

Leather Solar Resistance Improvement Study

The attached report is based on an actual study performed to reduce rejects due to part performance variability. The names of company and team members are purposely withheld.

Study Consultant/Facilitator: Ranjit K. Roy, Nutek, Inc.

(A BRIEF REPORT)**Project Title: Leather Solar Resistance Improvement Study**

Objective: Study leather curing process and determine the combination of process parameter for best performance under Xenon exposure (simulates exposure to solar light).

Observation & Recommendations: (From overall performance of 12 separate analyses)
The optimum condition shown below represents the combination of process parameters that is expected to produce the most desirable performance.

Optimum Condition *(Not tested, but one of possible 512 conditions)*

A: Pigment Type	(2)	SA Supplier
D:Top Coat Add-on	(2)	High
I:Crust Type	(1)	NA Crust
E:Foam Chemistry	(2)	Sa Foam
B:Top Coat Chemistry	(2 or 1)	NA Top Coat or SA Top Coat
C:Pigment Concentration	(1 or 2)	5 percent or 10 Percent
G:RB Upgrade Chemistry	(1 or 2)	Present or Absent
F:Milling -Dye Tr	(no effect at all)	Set this factor at any value within range.
H:RB Chemistry	(no effect at all)	Set this factor at any value within range.

Explanation:

1. Factors **A: Pigment Type** and **D:Top Coat Add-on** have the most influence (over 30%) on all the criteria of evaluations (Delta-L, Delta A, Delta-B, and Gray Scale). Both these factors must be set at level 2 as shown above.
2. Factors **I:Crust Type** and **E:Foam Chemistry** have moderate influence (over 10%) on the four criteria of evaluations. The desirable level for I:Crust Type 1 and that for E:Foam Chemistry is 2 as shown above.
3. Factors **B:Top Coat Chemistry**, **C:Pigment Concent**, and **G:RB Upgrade Chemistry** have only small influence (under 5%) on the four criteria of evaluation. The levels of these factors may be set to either level 1 or level 2 without significant influence on the results. The levels preferred for these factors are indicated above.
4. Factors **F:Milling -Dye Tr.** and **H:RB Chemistry** have no effects on the four criteria of evaluations at all. These factors may be set to any value within the range of study.

(Refer to data summaries in pages 3 – 9 below and analysis of results and experiment setup in attached pages 10 - 47)

Expected Performance

Based on representative analysis shown (page 36 -41), the performance expected from the optimum condition will range between 4.4 to 4.8 in Gray Scale reading (Current average is 3.8). The performance at optimum is expected to reduce variation and reflect 22% increase in capability index, Cpk, and yield 33% savings (Loss Function, page 41)

Additional Observations

1. Factors A:Pigment Type and B:Top Coat Chemistry have opposing influence on criteria Delta-A (C2A) and Delta-B (C2B). Consequently, optimum level for C2B is 2 while that for C2A is 1 (Table 5, Page 9). But, since the optimum level for C1 and C3 is also 2, it is selected as the optimum level.
2. Fortunately, there is no such conflicting influence exist for other significant factors.

(If the weighting of a particular criteria changes or otherwise influence a criteria becomes of interest, separate analysis can be performed to develop better understanding on the factor influence to the criterion.)

The magnitudes of the slope of average effect (Main Effect) lines represent the influence factors have on the results (evaluation criteria). Since there were 3 strengths of Xenon exposures (500KJ, 750 KJ & 1000KJ), the influence values are plotted against the strength of Xenon exposure. The plots for the 4 different criteria of evaluations are shown in attached graphs (Pages 4, 5, 6 & 7).

1. Influence of all factors tends to increase with increased energy levels of Xenon exposure for Delta-L, Delta-A and Delta-B criteria of evaluations. T
2. The bar graph shown in page 8 is an alternate way of displaying the factor influence.
3. The line graph at bottom of page 8 shows how the relative influence of the factor (ANOVA data) changes with Xenon exposure strengths.

Recommendation:

Set process condition as indicated and confirm performance before releasing for production. Run 2 or more samples at the optimum condition and compare average performance (Gray Scale value) with the predicted performance.

Sincerely,



Ranjit K. Roy, Ph.D., P.E, PMP
Consultant, Nutek, Inc.

Sept. 6, 2006

ANALYSIS SUMMARY

Project Title: GM Leather Xenon Exposure Study (Planned date: June 7, 2006)

1. Team Leader	?
2. Team member	?
3. Team member	?
4. Team member	?
5. Team member	?
6. Team member	?
7. Team member	?

Test: 12 separate tests with 9 factors at 2 levels each. Each test was performed with 2 samples. Each sample was evaluated with 4 different criteria of evaluations (C1, C2A, C2B, & C3) after 3 durations of Xenon exposure (500 KJ, 750 KJ & 1000 KJ, simulates exposure to sun light of 6 months duration)

Criterion C1 = delta L (absolute values, SMALLER QC)
 Criterion C2A = delta A (4 added to the results, BIGGER QC)
 Criterion C2B = delta B (4 added to the results, BIGGER QC)
 Criterion C3 = Grey Scale (BIGGER QC)

All analysis performed using S/N ratios of results and 95% confidence level is used for pooling factor influences. Significant factor influences are used draw conclusion on factor influence and optimum condition.

Analysis Strategy (Sept. 5, 2006)

[Based on experiments conducted and results provided by the project team, the following analyses are performed. The results of criteria C1, C2A, & C2B have been scaled appropriately for convenience of analysis.]

1. **2 separate experimental results** (3 exposure levels and 4 criteria, two samples in each) have been analyzed using Qualitek-4 software.
2. From each analysis, capture screens/data of 4 screens from each of 12 analyses:
 - a. Results (only first 8 trials shown)
 - b. Main Effect
 - c. ANOVA (pooled at 95% confidence level)
 - d. Optimum Condition
3. Data compiled in 5 tables are shown below
4. Conclusions from overall performance/trends drawn
 - a. Optimum
 - b. Factor influence & significance
 - c. Expected performance at the optimum for C3 criterion

Attachments:

1. Summary data from analyses of 12 separate experimental results (Pages 10 – 35) are shown in pages 3 -9.
2. A complete representative analysis (Qualitek-4 software output) is shown in pages 37 – 42.
3. Experiment setup and the trial conditions are shown in pages 43 – 47.

Table 1: Influence on Criteria C1

Factor Description	ME			ANOVA (%)		
	500KJ	750KJ	1000KJ	500KJ	750KJ	1000KJ
A:Pigment Type	5.11	6.57	9.1	50.55	43.6	47.18
B:Top Coat Chemis	1.11	2.79	3.3	0	7.09	0
C:Pigment Concent	1.52	2.19	2.8	3.89	0	0
D:Top Coat Add-on	3.46	4.26	5.2	22.86	17.79	15.07
E:Foam Chemistry	.97	.49	1.3	0	0	0
F:Milling -Dye Tr	.81	1.83	2.79	0	0	0
G:RB Upgrade Chem	.773	1.97	3.3	0	0	5.25
H:RB Chemistry	.0889	1.08	1.3	0	0	0
I:Crust Type	2.54	3.49	3.7	11.98	11.64	6.86

C1 = Criterion 1, DELTA L, absolute value of reading, QC = SMALLER is better

- ME = absolute value of the slope of Main Effect (Qualitek-4 Main Effect)
- ANOVA = Analysis of variance Results (relative influence of the factors to the variation of results.)
- KJ = Kilo Joules of energy level of Xenon exposure

Factor Influence (Main Effect for criterion C1)

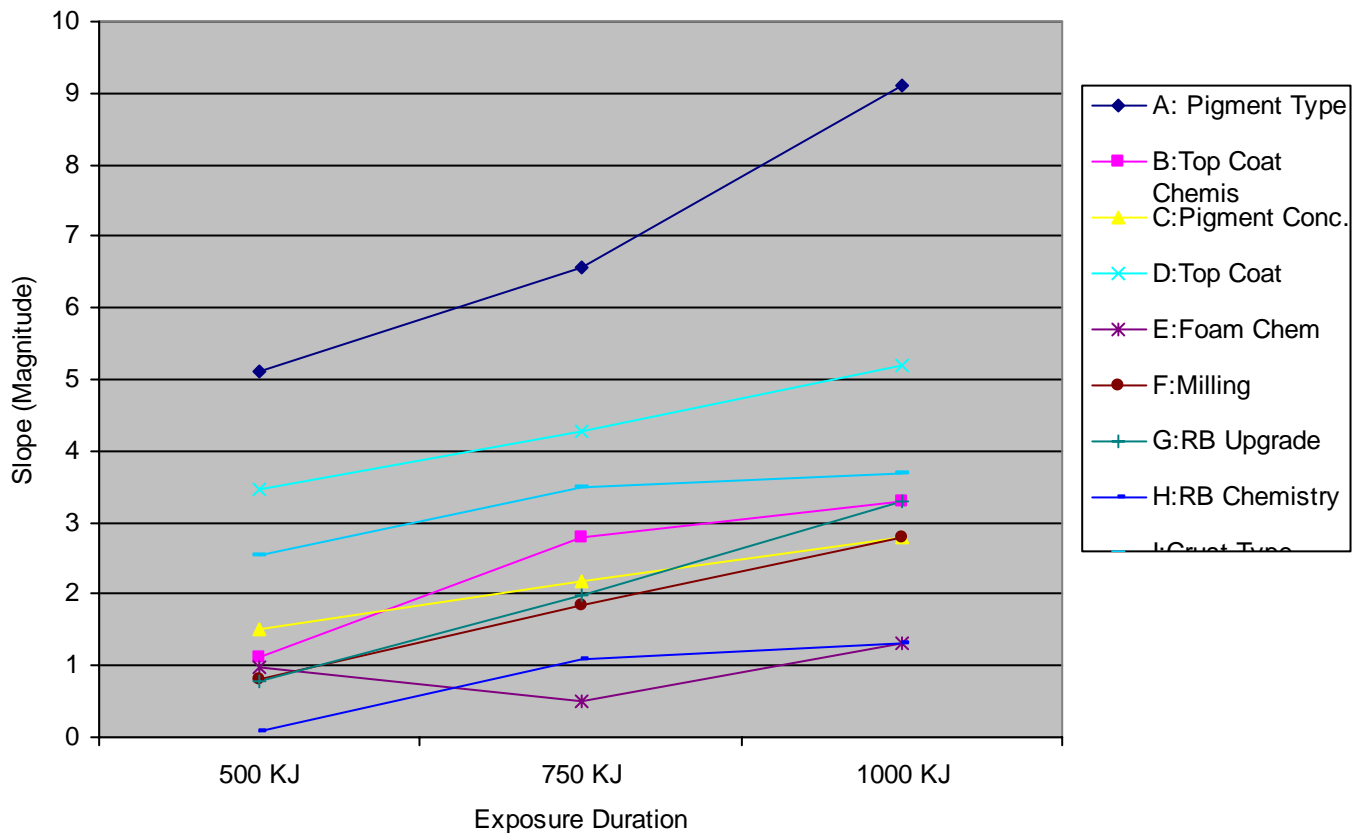


Table 2: Influence on Criteria C2A

Factor Description	ME			ANO VA (%)		
	500KJ	750KJ	1000KJ	500KJ	750KJ	1000KJ
A:Pigment Type	1.34	2.7	4.2	74.8	77.4	77.7
B:Top Coat Chemis	.44	.87	1.46	7.3	7.8	9.03
C:Pigment Concent	.48	.83	1.11	8.7	7	5.06
D:Top Coat Add-on	.29	.27	.38	3	0	0
E:Foam Chemistry	.15	.26	.36	0	0	0
F:Milling -Dye Tr	.05	.07	.04	0	0	0
G:RB Upgrade Chem	.19	.48	.77	0	2.2	2.23
H:RB Chemistry	.10	.33	.32	0	0	0
I:Crust Type	.20	.32	.63	1.3	0	0

C2A = Criterion 2A, **DELTA A**, All results scaled up by adding 4, QC = SMALLER is better

- ME = Absolute value of the slope of Main Effect (Qualitek-4 Main Effect)
- ANOVA = Analysis of variance Results (relative influence of the factors to the variation of results.)
- KJ = Kilo Joules of energy level of Xenon exposure

Factor Influence (Main Effect for criterion C2A)

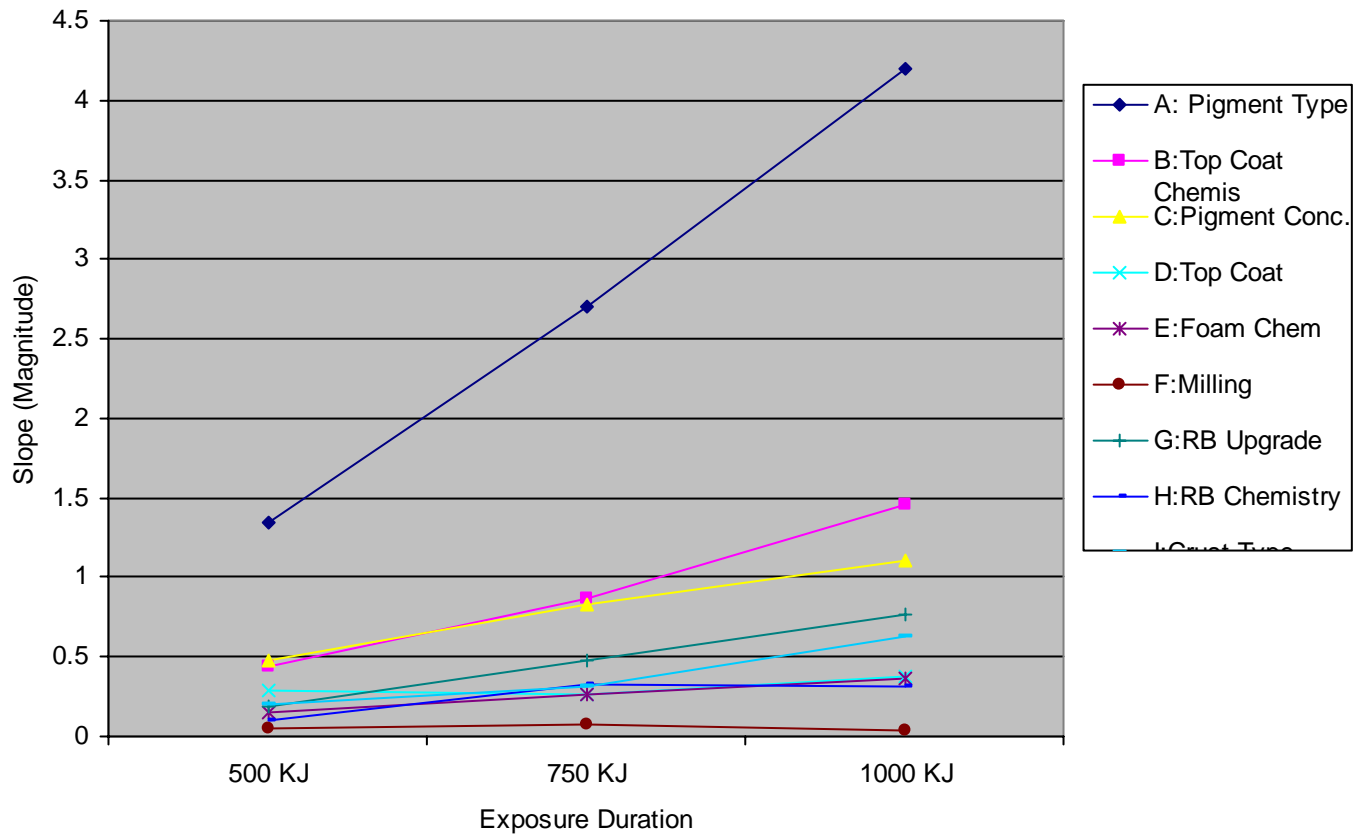


Table 3: Influence on Criteria C2B						
Factor Description	ME			ANOVA (%)		
	500KJ	750KJ	1000KJ	500KJ	750KJ	1000KJ
A:Pigment Type	1.6	2.3	3.2	46.6	55.3	65.6
B:Top Coat Chemis	.54	1.0	1.3	5.2	10.2	10.8
C:Pigment Concent	.14	.11	.05	0	0	0
D:Top Coat Add-on	1.32	1.57	1.6	31.7	24.0	16.0
E:Foam Chemistry	.76	.88	.88	10.8	7.4	4.7
F:Milling -Dye Tr	.11	.11	.18	0	0	.16
G:RB Upgrade Chem	.31	.40	.62	1.5	1.5	2.3
H:RB Chemistry	.14	.24	.24	0	.49	0
I:Crust Type	.31	.11	.15	1.6	0	0

C2A = Criterion 2A, **DELTA B**, All results scaled up by adding 4, QC = SMALLER is better

- ME = Absolute value of the slope of Main Effect (Qualitek-4 Main Effect)
- ANOVA = Analysis of variance Results (relative influence of the factors to the variation of results.)
- KJ = Kilo Joules of energy level of Xenon exposure

Factor Influence (Main Effect for criterion C2B)

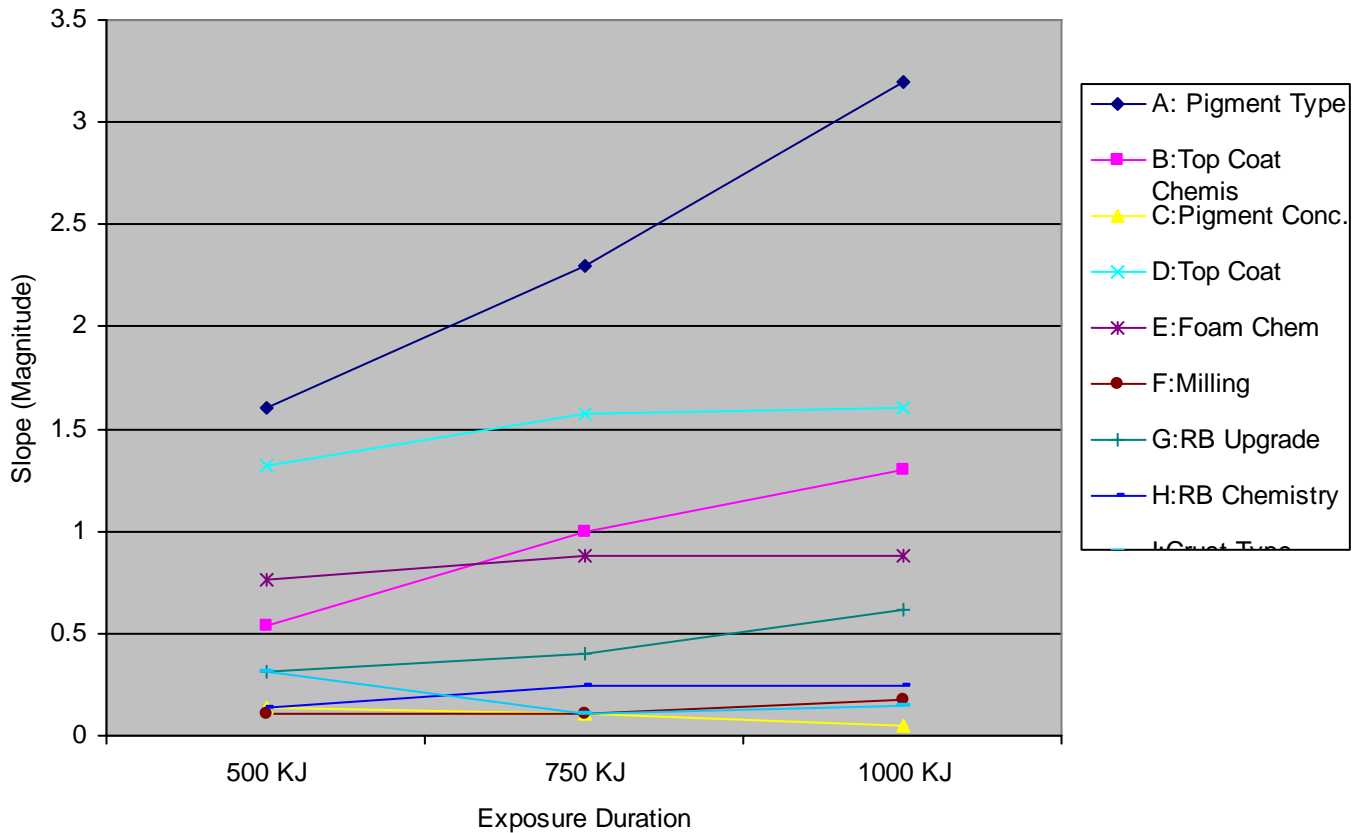


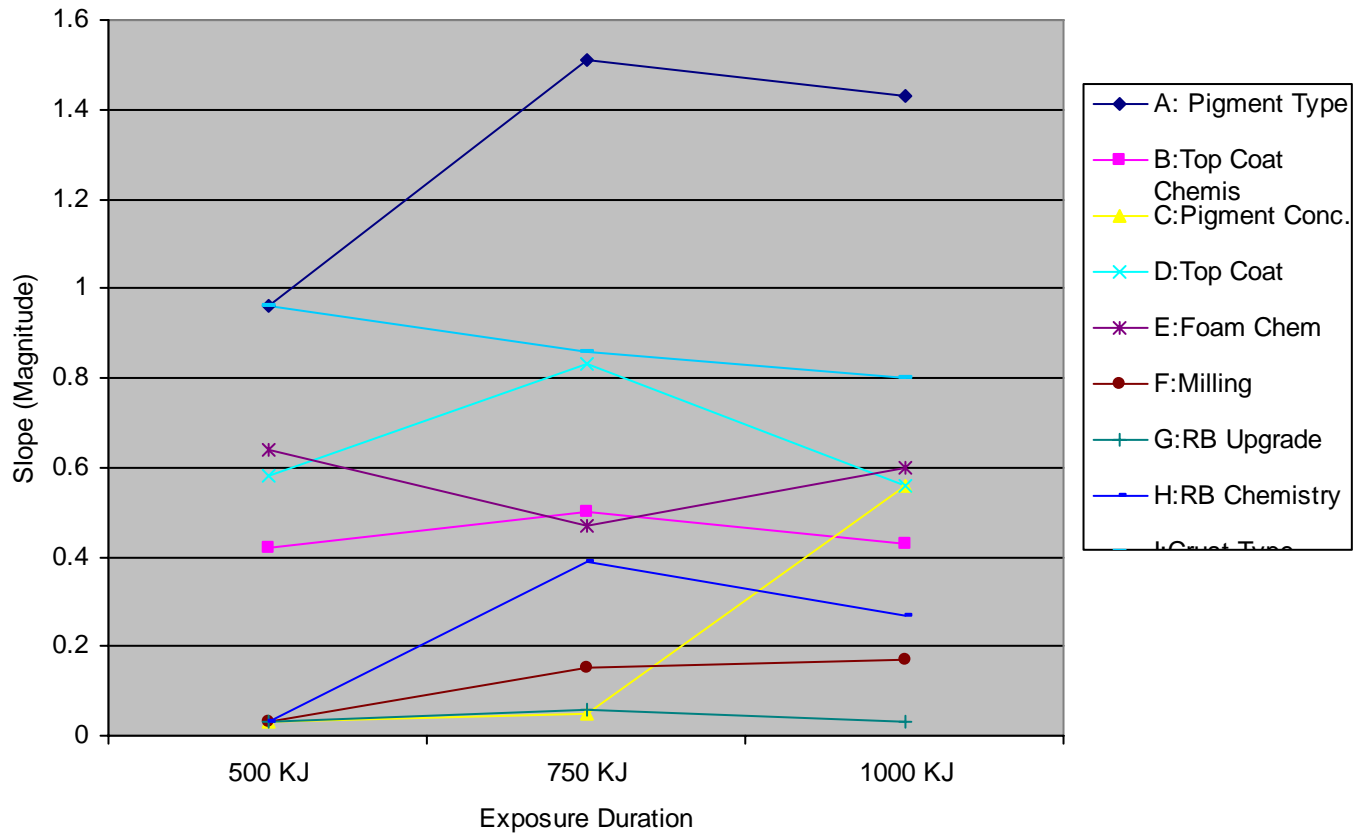
Table 4: Influence on Criteria C3

Factor Description	ME *			ANO VA (%)		
	500KJ	750KJ	1000KJ	500KJ	750KJ	1000KJ
A:Pigment Type	.96	1.51	1.43	30.2	50.2	43.8
B:Top Coat Chemis	.42	.50	.43	4.8	4.89	0
C:Pigment Concent	.03	.05	.56	0	0	0
D:Top Coat Add-on	.58	.83	.56	10.1	14.5	0
E:Foam Chemistry	.64	.47	.60	12.8	4.3	0
F:Milling -Dye Tr	.03	.15	.17	0	0	0
G:RB Upgrade Chem	.03	.06	.03	0	0	0
H:RB Chemistry	.03	.39	.27	0	0	0
I:Crust Type	.96	.86	.80	30.1	15.81	12.1

C3 = Criterion 3, **Gray Scale. Original Reading, BIGGER is better.**

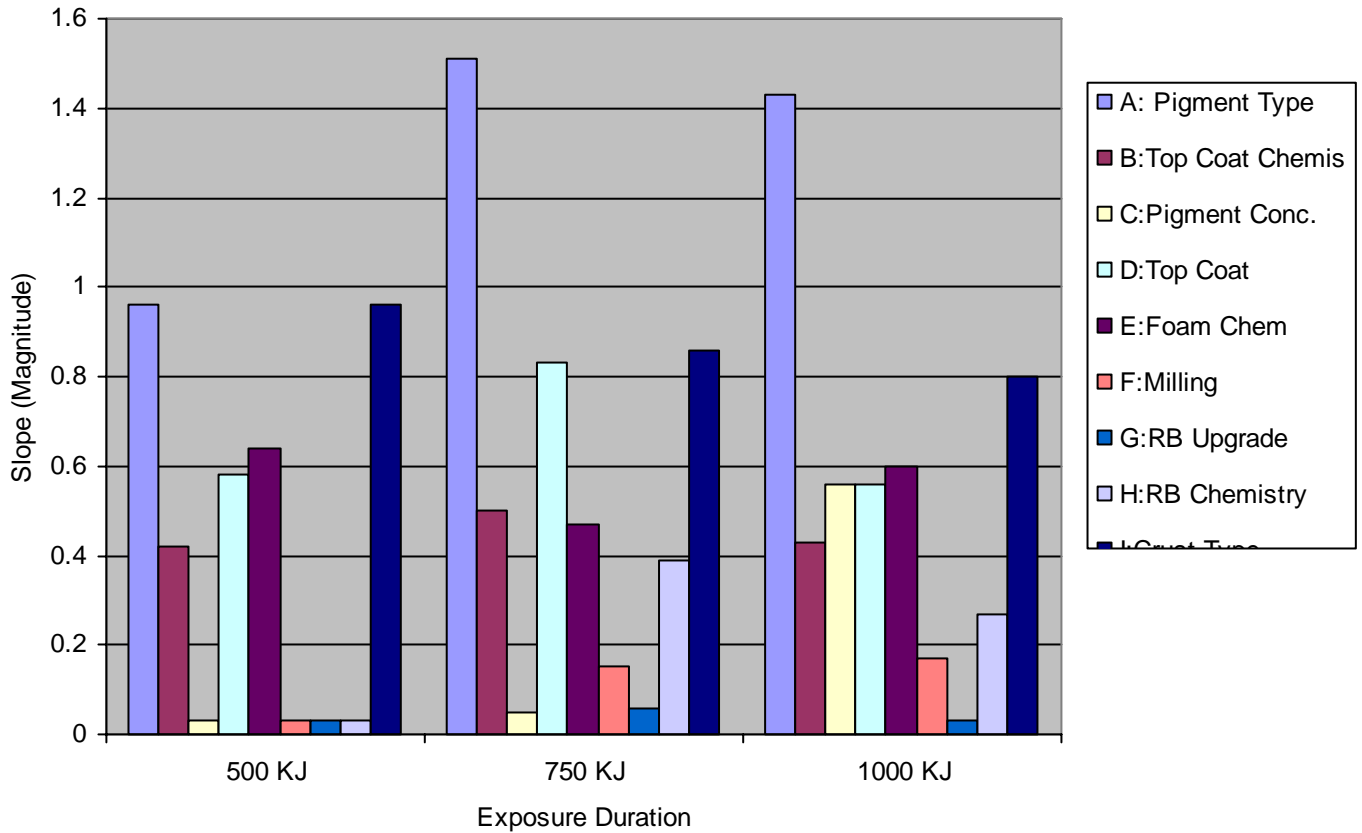
- ME = Absolute value of the slope of Main Effect (Qualitek-4 Main Effect)
- ANOVA = Analysis of variance Results (relative influence of the factors to the variation of results.)
- KJ = Kilo Joules of energy level of Xenon exposure.

Factor Influence (Main Effect for criterion C3)



Additionally, the graphs can be presented as bar graph and also using the relative influence of the factors (ANOVA) data as shown below.

Factor Influence (Main Effect for criterion C3)



Factor Influence (ANOVA for criterion C3)

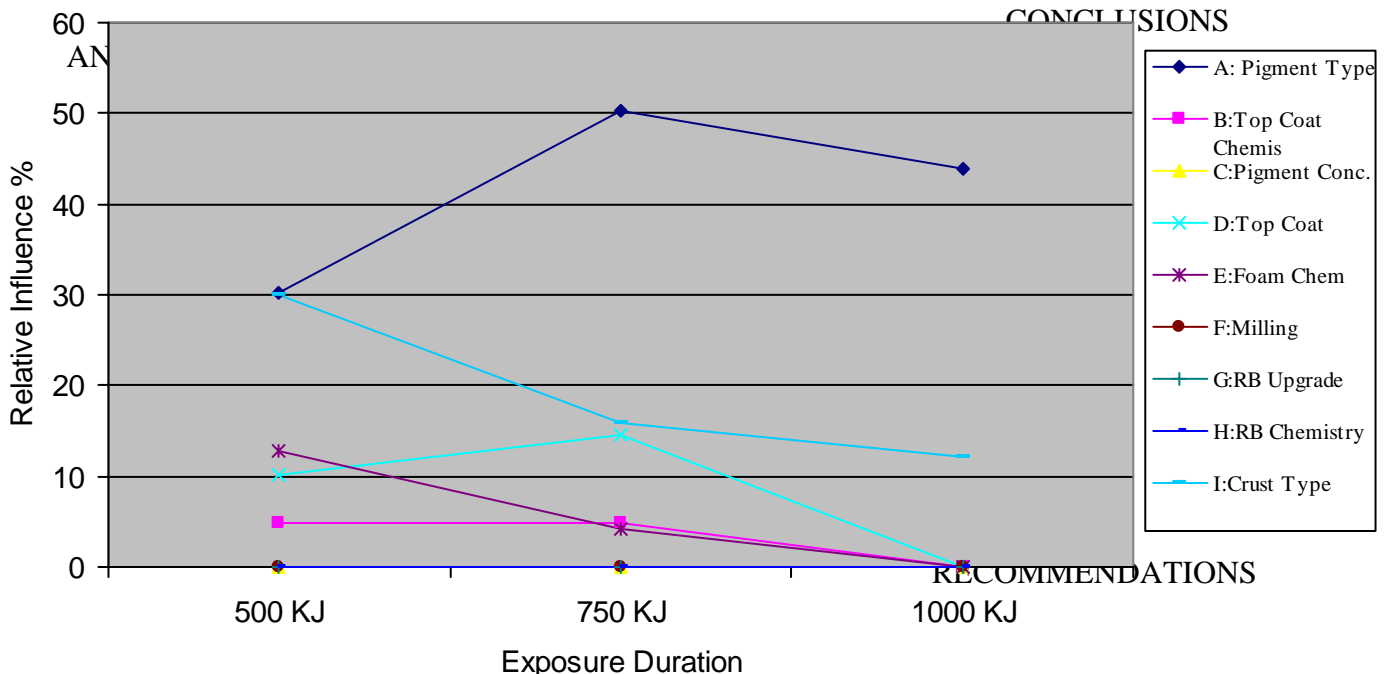


Table 5. Optimum Conditions (Levels 1 or 2 from all 12 analyses)

Factor Description	Criterion C1			Criterion C2A			Criterion C2B			Criterion C3		
	500	750	1K	500	750	1K	500	750	1K	500	750	1K
A: Pigment Type 2	2	2	2	1	1	1	2	2	2	2	2	2
B:Top Coat Chemis 2/1	-	2	-	1	1	1	2	2	2	2	2	-
C:Pigment Concent 2/1	1	-	-	2	2	2	-	-	-	-	-	-
D:Top Coat Add-on 2	2	2	2	2	-	-	2	2	2	2	2	-
E:Foam Chemistry 2	-	-	-	-	-	-	2	2	2	2	2	-
F:Milling -Dye Tr 0	-	-	-	-	-	-	-	-	-	-	-	-
G:RB Upgrade Chem 1/2	-	-	1	-	2	2	1	1	1	-	-	-
H:RB Chemistry 0	-	-	-	-	-	-	-	2	-	-	-	-
I:Crust Type 1	1	1	1	1	-	-	1	-	-	1	1	1

C1 = Light and Dark value change,, C2A = delta A, C2B = Delta B, C3 = Grey Scale (1 -5)

- ME = absolute value of the slope of Main Effect (Qualitek-4 Main Effect)
- ANOVA = Analysis of variance Results (relative influence of the factors to the variation of results.)
- KJ = Kilo Joules of energy level of Xenon exposure

Factor Description	Level 1	Level 2
A: Pigment Type	NA Supplier	SA Supplier
B:Top Coat Chemis	NA Top Coat	SA Top Coat
C:Pigment Concent	5 percent	10 Percent
D:Top Coat Add-on	Low	High
E:Foam Chemistry	NA Foam	Sa Foam
F:Milling -Dye Tr	Present	Absent
G:RB Upgrade Chem	Present	Absent
H:RB Chemistry	NA Roll B	SA Roll Base
I:Crust Type	NA Crust	SA Crust

Optimum Condition:

- A: Pigment Type (2) SA Supplier
- D:Top Coat Add-on (2) High
- I:Crust Type (1) NA Crust
- E:Foam Chemistry (2) Sa Foam
- B:Top Coat Chemistry (2 or 1) NA Top Coat or SA Top Coat
- C:Pigment Concent (2 or 1) 5 percent or 10 Percent
- G:RB Upgrade Chem (1 or 2) Present or Absent
- F:Milling -Dye Tr (no effect at all) Any value within range
- H:RB Chemistry (no effect at all) Any value within range

ANALYSIS OF RESULTS USING QUALITEK-4 SOFTWARE

Analysis with C1 – 500 KJ (S/N with QC = Smaller)
Results

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	2.32	2.79					-8.185
Trial# 2	3.35	3.38					-10.54
Trial# 3	2.57	2.3					-7.744
Trial# 4	1.42	1.69					-3.868
Trial# 5	1.94	2.09					-6.092
Trial# 6	2.58	2.22					-7.629
Trial# 7	1.32	0.94					-1.183
Trial# 8	1.59	1.63					-4.138

(All results: Avg = 1.871, StDev = .749)

ME

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	-7.343	-2.225	5.117
2 B:Top Coat Chemis	-5.342	-4.226	1.115
3 C:Pigment Concent	-4.022	-5.546	-1.525
4 D:Top Coat Add-on	-6.518	-3.05	3.467
5 E:Foam Chemistry	-5.273	-4.295	.977
6 F:Milling -Dye Tr	-5.189	-4.379	.81
7 G:RB Upgrade Chem	-4.397	-5.17	-.773
8 H:RB Chemistry	-4.829	-4.739	.089
9 I:Crust Type	-3.513	-6.055	-2.542

ANOVA (95%)

Expt. File: C1_500KJ_Q4W Data Type: S/N Ratio Print OK
 QC Type: Smaller is Better Help Cancel

Col # / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A:Pigment Type	1	78.586	78.586	80.053	77.604	50.552
2 B:Top Coat Chemis	(1)	(3.741)		POOLED	(CL=90.45%)	
3 C:Pigment Concent	1	6.961	6.961	7.091	5.98	3.895
4 D:Top Coat Add-on	1	36.078	36.078	36.751	35.096	22.862
5 E:Foam Chemistry	(1)	(2.869)		POOLED	(CL=88.21%)	
6 F:Milling -Dye Tr	(1)	(1.965)		POOLED	(CL=82.94%)	
7 G:RB Upgrade Chem	(1)	(1.792)		POOLED	(CL=82.99%)	
8 H:RB Chemistry	(1)	(.024)		POOLED	(CL= *NC*)	
9 I:Crust Type	1	19.383	19.383	19.745	18.401	11.987
Other/Error	7	12.5	1.786			10.704
Total:	11	153.512				100.00%

OPTIMUM

Expt. File: C1_500KJ_Q4W Data Type: S/N Ratio Print OK
 QC: Smaller is Better Help Cancel

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	2.559
3 C:Pigment Concent	5 percent	1	.761
4 D:Top Coat Add-on	1.8 g/dry	2	1.733
9 I:Crust Type	NA Crust	1	1.27
Total Contribution From All Factors...			6.322
Current Grand Average Of Performance...			-4.784
Expected Result At Optimum Condition...			1.539

Analysis with C1 – 750 KJ (S/N with QC = Smaller)

Results

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3	3.37					-10.077
Trial# 2	3.85	4.78					-12.75
Trial# 3	3.13	3.15					-9.939
Trial# 4	1.73	2.12					-5.733
Trial# 5	2.74	2.27					-8.015
Trial# 6	2.96	2.57					-8.856
Trial# 7	1.64	1.25					-3.276
Trial# 8	2.14	1.58					-5.488

(All results: Avg. = 2.239, StDev. = 1.029)

ME

File: C1 750KJ Q4W Data Type: S/N Ratio QC Type: Smaller is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	-9.228	-2.649	6.578
2 B:Top Coat Chemis	-7.335	-4.542	2.793
3 C:Pigment Concent	-4.842	-7.036	-2.194
4 D:Top Coat Add-on	-8.071	-3.806	4.264
5 E:Foam Chemistry	-5.692	-6.185	-.493
6 F:Milling -Dye Tr	-6.854	-5.024	1.83
7 G:RB Upgrade Chem	-4.95	-6.927	-1.977
8 H:RB Chemistry	-5.395	-6.482	-1.088
9 I:Crust Type	-4.191	-7.687	-3.497

ANOVA (95%)

Expt. File: C1 750KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Smaller is Better Help Cancel

Col # / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A:Pigment Type	1	129.876	129.876	48.026	127.172	43.623
2 B:Top Coat Chemis	1	23.391	23.391	8.649	20.687	7.096
3 C:Pigment Concent	(1)	(14.44)		POOLED	(CL=93.77%)	
4 D:Top Coat Add-on	1	54.568	54.568	20.178	51.864	17.79
5 E:Foam Chemistry	(1)	(.728)		POOLED	(CL= *NC*)	
6 F:Milling -Dye Tr	(1)	(10.048)		POOLED	(CL=91.26%)	
7 G:RB Upgrade Chem	(1)	(11.716)		POOLED	(CL=93.61%)	
8 H:RB Chemistry	(1)	(3.543)		POOLED	(CL=73.2%)	
9 I:Crust Type	1	36.662	36.662	13.557	33.958	11.648
Other/Error	7	47.02	6.717			19.843
Total:	11	291.523				100.00%

OPTIMUM

Expt. File: C1 750KJ Q4W Data Type: S/N Ratio Print
 QC: Smaller is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	3.289
2 B:Top Coat Chemis	SA Top Coat	2	1.396
4 D:Top Coat Add-on	1.8 g/dry	2	2.132
9 I:Crust Type	NA Crust	1	1.747
Total Contribution From All Factors...			8.564
Current Grand Average Of Performance...			-5.939
Expected Result At Optimum Condition...			2.625

Analysis with C1 – 1000 KJ (S/N with QC = Smaller)

Results

Expt. File: C1 1000K Q4W Data Type: S/N Ratio QC Type: Smaller is Better

Print Help

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3.62	3.59					-11.139
Trial# 2	4.809	4.98					-13.796
Trial# 3	3.48	3.42					-10.757
Trial# 4	2.33	2.44					-7.553
Trial# 5	2.65	2.75					-8.629
Trial# 6	3.31	2.73					-9.641
Trial# 7	1.53	1.04					-2.334
Trial# 8	2.04	1.81					-5.705
							-5.699

ME

C1 1000K Q4W Data Type: S/N Ratio QC Type: Smaller is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A: Pigment Type	-10.252	-1.145	9.107
2 B: Top Coat Chemis	-7.354	-4.044	3.31
3 C: Pigment Concent	-4.285	-7.113	-2.829
4 D: Top Coat Add-on	-8.342	-3.055	5.287
5 E: Foam Chemistry	-5.029	-6.369	-1.34
6 F: Milling -Dye Tr	-7.095	-4.303	2.791
7 G: RB Upgrade Chem	-4.031	-7.367	-3.337
8 H: RB Chemistry	-5.012	-6.386	-1.375
9 I: Crust Type	-3.835	-7.562	-3.728

ANOVA (95%)

Expt. File: C1 1000K.Q4W Data Type: S/N Ratio Print OK
 QC Type: Smaller is Better Help Cancel

Col # / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A: Pigment Type	1	248.813	248.813	38.726	242.388	47.186
2 B: Top Coat Chemis	(1)	(32.879)		POOLED	(CL=93.41%)	
3 C: Pigment Concent	(1)	(23.982)		POOLED	(CL=91.32%)	
4 D: Top Coat Add-on	1	83.856	83.856	13.051	77.431	15.074
5 E: Foam Chemistry	(1)	(5.388)		POOLED	(CL= *NC*)	
6 F: Milling -Dye Tr	(1)	(23.377)		POOLED	(CL=91.76%)	
7 G: RB Upgrade Chem	1	33.396	33.396	5.198	26.972	5.25
8 H: RB Chemistry	(1)	(5.667)		POOLED	(CL= *NC*)	
9 I: Crust Type	1	41.671	41.671	6.485	35.246	6.861
Other/Error	7	105.936	15.134			25.629
Total:	11	513.677				100.00%

OPTIMUM

Expt. File: C1 1000K.Q4W Data Type: S/N Ratio Print
 QC: Smaller is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A: Pigment Type	SA Supplier	2	4.553
4 D: Top Coat Add-on	1.8 g /dry	2	2.643
7 G: RB Upgrade Chem	Present	1	1.668
9 I: Crust Type	NA Crust	1	1.863
Total Contribution From All Factors...			10.726
Current Grand Average Of Performance...			-5.699
Expected Result At Optimum Condition...			5.028

Analysis with C2A – 500 KJ (S/N with QC = Bigger, 4 aded)

Results

Expt. File: C2A500KJ Q4W Data Type: S/N Ratio QC Type: Bigger is Better

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3.94	4					11.975
Trial# 2	3.92	3.9					11.843
Trial# 3	4.25	4.2					12.516
Trial# 4	4.08	4.059					12.19
Trial# 5	4.019	4.05					12.115
Trial# 6	4.13	4.07					12.254
Trial# 7	3.77	3.79					11.549
Trial# 8	3.64	3.69					11.28
							11.449

ME

File: C2A500KJ Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	12.149	10.75	-1.399
2 B:Top Coat Chemis	11.672	11.227	-.446
3 C:Pigment Concent	11.207	11.692	.484
4 D:Top Coat Add-on	11.303	11.596	.292
5 E:Foam Chemistry	11.376	11.523	.147
6 F:Milling -Dye Tr	11.472	11.426	-.046
7 G:RB Upgrade Chem	11.351	11.548	.196
8 H:RB Chemistry	11.399	11.5	.101
9 I:Crust Type	11.551	11.348	-.203

ANOVA (95%)

Expt. File: C2A500KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A:Pigment Type	1	5.869	5.869	269.412	5.847	74.81
2 B:Top Coat Chemis	1	.593	.593	27.245	.571	7.315
3 C:Pigment Concent	1	.704	.704	32.319	.682	8.729
4 D:Top Coat Add-on	1	.257	.257	11.8	.235	3.01
5 E:Foam Chemistry	(1)	(.065)		POOLED	(CL=87.44%)	
6 F:Milling -Dye Tr	(1)	(.006)		POOLED	(CL= *NC*)	
7 G:RB Upgrade Chem	(1)	(.116)		POOLED	(CL=94.75%)	
8 H:RB Chemistry	(1)	(.031)		POOLED	(CL=75.71%)	
9 I:Crust Type	1	.124	.124	5.694	.102	1.308
Other/Error	6	.267	.044			4.828
Total:	11	7.817				100.00%

OPTIMUM

Expt. File: C2A500KJ Q4W Data Type: S/N Ratio Print
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	NA Suppli	1	.699
2 B:Top Coat Chemis	NA Top Co	1	.222
3 C:Pigment Concent	10 Percent	2	.242
4 D:Top Coat Add-on	1.8 g /dry	2	.146
9 I:Crust Type	NA Crust	1	.101
Total Contribution From All Factors...			1.409
Current Grand Average Of Performance...			11.449
Expected Result At Optimum Condition...			12.859

Analysis with C2A – 750 KJ (S/N with QC = Bigger)

Results

Expt. File: C2A750KJ Q4W Data Type: S/N Ratio Print
QC Type: Bigger is Better Help

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3.88	3.96					11.864
Trial# 2	4.059	4.059					12.168
Trial# 3	4.27	4.29					12.628
Trial# 4	4.04	4.13					12.222
Trial# 5	4.13	4.14					12.329
Trial# 6	4.15	4.12					12.329
Trial# 7	3.53	3.5					10.918
Trial# 8	3.42	3.44					10.705
							10.905

ME

File: C2A750KJ Q4W Data Type: S/N Ratio F
QC Type: Bigger is Better H

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	12.257	9.554	-2.703
2 B:Top Coat Chemis	11.342	10.468	-.875
3 C:Pigment Concent	10.489	11.321	.831
4 D:Top Coat Add-on	10.772	11.039	.266
5 E:Foam Chemistry	10.777	11.033	.256
6 F:Milling -Dye Tr	10.866	10.944	.078
7 G:RB Upgrade Chem	10.663	11.148	.484
8 H:RB Chemistry	10.74	11.071	.33
9 I:Crust Type	11.067	10.743	-.324

ANOVA (95%)

Expt. File: C2A750KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A:Pigment Type	1	21.914	21.914	268.752	21.832	77.493
2 B:Top Coat Chemis	1	2.291	2.291	28.104	2.21	7.844
3 C:Pigment Concent	1	2.077	2.077	25.481	1.996	7.085
4 D:Top Coat Add-on	(1)	(.213)		POOLED	(CL=85.48%	
5 E:Foam Chemistry	(1)	(.197)		POOLED	(CL=90.63%	
6 F:Milling -Dye Tr	(1)	(.018)		POOLED	(CL= *NC*)	
7 G:RB Upgrade Chem	1	.706	.706	8.665	.625	2.218
8 H:RB Chemistry	(1)	(.329)		POOLED	(CL=92.19%	
9 I:Crust Type	(1)	(.314)		POOLED	(CL=92.42%	
Other/Error	7	1.181	.169			5.36
Total:	11	28.174				100.00%

OPTIMUM

Expt. File: C2A750KJ Q4W Data Type: S/N Ratio Print OK
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	NA Suppli	1	1.351
2 B:Top Coat Chemis	NA Top Co	1	.437
3 C:Pigment Concent	10 Percent	2	.416
7 G:RB Upgrade Chem	Absent	2	.242
Total Contribution From All Factors...			2.446
Current Grand Average Of Performance...			10.905
Expected Result At Optimum Condition...			13.351

Analysis with C2A – 1000 KJ (S/N with QC = Bigger)

Results

Expt. File: C2A 1000.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	4.059	3.94					12.037
Trial# 2	3.9	3.89					11.81
Trial# 3	4.26	4.25					12.577
Trial# 4	4.03	4.03					12.106
Trial# 5	3.95	4					11.986
Trial# 6	4.1	4.059					12.211
Trial# 7	3.18	3.15					10.007
Trial# 8	3.08	3.08					9.771

10.003

ME

File: C2A 1000.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A: Pigment Type	12.121	7.895	-4.227
2 B: Top Coat Chemis	10.742	9.275	-1.468
3 C: Pigment Concent	9.45	10.566	1.116
4 D: Top Coat Add-on	9.818	10.198	.38
5 E: Foam Chemistry	9.824	10.192	.368
6 F: Milling -Dye Tr	10.006	10.011	.004
7 G: RB Upgrade Chem	9.622	10.395	.772
8 H: RB Chemistry	9.85	10.167	.317
9 I: Crust Type	10.324	9.692	-.632

ANOVA (95%)

Expt. File: C2A 1000 Q4W Data Type: S/N Ratio Print QK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P(%)
1 A:Pigment Type	1	53.574	53.574	208.351	53.317	77.702
2 B:Top Coat Chemis	1	6.456	6.456	25.107	6.198	9.033
3 C:Pigment Concent	1	3.733	3.733	14.518	3.476	5.065
4 D:Top Coat Add-on	(1)	(.432)		POOLED	(CL=77.78%)	
5 E:Foam Chemistry	(1)	(.405)		POOLED	(CL=77.66%)	
6 F:Milling -Dye Tr	(1)	(0)		POOLED	(CL= *NC*)	
7 G:RB Upgrade Chem	1	1.792	1.792	6.97	1.535	2.237
8 H:RB Chemistry	(1)	(.301)		POOLED	(CL=69.86%)	
9 I:Crust Type	(1)	(1.195)		POOLED	(CL=94.27%)	
Other/Error	7	3.059	.437			5.963
Total:	11	68.618				100.00%

OPTIMUM

Expt. File: C2A 1000 Q4W Data Type: S/N Ratio Print
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	NA Suppli	1	2.112
2 B:Top Coat Chemis	NA Top Co	1	.733
3 C:Pigment Concent	10 Percent	2	.557
7 G:RB Upgrade Chem	Absent	2	.386
Total Contribution From All Factors...			3.788
Current Grand Average Of Performance...			10.008
Expected Result At Optimum Condition...			13.796

Analysis with C2B- 500 KJ (S/N with QC = Bigger, 3 added)

Results

Expt. File: C2B500KJ Q4W Data Type: S/N Ratio QC Type: Bigger is Better

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	2.47	2.36					7.651
Trial# 2	2.27	2.27					7.12
Trial# 3	3.02	2.89					9.404
Trial# 4	3.15	3.21					10.047
Trial# 5	2.89	2.93					9.277
Trial# 6	2.94	2.8					9.149
Trial# 7	3.34	3.32					10.443
Trial# 8	3.12	3.13					9.896
							9.572

ME

file: C2B500KJ Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	8.775	10.369	1.593
2 B:Top Coat Chemis	9.3	9.844	.543
3 C:Pigment Concent	9.501	9.643	.142
4 D:Top Coat Add-on	8.914	10.23	1.316
5 E:Foam Chemistry	9.185	9.96	.775
6 F:Milling -Dye Tr	9.515	9.629	.113
7 G:RB Upgrade Chem	9.725	9.419	-.306
8 H:RB Chemistry	9.501	9.643	.142
9 I:Crust Type	9.729	9.415	-.315

ANOVA (95%)

Expt. File: C2B500KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col # / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P(%)
1 A:Pigment Type	1	7.629	7.629	215.497	7.593	46.606
2 B:Top Coat Chemis	1	.889	.889	25.12	.853	5.24
3 C:Pigment Concent	(1)	(.061)		POOLED	(CL=78.28%)	
4 D:Top Coat Add-on	1	5.195	5.195	146.765	5.16	31.672
5 E:Foam Chemistry	1	1.802	1.802	50.921	1.767	10.847
6 F:Milling -Dye Tr	(1)	(.039)		POOLED	(CL=73.87%)	
7 G:RB Upgrade Chem	1	.28	.28	7.914	.244	1.502
8 H:RB Chemistry	(1)	(.059)		POOLED	(CL=80.71%)	
9 I:Crust Type	1	.294	.294	8.312	.258	1.588
Other/Error	5	.201	.04			2.545
Total:	11	16.293				100.00%

OPTIMUM

Expt. File: C2B500KJ Q4W Data Type: S/N Ratio Print OK
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	.797
2 B:Top Coat Chemis	SA Top Coat	2	.272
4 D:Top Coat Add-on	1.8 g /dry	2	.658
5 E:Foam Chemistry	Sa Foam	2	.387
7 G:RB Upgrade Chem	Present	1	.152
9 I:Crust Type	NA Crust	1	.156
Total Contribution From All Factors...			2.422
Current Grand Average Of Performance...			9.572
Expected Result At Optimum Condition...			11.994

Analysis with C2B – 750 KJ (S/N with QC = Bigger)

Results

Expt. File: C2B750KJ Q4W Data Type: S/N Ratio Print
QC Type: Bigger is Better Help

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	2.22	2.24					6.965
Trial# 2	2.13	2.31					6.905
Trial# 3	3.01	2.97					9.512
Trial# 4	3.22	3.33					10.3
Trial# 5	3	2.91					9.408
Trial# 6	2.93	2.89					9.277
Trial# 7	3.51	3.53					10.93
Trial# 8	3.23	3.15					10.073
							9.915

ME

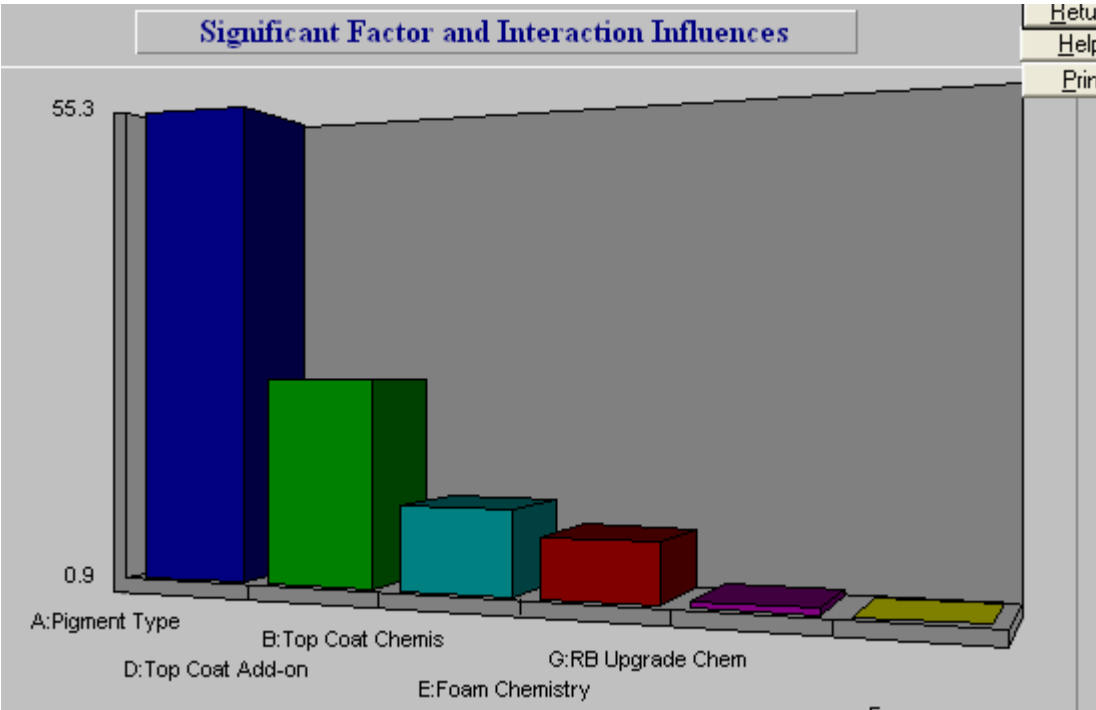
C2B750KJ Q4W Data Type: S/N Ratio
QC Type: Bigger is Better

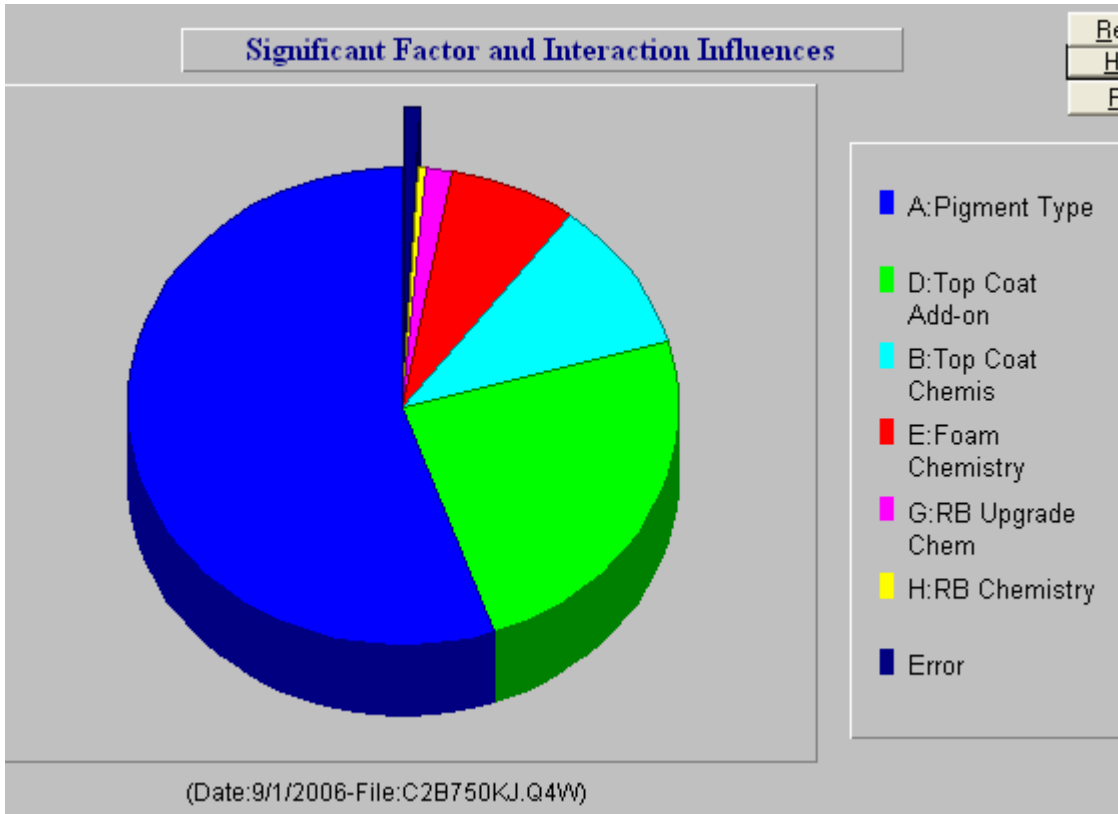
Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	8.728	11.102	2.374
2 B:Top Coat Chemis	9.402	10.428	1.026
3 C:Pigment Concent	9.856	9.973	.117
4 D:Top Coat Add-on	9.131	10.699	1.567
5 E:Foam Chemistry	9.478	10.352	.874
6 F:Milling -Dye Tr	9.857	9.973	.116
7 G:RB Upgrade Chem	10.117	9.713	-.405
8 H:RB Chemistry	9.795	10.035	.24
9 I:Crust Type	9.971	9.859	-.113

ANOVA (95%)

Expt. File: **C2B750KJ.Q4W** Data Type: **S/N Ratio** Print **OK**
 QC Type: **Bigger is Better** Help **Cancel**

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P(%)
1 A:Pigment Type	1	16.91	16.91	714.073	16.886	55.304
2 B:Top Coat Chemis	1	3.154	3.154	133.187	3.13	10.252
3 C:Pigment Concent	(1)	(.04)		POOLED	(CL=78.35%)	
4 D:Top Coat Add-on	1	7.377	7.377	311.515	7.353	24.082
5 E:Foam Chemistry	1	2.295	2.295	96.944	2.272	7.441
6 F:Milling -Dye Tr	(1)	(.04)		POOLED	(CL=80.94%)	
7 G:RB Upgrade Chem	1	.488	.488	20.633	.464	1.522
8 H:RB Chemistry	1	.173	.173	7.312	.149	.489
9 I:Crust Type	(1)	(.037)		POOLED	(CL=86.49%)	
Other/Error	5	.133	.027			.91
Total:	11	30.534				100.00%





OPTIMUM

Expt. File: **C2B750KJ.Q4W** Data Type: **S/N Ratio**

QC

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	1.187
2 B:Top Coat Chemis	SA Top Coat	2	.512
4 D:Top Coat Add-on	1.8 g/dry	2	.784
5 E:Foam Chemistry	Sa Foam	2	.437
7 G:RB Upgrade Chem	Present	1	.201
8 H:RB Chemistry	SA Roll Base	2	.12
Total Contribution From All Factors...			3.241
Current Grand Average Of Performance...			9.915
Expected Result At Optimum Condition...			13.156

Analysis with C2B – 1000 KJ (S/N with QC = Bigger)

Results

Expt. File: C2B 1000.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	2.29	2.17					6.956
Trial# 2	1.97	1.93					5.799
Trial# 3	2.92	2.83					9.169
Trial# 4	3.14	3.22					10.046
Trial# 5	2.75	2.82					8.894
Trial# 6	2.88	2.76					8.999
Trial# 7	3.6	3.6					11.126
Trial# 8	3.29	3.24					10.276
							9.943

ME

C2B 1000.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	8.31	11.575	3.264
2 B:Top Coat Chemis	9.279	10.606	1.326
3 C:Pigment Concent	9.918	9.967	.049
4 D:Top Coat Add-on	9.136	10.749	1.613
5 E:Foam Chemistry	9.504	10.381	.877
6 F:Milling -Dye Tr	10.031	9.854	-.178
7 G:RB Upgrade Chem	10.253	9.632	-.622
8 H:RB Chemistry	9.96	9.925	-.036
9 I:Crust Type	10.018	9.867	-.151

ANOVA (95%)

Expt. File: C2B 1000 Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P(%)
1 A:Pigment Type	1	31.965	31.965	2177.755	31.951	65.559
2 B:Top Coat Chemis	1	5.28	5.28	359.765	5.266	10.805
3 C:Pigment Concent	(1)	(.007)		POOLED	(CL= *NC*)	
4 D:Top Coat Add-on	1	7.813	7.813	532.29	7.798	16.001
5 E:Foam Chemistry	1	2.302	2.302	156.891	2.288	4.695
6 F:Milling -Dye Tr	1	.093	.093	6.372	.078	.161
7 G:RB Upgrade Chem	1	1.154	1.154	78.619	1.139	2.337
8 H:RB Chemistry	(1)	(.003)		POOLED	(CL= *NC*)	
9 I:Crust Type	(1)	(.067)		POOLED	(CL=92.49%)	
Other/Error	5	.124	.025			.442
Total:	11	48.736				100.00%

OPTIMUM

Expt. File: C2B 1000 Q4W Data Type: S/N Ratio Print Help
 QC: Bigger is Better

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	1.632
2 B:Top Coat Chemis	SA Top Coat	2	.663
4 D:Top Coat Add-on	1.8 g /dry	2	.806
5 E:Foam Chemistry	Sa Foam	2	.438
6 F:Milling -Dye Tr	present	1	.088
7 G:RB Upgrade Chem	Present	1	.31
Total Contribution From All Factors...			3.937
Current Grand Average Of Performance...			9.943
Expected Result At Optimum Condition...			13.88

Analysis with C3 – 500 KJ (S/N with QC = Bigger, 4 aded)

Results

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio Print
QC Type: Bigger is Better Help

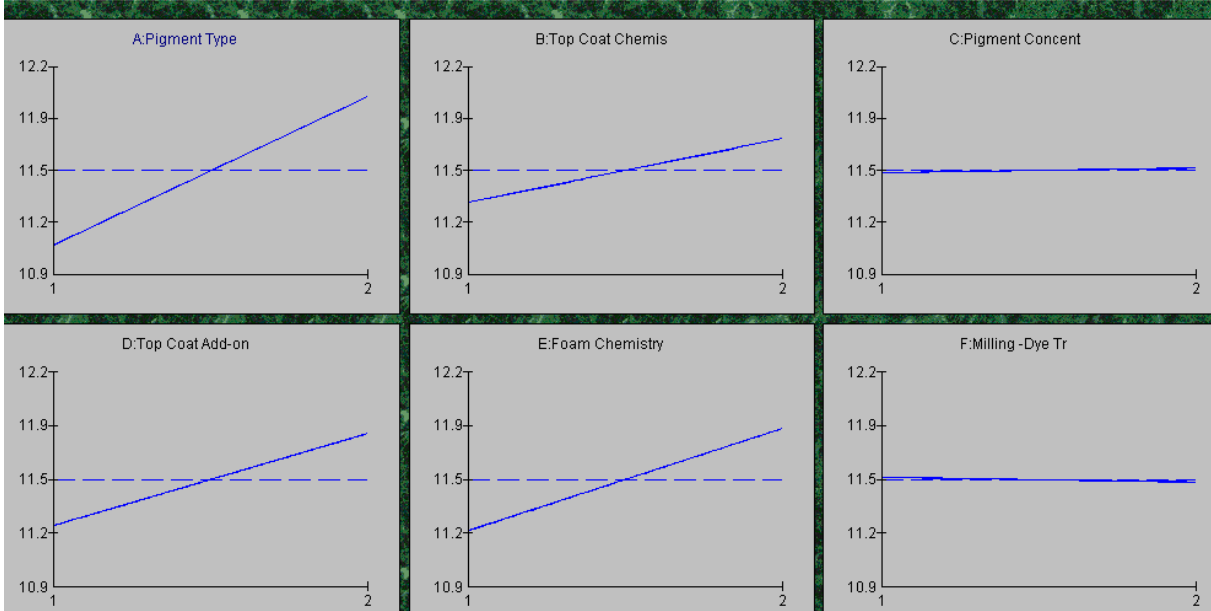
	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3.5	3.5					10.881
Trial# 2	3	3					9.542
Trial# 3	3.5	3.5					10.881
Trial# 4	4	4					12.041
Trial# 5	4	4					12.041
Trial# 6	3.5	3.5					10.881
Trial# 7	4	4.5					12.522
Trial# 8	4	4					12.041

11.526

ME

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio Print
QC Type: Bigger is Better Help

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	11.044	12.008	.963
2 B:Top Coat Chemis	11.318	11.734	.416
3 C:Pigment Concent	11.511	11.541	.03
4 D:Top Coat Add-on	11.238	11.815	.576
5 E:Foam Chemistry	11.205	11.847	.641
6 F:Milling -Dye Tr	11.541	11.511	-.031
7 G:RB Upgrade Chem	11.541	11.511	-.031
8 H:RB Chemistry	11.541	11.511	-.031
9 I:Crust Type	12.008	11.044	-.964



ANOVA (95%)

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A: Pigment Type	1	2.785	2.785	28.715	2.688	30.173
2 B: Top Coat Chemis	1	.52	.52	5.366	.423	4.753
3 C: Pigment Concent	(1)	(.002)		POOLED	(CL= *NC*)	
4 D: Top Coat Add-on	1	.998	.998	10.295	.901	10.12
5 E: Foam Chemistry	1	1.238	1.238	12.768	1.141	12.812
6 F: Milling -Dye Tr	(1)	(.002)		POOLED	(CL= *NC*)	
7 G: RB Upgrade Chem	(1)	(.002)		POOLED	(CL= *NC*)	
8 H: RB Chemistry	(1)	(.002)		POOLED	(CL= *NC*)	
9 I: Crust Type	1	2.785	2.785	28.715	2.688	30.173
Other/Error	6	.581	.096			11.969
Total:	11	8.91				100.00%

OPTIMUM

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio Print OK
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A: Pigment Type	SA Supplier	2	.481
2 B: Top Coat Chemis	SA Top Coat	2	.208
4 D: Top Coat Add-on	1.8 g /dry	2	.288
5 E: Foam Chemistry	Sa Foam	2	.321
9 I: Crust Type	NA Crust	1	.481
Total Contribution From All Factors...			1.779
Current Grand Average Of Performance...			11.526
Expected Result At Optimum Condition...			13.305

Analysis with C3 – 750 KJ (S/N with QC = Bigger)

Results

Expt. File: C3 750KJ Q4W Data Type: S/N Ratio Print
QC Type: Bigger is Better Help

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3	3					9.542
Trial# 2	3	2.5					8.678
Trial# 3	3	3					9.542
Trial# 4	4	3.5					11.422
Trial# 5	3.5	3.5					10.881
Trial# 6	3	3.5					10.16
Trial# 7	4	4					12.041
Trial# 8	3.5	4					11.422
							10.794

ME

File: C3 750KJ Q4W Data Type: S/N Ratio Pri
QC Type: Bigger is Better He

Column # / Factors	Level 1	Level 2	L2 - L1
1 A:Pigment Type	10.038	11.551	1.512
2 B:Top Coat Chemis	10.544	11.044	.5
3 C:Pigment Concent	10.767	10.821	.054
4 D:Top Coat Add-on	10.381	11.208	.826
5 E:Foam Chemistry	10.557	11.031	.474
6 F:Milling -Dye Tr	10.718	10.87	.151
7 G:RB Upgrade Chem	10.821	10.767	-.053
8 H:RB Chemistry	10.598	10.991	.392
9 I:Crust Type	11.225	10.364	-.861

ANOVA (95%)

Expt. File: C3 750KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P(%)
1 A:Pigment Type	1	6.871	6.871	75.682	6.78	50.273
2 B:Top Coat Chemis	1	.749	.749	8.258	.659	4.886
3 C:Pigment Concent	(1)	(.008)		POOLED	(CL= +NC+)	
4 D:Top Coat Add-on	1	2.051	2.051	22.591	1.96	14.534
5 E:Foam Chemistry	1	.674	.674	7.432	.584	4.329
6 F:Milling -Dye Tr	(1)	(.069)		POOLED	(CL= +NC+)	
7 G:RB Upgrade Chem	(1)	(.008)		POOLED	(CL= +NC+)	
8 H:RB Chemistry	(1)	(.462)		POOLED	(CL=94.38%)	
9 I:Crust Type	1	2.223	2.223	24.492	2.133	15.814
Other/Error	6	.915	.152			10.164
Total:	11	13.488				100.00%

OPTIMUM

Expt. File: C3 750KJ Q4W Data Type: S/N Ratio Print OK
 QC: Bigger is Better Help

Column # / Factor	Level Description	Level	Contribution
1 A:Pigment Type	SA Supplier	2	.756
2 B:Top Coat Chemis	SA Top Coat	2	.249
4 D:Top Coat Add-on	1.8 g/dry	2	.413
5 E:Foam Chemistry	Sa Foam	2	.237
9 I:Crust Type	NA Crust	1	.43
Total Contribution From All Factors...			2.085
Current Grand Average Of Performance...			10.794
Expected Result At Optimum Condition...			12.879

Analysis with C3 – 1000 KJ (S/N with QC = Bigger)

Results

Expt. File: C3 1000K.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3	3					9.542
Trial# 2	2.5	2.5					7.958
Trial# 3	3	3					9.542
Trial# 4	3.5	3.5					10.881
Trial# 5	3.5	3.5					10.881
Trial# 6	3	3.5					10.16
Trial# 7	4	4					12.041
Trial# 8	3.5	4					11.422
							10.541

(All results: Avg.= 3.395, StDev.= .416)

ME

File: C3 1000K.Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Column # / Factors	Level 1	Level 2	L2 - L1
1 A: Pigment Type	9.827	11.255	1.428
2 B: Top Coat Chemis	10.321	10.761	.439
3 C: Pigment Concent	10.261	10.821	.56
4 D: Top Coat Add-on	10.261	10.821	.56
5 E: Foam Chemistry	10.244	10.838	.593
6 F: Milling -Dye Tr	10.628	10.454	-.174
7 G: RB Upgrade Chem	10.525	10.557	.032
8 H: RB Chemistry	10.405	10.677	.272
9 I: Crust Type	10.941	10.141	-.801

ANOVA (95%)

Expt. File: C3 1000K Q4W Data Type: S/N Ratio QC Type: Bigger is Better

Col# / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A: Pigment Type	1	6.111	6.111	18.696	5.784	43.853
2 B: Top Coat Chemis	(1)	(.579)		POOLED	(CL=79.93%	
3 C: Pigment Concent	(1)	(.941)		POOLED	(CL=88.77%	
4 D: Top Coat Add-on	(1)	(.941)		POOLED	(CL=89.32%	
5 E: Foam Chemistry	(1)	(1.059)		POOLED	(CL=91.31%	
6 F: Milling -Dye Tr	(1)	(.09)		POOLED	(CL= +NC+)	
7 G: RB Upgrade Chem	(1)	(.003)		POOLED	(CL= +NC+)	
8 H: RB Chemistry	(1)	(.223)		POOLED	(CL= +NC+)	
9 I: Crust Type	1	1.922	1.922	5.881	1.595	12.096
Other/Error	9	5.154	.573			44.051
Total:	11	13.191				100.00%

OPTIMUM

Expt. File: C3 1000K Q4W Data Type: S/N Ratio QC: Bigger is Better

Column # / Factor	Level Description	Level	Contribution
1 A: Pigment Type	SA Supplier	2	.713
9 I: Crust Type	NA Crust	1	.4
Total Contribution From All Factors...			1.112
Current Grand Average Of Performance...			10.541
Expected Result At Optimum Condition...			11.654

REPRESENTATIVE ANALYSIS

(C3 Criterion, 500 KJ Exposure, 2 Samples in each trial)

Among the 12 separate experimental setups, this particular set is used as a representative tests and conclusions about confidence level and expected performance drawn from it.

RESULTS (Average performance = 3.791)

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio Print
 QC Type: Bigger is Better Help

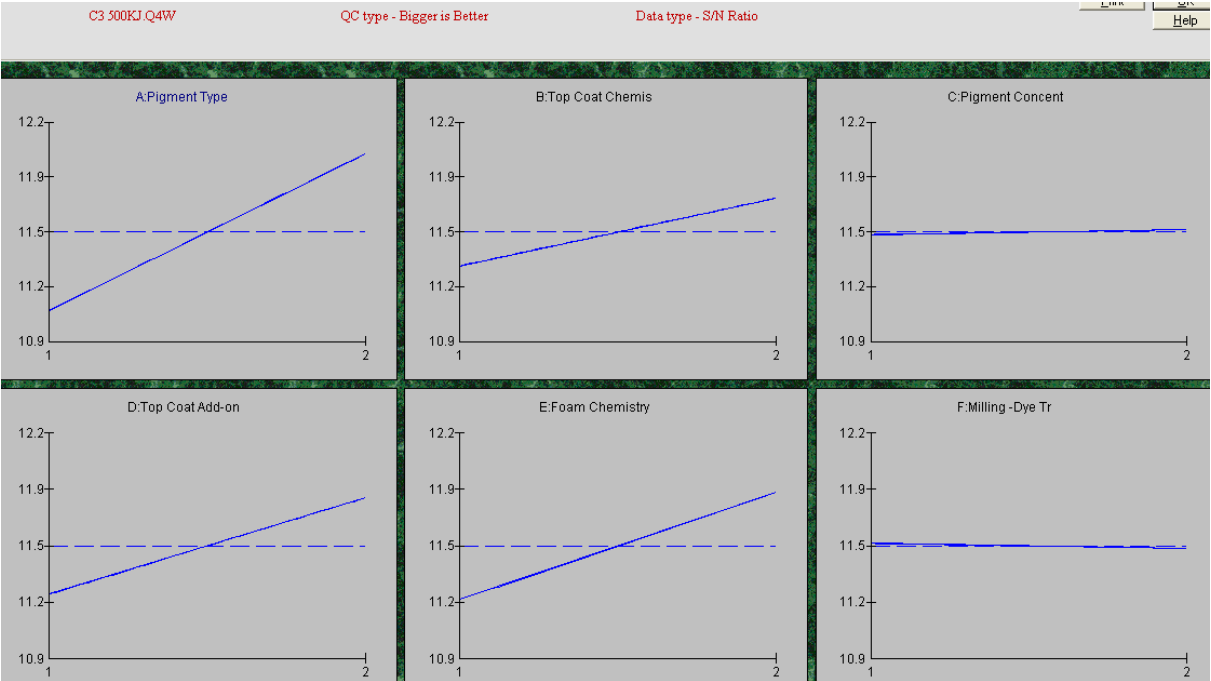
	Sample# 1	Sample# 2	Sample# 3	Sample# 4	Sample# 5	Sample# 6	S/N Ratio
Trial# 1	3.5	3.5					10.881
Trial# 2	3	3					9.542
Trial# 3	3.5	3.5					10.881
Trial# 4	4	4					12.041
Trial# 5	4	4					12.041
Trial# 6	3.5	3.5					10.881
Trial# 7	4	4.5					12.522
Trial# 8	4	4					12.041
Trial# 9	4	4					12.041
Trial# 10	3.5	3.5					10.881
Trial# 11	4.5	4					12.522
Trial# 12	4	4					12.041
							11.526

MAIN EFFECTS

Expt. File: C3 500KJ Q4W Data Type: S/N Ratio F
 QC Type: Bigger is Better H

Column # / Factors	Level 1	Level 2	L2 - L1
1 A: Pigment Type	11.044	12.008	.963
2 B: Top Coat Chemis	11.318	11.734	.416
3 C: Pigment Concent	11.511	11.541	.03
4 D: Top Coat Add-on	11.238	11.815	.576
5 E: Foam Chemistry	11.205	11.847	.641
6 F: Milling -Dye Tr	11.541	11.511	-.031
7 G: RB Upgrade Chem	11.541	11.511	-.031
8 H: RB Chemistry	11.541	11.511	-.031
9 I: Crust Type	12.008	11.044	-.964

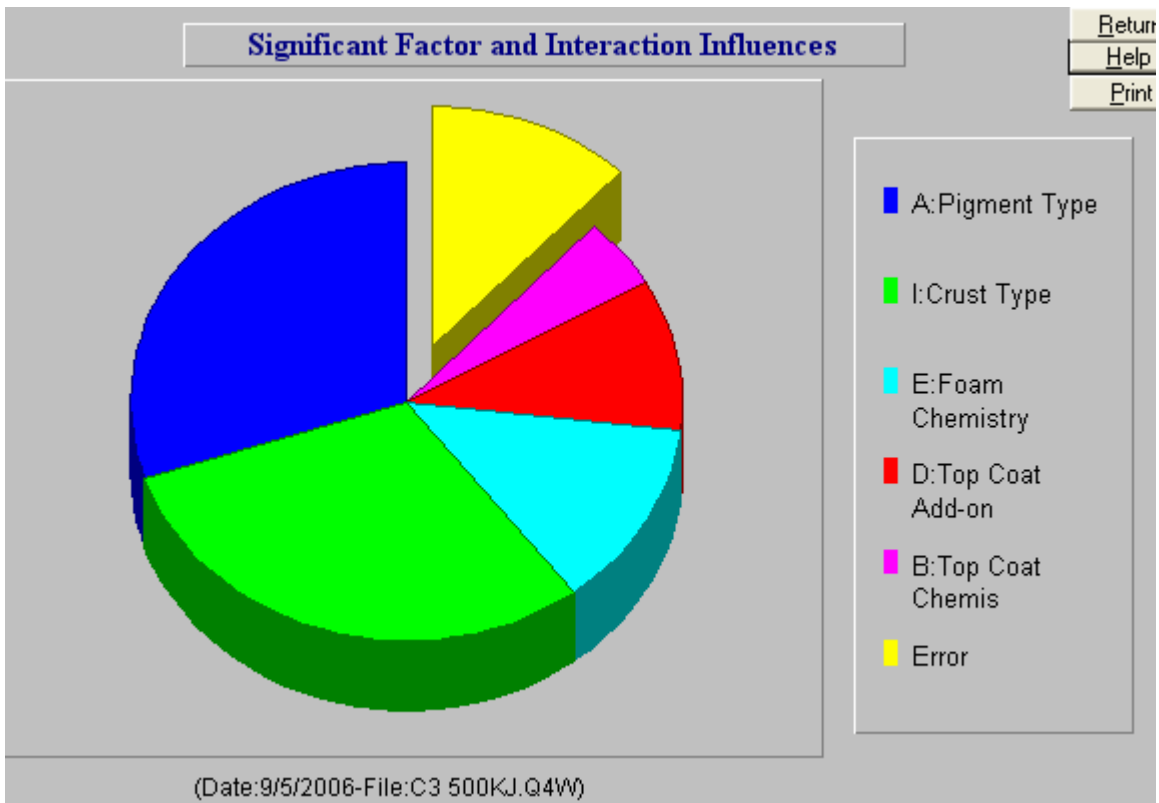
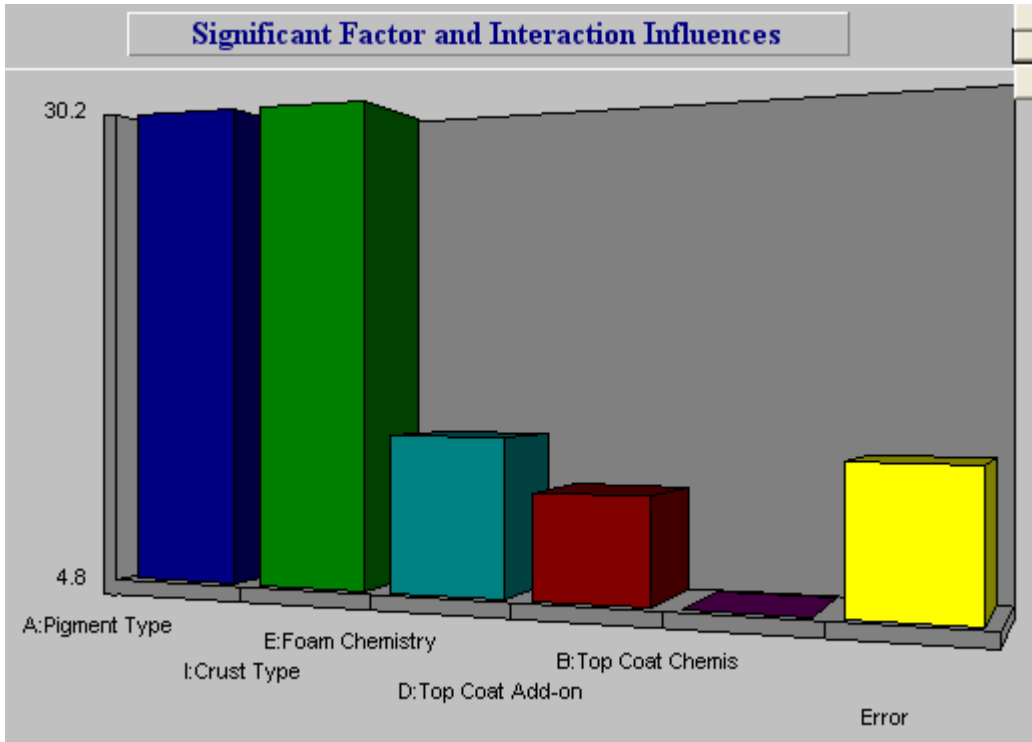
Plot of Main Effects of Selected Factors



ANOVA

Expt. File: C3 300KJ Q4W Data Type: S/N Ratio Print OK
 QC Type: Bigger is Better Help Cancel

Col # / Factor	DOF (f)	Sum of Sqrs. (S)	Variance (V)	F - Ratio (F)	Pure Sum (S')	Percent P (%)
1 A: Pigment Type	1	2.785	2.785	28.715	2.688	30.173
2 B: Top Coat Chemis	1	.52	.52	5.366	.423	4.753
3 C: Pigment Concent	(1)	(.002)		POOLED (CL= *NC*)		
4 D: Top Coat Add-on	1	.998	.998	10.295	.901	10.12
5 E: Foam Chemistry	1	1.238	1.238	12.768	1.141	12.812
6 F: Milling -Dye Tr	(1)	(.002)		POOLED (CL= *NC*)		
7 G: RB Upgrade Chem	(1)	(.002)		POOLED (CL= *NC*)		
8 H: RB Chemistry	(1)	(.002)		POOLED (CL= *NC*)		
9 I: Crust Type	1	2.785	2.785	28.715	2.688	30.173
Other/Error	6	.581	.096			11.969
Total:	11	8.91				100.00%



OPTIMUM CONDITION

Expt. File: C3 500KJ.Q4W Data Type: S/N Ratio Print Help

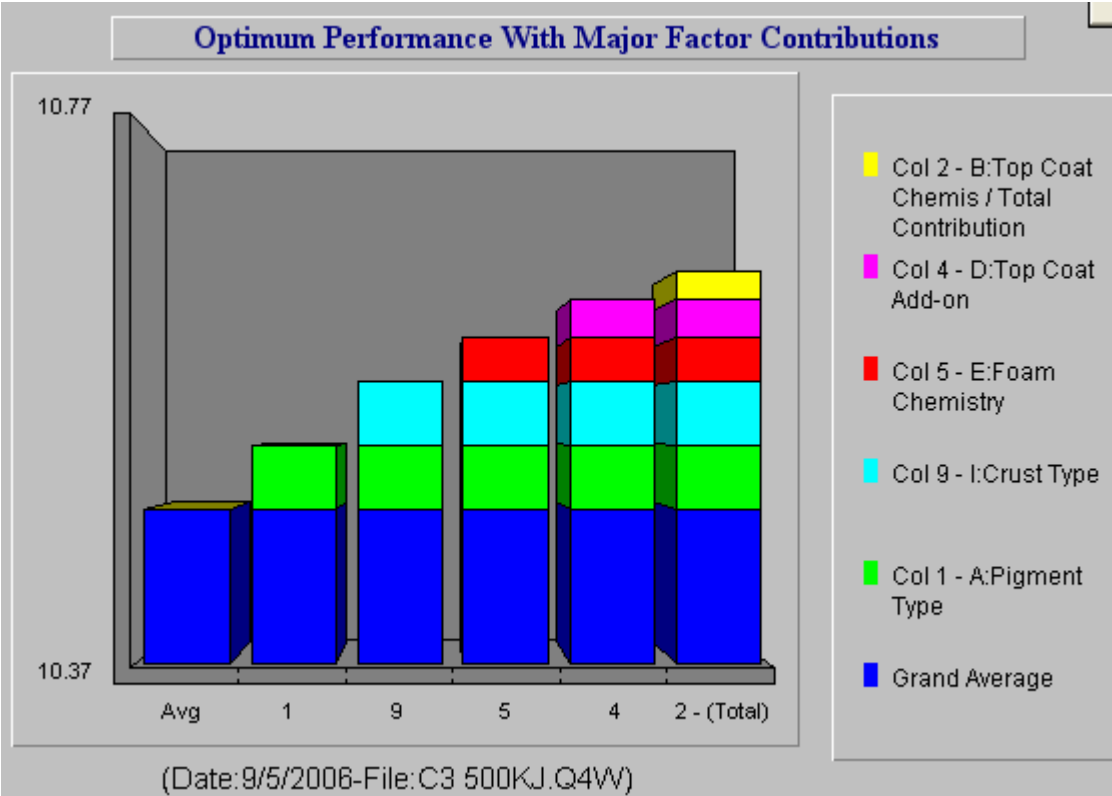
QC Bigger is Better

Column # / Factor	Level Description	Level	Contribution
1 A: Pigment Type	SA Supplier	2	.481
2 B: Top Coat Chemis	SA Top Coat	2	.208
4 D: Top Coat Add-on	1.8 g/dry	2	.288
5 E: Foam Chemistry	Sa Foam	2	.321
9 I: Crust Type	NA Crust	1	.481

Total Contribution From All Factors... 1.779

Current Grand Average Of Performance... 11.526

Expected Result At Optimum Condition... 13.305



CONFIDENCE INTERVAL at 90% C.L.

Confidence Interval Qualitek-4

Print
Help

Expression : C.I. = $\text{sqr. Root}((F(1,n2) * V_e) / N_e)$
 Where: $F(n1, n2) = 3.1$ (Computed Value)
 $n1 = 1$ Error DOF, $n2 = 6$
 $V_e =$ Error Variance = 0.097
 $N_e =$ Effective Number of Replications = 2.0
 [Factor DOF's Included in the Estimate = 5]
 Confidence Level = 90.
 Confidence Interval = +/- .388

Expected Results at Optimum = 13.305 +/- .388
 (Low Value = 12.917, High Value = 13.693)

Transformation of C.I. in S/N - Low Value

Expt File: C3 500KJ.Q4W
 Data Type: S/N Ratio
 QC Type: Bigger is Better

Print Return
 Help Cancel

Estimate of expected results from S/N ratio
 $S/N = -10 \text{ Log}(\text{MSD}) = 12.9172$
 or $\text{MSD} = 10^{[-(S/N)/10]} = 0.051083$
 where
 $\text{MSD} = [(1/y_1)^2 + (1/y_2)^2 + \dots + (1/y_n)^2] / n$
 $= [\text{Avg. } (1/y)^2] = 1/Y_{\text{exp}}^2$
 or $Y_{\text{exp}} = \text{SQR}(1/\text{MSD})$
 Expected performance in QC units
 (or overall evaluation criteria) is:
 $Y_{\text{exp}} = 4.424$ QC units
 (Based on $S/N = 12.917$ at optimum)

Low S/N Value = Higher Result when QC is SMALLER
 High value of S/N means more desirable results and low value of S/N means less desirable results in all types of quality characteristics. Consequently, the transformed S/N value displays magnitudes that are consistent with the quality characteristic.

Note: Transformation is only VALID when S/N is formulated using the standard definition; $S/N = -10 \text{ Log}(\text{MSD})$. Transformation is not possible when S/N is defined differently using two or more variables.

Average Performance = 3.8 (average of all 24 results)

Range of expected performance = 4.4 – 4.8 (90% confidence level)

Transformation of C.I. in S/N - High Value

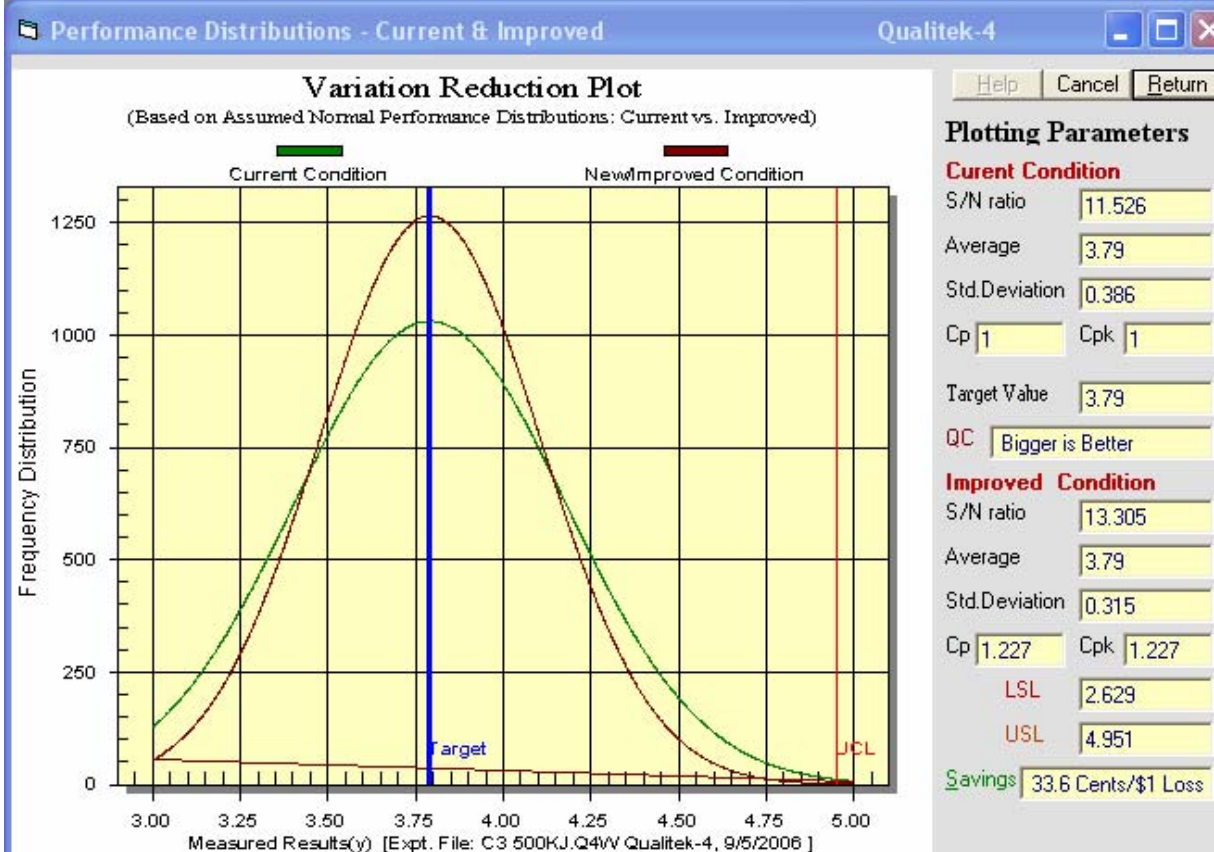
Expt File: C3 500KJ.Q4W
 Data Type: S/N Ratio
 QC Type: Bigger is Better

Estimate of expected results from S/N ratio
 $S/N = -10 \text{ Log (MSD)} = 13.6928$
 or $MSD = 10^{-(S/N)/10} = 0.042729$
 where
 $MSD = [(1/y_1)^2 + (1/y_2)^2 + \dots + (1/y_n)^2] / n$
 $= [\text{Avg. } (1/y)^2] = 1/Y_{exp}^2$
 or $Y_{exp} = \text{SQR}(1/MSD)$
 Expected performance in QC units
 (or overall evaluation criteria) is:
 $Y_{exp} = 4.838$ QC units
 (Based on $S/N = 13.693$ at optimum)

High S/N Value = Higher Result when QC is BIGGER.
 High value of S/N means more desirable results and low value of S/N means less desirable results in all types of quality characteristics. Consequently, the transformed S/N value displays magnitudes that are consistent with the quality characteristic.

Note: Transformation is only VALID when S/N is formulated using the standard definition; $S/N = -10 \text{ Log(MSD)}$. Transformation is not possible when S/N is defined differently using two or more variables.

VARIATION REDUCTION & EXPECTED SAVINGS



(Reference Materials)

Experiential factors and design:

Inner Array Design

Array Type: **L-12**

Use <ctrl> + <arrows> to move cursor.

	Factors	Level 1	Level 2
1	SA Supplier	NA Suppli	SA Supplier
2	B:Top Coat Chemis	NA Top Co	SA Top Coat
3	C:Pigment Concent	5 percent	10 Percent
4	D:Top Coat Add-on	1.0 g/ dr	1.8 g /dry
5	E:Foam Chemistry	NA Foam	SA Supplier
6	F:Milling -Dye Tr	present	ABsent
7	G:RB Upgrade Chem	Present	Absent
8	H:RB Chemistry	NA Roll B	SA Roll Base
9	I:Crust Type	NA Crust	SA Crust
10	COLUMN UNUSED	*UNUSED*	-----
11	COLUMN UNUSED	*UNUSED*	-----

Edit Inner Array

Array Type: **L-12**

	1	2	3	4	5	6	7	8	9	10	11
1	1	1	1	1	1	1	1	1	1	0	0
2	1	1	1	1	1	2	2	2	2	0	0
3	1	1	2	2	2	1	1	1	2	0	0
4	1	2	1	2	2	1	2	2	1	0	0
5	1	2	2	1	2	2	1	2	1	0	0
6	1	2	2	2	1	2	2	1	2	0	0
7	2	1	2	2	1	1	2	2	1	0	0
8	2	1	2	1	2	2	2	1	1	0	0
9	2	1	1	2	2	2	1	2	2	0	0
10	2	2	2	1	1	1	1	2	2	0	0
11	2	2	1	2	1	2	1	1	1	0	0
12	2	2	1	1	2	1	2	1	2	0	0

Case Study/Project Title
 EOF Leather Solar Resistance Improvement Study

Any Notes Or User/Experimenter Name
 Nine factors at two levels each studied

Quality Characteristics
 THE BIGGER THE BETTER (as selected for analysis)

Objective Of The Study
 Determine leather finish process that is resistant to solar exposure

Description of Experimental Trial Conditions (GM-SOLAR.TRL)
[Number of Trial = 12 Number of samples in each trial = 0]

Trial # 1 (Random order to conduct test is 9)

Table with 4 columns: Parameter, Value, Unit, Count. Rows include A:Pigment Type, B:Top Coat Chemis, C:Pigment Concent, D:Top Coat Add-on, E:Foam Chemistry, F:Milling -Dye Tr, G:RB Upgrade Chem, H:RB Chemistry, I:Crust Type.

Trial # 2 (Random order to conduct test is 6)

Table with 4 columns: Parameter, Value, Unit, Count. Rows include A:Pigment Type, B:Top Coat Chemis, C:Pigment Concent, D:Top Coat Add-on, E:Foam Chemistry, F:Milling -Dye Tr, G:RB Upgrade Chem, H:RB Chemistry, I:Crust Type.

Trial # 3 (Random order to conduct test is 7)

Table with 4 columns: Parameter, Value, Unit, Count. Rows include A:Pigment Type, B:Top Coat Chemis, C:Pigment Concent, D:Top Coat Add-on, E:Foam Chemistry, F:Milling -Dye Tr, G:RB Upgrade Chem, H:RB Chemistry, I:Crust Type.

Trial # 4 (Random order to conduct test is 3)

Table with 4 columns: Parameter, Value, Unit, Count. Rows include A:Pigment Type, B:Top Coat Chemis, C:Pigment Concent, D:Top Coat Add-on, E:Foam Chemistry, F:Milling -Dye Tr, G:RB Upgrade Chem, H:RB Chemistry, I:Crust Type.

Trial # 5 (Random order to conduct test is 10)

Table with 4 columns: Parameter, Value, Unit, Count. Rows include A:Pigment Type, B:Top Coat Chemis.

C:Pigment Concent	--	10 Percent	--	2
D:Top Coat Add-on	--	Low	--	1
E:Foam Chemistry	--	Sa Foam	--	2
F:Milling -Dye Tr	--	ABsent	--	2
G:RB Upgrade Chem	--	Present	--	1
H:RB Chemistry	--	SA Roll Base	--	2
I:Crust Type	--	NA Crust	--	1

Trial # 6 (Random order to conduct test is 5)

```
=====
```

A:Pigment Type	--	NA Suppli	--	1
B:Top Coat Chemis	--	SA Top Coat	--	2
C:Pigment Concent	--	10 Percent	--	2
D:Top Coat Add-on	--	High	--	2
E:Foam Chemistry	--	NA Foam	--	1
F:Milling -Dye Tr	--	ABsent	--	2
G:RB Upgrade Chem	--	Absent	--	2
H:RB Chemistry	--	NA Roll B	--	1
I:Crust Type	--	SA Crust	--	2

Trial # 7 (Random order to conduct test is 11)

```
=====
```

A:Pigment Type	--	SA Supplier	--	2
B:Top Coat Chemis	--	NA Top Co	--	1
C:Pigment Concent	--	10 Percent	--	2
D:Top Coat Add-on	--	High	--	2
E:Foam Chemistry	--	NA Foam	--	1
F:Milling -Dye Tr	--	present	--	1
G:RB Upgrade Chem	--	Absent	--	2
H:RB Chemistry	--	SA Roll Base	--	2
I:Crust Type	--	NA Crust	--	1

Trial # 8 (Random order to conduct test is 4)

```
=====
```

A:Pigment Type	--	SA Supplier	--	2
B:Top Coat Chemis	--	NA Top Co	--	1
C:Pigment Concent	--	10 Percent	--	2
D:Top Coat Add-on	--	Low	--	1
E:Foam Chemistry	--	Sa Foam	--	2
F:Milling -Dye Tr	--	ABsent	--	2
G:RB Upgrade Chem	--	Absent	--	2
H:RB Chemistry	--	NA Roll B	--	1
I:Crust Type	--	NA Crust	--	1

Trial # 9 (Random order to conduct test is 12)

```
=====
```

A:Pigment Type	--	SA Supplier	--	2
B:Top Coat Chemis	--	NA Top Co	--	1
C:Pigment Concent	--	5 percent	--	1
D:Top Coat Add-on	--	High	--	2
E:Foam Chemistry	--	Sa Foam	--	2
F:Milling -Dye Tr	--	ABsent	--	2
G:RB Upgrade Chem	--	Present	--	1
H:RB Chemistry	--	SA Roll Base	--	2
I:Crust Type	--	SA Crust	--	2

Trial # 10 (Random order to conduct test is 8)

```

=====
A:Pigment Type      -- SA Supplier      -- 2
B:Top Coat Chemis   -- SA Top Coat     -- 2
C:Pigment Concent   -- 10 Percent      -- 2
D:Top Coat Add-on   -- Low             -- 1
E:Foam Chemistry    -- NA Foam         -- 1
F:Milling -Dye Tr   -- present         -- 1
G:RB Upgrade Chem   -- Present         -- 1
H:RB Chemistry      -- SA Roll Base    -- 2
I:Crust Type        -- SA Crust        -- 2

```

Trial # 11 (Random order to conduct test is 2)

```

=====
A:Pigment Type      -- SA Supplier      -- 2
B:Top Coat Chemis   -- SA Top Coat     -- 2
C:Pigment Concent   -- 5 percent       -- 1
D:Top Coat Add-on   -- High            -- 2
E:Foam Chemistry    -- NA Foam         -- 1
F:Milling -Dye Tr   -- ABsent         -- 2
G:RB Upgrade Chem   -- Present         -- 1
H:RB Chemistry      -- NA Roll B       -- 1
I:Crust Type        -- NA Crust        -- 1

```

Trial # 12 (Random order to conduct test is 1)

```

=====
A:Pigment Type      -- SA Supplier      -- 2
B:Top Coat Chemis   -- SA Top Coat     -- 2
C:Pigment Concent   -- 5 percent       -- 1
D:Top Coat Add-on   -- Low             -- 1
E:Foam Chemistry    -- Sa Foam         -- 2
F:Milling -Dye Tr   -- present         -- 1
G:RB Upgrade Chem   -- Absent         -- 2
H:RB Chemistry      -- NA Roll B       -- 1
I:Crust Type        -- SA Crust        -- 2

```

**(sample
Test
results)**

criteria description	worst reading	best reading	Quality characteristic	Relative Weight (final)
light - dark value change	1	5	bigger is better	26%
C.S.P. delta a	20	0	nominal	39%
C.S.P. delta b	20	0	nominal	
Visual color (Delta L)	1	6	Absolute reading, SMALLER is better	35%

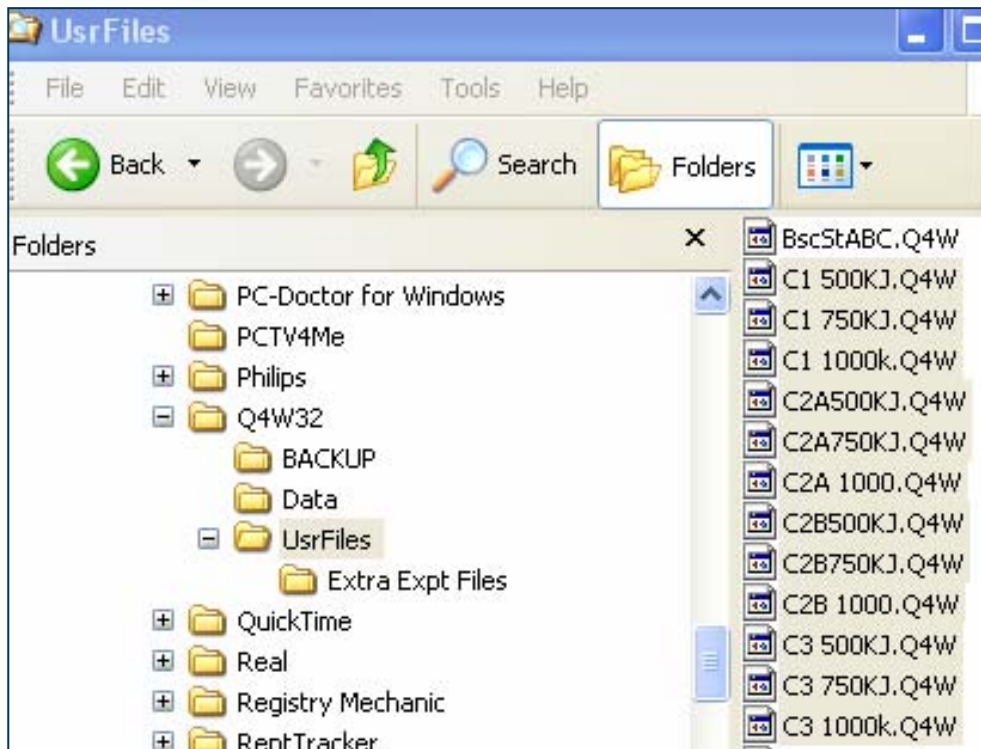
C1 = light - dark value; Delta L not modified to 1 worst to 5 best reading
 C2 = Delta A + B; original test data not modified to 20 worst and 0 best
 C3 = Visual color; original test data under gray scale; not modified to 1 worst and 10 best reading

Sample set 1							
500KJ							
#	Delta E	Gray scale	delta A	delta B	delta C	delta H	delta L
1	2.38	3-4	-0.06	-0.53	-0.53	-0.06	-2.32
3	3.43	3	-0.08	-0.73	-0.73	-0.10	-3.35
5	2.58	3-4	0.25	0.02	0.08	-0.24	-2.57
7	1.43	4	0.08	0.15	0.16	-0.04	-1.42
9	1.94	4	0.02	-0.11	-0.10	-0.05	-1.94
11	2.59	3-4	0.13	-0.06	-0.03	-0.14	-2.58
13	1.38	4	-0.23	0.34	0.28	0.30	-1.32
15	1.63	4	-0.36	0.12	0.03	0.37	-1.59
17	1.32	4	-0.51	0.71	0.58	0.65	-0.99
19	2.25	3-4	-0.67	0.05	-0.09	0.66	-2.15
21	1.09	4-5	-0.76	0.58	0.42	0.86	-0.52
23	1.82	4	-0.78	0.10	-0.07	0.79	-1.64

Sample set 2							
500KJ							
#	Delta E	Gray scale	delta A	delta B	delta C	delta H	delta L
2	2.87	3-4	0.00	-0.64	-0.63	-0.15	-2.79
4	3.46	3	-0.10	-0.73	-0.73	-0.07	-3.38
6	2.32	3-4	0.20	-0.11	-0.06	-0.22	-2.30
8	1.70	4	0.06	0.21	0.22	-0.01	-1.69
10	2.10	4	0.05	-0.07	-0.06	-0.06	-2.09
12	2.23	3-4	0.07	-0.20	-0.17	-0.12	-2.22
14	1.01	4-5	-0.21	0.32	0.26	0.28	-0.94
16	1.66	4	-0.31	0.13	0.05	0.34	-1.63
18	1.33	4	-0.50	0.62	0.50	0.62	-1.07
20	2.17	3-4	-0.68	0.05	-0.10	0.67	-2.07
22	1.34	4	-0.77	0.56	0.40	0.87	-0.94
24	1.60	4	-0.77	0.12	-0.05	0.78	-1.40

Results for 750 KJ & 100 KJ are not shown here.

12 Experiment files for analysis in Qualitek-4 software:



Source of results: Project Team