comparing the results obtained from all ARG digestions. The statistical analysis of Th for all three digestions was based upon axial and radial mode PF and AR data compared to only the axial mode Th data at 1.3 kW from the CC digestions, since the lower wattage measurements were clearly statistically different (see Table 3-1). Statistical comparison of U is presented for all three digestions in both axial and radial mode at 1.1 kW.

Table 3-2 Elemental concentrations of SB6 SRAT Receipt radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) of total dried solids basis.

Digestion Method →	Aqua Regia		Na ₂ O ₂ /NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]
Al	1.02E+01	1.E+00	1.095E+01	5.E-01	1.04E+01	8.E+00
B	<6.92E-03	NA	<3.50E-02	NA	NA	NA
Ca	5.27E-01	9.E-01	5.8E-01	2.E+00	5.1E-01	2.E+00
Cr	4.39E-02	7.E-01	4.6E-02	3.E+00	4.4E-02	3.E+00
Cu	6.97E-02	1.E+00	7.24E-02	9.E-01	5.1E-02	4.E+00
Fe	1.18E+01	2.E+00	1.18E+01	1.E+00	1.0E+01	2.E+00
Li	1.72E-02	2.E+00	1.9E-02	1.E+01	1.7E-02	8.E+00
K	6.0E-02	5.E+00	3.6E-01	1.E+01	<1.32E-01	NA
Mg	2.16E-01	2.E+00	2.13E-01	9.E-01	2.08E-01	2.E+00
Mn	4.14E+00	1.E+00	4.17E+00	7.E-01	3.9E+00	2.E+00
Na	1.54E+01	9.E-01	NA	NA	1.47E+01	2.E+00
Ni	1.69E+00	1.E+00	1.70E+00	1.E+00	1.50E+00	3.E+00
Si	5.2E-01	1.E+01	7.1E-01	3.E+00	NA	NA
Th (axial mode)	3.07E+00	1.E+00	2.79E+00	2.E+00	2.6E+00	1.E+01
Th (radial mode)	3.06E+00	2.E+00	2.85E+00	2.E+00	NA	NA
Ti	1.58E-02	4.E+00	1.69E-02	2.E+00	1.52E-02	3.E+00
U (axial mode)	2.48E+00	1.E+00	2.18E+00	1.E+00	2.29E+00	2.E+00
U (radial mode)	2.41E+00	2.E+00	2.31E+00	2.E+00	2.24E+00	3.E+00
Zr	1.6E-01	7.E+00	NA	NA	2.11E-01	2.E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations except for Al from the AR digestions which is based upon three replicates. Values are reported to the first digit of the calculated standard deviation. NA = Not Applicable. [#]%RSD is the percent relative standard deviation for the measurements.

Table 3-3 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB6 SRAT Receipt sludge. Digestions not having the same letter are statistically different at the 5% significance level.

Element	Aqua Regia Digestion*	Na ₂ O ₂ /NaOH Fusion Digestion*	DWPF Cold Chem Method Digestion*
Al	A	A	A
B	<MDL	<MDL	-
Ca	B	-	B
Cr	A	A	A
Cu	A	A	B
Fe	A	A	B
K	C	A	<MDL
Li	A	A	A
Mg	A	AB	B
Mn	A	A	B
Na	A	-	B
Ni	A	A	B
Si	B	B	-
Th	A (axial radial) A (radial mode)	AB (axial mode) AB (radial mode)	B (axial mode – 1.3 kW)
Ti	B	A	B
U	A (axial mode) AB (radial mode)	D (axial mode) BC (radial mode)	CD (axial mode) CD (radial mode)
Zr	B	-	A

*Analysis is based on averages from four replicate dissolutions and ICP-AES determinations except for Al from the AR digestions, which is based on three measurements. - = Not Applicable. <MDL = Less than minimum detection limit.

For the SRAT Receipt sample:

- The SRAT Receipt AR and CC digestion solutions contained white visible solids. The PF digestions solutions did not contain visible solids. The undissolved solids from the AR digestions were identified as boehmite from C-XRD analysis. The undissolved solids from the CC digestions were identified as calcium thorium fluoride (Ca_{0.5}Th_{0.5}F₃).
- No statistical difference of the means is observed in the Al concentration between the three digestions, indicating the undissolved amount of boehmite in the AR digestions is small or of small enough particle size to be still be analyzed by the ICP-ES.
- A statistical difference of means at the 5% significance level is noted for Fe, Mn, Na, Ni, Th and U (for the elements greater than 1.0 Wt% of total solids). Fe, Mn, Na, Ni and Th mean concentrations are lower in the CC digestions compared to the AR and PF digestions.
- The average Fe concentration from the CC digestions is ~16.5% lower than the average Fe concentration in the AR or PF digestions.
- The average Mn concentration from the CC digestions is ~6.4% lower than the average Mn concentration from the AR digestions and ~7.1% lower than the average Mn concentration from the PF digestions. This could have a potential impact on the calculated acid addition amount.
- The average Ni concentration from the CC digestions is ~11.5% lower than the average Ni concentration from the AR digestions and ~12.0% lower than the average Ni concentration from the PF digestions.
- Na was not reported for the PF digestions but the average Na value from the CC digestion is ~4.7% lower than the average Na value from the AR digestions.

Thorium and Uranium Analysis of the SRAT Receipt

An ICP-AES method was developed at SRNL in response to Th being present in SB6 which also resulted in the awareness that Th interferes with some U emission lines and an IEC had to be applied to U data. To verify the ICP-AES measurements, samples were analyzed by ICP-MS for both U and Th. The mean Th concentration in the CC digestions is lower (~7.5% - 17%) than the means of both the PF and AR digestions, respectively, as measured by ICP-AES which may be due to the small amount of Th that has precipitated out of solution from the CC digestions which is also indicated by C-XRD analysis. ICP-MS measurements trend in the same direction for Th for each type of digestion. A statistical difference of the means is also observed for the U results (after an IEC has been applied) but the difference between the AR and PF digestions relative to the CC digestions is less than 10%. There is good agreement between the ICP-MS measured U values and the ICP-AES U values once an IEC is applied (see Table 3-1). There is also good agreement between the ICP-AES and ICP-MS measured Th results. The DWPF lab should determine which Th and U lines to use based upon the results presented here, specific instrument resolution, and the plasma power setting (the CC digestions had to be analyzed at 1.3 kW versus 1.1kW for the PF digestions), and determine their own IEC factor/s.

The means of Mn and Ni from digestion of ARG glass standards using all three digestions are not statistically different. The means of Fe from the CC digestions and PF digestions are not statistically different, though the AR Fe result is lower but not statistically different from the mean of the PF digestions, see Table 3-6. The results from analysis of the multi-element standards (MES) indicate the ICP-AES instrument is operating as expected. Two MES samples were submitted with each digestion set, and in each case the Fe concentration is ~4% higher than the known Fe concentration for both MES samples with each set (i.e, a total of six MES samples analyzed and the Fe concentration is ~4% higher than the standard value).

Table 3-4 contains the elemental concentrations of the SB6 SRAT Product sample.

Table 3-4 Elemental concentrations of SB6 SRAT Product radioactive sludge slurry obtained from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions. Values are presented on a weight percent (Wt%) total dried solids basis.

Digestion Method →	Aqua Regia		Na ₂ O ₂ /NaOH Fusion		DWPF Cold Chem	
Element	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]	Avg Wt%*	%RSD [#]
Al	8.4E+00	5.E+00	9.13E+00	8.E-01	8.5E+00	1.E+00
B	9.E-03	1.E+01	<3.17E-02	NA	NA	NA
Ca	4.3E-01	2.E+00	5.2E-01	6.E+00	3.99E-01	9.E-01
Cr	3.88E-02	1.E+00	3.8E-02	5.E+00	3.84E-02	5.E-01
Cu	5.18E-02	2.E+00	5.67E-02	6.E+00	4.76E-02	1.E+00
Fe	9.5E+00	2.E+00	9.65E+00	9.E-01	8.5E+00	1.E+00
Li	1.55E-02	2.E+00	<6.4E-02	NA	<3.0E-02	NA
K	4.9E-02	4.E+00	5.2E-01	9.E+00	<8.0E-02	NA
Mg	1.71E-01	2.E+00	1.60E-01	3.E+00	1.68E-01	8.E-01
Mn	3.40E+00	2.E+00	3.38E+00	7.E-01	3.22E+00	8.E-01
Na	1.57E+01	2.E+00	NA	NA	1.508E+01	6.E-01
Ni	1.38E+00	3.E+00	1.38E+00	9.E-01	1.248E+00	8.E-01
Si	2.8E-01	2.E+01	6.7E-01	4.E+00	NA	NA
Th (axial mode)	2.86E+00	2.E+00	2.3E+00	5.E+00	2.2E+00	9.E+00
Th (radial mode)	2.69E+00	2.E+00	2.4E+00	5.E+00	NA	NA
Ti	1.44E-02	2.E+00	1.47E-02	2.E+00	1.8E-02	2.5E+01
U (axial mode)	1.99E+00	3.E+00	1.77E+00	4.E+00	2.02E+00	7.E-01
U (radial mode)	1.95E+00	4.E+00	1.9E+00	6.E+00	1.99E+00	1.E+00
Zr	1.7E-01	9.E+00	NA	NA	1.82E-01	1.5E+00

*All averages are based upon four replicate dissolutions and ICP-AES determinations. Values are reported to the first digit of the calculated standard deviation. NA = Not Applicable. [#]%RSD is the percent relative standard deviation for the measurements.

Table 3-5 Statistical comparison of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions of SB6 SRAT Product sludge. Digestions not having the same letter are statistically different at the 5% significance level.

Element	Aqua Regia Digestion*	Na ₂ O ₂ /NaOH Fusion Digestion*	DWPF Cold Chem Method Digestion*
Al	B	A	B
B	B	B	-
Ca	B	A	B
Cr	A	A	A
Cu	B	A	C
Fe	A	A	B
K	B	A	B
Li	C	A	B
Mg	A	B	A
Mn	A	A	B
Na	A	-	B
Ni	A	A	B
Si	B	B	-
Th	A (axial mode) A (radial mode)	B (axial mode) B (radial mode)	B (axial mode)
Ti	A	A	A
U	A (axial mode) A (radial mode)	B (axial mode) AB (radial mode)	A (axial mode) AB (radial mode)
Zr	A	-	A

*All averages are based upon four replicate dissolutions and ICP-AES determinations. NA = Not Applicable. <MDL = Less than minimum detection limit. - = Not Applicable.

For the SRAT Product sample:

- The SRAT Product AR and CC digestion solutions contained visible white solids. The PF digestions solutions did not contain visible solids.
- A statistical difference in the means is observed for the Al concentration in the PF digestions compared to both the AR and CC digestions. The average Al concentration in the CC digestions is ~6.6% lower than the PF digestions. The average Al concentration from the AR digestions is ~7.7% lower than the PF digestions.
- A statistical difference of means is also noted for Fe, Mn, Na, Ni and Th whose concentrations are lower in the CC digestions compared to the AR and PF digestions.
- The average Fe concentration from the CC digestions is ~11.5% lower than the average Fe concentration from the AR digestions and ~12.5% lower than the average Fe concentration from the PF digestions.
- The average Mn concentration from the CC digestions is ~5.6% lower than the average Mn concentration from the AR digestions and ~4.8% lower than the average Mn concentration from the PF digestions.
- The average Ni concentration from the CC digestions is ~10.3% lower than the average Ni concentration from the AR and ~9.7% lower than the average from the PF digestions.
- Na is not reported for the PF digestions but the average Na value from the CC digestion is ~4.0% lower than the average Na value from the AR digestions.

Thorium and Uranium Analysis of the SRAT Product

The mean Th concentration in the CC digestions is lower than the means of both the AR and PF digestions as measured by ICP-AES and ICP-MS which may be due to the small amount of Th that has precipitated out of solution from the CC digestions. No statistical difference of the means is observed for the U results (after and IEC has been applied) except the mean measurements made in axial mode of the PF digestions is different than the mean axial mode measurements from the CC and AR digestions. The ICP-AES U results are in good agreement with the ICP-MS results once an IEC factor is applied (see Table 3-1), and the Th results are also in good agreement.

The means of Fe, Mn, and Ni from digestion of ARG glass standards using all three digestions are not statistically different, see Table 3-6. The results from the analysis of the MES indicate the ICP-AES instrument is operating as expected. Two MES samples were submitted with each digestion set, and in each case the Fe concentration is ~1 - 6% higher than the known concentration for both MES samples with each set (i.e, a total of six MES samples analyzed and the Fe concentration is ~1 - 6% higher than the known value).

Table 3-6 through Table 3-9 contain the ICP-AES measured weight percent elemental results from triplicate digestions of the ARG standard performed concurrently with the SB6 SRAT samples to determine if the dissolutions were complete and the resulting analyses accurate. Comparison to the known elemental weight percent in the ARG standard is also given in Tables 3-6 - 3-9. The statistical comparison is presented for all six ARG digestions performed along with the SRAT Receipt and SRAT Product sludge samples.

Table 3-6. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis. Digestions not having the same letter are statistically different at the 5% significance level.

Aqua Regia*					
Element	Average Wt%	%RSD	Standard Value	%Difference (Measured vs Standard Value)	Statistical Comparison AR (PF, CC)
Al	2.27E+00	2.3E+00	2.50E+00	-9.3	B (A, AB)
B	2.45E+00	2.7E+00	2.69E+00	-8.9	C (BC, -)
Ca	9.99E-01	3.0E+00	1.02E+00	-2.0	A (- AB)
Cr	6.16E-02	2.7E+00	6.40E-02	-3.8	B (AB, A)
Cu	3.00E-03	4.3E+00	3.00E-03	0.0	E (DE, <MDL)
Fe	9.26E+00	2.6E+00	9.79E+00	-5.4	B (AB, A)
K	2.10E+00	2.5E+00	2.26E+00	-7.1	C (B, BC)
Li	1.41E+00	2.6E+00	1.49E+00	-5.4	A (A, A)
Mg	4.86E-01	2.7E+00	5.20E-01	-6.5	AB (AB, A)
Mn	1.36E+00	2.6E+00	1.46E+00	-7.1	A (A, A)
Na	8.03E+00	2.7E+00	8.52E+00	-5.8	A (-, A)
Ni	7.85E-01	2.7E+00	8.27E-01	-5.0	A (A, A)
Si	8.16E-01	3.2E+01	2.24E+01	-96.4	NA
Ti	5.39E-01	2.6E+00	6.90E-01	-21.9	C (A, A)
U	NA	NA	NA	NA	-
Zr	5.92E-02	1.4E+00	9.60E-02	-38.4	A (-, B)
Sodium Peroxide/Hydroxide Fusion*					
Element	Average Wt%	%RSD	Standard Value	%Difference (Measured vs Standard Value)	
Al	2.53E+00	8.2E-01	2.50E+00	1.1	
B	2.60E+00	1.8E+00	2.69E+00	-3.5	
Ca	1.14E+00	3.5E+00	1.02E+00	12.1	
Cr	6.58E-02	2.7E+00	6.40E-02	2.8	
Cu	4.31E-03	1.3E+01	3.00E-03	43.7	
Fe	9.80E+00	2.7E+00	9.79E+00	0.1	
K	2.37E+00	5.7E+00	2.26E+00	5.0	
Li	1.45E+00	4.0E-01	1.49E+00	-2.9	
Mg	5.25E-01	2.4E+00	5.20E-01	1.0	
Mn	1.44E+00	1.8E+00	1.46E+00	-1.4	
Na	NA	NA	8.52E+00	NA	
Ni	8.29E-01	2.6E+00	8.27E-01	0.2	
Si	2.07E+01	1.3E+00	2.24E+01	-7.6	
Ti	6.92E-01	1.1E+00	6.90E-01	0.2	
U	NA	NA	NA	NA	
Zr	NA	NA	9.60E-02	NA	

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

Table 3-7. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Receipt Sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	Average	%RSD	Standard Value	%Difference (Measured vs Standard Value)
Al	2.46E+00	6.1E+00	2.50E+00	-1.7
B	2.81E+00	1.1E+00	2.69E+00	4.5
Ca	1.06E+00	8.3E+00	1.02E+00	4.3
Cr	6.96E-02	6.7E+00	6.40E-02	8.7
Cu	<6.14E-03	NA	3.00E-03	NA
Fe	1.03E+01	5.0E+00	9.79E+00	5.4
K	2.24E+00	5.4E+00	2.26E+00	-1.0
Li	1.51E+00	6.0E+00	1.49E+00	1.1
Mg	5.38E-01	7.0E+00	5.20E-01	3.5
Mn	1.49E+00	5.7E+00	1.46E+00	2.1
Na	8.87E+00	6.0E+00	8.52E+00	4.1
Ni	8.21E-01	5.1E+00	8.27E-01	-0.7
Si	3.36E+01	2.3E+00	2.24E+01	50.1
Ti	6.96E-01	5.1E+00	6.90E-01	0.9
U	NA	NA	NA	NA
Zr	9.71E-02	5.4E+00	9.60E-02	1.1

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

Table 3-8. Elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

Aqua Regia*					
Element	Average	%RSD	Standard Value	%Difference (Measured vs Standard Value)	Statistical Comparison AR (PF, CC)
Al	2.46E+00	2.7E+00	2.50E+00	-1.7	AB (AB, AB)
B	2.66E+00	2.3E+00	2.69E+00	-1.1	AB (BC, -)
Ca	1.01E+00	1.3E+00	1.02E+00	-1.4	B (-, B)
Cr	6.64E-02	1.7E+00	6.40E-02	3.7	AB (AB, AB)
Cu	<1.11E-02	NA	3.00E-03	NA	- all <MDL
Fe	9.88E+00	2.1E+00	9.79E+00	0.9	AB (AB, AB)
K	2.28E+00	1.5E+00	2.26E+00	0.9	BC (A, BC)
Li	1.51E+00	1.0E+00	1.49E+00	1.6	A (A, A)
Mg	5.20E-01	1.8E+00	5.20E-01	0.1	AB (AB, B)
Mn	1.46E+00	2.4E+00	1.46E+00	0.2	A (A, A)
Na	8.68E+00	2.3E+00	8.52E+00	1.9	A (-, A)
Ni	8.25E-01	2.1E+00	8.27E-01	-0.2	A (A, A)
Si	6.72E-01	6.8E+01	2.24E+01	-97.0	-
Ti	6.07E-01	2.5E+00	6.90E-01	-12.0	B (A, AB)
U	NA	NA	NA	NA	-
Zr	5.81E-02	2.6E+00	9.60E-02	-39.5	A (-, B)
Sodium Peroxide/Hydroxide Fusion*					
Element	Average	%RSD	Standard Value	%Difference (Measured vs Standard Value)	
Al	2.48E+00	2.7E+00	2.50E+00	-0.9	
B	2.51E+00	2.8E+00	2.69E+00	-6.7	
Ca	1.15E+00	5.01E-01	1.02E+00	13.1	
Cr	6.49E-02	3.0E+00	6.40E-02	1.4	
Cu	<2.04E-02	NA	3.00E-03	NA	
Fe	9.71E+00	2.7E+00	9.79E+00	-0.8	
K	2.64E+00	3.6E+00	2.26E+00	16.8	
Li	1.48E+00	2.8E+00	1.49E+00	-0.9	
Mg	5.14E-01	1.9E+00	5.20E-01	-1.1	
Mn	1.42E+00	2.7E+00	1.46E+00	-2.5	
Ni	8.19E-01	2.7E+00	8.27E-01	-0.9	
Si	2.14E+01	7.3E+00	2.24E+01	-4.5	
Ti	6.77E-01	3.1E+00	6.90E-01	-2.9	
U	NA	NA	NA	NA	
Zr	NA	NA	9.60E-02	NA	

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

Table 3-9. Continuation of elemental concentrations of ARG standard from ICP-AES analysis of Aqua Regia, DWPF Cold Chem method and Sodium Peroxide/Hydroxide Fusion digestions performed concurrently with SB6 SRAT Product sample. Values are presented on a weight percent (Wt%) total solids basis.

DWPF Cold Chem Method*				
Element	Average	%RSD	Standard Value	%Difference (Measured vs Standard Value)
Al	2.32E+00	3.4E+00	2.50E+00	-7.2
B	2.62E+00	4.4E+00	2.69E+00	-2.5
Ca	9.51E-01	4.4E+00	1.02E+00	-6.7
Cr	6.48E-02	3.8E+00	6.40E-02	1.3
Cu	<5.80E-03	NA	3.00E-03	NA
Fe	9.50E+00	4.0E+00	9.79E+00	-3.0
K	2.12E+00	4.4E+00	2.26E+00	-6.3
Li	1.41E+00	3.5E+00	1.49E+00	-5.4
Mg	4.81E-01	3.9E+00	5.20E-01	-7.4
Mn	1.39E+00	3.7E+00	1.46E+00	-4.8
Na	8.34E+00	3.6E+00	8.52E+00	-2.2
Ni	7.57E-01	4.1E+00	8.27E-01	-8.5
Si	3.29E+01	6.0E+00	2.24E+01	47.0
Ti	6.62E-01	3.7E+00	6.90E-01	-4.0
U	NA	NA	NA	NA
Zr	9.35E-02	3.5E+00	9.60E-02	-2.6

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

Very good recoveries are observed for nearly all elements of significant weight percent in the ARG standards where appropriate. The low results observed for Fe, Mn and Ni in the CC digestions of the SB6 SRAT Receipt and SRAT Product are not mirrored in the ARG results potentially indicating problems with the digestion of the sludge matrix.

Hg Analysis

Mercury (Hg) was analyzed according to the outline in the experimental section and in a similar manner to that of the DWPF lab. Table 3-10 summarizes the results from analysis of the SB6 SRAT Receipt.

Table 3-10. CV Hg AA results of digested SB6 SRAT Receipt using the DWPF method and an Aqua Regia digestion for comparison. Values are presented on a weight percent (Wt%) total dried solids basis and %RSD is given in parentheses.

Digestion Method	Measured Hg Concentration (Wt%)	% Difference (DWPF Method vs Aqua Regia)
DWPF Method	3.851 (0.2)	~21%
Aqua Regia	3.21 (6.7)	

The mean DWPF Hg digestion method Hg value is ~21% higher than the mean value obtained using the AR digestion method. EPA method 7471B notes that either an aqua regia digestion or the mixture of oxidizing acids used in the DWPF method suffices for Hg analysis. The reason for the discrepancy between the methods is unknown, but it appears that the DWPF method is adequately digesting the Hg in SB6 sludge slurry.

4.0 CONCLUSIONS

The results presented in this memo document potential issues with the DWPF CC method and the accuracy of this digestion for certain elements contained in SB6. The relatively large difference observed between the CC digestions versus the AR and PF digestions for Fe, Mn and Ni, indicate the DWPF CC digestion may not be solubilizing these elements completely or perhaps they are precipitating out of solution as part of a fluoride salt. No statistical difference of the means for Mn or Ni was observed in the ARG glass digestions. The mean Fe concentration from AR digestion of the ARG standards digested with the SRAT Receipt was slightly low whereas the mean Fe concentration from digestion of the ARG standard with the CC method was slightly high leading to a statistical difference. The reason for a statistical difference in the means of the Al concentration in the SRAT Product and not in the SRAT Receipt is unclear. Visible solids were seen in the AR and CC digestions of both the SRAT Receipt sample and SRAT Product samples. For the SRAT receipt samples, the visible solids in the digestion solutions were identified as calcium thorium fluoride ($\text{Ca}_{0.5}\text{Th}_{0.5}\text{F}_3$). A Th method was developed for the Leeman Prodigy ICP and it was found that Th interferes with U leading to re-analysis and an IEC being applied to U data.

The peroxide fusion digestion method is the best method for digesting aluminum species that are sparingly soluble in acid. Furthermore, the PF could also be used for the quantification of Fe, Mn, Ni and Th with nitric acid uptake and the addition of hydrogen peroxide.

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5.0 RECOMMENDATIONS

The following short and long-term recommendations are based upon results from three digestion methods tested at SRNL for SB6 SRAT Receipt and SRAT Product material:

- A dissolution study should be performed on the SB6 WAPS sample by SRNL, which consists of the final composition of the sludge (the SB6 Blend), to determine if the Fe, Mn, Ni and Th concentrations are consistently lower in the CC digestions versus the AR and PF methods for SB6.
- Given the problems seen with measuring Al by the CC method for SB5 and that a SB5 heel remains in Tank 40, the DWPF lab should monitor the Al concentration in the first 10 SRAT Receipt batches of SB6 using both CC and PF methods to evaluate the adequacy of Al recovery by the CC method for SB6.
- Given the statistical difference and high relative difference in the means for Fe, Mn, Ni, and Th, the DWPF lab should also monitor these elements in the first 10 SRAT Receipt batches of SB6 using both the CC and PF methods to evaluate the adequacy of recovery by the CC method for SB6.
- The DWPF lab should establish an ICP-AES method to measure Th, determine which U emission lines are appropriate and determine if an IEC needs to be applied to U data due to the presence of Th, using this report only as a guide.
- The DWPF CC method was originally developed to be used for SME analyses. Given continuous visual observations of solids in the CC digestions both at SRNL and DWPF, potential issues with accurate Al measurements when processing HM waste, and the results of this report, the DWPF lab should consider a different digestion scheme that relieves some of these issues. Other digestion methods have been developed at SRNL targeting the DWPF lab's process sample analysis.(Need Chucks references)
- The impact of the results of this study need to be assessed against the blending spreadsheet used in DWPF for predicting the glass processing properties to determine the potential impact on SME acceptability. Specifically, the DWPF should compare SRAT blending projections to the SME product results. If the difference in elemental concentrations is significant, another type of digestion (i.e. sodium peroxide/hydroxide fusion) should be used to determine the concentration of the element in question. Additional emphasis should be placed on monitoring Al, Fe, Ni and Th concentrations in SB6 and in particular the Mn concentration which could have a potential impact on the calculated acid addition amount.

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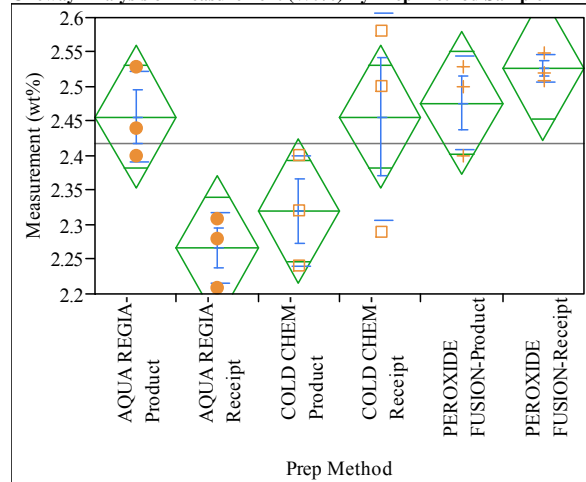
7.0 ACKNOWLEDGEMENTS

The authors would like to acknowledge Ramona Galloway, Monica Jenkins, Rita Sullivan, Loretta Farrow, and Adrienne Williams for help in making this work possible.

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8.0 APPENDIX A. SUPPORTING INFORMATION

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Al



Oneway Anova Summary of Fit

Rsquare 0.650098
Adj Rsquare 0.504306
Root Mean Square Error 0.08263
Mean of Response 2.417222
Observations (or Sum Wgts) 18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.15222778	0.030446	4.4591	0.0158
Error	12	0.08193333	0.006828		
C. Total	17	0.23416111			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.45667	0.04771	2.3527	2.5606
AQUA REGIA-Receipt	3	2.26667	0.04771	2.1627	2.3706
COLD CHEM-Product	3	2.32000	0.04771	2.2161	2.4239
COLD CHEM-Receipt	3	2.45667	0.04771	2.3527	2.5606
PEROXIDE FUSION-Product	3	2.47667	0.04771	2.3727	2.5806
PEROXIDE FUSION-Receipt	3	2.52667	0.04771	2.4227	2.6306

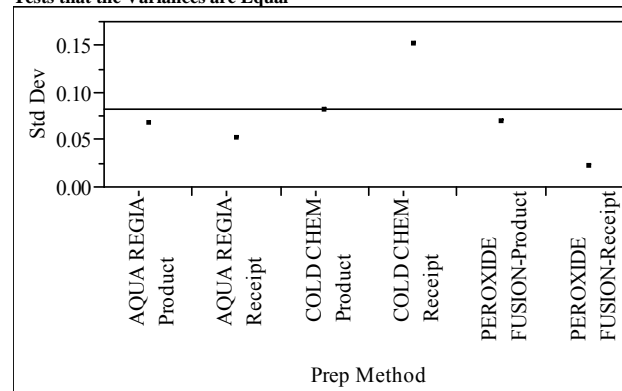
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.45667	0.066583	0.03844	2.2913	2.6221
AQUA REGIA-Receipt	3	2.26667	0.051316	0.02963	2.1392	2.3941
COLD CHEM-Product	3	2.32000	0.080000	0.04619	2.1213	2.5187

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Receipt	3	2.45667	0.149778	0.08647	2.0846	2.8287
PEROXIDE FUSION-Product	3	2.47667	0.068069	0.03930	2.3076	2.6458
PEROXIDE FUSION-Receipt	3	2.52667	0.020817	0.01202	2.4750	2.5784

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0665833	0.0488889	0.0566667
AQUA REGIA-Receipt	3	0.0513160	0.0377778	0.0433333
COLD CHEM-Product	3	0.0800000	0.0533333	0.0800000
COLD CHEM-Receipt	3	0.1497776	0.1111111	0.1233333
PEROXIDE FUSION-Product	3	0.0680686	0.0511111	0.0533333
PEROXIDE FUSION-Receipt	3	0.0208167	0.0155556	0.0166667

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1261	5	12	0.3978
Brown-Forsythe	2.7072	5	12	0.0731
Levene	2.2159	5	12	0.1202
Bartlett	1.1402	5	.	0.3364

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
10.4763	5	5.18	0.0100

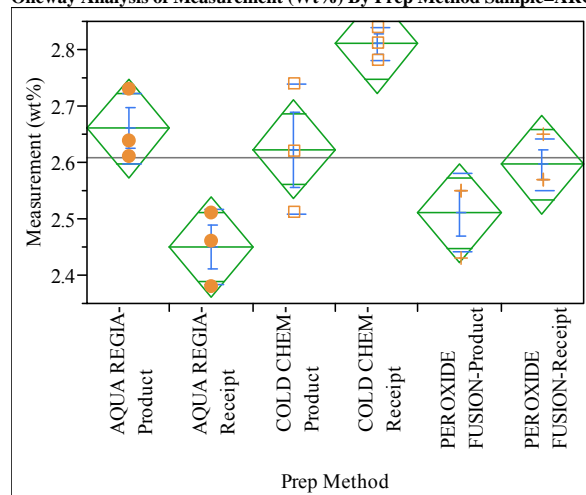
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION-Receipt A	2.5266667
PEROXIDE FUSION-Product A B	2.4766667
AQUA REGIA-Product A B	2.4566667
COLD CHEM-Receipt A B	2.4566667
COLD CHEM-Product A B	2.3200000
AQUA REGIA-Receipt B	2.2666667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=B



Oneway Anova Summary of Fit

Rsquare	0.800805
Adj Rsquare	0.717808
Root Mean Square Error	0.069841
Mean of Response	2.608333
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.23531667	0.047063	9.6485	0.0007
Error	12	0.05853333	0.004878		
C. Total	17	0.29385000			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.66000	0.04032	2.5721	2.7479
AQUA REGIA-Receipt	3	2.45000	0.04032	2.3621	2.5379
COLD CHEM-Product	3	2.62333	0.04032	2.5355	2.7112
COLD CHEM-Receipt	3	2.81000	0.04032	2.7221	2.8979
PEROXIDE FUSION-Product	3	2.51000	0.04032	2.4221	2.5979
PEROXIDE FUSION-Receipt	3	2.59667	0.04032	2.5088	2.6845

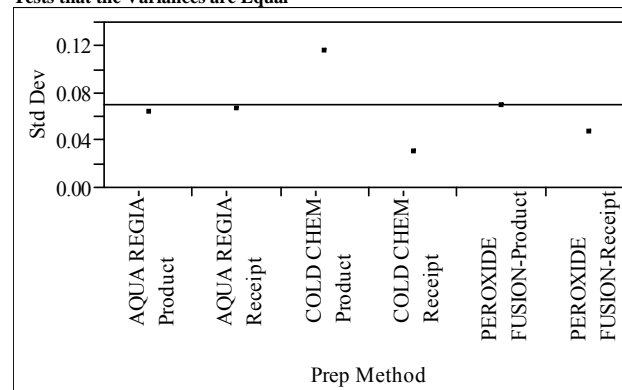
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.66000	0.062450	0.03606	2.5049	2.8151
AQUA REGIA-Receipt	3	2.45000	0.065574	0.03786	2.2871	2.6129

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Product	3	2.62333	0.115036	0.06642	2.3376	2.9091
COLD CHEM-Receipt	3	2.81000	0.030000	0.01732	2.7355	2.8845
PEROXIDE FUSION-Product	3	2.51000	0.069282	0.04000	2.3379	2.6821
PEROXIDE FUSION-Receipt	3	2.59667	0.046188	0.02667	2.4819	2.7114

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0624500	0.0466667	0.0500000
AQUA REGIA-Receipt	3	0.0655744	0.0466667	0.0600000
COLD CHEM-Product	3	0.1150362	0.0777778	0.1133333
COLD CHEM-Receipt	3	0.0300000	0.0200000	0.0300000
PEROXIDE FUSION-Product	3	0.0692820	0.0533333	0.0400000
PEROXIDE FUSION-Receipt	3	0.0461880	0.0355556	0.0266667

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8495	5	12	0.5408
Brown-Forsythe	2.1638	5	12	0.1269
Levene	0.9641	5	12	0.4768
Bartlett	0.6312	5	.	0.6759

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

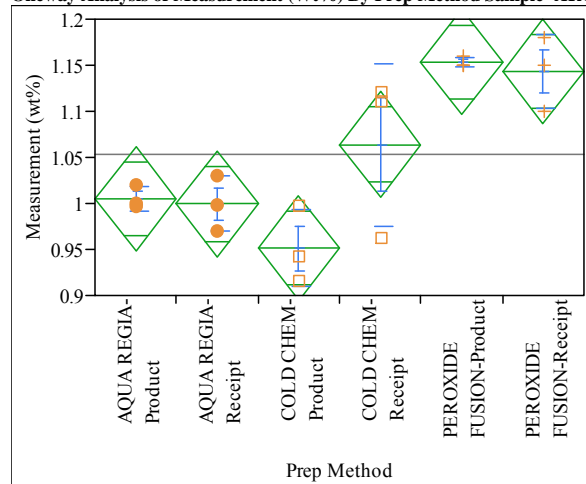
F Ratio	DFNum	DFDen	Prob > F
16.3740	5	5.4349	0.0029

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 2.8100000
AQUA REGIA-Product	A B 2.6600000
COLD CHEM-Product	A B C 2.6233333
PEROXIDE FUSION-Receipt	B C 2.5966667
PEROXIDE FUSION-Product	B C 2.5100000
AQUA REGIA-Receipt	C 2.4500000

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Ca



Oneway Anova Summary of Fit

Rsquare	0.804831
Adj Rsquare	0.72351
Root Mean Square Error	0.045291
Mean of Response	1.052778
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.10150778	0.020302	9.8970	0.0006
Error	12	0.02461533	0.002051		
C. Total	17	0.12612311			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.00533	0.02615	0.9484	1.0623
AQUA REGIA-Receipt	3	0.99933	0.02615	0.9424	1.0563
COLD CHEM-Product	3	0.95133	0.02615	0.8944	1.0083
COLD CHEM-Receipt	3	1.06400	0.02615	1.0070	1.1210
PEROXIDE FUSION-Product	3	1.15333	0.02615	1.0964	1.2103
PEROXIDE FUSION-Receipt	3	1.14333	0.02615	1.0864	1.2003

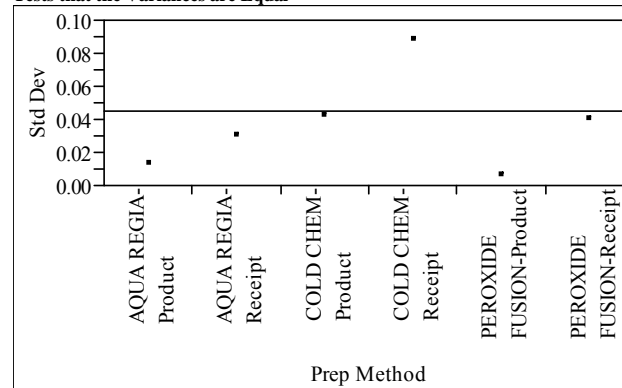
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.00533	0.012858	0.00742	0.9734	1.0373
AQUA REGIA-Receipt	3	0.99933	0.030022	0.01733	0.9248	1.0739
COLD CHEM-Product	3	0.95133	0.041789	0.02413	0.8475	1.0551
COLD CHEM-Receipt	3	1.06400	0.088476	0.05108	0.8442	1.2838

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	1.15333	0.005774	0.00333	1.1390	1.1677
PEROXIDE FUSION-Receipt	3	1.14333	0.040415	0.02333	1.0429	1.2437

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0128582	0.0097778	0.0093333
AQUA REGIA-Receipt	3	0.0300222	0.0204444	0.0293333
COLD CHEM-Product	3	0.0417892	0.0304444	0.0363333
COLD CHEM-Receipt	3	0.0884760	0.0680000	0.0560000
PEROXIDE FUSION-Product	3	0.0057735	0.0044444	0.0033333
PEROXIDE FUSION-Receipt	3	0.0404145	0.0288889	0.0366667

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3394	5	12	0.3128
Brown-Forsythe	0.9886	5	12	0.4640
Levene	4.7479	5	12	0.0126
Bartlett	2.1800	5	.	0.0534

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
57.2140	5	5.0351	0.0002

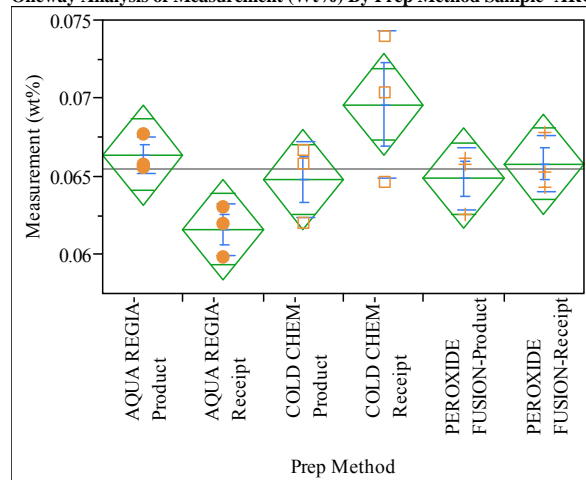
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION-Product A	1.1533333
PEROXIDE FUSION-Receipt A	1.1433333
COLD CHEM-Receipt A B	1.0640000
AQUA REGIA-Product B	1.0053333
AQUA REGIA-Receipt B	0.9993333
COLD CHEM-Product B	0.9513333

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Cr



Oneway Anova Summary of Fit

Rsquare 0.563632
Adj Rsquare 0.381811
Root Mean Square Error 0.002556
Mean of Response 0.065506
Observations (or Sum Wgts) 18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.00010126	0.000020	3.0999	0.0503
Error	12	0.00007839	6.533e-6		
C. Total	17	0.00017965			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.066367	0.00148	0.06315	0.06958
AQUA REGIA-Receipt	3	0.061600	0.00148	0.05838	0.06482
COLD CHEM-Product	3	0.064800	0.00148	0.06158	0.06802
COLD CHEM-Receipt	3	0.069600	0.00148	0.06638	0.07282
PEROXIDE FUSION-Product	3	0.064867	0.00148	0.06165	0.06808
PEROXIDE FUSION-Receipt	3	0.065800	0.00148	0.06258	0.06902

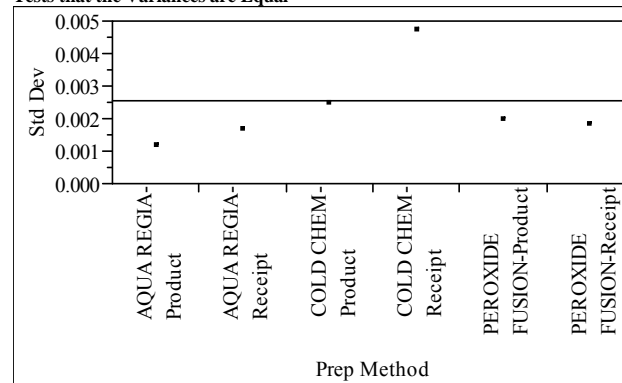
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.066367	0.001159	0.00067	0.06349	0.06925
AQUA REGIA-Receipt	3	0.061600	0.001637	0.00095	0.05753	0.06567
COLD CHEM-Product	3	0.064800	0.002458	0.00142	0.05869	0.07091
COLD CHEM-Receipt	3	0.069600	0.004689	0.00271	0.05795	0.08125

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	0.064867	0.001973	0.00114	0.05997	0.06977
PEROXIDE FUSION-Receipt	3	0.065800	0.001803	0.00104	0.06132	0.07028

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0011590	0.0008889	0.0007667
AQUA REGIA-Receipt	3	0.0016371	0.0012000	0.0014000
COLD CHEM-Product	3	0.0024576	0.0018667	0.0018000
COLD CHEM-Receipt	3	0.0046893	0.0033333	0.0043000
PEROXIDE FUSION-Product	3	0.0019732	0.0015111	0.0013333
PEROXIDE FUSION-Receipt	3	0.0018028	0.0013333	0.0015000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1486	5	12	0.3879
Brown-Forsythe	3.0155	5	12	0.0544
Levene	1.7266	5	12	0.2030
Bartlett	0.8550	5	.	0.5105

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.7729	5	5.4947	0.1328

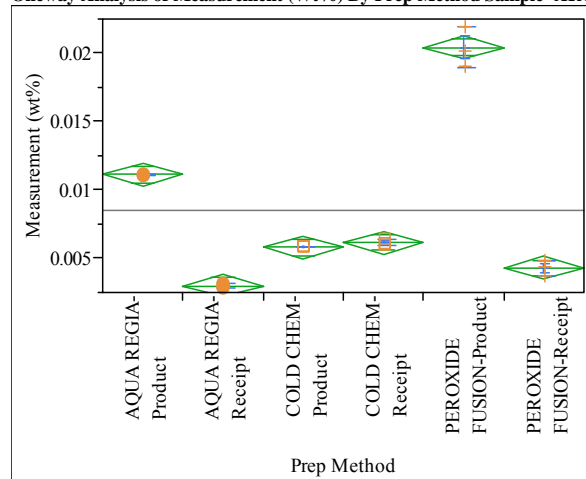
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 0.06960000
AQUA REGIA-Product	A B 0.06636667
PEROXIDE FUSION-Receipt	A B 0.06580000
PEROXIDE FUSION-Product	A B 0.06486667
COLD CHEM-Product	A B 0.06480000
AQUA REGIA-Receipt	B 0.06160000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Cu



Oneway Anova Summary of Fit

Rsquare	0.992021
Adj Rsquare	0.988696
Root Mean Square Error	0.00065
Mean of Response	0.008469
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.00063004	0.000126	298.3867	<.0001
Error	12	0.00000507	4.223e-7		
C. Total	17	0.00063511			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.011133	0.00038	0.01032	0.01195
AQUA REGIA-Receipt	3	0.003000	0.00038	0.00218	0.00382
COLD CHEM-Product	3	0.005800	0.00038	0.00498	0.00662
COLD CHEM-Receipt	3	0.006137	0.00038	0.00532	0.00695
PEROXIDE FUSION-Product	3	0.020433	0.00038	0.01962	0.02125
PEROXIDE FUSION-Receipt	3	0.004310	0.00038	0.00349	0.00513

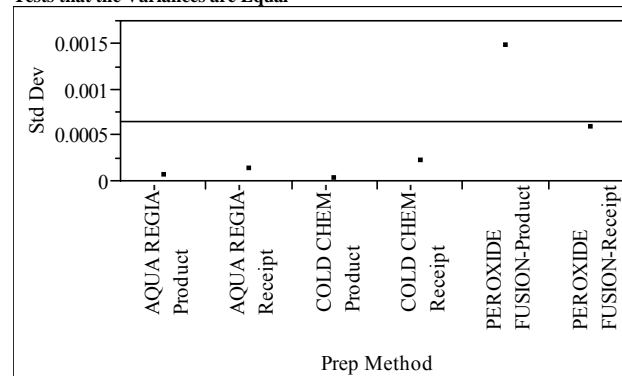
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.011133	0.000058	3.33e-5	0.01099	0.01128
AQUA REGIA-Receipt	3	0.003000	0.000130	7.51e-5	0.00268	0.00332
COLD CHEM-Product	3	0.005800	0.000017	0.00001	0.00576	0.00584
COLD CHEM-Receipt	3	0.006137	0.000204	0.00012	0.00563	0.00664

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	0.020433	0.001464	0.00085	0.01680	0.02407
PEROXIDE FUSION-Receipt	3	0.004310	0.000573	0.00033	0.00289	0.00573

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0000577	0.0000444	0.0000333
AQUA REGIA-Receipt	3	0.0001300	0.0000867	0.0001300
COLD CHEM-Product	3	0.0000173	0.0000133	0.0000100
COLD CHEM-Receipt	3	0.0002040	0.0001489	0.0001767
PEROXIDE FUSION-Product	3	0.0014640	0.0010444	0.0013333
PEROXIDE FUSION-Receipt	3	0.0005730	0.0004133	0.0005100

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.6480	5	12	0.2214
Brown-Forsythe	22.0567	5	12	<.0001
Levene	4.7464	5	12	0.0127
Bartlett	5.4432	5	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3308.6476	5	4.8513	<.0001

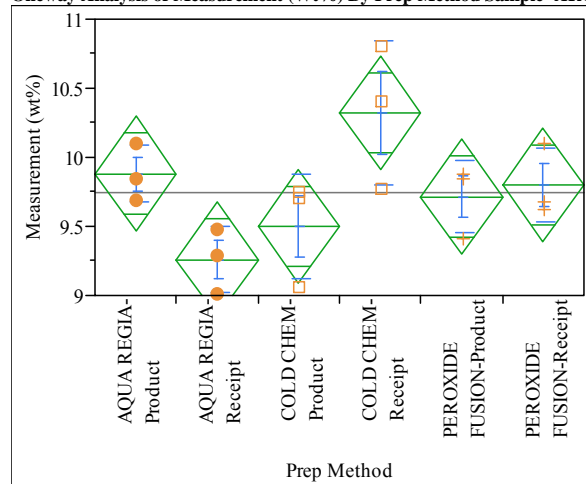
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION-Product A	0.02043333
AQUA REGIA-Product B	0.01113333
COLD CHEM-Receipt C	0.00613667
COLD CHEM-Product C D	0.00580000
PEROXIDE FUSION-Receipt D E	0.00431000
AQUA REGIA-Receipt E	0.00300000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Fe



Oneway Anova Summary of Fit

Rsquare	0.600183
Adj Rsquare	0.433593
Root Mean Square Error	0.329511
Mean of Response	9.746111
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	1.9558944	0.391179	3.6028	0.0320
Error	12	1.3029333	0.108578		
C. Total	17	3.2588278			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	9.8800	0.19024	9.4655	10.295
AQUA REGIA-Receipt	3	9.2600	0.19024	8.8455	9.675
COLD CHEM-Product	3	9.5000	0.19024	9.0855	9.915
COLD CHEM-Receipt	3	10.3233	0.19024	9.9088	10.738
PEROXIDE FUSION-Product	3	9.7133	0.19024	9.2988	10.128
PEROXIDE FUSION-Receipt	3	9.8000	0.19024	9.3855	10.215

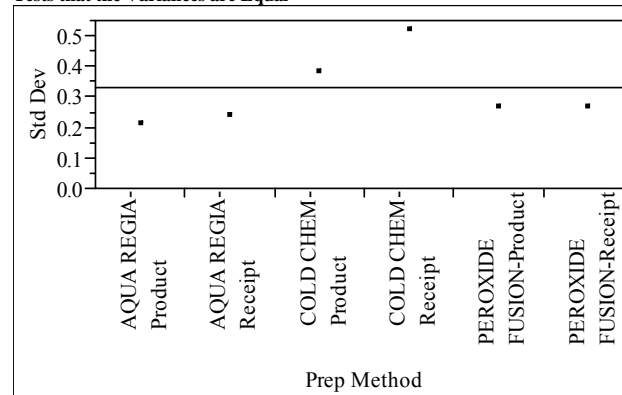
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	9.8800	0.206640	0.11930	9.3667	10.393
AQUA REGIA-Receipt	3	9.2600	0.236432	0.13650	8.6727	9.847
COLD CHEM-Product	3	9.5000	0.381576	0.22030	8.5521	10.448
COLD CHEM-Receipt	3	10.3233	0.519262	0.29980	9.0334	11.613

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	9.7133	0.263122	0.15191	9.0597	10.367
PEROXIDE FUSION-Receipt	3	9.8000	0.261534	0.15100	9.1503	10.450

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.2066398	0.1466667	0.1900000
AQUA REGIA-Receipt	3	0.2364318	0.1666667	0.2200000
COLD CHEM-Product	3	0.3815757	0.2933333	0.2400000
COLD CHEM-Receipt	3	0.5192623	0.3688889	0.4766667
PEROXIDE FUSION-Product	3	0.2631223	0.2022222	0.1666667
PEROXIDE FUSION-Receipt	3	0.2615339	0.2000000	0.1800000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.7402	5	12	0.6079
Brown-Forsythe	1.0061	5	12	0.4551
Levene	1.0515	5	12	0.4326
Bartlett	0.4374	5	.	0.8227

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.4607	5	5.5472	0.1605

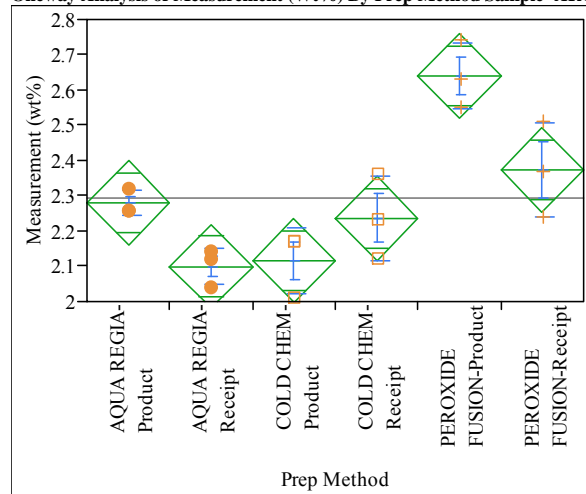
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 10.32333
AQUA REGIA-Product	A B 9.880000
PEROXIDE FUSION-Receipt	A B 9.800000
PEROXIDE FUSION-Product	A B 9.713333
COLD CHEM-Product	A B 9.500000
AQUA REGIA-Receipt	B 9.260000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=K



Oneway Anova Summary of Fit

Rsquare 0.845778
Adj Rsquare 0.781518
Root Mean Square Error 0.095131
Mean of Response 2.291111
Observations (or Sum Wgts) 18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.59557778	0.119116	13.1619	0.0002
Error	12	0.10860000	0.009050		
C. Total	17	0.70417778			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.28000	0.05492	2.1603	2.3997
AQUA REGIA-Receipt	3	2.10000	0.05492	1.9803	2.2197
COLD CHEM-Product	3	2.11667	0.05492	1.9970	2.2363
COLD CHEM-Receipt	3	2.23667	0.05492	2.1170	2.3563
PEROXIDE FUSION-Product	3	2.64000	0.05492	2.5203	2.7597
PEROXIDE FUSION-Receipt	3	2.37333	0.05492	2.2537	2.4930

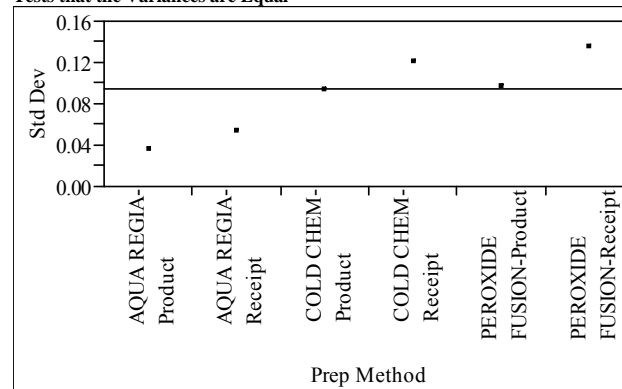
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	2.28000	0.034641	0.02000	2.1939	2.3661
AQUA REGIA-Receipt	3	2.10000	0.052915	0.03055	1.9686	2.2314
COLD CHEM-Product	3	2.11667	0.092376	0.05333	1.8872	2.3461
COLD CHEM-Receipt	3	2.23667	0.120139	0.06936	1.9382	2.5351

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	2.64000	0.095394	0.05508	2.4030	2.8770
PEROXIDE FUSION-Receipt	3	2.37333	0.135031	0.07796	2.0379	2.7088

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0346410	0.0266667	0.0200000
AQUA REGIA-Receipt	3	0.0529150	0.0400000	0.0400000
COLD CHEM-Product	3	0.0923760	0.0711111	0.0533333
COLD CHEM-Receipt	3	0.1201388	0.0822222	0.1166667
PEROXIDE FUSION-Product	3	0.0953939	0.0666667	0.0900000
PEROXIDE FUSION-Receipt	3	0.1350309	0.0911111	0.1333333

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6477	5	12	0.6687
Brown-Forsythe	3.1836	5	12	0.0465
Levene	0.7947	5	12	0.5738
Bartlett	0.6964	5	.	0.6261

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
11.3797	5	5.3517	0.0074

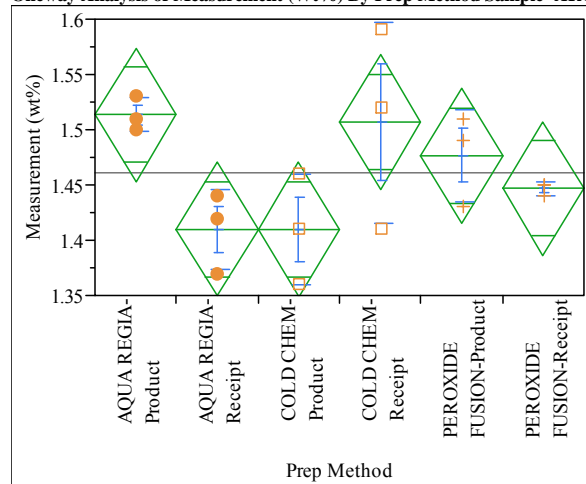
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION-Product A	2.6400000
PEROXIDE FUSION-Receipt B	2.3733333
AQUA REGIA-Product B C	2.2800000
COLD CHEM-Receipt B C	2.2366667
COLD CHEM-Product B C	2.1166667
AQUA REGIA-Receipt C	2.1000000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Li



Oneway Anova Summary of Fit

Rsquare	0.528247
Adj Rsquare	0.331684
Root Mean Square Error	0.048362
Mean of Response	1.460556
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.03142778	0.006286	2.6874	0.0746
Error	12	0.02806667	0.002339		
C. Total	17	0.05949444			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.51333	0.02792	1.4525	1.5742
AQUA REGIA-Receipt	3	1.41000	0.02792	1.3492	1.4708
COLD CHEM-Product	3	1.41000	0.02792	1.3492	1.4708
COLD CHEM-Receipt	3	1.50667	0.02792	1.4458	1.5675
PEROXIDE FUSION-Product	3	1.47667	0.02792	1.4158	1.5375
PEROXIDE FUSION-Receipt	3	1.44667	0.02792	1.3858	1.5075

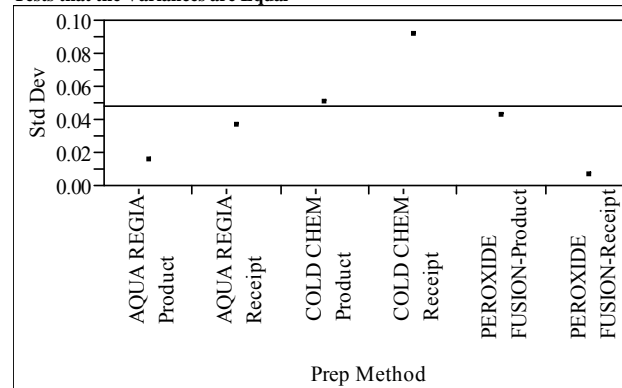
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.51333	0.015275	0.00882	1.4754	1.5513
AQUA REGIA-Receipt	3	1.41000	0.036056	0.02082	1.3204	1.4996
COLD CHEM-Product	3	1.41000	0.050000	0.02887	1.2858	1.5342
COLD CHEM-Receipt	3	1.50667	0.090738	0.05239	1.2813	1.7321

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	1.47667	0.041633	0.02404	1.3732	1.5801
PEROXIDE FUSION-Receipt	3	1.44667	0.005774	0.00333	1.4323	1.4610

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0152753	0.0111111	0.0133333
AQUA REGIA-Receipt	3	0.0360555	0.0266667	0.0300000
COLD CHEM-Product	3	0.0500000	0.0333333	0.0500000
COLD CHEM-Receipt	3	0.0907377	0.0644444	0.0833333
PEROXIDE FUSION-Product	3	0.0416333	0.0311111	0.0333333
PEROXIDE FUSION-Receipt	3	0.0057735	0.0044444	0.0033333

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2446	5	12	0.3481
Brown-Forsythe	10.1953	5	12	0.0005
Levene	2.3338	5	12	0.1064
Bartlett	2.0487	5	.	0.0686

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
7.6477	5	4.9609	0.0221

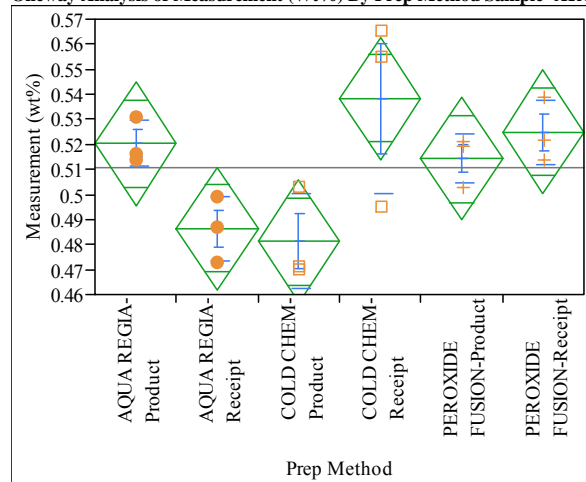
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA-Product	A 1.5133333
COLD CHEM-Receipt	A 1.5066667
PEROXIDE FUSION-Product	A 1.4766667
PEROXIDE FUSION-Receipt	A 1.4466667
AQUA REGIA-Receipt	A 1.4100000
COLD CHEM-Product	A 1.4100000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Mg



Oneway Anova Summary of Fit

Rsquare	0.622459
Adj Rsquare	0.465151
Root Mean Square Error	0.019586
Mean of Response	0.510944
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.00758961	0.001518	3.9569	0.0237
Error	12	0.00460333	0.000384		
C. Total	17	0.01219294			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.520333	0.01131	0.49570	0.54497
AQUA REGIA-Receipt	3	0.486333	0.01131	0.46170	0.51097
COLD CHEM-Product	3	0.481333	0.01131	0.45670	0.50597
COLD CHEM-Receipt	3	0.538333	0.01131	0.51370	0.56297
PEROXIDE FUSION-Product	3	0.514333	0.01131	0.48970	0.53897
PEROXIDE FUSION-Receipt	3	0.525000	0.01131	0.50036	0.54964

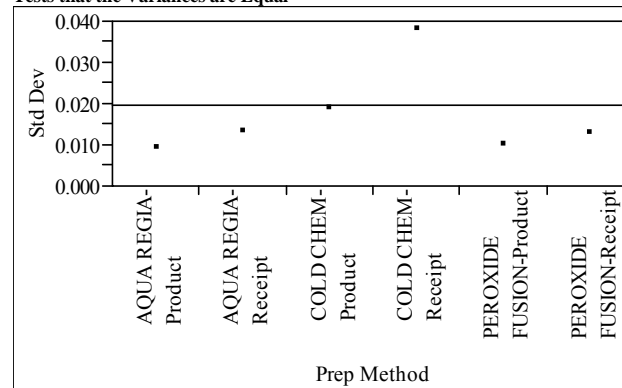
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.520333	0.009292	0.00536	0.49725	0.54341
AQUA REGIA-Receipt	3	0.486333	0.013013	0.00751	0.45401	0.51866
COLD CHEM-Product	3	0.481333	0.018771	0.01084	0.43470	0.52796
COLD CHEM-Receipt	3	0.538333	0.037859	0.02186	0.44429	0.63238

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
PEROXIDE FUSION-Product	3	0.514333	0.009866	0.00570	0.48983	0.53884
PEROXIDE FUSION-Receipt	3	0.525000	0.012767	0.00737	0.49328	0.55672

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0092916	0.0071111	0.0063333
AQUA REGIA-Receipt	3	0.0130128	0.0088889	0.0126667
COLD CHEM-Product	3	0.0187705	0.0144444	0.0113333
COLD CHEM-Receipt	3	0.0378594	0.0288889	0.0266667
PEROXIDE FUSION-Product	3	0.0098658	0.0075556	0.0066667
PEROXIDE FUSION-Receipt	3	0.0127671	0.0093333	0.0110000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2965	5	12	0.3283
Brown-Forsythe	0.7632	5	12	0.5934
Levene	3.8483	5	12	0.0259
Bartlett	1.1063	5	.	0.3545

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.6121	5	5.5176	0.0825

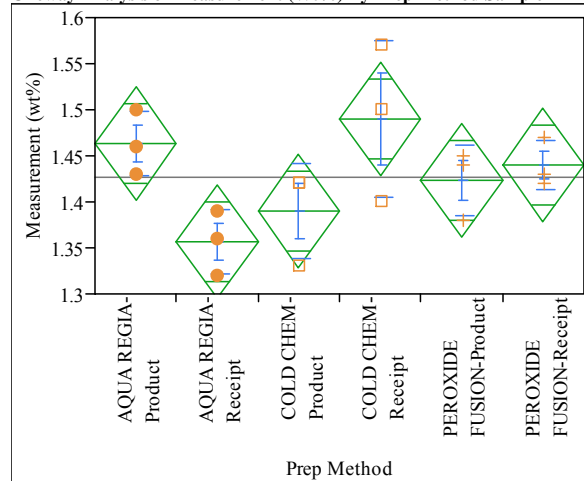
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 0.53833333
PEROXIDE FUSION-Receipt	A B 0.52500000
AQUA REGIA-Product	A B 0.52033333
PEROXIDE FUSION-Product	A B 0.51433333
AQUA REGIA-Receipt	A B 0.48633333
COLD CHEM-Product	B 0.48133333

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Mn



Oneway Anova Summary of Fit

Rsquare 0.547715
Adj Rsquare 0.359263
Root Mean Square Error 0.049329
Mean of Response 1.427222
Observations (or Sum Wgts) 18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.03536111	0.007072	2.9064	0.0603
Error	12	0.02920000	0.002433		
C. Total	17	0.06456111			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.46333	0.02848	1.4013	1.5254
AQUA REGIA-Receipt	3	1.35667	0.02848	1.2946	1.4187
COLD CHEM-Product	3	1.39000	0.02848	1.3279	1.4521
COLD CHEM-Receipt	3	1.49000	0.02848	1.4279	1.5521
PEROXIDE FUSION-Product	3	1.42333	0.02848	1.3613	1.4854
PEROXIDE FUSION-Receipt	3	1.44000	0.02848	1.3779	1.5021

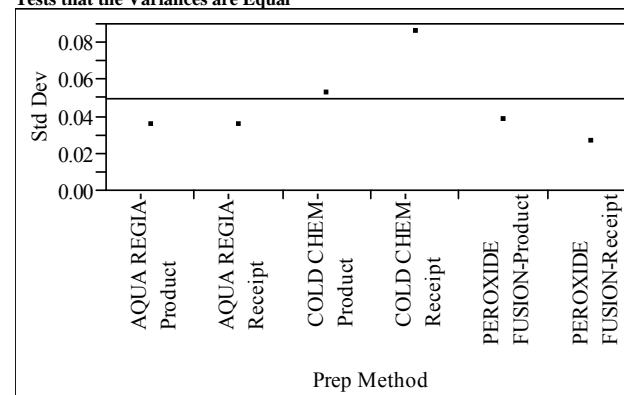
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	1.46333	0.035119	0.02028	1.3761	1.5506
AQUA REGIA-Receipt	3	1.35667	0.035119	0.02028	1.2694	1.4439
COLD CHEM-Product	3	1.39000	0.051962	0.03000	1.2609	1.5191

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Receipt	3	1.49000	0.085440	0.04933	1.2778	1.7022
PEROXIDE FUSION-Product	3	1.42333	0.037859	0.02186	1.3293	1.5174
PEROXIDE FUSION-Receipt	3	1.44000	0.026458	0.01528	1.3743	1.5057

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0351188	0.0244444	0.0333333
AQUA REGIA-Receipt	3	0.0351188	0.0244444	0.0333333
COLD CHEM-Product	3	0.0519615	0.0400000	0.0300000
COLD CHEM-Receipt	3	0.0854400	0.0600000	0.0800000
PEROXIDE FUSION-Product	3	0.0378594	0.0288889	0.0266667
PEROXIDE FUSION-Receipt	3	0.0264575	0.0200000	0.0200000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9879	5	12	0.4644
Brown-Forsythe	1.9889	5	12	0.1527
Levene	1.2667	5	12	0.3395
Bartlett	0.6469	5	.	0.6639

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.5572	5	5.5282	0.1512

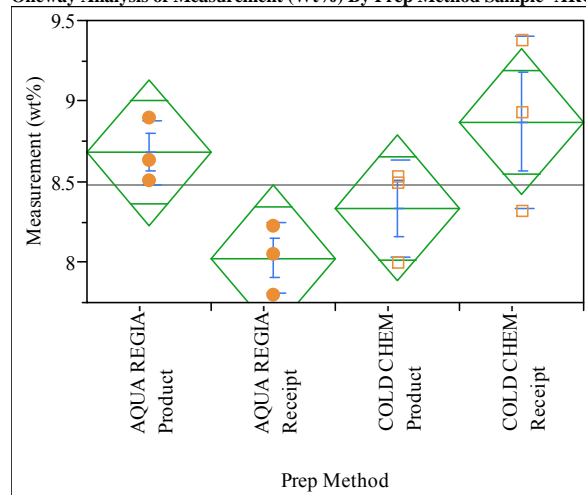
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 1.4900000
AQUA REGIA-Product	A 1.4633333
PEROXIDE FUSION-Receipt	A 1.4400000
PEROXIDE FUSION-Product	A 1.4233333
COLD CHEM-Product	A 1.3900000
AQUA REGIA-Receipt	A 1.3566667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Na



Missing Rows
6

Oneway Anova Summary of Fit

Rsquare 0.576548
Adj Rsquare 0.417753
Root Mean Square Error 0.339362
Mean of Response 8.478333
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	3	1.2544333	0.418144	3.6308	0.0643
Error	8	0.9213333	0.115167		
C. Total	11	2.1757667			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	8.68000	0.19593	8.2282	9.1318
AQUA REGIA-Receipt	3	8.02667	0.19593	7.5748	8.4785
COLD CHEM-Product	3	8.33667	0.19593	7.8848	8.7885
COLD CHEM-Receipt	3	8.87000	0.19593	8.4182	9.3218
PEROXIDE FUSION-Product	0	.	.	.	.
PEROXIDE FUSION-Receipt	0	.	.	.	.

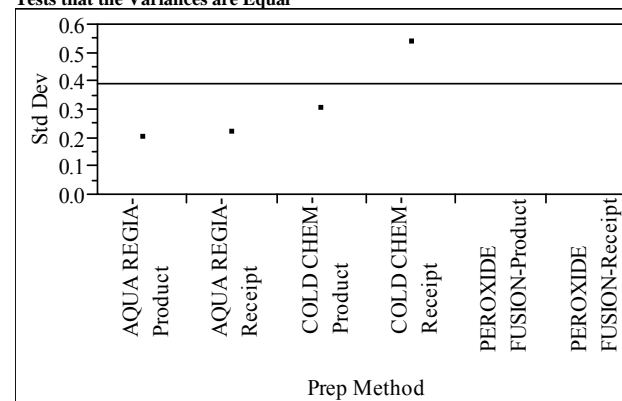
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	8.68000	0.199750	0.11533	8.1838	9.176
AQUA REGIA-Receipt	3	8.02667	0.215948	0.12468	7.4902	8.563
COLD CHEM-Product	3	8.33667	0.300888	0.17372	7.5892	9.084

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Receipt	3	8.87000	0.532541	0.30746	7.5471	10.193
PEROXIDE FUSION-Product	0	.	.	.	.	.
PEROXIDE FUSION-Receipt	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.1997498	0.1466667	0.1700000
AQUA REGIA-Receipt	3	0.2159475	0.1511111	0.2033333
COLD CHEM-Product	3	0.3008876	0.2311111	0.1933333
COLD CHEM-Receipt	3	0.5325411	0.3733333	0.5000000
PEROXIDE FUSION-Product	0	.	0.0000000	0.0000000
PEROXIDE FUSION-Receipt	0	.	0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.0093	3	8	0.4375
Brown-Forsythe	3.2356	3	8	0.0818
Levene	1.2818	3	8	0.3448
Bartlett	0.7192	3	.	0.5403

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.4087	3	4.2961	0.0857

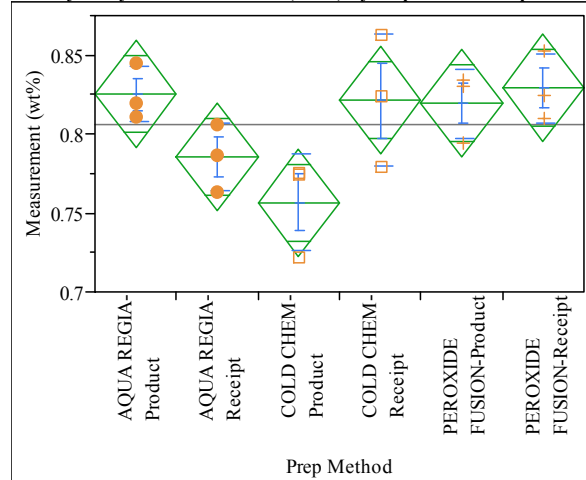
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	8.8700000
AQUA REGIA-Product	8.6800000
COLD CHEM-Product	8.3366667
AQUA REGIA-Receipt	8.0266667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Ni



Oneway Anova Summary of Fit

Rsquare	0.586338
Adj Rsquare	0.413979
Root Mean Square Error	0.027141
Mean of Response	0.806167
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.01252917	0.002506	3.4018	0.0382
Error	12	0.00883933	0.000737		
C. Total	17	0.02136850			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.825333	0.01567	0.79119	0.85947
AQUA REGIA-Receipt	3	0.785333	0.01567	0.75119	0.81947
COLD CHEM-Product	3	0.756667	0.01567	0.72253	0.79081
COLD CHEM-Receipt	3	0.821333	0.01567	0.78719	0.85547
PEROXIDE FUSION-Product	3	0.819333	0.01567	0.78519	0.85347
PEROXIDE FUSION-Receipt	3	0.829000	0.01567	0.79486	0.86314

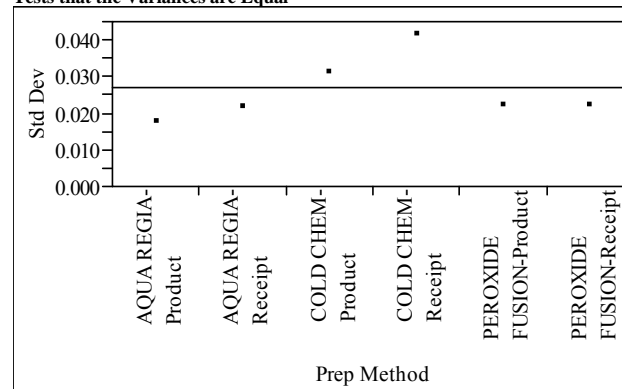
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.825333	0.017616	0.01017	0.78157	0.86909
AQUA REGIA-Receipt	3	0.785333	0.021548	0.01244	0.73180	0.83886
COLD CHEM-Product	3	0.756667	0.030892	0.01784	0.67993	0.83341

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Receipt	3	0.821333	0.041525	0.02397	0.71818	0.92449
PEROXIDE FUSION-Product	3	0.819333	0.022030	0.01272	0.76461	0.87406
PEROXIDE FUSION-Receipt	3	0.829000	0.021932	0.01266	0.77452	0.88348

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0176163	0.0131111	0.0143333
AQUA REGIA-Receipt	3	0.0215484	0.0148889	0.0206667
COLD CHEM-Product	3	0.0308923	0.0237778	0.0183333
COLD CHEM-Receipt	3	0.0415251	0.0282222	0.0406667
PEROXIDE FUSION-Product	3	0.0220303	0.0168889	0.0146667
PEROXIDE FUSION-Receipt	3	0.0219317	0.0160000	0.0190000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6439	5	12	0.6713
Brown-Forsythe	1.2225	5	12	0.3569
Levene	0.6379	5	12	0.6754
Bartlett	0.3549	5	.	0.8794

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.4525	5	5.5535	0.1613

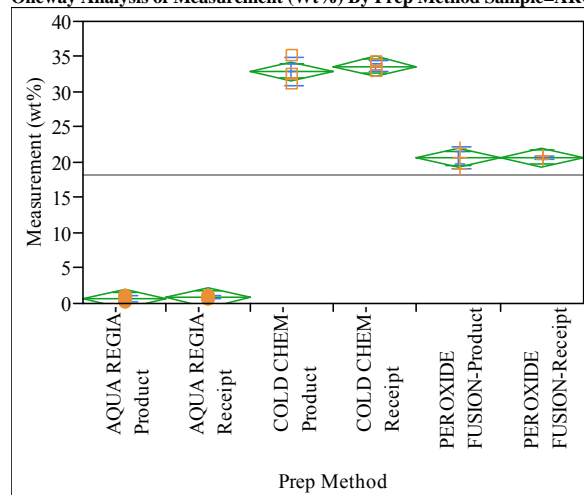
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION-Receipt	A 0.82900000
AQUA REGIA-Product	A 0.82533333
COLD CHEM-Receipt	A 0.82133333
PEROXIDE FUSION-Product	A 0.81933333
AQUA REGIA-Receipt	A 0.78533333
COLD CHEM-Product	A 0.75666667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Si



Oneway Anova Summary of Fit

Rsquare	0.995608
Adj Rsquare	0.993778
Root Mean Square Error	1.089775
Mean of Response	18.23128
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	3230.6099	646.122	544.0524	<.0001
Error	12	14.2513	1.188		
C. Total	17	3244.8612			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.6720	0.62918	-0.70	2.043
AQUA REGIA-Receipt	3	0.8157	0.62918	-0.56	2.187
COLD CHEM-Product	3	32.9333	0.62918	31.56	34.304
COLD CHEM-Receipt	3	33.6333	0.62918	32.26	35.004
PEROXIDE FUSION-Product	3	20.6333	0.62918	19.26	22.004
PEROXIDE FUSION-Receipt	3	20.7000	0.62918	19.33	22.071

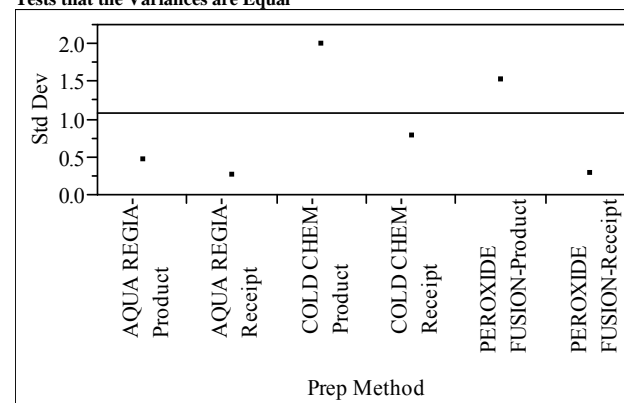
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.6720	0.45778	0.2643	-0.47	1.809
AQUA REGIA-Receipt	3	0.8157	0.25709	0.1484	0.18	1.454

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Product	3	32.9333	1.98578	1.1465	28.00	37.866
COLD CHEM-Receipt	3	33.6333	0.76376	0.4410	31.74	35.531
PEROXIDE FUSION-Product	3	20.6333	1.50111	0.8667	16.90	24.362
PEROXIDE FUSION-Receipt	3	20.7000	0.26458	0.1528	20.04	21.357

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.457781	0.339333	0.378000
AQUA REGIA-Receipt	3	0.257092	0.196222	0.180667
COLD CHEM-Product	3	1.985783	1.444444	1.733333
COLD CHEM-Receipt	3	0.763763	0.555556	0.666667
PEROXIDE FUSION-Product	3	1.501111	1.022222	1.466667
PEROXIDE FUSION-Receipt	3	0.264575	0.200000	0.200000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2745	5	12	0.3365
Brown-Forsythe	10.3809	5	12	0.0005
Levene	2.7511	5	12	0.0701
Bartlett	2.1181	5	.	0.0601

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1787.0450	5	5.3731	<.0001

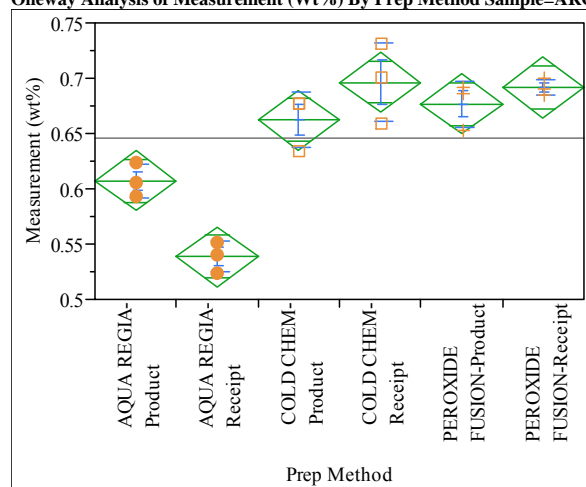
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	33.633333
COLD CHEM-Product	32.933333
PEROXIDE FUSION-Receipt	20.700000
PEROXIDE FUSION-Product	20.633333
AQUA REGIA-Receipt	0.815667
AQUA REGIA-Product	0.672000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Ti



Oneway Anova Summary of Fit

Rsquare	0.910471
Adj Rsquare	0.873167
Root Mean Square Error	0.021536
Mean of Response	0.645444
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.05659711	0.011319	24.4070	<.0001
Error	12	0.00556533	0.000464		
C. Total	17	0.06216244			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.607000	0.01243	0.57991	0.63409
AQUA REGIA-Receipt	3	0.538667	0.01243	0.51158	0.56576
COLD CHEM-Product	3	0.662333	0.01243	0.63524	0.68942
COLD CHEM-Receipt	3	0.696333	0.01243	0.66924	0.72342
PEROXIDE FUSION-Product	3	0.676667	0.01243	0.64958	0.70376
PEROXIDE FUSION-Receipt	3	0.691667	0.01243	0.66458	0.71876

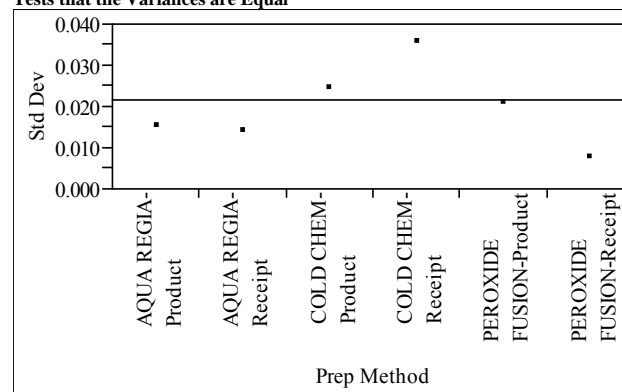
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.607000	0.015100	0.00872	0.56949	0.64451
AQUA REGIA-Receipt	3	0.538667	0.014048	0.00811	0.50377	0.57356

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Product	3	0.662333	0.024542	0.01417	0.60137	0.72330
COLD CHEM-Receipt	3	0.696333	0.035642	0.02058	0.60779	0.78487
PEROXIDE FUSION-Product	3	0.676667	0.020648	0.01192	0.62537	0.72796
PEROXIDE FUSION-Receipt	3	0.691667	0.007638	0.00441	0.67269	0.71064

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0150997	0.0106667	0.0140000
AQUA REGIA-Receipt	3	0.0140475	0.0097778	0.0133333
COLD CHEM-Product	3	0.0245425	0.0188889	0.0146667
COLD CHEM-Receipt	3	0.0356417	0.0248889	0.0336667
PEROXIDE FUSION-Product	3	0.0206478	0.0157778	0.0143333
PEROXIDE FUSION-Receipt	3	0.0076376	0.0055556	0.0066667

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.9111	5	12	0.5056
Brown-Forsythe	1.6823	5	12	0.2132
Levene	1.5118	5	12	0.2577
Bartlett	0.8215	5	.	0.5341

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
41.7048	5	5.3605	0.0003

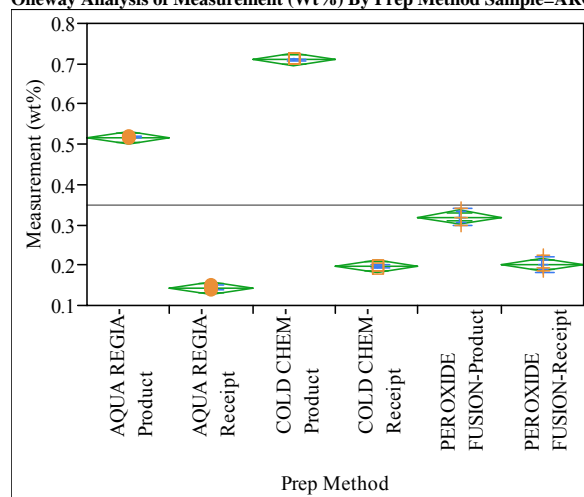
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt	A 0.69633333
PEROXIDE FUSION-Receipt	A 0.69166667
PEROXIDE FUSION-Product	A 0.67666667
COLD CHEM-Product	A B 0.66233333
AQUA REGIA-Product	B 0.60700000
AQUA REGIA-Receipt	C 0.53866667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=U



Oneway Anova Summary of Fit

Rsquare	0.997383
Adj Rsquare	0.996293
Root Mean Square Error	0.012721
Mean of Response	0.348056
Observations (or Sum Wgts)	18

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	5	0.74025494	0.148051	914.8362	<.0001
Error	12	0.00194200	0.000162		
C. Total	17	0.74219694			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.517333	0.00734	0.50133	0.53334
AQUA REGIA-Receipt	3	0.144000	0.00734	0.12800	0.16000
COLD CHEM-Product	3	0.710000	0.00734	0.69400	0.72600
COLD CHEM-Receipt	3	0.196000	0.00734	0.18000	0.21200
PEROXIDE FUSION-Product	3	0.319667	0.00734	0.30366	0.33567
PEROXIDE FUSION-Receipt	3	0.201333	0.00734	0.18533	0.21734

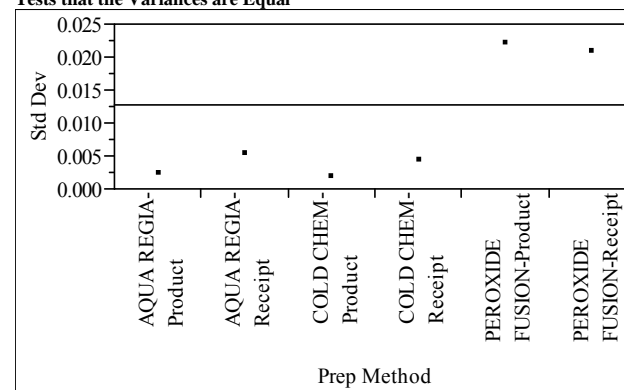
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.517333	0.002309	0.00133	0.51160	0.52307
AQUA REGIA-Receipt	3	0.144000	0.005292	0.00306	0.13086	0.15714

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
COLD CHEM-Product	3	0.710000	0.001732	0.00100	0.70570	0.71430
COLD CHEM-Receipt	3	0.196000	0.004359	0.00252	0.18517	0.20683
PEROXIDE FUSION-Product	3	0.319667	0.022121	0.01277	0.26472	0.37462
PEROXIDE FUSION-Receipt	3	0.201333	0.020648	0.01192	0.15004	0.25263

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0023094	0.0017778	0.0013333
AQUA REGIA-Receipt	3	0.0052915	0.0040000	0.0040000
COLD CHEM-Product	3	0.0017321	0.0013333	0.0010000
COLD CHEM-Receipt	3	0.0043589	0.0033333	0.0030000
PEROXIDE FUSION-Product	3	0.0221209	0.0155556	0.0206667
PEROXIDE FUSION-Receipt	3	0.0206478	0.0157778	0.0143333

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3397	5	12	0.3127
Brown-Forsythe	3.8030	5	12	0.0269
Levene	4.4782	5	12	0.0156
Bartlett	3.0883	5	.	0.0086

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8521.4347	5	5.3039	<.0001

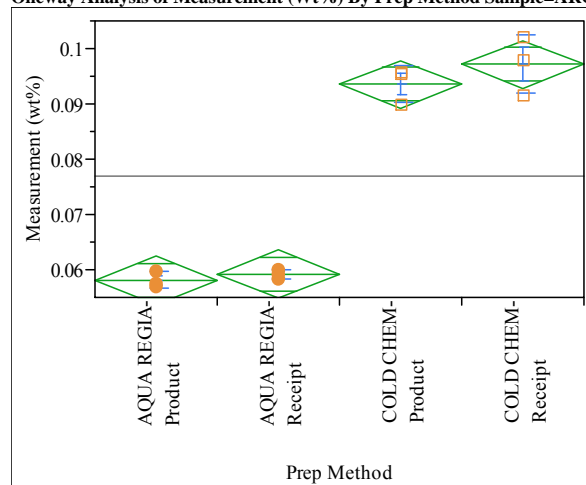
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Product	A 0.71000000
AQUA REGIA-Product	B 0.51733333
PEROXIDE FUSION-Product	C 0.31966667
PEROXIDE FUSION-Receipt	D 0.20133333
COLD CHEM-Receipt	D 0.19600000
AQUA REGIA-Receipt	E 0.14400000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=ARG, Element=Zr



Missing Rows

6

Oneway Anova Summary of Fit

Rsquare 0.979728
Adj Rsquare 0.972126
Root Mean Square Error 0.003241
Mean of Response 0.076967
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	3	0.00406157	0.001354	128.8773	<.0001
Error	8	0.00008404	0.000011		
C. Total	11	0.00414561			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.058067	0.00187	0.05375	0.06238
AQUA REGIA-Receipt	3	0.059167	0.00187	0.05485	0.06348
COLD CHEM-Product	3	0.093533	0.00187	0.08922	0.09785
COLD CHEM-Receipt	3	0.097100	0.00187	0.09278	0.10142
PEROXIDE FUSION-Product	0	.	.	.	.
PEROXIDE FUSION-Receipt	0	.	.	.	.

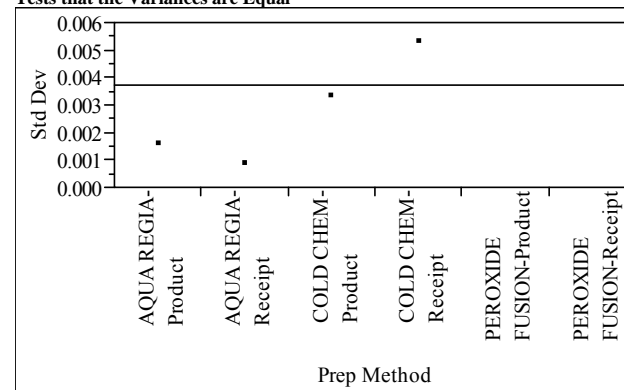
Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Product	3	0.058067	0.001531	0.00088	0.05426	0.06187

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA-Receipt	3	0.059167	0.000850	0.00049	0.05705	0.06128
COLD CHEM-Product	3	0.093533	0.003320	0.00192	0.08529	0.10178
COLD CHEM-Receipt	3	0.097100	0.005285	0.00305	0.08397	0.11023
PEROXIDE FUSION-Product	0	.	.	.	.	.
PEROXIDE FUSION-Receipt	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA-Product	3	0.0015308	0.0011556	0.0011667
AQUA REGIA-Receipt	3	0.0008505	0.0005778	0.0008333
COLD CHEM-Product	3	0.0033201	0.0025556	0.0019667
COLD CHEM-Receipt	3	0.0052849	0.0037333	0.0049000
PEROXIDE FUSION-Product	0	.	0.0000000	0.0000000
PEROXIDE FUSION-Receipt	0	.	0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2175	3	8	0.3644
Brown-Forsythe	3.1897	3	8	0.0842
Levene	2.7453	3	8	0.1127
Bartlett	1.7379	3	.	0.1568

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
112.4765	3	3.9044	0.0003

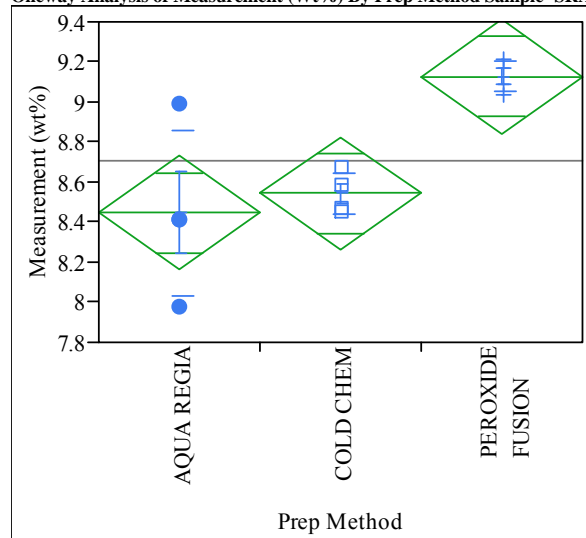
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM-Receipt A	0.09710000
COLD CHEM-Product A	0.09353333
AQUA REGIA-Receipt B	0.05916667
AQUA REGIA-Product B	0.05806667

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Al



Oneway Anova Summary of Fit

Rsquare 0.657618
Adj Rsquare 0.581533
Root Mean Square Error 0.250516
Mean of Response 8.705833
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	1.0848667	0.542433	8.6432	0.0080
Error	9	0.5648250	0.062758		
C. Total	11	1.6496917			

Means for Oneway Anova

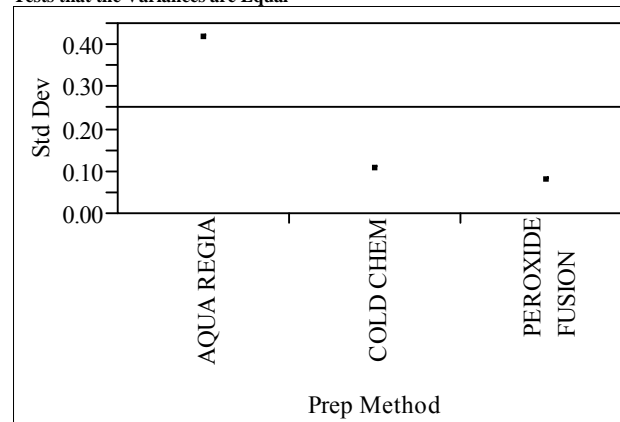
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	8.44750	0.12526	8.1641	8.7309
COLD CHEM	4	8.54250	0.12526	8.2591	8.8259
PEROXIDE FUSION	4	9.12750	0.12526	8.8441	9.4109

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	8.44750	0.414598	0.20730	7.7878	9.1072
COLD CHEM	4	8.54250	0.102429	0.05121	8.3795	8.7055
PEROXIDE FUSION	4	9.12750	0.076757	0.03838	9.0054	9.2496

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.4145982	0.2712500	0.2525000
COLD CHEM	4	0.1024288	0.0825000	0.0825000
PEROXIDE FUSION	4	0.0767572	0.0625000	0.0625000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.7020	2	9	0.2361
Brown-Forsythe	1.4330	2	9	0.2882
Levene	2.0979	2	9	0.1787
Bartlett	4.1113	2	.	0.0164

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
39.3179	2	5.2737	0.0007

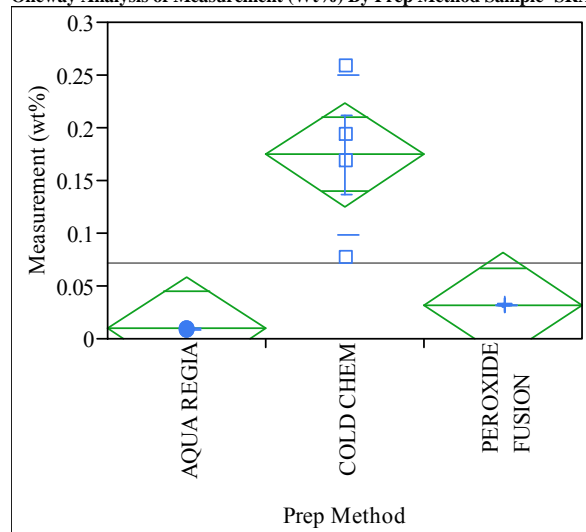
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	9.1275000
COLD CHEM B	8.5425000
AQUA REGIA B	8.4475000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=B



Oneway Anova Summary of Fit

Rsquare 0.78869
 Adj Rsquare 0.741732
 Root Mean Square Error 0.04368
 Mean of Response 0.071829
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.06409182	0.032046	16.7957	0.0009
Error	9	0.01717183	0.001908		
C. Total	11	0.08126364			

Means for Oneway Anova

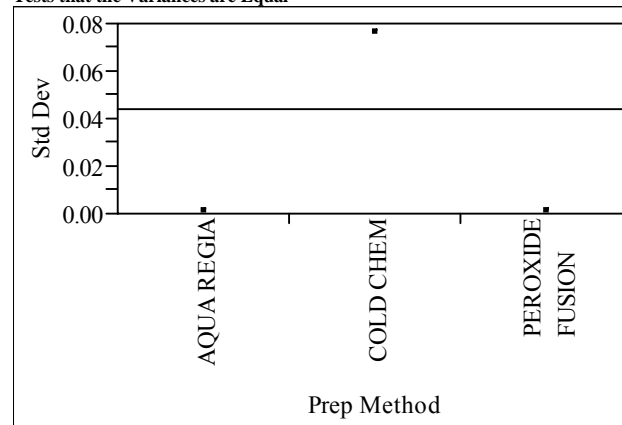
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.009388	0.02184	-0.0400	0.05879
COLD CHEM	4	0.174375	0.02184	0.1250	0.22378
PEROXIDE FUSION	4	0.031725	0.02184	-0.0177	0.08113

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.009388	0.001130	0.00056	0.00759	0.01119
COLD CHEM	4	0.174375	0.075645	0.03782	0.05401	0.29474
PEROXIDE FUSION	4	0.031725	0.000660	0.00033	0.03067	0.03278

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0011300	0.0009625	0.0009625
COLD CHEM	4	0.0756454	0.0521250	0.0521250
PEROXIDE FUSION	4	0.0006602	0.0005250	0.0005250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0339	2	9	0.1867
Brown-Forsythe	4.8933	2	9	0.0365
Levene	5.0297	2	9	0.0342
Bartlett	19.0681	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
520.1086	2	4.9367	<.0001

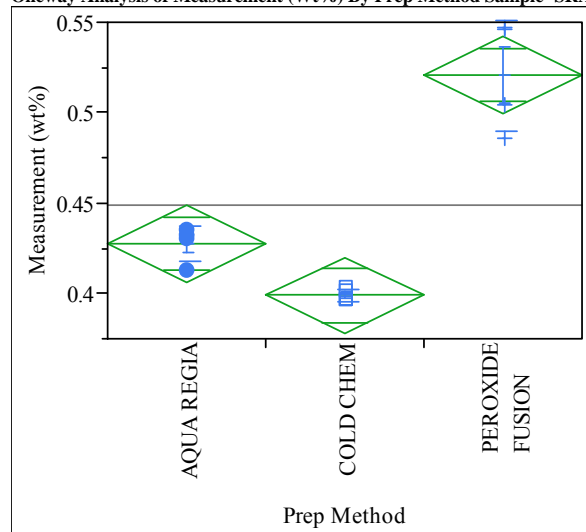
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM	A 0.17437500
PEROXIDE FUSION	B 0.03172500
AQUA REGIA	B 0.00938750

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Ca



Oneway Anova Summary of Fit

Rsquare 0.911604
 Adj Rsquare 0.89196
 Root Mean Square Error 0.018696
 Mean of Response 0.449083
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.03244117	0.016221	46.4071	<.0001
Error	9	0.00314575	0.000350		
C. Total	11	0.03558692			

Means for Oneway Anova

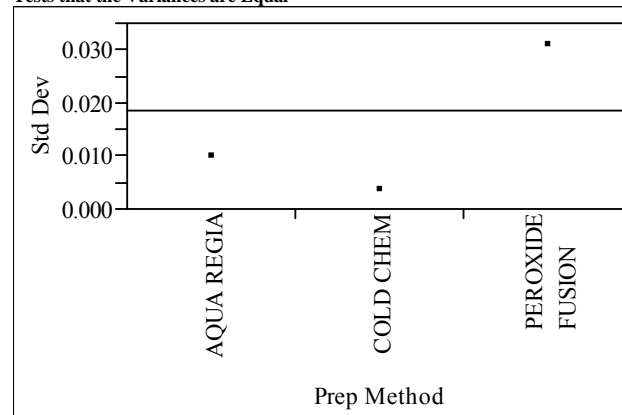
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.427500	0.00935	0.40635	0.44865
COLD CHEM	4	0.399000	0.00935	0.37785	0.42015
PEROXIDE FUSION	4	0.520750	0.00935	0.49960	0.54190

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.427500	0.009883	0.00494	0.41177	0.44323
COLD CHEM	4	0.399000	0.003559	0.00178	0.39334	0.40466
PEROXIDE FUSION	4	0.520750	0.030631	0.01532	0.47201	0.56949

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0098826	0.0072500	0.0060000
COLD CHEM	4	0.0035590	0.0030000	0.0030000
PEROXIDE FUSION	4	0.0306309	0.0257500	0.0257500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	7.3119	2	9	0.0130
Brown-Forsythe	12.6213	2	9	0.0024
Levene	21.3033	2	9	0.0004
Bartlett	4.7100	2	.	0.0090

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
38.5758	2	4.499	0.0015

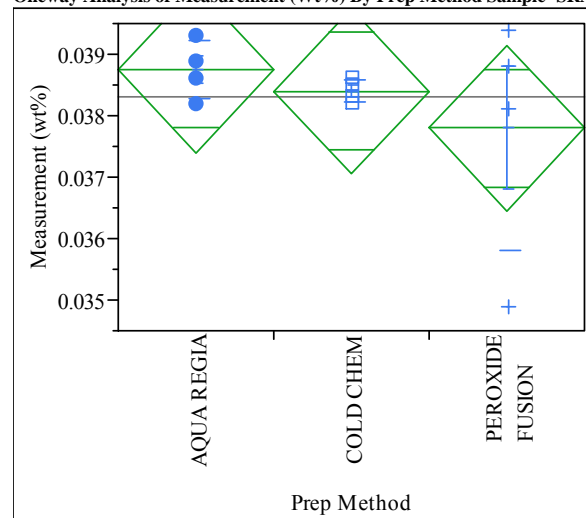
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.52075000
AQUA REGIA B	0.42750000
COLD CHEM B	0.39900000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Cr



Oneway Anova Summary of Fit

Rsquare 0.125995
Adj Rsquare -0.06823
Root Mean Square Error 0.001193
Mean of Response 0.038317
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00000185	9.2333e-7	0.6487	0.5455
Error	9	0.00001281	1.4233e-6		
C. Total	11	0.00001466			

Means for Oneway Anova

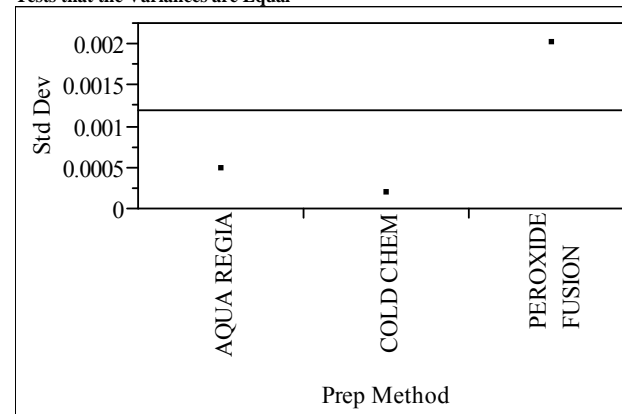
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.038750	0.00060	0.03740	0.04010
COLD CHEM	4	0.038400	0.00060	0.03705	0.03975
PEROXIDE FUSION	4	0.037800	0.00060	0.03645	0.03915

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.038750	0.000465	0.00023	0.03801	0.03949
COLD CHEM	4	0.038400	0.000183	9.13e-5	0.03811	0.03869
PEROXIDE FUSION	4	0.037800	0.002005	0.00100	0.03461	0.04099

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0004655	0.0003500	0.0003500
COLD CHEM	4	0.0001826	0.0001500	0.0001500
PEROXIDE FUSION	4	0.0020050	0.0014500	0.0013000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5627	2	9	0.2615
Brown-Forsythe	1.8980	2	9	0.2052
Levene	4.6178	2	9	0.0417
Bartlett	6.0075	2	.	0.0025

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.0349	2	4.5506	0.4261

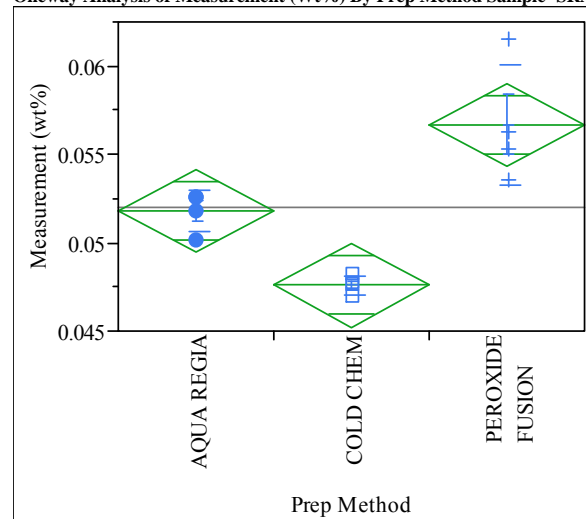
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA	A 0.03875000
COLD CHEM	A 0.03840000
PEROXIDE FUSION	A 0.03780000

Levels not connected by same letter are significantly different.

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



Oneway Anova Summary of Fit

Rsquare 0.806988
Adj Rsquare 0.764097
Root Mean Square Error 0.002094
Mean of Response 0.052025
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00016502	0.000083	18.8147	0.0006
Error	9	0.00003947	4.385e-6		
C. Total	11	0.00020448			

Means for Oneway Anova

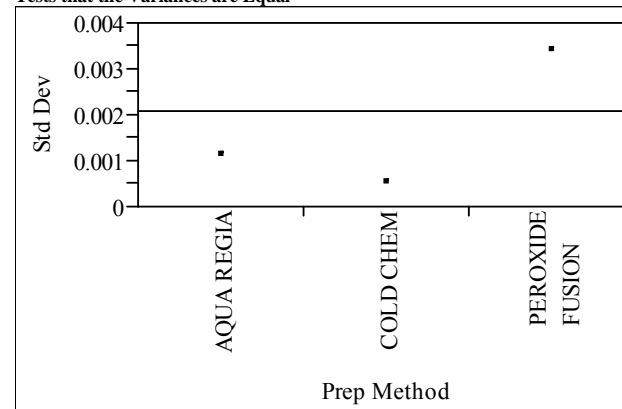
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.051800	0.00105	0.04943	0.05417
COLD CHEM	4	0.047600	0.00105	0.04523	0.04997
PEROXIDE FUSION	4	0.056675	0.00105	0.05431	0.05904

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.051800	0.001131	0.00057	0.05000	0.05360
COLD CHEM	4	0.047600	0.000535	0.00027	0.04675	0.04845
PEROXIDE FUSION	4	0.056675	0.003404	0.00170	0.05126	0.06209

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0011314	0.0008000	0.0008000
COLD CHEM	4	0.0005354	0.0003500	0.0003500
PEROXIDE FUSION	4	0.0034043	0.0024125	0.0022250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.5078	2	9	0.2724
Brown-Forsythe	1.6968	2	9	0.2370
Levene	3.2229	2	9	0.0880
Bartlett	3.9027	2	.	0.0202

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
30.0051	2	4.7793	0.0020

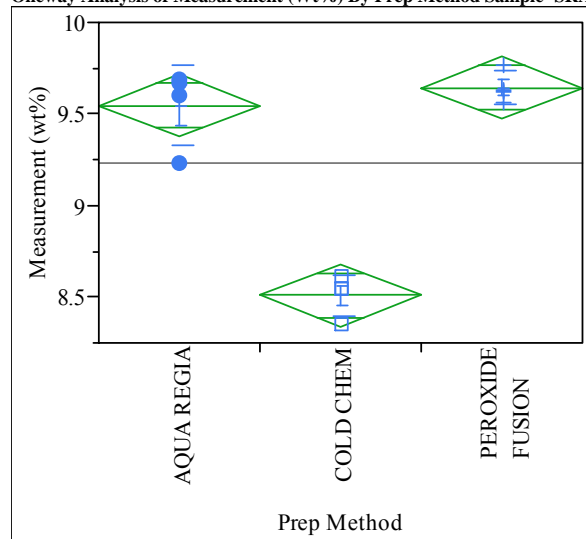
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.05667500
AQUA REGIA B	0.05180000
COLD CHEM C	0.04760000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Fe



Oneway Anova Summary of Fit

Rsquare 0.940581
Adj Rsquare 0.927376
Root Mean Square Error 0.149062
Mean of Response 9.234167
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	3.1655167	1.58276	71.2330	<.0001
Error	9	0.1999750	0.02222		
C. Total	11	3.3654917			

Means for Oneway Anova

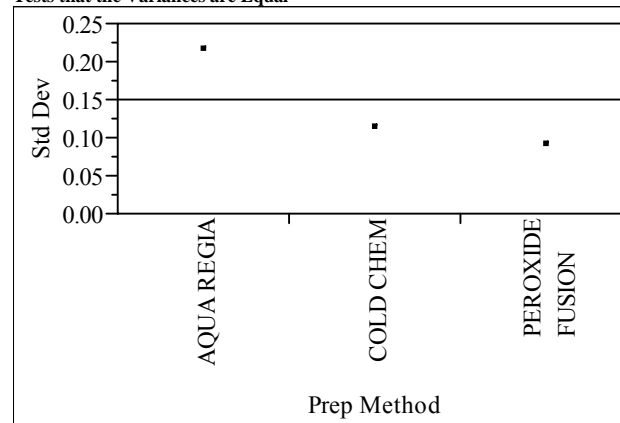
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	9.54750	0.07453	9.3789	9.7161
COLD CHEM	4	8.51000	0.07453	8.3414	8.6786
PEROXIDE FUSION	4	9.64500	0.07453	9.4764	9.8136

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	9.54750	0.215155	0.10758	9.2051	9.8899
COLD CHEM	4	8.51000	0.111654	0.05583	8.3323	8.6877
PEROXIDE FUSION	4	9.64500	0.088882	0.04444	9.5036	9.7864

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.2151550	0.1587500	0.1325000
COLD CHEM	4	0.1116542	0.0800000	0.0650000
PEROXIDE FUSION	4	0.0888819	0.0625000	0.0550000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.8704	2	9	0.4513
Brown-Forsythe	0.4684	2	9	0.6404
Levene	1.6332	2	9	0.2482
Bartlett	1.1471	2	.	0.3176

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
117.0574	2	5.5577	<.0001

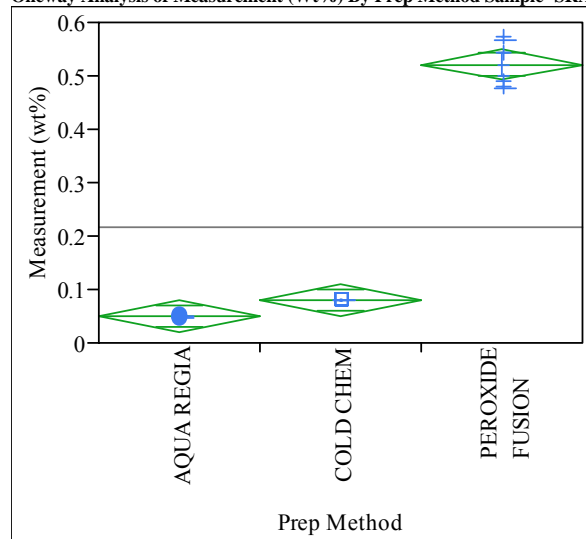
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	9.6450000
AQUA REGIA A	9.5475000
COLD CHEM B	8.5100000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=K



Oneway Anova Summary of Fit

Rsquare	0.989448
Adj Rsquare	0.987104
Root Mean Square Error	0.025717
Mean of Response	0.217017
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.55813945	0.279070	421.9769	<.0001
Error	9	0.00595205	0.000661		
C. Total	11	0.56409150			

Means for Oneway Anova

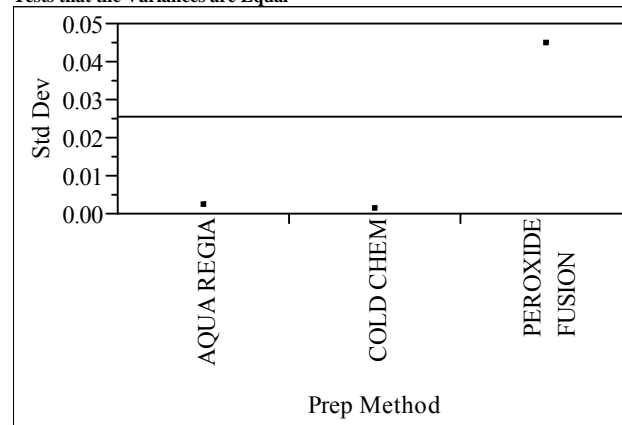
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.049450	0.01286	0.02036	0.07854
COLD CHEM	4	0.080100	0.01286	0.05101	0.10919
PEROXIDE FUSION	4	0.521500	0.01286	0.49241	0.55059

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.049450	0.001905	0.00095	0.04642	0.05248
COLD CHEM	4	0.080100	0.001178	0.00059	0.07823	0.08197
PEROXIDE FUSION	4	0.521500	0.044486	0.02224	0.45071	0.59229

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0019053	0.0013750	0.0011000
COLD CHEM	4	0.0011776	0.0010000	0.0010000
PEROXIDE FUSION	4	0.0444860	0.0370000	0.0370000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	6.5908	2	9	0.0173
Brown-Forsythe	27.2843	2	9	0.0002
Levene	33.1369	2	9	<.0001
Bartlett	13.4255	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
510.8611	2	5.002	<.0001

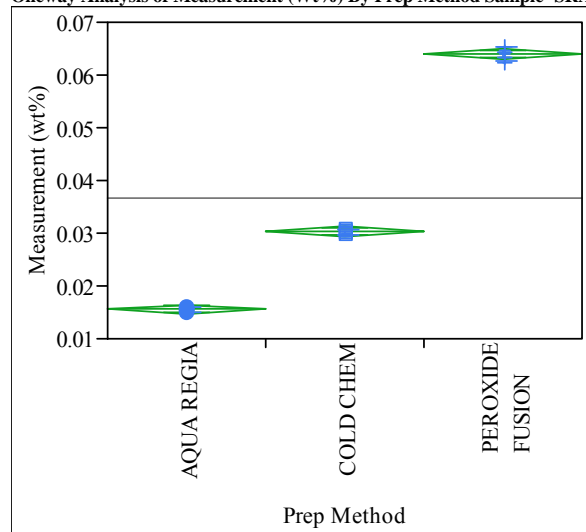
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.52150000
COLD CHEM B	0.08010000
AQUA REGIA B	0.04945000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Li



Oneway Anova Summary of Fit

Rsquare	0.998662
Adj Rsquare	0.998365
Root Mean Square Error	0.000855
Mean of Response	0.036542
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00491485	0.002457	3359.941	<.0001
Error	9	0.00000658	7.314e-7		
C. Total	11	0.00492143			

Means for Oneway Anova

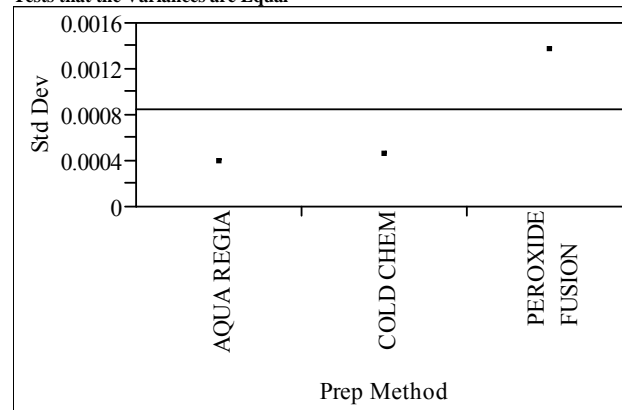
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.015525	0.00043	0.01456	0.01649
COLD CHEM	4	0.030225	0.00043	0.02926	0.03119
PEROXIDE FUSION	4	0.063875	0.00043	0.06291	0.06484

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.015525	0.000386	0.00019	0.01491	0.01614
COLD CHEM	4	0.030225	0.000443	0.00022	0.02952	0.03093
PEROXIDE FUSION	4	0.063875	0.001360	0.00068	0.06171	0.06604

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0003862	0.0002750	0.0002750
COLD CHEM	4	0.0004425	0.0003750	0.0003750
PEROXIDE FUSION	4	0.0013598	0.0010750	0.0010750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.7890	2	9	0.1141
Brown-Forsythe	5.9869	2	9	0.0222
Levene	6.2466	2	9	0.0199
Bartlett	2.5868	2	.	0.0753

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2741.3132	2	5.4516	<.0001

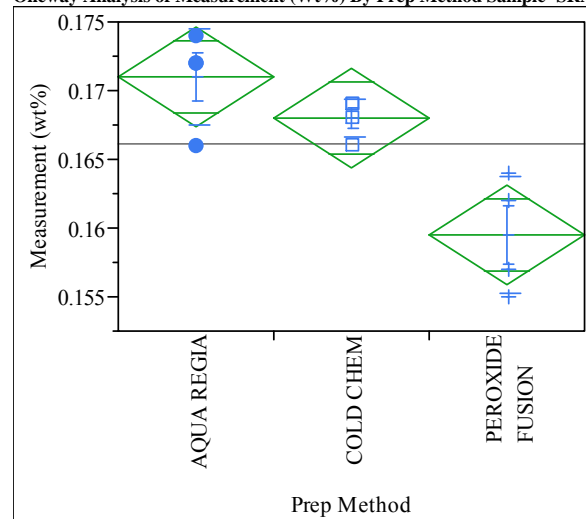
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.06387500
COLD CHEM B	0.03022500
AQUA REGIA C	0.01552500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Mg



Oneway Anova Summary of Fit

Rsquare 0.749781
Adj Rsquare 0.694176
Root Mean Square Error 0.003249
Mean of Response 0.166167
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00028467	0.000142	13.4842	0.0020
Error	9	0.00009500	0.000011		
C. Total	11	0.00037967			

Means for Oneway Anova

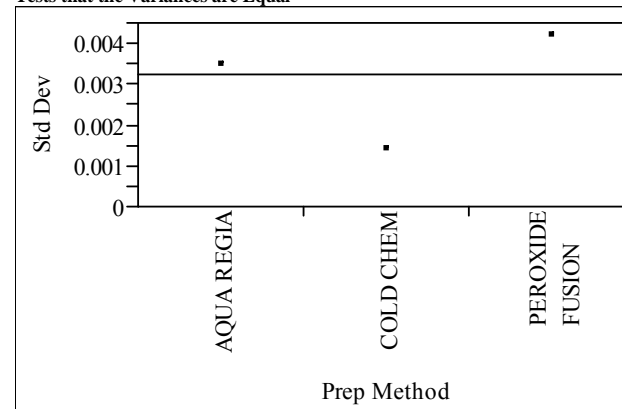
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.171000	0.00162	0.16733	0.17467
COLD CHEM	4	0.168000	0.00162	0.16433	0.17167
PEROXIDE FUSION	4	0.159500	0.00162	0.15583	0.16317

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.171000	0.003464	0.00173	0.16549	0.17651
COLD CHEM	4	0.168000	0.001414	0.00071	0.16575	0.17025
PEROXIDE FUSION	4	0.159500	0.004203	0.00210	0.15281	0.16619

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0034641	0.0025000	0.0020000
COLD CHEM	4	0.0014142	0.0010000	0.0010000
PEROXIDE FUSION	4	0.0042032	0.0035000	0.0035000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.3846	2	9	0.2990
Brown-Forsythe	1.8387	2	9	0.2140
Levene	3.3529	2	9	0.0816
Bartlett	1.3329	2	.	0.2637

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
8.3715	2	4.8922	0.0263

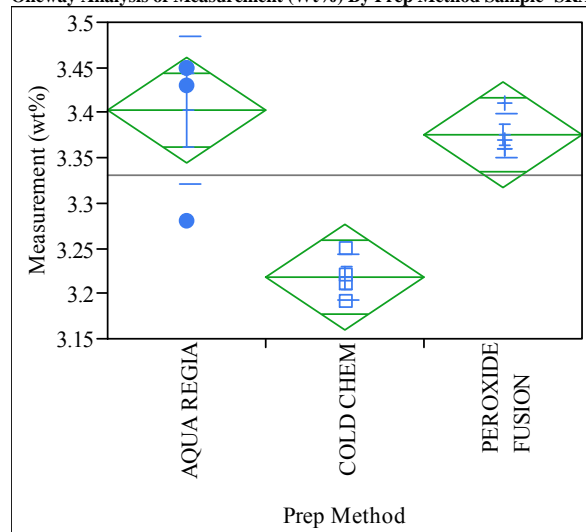
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA	A 0.17100000
COLD CHEM	A 0.16800000
PEROXIDE FUSION	B 0.15950000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Mn



Oneway Anova Summary of Fit

Rsquare 0.769714
Adj Rsquare 0.718539
Root Mean Square Error 0.051478
Mean of Response 3.331667
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.07971667	0.039858	15.0409	0.0013
Error	9	0.02385000	0.002650		
C. Total	11	0.10356667			

Means for Oneway Anova

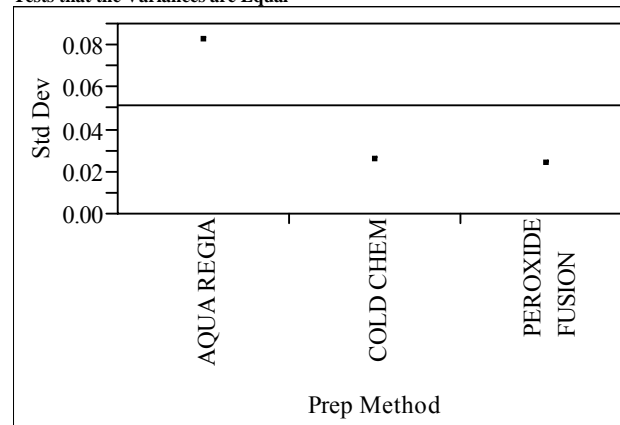
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	3.40250	0.02574	3.3443	3.4607
COLD CHEM	4	3.21750	0.02574	3.1593	3.2757
PEROXIDE FUSION	4	3.37500	0.02574	3.3168	3.4332

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	3.40250	0.082209	0.04110	3.2717	3.5333
COLD CHEM	4	3.21750	0.025000	0.01250	3.1777	3.2573
PEROXIDE FUSION	4	3.37500	0.023805	0.01190	3.3371	3.4129

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0822091	0.0612500	0.0475000
COLD CHEM	4	0.0250000	0.0175000	0.0175000
PEROXIDE FUSION	4	0.0238048	0.0175000	0.0150000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2166	2	9	0.3407
Brown-Forsythe	0.6280	2	9	0.5555
Levene	3.5924	2	9	0.0713
Bartlett	2.6794	2	.	0.0686

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
39.7618	2	5.4733	0.0005

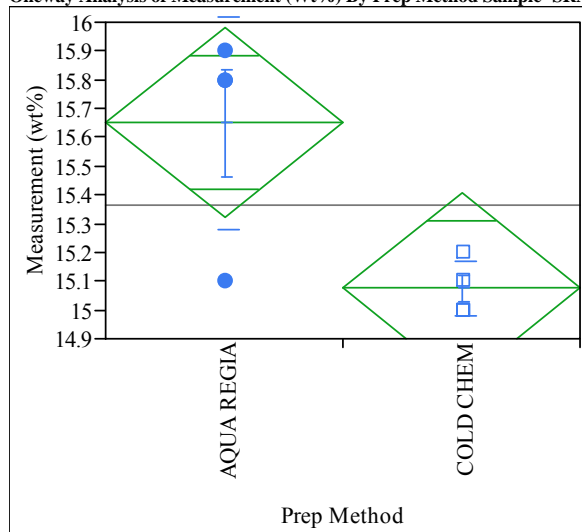
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA	A 3.4025000
PEROXIDE FUSION	A 3.3750000
COLD CHEM	B 3.2175000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Na



Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.60182
Adj Rsquare 0.535457
Root Mean Square Error 0.270031
Mean of Response 15.3625
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	1	0.6612500	0.661250	9.0686	0.0237
Error	6	0.4375000	0.072917		
C. Total	7	1.0987500			

Means for Oneway Anova

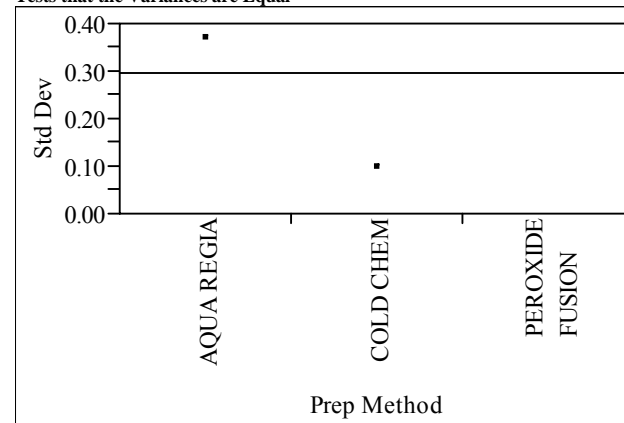
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	15.6500	0.13502	15.320	15.980
COLD CHEM	4	15.0750	0.13502	14.745	15.405
PEROXIDE FUSION	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	15.6500	0.369685	0.18484	15.062	16.238
COLD CHEM	4	15.0750	0.095743	0.04787	14.923	15.227
PEROXIDE FUSION	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.3696846	0.2750000	0.2000000
COLD CHEM	4	0.0957427	0.0750000	0.0750000
PEROXIDE FUSION	0	.	0.0000000	0.0000000

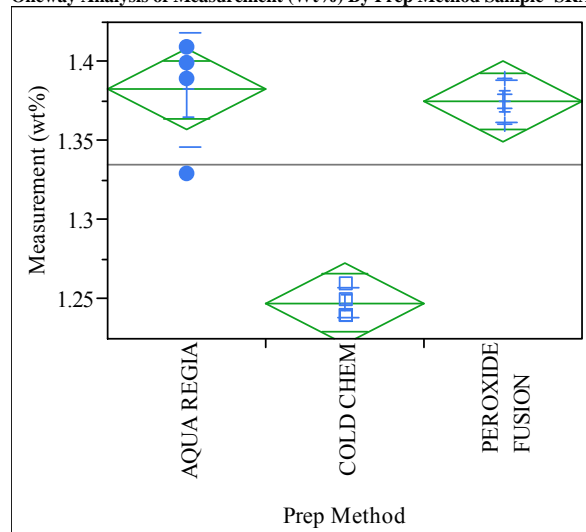
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2881	1	6	0.2997
Brown-Forsythe	0.5396	1	6	0.4903
Levene	4.2667	1	6	0.0844
Bartlett	3.7170	1	.	0.0539

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
9.0686	1	3.4006	0.0487

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Ni



Oneway Anova Summary of Fit

Rsquare	0.908284
Adj Rsquare	0.887903
Root Mean Square Error	0.02273
Mean of Response	1.335
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.04605000	0.023025	44.5645	<.0001
Error	9	0.00465000	0.000517		
C. Total	11	0.05070000			

Means for Oneway Anova

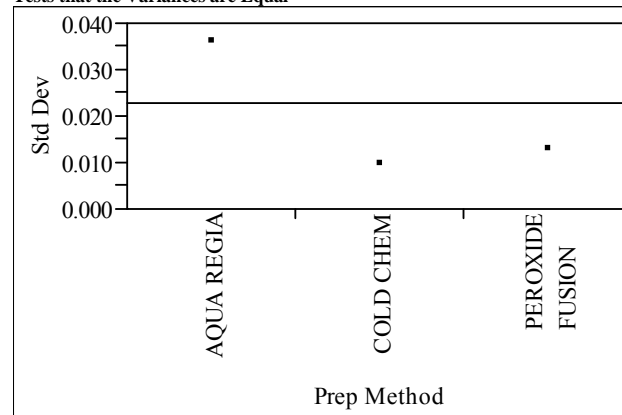
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	1.38250	0.01137	1.3568	1.4082
COLD CHEM	4	1.24750	0.01137	1.2218	1.2732
PEROXIDE FUSION	4	1.37500	0.01137	1.3493	1.4007

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	1.38250	0.035940	0.01797	1.3253	1.4397
COLD CHEM	4	1.24750	0.009574	0.00479	1.2323	1.2627
PEROXIDE FUSION	4	1.37500	0.012910	0.00645	1.3545	1.3955

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0359398	0.0262500	0.0225000
COLD CHEM	4	0.0095743	0.0075000	0.0075000
PEROXIDE FUSION	4	0.0129099	0.0100000	0.0100000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2832	2	9	0.3234
Brown-Forsythe	0.8774	2	9	0.4486
Levene	2.9409	2	9	0.1040
Bartlett	2.5402	2	.	0.0789

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
122.4956	2	5.3418	<.0001

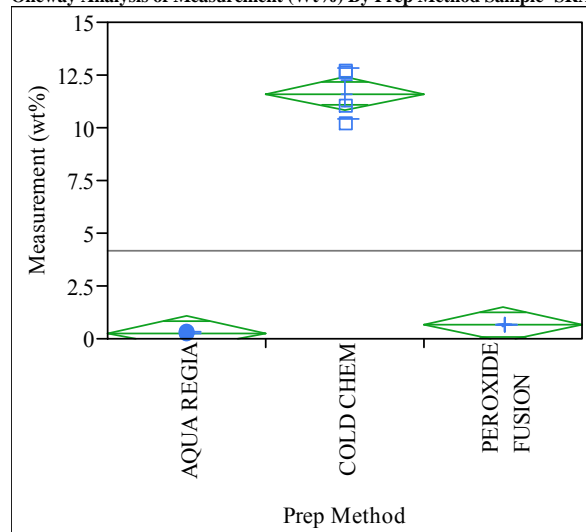
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA A	1.3825000
PEROXIDE FUSION A	1.3750000
COLD CHEM B	1.2475000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Si



Oneway Anova Summary of Fit

Rsquare	0.986493
Adj Rsquare	0.983491
Root Mean Square Error	0.710487
Mean of Response	4.192
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	331.80662	165.903	328.6567	<.0001
Error	9	4.54313	0.505		
C. Total	11	336.34975			

Means for Oneway Anova

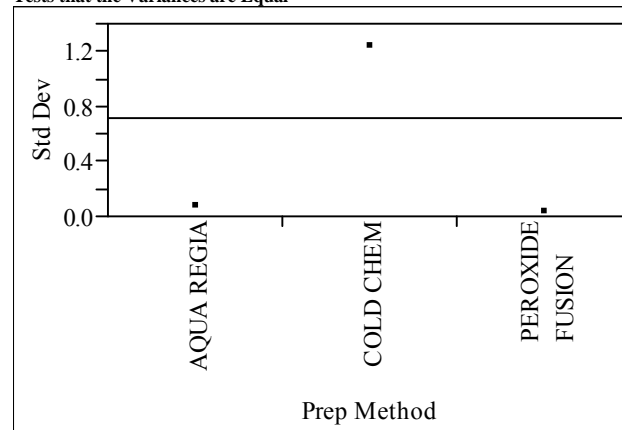
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.2788	0.35524	-0.52	1.082
COLD CHEM	4	11.6250	0.35524	10.82	12.429
PEROXIDE FUSION	4	0.6723	0.35524	-0.13	1.476

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.2788	0.06804	0.03402	0.1705	0.387
COLD CHEM	4	11.6250	1.22848	0.61424	9.6702	13.580
PEROXIDE FUSION	4	0.6723	0.02410	0.01205	0.6339	0.711

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.068036	0.057750	0.057750
COLD CHEM	4	1.228481	1.025000	1.025000
PEROXIDE FUSION	4	0.024102	0.016750	0.016750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	7.0510	2	9	0.0144
Brown-Forsythe	26.1132	2	9	0.0002
Levene	35.9415	2	9	<.0001
Bartlett	13.5400	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
190.9754	2	4.4412	<.0001

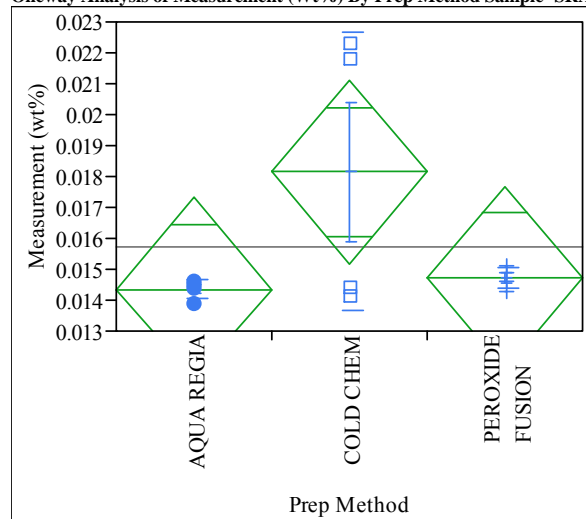
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM	A 11.625000
PEROXIDE FUSION	B 0.672250
AQUA REGIA	B 0.278750

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Ti



Oneway Anova Summary of Fit

Rsquare 0.362604
Adj Rsquare 0.220961
Root Mean Square Error 0.002618
Mean of Response 0.015742
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00003508	0.000018	2.5600	0.1318
Error	9	0.00006167	6.852e-6		
C. Total	11	0.00009675			

Means for Oneway Anova

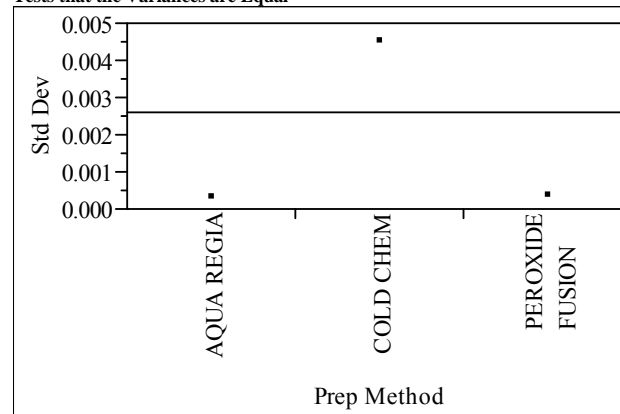
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.014350	0.00131	0.01139	0.01731
COLD CHEM	4	0.018150	0.00131	0.01519	0.02111
PEROXIDE FUSION	4	0.014725	0.00131	0.01176	0.01769

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.014350	0.000311	0.00016	0.01386	0.01484
COLD CHEM	4	0.018150	0.004510	0.00225	0.01097	0.02533
PEROXIDE FUSION	4	0.014725	0.000350	0.00018	0.01417	0.01528

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0003109	0.0002250	0.0002000
COLD CHEM	4	0.0045096	0.0039000	0.0039000
PEROXIDE FUSION	4	0.0003500	0.0002750	0.0002750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	170.1347	2	9	<.0001
Brown-Forsythe	385.6707	2	9	<.0001
Levene	495.7907	2	9	<.0001
Bartlett	9.4029	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.2917	2	5.3182	0.1915

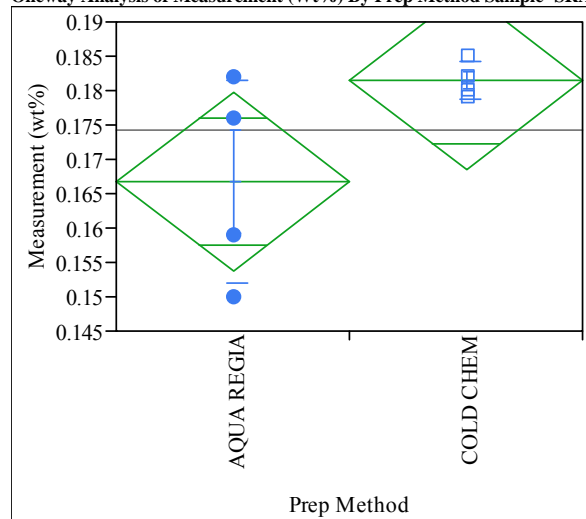
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM	A 0.01815000
PEROXIDE FUSION	A 0.01472500
AQUA REGIA	A 0.01435000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Product, Element=Zr



Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.39029
 Adj Rsquare 0.288672
 Root Mean Square Error 0.010644
 Mean of Response 0.174125
 Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	1	0.00043512	0.000435	3.8408	0.0977
Error	6	0.00067975	0.000113		
C. Total	7	0.00111488			

Means for Oneway Anova

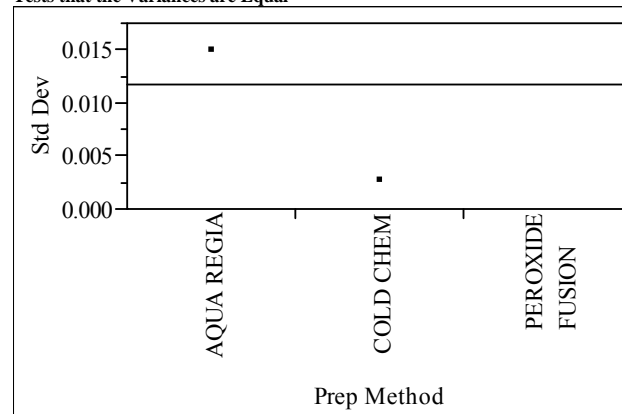
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.166750	0.00532	0.15373	0.17977
COLD CHEM	4	0.181500	0.00532	0.16848	0.19452
PEROXIDE FUSION	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.166750	0.014818	0.00741	0.14317	0.19033
COLD CHEM	4	0.181500	0.002646	0.00132	0.17729	0.18571
PEROXIDE FUSION	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0148183	0.0122500	0.0122500
COLD CHEM	4	0.0026458	0.0020000	0.0020000
PEROXIDE FUSION	0	.	0.0000000	0.0000000

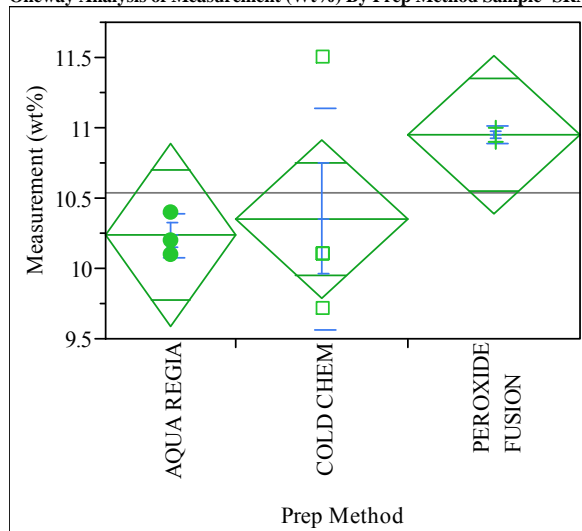
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	5.5266	1	6	0.0570
Brown-Forsythe	18.8876	1	6	0.0048
Levene	19.8543	1	6	0.0043
Bartlett	5.4573	1	.	0.0195

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
3.8408	1	3.1911	0.1394

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Al



Missing Rows

1

Oneway Anova Summary of Fit

Rsquare 0.363956
Adj Rsquare 0.204945
Root Mean Square Error 0.489099
Mean of Response 10.53727
Observations (or Sum Wgts) 11

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	1.0950765	0.547538	2.2889	0.1637
Error	8	1.9137417	0.239218		
C. Total	10	3.0088182			

Means for Oneway Anova

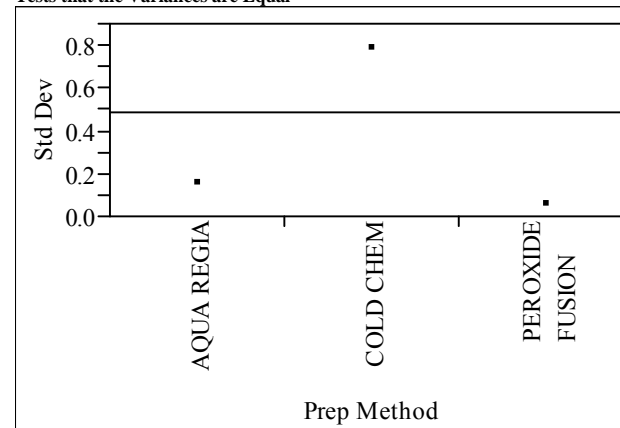
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	3	10.2333	0.28238	9.582	10.885
COLD CHEM	4	10.3525	0.24455	9.789	10.916
PEROXIDE FUSION	4	10.9500	0.24455	10.386	11.514

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	3	10.2333	0.152753	0.08819	9.854	10.613
COLD CHEM	4	10.3525	0.786781	0.39339	9.101	11.604
PEROXIDE FUSION	4	10.9500	0.057735	0.02887	10.858	11.042

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	3	0.1527525	0.1111111	0.1333333
COLD CHEM	4	0.7867814	0.5737500	0.4475000
PEROXIDE FUSION	4	0.0577350	0.0500000	0.0500000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.2866	2	8	0.3277
Brown-Forsythe	1.0475	2	8	0.3944
Levene	4.6300	2	8	0.0462
Bartlett	6.2299	2	.	0.0020

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
25.9134	2	3.5946	0.0073

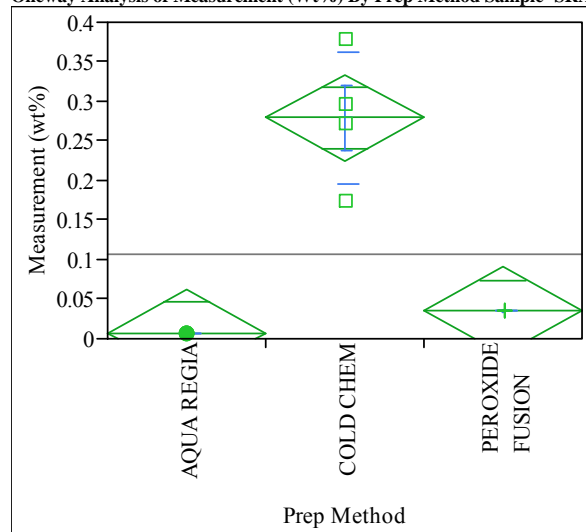
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	10.950000
COLD CHEM A	10.352500
AQUA REGIA A	10.233333

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=B



Oneway Anova Summary of Fit

Rsquare 0.894305
 Adj Rsquare 0.870817
 Root Mean Square Error 0.048488
 Mean of Response 0.10703
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.17903934	0.089520	38.0752	<.0001
Error	9	0.02116016	0.002351		
C. Total	11	0.20019950			

Means for Oneway Anova

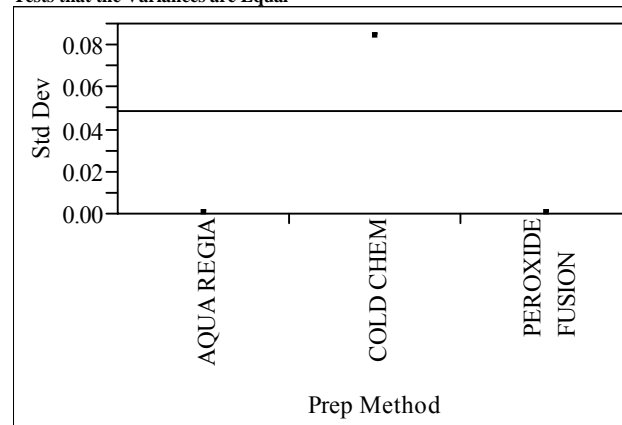
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.006915	0.02424	-0.0479	0.06176
COLD CHEM	4	0.279000	0.02424	0.2242	0.33384
PEROXIDE FUSION	4	0.035175	0.02424	-0.0197	0.09002

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.006915	0.000068	3.4e-5	0.00681	0.00702
COLD CHEM	4	0.279000	0.083984	0.04199	0.14536	0.41264
PEROXIDE FUSION	4	0.035175	0.000222	0.00011	0.03482	0.03553

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0000681	0.0000475	0.0000450
COLD CHEM	4	0.0839841	0.0570000	0.0570000
PEROXIDE FUSION	4	0.0002217	0.0001625	0.0001250

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0158	2	9	0.1891
Brown-Forsythe	4.7243	2	9	0.0396
Levene	4.7580	2	9	0.0389
Bartlett	29.8050	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
25754.755	2	4.3417	<.0001

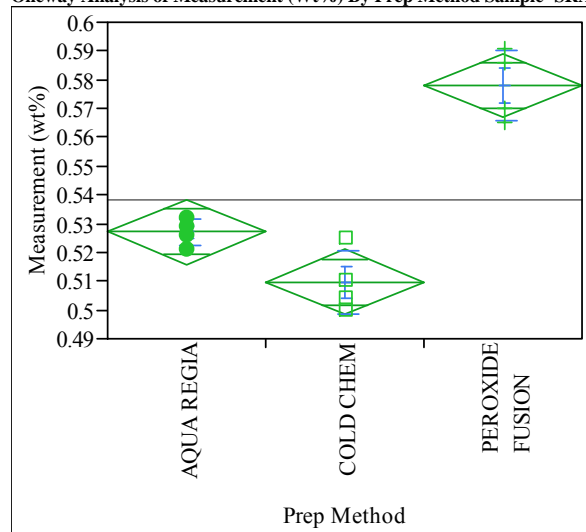
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM	A 0.27900000
PEROXIDE FUSION	B 0.03517500
AQUA REGIA	B 0.00691500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Ca



Oneway Anova Summary of Fit

Rsquare	0.918606
Adj Rsquare	0.900518
Root Mean Square Error	0.00996
Mean of Response	0.53825
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.01007550	0.005038	50.7866	<.0001
Error	9	0.00089275	0.000099		
C. Total	11	0.01096825			

Means for Oneway Anova

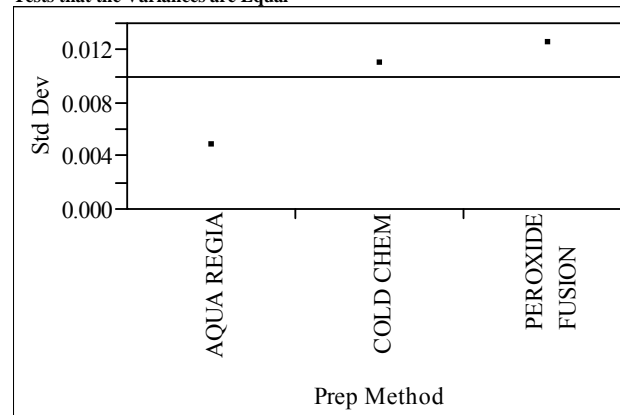
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.527000	0.00498	0.51573	0.53827
COLD CHEM	4	0.509750	0.00498	0.49848	0.52102
PEROXIDE FUSION	4	0.578000	0.00498	0.56673	0.58927

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.527000	0.004690	0.00235	0.51954	0.53446
COLD CHEM	4	0.509750	0.010966	0.00548	0.49230	0.52720
PEROXIDE FUSION	4	0.578000	0.012463	0.00623	0.55817	0.59783

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0046904	0.0035000	0.0035000
COLD CHEM	4	0.0109659	0.0077500	0.0077500
PEROXIDE FUSION	4	0.0124633	0.0105000	0.0105000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.4214	2	9	0.2908
Brown-Forsythe	2.3110	2	9	0.1549
Levene	2.7554	2	9	0.1165
Bartlett	1.1302	2	.	0.3230

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
32.9133	2	4.9985	0.0013

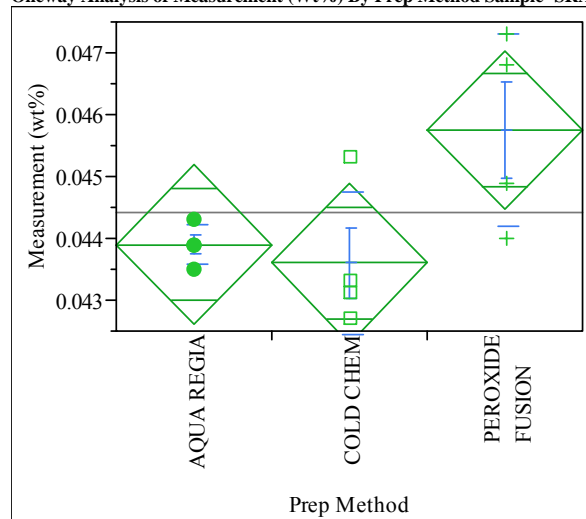
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.57800000
AQUA REGIA B	0.52700000
COLD CHEM B	0.50975000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Cr



Oneway Anova Summary of Fit

Rsquare	0.482146
Adj Rsquare	0.367067
Root Mean Square Error	0.001138
Mean of Response	0.044417
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00001085	5.4233e-6	4.1897	0.0518
Error	9	0.00001165	1.2944e-6		
C. Total	11	0.00002250			

Means for Oneway Anova

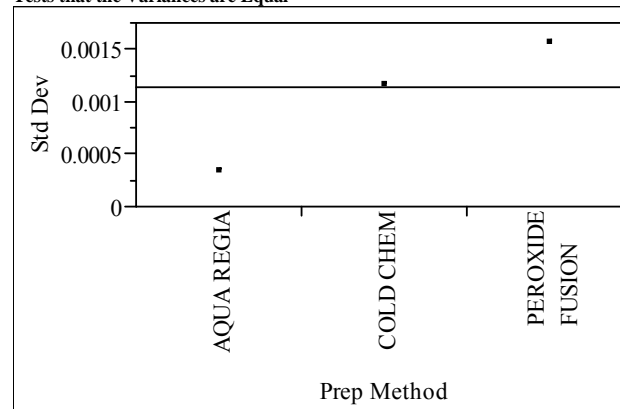
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.043900	0.00057	0.04261	0.04519
COLD CHEM	4	0.043600	0.00057	0.04231	0.04489
PEROXIDE FUSION	4	0.045750	0.00057	0.04446	0.04704

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.043900	0.000327	0.00016	0.04338	0.04442
COLD CHEM	4	0.043600	0.001160	0.00058	0.04175	0.04545
PEROXIDE FUSION	4	0.045750	0.001559	0.00078	0.04327	0.04823

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0003266	0.0002000	0.0002000
COLD CHEM	4	0.0011605	0.0008500	0.0007000
PEROXIDE FUSION	4	0.0015588	0.0013000	0.0013000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.0305	2	9	0.1872
Brown-Forsythe	3.1652	2	9	0.0910
Levene	5.9837	2	9	0.0222
Bartlett	2.3866	2	.	0.0919

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
2.5179	2	4.4462	0.1857

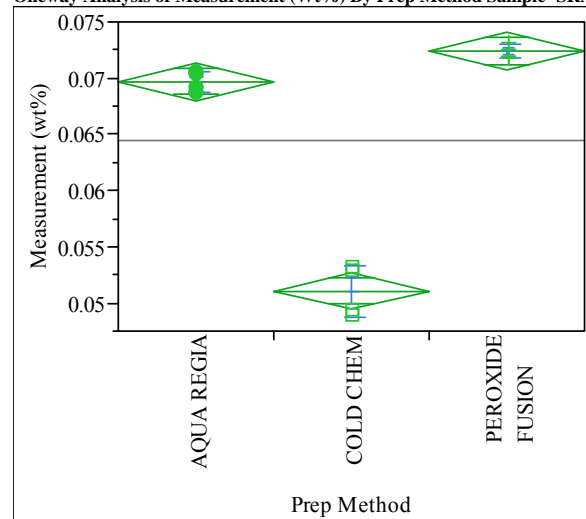
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.04575000
AQUA REGIA A	0.04390000
COLD CHEM A	0.04360000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Cu



Oneway Anova Summary of Fit

Rsquare	0.982414
Adj Rsquare	0.978506
Root Mean Square Error	0.001465
Mean of Response	0.064392
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00107858	0.000539	251.3851	<.0001
Error	9	0.00001931	2.145e-6		
C. Total	11	0.00109789			

Means for Oneway Anova

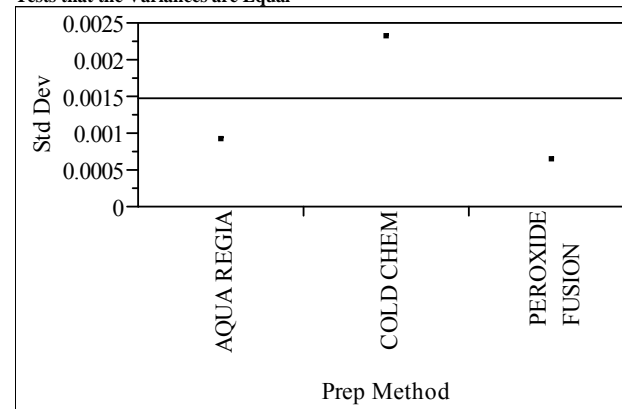
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.069700	0.00073	0.06804	0.07136
COLD CHEM	4	0.051075	0.00073	0.04942	0.05273
PEROXIDE FUSION	4	0.072400	0.00073	0.07074	0.07406

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.069700	0.000891	0.00045	0.06828	0.07112
COLD CHEM	4	0.051075	0.002290	0.00114	0.04743	0.05472
PEROXIDE FUSION	4	0.072400	0.000632	0.00032	0.07139	0.07341

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0008907	0.0007500	0.0007500
COLD CHEM	4	0.0022897	0.0019750	0.0019750
PEROXIDE FUSION	4	0.0006325	0.0005000	0.0005000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	38.2139	2	9	<.0001
Brown-Forsythe	41.7349	2	9	<.0001
Levene	49.3022	2	9	<.0001
Bartlett	2.3265	2	.	0.0976

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
145.3865	2	5.3177	<.0001

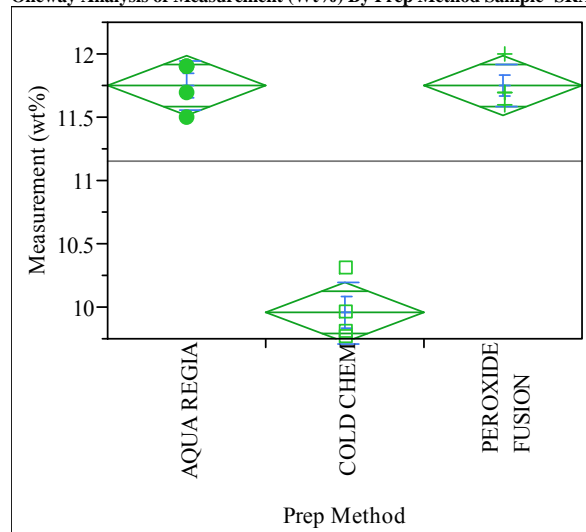
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.07240000
AQUA REGIA A	0.06970000
COLD CHEM B	0.05107500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Fe



Oneway Anova Summary of Fit

Rsquare 0.957825
 Adj Rsquare 0.948453
 Root Mean Square Error 0.204742
 Mean of Response 11.1525
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	8.5681500	4.28408	102.1978	<.0001
Error	9	0.3772750	0.04192		
C. Total	11	8.9454250			

Means for Oneway Anova

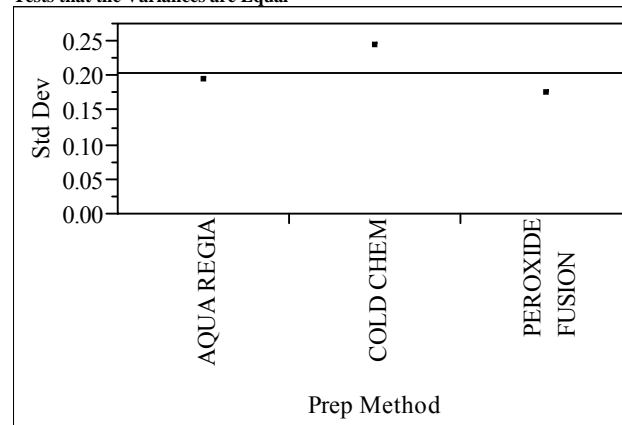
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	11.7500	0.10237	11.518	11.982
COLD CHEM	4	9.9575	0.10237	9.726	10.189
PEROXIDE FUSION	4	11.7500	0.10237	11.518	11.982

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	11.7500	0.191485	0.09574	11.445	12.055
COLD CHEM	4	9.9575	0.243088	0.12154	9.571	10.344
PEROXIDE FUSION	4	11.7500	0.173205	0.08660	11.474	12.026

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.1914854	0.1500000	0.1500000
COLD CHEM	4	0.2430878	0.1725000	0.1725000
PEROXIDE FUSION	4	0.1732051	0.1250000	0.1000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.2497	2	9	0.7843
Brown-Forsythe	0.2878	2	9	0.7566
Levene	0.1922	2	9	0.8284
Bartlett	0.1634	2	.	0.8492

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
76.3785	2	5.8986	<.0001

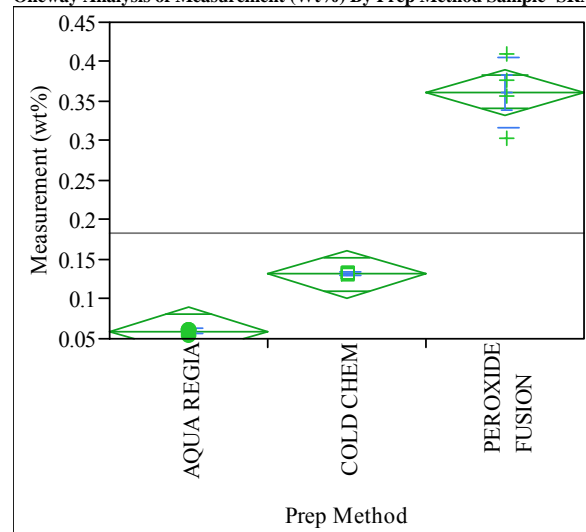
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA	A 11.750000
PEROXIDE FUSION	A 11.750000
COLD CHEM	B 9.957500

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=K



Oneway Anova Summary of Fit

Rsquare	0.969992
Adj Rsquare	0.963324
Root Mean Square Error	0.026151
Mean of Response	0.18425
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.19894550	0.099473	145.4599	<.0001
Error	9	0.00615465	0.000684		
C. Total	11	0.20510015			

Means for Oneway Anova

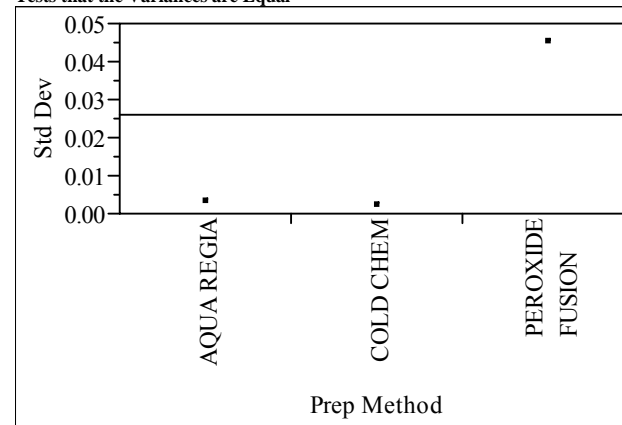
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.059500	0.01308	0.02992	0.08908
COLD CHEM	4	0.131750	0.01308	0.10217	0.16133
PEROXIDE FUSION	4	0.361500	0.01308	0.33192	0.39108

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.059500	0.003209	0.00160	0.05439	0.06461
COLD CHEM	4	0.131750	0.001893	0.00095	0.12874	0.13476
PEROXIDE FUSION	4	0.361500	0.045141	0.02257	0.28967	0.43333

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0032094	0.0023500	0.0020000
COLD CHEM	4	0.0018930	0.0013750	0.0012500
PEROXIDE FUSION	4	0.0451405	0.0320000	0.0320000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.1161	2	9	0.1765
Brown-Forsythe	5.2127	2	9	0.0314
Levene	5.3759	2	9	0.0291
Bartlett	10.9157	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
716.0749	2	4.9523	<.0001

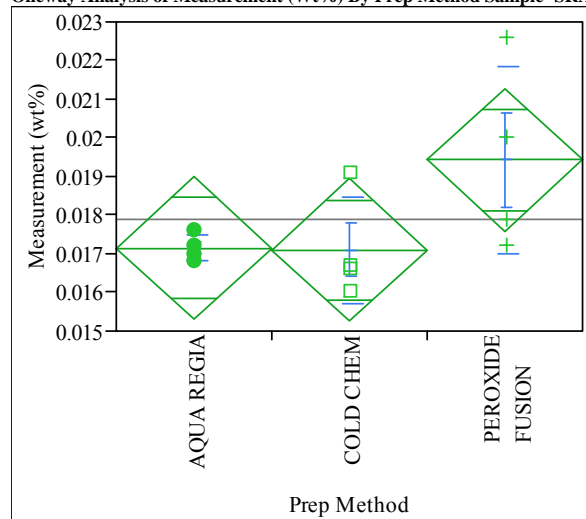
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.36150000
COLD CHEM B	0.13175000
AQUA REGIA C	0.05950000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Li



Oneway Anova Summary of Fit

Rsquare 0.373629
Adj Rsquare 0.234436
Root Mean Square Error 0.001621
Mean of Response 0.017892
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00001411	7.0558e-6	2.6842	0.1218
Error	9	0.00002366	2.6286e-6		
C. Total	11	0.00003777			

Means for Oneway Anova

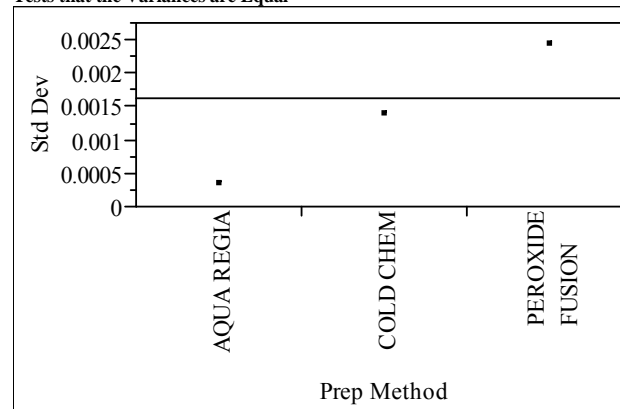
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.017150	0.00081	0.01532	0.01898
COLD CHEM	4	0.017100	0.00081	0.01527	0.01893
PEROXIDE FUSION	4	0.019425	0.00081	0.01759	0.02126

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.017150	0.000342	0.00017	0.01661	0.01769
COLD CHEM	4	0.017100	0.001369	0.00068	0.01492	0.01928
PEROXIDE FUSION	4	0.019425	0.002428	0.00121	0.01556	0.02329

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0003416	0.0002500	0.0002500
COLD CHEM	4	0.0013687	0.0010000	0.0008000
PEROXIDE FUSION	4	0.0024281	0.0018750	0.0018750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.8024	2	9	0.2196
Brown-Forsythe	2.8907	2	9	0.1072
Levene	4.4551	2	9	0.0452
Bartlett	3.4567	2	.	0.0315

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1.4985	2	4.3064	0.3206

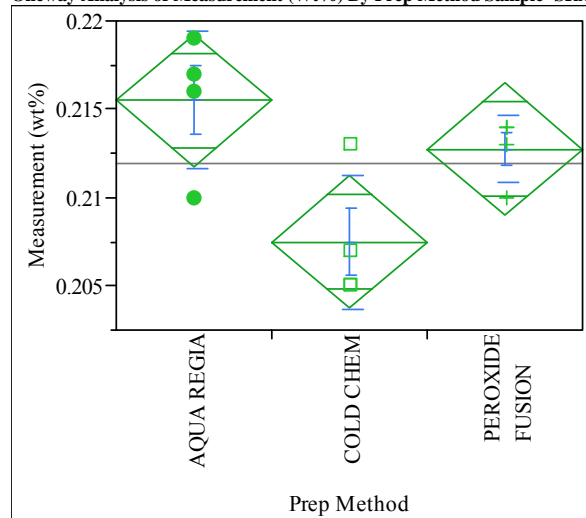
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.01942500
AQUA REGIA A	0.01715000
COLD CHEM A	0.01710000

Levels not connected by same letter are significantly different.

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



Oneway Anova Summary of Fit

Rsquare 0.572357
Adj Rsquare 0.477325
Root Mean Square Error 0.003312
Mean of Response 0.211917
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.00013217	0.000066	6.0228	0.0219
Error	9	0.00009875	0.000011		
C. Total	11	0.00023092			

Means for Oneway Anova

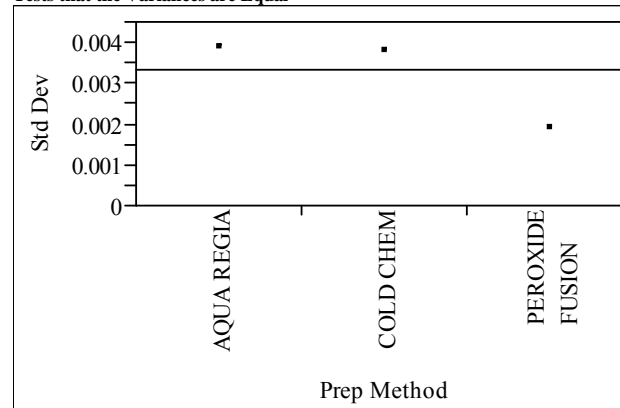
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.215500	0.00166	0.21175	0.21925
COLD CHEM	4	0.207500	0.00166	0.20375	0.21125
PEROXIDE FUSION	4	0.212750	0.00166	0.20900	0.21650

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.215500	0.003873	0.00194	0.20934	0.22166
COLD CHEM	4	0.207500	0.003786	0.00189	0.20148	0.21352
PEROXIDE FUSION	4	0.212750	0.001893	0.00095	0.20974	0.21576

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0038730	0.0027500	0.0025000
COLD CHEM	4	0.0037859	0.0027500	0.0025000
PEROXIDE FUSION	4	0.0018930	0.0013750	0.0012500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.4717	2	9	0.6386
Brown-Forsythe	0.3247	2	9	0.7309
Levene	0.7393	2	9	0.5043
Bartlett	0.7044	2	.	0.4944

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
4.1701	2	5.3155	0.0815

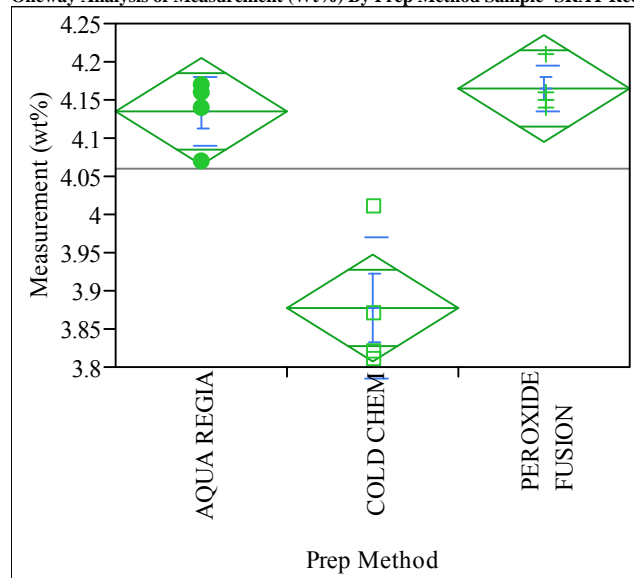
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
AQUA REGIA A	0.21550000
PEROXIDE FUSION A B	0.21275000
COLD CHEM B	0.20750000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Mn



Oneway Anova Summary of Fit

Rsquare	0.852854
Adj Rsquare	0.820155
Root Mean Square Error	0.061891
Mean of Response	4.059167
Observations (or Sum Wgts)	12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.19981667	0.099908	26.0819	0.0002
Error	9	0.03447500	0.003831		
C. Total	11	0.23429167			

Means for Oneway Anova

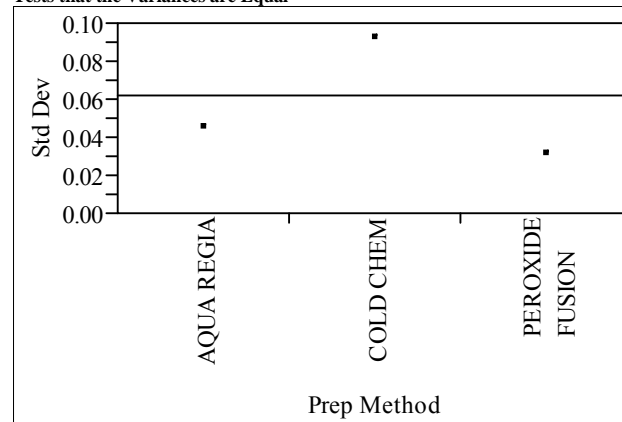
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	4.13500	0.03095	4.0650	4.2050
COLD CHEM	4	3.87750	0.03095	3.8075	3.9475
PEROXIDE FUSION	4	4.16500	0.03095	4.0950	4.2350

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	4.13500	0.045092	0.02255	4.0632	4.2068
COLD CHEM	4	3.87750	0.092150	0.04608	3.7309	4.0241
PEROXIDE FUSION	4	4.16500	0.031091	0.01555	4.1155	4.2145

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0450925	0.0325000	0.0300000
COLD CHEM	4	0.0921502	0.0662500	0.0625000
PEROXIDE FUSION	4	0.0310913	0.0225000	0.0200000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1276	2	9	0.3656
Brown-Forsythe	0.9270	2	9	0.4305
Levene	1.7733	2	9	0.2242
Bartlett	1.5863	2	.	0.2047

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
15.5471	2	5.3672	0.0058

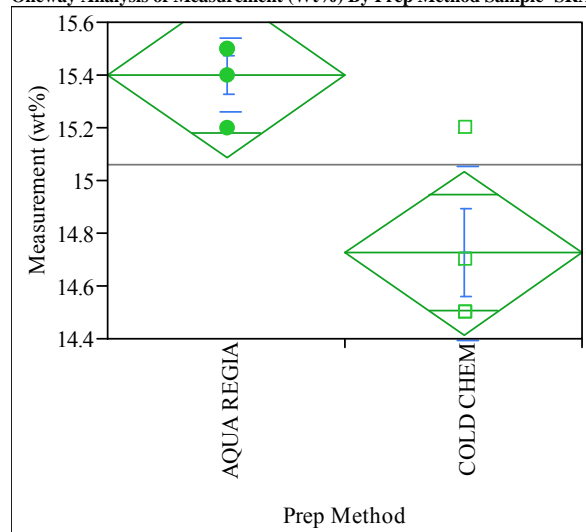
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	4.1650000
AQUA REGIA A	4.1350000
COLD CHEM B	3.8775000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Na



Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.701636
Adj Rsquare 0.651909
Root Mean Square Error 0.254133
Mean of Response 15.0625
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	1	0.9112500	0.911250	14.1097	0.0094
Error	6	0.3875000	0.064583		
C. Total	7	1.2987500			

Means for Oneway Anova

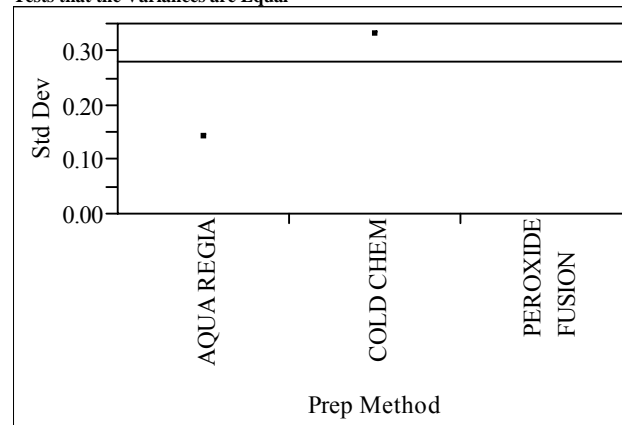
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	15.4000	0.12707	15.089	15.711
COLD CHEM	4	14.7250	0.12707	14.414	15.036
PEROXIDE FUSION	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	15.4000	0.141421	0.07071	15.175	15.625
COLD CHEM	4	14.7250	0.330404	0.16520	14.199	15.251
PEROXIDE FUSION	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.1414214	0.1000000	0.1000000
COLD CHEM	4	0.3304038	0.2375000	0.2250000
PEROXIDE FUSION	0	.	0.0000000	0.0000000

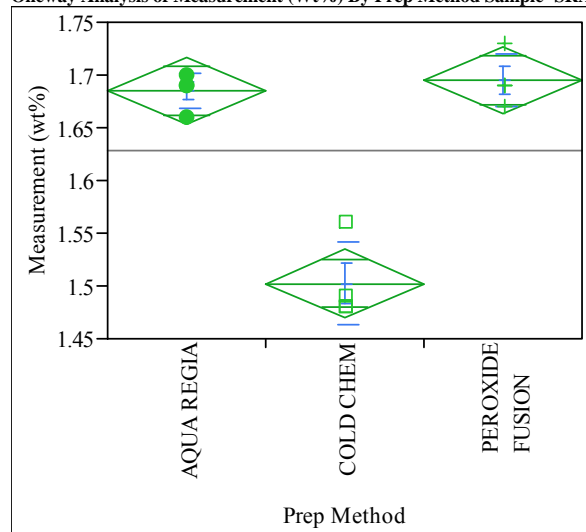
Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1404	1	6	0.3266
Brown-Forsythe	0.8621	1	6	0.3890
Levene	1.8615	1	6	0.2214
Bartlett	1.6645	1	.	0.1970

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
14.1097	1	4.0635	0.0193

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Ni



Oneway Anova Summary of Fit

Rsquare 0.92813
 Adj Rsquare 0.912159
 Root Mean Square Error 0.028431
 Mean of Response 1.6275
 Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	0.09395000	0.046975	58.1134	<.0001
Error	9	0.00727500	0.000808		
C. Total	11	0.10122500			

Means for Oneway Anova

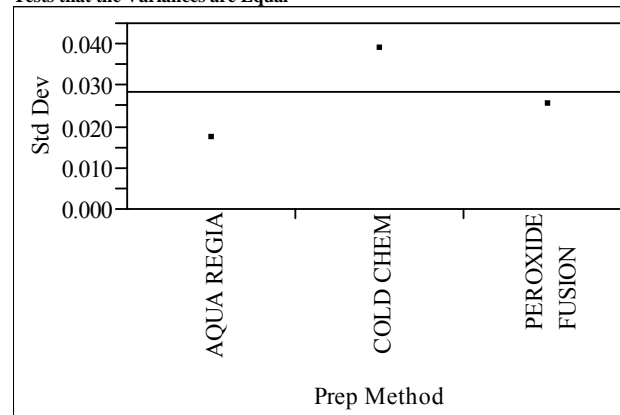
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	1.68500	0.01422	1.6528	1.7172
COLD CHEM	4	1.50250	0.01422	1.4703	1.5347
PEROXIDE FUSION	4	1.69500	0.01422	1.6628	1.7272

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	1.68500	0.017321	0.00866	1.6574	1.7126
COLD CHEM	4	1.50250	0.038622	0.01931	1.4410	1.5640
PEROXIDE FUSION	4	1.69500	0.025166	0.01258	1.6550	1.7350

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0173205	0.0125000	0.0100000
COLD CHEM	4	0.0386221	0.0287500	0.0225000
PEROXIDE FUSION	4	0.0251661	0.0175000	0.0150000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6369	2	9	0.5512
Brown-Forsythe	0.2651	2	9	0.7729
Levene	1.1770	2	9	0.3515
Bartlett	0.8133	2	.	0.4434

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
36.4922	2	5.5137	0.0007

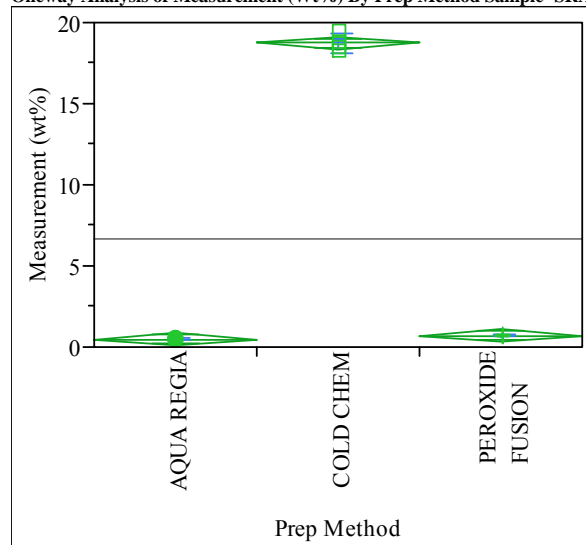
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	1.6950000
AQUA REGIA A	1.6850000
COLD CHEM B	1.5025000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Si



Oneway Anova Summary of Fit

Rsquare 0.998856
Adj Rsquare 0.998602
Root Mean Square Error 0.333864
Mean of Response 6.642167
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	876.06597	438.033	3929.763	<.0001
Error	9	1.00319	0.111		
C. Total	11	877.06916			

Means for Oneway Anova

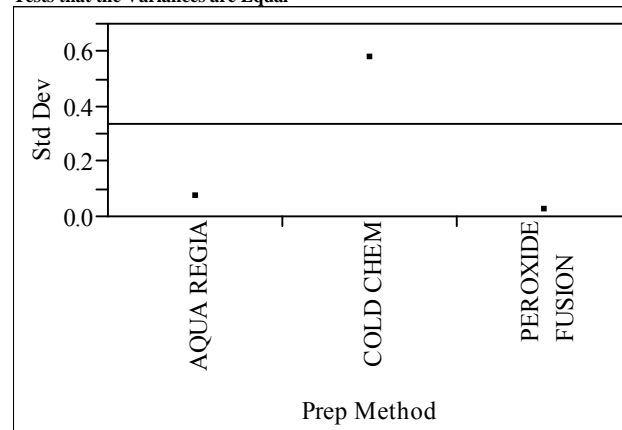
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.4908	0.16693	0.113	0.868
COLD CHEM	4	18.7250	0.16693	18.347	19.103
PEROXIDE FUSION	4	0.7108	0.16693	0.333	1.088

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.4908	0.069591	0.03480	0.380	0.601
COLD CHEM	4	18.7250	0.573730	0.28687	17.812	19.638
PEROXIDE FUSION	4	0.7108	0.019670	0.00984	0.679	0.742

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0695911	0.0537500	0.0537500
COLD CHEM	4	0.5737305	0.4250000	0.4250000
PEROXIDE FUSION	4	0.0196702	0.0157500	0.0157500

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	2.2568	2	9	0.1606
Brown-Forsythe	5.5497	2	9	0.0269
Levene	6.8641	2	9	0.0155
Bartlett	10.0814	2	.	<.0001

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
1724.2361	2	4.2985	<.0001

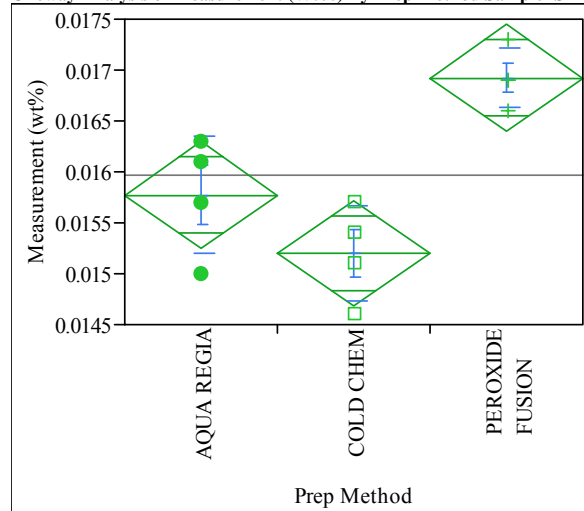
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
COLD CHEM	A 18.725000
PEROXIDE FUSION	B 0.710750
AQUA REGIA	B 0.490750

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Ti



Oneway Anova Summary of Fit

Rsquare 0.765083
Adj Rsquare 0.712879
Root Mean Square Error 0.000459
Mean of Response 0.015967
Observations (or Sum Wgts) 12

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	2	6.17167e-6	3.0858e-6	14.6557	0.0015
Error	9	1.895e-6	2.1056e-7		
C. Total	11	8.06667e-6			

Means for Oneway Anova

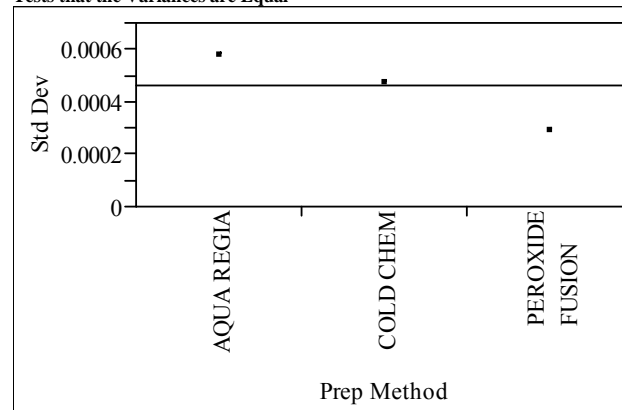
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.015775	0.00023	0.01526	0.01629
COLD CHEM	4	0.015200	0.00023	0.01468	0.01572
PEROXIDE FUSION	4	0.016925	0.00023	0.01641	0.01744

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.015775	0.000574	0.00029	0.01486	0.01669
COLD CHEM	4	0.015200	0.000469	0.00023	0.01445	0.01595
PEROXIDE FUSION	4	0.016925	0.000287	0.00014	0.01647	0.01738

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0005737	0.0004250	0.0004250
COLD CHEM	4	0.0004690	0.0003500	0.0003500
PEROXIDE FUSION	4	0.0002872	0.0001875	0.0001750

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	0.6500	2	9	0.5449
Brown-Forsythe	0.9331	2	9	0.4283
Levene	0.9792	2	9	0.4123
Bartlett	0.5830	2	.	0.5582

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

F Ratio	DFNum	DFDen	Prob > F
19.6621	2	5.4968	0.0031

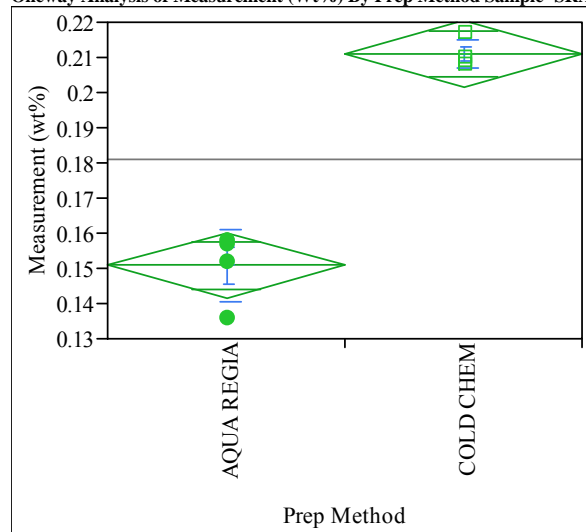
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
PEROXIDE FUSION A	0.01692500
AQUA REGIA B	0.01577500
COLD CHEM B	0.01520000

Levels not connected by same letter are significantly different.

Oneway Analysis of Measurement (Wt%) By Prep Method Sample=SRAT Receipt, Element=Zr



Missing Rows

4

Oneway Anova Summary of Fit

Rsquare 0.952663
Adj Rsquare 0.944773
Root Mean Square Error 0.007754
Mean of Response 0.180875
Observations (or Sum Wgts) 8

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep Method	1	0.00726012	0.007260	120.7505	<.0001
Error	6	0.00036075	0.000060		
C. Total	7	0.00762087			

Means for Oneway Anova

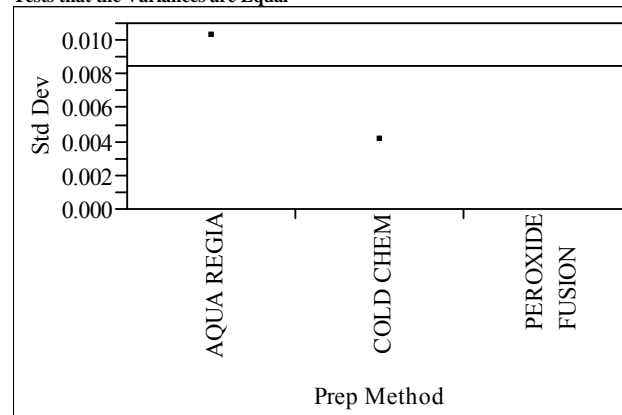
Level	Number	Mean	Std Error	Lower 95%	Upper 95%
AQUA REGIA	4	0.150750	0.00388	0.14126	0.16024
COLD CHEM	4	0.211000	0.00388	0.20151	0.22049
PEROXIDE FUSION	0	.	.	.	.

Std Error uses a pooled estimate of error variance

Means and Std Deviations

Level	Number	Mean	Std Dev	Std Err Mean	Lower 95%	Upper 95%
AQUA REGIA	4	0.150750	0.010178	0.00509	0.13456	0.16694
COLD CHEM	4	0.211000	0.004082	0.00204	0.20450	0.21750
PEROXIDE FUSION	0	.	.	.	.	.

Tests that the Variances are Equal



Level	Count	Std Dev	MeanAbsDif to Mean	MeanAbsDif to Median
AQUA REGIA	4	0.0101776	0.0073750	0.0067500
COLD CHEM	4	0.0040825	0.0030000	0.0025000
PEROXIDE FUSION	0	.	0.0000000	0.0000000

Test	F Ratio	DFNum	DFDen	Prob > F
O'Brien[.5]	1.1551	1	6	0.3238
Brown-Forsythe	0.9909	1	6	0.3580
Levene	2.1429	1	6	0.1936
Bartlett	1.9005	1	.	0.1680

Warning: Small sample sizes. Use Caution.

Welch Anova testing Means Equal, allowing Std Devs Not Equal

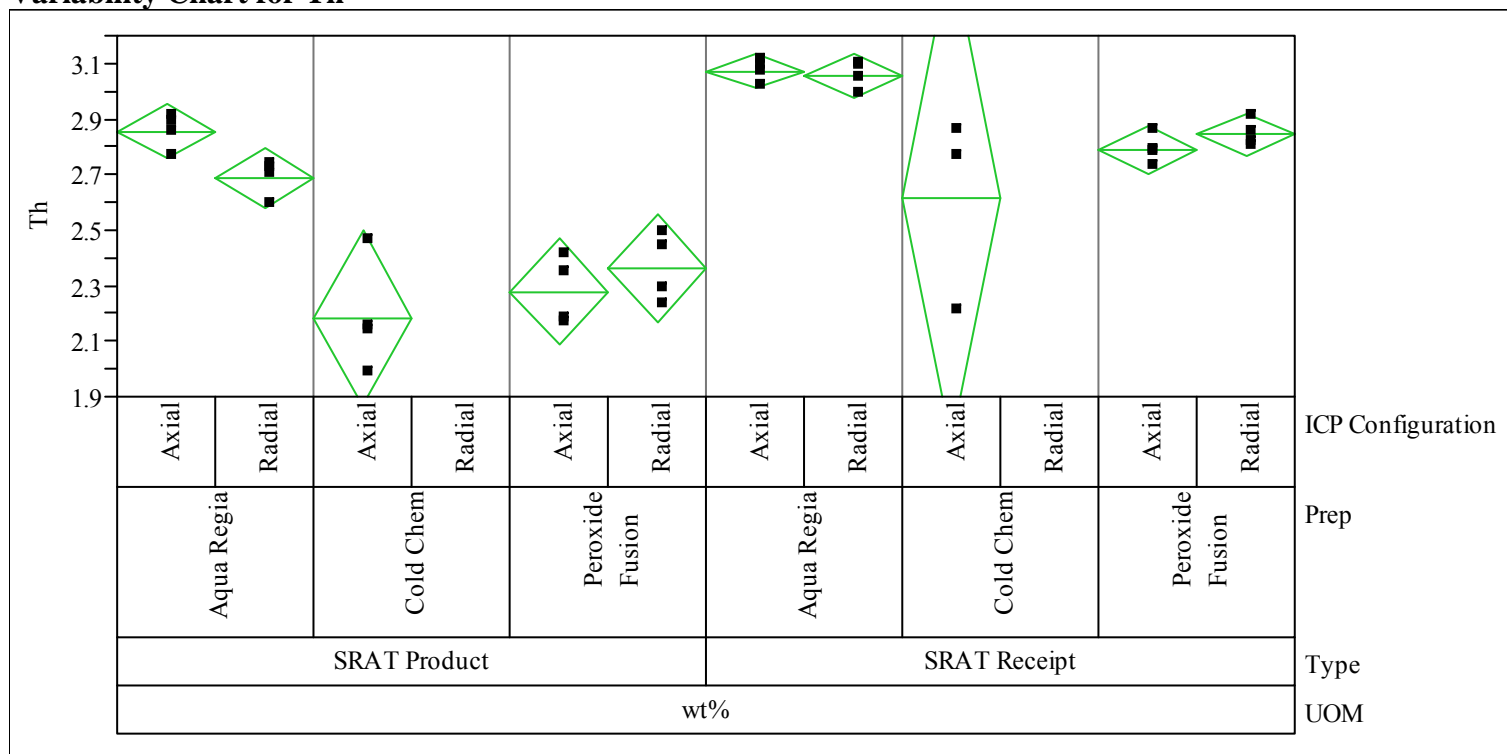
F Ratio	DFNum	DFDen	Prob > F
120.7505	1	3.941	0.0004

Th and U Axial and Radial Stat Comparison

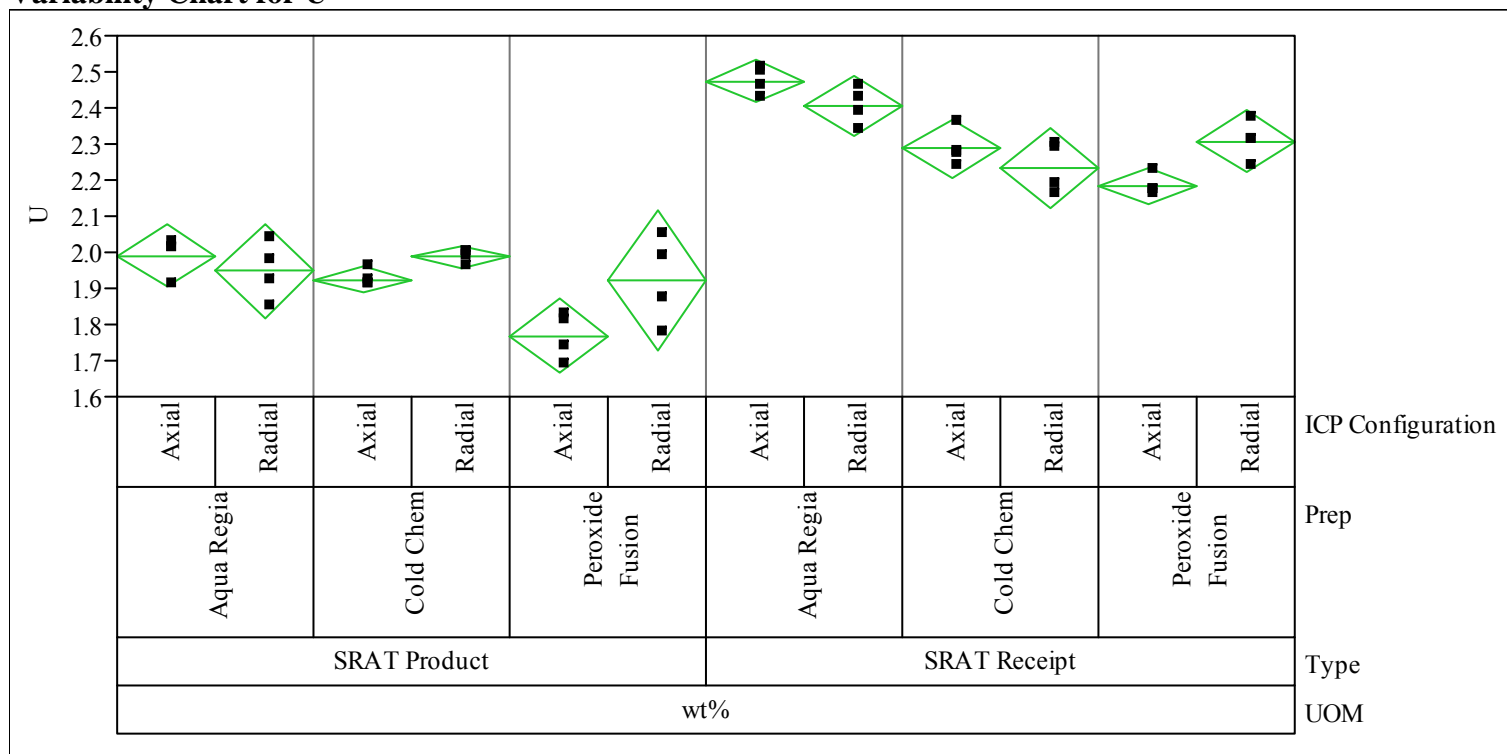
Data Table:

Type	Prep	Sample ID	LIMS	UOM	Th Axial	Th Radial	U Axial	U Radial
SRAT Product	Aqua Regia	TS144_09_A_105230	300268412	Wt%	2.85	2.7	2.01	1.98
SRAT Product	Aqua Regia	TS144_09_A_105231	300268413	Wt%	2.89	2.74	2.03	2.04
SRAT Product	Aqua Regia	TS144_09_A_105232	300268414	Wt%	2.91	2.72	2.01	1.92
SRAT Product	Aqua Regia	TS144_09_A_105233	300268415	Wt%	2.77	2.59	1.91	1.85
SRAT Product	Cold Chem	TS144_09_A_105258	300269104	Wt%	2.46	.	2.03	2
SRAT Product	Cold Chem	TS144_09_A_105259	300269107	Wt%	1.99	.	2	1.96
SRAT Product	Cold Chem	TS144_09_A_105260	300269109	Wt%	2.15	.	2.01	1.99
SRAT Product	Cold Chem	TS144_09_A_105261	300269110	Wt%	2.14	.	2.03	2
SRAT Product	Peroxide Fusion	TS144_09_A_105242	300268425	Wt%	2.35	2.44	1.81	1.87
SRAT Product	Peroxide Fusion	TS144_09_A_105243	300268427	Wt%	2.41	2.49	1.83	2.05
SRAT Product	Peroxide Fusion	TS144_09_A_105244	300268428	Wt%	2.18	2.29	1.69	1.78
SRAT Product	Peroxide Fusion	TS144_09_A_105245	300268430	Wt%	2.17	2.23	1.74	1.99
SRAT Receipt	Aqua Regia	TS144_09_A_105511	300271682	Wt%	3.02	2.99	2.43	2.39
SRAT Receipt	Aqua Regia	TS144_09_A_105512	300271683	Wt%	3.07	3.05	2.46	2.34
SRAT Receipt	Aqua Regia	TS144_09_A_105513	300271684	Wt%	3.09	3.09	2.5	2.46
SRAT Receipt	Aqua Regia	TS144_09_A_105514	300271685	Wt%	3.11	3.1	2.51	2.43
SRAT Receipt	Cold Chem	TS144_09_A_105164	300267523	Wt%	2.77	.	2.28	2.29
SRAT Receipt	Cold Chem	TS144_09_A_105165	300267525	Wt%	2.86	.	2.27	2.19
SRAT Receipt	Cold Chem	TS144_09_A_105166	300267526	Wt%	.	.	2.36	2.3
SRAT Receipt	Cold Chem	TS144_09_A_105167	300267528	Wt%	2.21	.	2.24	2.16
SRAT Receipt	Peroxide Fusion	TS144_09_A_105129	300267073	Wt%	2.86	2.91	2.23	2.31
SRAT Receipt	Peroxide Fusion	TS144_09_A_105130	300267075	Wt%	2.78	2.85	2.16	2.24
SRAT Receipt	Peroxide Fusion	TS144_09_A_105131	300267076	Wt%	2.79	2.82	2.17	2.31
SRAT Receipt	Peroxide Fusion	TS144_09_A_105132	300267078	Wt%	2.73	2.8	2.17	2.37

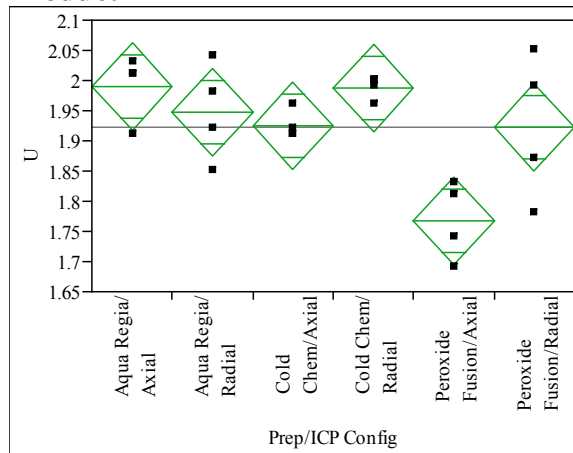
Variability Chart for Th



Variability Chart for U



Oneway Analysis of U By Prep/ICP Config Type=SRAT Product



Oneway Anova Summary of Fit

Rsquare	0.603671
Adj Rsquare	0.49358
Root Mean Square Error	0.069841
Mean of Response	1.923333
Observations (or Sum Wgts)	24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep/ICP Config	5	0.13373333	0.026747	5.4834	0.0031
Error	18	0.08780000	0.004878		
C. Total	23	0.22153333			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia/Axial	4	1.99000	0.03492	1.9166	2.0634
Aqua Regia/Radial	4	1.94750	0.03492	1.8741	2.0209
Cold Chem/Axial	4	1.92500	0.03492	1.8516	1.9984
Cold Chem/Radial	4	1.98750	0.03492	1.9141	2.0609
Peroxide Fusion/Axial	4	1.76750	0.03492	1.6941	1.8409
Peroxide Fusion/Radial	4	1.92250	0.03492	1.8491	1.9959

Std Error uses a pooled estimate of error variance

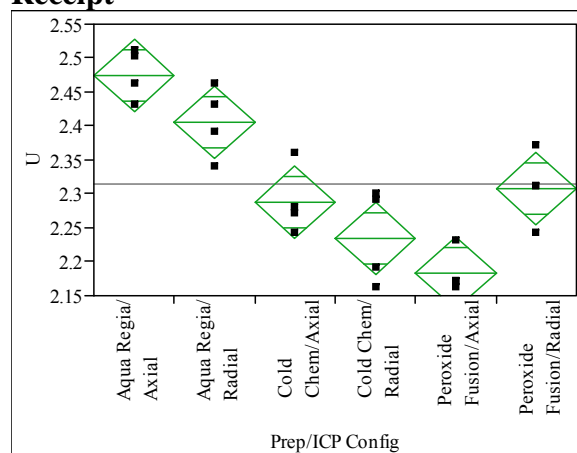
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
Aqua Regia/Axial A	1.9900000
Cold Chem/Radial A	1.9875000
Aqua Regia/Radial A	1.9475000
Cold Chem/Axial A	1.9250000
Peroxide Fusion/Radial A B	1.9225000
Peroxide Fusion/Axial B	1.7675000

Levels not connected by same letter are significantly different.

Oneway Analysis of U By Prep/ICP Config Type=SRAT Receipt



Oneway Anova Summary of Fit

Rsquare 0.834074
 Adj Rsquare 0.787983
 Root Mean Square Error 0.05084
 Mean of Response 2.315417
 Observations (or Sum Wgts) 24

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep/ICP Config	5	0.23387083	0.046774	18.0964	<.0001
Error	18	0.04652500	0.002585		
C. Total	23	0.28039583			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia/Axial	4	2.47500	0.02542	2.4216	2.5284
Aqua Regia/Radial	4	2.40500	0.02542	2.3516	2.4584
Cold Chem/Axial	4	2.28750	0.02542	2.2341	2.3409
Cold Chem/Radial	4	2.23500	0.02542	2.1816	2.2884
Peroxide Fusion/Axial	4	2.18250	0.02542	2.1291	2.2359
Peroxide Fusion/Radial	4	2.30750	0.02542	2.2541	2.3609

Std Error uses a pooled estimate of error variance

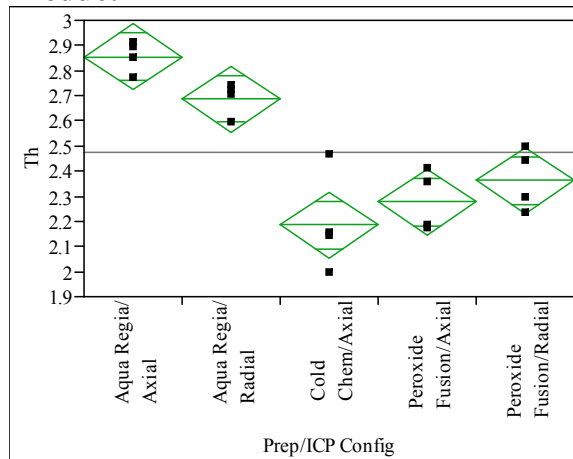
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
Aqua Regia/Axial A	2.4750000
Aqua Regia/Radial A B	2.4050000
Peroxide Fusion/Radial B C	2.3075000
Cold Chem/Axial C D	2.2875000
Cold Chem/Radial C D	2.2350000
Peroxide Fusion/Axial D	2.1825000

Levels not connected by same letter are significantly different.

Oneway Analysis of Th By Prep/ICP Config Type=SRAT Product



Oneway Anova Summary of Fit

Rsquare 0.849336
 Adj Rsquare 0.809159
 Root Mean Square Error 0.12405
 Mean of Response 2.4735
 Observations (or Sum Wgts) 20

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep/ICP Config	4	1.3012300	0.325308	21.1399	<.0001
Error	15	0.2308250	0.015388		
C. Total	19	1.5320550			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia/Axial	4	2.85500	0.06202	2.7228	2.9872
Aqua Regia/Radial	4	2.68750	0.06202	2.5553	2.8197
Cold Chem/Axial	4	2.18500	0.06202	2.0528	2.3172
Peroxide Fusion/Axial	4	2.27750	0.06202	2.1453	2.4097
Peroxide Fusion/Radial	4	2.36250	0.06202	2.2303	2.4947

Std Error uses a pooled estimate of error variance

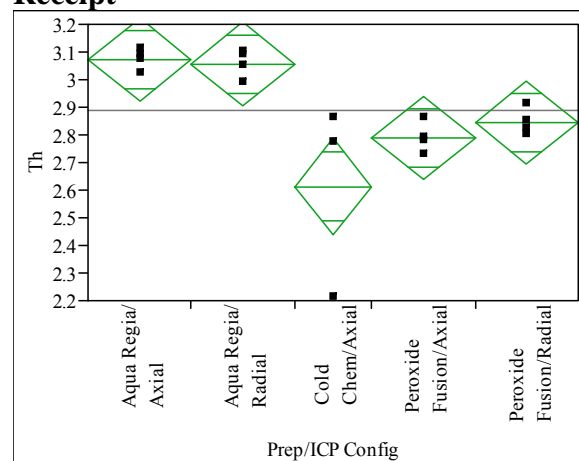
Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
Aqua Regia/Axial A	2.8550000
Aqua Regia/Radial A	2.6875000
Peroxide Fusion/Radial B	2.3625000
Peroxide Fusion/Axial B	2.2775000
Cold Chem/Axial B	2.1850000

Levels not connected by same letter are significantly different.

Oneway Analysis of Th By Prep/ICP Config Type=SRAT Receipt



Oneway Anova Summary of Fit

Rsquare 0.655041
 Adj Rsquare 0.556482
 Root Mean Square Error 0.140285
 Mean of Response 2.889474
 Observations (or Sum Wgts) 19

Analysis of Variance

Source	DF	Sum of Squares	Mean Square	F Ratio	Prob > F
Prep/ICP Config	4	0.52317807	0.130795	6.6461	0.0032
Error	14	0.27551667	0.019680		
C. Total	18	0.79869474			

Means for Oneway Anova

Level	Number	Mean	Std Error	Lower 95%	Upper 95%
Aqua Regia/Axial	4	3.07250	0.07014	2.9221	3.2229
Aqua Regia/Radial	4	3.05750	0.07014	2.9071	3.2079
Cold Chem/Axial	3	2.61333	0.08099	2.4396	2.7870
Peroxide Fusion/Axial	4	2.79000	0.07014	2.6396	2.9404
Peroxide Fusion/Radial	4	2.84500	0.07014	2.6946	2.9954

Std Error uses a pooled estimate of error variance

Means Comparisons

Comparisons for all pairs using Tukey-Kramer HSD

Level	Mean
Aqua Regia/Axial A	3.0725000
Aqua Regia/Radial A	3.0575000
Peroxide Fusion/Radial A B	2.8450000
Peroxide Fusion/Axial A B	2.7900000
Cold Chem/Axial B	2.6133333

Levels not connected by same letter are significantly different.

Matched Pairs Type=SRAT Product, Prep=Aqua Regia Difference: Th Radial-Th Axial				Difference: U Radial-U Axial			
Th Radial	2.6875	t-	-	U Radial	1.9475	t-	-
		Ratio	16.2499			Ratio	1.9897
Th Axial	2.855	DF	3	U Axial	1.99	DF	3
Mean	-0.1675	Prob	0.0005	Mean	-0.0425	Prob	0.1407
Difference		> |t|		Difference		> |t|	
Std Error	0.01031	Prob	0.9997	Std Error	0.02136	Prob	0.9296
		> t				> t	
Upper95%	-0.1347	Prob	0.0003	Upper95%	0.02548	Prob	0.0704
		< t				< t	
Lower95%	-0.2003			Lower95%	-0.1105		
N	4			N	4		
Correlation	0.95193			Correlation	0.87713		
Matched Pairs Type=SRAT Product, Prep=Peroxide Fusion Difference: Th Radial-Th Axial				Difference: U Radial-U Axial			
Th Radial	2.3625	t-	8.166536	U Radial	1.9225	t-	3.29837
		Ratio				Ratio	
Th Axial	2.2775	DF	3	U Axial	1.7675	DF	3
Mean	0.085	Prob	0.0038	Mean	0.155	Prob	0.0458
Difference		> |t|		Difference		> |t|	
Std Error	0.01041	Prob	0.0019	Std Error	0.04699	Prob	0.0229
		> t				> t	
Upper95%	0.11812	Prob	0.9981	Upper95%	0.30455	Prob	0.9771
		< t				< t	
Lower95%	0.05188			Lower95%	0.00545		
N	4			N	4		
Correlation	0.98547			Correlation	0.63795		
Matched Pairs Type=SRAT Receipt, Prep=Aqua Regia Difference: Th Radial-Th Axial				Difference: U Radial-U Axial			
Th Radial	3.0575	t-	-	U Radial	2.405	t-	-
		Ratio	2.32379			Ratio	3.65563
Th Axial	3.0725	DF	3	U Axial	2.475	DF	3
Mean	-0.015	Prob	0.1027	Mean	-0.07	Prob	0.0354
Difference		> |t|		Difference		> |t|	
Std Error	0.00645	Prob	0.9486	Std Error	0.01915	Prob	0.9823
		> t				> t	
Upper95%	0.00554	Prob	0.0514	Upper95%	-0.0091	Prob	0.0177
		< t				< t	

Lower95%	-0.0355			Lower95%	-0.1309		
N	4			N	4		
Correlation	0.98986			Correlation	0.67675		
Matched Pairs Type=SRAT Receipt, Prep=Peroxide Fusion Difference: Th Radial-Th Axial				Difference: U Radial-U Axial			
Th Radial	2.845	t-	5.744563	U Radial	2.3075	t-	4.351941
		Ratio				Ratio	
Th Axial	2.79	DF	3	U Axial	2.1825	DF	3
Mean	0.055	Prob	0.0105	Mean	0.125	Prob	0.0224
Difference		> |t|		Difference		> |t|	
Std Error	0.00957	Prob	0.0052	Std Error	0.02872	Prob	0.0112
		> t				> t	
Upper95%	0.08547	Prob	0.9948	Upper95%	0.21641	Prob	0.9888
		< t				< t	
Lower95%	0.02453			Lower95%	0.03359		
N	4			N	4		
Correlation	0.93467			Correlation	0.16161		

Distribution

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

ADS Files