

APPENDIX - STATISTICAL ANALYSIS OF THERMAL DEGRADATION

The parameters submitted to the statistical analysis were the "Percentages of Thermal Degradation" for each of "Thermal Time Lengths (minutes)", i.e., 30, 60, 90, and 120 minutes. The analysis was performed in the *Minitab 17* software. The sequence of tests and the respective results are presented below.

1. Normality Test: % Thermal Degradation

All thermal degradation values were subjected to the Normality Test.

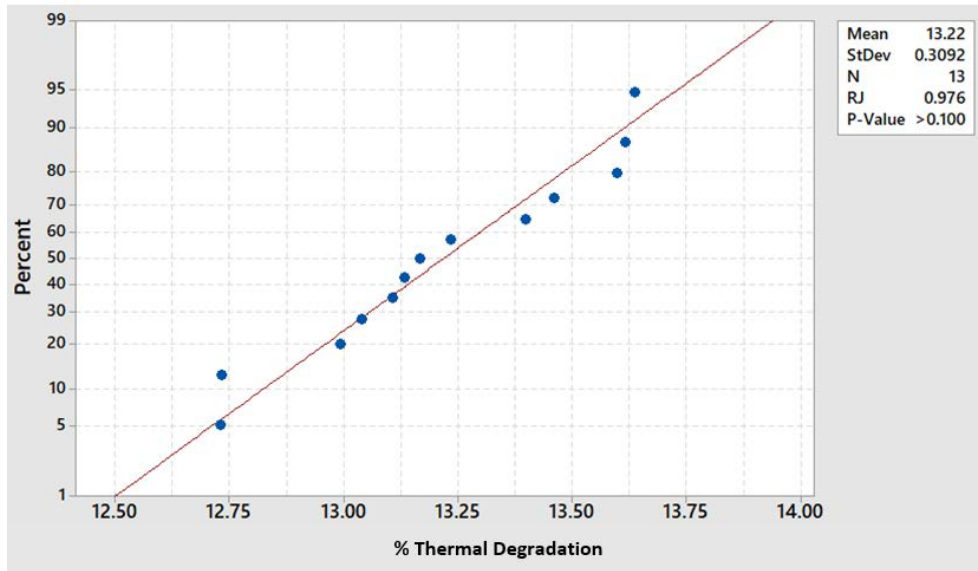


Figure 1. Normality Test performed with the thermal degradation values of all samples.

Result of Test: p-value > 0.100 (greater than 0.05) indicates that the distribution is normal.

2. Test for Equal Variances - Levene's Test: % Thermal Degradation versus Thermal Time Lengths (minutes)

Method

Null hypothesis All variances are equal
 Alternative hypothesis At least one variance is different
 Significance level $\alpha = 0.05$

95% Bonferroni Confidence Intervals for Standard Deviations

Time (min)	N	StDev	CI
30	3	0.151111	(0.0005781; 235.907)
60	4	0.155561	(0.0189908; 3.393)
90	3	0.019776	(0.0000757; 30.873)
120	3	0.168102	(0.0006431; 262.431)

Individual confidence level = 98.75%

Tests

Method	Test Statistic	P-Value
Multiple comparisons	-	0.058
Levene	0.52	0.680

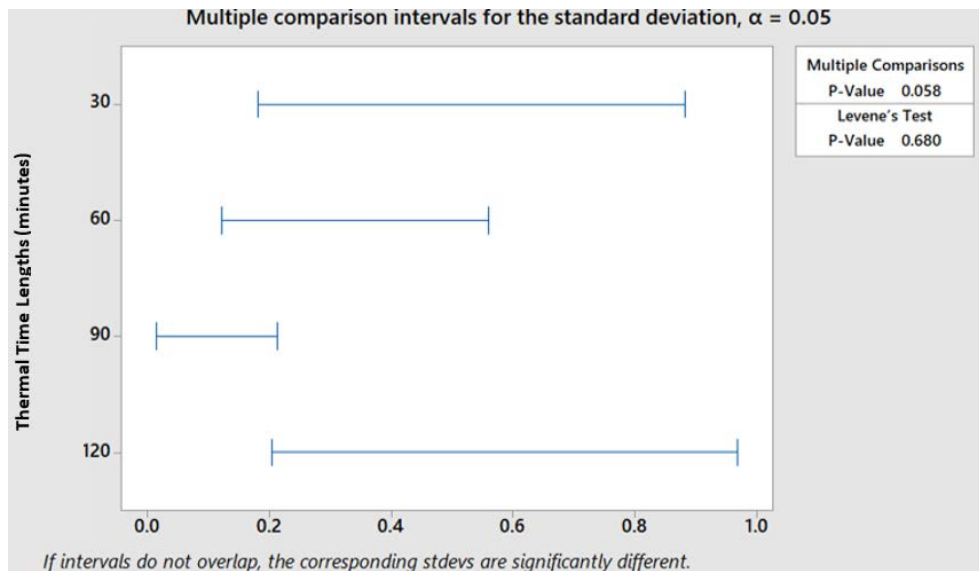


Figure 2. Test for Equal Variances or Levene's Test (% Thermal Degradation versus Thermal Time Lengths in minutes).

Result of Test: p-value = 0.680 (greater than 0.05) indicates that the variances are homogeneous. Therefore, the One-way ANOVA test can be applied.

3. One-way ANOVA: % Thermal Degradation versus Thermal Time Lengths (minutes)

Method

Null hypothesis All means are equal
Alternative hypothesis At least one mean is different
Significance level $\alpha = 0.05$

Equal variances were assumed for the analysis.

Factor Information

Factor	Levels	Values
Time (min)	4	30; 60; 90; 120

Analysis of Variance

Source	DF	Adj SS	Adj MS	F-Value	P-Value
Time (min)	3	0.9717	0.32389	16.60	0.001
Error	9	0.1756	0.01951		
Total	12	1.1472			

Result of Test: p-value = 0.001 (less than 0.05) indicates that at least one mean is different from the others.

Model Summary

S	R-sq	R-sq(adj)	R-sq(pred)
0.139668	84.70%	79.60%	68.56%

Means

Time (min)	N	Mean	StDev	95% CI
30	3	12.8188	0.1511	(12.6364; 13.0012)
60	4	13.1781	0.1556	(13.0201; 13.3361)
90	3	13.6169	0.0198	(13.4345; 13.7993)
120	3	13.2757	0.1681	(13.0933; 13.4581)

Pooled StDev = 0.139668

4. Tukey Pairwise Comparisons: % Thermal Degradation versus Thermal Time Lengths(minutes)

Tukey Pairwise comparisons were used to compare the means with each other and verify if they are similar or different, for a confidence interval (CI) equal to 95 %.

Grouping Information Using the Tukey Method and 95% Confidence

Time (min)	N	Mean	Grouping
90	3	13.6169	A
120	3	13.2757	A B
60	4	13.1781	B
30	3	12.8188	C

Means that do not share a letter are significantly different.

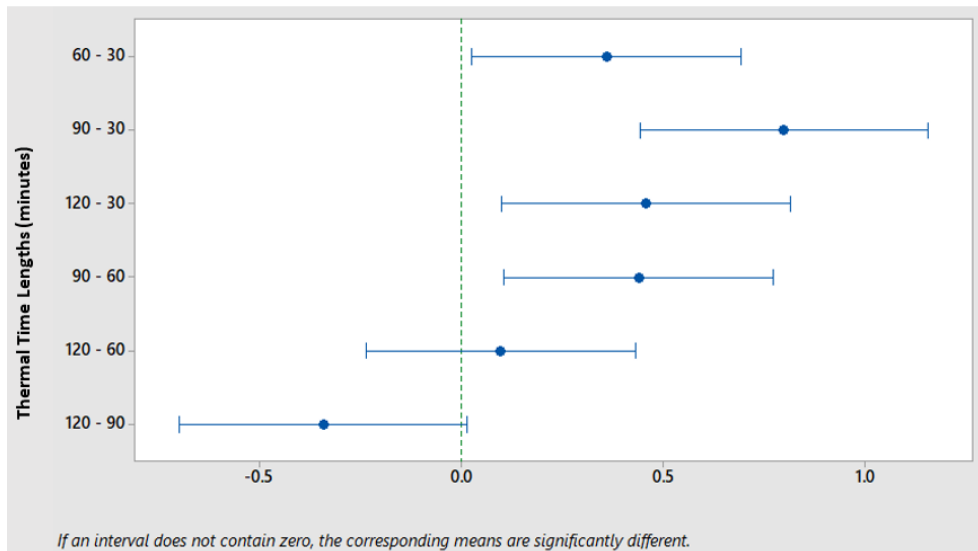


Figure 3. Tukey Pairwise Comparisons (% Thermal Degradation versus Thermal Time Lengths in minutes).

Result of Test: By Tukey's test, there is statistical similarity between the 120 and 90 minute means, as well as between the 120 and 60 minute means, however, there is no similarity between 90 and 60 minutes.

5. Interval Plot of % Thermal Degradation versus Thermal Time Lengths (minutes)

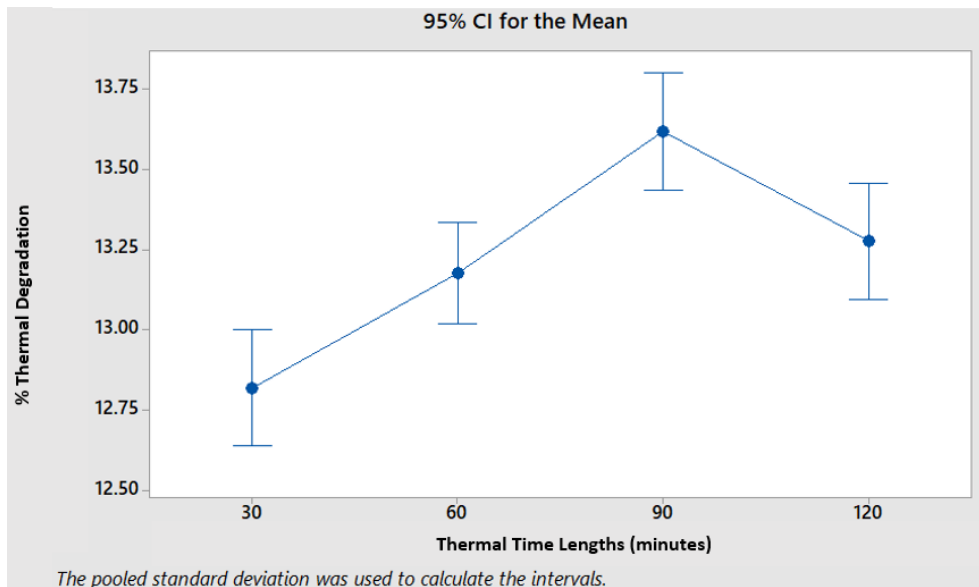


Figure 4. The percentages of thermal degradation and their standard deviations are plotted as a function of time.

It is observed that the 90 minute samples stand out with higher values. Also, it is observed that the 120 minute samples had similar values to 90 and 60 minutes. The 30 minute samples had lower values.

6. Summary Report for % Thermal Degradation

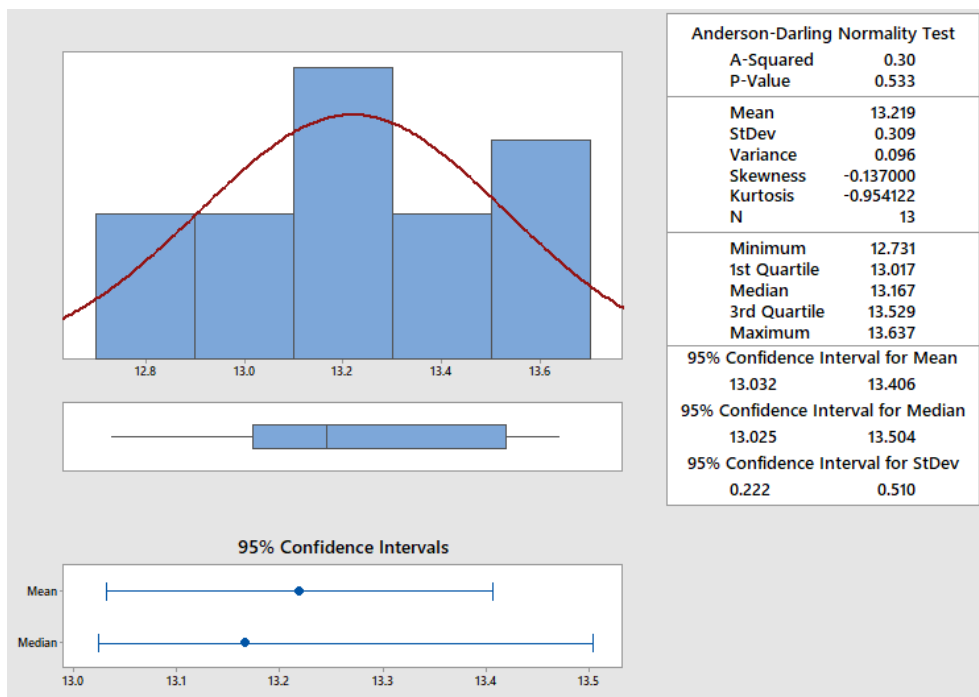


Figure 5. Summary Report for % Thermal Degradation.